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# **The Indian Journal of HOME SCIENCE**

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## FROM THE EDITOR'S DESK

*Greetings of the day.*

*We are happy to inform the readers that the present issue contains those papers which have won the senior scientists, mid-career scientists and junior scientists' award in the 35th biennial Conference of the Home science Association of India, held from 17th to 19th of January 2024 at the College of Post Graduate Studies in Agricultural Sciences, Umiam, Meghalaya. The theme of the conferences was "Multidisciplinary Approaches in Home and Community Sciences for Sustainable Development".*

*It is observed that the research papers published in this journal reflect a general trend that researchers are investigating and presenting findings on various new and those areas of concern which are comparatively less studied but are significant. They are addressing contemporary issues and are more community oriented. The researches would be highly meaningful when the findings and outcomes are shared with various stakeholders including the respondents. Over and above publishing papers in the Journals, the findings if published in common magazines, newspapers and other modes of mass media, the public image of Home Science can be strengthened.*

*With best wishes*

**PROF. MANEESHA SHUKUL**



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## EVALUATION OF COLOUR FASTNESS PROPERTIES OF FABRIC DYED WITH AQUEOUS EXTRACT OF KESULA FLOWERS

Anju Kushwaha<sup>1</sup> & Rashi Kushwaha<sup>2</sup>

<sup>1&2</sup>Research Scholar (Textile & Apparel Designing)

Department of Family and Community Sciences

University of Allahabad, Prayagraj, India

E-mail: anjukushwaha586@gmail.com

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### ABSTRACT

One important step in the creation of textile material is the colouring of the textiles. The process of dyeing is an ancient technique. Proofs of natural dyes are also available in the Ramayna and Mahabharat. Natural dyes are obtained from variety of vegetable and animal source. Colorants may be found in a variety of plant components, including the roots, stems, bark, leaves, fruits, flowers, and seeds. Natural colours are typically made from minerals, insect dead dried bodies, and the roots, stems, leaves, flowers, and fruits of different plants. Natural dyes produce very uncommon, soothing and soft shades as compared to synthetic dyes. Hence, due to the current eco-consciousness, the researcher's attention has been shifted to the use of natural dyes for dyeing textile materials. The present study demonstrated dyeing of cotton fabric with the pigment extracted through kesula (*Butea Monosperma*) flowers. For this, the extracted dye was applied on cotton fabric that was already double pre-mordanted mordanted with harda and other five different metallic salts. The effect of various mordants has been examined through stability and colour shades. Finally, various fastness properties have been evaluated to find out the performance of individual mordants in natural dyeing.

**Keywords:** Cotton fabric, Dyes, Harda, Kesula, Mordants, Natural colour

### INTRODUCTION

Dyeing is the procedure that applies colour to textile products. One important step in the creation of textile material is the colouring of the textiles. The process of dyeing is an ancient technique. For example, it was widely used all over Europe during the Bronze Age (Zubairu, A., & Mshelia, Y. M. 2015). Proofs of natural dyes are also available in the Ramayna and Mahabharat. Fulfilling customer demands, improving efficiency, and enhancing value addition might be among the primary goals of textile material dyeing. A dye is a type of chemical that has the ability to both absorb and reflect light at specific wavelengths. Dye enhances our lives by adding colour to fabrics (Maulik SR, Roy S 2019). In literature, dye sources are separated into two groups: natural and manmade.

Natural dyes are obtained from variety of vegetable and animal source with little or often no processing (Kumaresan, M., et al. 2012). Numerous plants and even animals have been found to have high potential natural dye concentrations; some of these have long been employed in natural dyeing processes. Colorants may be found in a variety of plant components, including the roots, stems, bark, leaves, fruits, flowers, and seeds. Natural colours are typically made from minerals, insect dead dried

bodies, and the roots, stems, leaves, flowers, and fruits of different plants. Depending on the portion of the plant used, certain plants can have numerous hues. The time of year a plant is harvested, its cultivation method, the quality of the soil, and other factors will all affect the colour shade it yields. The water's minerals that are utilized to make colour also affect the colour shade (Vankar, P. S. 2000).

Natural dyes have several benefits over synthetic ones, including being non-carcinogenic, allergy-free, and environmentally beneficial (Deo S, Sarkara SR 2007). For this vital concern more interest has been shown in the use of natural dyes since 20<sup>th</sup> century again (Adeel S, et al 2009). Natural dyes produce very uncommon, soothing and soft shades as compared to synthetic dyes (Samanta, A. K., & Agarwal, P. 2009). Hence, due to the current eco-consciousness, the researcher's attention has been shifted to the use of natural dyes for dyeing textile materials.

The topic of this study is the aqueous extraction of natural dye from kesula (*Butea Monosperma*) flowers. It is a South Asian native plant. India, Nepal, Bangladesh, Sri Lanka, Myanmar, Thailand, Malaysia, and western Indonesia are among the countries where the plant is found. In India, it is also referred to as Tesu and Palash. Its historical origins are in Jharkhand and Bihar. It is also Jharkhand's official flower. The flowers of kesula are used to make a traditional holi colour and as well as used to extract fabric dye. The flowers have a spectacular late winter bloom, which lasts from February to April, is very stunning.

## **OBJECTIVES**

The present study demonstrated with the following objectives-

- To mordant the cotton fabric with harda.
- To do double mordanting of harda treated cotton fabric with other five different metallic salts.
- To dye double pre-mordanted cotton fabric with the pigment extracted from kesula (*Butea Monosperma*) flowers.
- At last, to evaluate various colour fastness properties of dyed cotton fabric and find out the best performance of mordants in natural dyeing.

## **MATERIALS AND METHODS**

The greige 100% pure cotton fabric (plain weave, EPI 110 and PPI 80) was selected for dyeing using extract of different flowers kesula. These flowers were collected from the campus of University of Allahabad, Prayagraj, U.P., India. After collection of flowers, the petals are washed properly with water to remove any dirt and then dried in shade. Non-ionic surface-active agent (Felosan HLDN) was purchased from CHT India Pvt, Ltd. Maharashtra. NaOH, H<sub>2</sub>O<sub>2</sub> and Na<sub>2</sub>SiO<sub>3</sub> were purchased from the local market of Prayagraj.

### **Pre-treatments of fabric**

Before applying any dye on cotton fabric, the entire length of fabric was pre-treated using standardized recipes, as given hereunder-

#### **1. Scouring**

For scouring process, greige cotton fabric was treated with NaOH (2% owf) and non-ionic surface-active agent (2g/l) at 90°C for 1 hour, keeping the material to liquor ratio at 1:20. After scouring the fabric was washed thoroughly in cold water and then treated with acetic acid (2 ml/l) for

20 minutes at room temperature to neutralize the residual alkali present in the fabric. Thereafter, the fabric was washed with cold water and dried (Pan, N. C., et al 2013).

### **2. Bleaching**

Bleaching process of scoured cotton fabric was done by using the standard recipe given by Karaca, B. et al., 2012. In which 5g of H<sub>2</sub>O<sub>2</sub> (5 g/l), 1g of NaOH (1g/l) and 1ml of Na<sub>2</sub>SiO<sub>3</sub> (1ml/l) were added to 1000ml of water. It was heated to 80°C and then cotton fabric was dipped into this solution and stirred gently for about 1 hour. After treatment, the fabric was rinsed thoroughly with cold water then washed with hot water for 5 min and dried at room temperature.

### **3. Single mordanting of cotton fabric with harda (*myrabolan*)**

Not all natural or vegetable dyes work well on cotton fabric. Furthermore, unless cotton is pre-treated with tannic acid or another metal mordant, these colours do not work quickly on it. Tannic acid is naturally found in harda. Harda solution was therefore applied to the cotton cloth that had been bleached. Harda powder (20 g/l) was allowed to swell in water medium for 12 hours at room temperature (25 ± 5° C) in order to create harda solution. This aqueous harda gel was diluted to the necessary strength by adding a specified volume of water to it. Harda solution was used to soak bleached cotton cloth at 40° C for 15 minutes while stirring continuously. It was removed from the harda solution after fifteen minutes, evenly pressed, and dried in shade without washing for second mordanting in sequence. When the fabric is dried, excess harda powder deposited on the surface of the fabric was removed by beating with a miller or by the fabric itself beaten on a hard surface. It helps in good penetration of mordants and dyes in the fabric in subsequent process resulting better dyeing or printing qualities.

### **Sequential double pre-mordanting**

When using a sequential double pre-mordanting procedure, Myrobolan/ harda treated Cotton fabric was also treated independently with alum, potassium dichromate, copper sulfate, ferrous sulfate, and stannous chloride (Tin). To get five distinct colour tones from kesula flowers, varying amounts of the following five common mordants (see Table 1) are used. These dyes have a special quality that allows them to produce a variety of tints when handled with various mordants.

**Table 1 Five popular mordants used in double pre-mordanting of cotton fabric**

<b>Sr. No.</b>	<b>Name of mordant</b>	<b>Quantity(g/l)</b>	<b>Treatment temperature</b>	<b>Time (minute)</b>
1	Stannous chloride (Tin)	2	40°C	15
2	Alum	10	Room temp.	15
3	Potassium Dichromate	0.5	40°C	15
4	Copper Sulphate	1	40°C	15
5	Ferrous Sulphate	0.25	40°C	15

For sequential double pre-mordanting the harda treated sample was immersed in the aforementioned mordants in different containers and continuously stirred for fifteen minutes. Fabrics were removed from the mordants after fifteen minutes, uniformly squeezed, and then allowed to dry

in the shade. In order to prepare the fabric samples for the current work's natural dyeing using kesula extract, the fabric samples were finally dried in air without washing after the second mordanting.

### **Extraction of dyes from flowers**

Plants and other materials were traditionally utilized to extract colours by the aqueous extraction process. To increase the effectiveness of the extraction process, the dye-containing material is first ground into tiny bits or powdered using a grinder before being sieved. An aqueous experiment with a material to liquid ratio of 1:10 was carried out at boiling temperature in order to determine the ideal extraction conditions. As a result, dried flower petals are boiled in a bath for 45 minutes with the material to liquor ratio maintained at 1:10 in order to extract dye from kesula flowers. Prior to adding the dye solution into the dye bath, it had to be sieved out.

### **Dyeing of fabric**

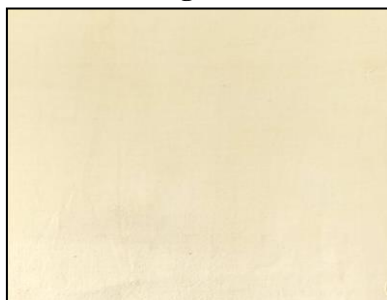
Each per-mordanted sample was dyed separately in dye baths that contained the dye solutions that had been previously prepared from kesula flowers. Each per-mordanted sample was immersed into dye solution in separate dye bath and heated gradually to 80°C for 45 minutes while being stirred frequently. After 45 minutes, the coloured fabric samples were removed from the dye solution, uniformly squeezed, and allowed to cool down to room temperature before being rinsed in plain water. The fabric was first soaped with 1 gm/l neutral soap at 40°C for 15 minutes to remove any unfixed dye. Following this, the dyed cloth was completely cleaned in plain water and allowed to dry in the shade.

### **Testing of dyed samples**

Following the completion of the experiment, the dyed fabric samples were left to age for a week in a dry, dark environment to allow the colours to set. They were then cleaned using a standard industrial detergent solution, and additional tests were carried out at NITRA (Northern India Textile Research Association) in Ghaziabad using a variety of ISO and AATCC standards. These tests included colour fastness to washing (ISO 105 C06 A1S: 2010 (400C), colour fastness to perspiration in both acidic and alkaline medium (ISO 105-E04: 2013), colour fastness to sunlight exposure (ISO 105-B01), and colour fastness to dry and wet crocking (AATCC 8-2016e).

## **RESULTS AND DISCUSSIONS**

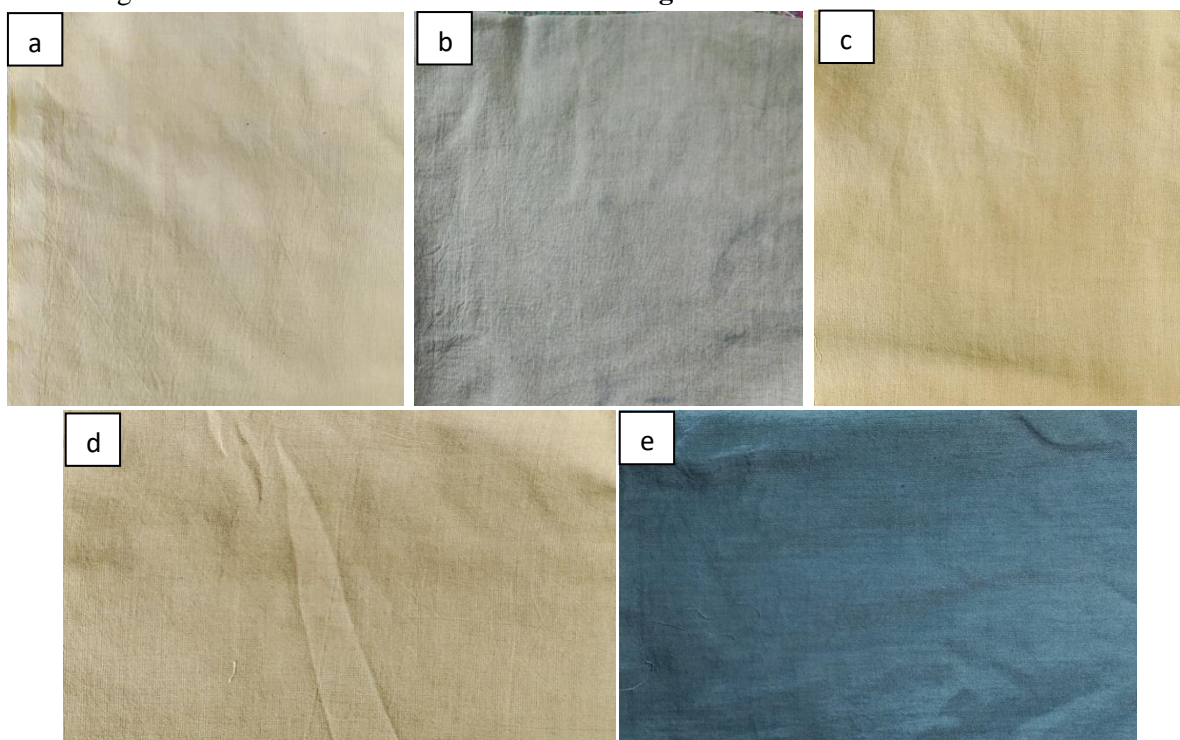
**Effect of single pre-mordanting on cotton fabric with harda (myrabolan)** Effect of harda on scoured and bleached cotton fabric is shown in **Fig. 1**.



**Fig. 1** Effect of Harda on Cotton Fabric







**Effect of double pre-mordanting applied on harda treated cotton fabric** Effect of double pre-mordanting on harda treated cotton fabric is shown in **Fig. 2**.



**Fig. 2 Effect of (a) Stannous chloride (Tin) (b) Alum (c) Potassium Dichromate (d) Copper Sulphate and (e) Ferrous Sulphate on harda treated cotton fabric**

**Effect of dye extract from kesula on cotton fabric** Double pre-mordanted cotton fabric was dyed with the extract of kesula and its effect is exposed in Table 2.

**Table 2 Effect of Dye extract from extract of Kesula**

Name of mordents	Kesula
Stannous chloride (Tin)	
Alum	
Potassium Dichromate	
Copper Sulphate	

Ferrous Sulphate			
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### Analysis of fastness properties

To investigate the colour fastness of fabric dyed with the extract of kesula flowers, the dye applied on to the fabric and their fastness to light, washing, rubbing and, perspiration was conducted. Colour change (CC) and staining (CS) of fabrics were determined.

#### 1. Colourfastness to washing

In this experiment, the ISO 105 C06 A1S technique was used to determine the colour fastness of all the samples using multi-fiber fabric in the lab. Grey scales were used to assess the staining intensity and colour change of the dyed samples. Table 3 displays and Table 4 grades colour changes in dyed samples (CC) and staining (CS) on cotton fabric.

**Table: 3: Effect of different mordanting agents on the colour fastness to washing**

Name of Mordants	Colour change grade	Numerical rating for staining
Stannous chloride (Tin)	3-4	4
Alum	4	4-5
Potassium Dichromate	4-5	3
Copper Sulphate	5	5
Ferrous Sulphate	3-4	4

The impact of mordanting chemicals on the colour fastness to washing is displayed in Table 3. Table 3 demonstrates unequivocally that fabric dyed with kesula extract exhibits outstanding colour fastness when pre-mordanted with copper sulphate, fair colour fastness when pre-mordanted with potassium dichromate and alum. The numerical rating for staining on adjacent cotton fabric during the assessment of colourfastness to washing is also shown in Table 3. Table 3 makes it abundantly evident that kesula extract dyed fabric shows best result when mordanted with copper sulphate and alum, better for stannous chloride and ferrous sulphate and moderate for potassium dichromate.

#### 2. Colour fastness to perspiration

In this experiment, all fabric samples were evaluated for colour fastness to perspiration (in both acid and alkali medium) using the ISO 105-E04 method. Based on the amount of colour change and stains on the nearby fabric, the chosen sample's colour fastness to perspiration was graded as both acidic and alkaline. A grey scale reading for the colour fastness to perspiration test was obtained, and tabulated in Table 4.

**Table: 4- Evaluation of colour fastness to perspiration in acidic medium**

Name of Mordants	Colour change grade	Numerical rating for staining
Stannous chloride (Tin)	5	4
Alum	4	3
Potassium Dichromate	3	4-5
Copper Sulphate	4	4-5
Ferrous Sulphate	3	5

The results of **Table 5** expose the colour fastness to perspiration in acidic medium. From the **Table 5** it is clearly expose that sample which mordanted with **Stannous chloride (Tin)** is more resist to acidic perspiration in the case of kesula extract dyed fabric. In addition, **Table 5** also expose that ratings for colour staining on the adjacent fabric are almost excellent to good for all mordents when cotton fabric was dyed with kesula extract.

**Table: 5- Evaluation of colour fastness to perspiration in alkaline medium**

Name of Mordants	Colour change grade	Numerical rating for staining
Stannous chloride (Tin)	3	4
Alum	4-5	4-5
Potassium Dichromate	4	4
Copper Sulphate	5	5
Ferrous Sulphate	4-5	4-5

The colour fastness to perspiration in an alkaline medium is shown in Table 5. Table 5 makes it abundantly evident that samples coloured with kesula extract and mordanted with copper sulphate, alum and ferrous sulphate are more resistant to acidic sweat followed by potassium dichromate and stannous chloride. The ratings for colour staining range from almost excellent to good for all mordents.

### **3. Colour fastness to light (Sunlight)**

In this experiment, colour fastness to light was evaluated for all samples using multi-fiber fabric using the ISO 105-B01 technique. This procedure involved exposing the specimens to daylight, and the fastness was determined by comparing the colour changes. Table 6 presents the light fastness data, which provide a numerical grade for colour change.

**Table: 6 -Effect of different mordanting agents on the colour fastness to light**

Name of Mordants	Colour change grade
Stannous chloride (Tin)	5
Alum	4
Potassium Dichromate	3
Copper Sulphate	4
Ferrous Sulphate	4-5

Tables 6 shows that stannous chloride (Tin) yield the greatest fastness results when used to dye fabric using kesula extract. Alum, copper sulphate and ferrous sulphate also performed well, while potassium dichromate demonstrated good light-fastness.

#### 4. Colour fastness to rubbing

The rubbing fastness was carried out in dry as well as in wet conditions. Assessment of fabrics was carried out for the staining of the rubbing cotton cloth with grey scale.

**Table 7 Effect of different mordanting agents on the colour fastness to rubbing**

Name of Mordants	Colour change grade	
	Dry rubbing	Wet rubbing
Stannous chloride (Tin)	4-5	4-5
Alum	4	5
Potassium Dichromate	4-5	4
Copper Sulphate	4	4-5
Ferrous Sulphate	5	5

The results of **Table 7** expose the colour fastness to dry rubbing. **Table 7** also reveals that the Ferrous Sulphate shows best colour fastness in the case of kesula extract dyed fabric. However, in the case of kesula extract dyed fabric, ferrous sulphate shows best colour fastness while rest of mordants show good colour fastness to dry rubbing.

### CONCLUSION

This study explored the impacts of a kesula flower aqueous extract on double-pre-mordanted cotton fabric. Following the completion of the experiment, the colourfastness of the fabric samples was tested using a variety of ISO and AATCC standards. The colour fastness against sun exposure, crocking (in both dry and wet situations), washing, and perspiration (in both acidic and alkaline media) were tested. The ferrous sulphate mordanted fabric sample showed the best outcomes for all fastness measurement techniques, according to a thorough observation.

### **SUGGESTIONS FOR FUTURE RESEARCH**

- The application of natural dye in textile industry will lead to sustainable development.
- Different mordanting techniques can also be used.
- Various dye extraction methods can be optimized.
- Different colouring technique like printing (block, screen, stencil etc.) can also be used to colour the textiles.

### **ACKNOWLEDGMENT**

The research scholar wishes to thank to NITRA (Northern India Textile Research association) Ghaziabad for their support and cooperation. The whole testing of colour fastness (washing, perspiration, sunlight and crocking) was done in NITRA lab.

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## TAMARIND SEED COAT EXTRACT AS BIO-MORDANT IN SINGLE-STAGE NATURAL DYEING OF COTTON

Deepali Singhee<sup>1</sup> & Yamini Dhanania<sup>2</sup>

<sup>1</sup>Professor and Principal, <sup>2</sup>Assistant Professor

Department of Textile Science, Clothing and Fashion Studies,

J. D. Birla Institute, Kolkata-700020,

email: <sup>1</sup>deepalisingheejdbi@gmail.com, <sup>2</sup>yaminidhanaia@gmail.com.

HSAI membership number: 03/S-14/LF

### ABSTRACT

Uniform and dark yellowish-brown shades with good colour fastness to light, wash, rub and perspiration are developed on cotton by simultaneous mordanting and dyeing with aqueous extracts of tamarind seed coat (TSC) as a bio-mordant and, onion peel as the natural dye under variable process conditions. The colour interaction parameters are also studied along with phytochemical screening and Fourier Transform Infrared Spectroscopy (FT-IR) analysis. The study indicates that cotton can be dyed with natural dyes having good colour uptake and fastness without the initial treatment of tannins or additional use of metallic mordants. The single-stage application of the mordant and dye, both derived from agro wastes furthers the initiative of making the process of natural dyeing more economical.

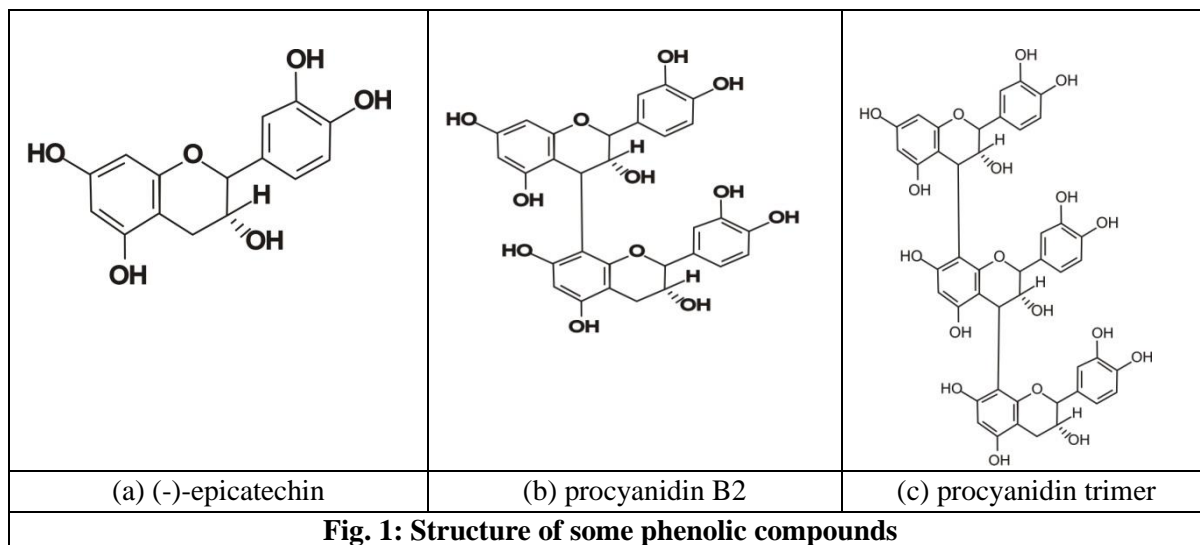
**Keywords:** Bio-mordant, natural dyes, onion peel, simultaneous mordanting, tamarind seeds.

### INTRODUCTION

Bio-mordants mostly derived from vegetal sources are better and an ecofriendly alternative to the metal-mordants. They are biodegradable, less toxic to cause allergic reactions and eco-sustainable (Vankar et al., 2008). Most of them contain high contents of tannins/flavonoids with mordantable polyphenols and carboxylic acid groups that assist in the formation of larger (giant-sized) fiber-bio-mordant-mordantable dye adducts (Singhee et al., 2020), and thus they render the dyed fibre with reasonably good fastness properties (Prabhu & Teli, 2014).

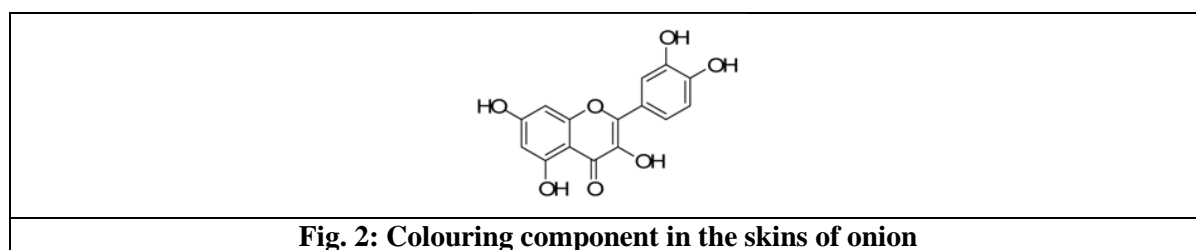
Bio-mordants can also form ester/ether linkages with cotton cellulose and can expectedly help to substitute the two-step of mordant application for dyeing cotton with natural dyes having good fastness by a single-stage application that is completely devoid of the additional use of a metal-mordant. The higher content of tannins in such bio-mordants expectedly allows formation of more dye sites through introduction of more functional groups in the fibre. Some bio-mordants have already proved to be effective in the application of natural dyes without the additional use of metallic mordants (Vankar et al., 2008).

Tamarind seed coat (TCS) comprises of proanthocyanidins, commonly known as condensed tannins or phlobatannin and procyanidin B2, (-)-epicatechin and procyanidin trimer (Sydjaroen et al., 2005).



So far, use of tamarind seed coat (TSC) as a mordant in natural dyeing has been explored to a limited extent by some authors (Prabhu and Teli, 2014).

Natural dyes are expensive and have to be used in huge quantities to get an appreciable depth of shade on textiles (Ali et al., 2012). This can be economized by use of waste materials like the outer thin papery skin/peels of the onion bulb. The thin outer papery layer/peel of onion accounting for 10-25% (w/w) of the total weight (Gulrajani & Gupta, 1992) are essentially removed before usage and is considered a natural by-product of the food industry. It contains considerable amounts of quercetin (a flavonoid) as the colouring matter apart from quercetin-3-glucoside, kaempferol, some procatechuic tannins and anthocyanidines (Teli et al., 2012) as shown in Fig. 2. The peels of the bulb have been used effectively by many researchers (Singhee, 2020) to dye different fibres (Singhee and Dhanania, 2016).



### OBJECTIVE OF THE STUDY

1. To study the effect of different natural mordants on cotton and standardize the dyeing process variables for natural dyeing of cotton with tamarind seed coat as a natural mordant and onion peel as a natural dye using simultaneous/concurrent mordanting and dyeing process.
2. To understand the chemical interaction between the natural dye, fibre and natural mordant using FT-IR analysis.

## EXPERIMENTAL METHDOLOGY

### Materials

Bleached 100% cotton, plain weave fabric (poplin), weighing 117 g/m<sup>2</sup> with 61 ends/inch, 96 picks/inch, and fabric thickness of 0.28 mm was used.

Skinned seed coats from seeds of *Tamarindus indica L.* (TSC), dried fruits of *Terminalia chebula* known as myrobalan a bio-mordant; and dried papery peels of the onion bulb botanically known as *Allium cepa* as the natural dye obtained from local market were further dried in sun and powdered using a mechanical grinder.

### Desizing and Scouring of Cotton

The cotton fabric was desized in the presence of amylase under conditions mentioned in an earlier study (Hao et al., 2013).

### Aqueous Extraction of bio-mordant and natural dye

Standardized recipe from research undertaken by another author was used (Sinnur et al., 2017) was used for extraction of myrobalan.

The colouring matter from the dried and powdered bio-mordant (TSC) was extracted in water under varying process conditions and optimized on the basis of highest colour yield (optical density) at the wavelength of maximum absorbance ( $\lambda_{max}$ ).

Aqueous extract of onion peels (natural dye) was prepared using the conditions established by the authors in their earlier study (Singhee and Dhanania, 2016).

### Pre-mordanting of Cotton

Desized and scoured cotton samples were separately pre-mordanted at optimized conditions (Sinnur et al., 2017) with 10% (owf) alum and myrobalan fruit powder extracted under conditions followed by other authors (Sinnur et al., 2017) and 10% (owf) tamarind seed powder extracted at conditions optimized earlier in this study using MLR - 1:20 at 80°C for 30 min. The treated fabrics were rinsed in running water and dried in shade.

### Dyeing of Cotton with Onion Peel Extract

Desized and scoured cotton samples were dyed by earlier established method (Silva et al., 2018). The dyed fabrics were thoroughly washed in running water and dried in shade.

### Simultaneously Mordanting and Dyeing of Cotton with TSC (Bio-Mordant) and Onion Peels (Natural Dye)

Desized and scoured cotton samples was mordanted with TSC extract and dyed with onion peel extract in the same bath under variable conditions of mordant concentration (5-30% owf), dye concentration (5-30% owf), pH (3-11), MLR (1:10-1:50), time (15-90 min) and temperature (room



temperature i.e 28-30°C to boil i.e 80°C) and the samples were rinsed in 1gpl of non-ionic soap using 1:30 MLR at 60°C for 10 min followed by drying in shade.

**Test Methods**

- Phytochemical Analysis of TSC, Myrobalan and Onion Peel Extract (Evans, 2000; Harbone, 1998)
- FT-IR Analysis: (Mizi et al., 2012)
- Surface colour strength (K/S values) (Bhattacharya and Shah, 2000)
- Colour fastness to light (AATCC, 2010)
- Washing fastness (ISO-II and ISO-III) (AATCC, 2010)
- Rubbing fastness (dry and wet) (AATCC, 2010)
- Perspiration fastness (alkaline and acidic) (AATCC, 2010)

**RESULTS AND DISCUSSION**

**Optimization of Extraction Conditions for TSC (bio-mordant)**

The wavelength of maximum absorbance ( $\lambda_{max}$ ) for TSC (bio-mordant) extract was identified at 410 nm on the basis of highest colour yield (optical density).

Higher colour yield is visible at higher (alkaline) pH 11 (Table 1) indicating that alkaline pH is most suitable for extraction of tannins from tamarind seeds. Increased MLR has a dilution effect on the extract and thus gives lower yields. Heat appears to be more favourable for extraction of tannins from TSC and thus extraction at boil gives maximum colour yield of 2.8. Increase in extraction time to 90 min causes maximum leaching out of tannins from the TSC and thus gives highest colour yield of 2.9. Any further increase in time reduces this yield.





**Table 1.** Optical densities at 410 nm ( $\lambda_{max}$ ) of the aqueous extract of tamarind seed coat (TSC)

<b>pH</b>	Parameters Varied	3	5	7	9	11		
	Optical Density	2.4	2.6	2.7	2.8	3.0*		
<b>MLR</b>	Parameters Varied	1:10	1:20	1:30	1:40	1:50		
	Optical Density	3.1*	2.7	2.6	2.3	1.9		
<b>Temperature (°C)</b>	Parameters Varied	RT	60	80	Boil (> 90°C)			
	Optical Density	1.6	1.7	2.2	2.8*			
<b>Time (min)</b>	Parameters Varied	15	30	45	60	75	90	120
	Optical Density	1.4	1.7	2.0	2.3	2.8	2.9*	2.4
*highest values								

**Optimization of Mordant Concentration and Selection of Mordant**

As expected, use of all mordants drastically increases the surface colour strength (K/S) of the treated cotton fabric (Table 2). Among the two natural mordants investigated in this study, the K/S results are much better when TSC is used as a mordant (Table 2) compared to myrobalan probably as the former contain higher amounts of tannins (40%) than the latter (30%). Thus, justifying the use of TSC as a bio-mordant as substitute for the more harmful metallic mordant like alum.

**Table 2. K/S values (at  $\lambda_{max}$ ) of cotton pre-mordanted with metallic mordant (alum) and bio-mordants (myrobalan and tamarind seed coat) and dyed with onion peel extracted at optimized conditions.**

Mordant Conc. (owf)	Cotton dyed without any mordant	Myrobalan mordanted	Tamarind seed coat -mordanted	Alum mordanted
5%	1.2	3.3	3.9	2.8
10%	1.4	3.4	4.1	2.9
15%	1.6	3.6	4.4	3.1
20%	1.7	3.5	4.9	3.3
25%	1.5	3.3	4.6	3.3
30%	1.4	3.2	4.5	3.5
DYED SAMPLES				

**Optimization of Dyeing Condition Parameters**

Since TSC extract gave better results in dyeing of cotton with onion peel extract compared to myrobalan and alum as mordants, the further study on dyeing of cotton with onion peel was restricted to the use of TSC as a mordant.

**Colour Interaction**

Cotton develops dark brownish shades with reddish-yellowish tone when mordanted and dyed respectively with TSC and onion peel in the same bath. Positive values of  $a^*$  and  $b^*$  colour coordinates indicate corresponding redder and yellow tone of the dyed results. Among the corresponding  $a^*$  and  $b^*$  values, the yellowness tone ( $b^*$  value) is always higher than the redness tone ( $a^*$  value). This indicates that the yellowness in the resultant shades of dyed cotton is enhanced due to the combination of the mordant containing epicatechin as the colouring component and the dye containing quercetin in the form of fibre-mordant-dye adducts during the simultaneous mordanting and dyeing process.

*Surface Colour Strength*

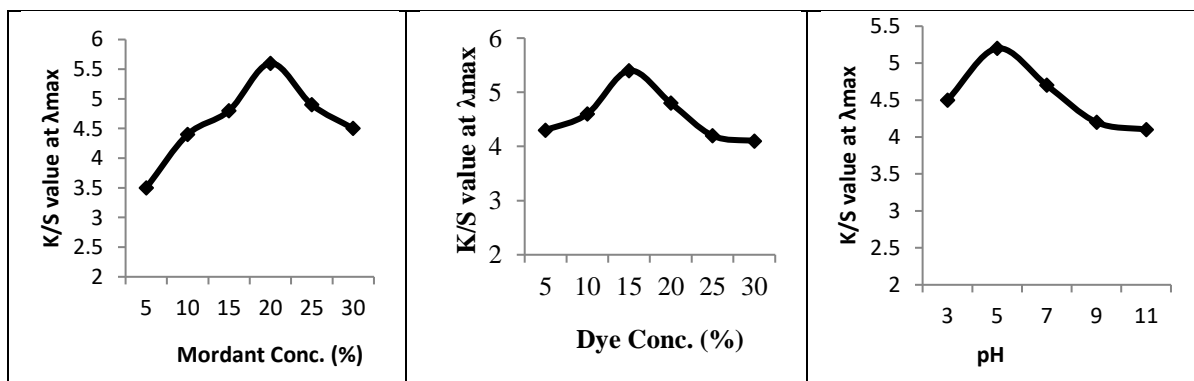
Dye concentration was optimized by studying the effect of its varying amounts (5% to 30%) on the resultant dye uptake by cotton. The K/S values of the dyed cotton fabric, increases initially with increase in the amount of dye concentration. Beyond the use of 15% (owf) dye, K/S values decrease as the dyeing equilibrium for onion peel as natural dye is attained at 15% (owf) dye concentration. At higher concentrations of the dye, the dye molecules probably agglomerate and thus cannot be adsorbed by the fibre and so there is a drop in the surface colour strength (K/S values) at dye concentration beyond 15%.

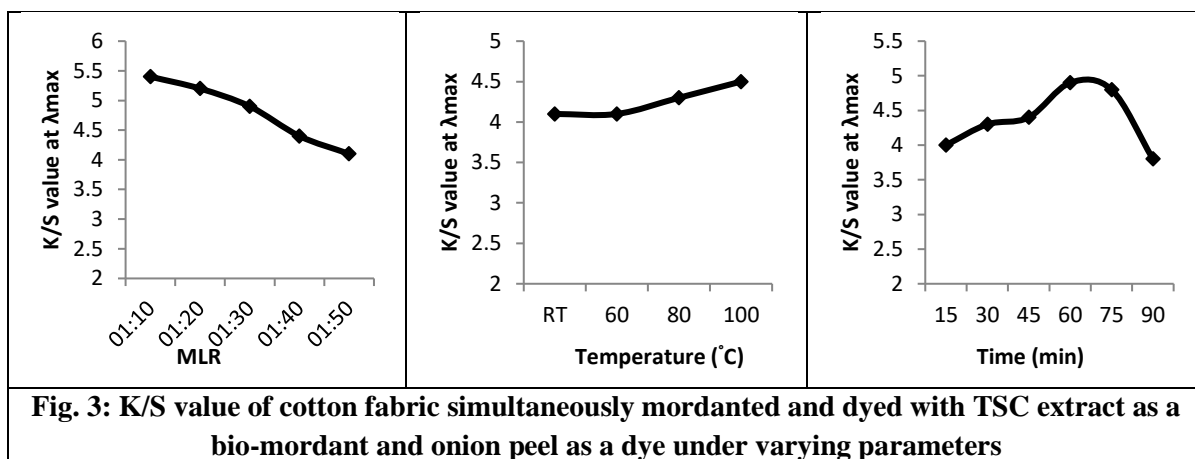
Acidic pH assists in the ionization of the phenoxy-hydroxyl (-OH) containing colour component present in both the natural dye (onion peels) and the bio-mordant (TSC) especially in an aqueous medium and results in easy diffusion of the colour components inside the cotton-cellulosic fibre facilitating formation of dye-mordant-fibre complexes inside the fibre. This is reflected in the higher K/S values of the dyed cotton at acidic pH ranging from 3-5 compared to alkaline pH of 9-11. Acidity of the dye bath enhances ionization of the dye molecules and its transportation leading to higher adsorption on the fibre surface and subsequent higher diffusion. Highest K/S value is observed at pH 5.

The surface colour strength of the dyed cotton fabric decrease significantly with increase in the material to liquor ratio (MLR). In general, higher MLR gives less concentrated (diluted) dye solution and hence the rate of strike of the dye molecules on the fibre surface and its consequent uptake by the fibre decreases. Though MLR of 1:10 gives highest K/S values, but for the ease of dyeing in batches, MLR 1:20 that gives comparable results (K/S) has been selected.

Temperature provides additional energy for the ionization and transportation of the dye molecules onto the fibre surface giving higher rate of dye sorption followed by diffusion into the swollen fibre. Thus, dyeing cotton with onion peel extract at boil gives highest surface colour strength.

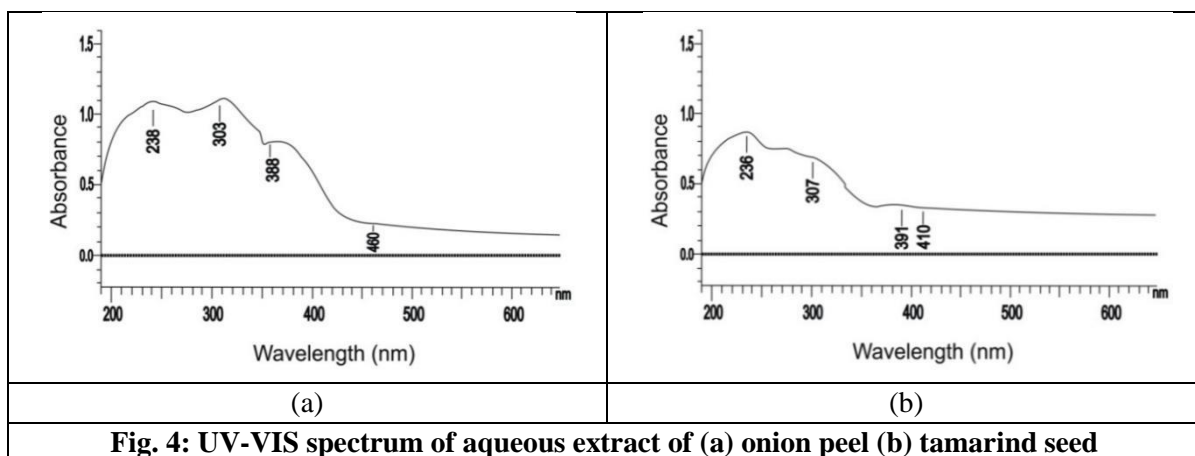
K/S values increase with the increase in duration of dyeing from 15 min to 75 min. When dyeing is carried out for 60 min, highest surface colour strength is obtained. Most tannins (from TSC) and flavonoids (from quercetin of onion peel) are taken up by the cotton fibre within 60 min. With any further increase in the duration of dyeing beyond this equilibrium stage, the K/S value starts decreasing as a result of desorption of the dye molecules from the fibre or breaking up of the dye-fibre-mordant complexes leading to a decrease in the colour value of the dyed cotton.





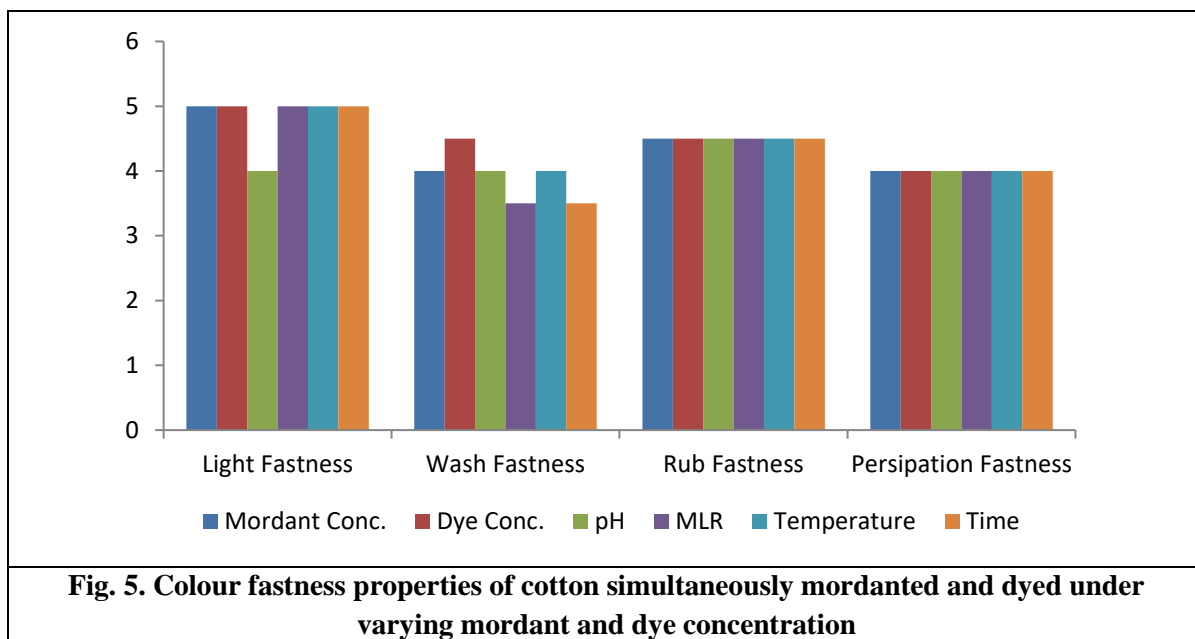
### Colour Fastness Properties

Cotton fabric simultaneously mordanted with TSC rich in tannins and dyed with onion peel shows moderate to good (3 to 5) light fastness in most cases (Fig. 5). This improvement in light fastness can thus be attributed to the light stability of (a) colour component (quecetin) in onion peel, (b) tannins and colouring matter in TSC extract and (c) stable formation of large mordant-fibre-dye complex/adducts between TSC and onion peel. The effect can also be corroborated with the UV-VIS spectrum of aqueous extract of onion peel (Fig. 4a) and TSC (Fig. 4b) which shows presence of some small peaks in the UV region (238 nm, 303 nm, 388 nm and 480 nm for onion peel and 236 nm, 236 nm, 307 nm, 391 nm and 410 nm for tamarind seed coat) indicating that the dye adducts formed between cotton-TSC mordant-onion peel dye can preferentially absorb UV rays and thus reduces the intensity of the effect of these UV-rays on the coloured components present in the dye and mordant.



The overall wash fastness property of cotton simultaneously mordanted with aqueous extract of TSC and dyed with onion peel (Fig. 5) ranges from good to very good (3-4 to 4-5). The attachment of the phenolic hydroxyl groups of tannins in TSC and flavonols in onion peel with the cotton fibre through H-bonds and possibly ether/ester linkages forming large mordant-dye-fibre complexes is mainly responsible for this overall good fastness of cotton.

Rubbing fastness of cotton fabric mordanted and dyed together with TSC and onion peel respectively range from poor (2-3) to very good (5). The good fastness to dry rubbing fastness indicates absence of loosely adhered dye on the fabric surface and corresponding formation of large mordant-fibre-dye complexes.



### Phytochemical Analysis

The phytochemical screening of the chemical constituents in tamarind seed coat, myrobalan and onion peel extracts indicates the presence of active compounds in the aqueous extracts (Table 3).

**Table 3. Qualitative analysis of the phytochemicals in bio-mordants (tamarind seed coat and myrobalan extracts) and natural dye (onion peel extract)**

Phytochemical Screening		TSC		Myrobalan		Onion Peel	
		AE	EE	AE	EE	AE	EE
<b>Alkaloids</b>	Dragendorff's reagent	++	++	++	++	++	++
	Mayer's reagent	+	++	+	++	++	++
	Wagner's reagent	++	++	++	++	++	++
	Picric Acid	++	++	++	++	++	++
<b>Flavonoids</b>	Ammonium test	++	+++	++	++	++	+++
	Aluminum chloride test	++	+++	++	++	++	+++
<b>Tannins</b>	Ferric chloride test	++	+++	+++	+++	++	+++

<b>Terpenoids</b>	Salkowski test	+	++	+	++	-	++
<b>Saponins</b>	Emulsion test	+	++	+	++	+	++
-absence of compound; + presence in low amount; ++ presence in moderate abundance; +++ presence in high amount AE- Aqueous extract; EE- Ethanolic extract							

### Fourier Transform Infrared Spectroscopy (FT-IR) Analysis

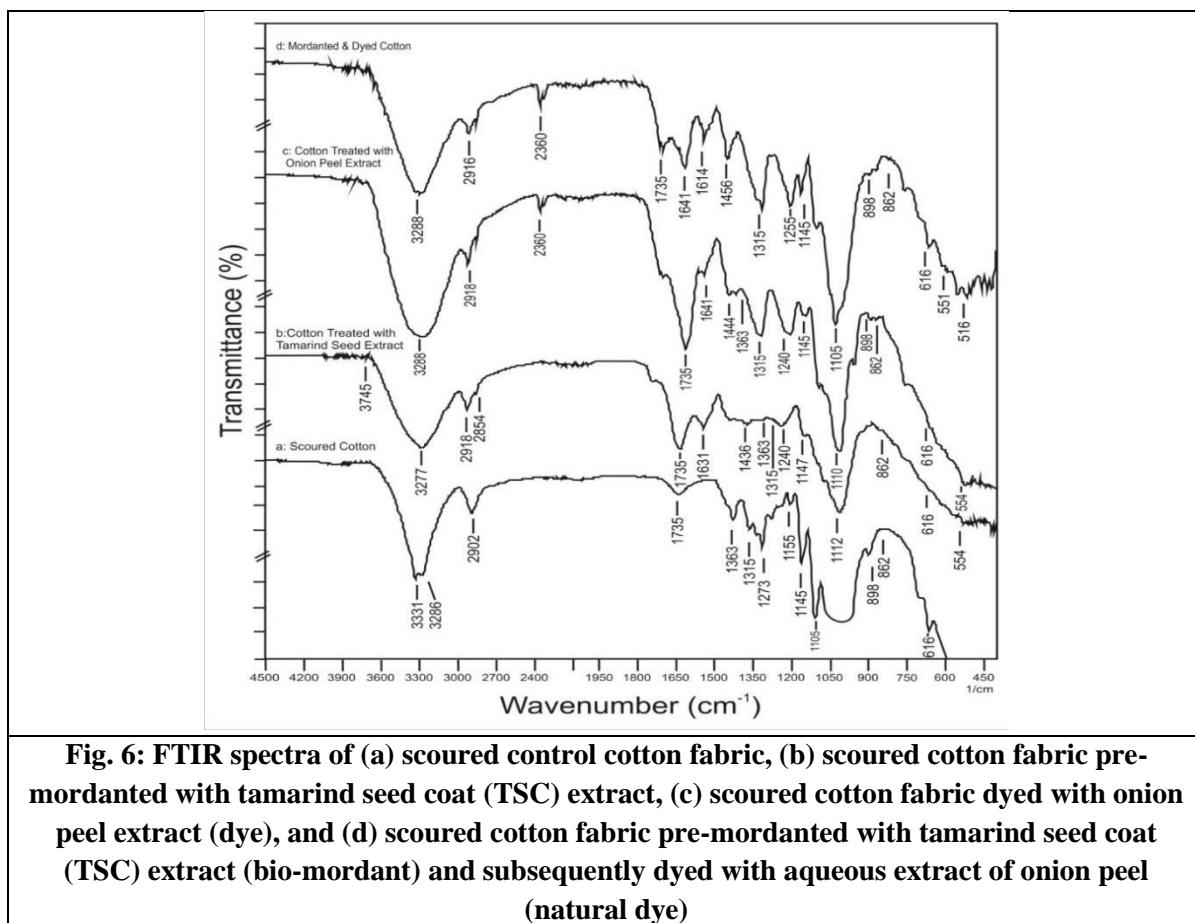
FTIR spectra of treated and untreated cotton fabric in Figure 6 indicate similarity with some minor differences that are related to the interaction of functional groups and/or their attachments therein (Table 4).

**Table 4.** FT-IR analysis of untreated and treated cotton showing the functional groups those are responsible for mordant-fibre-dye interactions.

Peaks (cm <sup>-1</sup> )	Functional Groups Identified/Responsible	Specific Observations/Probable Causes
<b>Common peaks for scoured cotton (Spectra a), TSC-treated cotton (undyed) showing the following additional/difference peaks (Spectra b) and onion skin treated cotton (undyed) showing the following additional/difference peaks (Spectra c)</b>		
616 cm <sup>-1</sup>	Alkyne C-H bending	Alkyne C-H bending of cellulose
862-898 cm <sup>-1</sup>	C-O-O stretching	carboxylic acid group of cellulose after bleaching
1105-1135 cm <sup>-1</sup>	Alkyl-substituted ether C-O stretching	Alkyl-substituted ether C-O stretching of cellulose
1315 cm <sup>-1</sup>	Primary or secondary -OH in plane bending	Primary or secondary -OH in plane bending of cellulose
1363 cm <sup>-1</sup>	Phenol alcohol -OH bending	Phenol alcohol -OH bending of cellulose structure
2902-2918 cm <sup>-1</sup>	Methyne C-H stretching	Methyne C-H stretching in aromatic structure of cellulose
3286-3288 cm <sup>-1</sup>	Alkyne C-H stretch & hydroxy group, H bonded -OH stretching	Alkyne C-H stretch & hydroxy group, H bonded -OH stretching in cellulose structure of cotton
3331 cm <sup>-1</sup>	Hydroxy group, H-bonded -OH stretching	Hydroxyl group, H-bonded -OH stretching of cellulose
<b>TSC treated cotton (undyed) showing the following additional/difference peaks (Spectra b)</b>		
1240-1255 cm <sup>-1</sup>	Aromatic ethers aryl C-O stretch	Combining of -OH of cotton cellulose (cellubiose) with phenolic -OH of tamarind seed compounds forming ether linkages under acidic pH (pH 5) due to amino acid residue in TSC, to show aryl C-O stretching of amino acid residue

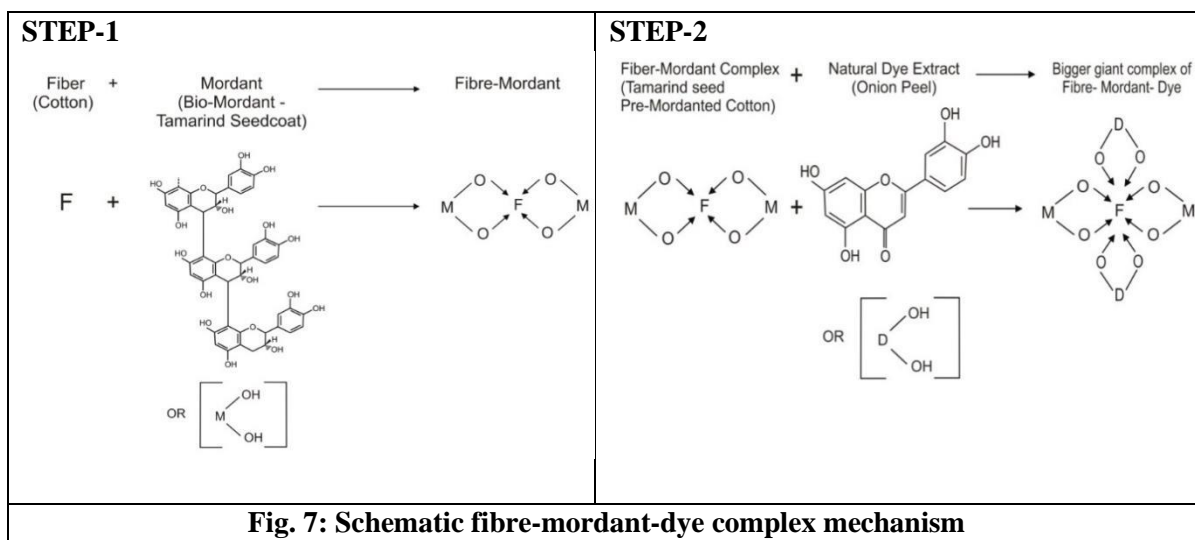
1363 cm <sup>-1</sup>	Phenol alcohol –OH stretching	Conversion of 1315 cm <sup>-1</sup> of cotton for primary –OH or secondary -OH in plane bending due to overlapping of phenolic –OH of tamarind seed compound
1436 cm <sup>-1</sup>	O-H bending of -CH-OH in tamarind seed compound	--
1631-1641 cm <sup>-1</sup>	Alkenyl stretching of tamarind seed compound	--
2854 cm <sup>-1</sup>	Methyne C-H stretching of tamarind seed compound	--
2918 cm <sup>-1</sup>	Methene C-H asymmetrical / symmetrical stretching	--
3277 cm <sup>-1</sup>	Alkyne C-H stretch & hydroxy group, H bonded -OH stretching of tamarind seed compound	Alkyne C-H stretch & Hydroxy group, H bonded -OH stretching present in tamarind seed compound
3745 cm <sup>-1</sup>	Non-bonded hydroxyl OH stretching in ortho position of tamarind seed compound	
<b>Onion skin treated cotton (undyed) showing the following additional/difference peaks (Spectra c)</b>		
1240 cm <sup>-1</sup>	Aromatic ether with aryl –C-O stretching	Combining of -OH of cotton cellulose (cellubiose) with phenolic -OH of tamarind seed compounds forming ether linkages under acidic pH (pH 5), to show aryl C-O stretching
1444 cm <sup>-1</sup>	Small duplet for overlapping of –O-H of bending/stretching of cotton at 1363 cm <sup>-1</sup> and 1436 cm <sup>-1</sup> of tamarind seed compound's -O-H bending of CH-OH and 1240 cm <sup>-1</sup> for aryl ether for combining with fibre-mordant-dye complex.	Small duplet for overlapping of –OH due to overlap of bending/stretching of cotton at 1363 cm <sup>-1</sup> and 1436 cm <sup>-1</sup> of tamarind seed compound's –OH bending of CH-OH and 1240 cm <sup>-1</sup> for aryl ether for combining with fibre-mordant-dye complex.
1641 cm <sup>-1</sup>	Aromatic ring C-C stretching of onion peel compound	Presence of quercetin in onion peel
1735 cm <sup>-1</sup>	Aromatic –C=O stretching of quercetin	Combining of -OH of cotton cellulose (cellubiose) with phenolic -OH of tamarind seed compounds forming ether linkages under acidic pH (pH 5), to show aryl C-O stretching
<b>Cotton pre-mordanted with TSC and dyed with onion peel showing the following additional/difference peaks (Spectra d)</b>		
1240-1255 cm <sup>-1</sup>	Aromatic ethers with aryl –C=O	

	stretching	
1614 cm <sup>-1</sup>	-C-C skeletal vibration	Increase of C-C concentration in mordant and dye forming complex
2360 cm <sup>-1</sup>	-C=C-C stretching	-C=C stretching of onion peel compound as a result of presence of quercetin



Thus, the interactive association of the bio-mordant (tamarind seed coat - TSC) and onion peel (natural dye) with cotton fibre can be further demonstrated with the probable fibre-mordant-dye complex mechanism illustrated in Figure 7 indicating formation of big and giant adducts of tannin procyanadin in TSC and quercetin in the natural dye with TSC pre-mordanted cotton through coordinate and covalent bond. However formation of ether linkages between phenolic -OH of TSC and colour component of onion peel along with the -OH group of cellulose cannot be excluded, as in all spectra b, c and d, aromatic ethers with aryl -C=O stretching was observed in all the three cases in the respective spectra.





## CONCLUSION

Tamarind seeds containing higher amounts of tannins renders better surface colour when used as a mordant to dye cotton with onion extract compared to other natural mordant (myrobalan) or metallic mordant (alum) and can thus be used to substitute alum, a harmful metallic mordant. It also allows elimination of the mandatory pre-treatment of cotton with tannins in addition to application of metal mordants while dyeing cotton with natural dyes. Tannins and flavonoids are present in abundance in methalonic extracts of TSC and onion peel. The optimized conditions for aqueous extraction for tamarind seeds were identified at 11 (pH), 1:10 (MLR), 90 min (time) and 100°C (temperature). Darker shades with a reddish-yellow tone with excellent degree of colour uniformity and good light, wash, rub and perspiration fastness was obtained by the more simpler and economical single-stage simultaneously mordanting and dyeing process of cotton using TSC (mordant) and onion peel (natural dye) extract under optimized conditions (mordant concentration – 20% (owf), dye concentration – 15% (owf), pH – 5, MLR – 1:20, temp – 80°C and time – 60 min). This indicates formation of big and giant adducts of tannin in TSC and quercetin in the natural dye with TSC pre-mordanted cotton through coordinate and covalent bond apart from formation of some ether linkages between phenolic -OH of TSC and colour component of onion peel along with the -OH group of cellulose. The process is thus sustainable as it uses agro wastes and involves no harmful chemicals.

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## UTILIZING VEGETABLE DYES AND THICKENERS IN SCREEN PRINTING ON REGENERATED FABRICS: PROMOTING SUSTAINABLE AND ECO-FRIENDLY PRACTICE

Dr. Divya Ojha <sup>1</sup>, Prof. (Dr.) Sangita Deodiya <sup>2</sup>

<sup>1</sup> School of Vocational Education and Training IGNOU, New Delhi

<sup>2</sup> Department of Home Science (Clothing and Textiles),

Banaras Hindu University, Varanasi, India, 221005

E-mail: <sup>1</sup>divyabh89@gmail.com <sup>2</sup>vkm.sangita@gmail.com

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### ABSTRACT

Consumers are shifting away from synthetic products and toward natural ones these days, which is driving up demand for eco-friendly, non-toxic, and sanitary fabrics. The aim of research and development is to offer workable solutions that are safe for people and the environment. The mass market does not yet have widespread access to materials printed and dyed using vegetables. The issue of sustainable development in the textile industry can be effectively addressed by using traditional methods of printing with natural dyes on natural materials, potentially gaining a lot of momentum in the export market. Most synthetic materials used to dye textiles nowadays are harmful to the environment. Natural substances sourced from plants and animals are gaining popularity, such as guar gum, chitosan, and vegetable colourings. In this study, cellulosic fabrics, specifically bamboo and lyocell, were dyed with natural red dyes and their shades, Madder dye (*Rubia cordifolia*), Kattha (*Acacia catechu*), and Annatto (*Bixa orellana*), using hand screen printing. The research was conducted in three phases: the first stage involved extracting colouring pigments from the dyes using an alcoholic extraction method; the second stage involved making a printing paste by varying the ratios of guar gum to chitosan; and the third stage involved testing the printed fabrics for color fastness and antimicrobial activity against *E. coli* and *S. aureus*.

**Key Words:** Natural dyes, Chitosan, Guar gum, Regenerated fabric, sustainable textile

### INTRODUCTION

Color, a fundamental feature of the natural world, adds aesthetic and emotional value to human existence. Certain colors are connected to particular seasons, occasions, human characteristics, feelings, and passions (Vankar 2007). In terms of natural dyeing, Indians have long been the pioneers. However, the use of natural dyes has declined over generations as a result of inaccurate understanding regarding extraction and dyeing processes as well as a lack of recordkeeping. Most synthetic materials that are bad for the environment are used to dye garments these days. These compounds are involved in non-biodegradability, cancer, water contamination, and waste disposal problems. An increasing number of people are becoming interested in natural components such as chitosan derived from animals, vegetable colors generated from plants, and guar gum as environmentally friendly alternatives. Natural dyes are used to color a variety of things, including wood, paper, and textiles, even if there isn't much of a market for them. Moreover, they are used in

food, cosmetics, and pharmaceuticals and provide a range of health benefits (Chengaiyah et al.,2010). Many plants that are used to extract color are also thought of as medicinal dyes; in fact, recent research has indicated that some of these plants may even have antibacterial properties (Siva, 2007). In this investigation, three plant-based dyes with medicinal properties—Madder (*Rubia cordifolia*), Kattha (*Acacia catechu*), and Annato (*Bixa orellana*)—were selected for use in fabric printing. Two types of regenerated cellulosic fabrics were used in this study: Bamboo and Lyocell. Lyocell is a cellulosic fibre that possesses all the benefits associated with that kind of fibre, such as absorbency, total biodegradability, and exceptional handling flexibility due to the application of chemical finishing techniques and enzymes. Bamboo fibre, which is made entirely of bamboo pulp, has excellent permeability, good hygroscopicity, a soft feel, ease of dyeing and straightening, and pigmentation that results in a lovely color. Considered a noteworthy biopolymer, bamboo fibre finds application in various industries, including textiles. Materials that have been printed and dyed using vegetables are not widely available to the general population (Mishra, 2014). Using natural dyes helps lessen the harm that synthetic dyes do to the environment and to people's health. Thus, the development of technology for the extraction of natural dyes and their use in textile materials is essential.

### **OBJECTIVES OF THE STUDY**

Present study was carried out on the basis of following objectives:

- To choose red natural colors with medicinal qualities.
- To create printing paste for screen printing by varying the ratio of guar gum to chitosan as a thickening agent.
- To print on regenerated cellulosic fabrics using specific dye sources.
- Characterization of printed fabric.

### **MATERIALS AND METHODS**

**SELECTION OF FABRIC:** Bamboo and lyocell, two types of regenerated cellulosic fabric, were used for this study. The chosen fabrics also differed in terms of their textures and qualities. Lyocell fabric was bought from H.P. Singh Agency in New Delhi, and bamboo fabric was bought from Krishna Silk House in Bhagalpur, Bihar.

**PREPARATION OF THE FABRIC:** Prior to printing, the fabric underwent pretreatment. Oil, fats, and other solid contaminants that may have been present during the fabric's production process were removed from it by the scouring process.

**SELECTION OF DYES:** Two naturally occurring dye sources with medicinal qualities were chosen for the current research work: madder (*Rubia Cordifolia*), kattha (*Acacia catechu*), and annato (*Bixa Orellana*). These particular natural dye suppliers were bought from Sodhani BioTech Pvt Ltd in Jaipur, Rajasthan. The dyes were bought in prepared in powdered form, followed by an extraction procedure.

**EXTRACTION OF DYE:** Since the acquired dye in the current investigation was in powder form, an extraction procedure was carried out to create printing paste. The alcohol extraction procedure was used in the case.

**PREPARATION OF PRINTING PASTE:** The usual recipe from the (Abdou. E.S. et al., 2013) was used to prepare the printing paste. A formula for printing on 20/20-inch cloth sample size was established for the current investigation based on the standard quantity and materials employed. For the recipe's four ratio to vary of the thickening agent was created. Three of the mix formulations included the thickener, and one was a specially made unique recipe. The ratios of thickeners created for this investigation are as follows:

- 1 75% Guar Gum+ 25% Chitosan
- 2 25% Guar Gum + 75% Chitosan
- 3 50% Guar Gum + 50% Chitosan
- 4 Guar Gum 100%

**PRINTING OF THE FABRIC:** After the fabric was pre-treated, it was printed using pure guar gum paste and printing paste with varying blend ratios. The screen-printing approach was employed in this experiment.

**AFTER TREATMENT OF THE FABRIC:** Because improving the print's fastness requires that any printed material penetrate and fix the print on the fabric. The generated sample was steam-fixed to correct the print.

**CHARACTERIZATION OF THE PRINTED FABRIC:** A variety of parameters were used to characterize the printed fabric using natural dyes and thickeners, including color fastness, physical strength, and antimicrobial activity. These tests were conducted at the Polymer Technology lab at Delhi Technological University in New Delhi, as well as the NITRA testing lab in Varanasi.

## RESULTS AND DISCUSSION

Three of the chosen colors from the plant sources were used to print on the regenerated cellulosic fabrics (Lyocell and Bamboo). The impact of changing the thickener's ratio was investigated. The impact was examined using color fastness, physical characteristics, and antibacterial activity as research criteria. The following sections include the results of the experiment that were conducted:

### Properties of printed Lyocell, a regenerated cellulosic fabric

#### 1 Assessment of colorfastness of the printed Lyocell fabric

##### (a) Fastness to washing

**Table no. 1 Fastness to washing of the printed Lyocell fabric (ISO 105 C06 (ISO test no. 3)**

S.no	Recipe Prepared for Printing	Dye	Washing Fastness		
			CC	CS	
				Wool	Cotton
	Ratio	Madder			
1	75% (GG)+25% (CH)		1-2	4-5	5
2	25% (GG)+75% (CH)		2	4	5
3	50% (GG)+50% (CH)		1	4	5

4	100% Guar Gum		1	4	5
		Katha			
5	75% (GG)+25% (CH)		3-4	4	5
6	25% (GG)+75% (CH)		4-5	4-5	5
7	50% (GG)+50% (CH)		4-5	4-5	5
8	100% Guar Gum		4-5	4-5	5
		Annatto Seed			
9	75% (GG)+25% (CH)		1-2	4-5	4-5
10	25% (GG)+75% (CH)		2	4-5	4-5
11	50% (GG)+50% (CH)		1-2	4-5	4-5
12	100% Guar Gum		2-3	4-5	4-5

GG-Guar gum, CH- Chitosan, CC- Color Change, CS- Color Staining

Table No. 1 demonstrates that following the evaluation of color fastness to washing using a gray scale, it was discovered that Lyocell fabric printed with Madder dye and thickener 25%GG+75% CH had a significant change in color, rated (2) on the gray scale. In contrast, color staining on wool was found to be somewhat to non-existent (4-5) with the ratio 75%GG+25% CH, and no staining (5) was found on cotton with all developed recipes.

In contrast, fabric printed with Katha dye in three different ratios—25%GG+75%CH, 50%GG+50%CH, and 100% Guar Gum—was rated on a gray scale of 4-5, meaning there was little to no color change. Wool fabric was likewise found to have little to no color staining; however, cotton cloth received a point 5 rating, indicating that no color staining was present. When cloth printed with Annatto seed was examined, variations in the color parameter were noted, and thickening ratios were calculated. A sample printed with a 25% GG+75% CH ratio exhibited a considerable change that was rated as a 2 on the gray scale, while fabric printed with a 100% guar gum paste ratio was found to be in good to fair (2–3) condition. Regarding the color staining portion, both wool and cotton fabrics rated with a point 5 on a gray scale showed little to no change in the fabric printed using all of the established recipes.

#### Gray scale for Evaluation:

Rating for Change in Colour	Rating for Colour Staining
5- Negligible or no change	5- Negligible or no staining
4- Slightly Changed	4- Slightly stained
3- Noticeable Changed	3- Noticeable stained
2- Considerably Changed	2- Considerably stained
1- Much Changed	1- Heavily Stained

#### b) Fastness to Rubbing (IS 706, ISO 105-X 12, AATCC- 8)

Table no. 2 Fastness to Rubbing of the printed Lyocell fabric (IS 706, ISO 105-X 12, AATCC- 8)

S.no	Recipe Prepared for Printing	Dye	Rubbing Fastness	
			Dry Rubbing	Wet Rubbing
	Ratio	Madder		
1	75% (GG)+25% (CH)		5	2
2	25% (GG)+75% (CH)		5	4-5

3	50% (GG)+50% (CH)		4-5	4
4	100% Guar Gum		4-5	4-5
		Katha		
5	75% (GG)+25% (CH)		5	4
6	25% (GG)+75% (CH)		4-5	5
7	50% (GG)+50% (CH)		5	4-5
8	100% Guar Gum		5	5
		Annatto Seed		
9	75% (GG)+25% (CH)		5	4
10	25% (GG)+75% (CH)		5	3-4
11	50% (GG)+50% (CH)		5	2
12	100% Guar Gum		5	4-5

Table No. 2 shows that there was no color difference between the 75%GG+25%CH and 25%GG+75%CH ratios printed with madder dye after the fabric was rubbed dry. On the other hand, the combination of 25%GG+75%CH and 100% guar gum produced the best results when the cloth was rubbed wet. This ratio was graded 4-5 on a gray scale, indicating that there was either no change or very minor change. With respect to Katha dye, all three ratios—except 25%GG+75%CH—exhibited no variation in dry rubbing. Two ratios, 25%GG+75%CH and 100% guar gum, exhibited no color change in the wet condition and received a 5 on the gray scale. After printing the fabric with Annatto seed dye, it was discovered that all of the ratios displayed no color change when rubbing the fabric dry. In contrast, the ratios containing 100% guar gum displayed little to no color change when rubbing the fabric wet, with the remaining ratios falling between 4 and 3-4 and 2 on the gray scale.

**c) Fastness to Perspiration (IS 971, ISO 105 E01)**

**Table no.3 Fastness to Perspiration of the printed Lyocell fabric (IS 971, ISO 105 E01)**

S.no	Recipe Prepared for Printing	Dye	Acid			Alkaline		
			CC	CS		CC	CS	
				W	C		W	C
	<b>Ratio</b>	<b>Madder</b>						
1	75% (GG)+25% (CH)		3	4	4-5	3	4	4-5
2	25% (GG)+75% (CH)		3	4-5	5	3	5	4-5
3	50% (GG)+50% (CH)		3-4	4-5	4-5	3-4	4-5	4-5
4	100% Guar Gum		4	5	4-5	4	5	5
		Katha						
5	75% (GG)+25% (CH)		3	5	4-5	4-5	4-5	4-5
6	25% (GG)+75% (CH)		5	5	4-5	4-5	5	4-5
7	50% (GG)+50% (CH)		5	4-5	4-5	4-5	5	4
8	100% Guar Gum		5	4-5	4-5	4-5	4-5	4
		Annatto Seed						
9	75% (GG)+25% (CH)		4	5	5	4-5	5	4-5
10	25% (GG)+75% (CH)		4-5	5	5	4-5	5	5
11	50% (GG)+50% (CH)		4-5	5	4-5	4-5	5	5
12	100% Guar Gum		4-5	5	5	5	5	4-5

From the above data, we can infer the printed Lyocell fabric's fastness to perspiration using the developed thickening and natural dye formulae. Sweating's acidic and alkaline properties were both utilized to gauge how rapidly a person perspired. Regarding the acidic sweat, it was discovered that the 100% gum gum ratio scored between

a 3 and a 4, whilst the fabric printed with madder dye underwent a slight color shift and received a score of 4. In the color staining section, wool fabric with a ratio of 100% Guar gum exhibited no staining (5), whereas cotton fabric with a ratio of 25%GG+75%CH received the same rating.

A 100% guar gum ratio produced the best color change results with the alkaline solution, which is similar to the acidic solution. In the color staining section, it was found that two ratios, 25%GG+75%CH and 100% guar gum, did not stain wool cloth (5). On the other hand, 100% guar gum yielded the same result on cotton.

With the exception of the ratio 75%GG+25%CH with the acidic solution, fabric printed with Katha dye was found to have no color alteration(5), but all four ratios with the alkaline solution showed little to no color change (4-5). In terms of color staining, it was discovered that all ratios on cotton were scored on (4-5) using the acidic solution, however two of the ratios, 25%GG+75%CH and 75%GG+25% CH, had no staining (5) on wool. The alkaline solution that had the best results for color staining wool was 25%GG+75%CH and 50%GG+50%CH. On cotton, on the other hand, two of the ratios (75%GG+25%CH and 25%GG+75%CH) showed little to no change in color.

The ratio 100% Guar gum showed no color change in the event of alkaline sweat, whereas the other three ratios received ratings of 4-5 on the gray scale. With the exception of 75%GG+25%CH, it was observed that there was little to no change in color (4-5) in the case of acidic sweat of the printed fabric using Annatto seed dye.

The results of the color staining section revealed that cotton printed fabric stained with three different ratios (75%GG+25%CH, 25%GG+75%CH, and 100% Guar gum with acidic solution) showed the same results as wool printed fabric stained with Annatto seed dye. The cotton printed fabric stained with two of the ratios, 50%GG+50%CH and 25%GG+75%CH, received a gray scale rating of 5, while wool printed fabric stained with all of the ratio did not show any staining (5) when using an alkaline solution.

**d) Fastness to Sunlight (IS: 686-1957)**

**Table no.4 Fastness to Sunlight of the printed Lyocell fabric (IS: 686-1957)**

S.no	Recipe Prepared for Printing	Dye	Sunlight Fastness
	<b>Ratios</b>	<b>Madder</b>	
1	75% (GG)+25% (CH)		5
2	25% (GG)+75% (CH)		4
3	50% (GG)+50% (CH)		4-5
4	100% Guar Gum		5
		<b>Katha</b>	
5	75% (GG)+25% (CH)		5
6	25% (GG)+75% (CH)		5
7	50% (GG)+50% (CH)		5
8	100% Guar Gum		5
		<b>Annatto Seed</b>	
9	75% (GG)+25% (CH)		4
10	25% (GG)+75% (CH)		4-5
11	50% (GG)+50% (CH)		4
12	100% Guar Gum		4-5



The process was followed, and it was found that the cloth printed with madder dye, in two of the ratios (75% GG+25% CH and 100% Guar gum paste), had Good (5) sunlight fastness. With all of the created formulations, it was found that the cloth printed with Katha dye showed Good fastness (5) towards sunlight (Gupta.Deepti, Natural dyes and their application to Textiles). On the other hand, two of the ratios of 100% Guar gum and 25% GG+75% CH of Annatto seed dye were evaluated as fairly good (3).

## 1.2 Antimicrobial Activity of Grey and Printed Lyocell Fabric

**Table no. 5 Antimicrobial Activity of Grey and Printed Lyocell Fabric**

S.no	Recipe Prepared for Printing	Dye	Antimicrobial Activity	
			<i>E.coli</i>	<i>S.aureus</i>
	<b>Grey Fabric</b>		-	-
1	75% (GG)+25% (CH)	Madder	-	+
2	25% (GG)+75% (CH)		+	
3	50% (GG)+50% (CH)			
4	75% (GG)+25% (CH)	Katha	+	-
5	25% (GG)+75% (CH)		+	-
6	50% (GG)+50% (CH)		-	
7	75% (GG)+25% (CH)	Annatto Seed	+	+
8	25% (GG)+75% (CH)		+	+
9	50% (GG)+50% (CH)		+	-

Table No. 5 shows the antibacterial activity of printed Lyocell fabric with specific natural dye and thickener ratios. E. Coli and S. aureus bacteria do not exhibit any antibacterial activity against grey Lyocell fabric. Fabric printed with madder dye was found to exhibit antibacterial action against two different strains of bacteria: 25%GG+75%CH with E. coli and 75%GG+25%CH with S. aureus. The dye Katha was found to exhibit antibacterial activity with the bacteria E. coli in the ratios of 75%GG+25%CH and 25%GG+75%CH; no similar activity was observed with S. aureus. In contrast, three ratios of 75%GG+25%CH, 25%GG+75%CH, and 50%GG+50%CH with E. coli and 75%GG+25%CH and 25%GG+75%CH ratio of thickener with S. aureus bacteria

## 2 Characterization of Printed regenerated cellulosic Fabric: Bamboo

### 2.1 Assessment of Colorfastness of the Printed Bamboo Fabric

- (a) Fastness to washing (ISO 105 C06 (ISO test no. 3))

**Table no. 6 Fastness to washing of the Printed Bamboo Fabric (ISO 105 C06 (ISO test no. 3)**

S.no	Recipe Prepared for Printing	Dye	Washing Fastness		
			CC	CS	
				Wool	Cotton
	Ratios	Madder			
1	75% (GG)+25% (CH)		1	4	5
2	25% (GG)+75% (CH)		1-2	4-5	5
3	50% (GG)+50% (CH)		1	4-5	5
4	100% Guar Gum		1	4	5
		Katha			
5	75% (GG)+25% (CH)		4	4-5	5
6	25% (GG)+75% (CH)		3-4	4-5	5
7	50% (GG)+50% (CH)		3-4	4-5	4-5
8	100% Guar Gum		4	4-5	5
		Annatto Seed			
9	75% (GG)+25% (CH)		1-2	4-5	4-5
10	25% (GG)+75% (CH)		1	4-5	4-5
11	50% (GG)+50% (CH)		3-4	4-5	4-5
12	100% Guar Gum		2	4-5	4

The rate at which the color of the printed fabric will change and stain is shown in Table No. 6. All samples, with the exception of the fabric printed with Katha dye, showed a change in color (CC) between 2, 1-2, and 1, except for the fabric graded with (3-4) for the ratio 75% GG + 25% CH and 100% Guar gum, and between 4-5 and 5 on a gray scale for the ratio 25% GG + 75% CH and 50% GG + 50% CH.

**b) Fastness to Rubbing (IS 706, ISO 105-X 12, AATCC- 8)**

**Table no. 7 Fastness to Rubbing of the Printed Bamboo Fabric (IS 706, ISO 105-X 12, AATCC- 8)**

S.no	Recipe Prepared for Printing	Dye	Rubbing Fastness	
			Dry Rubbing	Wet Rubbing
	Ratios	Madder		
1	75% (GG)+25% (CH)		4-5	2
2	25% (GG)+75% (CH)		4-5	4
3	50% (GG)+50% (CH)		5	4
4	100% Guar Gum		5	3-4
		Katha		
5	75% (GG)+25% (CH)		5	4-5
6	25% (GG)+75% (CH)		5	4-5
7	50% (GG)+50% (CH)		5	5
8	100% Guar Gum		5	4
		Annatto Seed		
9	75% (GG)+25% (CH)		5	3-4
10	25% (GG)+75% (CH)		5	4-5
11	50% (GG)+50% (CH)		5	4
12	100% Guar Gum		5	4-5

Table No. 8 presents the developed samples' fastness to rubbing. When all colors were dry-rubbed on printed fabric, minimal variation was seen; all dyes fell between the 5 and 4-5 range on a grayscale. When the conditions were wet, some variation was seen; fabric printed with madder dye at a blend ratio of 75%+25% showed insufficient (2) rubbing fastness while wet. The fastness of the Annatto seed and Kath dye was found to be between 5,4-5.

**c) Fastness to Perspiration (IS 971, ISO 105 E01)**

**Table no 9 Fastness to Perspiration of the printed Bamboo fabric (IS 971, ISO 105 E01)**

S.no	Recipe Prepared for Printing	Dye	Acid			Alkaline		
			CC	CS		CC	CS	
				W	C		W	C
	Ratios	Madder						
1	75% (GG)+25% (CH)		4	4-5	4-5	3-4	4-5	4-5
2	25% (GG)+75% (CH)		4	5	4-5	4	5	4-5
3	50% (GG)+50% (CH)		4	4-5	4-5	4	4-5	4-5
4	100% Guar Gum		4	4	4-5	4	4-5	4-5
		Katha						
5	75% (GG)+25% (CH)		5	5	4-5	4-5	4-5	4-5
6	25% (GG)+75% (CH)		4-5	5	5	4-5	4-5	4-5
7	50% (GG)+50% (CH)		4-5	5	5	4	5	4-5
8	100% Guar Gum		4-5	4-5	4-5	4	4-5	4-5
		Annatto Seed						
9	75% (GG)+25% (CH)		4-5	5	5	4-5	5	5
10	25% (GG)+75% (CH)		4-5	5	5	4	5	5
11	50% (GG)+50% (CH)		5	5	5	5	5	5
12	100% Guar Gum		4	5	4-5	4-5	4-5	4-5

The speed at which the printed bamboo samples perspire is seen in Table No. 9. It was found that the Madder, Katha, and Annatto Seed-printed cloth had grayscale ratings of (3-4) and (4-5). With grades ranging from (4-5) to (4), all of the samples in the alkaline solution showed little to no change in color.

d) Fastness to Sunlight (IS: 686-1957)

Table no 10 Fastness to Sunlight of the printed Bamboo Fabric (IS: 686-1957)

S.no	Recipe Prepared for Printing	Dye	Sunlight Fastness
	Ratios	Madder	
1	75% (GG)+25% (CH)		4-5
2	25% (GG)+75% (CH)		4-5
3	50% (GG)+50% (CH)		5
4	100% Guar Gum		4-5
		Katha	
5	75% (GG)+25% (CH)		5
6	25% (GG)+75% (CH)		5
7	50% (GG)+50% (CH)		5
8	100% Guar Gum		5
		Annatto Seed	
9	75% (GG)+25% (CH)		3-4
10	25% (GG)+75% (CH)		4-5
11	50% (GG)+50% (CH)		4
12	100% Guar Gum		4-5

With values ranging from 5 to 4-5 on the blue wool scale, the table clearly shows that the cloth printed with madder dye had good to reasonably good fastness to sunlight. On a scale, each Katha dye ratio received a grade of five. Fabric printed with a 25%GG+75%CH ratio of Annatto seed dye and 100% Guar gum had good to fairly good print fastness when exposed to sunlight.

### CONCLUSION

The results of the present investigation indicate that the anatto seed, madder, katha, and bamboo, as well as the regenerated cellulosic fabric, were all compatible with the selected dye sources. The best results across all assessment criteria were obtained from three of the four developed recipes that had varying mix percentages. Two of the ratios yielded the best results for fabric printed with Katha dye among all the ratios. The fabric was printed using all of the dyes and three thickener ratios, with the exception of the 100% guar gum recipe, which demonstrated antibacterial action.

These value-added treatments for regenerated cellulosic fabrics with unusual coloring and thickening agents can also be applied with the fabric's dye prior to printing in order to enhance the dye's fastness properties. The research led to the development of dye-thickener recipes that, by controlling the development of microorganisms on the fabric, can be used in place of dangerous synthetic dyes. Consequently, carpets, smart textiles, children's clothing, and medical textiles can all be produced with these dyes.

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## DEVELOPMENT OF EMBROIDERY KIT FOR POPULARISING TRADITIONAL KANTHA EMBROIDERY AMONG SCHOOL CHILDREN

Ms. Jaskirat Kaur<sup>1</sup>, Dr. Poonam Magu<sup>2</sup>, Dr. Amita Walia<sup>3</sup>

<sup>1</sup>Research Scholar

<sup>2</sup>Associate Professor, Department of Resource Management and Design Applications

<sup>3</sup>Professor, Department of Fabric and Apparel Science

INSTITUTE OF HOME ECONOMICS

F-4, Hauz Khas Enclave, Hauz Khas, New Delhi, Delhi 110016

E-mail: <sup>1</sup>jaskirat.2020fas005@ihe.du.ac.in, <sup>2</sup>poonam.magu@ihe.du.ac.in

<sup>3</sup>amita.walia@ihe.du.ac.in

HSAI Life membership number: <sup>3</sup>05/W-1/LF

<sup>2</sup>HSAI-2022-DL-1137-LF

### ABSTRACT

India is home to many types of embroidery. The embroideries are not just part of the country's rich cultural heritage but are reflection of the skills, life and environment of the practitioners. Initially, the art was practiced only on items of personal use but gradually it was used on commercial products, thus acting as a source of income for the artisans. Today, however due to the availability of cheaper, factory made products, consumers are fast moving away from them. Earlier, the art was taught by the eldest members of the family to the younger ones so that both the art and the benefits it provided passed on from one generation to the other. But now, most of the adults are themselves unaware of the process of embroidery and the benefits it provides to the practitioners. Their knowledge is limited whereby they are not able to pass on the knowledge to the next generation. Also, children have moved on to more mechanized forms of entertainment such as video games, play-stations etc. Therefore, in order to prevent this art from dying out, it is important to popularize it among the masses and especially among children. The present study was conducted to popularize a traditional indian embroidery - *kantha* which was selected mainly for its simplicity and colourful motifs, by means of a kit. The kit was designed by involving the end - users i.e. school going children. The children were involved in a number of embroidery activities and a *kantha* embroidery kit was developed by incorporating all the suggestions and problems faced by the respondents.

**Keywords:** Cultural heritage, handicraft, kantha, stitches, traditional craft.

### INTRODUCTION

Embroideries are part of the rich cultural heritage of India. However, in today's mechanized world, children have no interest in spending time on traditional and simple handicrafts such as embroideries. But the scope of the two i.e. the children and the embroidery, in being mutually beneficial is immense. Therefore, a study was conducted with the objective of developing an embroidery kit with the participation of the school children. The aim was to get them interested in the art of embroidery so as to keep alive the rich cultural heritage of the country.

### **Kantha Embroidery**

*Kantha* is as beautiful, simple and creative as any other Indian embroidery and at the same time, since it was traditionally done on old worn-out materials using mainly leftovers, it is also in line with the sustainable goals of today. It was stated (“Bengal’s eye of the needle – *kantha* fabric art”,2019) that “*kantha* is an art of what we call ‘recycling’ in today’s common parlance”. Zaman (1993) also states that the *bengali* women embroidered using her imagination and inspiration and converted the old *dhotis* into a recycled product. But more than anything, *kantha* is a medium of expression for a woman who is otherwise ‘voiceless’. Jasimuddin writes beautifully about *kantha*,

“Spreading the embroidered quilt  
She works the lifelong night,  
As if the quilt her poet were  
Of her bereaved plight.  
Many a joy and many a sorrow  
Is written on its breast:  
The story of Rupa’s life is there,  
Line by line expressed” (Jasimuddin,1929)



**Figure 1. Kantha embroidery**

This beautiful art, however is of little interest to the modern-day Indian. As per Poray (2019), the major problem in the case of India is that the ‘true value’ of the craft is not understood by the market. It is important to introduce this skill to the children so that they can take forward components of the rich cultural heritage and keep alive the country’s symbol of pride.

### **Children and Embroidery**

The skill of embroidery needs to be taught to the children not only to keep alive the cultural traditions but also because it helps in physical and mental development of the child. Saxena (2021) calls it “a forgotten craft” but one which teaches many good things such as muscle coordination, fine motor skills and improves concentration. Prapanna (2021) also considers hand embroidery to be a

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creative activity which can help a child get over difficult times. Fernandes (2021) considers embroidery to be a way of taking children away from the screens and helping them develop their creativity and imagination. Steele (2018) looks at embroidery as a skill which can help children throughout their life. It not only improves dexterity and fine motor skills but also strengthens their 'emotional intelligence'.

While the importance of embroidery cannot be questioned, it is a challenge to get children interested in the art. In order to get their attention, the process of teaching embroidery can be done in the game format. According to Aypay (2016), games play an important role in the life of a child. These are not only sources of entertainment but also serve many purposes. Thus, if skills of traditional importance have to be passed on to the next generation, then converting them into a game could be of some help. It was with this objective that the present study was conducted. The traditional embroidery - *kantha* was selected. The end users of the kit i.e. school going children were active participants in the entire study. Their problems and suggestions were used to make a kit which would more suitably meet the expectations of the target group than if the same was designed by an adult.

The *kantha* embroidery was especially chosen because of the following reasons -

- It uses simple and basic stitch i.e. the running stitch.
- Brightly coloured threads are used which can attract the attention of any child.
- The motifs are those that children can identify with - flowers, animals, birds, etc.

### **OBJECTIVE**

To develop a *kantha* embroidery kit for school students of Class VII to IX.

### **METHODOLOGY**

The study was conducted in three phases -

#### **Stage I: Collection of information**

During this stage, data was collected from libraries and online e-platforms regarding traditional embroideries and more specifically about *kantha*. A review of literature was done to understand the effects of embroidery on the health of the children.

#### **Stage II: Field Study**

##### **Selection of Sample**

The aim of the study was to prepare a kit which would help to popularize *kantha* embroidery among school children. The sample consisted of school children (both girls & boys) of Class VII to IX who were in the age group of 12 years to 15 years. It has been found that children above 12 years of age can use sharp objects like sewing needles as they can prevent themselves from physical injury. By this age, their fine motor skills are almost like adults, and they can engage in activities that require attention and concentration. It was decided to involve the target group throughout the different stages of the study.

##### **Sample size and sampling method**

Ten school children were selected via convenience sampling and snowball sampling technique. The study was carried out in Tilak Nagar, Delhi.



### **Checking existing level of embroidery skill of the respondents**

It was essential to check the existing level of embroidery skill of all the participants. Therefore, samples of 9.5 × 9.5 inches were given to the respondents and they were asked to make whatever they could. Specifically, they were assessed in terms of their ability to do the following specific tasks -

Thread the needle without a needle threader

Tie a knot at the terminal end of the thread

Fix the fabric onto the frame

This was followed by the analysis of the finished samples

The researcher observed the respondents while working and evaluated each finished sample. The information was used to design a series of activities which would enable the respondents to make simple products with *kantha*.

### **Development of Embroidered Products**

A number of discussions were conducted with the respondents and they were asked to give suggestions about the type of products they would like to make. The three shortlisted products were -

- i. Friendship band
- ii. Keychain
- iii. Wall frame

### **Stage III : Development of Embroidery kit**

A traditional *kantha* embroidery kit was prepared keeping in mind all the suggestions and problems faced by the respondents. The development of the embroidery kit was done in four stages which have been discussed in the next section.

## **FINDINGS AND DISCUSSION**

### **Analysis of level of embroidery skill of the respondents**

The respondents were observed while working and the samples were critically analyzed as per the following predetermined criterion -

Thread the needle without a needle threader

Fifty percent of respondents were not able to thread the needle and therefore it was decided that a needle threader had to be provided in the kit, and the method of using it mentioned in the booklet.

Tie a knot at the terminal end of the thread

Thirty percent of the respondents were not able to make a knot at the end of the thread. It was decided that the procedure of tying a knot be included in the given set of instructions.

Fix the fabric onto the frame

Only 30 percent of the respondents were able to fix the fabric on the embroidery frame. Hence, it was decided to include stepwise fixing of the fabric on the frame in the instruction booklet.

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Analysis of the finished samples

The embroidered sample were judged in terms of the following criterion -

Uniformity in the length of stitches

Distance between stitches

Finishing on wrong side

Overall look

A five-point Likert rating scale was used to analyze the finished fabric i.e. 1 = Poor, 2 = Unsatisfactory, 3 = Satisfactory, 4 = Good, 5 = Excellent.

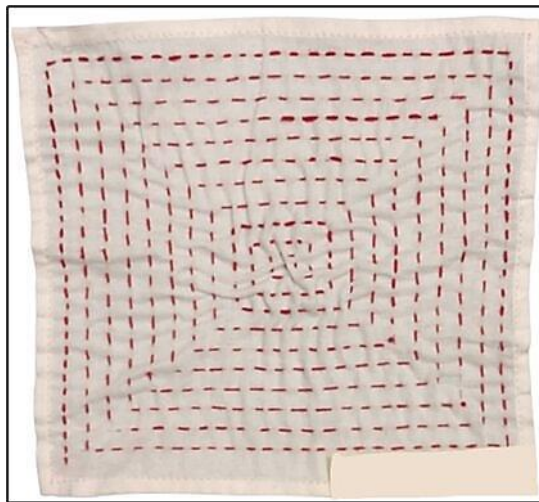
On evaluation it was found that the work of most of the respondents was either poor or unsatisfactory. Thus, it was decided to create simple products which would not only teach the basic running stitch but also gradually increase their level of competency to create a good embroidered product.

### Development of Embroidered Products

After the analysis, it was decided that students should start with simple products and then go on to slightly more complicated ones in order to maintain their interest.

#### Sample with Concentric squares

Even though traditionally *kantha* is never done on a traced design, it was felt that someone who was doing embroidery for the first time should be given a traced design and be given some kind of practice before they started making the products. Therefore, a 9 inches  $\times$  9 inches piece of cotton cloth with concentric squares traced on it was provided to each respondent and they were instructed to do the running stitch. The process of making the running stitch was explained with the help of a diagram and this instruction material was provided to the students.



**Figure 2: Concentric squares**

The samples were again analyzed on the basis of the predetermined criteria and it was found that the majority of the respondents could make uniform size stitches which were at more or less regular distance. Thus, doing embroidery on traced design did help to improve the quality of the stitch. In terms of quality of finishing on the wrong side only three respondents did a good job. Most of them

were unclear about the right side and wrong side of the fabric. The overall look was excellent in the case of one respondent, good in the case of two respondents, satisfactory in the case of five respondents and the remaining two respondents work was unsatisfactory.

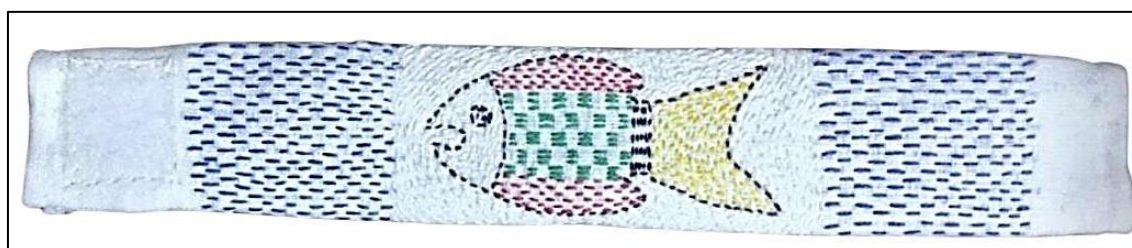
After analyzing the concentric squares sample, it could be concluded that the respondents can do the *kantha* stitch if the design is traced onto the fabric. Therefore, it was decided that all products to be made in the kit will have the design traced on them and the concentric squares sample will be included in the embroidery kit as a practice sample.

### **Products to be included in the kit**

As per the requirements of each selected product, suitable material with the design traced on them was provided along with needles, thread etc. An instruction sheet was also given which was modified as per the suggestions given by the respondents and later compiled to form an instruction booklet. Each product was analysed on the basis of the same criterion that was used to evaluate the first finished sample i.e uniformity in the length of stitches, distance between stitches, finishing on wrong side and the overall look. The details of the three products are as given below -

#### **i. Friendship Band**

Three pieces of 9 inches × 1.3 inches of *mulmul* fabric were cut, ironed, and basted together. A design of a fish motif was made and transferred onto the topmost layer of the sample. The basting and securing of the edges were done and ten such samples were prepared and given to all the respondents.



**Figure 3: Friendship Band**

The finished product was later analyzed on the basis of the predetermined criteria. In terms of uniformity in the length of stitches only one respondent did good work and three respondents could achieve a satisfactory level. Five respondents were not able to make most of the stitches of equal length. One respondent's work reflected very poor workmanship. The data pointed towards regression in the performance of the respondents. The distance between stitches and finishing on wrong side was good or satisfactory in majority of the cases. But the overall look was unsatisfactory of five respondents as they were not able to make the *chatai* stitch and alternate it properly with the running stitch.

The results were not very promising but the respondents were quite satisfied with their achievements. After making a simple concentric square sample this was the first complete product which they had made and they wanted to show it to their family and friends.

Since the respondents were not able to make *chatai* stitch properly, it was felt essential to include a stepwise detailed process of making *chatai* stitches in the instruction booklet.

**ii. Keychain.**

To make the keychain, two pieces of poplin fabric 4 inches  $\times$  4 inches were taken. A lotus motif was transferred to one piece. Both the pieces of fabric were stitched together from three sides, corners mitered and the sample was turned inside out. The ready sample size of 3.5 inches  $\times$  3.5 inches was stuffed with polyfill to give the form of a cushion. The open side was secured with the hemming stitch. A multi - colored string of thread and a metal ring was attached at one corner. Ten similar samples were prepared and given to all the respondents. The finished products were again analyzed and it was found that three respondents did a good job and five respondents could achieve satisfactory level related to the uniformity in length of stitches. Five respondents were able to satisfactorily maintain equal distance between the stitches, four respondents did a good job while one respondent did an excellent job. Since the keychain ‘cushion’ was filled with polyfill there was no wrong side. The overall look of the keychain was satisfactory in the case of five respondents and good in the case of two respondents. One respondent was able to do excellent work and there were two respondents whose work was unsatisfactory.

Thus, the keychain was embroidered better than the friendship band. But a number of respondents were not able to make the *vajr* stitch. Therefore, it was felt essential to include a more detailed stepwise process of making the *vajr* stitch in the instruction booklet.



**Figure 4: Keychain**

**iii. Wall Frame.**

Ten samples of 9.5  $\times$  9.5 inches of poplin fabric were cut, ironed, and the four edges of all the samples were secured with the machine stitch. A plate with elephant and bird motif was created and the design was transferred onto the fabric. The finished products were analyzed. Five respondents did unsatisfactory work in terms of uniformity in the sizes of the stitches. But the work of majority of the respondents was satisfactory in terms of the distance between the stitches. The finishing on the wrong side was unsatisfactory only in the case of two respondents. By now most of them had understood the importance of a neat look on the wrong side of the embroidered fabric. It was also felt that the workmanship of the respondents had improved gradually. The overall look of the product was good or satisfactory in the case of majority of the respondents.

After observing the wall frame samples embroidered by the respondents, it was found that the bird design in the center was not aesthetically appealing since radial symmetry could not be achieved. Therefore, it was decided to replace the bird motif with the lotus motif in the center of the sample for the kit.



**Figure 5: Wall frames - the first one had a bird motif in the center and the second one had a lotus in the center for better radial symmetry**

### **Conclusion of Skill Test - key findings used in the development of the kit**

On the basis of the observation and analysis of the embroidery done by the respondents it was decided that the kit to be prepared must take into consideration the following findings -

1. It was felt essential to include a needle threader in the kit.
2. The instruction booklet should have the details of the method of -
  - Using needle threader.
  - Tying of knot at the end of the thread.
  - Method of using the frame.
  - Stepwise procedure of making the running stitch, *Vajr* and *Chatai* stitches.
3. All designs to be traced on the fabric.
4. Although concentric squares sample was not really a useable product it should be included in the embroidery kit as a practice sample.
5. All products to be complete in all respects and require only embroidery to be done.
6. It was decided to use white colour as base, which is also the colour of traditional *kantha*.

### **Development of the Embroidery kit**

On the basis of the analysis of the result of the field study as well as the suggestions given by the respondents, a traditional *kantha* embroidery kit was developed. The development of the embroidery kit was done in 4 stages.

#### **Step 1: Finalization of the materials to be provided in the kit**

The kit included:

- Embroidery threads
- A wooden embroidery frame
- Sewing needles

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- Needle threader
- Thread cutter
- Four ready - to - embroider products -
  1. Sample with concentric squares
  2. Friendship band
  3. Keychain
  4. Wall frame

### Step 2: Preparation of the Instruction booklet:

A bilingual i.e. both in English and in Hindi instruction booklet was prepared. It had the following information:

- To create awareness regarding *kantha*, information was given about the origin and types of *kantha*. Few images of common *kantha* designs were also included.
- Some popular motifs were drawn on Corel Draw Suite 2020 and included in case the user wanted to do some additional embroidery.
- Detailed stepwise instructions to do the embroidery and make each product.

### Step 3: Preparation of the leaflet

To make learning more interesting and to add some fun, knowledge-enhancing games were created. The games were:

1. Fill in the boxes with the correct type of *kantha*
2. Search for the *kantha* motifs
3. Unscramble to find *kantha*-related words

### Step 4: Preparation of the kit box:

**Size:** The dimensions of all the items in the kit were considered while deciding the size of the kit box. 11 inches × 10 inches size was found to be a good size to hold all tools and materials.

**Outer cover:** The Corel Draw suite 2020 software was used to design the outer cover of the kit. Since it was a *kantha* kit, two lines were added around the box to give the look of *kantha*. All ready-to-make products and materials provided in the kit were shown on the cover. The picture of the finished product was also put in order to help children with colour combinations.

The box also had the following important information -

#### **Brand name**

Jap Ji Creations was decided as the brand name of the kit.

#### **Logo**

The design of the logo was made keeping in mind the colours and stitches used in the *kantha* embroidery.

#### **Age group**

The age group of target group for whom the kit was made i.e. 12+ years was mentioned on the box.



### Safety warning

While doing embroidery there are various sharp tools used such as needles, scissors, and thread cutter. This was clearly mentioned on the backside of the kit's cover along with the instruction that it should not to be used by children under 12 years. While using the kit, adult supervision was recommended.

### Benefits

To create interest and to provide more information about the benefits of the embroidery, few points were highlighted on the cover.

### Recycling

The kit has products which can be **reused** - needles, scissors, thread cutter, needle threader, and wooden frame. The box is made of cardboard which can be **recycled**. It can be used for storing the kit items thereby **reducing** the need to transfer the contents to another container. Thus, the 3Rs are applicable to the designed kit and a mention was made on the box.



Figure 6: Picture of box with all materials

## SUMMARY, CONCLUSION AND IMPLICATIONS

The activity of embroidery is a creative meaningful activity which can be taught to school going children. It will take them away from the electronic devices and help develop their fine muscle coordination. But it is essential to design the activities with the involvement of the target group. Such a strategy will also help in its marketing. The development of the *kantha* kit was a step in that direction. Similar studies can be conducted with other types of traditional embroideries too.

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## ANTIMICROBIAL ACTIVITY OF BAUHINIA VARIEGATA AND ZINC OXIDE NANOPARTICLE COMPOSITE AS AN EFFECTIVE ANTIMICROBIAL FINISH

<sup>1</sup>M. Nazeem Banu & <sup>2</sup>Dr.Shabiya Thaseen

<sup>1</sup>Assistant Professor & Ph.D. Scholar - <sup>2</sup>Associate Professor & Research Supervisor- JBAS  
College for women, Chennai  
E-Mail-nazeembanu84@gmail.com  
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### ABSTRACT

The antimicrobial treatment for medical textiles have shown increasing demand among the consumers to control the cross infections by pathogenic microorganisms, especially bacteria such as *Staphylococcus aureus*, *Escherichia coli*, *Klebsiella pneumonia* and fungi such as *Candida albicans*, and *Candida tropicalis* to control the microbial infestation, and to arrest metabolism in microbes in order to reduce the microbial growth. In the current study, it was aimed to determine the antimicrobial activity of recycled polyester and viscose rayon blended fabrics treated with medicinal herb Bauhinia Variegata having a common name Malaiyathi in Tamil and Zinc Oxide nanoparticle composite. The findings of the this study showed that the most susceptible bacteria *E.coli* and *S. aureus* and Fungi *Candida Albicans*, and *Candida Tropicalis* showed a prominent zone of inhibitions in the Zinc Oxide Bauhinia Variegata composite treated fabric.

**Keywords:** *Staphylococcus aureus*, *Escherichia coli*, *Klebsiella pneumonia*, *Candida albicans*, and *Candida tropicalis*, Bauhinia Variegata, Zinc Oxide nanoparticle

### INTRODUCTION

Microbial treated fabrics have gained importance in research as there is a high risk of infections in the current environmental conditions. These materials may find use in air filters, medical settings, labs, sportswear, personal protective apparel, sanitary napkins, infant diapers, carpets, and other areas. The microbial treatments given to fabrics must meet two major conditions that they must be non-toxic to humans and secondly should have a strong affinity to the textile materials. Leaching of the finish after repeated wash and inhibition of the microbial growth is also an important factor to be considered in the treatment. The main purpose of inorganic metal and metal oxide nanoparticles is to give textiles multifunctional qualities because of their high surface energy and vast surface area. Most metallic nanoparticles exhibit a strong propensity to agglomerate and exhibit instability. Thus, maintaining the nanoparticles' high stable in the dispersing media is crucial. Better adherence and deeper penetration into the fabric matrix are made possible by the individual nanoparticles.

A study aims to apply antimicrobial finishes that are naturally antibacterial, antifungal, and antiviral on 20's cotton sheeting fabric used as bed sheets in the home textile industry. Where nine herbal extracts and six essential oils were applied in combination through encapsulation and pad-

dry-cure method and certain combinations showed higher percent reduction values, as high as 99.99% against *Staphylococcus aureus* and *Klebsiella pneumonia* (Tulshyan, A et al., 2023)

Because metals have some range of antimicrobial activity, they are used more often than other metallic nanoparticles. The thermal stability, nontoxicity, biocompatibility and affordability of other metallic oxides such as Titanium oxide, Zinc Oxide, Copper Oxide, Magnesium Oxide and Silicon Oxide make them useful as well. As the impact of microorganisms grows from epidemic to pandemic, there is a global rise in knowledge for personal protective equipment and resulting in an increased demand for personal protective equipment. A novel application of herbal and metal oxide composite is carried out in this study.

### **Bauhinia Variegata**

A genus of flowering herbs in the legume family of Fabaceae, *Bauhinia Variegata* L. has been attributed immensely for medicinal uses such as treating skin conditions, diarrhea, ulcers, wounds, edema, eye conditions, piles, hemorrhoids, and as a snake bite antidote (Ali, M, et al. 2021) (Qaisar, M et al., 2012). In Marathi it is known to be as Raktakanchan, in Hindi known as Kovidara, and in Sanskrit it is known as Kanchanara are other names for *Bauhinia variegata* Linn. When it came to *Pseudomonas aeruginosa*, *Staphylococcus aureus*, *Escherichia coli*, and *Bacillus subtilis* organisms *Bauhinia Variegata* L showed impressive antibacterial activity. Additionally, *Bauhinia Variegata* L exhibits strong antifungal action against *Penicillium crysogenum* and *Aspergillus niger* (Mishra et al., 2016).

### **Zinc Oxide Nano Particle**

In textiles, the conatural shortcomings of component fibres are frequently addressed by mixing synthetic and natural fibres. For fabrics intended for clothing, a cotton/polyester combination is frequently utilized. In cotton/polyester blended fabrics, the effectiveness of nanoparticle Zinc Oxide for *S. aureus*, *K. pneumonia*, *E. coli*, and *M. luteus* was reported good inhibitory zone (Kathirvelu S et al., 2008).

The main advantages of using zinc oxide (ZnO) nano particles as antibacterial agent is that they are not harmful to human cells (Huang Z et al., 2008).

As Microscale and Nanoscale formulations of ZnO metals are being effectively applied as antimicrobial treatments against *E. coli* and *S. aureus* (Applerot et al., 2009). Varaprasad et al., (2016) concluded that rod-shaped nano-Zinc Oxide has excellent anti bacterial effects against *E. coli*.

Similar kinds of metals in nano sizes can be added to nano-ZnO to increase its antibacterial characteristics. Cotton gauge treated with Ag/ZnO nano composite showed improved antibacterial efficiency for *S. aureus* (99%) and *E. coli* (96%) (Farouk A. et al., 2012).

According to a study, application of nanoparticle Zinc Oxide on Cotton fabric had good antibacterial characteristic (Rajendra R et al., 2010). For improved nanoparticle adherence on textiles, polymer binders—natural or synthetic—are typically utilized. Gallic acid has been used to effectively to bind nano-Zinc Oxide onto cotton fabric, and reported that it allows the cotton fabric's antimicrobial efficacy to last for up to 60 launderings (Salat et al., 2018).

(Shateri M et al., 2013) suggested the long-term viability of the metallic nanoparticles on textiles. Metallic nanoparticles must be securely fixed in fabric so as to avoid peeling during washing or rubbing. According to Gopalakrishnan P (2020) When ZnO particle size decreases and

yarn twist increases, samples' antimicrobial efficiency rises. Samples of polyester cotton blends exhibit superior antimicrobial efficiency compared to samples of cotton

On various test microorganisms, plant extract/Titanium Oxide nanocomposite materials have reported effective antibacterial activity. The *Bauhinia variegata*/ Titanium Oxide aqueous extract showed better antibacterial potentiality as inhibitory zone of microbes in millimeter (Maurya et al., 2012).

## **OBJECTIVES OF THE STUDY**

1. To study the antibacterial efficiency of *Bahunia Varigatta* and Zinc metal oxide nanoparticle composite treatment given to recycled polyester and viscose blended fabric.
2. To study the antifungal efficiency of *Bahunia Varigatta* and Zinc metal oxide nanoparticle composite treatment given to recycled polyester and viscose blended fabric.
3. To study the anti-adherent efficiency of *Bahunia Varigatta* and Zinc metal oxide nanoparticle composite treatment given to recycled polyester and viscose blended fabric.

## **METHODOLOGY**

### **Fabric Selection**

For this present study, 80% Recycled Polyester 20% Viscose Rayon was taken and woven from SITRA having a fabric weight of 121 g/sqm and fabric thickness of 0.26mm.

### **Zinc Oxide Nanoparticle- Synthesis**

Using Starch as stabilizer, Zinc Nitrate and Zinc hydroxide as precursors, Zinc Oxide was developed by wet chemical treatment in nanoscale size. In 500ml of distilled water a standard concentration of soluble starch (0.5%) was dissolved. Zinc nitrate, 14.874g (0.1M) was added in the above solution. The zinc nitrate was then thoroughly dissolved by continuously swirling the mixture with a magnetic stirrer. Following the full dissolution of the zinc nitrate, 0.2M of sodium hydroxide solution was added while the mixture was continuously stirred, slowly coming into contact with the vessel's walls. Two hours were given to the chemical reaction once the sodium hydroxide was fully added. After the completion of reaction, the solution settled down overnight and the scum floating over solution was then discarded. The leftover solution at 10,000 rpm was given stirring with centrifugal force for 10 minutes, and the floating scum was disposed of. The resulting nanoparticles were then cleaned three times using purified water. To eliminate extra starch and byproducts that were attached to the nanoparticles, washing was done. The nanoparticles were cleaned and dried overnight at 80°C. Zinc hydroxide completely transforms into zinc oxide upon drying (Klink et al., 2022).

### **Extraction of Herb (Soxhlet Extraction Of *Bauhinia Variegata* – Methanol Extract)**

In the Soxhlet extraction method, finely ground sample - *Bauhinia variegata* powder was placed in a porous bag or “thimble” made from a strong filter. The Soxhlet apparatus has a thimble chamber where paper or cellulose is put. The extraction solvent is heated in the bottom flask,

where it vaporizes and drips back into the sample thimble before condensing in the condenser. The procedure is repeated after the liquid content touches the syphon arm and is dumped into the flask at bottom. In Soxhlet extraction method the thimble with the powdered herbs was put inside the soxhlet extractor. After filling the extractor with a methanol solvent solution and setting the temperature to 60°C, it was left for six hours. Temperature increases were made gradually and steadily up to 100°C. The thimble's extract was gathered in the circular bottom flask and exposed to heating mantle below by passing through a side arm tube (Mishra et al., 2013).

### **Developing Herbal+Metal Oxide+Binder Composite**

To obtain Herbal-Metal composite, magnetic stirrer was set to 180 rpm and 40 °C in which *Bauhinia Variegata* extracts were maintained in a beaker under stirring conditions. At a rate of one millilitre per minute, Zinc Oxide solution was then added slowly to the extract *Bauhinia Variegata* extract. The composite was kept in bottles in the refrigerator for two hours then tested for antibacterial and antifungal activities (Rafiqul Islam et al., 2015).

### **Finishing the Fabrics with Herbal+Metal Oxide+Binder composite**

Five standard steps were involved in fabric finish using herbal-metal composite. As first step, a fabric finishing composite liquid was prepared. This liquid contains selected herbal-metal composite (3:3:2 – herbal concentration: metal concentration: binder concentration), flexible acrylic binder 1% and wetting agent 0.5%. As a second step, the above recipe was applied onto selected fabric using standard M:L ratio (1:10) using padding mangle under standard finishing conditions (80% wetting, pH 7.0, Temperature 28°C to 30°C). In the third step, the treated fabric was dried at normal room temperature, followed by drying at 80°C/10min using a conventional oven. As fourth step, curing process was done where finished fabric was exposed to elevated temperature for a short period of time (120°C/5min) for effective binding of ZBVc into inner fibre structure. In the final step, ironing was done for all ZBVc finished samples that confirm the binding of particles to the core of yarn structures. The finished fabric sample was made ready for testing the different functional parameters. The treated fabric was sterilized with UV rays in a laminar air flow chamber for half an hour and this was kept in a sterile place for further study (Rajendran et al., 2010).

## **RESULTS AND DISCUSSIONS**

### **Antibacterial activity of ZBVc finished fabric using ENISO 20645 Standard**

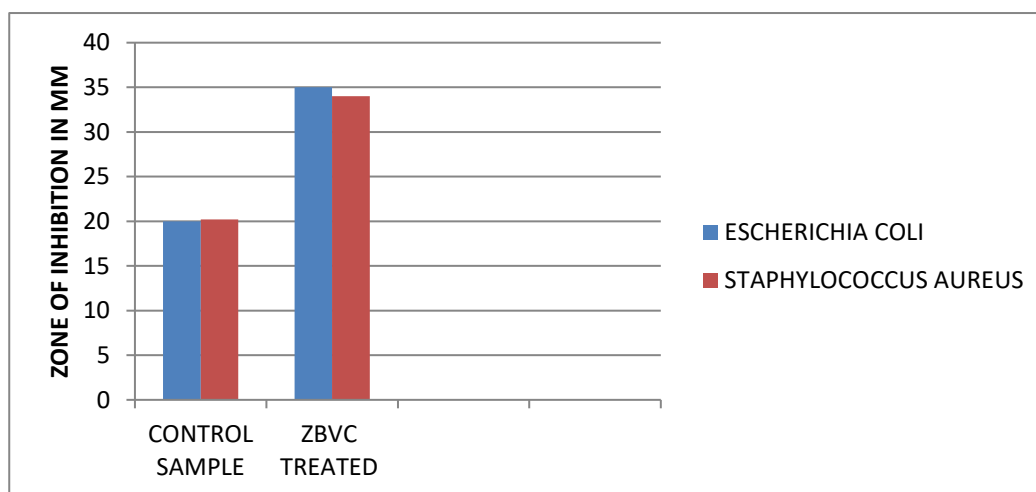
Following the ZBVc treatment to fabric, the test specimens (swatches) were divided into sections having a diameter of 20 mm and tested against two bacterial cultures (*Escherichia coli* and *Staphylococcus aureus*). In a microbiology lab, both test microorganisms are kept in nutrient agar slants. Every broth tube that had been injected was kept under incubation at 37°C for 12 to 24 hours, or until the bacteria started to grow turbidly. One loop full of each test bacterial culture (*Escherichia coli* and *Staphylococcus aureus*) was transferred by swabbing the Mueller-Hinton agar (MHA) plate's surface and the petridish's middle area with an inoculation loop measuring 4mm. In a sterile area, for every test organism a distinct Mueller-Hinton agar plate was used. Each

test fabric swatch (ZBvc treated fabric and control fabric) was placed on both sides of each MHA plate after the test bacteria were swabbed. The process repeated for each test swatch. In a traditional incubator, all plates containing test swatches were kept for 12 to 24 hours at 37°C. All test plates were inspected for any prominent inhibition zone around the samples during incubation period. Each sample fabric had its inhibition zone in millimetres (mm), and the readings were noted. The inhibition zone for bacterial cultures of Zinc Oxide Bauhinia Variegata composite finished Recycled Polyester and viscose rayon blended fabric was observed to be 35mm for *Escherichia coli* and 34 mm for *Staphylococcus aureus*. It was an evident that the finished samples had higher zone of inhibition than the control sample which had no significant effect.

**Table-1: Antibacterial Activity Of Zbvc Finished And Control Sample**

TEST SAMPLE	ANTIBACTERIAL ACTIVITY			
	ZONE OF INHIBITION (MM)			
CONTROL SAMPLE (a)	MEAN	S.D	T	P (p<0.05)
<i>Escherichia Coli</i>	20	0.71	1.414	0.1950**
<i>Staphylococcus Auerus</i>	20.2	0.89		
ZBvc FINISHED SAMPLE (b)	MEAN	S.D	T	P
<i>Escherichia Coli</i>	35	0.45	4.000	0.0161(<0.05)*
<i>Staphylococcus Auerus</i>	34	0.71		

\*- significant, \*\*- non significant



**Figure-1: Antibacterial Activity Of Zbvc Finished And Control Sample**

#### Antifungal Activity of Zbvc finished fabric using ENISO 20645 Standard

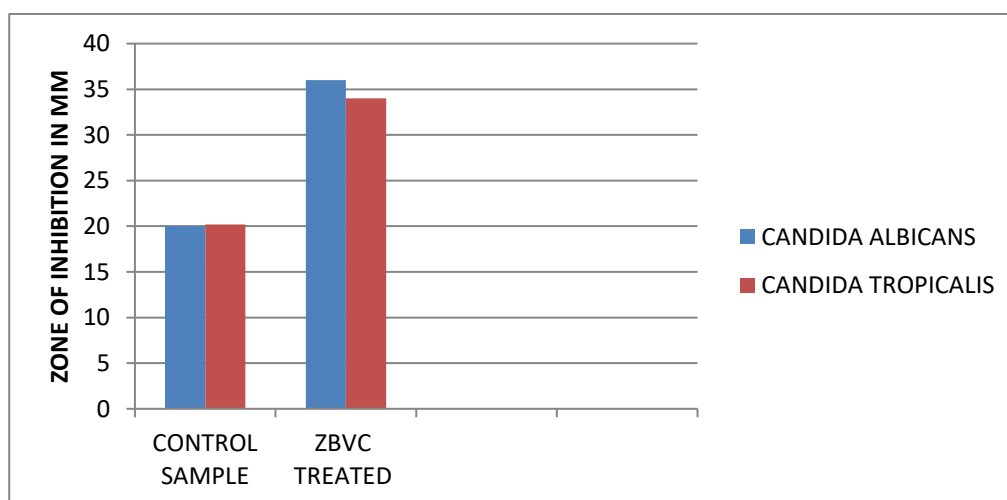
The test specimens finished using ZBvc, was made into 20mm-diameter portions and tested against two fungus cultures (*Candida albicans* and *Candida tropicalis*). In a microbiology lab, both test microorganisms are kept in nutrient agar slants. Every broth tube that had been

injected was kept under incubation at 37°C for 12 to 24 hours till the fungi starts to grow turbidly. One full loop of each test fungal culture (*Candida albicans* and *Candida tropicalis*) was transferred using a sterilized with an inoculation loop measuring 4mm. By swabbing the Mueller-Hinton agar (MHA) plate's surface and petridish's center area. In a sterile area, for every test organism distinct Mueller-Hinton agar plate was used. Each test fabric swatch (completed fabric and control fabric) were placed on opposite sides of an MHA plate after the test fungi were swabbed. The process was repeated for each test. In a traditional incubator, all plates containing test swatches were kept at 37 °C for 12 to 24 hours. They were inspected for the growth of any fungal inhibition zone around the completed fabric swatch following the designated incubation period. Every kind of fabric samples had its inhibition zone which was measured in millimetres (mm), and the readings were noted. The inhibition zone for antifungal activity of Zinc Oxide Bauhinia Variegata composite finished on Recycled Polyester and viscose rayon blended fabric was observed to be 36mm for *Candida Albicans* and 34 mm for *Candida Tropicalis*. It was an evident that the ZBVc samples had good zone of inhibition than the control fabric sample for fungi.

**Table- 2: Antifungal Activity Of Zbvc Finished And Control Sample**

TEST SAMPLE	ANTIFUNGAL ACTIVITY			
	ZONE OF INHIBITION (MM)			
<b>CONTROL SAMPLE(a)</b>	<b>MEAN</b>	<b>S.D</b>	<b>T</b>	<b>P (p&lt;0.05)</b>
<i>Candida Albicans</i>	<b>20</b>	<b>0.45</b>	<b>1.000</b>	<b>0.3466**</b>
<i>Candida Tropicalis</i>	<b>20.2</b>	<b>0.00</b>		
<b>ZBVc FINISHED FABRIC (b)</b>	<b>MEAN</b>	<b>S.D</b>	<b>T</b>	<b>P</b>
<i>Candida Albicans</i>	<b>36</b>	<b>0.45</b>	<b>7.0711</b>	<b>0.0001(&lt;0.05)*</b>
<i>Candida Tropicalis</i>	<b>34</b>	<b>0.45</b>		

\*- significant \*\*- non significant



**Figure 2: Antifungal Activity Of Zbvc Finished And Control Sample**

**Anti-Adherent study of ZBVc finished fabric- AATCC Test Method 100**

The anti-adherent test of ZBVc treated fabric swatches were tested using AATCC-100 test method. Anti-adherent test is the proper indicator of degree of fixation of antibacterial agents that is fixed on to the textile material without leaching out. Briefly, 1ml of 12h challenge bacterial inoculum (*Klebsiella pneumoniae*) was dispersed as droplets over the swatches (test samples) with a micropipette. The swatches were inoculated in pre-sterilized 250ml Erlenmeyer flasks. After the inoculation, the flask was kept at  $37 \pm 2^{\circ}\text{C}$  for 18h before being assayed for bacterial population density. The bacterial population density was recorded by the taking bacteria from the fabric and adding 100ml of distilled water to each flask and shaken using an orbital shaker for 1min. Then aliquots were serially diluted and poured into plate to determine the density of bacterial growth. The difference in number of viable bacteria was calculated as percentage reduction of organism. Percentage reduction of organism was calculated using the formula.

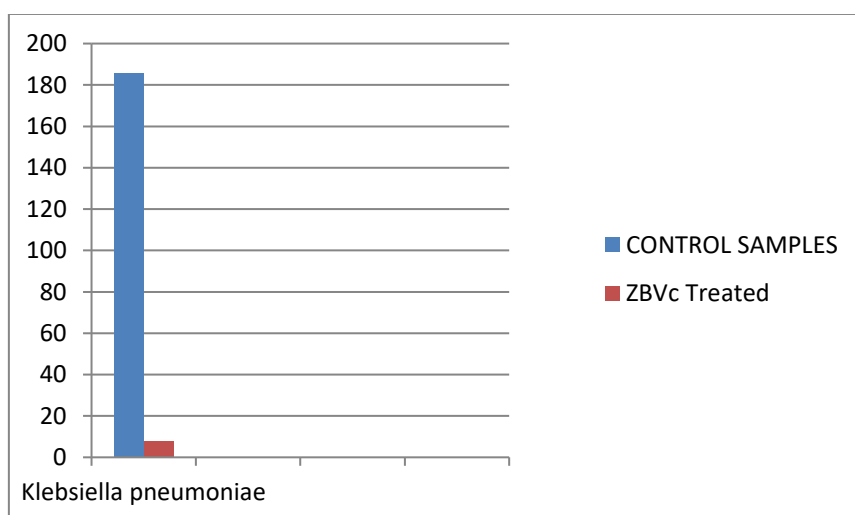
$$R = (A-B) / A \times 100$$

Where, R stands for percentage reduction; A and B represent the quantity of bacteria taken from the broth inoculated with treated test fabric sample after necessary contact period of 18 hours. A is the quantity of bacteria in the broth soon after inoculation at zero contact time.

The inhibition zone in anti-adherent property of Zinc Oxide Bauhinia Variegata composite finished Recycled Polyester and viscose rayon blended fabric was observed to be 08 colonies of bacterial organisms than the untreated fabric which is 186 colonies of bacterial organisms. Hence inhibition zone is 95.7% for *klebsiella pneumonia*.

**Table 3: Anti-Adherent Study Of Control And Zbvc Finished Sample**

Organisms	No of colonies		% of Inhibition
	ZBVc finished (b)	Control Sample(a)	
<i>Klebsiella pneumoniae</i>	8	186	95.7%

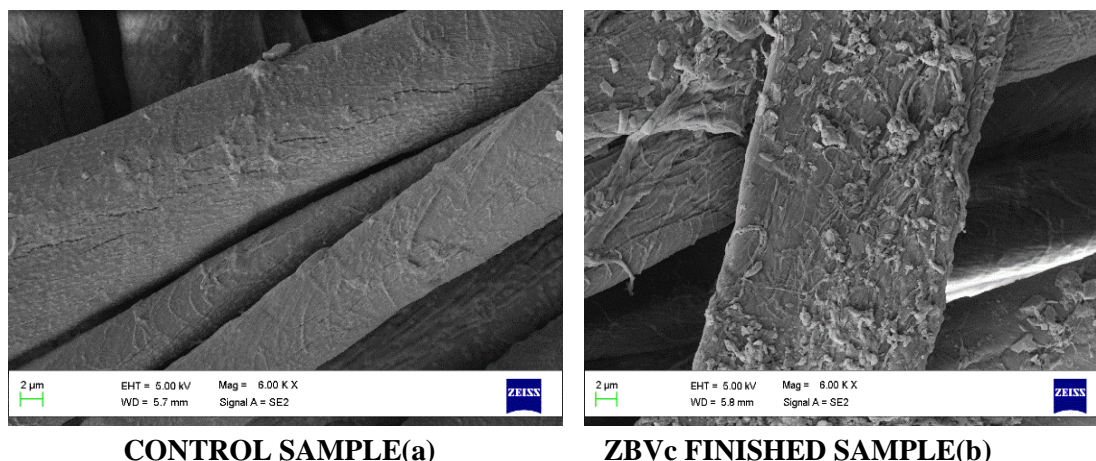


**Figure 3: Anti-Adherent Study Of Control And Zbvc Finished Sample**

**FESEM analysis of control and ZBVc finished samples**

The surface coating of the herbal-metal composite (ZBVc) fabric sample was examined using Field Emission Scanning electron microscopy (FESEM). FESEM analysis was also used to

check the uniformity of chemical finish coated over the specimen. The topographic analysis of ZBVc finished and unfinished plain fabric was prepared for FESEM with a vacuum (less than 5 Pa), an appropriate accelerating voltage (10 KV) and magnification (6.00KX), metal coating given acts as conducting material to determine the sample (Venkatrajah et al., 2013).



**Figure 4: Fesem Analysis Of Control Sample And Zbvc Finished Sample**

FESEM micrographs of control sample and ZBVc finished sample is represented in the Figure 4 where the image of control sample shows that the surface of the control sample is smooth without any imperfections, whereas the image of the ZBVc sample shows imperfections which suggests the uniform deposit of the ZBVc on the fabric surface.

### **RECOMMENDATIONS FOR FURTHER STUDIES**

1. A comparative study on the antimicrobial properties of *Wrightia tinctoria* (Neem) and Silver Oxide Nanoparticle as a composite on Polyester/ Cotton fabric.
2. A study on the anti-viral properties of *Bauhinia Variegata* and Zinc Oxide Nano Finished fabrics as effective antiviral finish.

### **CONCLUSIONS**

As conclusion the composite of Zinc Oxide *Bauhinia Variegata* finished on Recycled Polyester and viscose rayon blended fabric exhibited good antibacterial and antifungal characteristics against organisms *Escherichia coli* and *Staphylococcus aureus*, *klebsiella pneumonia*, *Candida Albicans* and *Candida Tropicalis*. Zinc Oxide *Bauhinia Variegata* composite finish can be effectively used as anti-microbial finish in Medical textiles and various personal hygiene care products.



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## A STUDY ON THE CLOTHING PROBLEMS OF CHILDREN AFFECTED WITH CEREBRAL PALSY

Nair Supriya Damodaran,<sup>1</sup> Dr. N. Dhanya<sup>2</sup>

<sup>1</sup> Research Scholar,<sup>2</sup> Associate Professor,

<sup>1</sup> Department of Home Science (Clothing and Textiles)

<sup>2</sup> Department of Home Science (Child Development)

St. Teresa's College (Autonomous), Ernakulam,

Mahatma Gandhi University, Kottayam

Email: supriyanair@teresas.ac.in, dhnn9179@gmail.com

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### ABSTRACT

Cerebral palsy (CP) is a disorder that appears in early childhood which affects the movement. Poor coordination, stiff muscles, weak muscles, and tremors are some of its symptoms. It is generally seen that wearing of garments becomes a difficult task for the children with CP because of the symptoms like poor coordination, stiff and weak muscles. The parents and caretakers of these children find it very difficult to make the children wear the garments because the movement of limbs and muscles is very restricted. The study was planned with the objectives of understanding the medical condition of cerebral palsy with reference to symptoms, clothing needs, comfort, and behavioural patterns and to understand the practical difficulties faced by the parents and care takers of children with CP with special mention to their clothing. A total of ten samples of the children affected with cerebral palsy in the age group of five years to fourteen years were selected for conducting the study from institutions for special children using purposive and snow ball sampling technique and a self-constructed questionnaire was used to collect data. The study revealed that the children affected with cerebral palsy had clothing problems which need to be addressed as comfortable clothing is essential for promoting a child's physical, mental, and emotional well-being. An ideal suggestion to this problem can be to provide the children with adaptive clothing which would help to bring comfort to the children as well as the parents and caretakers would find it easy to dress the children.

**Keywords:** - Differently Abled, Children, Clothing Needs, Comfort

### INTRODUCTION

The WHO (1980) has said that 'differently abled is a person who has impairment that produces functional limitations, restrictions in activities or has social handicap.' The experience of being differently abled is intricate, resulting from the interplay between an individual's bodily characteristics and the societal context in which they exist. They are having difficulties in performing daily activities due to many interrelating factors, some related to the individual and some to the surroundings in which they reside.

Cerebral palsy (CP) is a disorder that appears in early childhood which affects the movement. Poor coordination, stiff muscles, weak muscles, and tremors are some of its symptoms. (Neurological et. al. 1980) There may be problems with sensation, vision, hearing, swallowing,

and speaking. Often babies with cerebral palsy do not roll over, sit, crawl, or walk as early as other children of their age. Problems with thinking and reasoning and seizure are few of the other symptoms which are found in one third of people with CP.

According to National Institute of Neurological Disorders and Stroke, Cerebral palsy results from abnormal development or injury to the areas of the brain responsible for coordinating movement, balance, and posture. The majority of cases stem from prenatal complications, although they can also occur during childbirth or shortly thereafter. Infants with severe CP often display atypical body positioning, with either excessive floppiness or stiffness. Additional birth abnormalities, like spinal curvature, a small jaw, or reduced head size, may accompany CP. Symptoms may manifest or evolve as the child grows older. Typically, CP becomes noticeable around 6 ½ to 9 months of age, during the early stages of mobility, marked by limb preference, asymmetry, or delays in gross motor skills development. (Patel et al., 2020)

It is generally seen that wearing of garments becomes a difficult task for the children with CP because of the symptoms like poor coordination, stiff and weak muscles. The parents and caretakers of these children find it very difficult to make the children wear the garments because the movement of limbs and muscles is very restricted. The researcher wanted to explore more about the specific problems faced by the parents and caretakers of the children with cerebral palsy in connection with their clothing. Keeping this purpose in mind, the following objectives were framed for the conduct of this study.

## **OBJECTIVES**

1. To understand the medical condition of cerebral palsy with reference to symptoms, clothing needs, comfort, and behavioural patterns.
2. To evaluate and understand the practical difficulties faced by the parents and care takers of children with CP with special mention to their clothing.

## **METHODOLOGY**

Based on the above objectives the methodology of the study is given below: -

**Selection of Area** – The selected areas of Ernakulam district housing institutions for children with special needs was chosen for the study. The special schools where the children affected with cerebral palsy had enrolled were selected and the officials were contacted to get permission for the conduct of the study.

**Selection of Sample** – A total of ten samples of the children affected with cerebral palsy in the age group of five years to fourteen years were selected for conducting the study from institutions for special children using purposive and snow ball sampling technique. This technique was used to deliberately choose the participants with the condition of cerebral palsy.

**Selection of tool** - A self - constructed questionnaire was administered to get data about the challenges faced in clothing by the children with cerebral palsy from the parents and/or caretakers. The questionnaire included questions to get general information like the physical condition, gender, cause of handicap, degree of disability, degree of dependency of the children. It also included questions to get information regarding the fabric and garment preferences. The questions to collect the information regarding the attiring of the children and the procurement of garments was also included in the questionnaire.

The questionnaire was administered to ten parents of children affected with cerebral palsy in the age group of five – fourteen years from the special schools Adarsh Rehabilitation Centre, Ernakulam, and Shraddha – School for Children with Special Needs, Ernakulam. The researcher met the parents and collected the data by the personal interview method at Adarsh Rehabilitation Centre and at Shraddha – School for Children with Special Needs the questionnaire was send, filled, and collected back from the parents through the class teachers. All the parents were very cooperative and gave the required information without any hesitation.

## **RESULTS AND DISCUSSION**

The data obtained was entered in an excel sheet, evaluated, and statistically analysed using percentage analysis. The analysis is represented as tables and graphs to convey the information more clearly and accurately.

### **General Information about the children affected with cerebral palsy**

The details regarding the physical condition, gender, cause of handicap, degree of disability, degree of dependency of the children were collected from the respondents.

Out of the ten children, six were male and four were female. Of the children surveyed, forty percent were confined to their beds, twenty percent were partially bedridden, and the remaining forty percent were mobile. The cause for handicap in eighty percent of the children was congenital and in twenty percent it was due to some diseases. The children with severe disability were sixty percent and eighty percent of the children were completely dependent on the parents and family members for their day-to-day activities. The children having drooling were seventy percent and they were not able to wipe themselves.

### **Fabric and Garment preferences**

Cotton fabric was preferred by ninety percent of the parents for their children's casual wear. The knitted fabric construction was preferred by seventy percent of the parents and the reason for this was the comfort of the garments and the ease in wearing the garments. No child showed a specific preference for colour of the garment. As per the data collected, sixty percent of parents responded that their children do not show a preference for sleeve in the garment. Two - piece garments were more comfortable for their children when compared to one - piece garment informed ninety percent of the parents and seventy percent parents preferred loose fitted garments and waistline with elastic for their children. The preference to have pockets as the design detail in their children's garments was informed by sixty percent of the parents. It was noticed that the parents had very clear clothing preferences for their children. Similar findings were reported by Putri et al., (2020)

### **Attiring of the children**

The details regarding the various aspects of attiring the children were collected and is given in Table 1.

Table 1 - Information Related To Attiring Of The Children

SL NO.	PARTICULARS	CHILDREN AFFECTED WITH CEREBRAL PALSY (n = 10)	
		Frequency	Percentage (%)
1	<b>Child able to wear clothes themselves</b>		
	• Yes	1	10
	• No	9	90
2	<b>Child able to move their extremities</b>		
	• Yes	8	80
	• No	2	20
3	<b>Child using any assistive devices</b>		
	• Yes	5	50
	• No	5	50
4	<b>Child comfortable in wearing all kinds of clothes</b>		
	• Yes	2	20
	• No	8	80
5	<b>Child has separate garment for nightwear</b>		
	• Yes	7	70
	• No	3	30
6	<b>Child is comfortable with fasteners</b>		
	• Yes	4	40
	• No	6	60
7	<b>Parents make garment alterations as per need</b>		
	• Yes	4	40
	• No	6	60

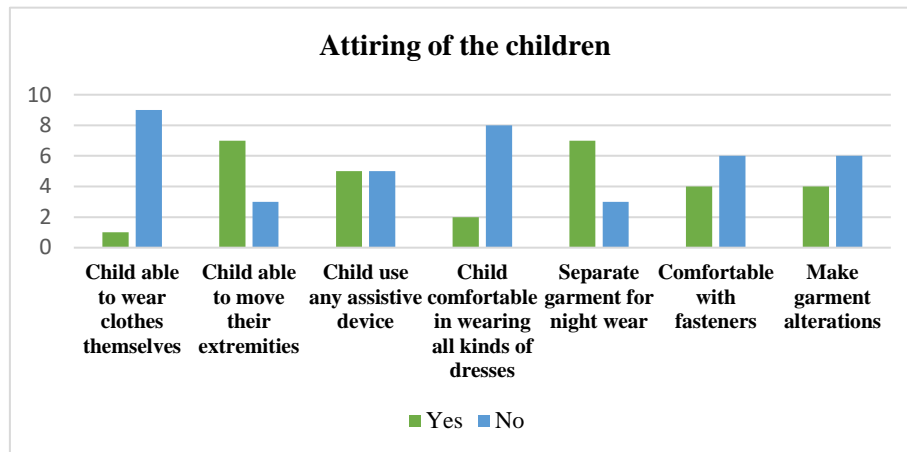


Figure 1 - information related to attiring of the children

From the figure given above it is conveyed that ninety percent of the children were not able to dress by themselves and they are not comfortable with fasteners. This finding is consistent with the study of Na, H.-S. (2007) wherein they have mentioned that it is difficult for the children affected with cerebral palsy to dress by themselves. Certain fasteners caused irritation and the parents expressed that the children were not comfortable with such fasteners. The children using separate garments for night wear were seventy percent and eighty percent of the parents responded that the children were not comfortable in wearing all kinds of dresses. The discomfort shown by the children was in the manner of irritation and tantrums. About seventy percent of the children were able to move their extremities and fifty percent used assistive devices. The data collected revealed that sixty percent of the parents did not make any alterations for their children’s garments. They made the children wear the garments as they are without making changes for the physical condition of the child.

### Procurement of Garments

Data was collected from the parents to know the pattern of dressing the children and regarding the procurement of the garments, the details of which are shown as pie diagrams. In the figure 2 information regarding the time taken for dressing themselves is shown. In figure 3, the position in which the child is dressed is shown. In figure 4, the frequency of changing the dress is shown. In figure 5, the details regarding the procurement of the garments are shown and in figure 6, the frequency of clothing purchases is shown.



Figure 2 – Time taken for dressing themselves

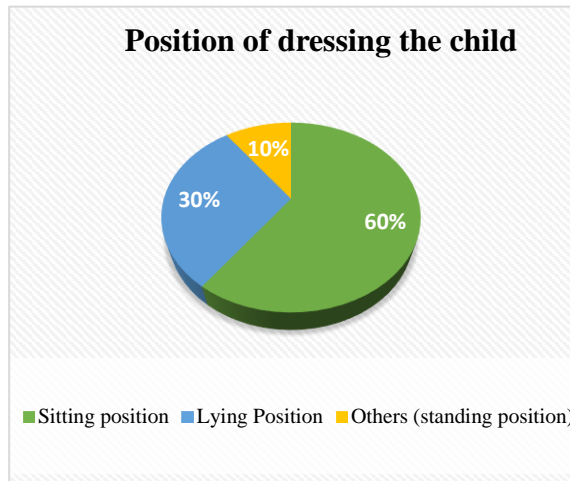


Figure 3 – Position of dressing the child

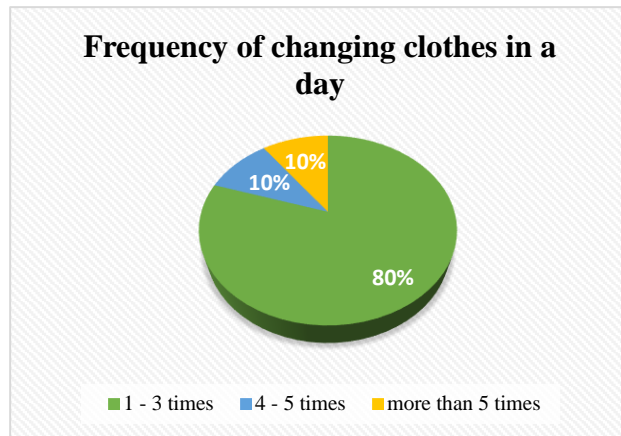


Figure 4 – Frequency of changing clothes

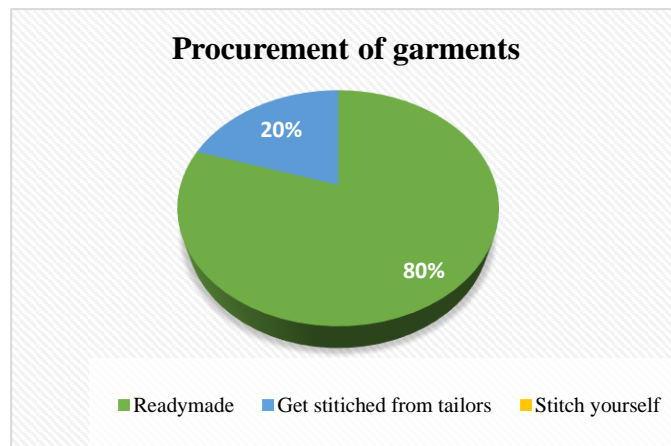


Figure 5 – Procurement of garments



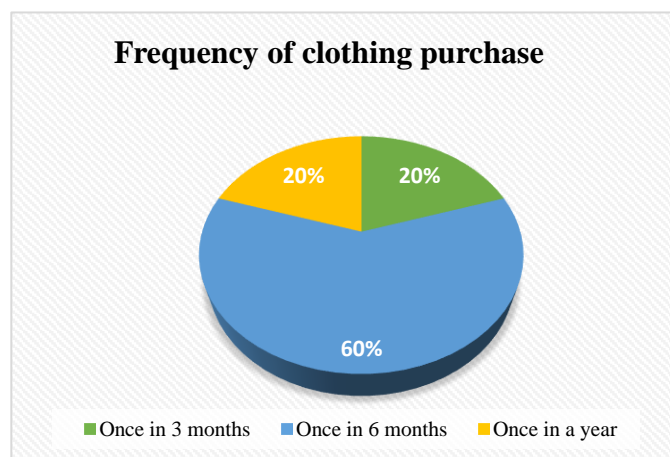


Figure 6 – Frequency of clothing purchase

Dressing is a difficult task for the children affected with cerebral palsy. The parents who dressed their children in sitting position were sixty percent, thirty percent dressed in lying position and ten percent dressed in standing position. The position of dressing the child depended upon the physical condition of the child and on the movement of the extremities. The parents informed that they changed the garments of their children from one to three times in a day due to drooling, dripping of food and such reasons. Information of procurement of garments revealed that eighty percent of the parents bought readymade garments and sixty percent of parents purchased the garments once in six months for their children. The parents informed that they do not get the garments stitched from the tailors as per the requirement for the child instead they just buy readymade garments for the ease of procurement.

### CONCLUSION

The study revealed that the children affected with cerebral palsy had clothing problems which need to be addressed. The fabric mostly preferred for casual wear was cotton and the fabric construction preferred was knitted as it provided some level of comfort for the children. The children those who were mobile were able to dress by themselves but took more time. The children who were partially and completely bedridden were dressed by the parents or caretakers and it took around six to ten minutes to dress them. The children were not comfortable with fasteners and preferred waistline with elastics. The parents bought readymade garments for these children which was altered only by a few as per the requirements of the children. In such cases, it is evident that the clothing problems faced by the children were not addressed. If the clothing is not comfortable it will affect the well-being of the children in several ways especially with differently abled children as they are not able to communicate in a manner that normal children can. So, ensuring comfortable clothing is essential for promoting a child's physical, mental, and emotional well-being. An ideal suggestion to this problem can be to provide the children with adaptive clothing which would help to bring comfort to the children and the parents and caretakers would find it easy to dress the children. This will also improve the quality of life of both the child and the parents and the children will gain confidence to perform activities which was earlier restricted using conventional clothing.

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## INVESTIGATION OF THERMAL BONDED NONWOVENS MADE OF RECLAIMED FIBRES FOR THERMAL INSULATION PURPOSE

Siva Dharshini.S<sup>1</sup> and Dr. R. Prabha<sup>2</sup>

<sup>1</sup>Research Scholar & <sup>2</sup>Assistant Professor (SG)

Department of Textiles and Clothing,

Avinashilingam Institute for Home Science and Higher Education for Women,  
Coimbatore, Tamil Nadu, India.

Email: <sup>1</sup>21phtcf002@avinuity.ac.in and <sup>2</sup>prabha\_tc@avinuity.a.cin

HSAI membership numbers: <sup>1</sup> HSAI-2022-TN-1135-LF and <sup>2</sup> HSAI-2023-TN-1389-LF

### ABSTRACT

The textile industry is identified as one of the largest polluting industries in the world, in terms of land, air and water. The hard waste discarded from the textile industry ends up in incineration or landfills. In such cases, recycling solid waste can help to reduce landfills, reduce the burning rate, reduce waste, save raw materials and create economical products. In this study, thermally bonded nonwoven samples were manufactured by recycling discarded textile wastes. Textile wastes were procured and the reclaimed fibres were prepared through a sequence of processes. Carded fibre laps were prepared using the mechanical carding machine. This study aims to analyse the thermal insulation properties of reclaimed fibres made of Cotton/polyester selvedge waste and tailor discards. The thermal bonding method was used to prepare multilayer sheets of different compositions using PET fibre. According to ASTM Standard, all samples were tested for their physical and thermal properties. Thermal conductivity and insulation were tested using a Flat-plate Fabric Heat Retaining Instrument. Results depict that the nonwoven produced from 50:50 RP/P nonwoven sheets shows better insulation performance than other samples. Hence, it can be concluded that the thermal bonded nonwoven sheets made from discarded textile wastes have the potential for thermal insulation applications in technical textiles.

**Keywords:** Reclaimed fibres, Recycling, Sustainability, Thermal insulation, Textile waste

### INTRODUCTION

Recycling Solid textile waste can be a great solution to tremendous challenges, faced by textile industries on waste and resource management (Apsara, 2022). Textile waste recycling allows the creation of new products by recovering raw materials from discarded waste, hence this process conserves resources and also reduces the number of landfills & incinerations (Dissanayake, 2018). One of the major solid textile wastes is waste derived from the production section of textiles.

Thermo-insulation property of textile fibres plays an important role in the manufacturing of thermal insulation fabrics (Jordeva, 2019 & Matusiak, 2014). Many studies have shown that

reclaimed fibres are evident in producing nonwoven thermal insulators via mechanical processes (Hegyi, 2022; Brigya, 2013; Matusiak, 2014). In this study, selvedge waste from the loom was selected for investigation, as it has the potential to insulate the heat, based on previous studies.

Sakthivel et al. investigated about acoustic and thermal properties of Polycotton selvedge using the air-laid method of nonwoven. The report shows that, based on the value  $-0.13 \text{ W/mK}$  (thermal conductivity), the samples can be used for roof-ceiling applications (Sakthivel, 2020). Bogale et al. have studied about thermal insulation properties of different-layer nonwoven sheets using the chemical bonding method. Detailed the impact of physical properties on thermal insulation material made of Polycotton selvedge wastes. The above studies concluded that the nonwovens produced using selvages were satisfied with thermal insulation applications (Meseret, 2021). Mundkur had prepared the nonwoven from reclaimed fibres of post-consumer clothing wastes with a multilayer consisting of nylon and polyester woven fabric. Results sum up that nonwoven with  $250 \text{ g/m}^2$  gave a thermal insulation value of nearly 1 clo, which is suitable for light winter jackets (Mundkur, 2016). However, none of the studies had tested thermally bonded samples for thermal insulation.

The basic thermal properties such as resistance, conductivity and insulation stand as essential criteria for finding out the transmission of heat through the fabric and act as a dynamic property for many applications in technical textiles (Matusiak, 2014). For maintaining thermal comfort, the fabric's resistance to the transfer of heat through it is crucial (Swapan, 2016). Insulation value can be increased with compressible and lightweight insulation materials (Gibson, 2007). Hence, in this research, the thermal bonding fabrication method was implicated in producing nonwoven sheets for their lightweight and higher-strength properties, which is a research gap from the literature review. This research work exhibits the thermal properties of samples fabricated using reclaimed Polycotton fibres.

The novelty of this work is the mixing of various textile wastes to find its suitability in blending and generating reclaimed fibres for mass production. Polyester fibre has the advantage of inert characteristics to moisture or water compounds. Selvedge waste made of cotton and polyester fibre blends was taken for the thermal insulation test to reduce the burden of textile waste and efficient usage of resources. Gives an advantage of producing low-cost products with eco protection than conventional materials.

Thermal insulation of four samples made of different layered nonwoven was analyzed. For this purpose, multilayer nonwoven sheets were manufactured using the thermal-bonding method. As per the ASTM Standards, all samples were tested for insulation properties. Saleh has investigated the properties of cotton, polyester, blended fibres and recycled fibres for interlining purposes. From this study, it is concluded that fibre type, fabric weight, fabric thickness and mass can have a visible impact on the thermal properties of the fabric (Saleh, 2011). The main aim of this work is to find the effects of various physical properties on the thermal insulation behaviour of thermally bonded nonwoven made of reclaimed fibres. The prepared thermal bonded samples using reclaimed cotton blended polyester fibres were examined for thermal insulation performance and find their suitability for interlining applications in technical textiles.

### **OBJECTIVES OF THE STUDY**

The aims of the current study are listed below:

- To select the required textile wastes
- To extract the reclaimed fibres from textile waste via a mechanical process
- To prepare the nonwoven fabrics using the thermal bonding method
- To investigate the physical properties and their impact on the insulation performance of developed samples and find its application in technical textiles

### HYPOTHESIS

The hypothesis stated for this work is given below:

**Null Hypothesis-** Selected nonwoven sheets made from discarded textile waste have the potential for thermal insulation properties.

**Alternate Hypothesis-** Selected nonwoven sheets made from discarded textile waste do not have the potential for thermal insulation properties.

### METHODOLOGY

The resources selected for this research work are Polycotton selvedge waste and polyester fabric cutting waste. The Polyethylene Terephthalate (PET) fibres were used to produce the nonwoven sheets using the thermal bonding method. A series of steps should be followed to obtain reclaimed fibres. The development process of thermal bonded nonwoven sheets is shown in Fig.-1.

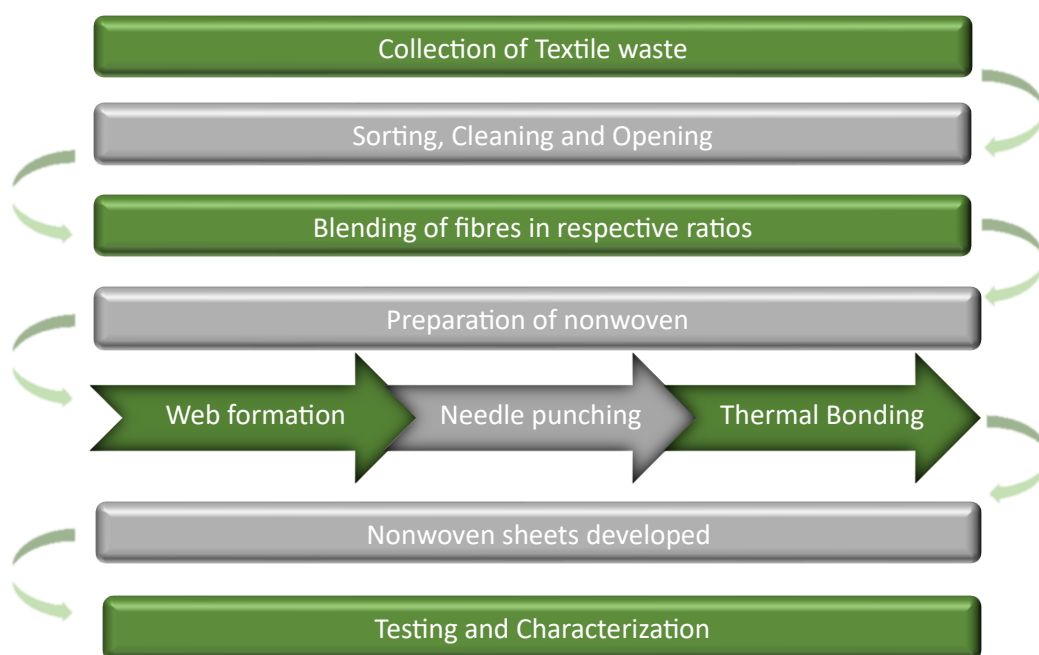


Fig.-1: The development process of thermal bonded nonwoven sheets

#### Collection of Textile waste

The selvedge wastes were collected from the local looms, Namakkal for the preparation of nonwoven. The cutting waste of polyester fabric was collected from a local tailor shop. Table-1 shows the nomenclature used in this article. The photographic image of Polycotton selvedge waste and tailor discards of polyester fabric are shown in Fig.-2 and Fig.-3.

**Table-1: Nomenclature for the raw materials**

Fibre specifications	Coding
Recycled Polycotton fibre	R
Recycled Polycotton fibre blended with Polyester fibre	RP
PET fibre	P



**Fig.-2: Cotton/Polyester blended selvedge wastes**



**Fig.-3: Cutting waste of polyester fabric**

### Sorting and Opening

After collection, the textile wastes were sorted and manual cleaning was required to remove the dust particles and non-cotton/ polyester materials. Afterwards, it is opened and processed into the fibrous form using a laboratory model carding machine.

### Blending of selected fibres

Recycled Polycotton fibres were blended with polyester fabric discards using various proportions. The fibres were blended and carded twice in a mini laboratory carding machine. PET fibre is used for thermal bonding purposes in a sandwich model. Table-2 describes the fibre composition of prepared nonwoven samples.

**Table-2. Fibre blend ratio and sample code**

Fibre blend ratio	S/P	Coding
60% Recycled Polycotton fibre and 40% PET	60:40	G1
35% Recycled Polycotton+25% polyester fibre and 40% PET	60:40	G2
50% Recycled Polycotton fibre and 50% PET	50:50	G3
25% Recycled cotton+25% polyester fibre and 50% PET	50:50	G4

S/P-Selvedge/Polyester

### Web Formation

A carding process is needed to open the blended fibres into individual fibres and comb them to make them parallel (Govindarajau, 2018). Recycled selvedge fibres and their respective weighed PET fibres were laid in the conveyor belt of a laboratory carding machine and it is processed to obtain the required webs. Carding is done twice to obtain uniform carded webs. The different web

sheets were layered above one other to get the required amount of thickness in the final nonwoven fabric. Fig-4 shows the Card web-making process.



**Fig.-4: Card web-making process**



**Fig.-5: Needle-punching process**



**Fig.-6: Thermal bonding process**

### **Needle-punching Process**

The Delta laboratory model needle-punching machine was used for the needle-punching process with a barbed needle. The process was performed at 50 punches/min with a 25-feed rate (mm/stroke). The needle-punching process of the carded lap is shown in Fig.-5.

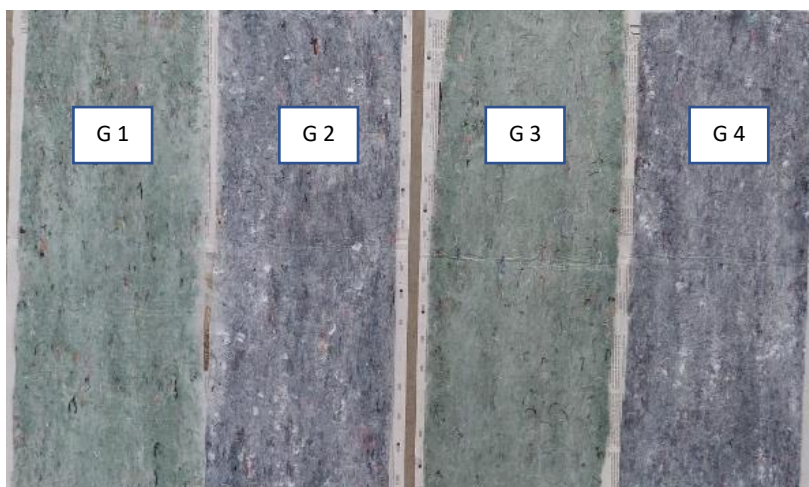
### **Thermal Bonding Process**

The Lab model Thermal Bonding machine was used for the Thermal bonding process. The needle-punched webs were fed into rollers of the machine with a heat setting of 160°C and at a constant pressure to melt the PET fibre and adhere to recycled fibres as shown in Fig.-6. Fig.-6 depicts the thermal bonding process of conversion of fibrous layer web into nonwoven fabric.

### **Thermal-bonded nonwoven sheets**

The fabricated samples such as G1 R/P (60:40) and G3 R/P (50:50) of recycled fibres: PET, G2 RP/P (60:40) and G4 RP/P (50:50) recycled cotton/polyester fibres: PET were prepared. The prepared thermal bonded samples were lightweight and ranged from 30 cm in width and 100 cm in length were shown in Fig.-7.





**Fig.-7: Image of reclaimed selvedge waste thermal bonded nonwoven sheets (G1) 60:40 R/P, (G2) 60:40 RP/P, (G3) 50:50 R/P & (G4) 50:50 RP/P**

### Testing Methods

All nonwoven samples prepared from recycled selvedge waste fibres were tested for thermal conductivity and physical properties such as fabric weight, thickness and bulk density according to ASTM standards. To avoid the errors in result, all samples were maintained in standard conditions for 24 hr ( $21\pm 1^{\circ}\text{C}$  temp and  $65\%\pm 2$  RH).

### Fabric Weight

GSM (Gram per square meter) is the standard system of the fabric weight with the unit of  $\text{g}/\text{m}^2$  (i.e. the weight of fabric in one gram per square meter). The GSM Cutter is used to cut the circular specimen of  $100\text{ cm}^2$  very accurately according to ASTM D 3776. Digital balance is used to weigh the samples. The obtained values in grams were multiplied by 100 and the resulting values were the GSM of the fabric.

### Fabric Thickness

A thickness tester is used to measure the thickness of samples as per ASTM D1777-64. The fabric was positioned between the anvil and the pressure foot. According to ASTM Standard, 4.1. Kpa weight was used. The weight was used as per ASTM Standards. The readings were noted from the dial. Ten random readings from different places of samples were taken and the mean value was calculated. The average thickness of the sample is the computed outcome and is denoted in mm.

### Bulk Density

The bulk density of fabric depends upon its thickness and weight of the fabric. According to M.Venkataraman, fabric bulk density ( $\text{kg}/\text{m}^3$ ) is calculated as the fabric mass [ $\text{G}(\text{g}/\text{m}^2)$ ] to thickness ratio [ $h(\text{mm})$ ]. Hence, by applying the following formula

$$\text{Fabric bulk density} = \text{G} (\text{g}/\text{m}^2)/h (\text{mm}) \quad \dots\dots(1) \text{ (Venkataraman, 2017)}$$



### Thermal Conductivity

Flat-plate Fabric Heat Retaining Instrument YG606D was used to evaluate the prepared thermal bonded sample's thermal conductivity according to ASTM D518. A cut sample of 30×30 cm was placed on the testing plate inside the chamber. The thermal testing apparatus shown in Fig.-8, has having data processing unit with microcomputer control and excellent temperature sensors. Its purpose is to determine the heat retention capacity of various fabrics.



Fig.-8: Testing of thermal conductivity of nonwoven

### FINDINGS AND DISCUSSION

The samples are made of reclaimed Polycotton/PET fibres with different ratios, GSM, thickness and density. Table-3 shows the results of an average value of physical properties of thermal bonded nonwoven samples G1 R/P (60:40), G2 RP/P (60:40), G3 R/P (50:50) and G4 RP/P (50:50), according to ASTM Standards.

Table-3: Physical properties of Thermal-bonded nonwoven sheets

Sample	Fabric weight (g/m <sup>2</sup> )	Fabric Thickness (mm)	Bulk Density (kg/m <sup>3</sup> )
G1	249.1	1.34	185.8
G2	333.7	1.87	178.4
G3	269.1	1.63	165.0
G4	332.1	1.99	166.8

Table-3 depicts that G2 and G4 show similar results in the fabric weight of the samples. It is clear that, fibre content increases the weight of the nonwoven samples (Sakthivel, 2020). The table shows that when fabric thickness increases, the fabric weight also increases. It is found that when fabric weight and thickness increase, bulk density decreases.

Table-4: Thermal properties of Thermal-bonded nonwoven sheets

Sample code	Thermal Conductivity (W/Mk)	Thermal Insulation (m <sup>2</sup> K/W)
G1	0.052	0.025
G2	0.063	0.029
G3	0.054	0.030
G4	0.042	0.047

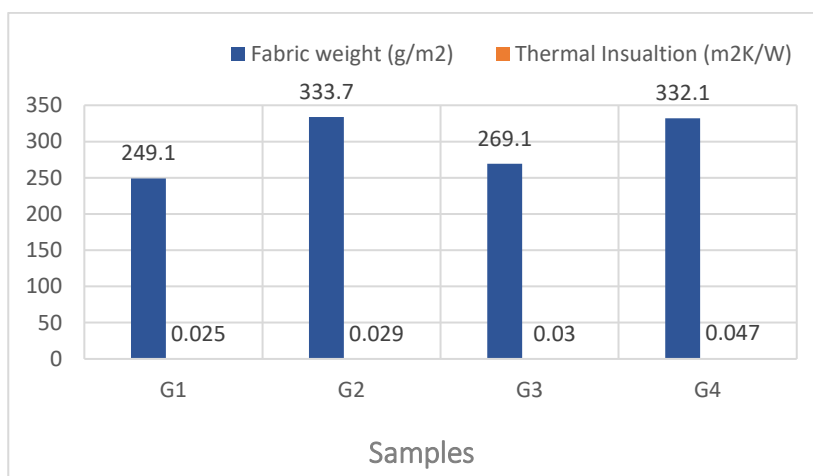
Table-4 demonstrates that as the nonwoven fibre content increased, all of the sample's thermal conductivity increased as well. All fabricated nonwoven prototypes exhibit improved insulation properties. The thermal insulation property depends upon the factors of physical property as well. When the thickness of the sample increases, the insulation value of nonwoven increases (Meseret, 2021). Hence, it can be concluded that G4 has the best thermal performance compared to other samples.

The thermal insulation property could be affected by various factors such as fabric weight, thickness and bulk density. Hence, the impact of physical characteristics on the thermal insulation of thermally bonded nonwoven was examined in this work.

#### ***Impact of weight per unit area on nonwoven's thermal insulation***

Fig.-9 shows that an increase in the sample weight increases the value of thermal insulation. As a result, thermal insulation behaviour is heavily impacted by the GSM of the nonwoven samples. This is because when the number of fibres per unit area increases, the amount of space between those fibre air sacs decreases. Thus, the fabric insulation increases.

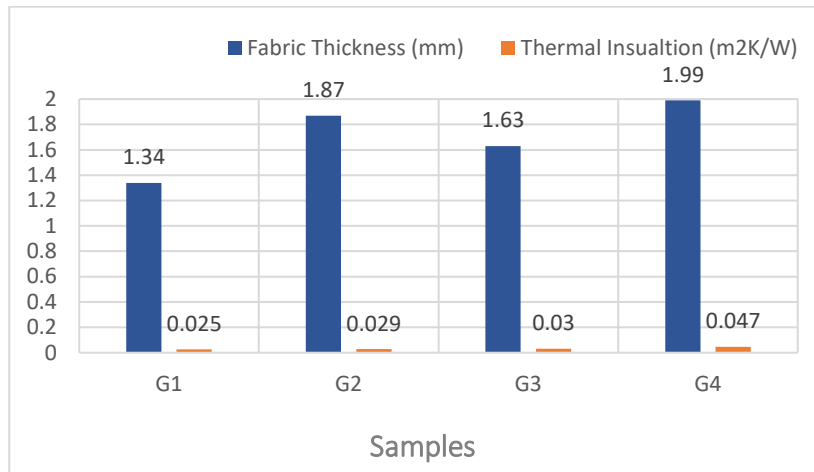
Also, we can observe that the fibre blending ratio has a significant role in determining the nonwoven weight. Fig.-9 depicts that the nonwoven made from RP/P blend shows higher weight and best insulation performance when compared to R/P blend nonwoven. This is due to the following reason, polyester fibre has an inbuilt structure for the reduction of heat loss (Mundkur, 2016).



**Fig.-9: Impact of weight per unit area on nonwoven's thermal insulation**

#### ***Impact of thickness on nonwoven's thermal insulation***

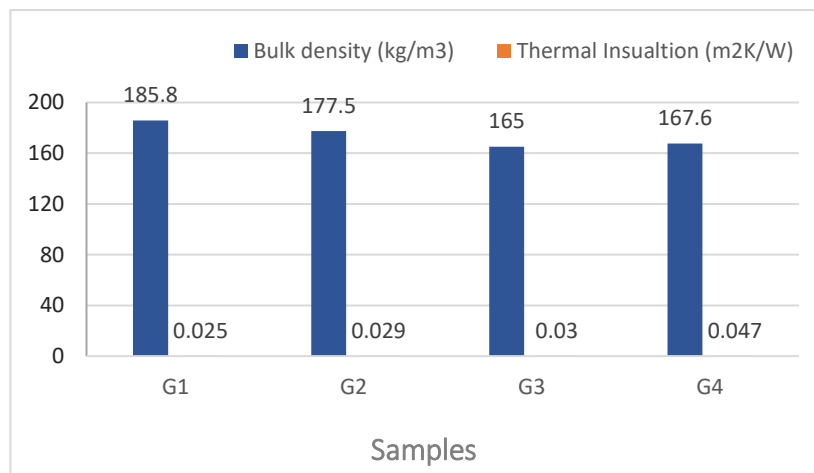
Fig.-10 depicts that thermal insulation value increases with increases in fabric thickness. It shows that G4 and G2 having a thickness of 1.99 and 1.87 shows insulation value of 0.047 and 0.029. This is due to the reason that; the nonwoven with higher unit per area were thicker and increases the insulation value (Sakthivel, 2012).



**Fig.-10: Impact of thickness on nonwoven’s thermal insulation**

***Impact of bulk density on nonwoven’s thermal insulation***

Fig.-11 demonstrates the indirect relationship between bulk density and thermal insulation values. From Fig-11, it is also clear that as the bulk density of the nonwoven samples decreases, the thermal insulation value increases. Cotton/PET nonwoven shows the highest bulk density value of 185.8 and gives the lowest thermal insulation value of 0.025.



**Fig.-11: Impact of bulk density on nonwoven’s thermal insulation**

***Impact of thermal conductivity on nonwoven’s thermal insulation***

Thermal insulation values were highly dependent on the thermal conductivity of samples. Fig.-12 depicts the thermal conduciveness of nonwoven samples made from reclaimed fibres. As thermal conductivity decreases, the transmission of heat through the material is restricted, hence increasing the thermal insulation property in nonwoven samples (Meseret, 2021 & Wazna, 2019). The outcome shows that the G4 sample (50:50 RP/P) has a thermal insulation value of 0.047 and a thermal conductivity of roughly 0.042 W/Mk, which is greater than the thermal conductivity of the other samples G1, G2, and G3 and acceptable for interlining applications.

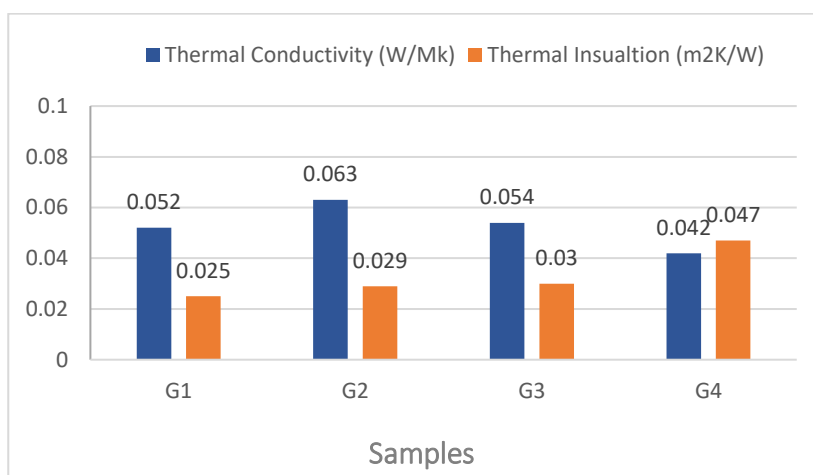


Fig-12. Impact of thermal conductivity on nonwoven's thermal insulation

## CONCLUSION

In this study, the transmission of heat through four different recycled selvedge waste nonwoven sheets (G1 R/P, G2 RP/P, G3 R/P, G4 RP/P) with two different blending proportions were inspected. In a Flat-plate thermal tester, the nonwoven sheets were examined for their ability to act as insulators. The physical characteristics of thermally bonded nonwovens have a substantial impact on the insulation values of samples.

- The fabric weight and thickness have a direct relationship with thermal insulation value, whereas an indirect relationship is been observed with bulk density and thermal conductivity of fabric.
- From this analysis, the best thermal insulation performance was exhibited by 50/50 G4 RP/P nonwoven.
- The results concluded that reclaimed fibres from Polycotton selvedge waste could be used as insulation materials in Clothing, Automobile, Home and Pack tech.

## SUGGESTIONS FOR FUTURE RESEARCH

- Other textile wastes can be used to find the best insulation property.
- Aim to increase the proposition of textile waste while producing samples, hence recycling more waste.

## Declaration of conflicting interests

The author(s) declared no potential conflicts of interest concerning the research, authorship, and/or publication of this article.

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## THE USAGE OF DIGITAL MEDIA BY SENIOR ADULTS IN VADODARA FOR THEIR HEALTH PURPOSES

**Ms. Dhara Patel<sup>1</sup>, Dr. Avani Maniar<sup>2</sup>**

Ph.D. Scholar<sup>1</sup>, Head, Associate Professor<sup>2</sup>

Department of Extension and Communication,

Faculty of Family and Community Sciences

The Maharaja Sayajirao University of Baroda

Vadodara

Email: dhara.patel3104@gmail.com,

maniar.avani-extcomm@msubaroda.ac.in

Membership Number: 13/GJ/P-8/LF

### ABSTRACT

India's rapid adoption of digital health results from the COVID-19 epidemic. The advent of telemedicine and the subsequent era of remote and patient-centered care were made possible by the exceptional health crisis. In addition to helping individuals monitor and manage chronic illnesses, digital healthcare may help prevent disease and save healthcare expenditures. The elderly population stands to benefit significantly from this development, as does every other group that is geographically and socially isolated. As more and more elderly people use digital and social media, the "digital divide" is closing, and the door is opened to the potential use of digital technology to provide services to this demographic. The study's primary objectives were to know digital media usage for health purposes and the problems faced by the elderly residing in Vadodara City using digital media. 81 elderly who used digital media were selected for data collection. Purposive and snowball techniques were used. A structured questionnaire was distributed to the elderly. The study's significant findings were that all the elderly used digital media for health purposes. The majority of the elderly used digital media for watching videos (34.57%) for health purposes and home remedies, followed by exercise (38.27%). Conversely, most elderly people face problems like authentic information and pop-up menus (27.16%). Today, the aging population in cities with access to digital media remains constantly in touch with their progenies. In a way, it can be said that digital media can enrich older people's lives by providing the purpose and scope for creative productivity.

**Key Words:** Digital Media, Elderly Citizens, Health, Usage

### INTRODUCTION

Since the latter part of the 1990s, two significant societal trends have emerged: the development of digital media and the aging of the population. The development and proliferation of digital media have led to the widespread use of personal computers in daily life, revolutionizing several fields, including communication, commerce, and education. These days, being able to use

digital media is seen as necessary to participate in the "information society." Insufficient information at the time will lead to low productivity and poor-quality research already completed by others or in other nations. Digital media and our everyday needs are now inextricably linked. Digital media significantly impact our daily lives.

**Table :1 The table below shows the growth of internet users from 2014 to 2023.**

<b>Year</b>	<b>Percentage of users</b>
2014	40.70%
2015	43.00%
2016	44.60%
2017	46.80%
2018	48.90%
2019	50.80%
2020	52.40%
2021	53.70%
2022	63.10%
2023	63.10%

**Source: Daniel R (2023) Internet user's statistics**

### **What is Digital Media?**

Information shared via a digital device or screen is called digital media. Essentially, it refers to any media whose production, distribution, viewing, and storage depend on an electronic device. Most modern marketing uses digital content, such as blogs, research articles, videos, and social media posts, to produce and display adverts.

### **Digital Media in India**

The digital economy and the ICT sector are India's leading economic engines, accounting for nearly 13 percent of the nation's GDP. By 2025, India wants to see \$1 trillion, or 20% of GDP, invested in the ICT sector. The National Association of Software and Services Companies (NASSCOM) reports that the technology sector in India grew at the fastest rate ever, with revenue rising from \$200 billion in 2020 to \$227 billion in 2021. In 2021, double-digit growth was reported by all of the technology industry's subsectors, including IT and business process management, IT-enabled services, engineering research and development, hardware, software products, and e-commerce. In 2021, computer and electronic equipment (NAICS code 334) was imported by India worth more than \$2.4 billion from the US. Gartner predicts that by 2022, India's IT spending will reach \$101.8 billion, a 7% rise.

With 1.2 billion users, the Indian telecom market is the second largest around the globe. Widespread adoption—98% of phone utilization in India is attributed to wireless subscriptions—has propelled the country's mobile industry. Deloitte predicts India to increase its smartphone population



from 750 million to 1 billion by 2026. Additionally, India is now the world's second-largest producer of mobile phones. There are 788 million broadband users in India.

### **Elderly and Digital Media**

The ubiquity of technology nowadays dramatically benefits both the young and the old. For the elderly who know how to utilize digital tools, technology makes life easier, live alone, and are separated from their children. Technology provides them many practical advantages, from placing online orders for food and medications to using telemedicine or handling various banking requirements. Significantly, it has been crucial in helping them establish connections with distant relatives, obtain emergency and medical assistance, and obtain their rights and benefits.

Seniors in rural and urban India can benefit greatly from technology, which can improve their ability to lives in various ways. First, it can help them stay in touch with friends and relatives. Technological advancements enable senior citizens to communicate continuously with their loved ones, even if their children or friends reside abroad or nationwide. In ways that expensive phone calls and physical letters could never match, social media platforms and the countless WhatsApp groups keep us all connected. For many seniors, loneliness is a severe problem somewhat mitigated by connectedness.

Second, technology may be utilized to raise quality of life, combat loneliness, and promote health. Digital devices and telemedicine have significantly altered the nature of healthcare access. Elderly people with long-term conditions like diabetes, depression, hypertension, stroke, and heart issues benefit from it.

### **Elderly and Digital Healthcare**

Chronic illnesses like hearing loss, diabetes, cardiovascular disease, chronic obstructive pulmonary disease, cataracts, depression, osteoarthritis, Alzheimer's disease, and other dementias are more common as people age. These illnesses put older people's independence and quality of life in jeopardy and place a high cost on people, communities, and healthcare systems. Larger aging populations will lead to an increase in chronic illnesses and a corresponding decline in independence, which will increase the need for healthcare services, drive up costs for the healthcare system, and exacerbate inequities for people who are unable to pay or access it. Chronic illnesses such as osteoarthritis, diabetes, cardiovascular disease, chronic obstructive pulmonary disease, cataracts, Alzheimer's and other dementias, depression, and hearing loss are more prevalent as people age. These illnesses place a heavy strain on people, communities, and healthcare systems while posing a threat to the independence and standard of living of the elderly. Increased use of healthcare services, higher costs to the healthcare system, and more pronounced disparities for people who are struggling affording or accessing healthcare are all linked to the consequent increases in chronic conditions and a corresponding decrease in independence that will accompany a larger aged population. Information and communication technologies (ICTs)—such as computers, smartphones, the Internet, and other communication devices—may be used for digital health or eHealth initiatives to address the current and preventing barriers to accessing healthcare. This could help to reduce health inequities. Through remote monitoring, telemedicine, and other internet-based assistance, ICTs may offer unique potential for equitable healthcare access to manage and improve older persons' health and quality of life. **Pereira P (2022)** found in his study that instead of seeking a second opinion, the seniors access the internet to research health issues, and their children also searched the internet for information and explained it to them. The capacity to locate, comprehend, and analyze health data from digital

resources and utilize new knowledge to health-related management and decision-making processes is known as e-health literacy. Digital literacy and well-being are especially crucial for older persons. The ability to get and comprehend health information and apply newly gained knowledge to make wise decisions regarding one's health is referred to as health literacy. Low health literacy in older persons is linked to worse health management, such as understanding when to seek medical attention, adhering to prescription regimens, and adopting preventative health behaviors.

Furthermore, wearable digital technologies are anticipated to give medical personnel ongoing access to senior citizens' health and present particular chances for efficient remote care. Wearable technology can help older persons monitor for safety issues, track ongoing therapies for chronic health disorders, and track these remotely without interfering with their routines. For instance, biometric and biomolecular data may be continuously and non-invasively collected by wearable platforms, which is impossible using conventional health evaluation methods. They can instantly sound an alert in an emergency, such as a stroke, seizure, or fall, enabling prompt medical attention. By facilitating greater access to healthcare services available to elderly residents of rural areas, these tools are anticipated to mitigate geographic disparities.

## **LITERATURE REVIEW**

**Finkelstein R et al. (2022)** conducted a study on older adults' experiences using information and communication technology and tech support services in New York City: findings and recommendations for post-pandemic digital pedagogy for older adults. The study's primary goal was to discover more about how older persons used ICT and ICT support services so that present and future technology can better serve older adults during and after the epidemic. Thirty-five older adults in New York City who received ICT equipment, connectivity, and training completed surveys administered by interviewers. The study's significant findings were that about 80% of senior citizens use email effectively. • Online purchasing was preferred by 60% of senior citizens. More than half (70%) of elderly people downloaded media and played games online. Just 10% of senior citizens use telehealth services.

**Rojanasumapong A. et al. (2021)** conducted a cross-sectional study in an urban primary care center in Thailand on using the Internet, electronic health literacy, and hypertension control among the elderly. This study sought to look at the connection between electronic health literacy (e-HL) and blood pressure control and internet usage and e-HL among persons with hypertension 60 years and older. The study's significant findings were that 47 participants said they could Make wiser choices regarding your health with the Internet, and 47 thought they needed access to online health resources. 33 out of 56 older adults felt comfortable using the information they found online to make health-related decisions. Just 51.9% of senior citizens using the Internet to control their blood pressure.

**Han M. et al. (2020)** Conducted a qualitative study titled "Social Media and its Impact on Health-Related Outcomes Among Older Adults in Singapore." The study's objectives were to learn more about older persons' social media experiences in Singapore and how they perceived social media's influence on health-related outcomes. Aged 60–80, typical aging older individuals (N=16) were chosen using purposeful sampling with greatest variance. In-depth, semi-structured interviews

were done. The study's significant findings were that two mentioned that health-related information could occasionally be unclear. Some videos claim it's good, but others claim it's not. Four of them thought that elderly individuals had a higher likelihood than younger people be more "disciplined" and "aware" of how frequently they utilize their smartphones because of their life experiences.

**Momeni M et al. (2018)** conducted a phenomenological study titled "Barriers and Challenges Experienced by Seniors in Using Online Social Networks." The study aims to shed light on older individuals' experiences navigating social network obstacles and difficulties. The study's significant findings were that the elderly should grasp the bare minimum of technical abilities. The knowledge they lacked included fundamental instructions on joining and using online social networks and operating computers, tablets, and smartphones. They also needed to know how to connect to the Internet using various technologies. Some of them don't believe the advice given by these networks, such as when it suggests using black oil to treat an abscess.

### **JUSTIFICATION OF THE STUDY**

The digital media is a growing source of health information delivery. Simultaneously, more patients are searching digital media for information on their condition or course of therapy. This is a beneficial development because patients' health-related outcomes are improved when Web-based health information technologies (such as Web-based patient education, patient portals, and health-related apps). A significant demographic for Web-based health information is senior patients since numerous diseases (such as cancer, diabetes, and hypertension) afflict the elderly. According to a recent literature review, older patients benefit from the growing number of web-based health information tools developed for them. Improved outcomes like blood pressure, cholesterol, hemoglobin levels, and self-efficacy demonstrate this. These outcomes were prevalent for multifunctional Web-based health information solutions.

Older people utilize digital media to look up health-related information. This may have a favorable effect on their health. Still, we don't see how they use and assess Web-based health resources. Due to their lack of expertise with Web-based technologies, older patients have more challenges utilizing them than patients in younger age groups. Future generations of elderly people could possess more experience with Web-based technologies and thus solve this problem. Still, it is expected that age-related issues like cognitive decline and functional and sensory limitations will also cause usability issues for them.

Nevertheless, very few senior citizens in our nation use the internet. This might be the outcome of several significant factors, including educational background, family and individual income, employment, and health. As a result, it is imperative that research this topic to comprehend how older people utilize digital media for health-related purposes, including their motivations, usage patterns, level of proficiency, recommendations, and goals for this medium. This kind of research will assist us in determining the best ways to enable our elderly adults to use the internet to their full potential and to make life's duties more manageable and convenient.

### OBJECTIVES OF THE STUDY

1. T: To study the demographic profile of the elderly in Vadodara City.
2. To study the digital media usage of elderly citizens in Vadodara City.
3. To study digital media usage for health purposes by the elderly citizens residing in Vadodara City.
4. To study the problems faced by the elderly while using digital media.
5. To study the use of digital media equipment by elderly citizens to measure different health parameters.

### METHODOLOGY

Population of the study	Sample of the study	Sample size	Sampling Method	Data Collection	Analysis of data
•Elderly Citizens residing in Vadodara City	•Elderly men and women using Digital Media for health purposes	•Eighty one elderly citizens using digital media	•purposive and snow ball sampling method was used	•Detailed questionnaire was prepared for the data collection	•Frequency and percentage was used for analyzing the data.

The research adopted an exploratory design to investigate the usage of digital media by senior adults in Vadodara for health purposes. Originally, a purposive sampling method was initially employed to identify elderly citizens who are active digital media users. A snowball sampling technique expanded the sample size by recruiting enlisting individuals via recommendations from the initial subjects. Data collection was conducted using a structured questionnaire designed to capture detailed information on the demographic profile of the participants, their digital media usage habits, and the specific health-related purposes for which they use digital media. The questionnaire included closed and open-ended questions to gather quantitative data and qualitative insights. The sample size consisted of [specific number] participants, with [number] male and [number] female respondents ranging in age from [youngest age] to [oldest age]. Data analysis was performed using [statistical software], employing descriptive statistics to summarize the demographic data and usage patterns and inferential statistics to identify significant correlations and trends.

### FINDINGS OF THE STUDY

**Table 2: Different health issues among Elderly Citizens**

Health Issue	N=61	
	F	%
<b>Blood pressure</b>	<b>46</b>	<b>75.41</b>
Diabetes	28	45.90
Cholesterol	10	16.39
Thyroid	9	14.75

Arthritis	8	13.11
Heart issues	7	11.48
Constipation	6	9.84
Obesity	4	6.56
Asthma	2	3.28
Cancer	<b>1</b>	<b>1.64</b>
Alzheimer	<b>1</b>	<b>1.64</b>
Stroke	<b>1</b>	<b>1.64</b>

**\*Multiple responses**

The table shows that the majority (75.41%) of elderly citizens had high blood pressure, which was followed by diabetes (45.90%). Additionally, they had some degree of heart problems (11.48%), thyroid (14.75%), arthritis (13.11%), and cholesterol (16.39%). Few senior people (1.64%) experienced cancer, Alzheimer's disease, or a stroke.

**Table 3: Usage of Digital media by Elderly Citizens**

**(N=81)**

Digital media	F	%
<b>Mobile Apps</b>	<b>70</b>	<b>86.41</b>
Videos	66	81.48
Social Media (Facebook, Instagram, Twitter etc)	60	74.07
SMS	49	49.38
Email	32	39.50
Websites	29	35.80
MP4audios	20	24.69
Online display advertisements	20	24.69
Digital photos	19	23.46
E-books	6	7.41
Blog	5	6.17
Virtual reality	4	4.94
Digital art	4	4.94
<b>Podcasts</b>	<b>3</b>	<b>3.70</b>

**\*Multiple responses**

This table shows the usage of digital media by elderly citizens. The majority of them were using it for mobile apps (86.41%), followed by videos (81.48%) and social media (74.07%). One-fourth (25%) used MP4 audio and online display advertisements. Usage of SMS (49.38%), Email (39.50%), and websites (35.80%) were also prevalent among the elderly.

**Table 4: Purpose of Usage of Digital Media by Elderly Citizens**

(N=81)

<b>Purpose of Digital Media Usage</b>	<b>F</b>	<b>%</b>
Health	<b>81</b>	<b>100</b>
Chatting	45	55.55
Watching/reading news	45	55.55
Internet telephone	44	54.32
Watching live telecasts of sports, TV	37	45.67
Reunion with old friends	34	41.97
Finding information on activities for senior citizens	34	41.97
Email	28	34.56
Online banking or payment	26	32.09
Downloading songs	22	27.16
Watching online movies	20	24.69
Online shopping	19	23.45
Booking of air/railway tickets	13	16.04
Playing online games	8	9.87
Hotel booking	8	9.87
Matrimonial information for children, grandchildren, relatives	<b>6</b>	<b>7.40</b>

\*Multiple Responses

This table shows that all elderly citizens (100%) use digital media for medical needs. Greater than fifty per cent of the elderly (55.55%) used chatting and watching or reading news, followed by Internet telephone (54.32%). Less than half of the elderly (45.67%) used digital media to watch live sports telecasts and TV, followed by reunions with friends and finding information on activities for senior citizens (41.97%). Elderly citizens were also engaged in using email (34.56%), online banking or payment (32.09%), and downloading songs (27.16%).

**Table 5: Source of getting health information on health issues by Elderly citizens**

(N=81)

<b>Source of information for health issues</b>	<b>F</b>	<b>%</b>
Videos	<b>57</b>	<b>70.37</b>
You tube	53	65.43
WhatsApp	51	62.96
Facebook	37	45.67
Images	24	29.62
Textual material	22	27.16
Advertisements	11	13.58
Instagram	8	9.87
Podcast/audio taps	2	2.46
Any other (Doctor, telegram, TV)	<b>6</b>	<b>7.40</b>

\*Multiple Responses

This table shows sources of information on health issues by elderly citizens. Most of the elderly use videos (70.37%), followed by YouTube (65.43%), WhatsApp (62.96%), and Facebook (45.67%) to get health information, and over one-fourth of the elderly also use Images (29.62%) and textual material (27.16%). Only thirteen percent of them used advertisements as a source of health information.

**Table 6: Usage of Digital Media equipment for measuring health parameters by Elderly Citizens.**

(N=81)

Digital Equipment	F	%
BP measuring machine	49	60.49
Thermometer	42	51.85
Oximeter	35	43.20
Weighing machine	23	28.39
CGM (Continuous Glucose monitor)	12	14.81
Smartwatch	6	7.40

**\*Multiple Responses**

As the previous finding shows, most elderly citizens suffer from high blood pressure, and this table supports the finding. The majority of the elderly keep track of their Blood Pressure through a BP machine (60.49) followed by a thermometer (51.85%) and oximeter (43.40%). Thyroid and obesity were also seen in the elderly; they monitor their health parameter by using a weighing machine (28.39%) and CGM (Continuous Glucose Monitor) (14.81%). Only seven percent of them used smart watches to check their health parameters.

**Table 7: Item-wise intensity indices for usage of Digital Media by Elderly Citizens**

(N=81)

Usage of Digital Media	MT (%)	ST (%)	R/N (%)	I.I (%)
Home remedies	35.8	44.44	19.75	2.16
Watching videos	34.57	46.91	18.52	2.16
Exercise	38.27	25.93	35.8	2.02
Sharing health-related information with others	28.4	41.98	29.63	1.98
Keeping track of BP	30.86	35.8	33.33	1.98
Yoga	34.57	27.16	38.27	1.96
Different diseases	18.52	55.56	25.93	1.92
Diet/food	28.4	30.86	40.74	1.88
Medication	24.69	32.1	43.21	1.81
Ayurvedic treatment	18.52	39.51	41.98	1.77
Enhance understanding regarding illness	9.88	51.85	38.27	1.72
Experts/ doctors near me	14.81	40.74	44.44	1.70
Hospitals near me	19.75	29.63	50.62	1.67
Effects of medicines on health	16.05	38.27	45.68	1.65
Content of medicines	16.05	33.33	50.62	1.65

Get updated about health services	12.35	37.04	50.62	1.62
Keeping track of glucose level	20.99	19.75	59.26	1.62
Price of medicines	17.28	25.93	56.79	1.60
Diagnostic center	4.94	46.91	48.15	1.57
Watching interviews with Doctors	8.64	34.57	56.79	1.52
Naturopathy treatment	11.11	25.93	62.96	1.48
Alternative/generic medicines	12.35	19.75	12.35	1.44
Homeopathy treatment	6.17	29.63	64.2	1.42
Ordering online medicines	6.17	19.75	74.07	1.32
Keeping track of Heart rate	6.17	17.28	76.54	1.30
Online consultation	3.7	14.18	81.48	1.22
Telemedicine	2.47	17.28	80.25	1.22
Keeping track of calories	4.94	11.11	83.95	<b>1.21</b>

The above table shows the item-wise intensity indices for items related to using Digital Media, ranging between 2.50 – 1.00. This indicates that the application of Digital for health proposed by elderly citizens was more to less. Digital media used for home remedies, watching videos, and searching exercises are more rather than sharing health-related information, keeping track of BP, Yoga, Different diseases, healthy diet, and food, medication, ayurvedic treatment, enhancing understanding regarding illness, information regarding nearby doctors, effects of medicines on health, the content of drugs, health services, keeping track of glucose level, price of medicines, diagnostic centers and watching interviews of doctors.

Additionally, it was discovered that digital media usage was shallow among elderly citizens when it came to getting information regarding naturopathy and homeopathy treatment, alternative or generic medicines, ordering online medicines, keeping track of heart rate and calories, online consultation, and telemedicine.

**Table 8: Item-wise intensity indices for problems faced by elderly citizens while using Digital Media**

(N=81)

<b>Problems Faced by Elderly Citizens</b>	<b>MT (%)</b>	<b>SM (%)</b>	<b>R/N (%)</b>	<b>I.I (%)</b>
Authentic information	27.16	41.98	30.86	<b>1.96</b>
Pop-up menu (when you open any site, unwanted advertisement appears)	25.46	44.44	29.63	<b>1.96</b>
Low internet speed	19.75	51.85	28.4	1.91
A large amount of information	24.69	41.98	33.33	1.91
Small font size	23.46	39.51	37.04	1.86
Lack of technical skills	18.52	49.38	32.1	1.86
Old age problems like backache, sitting, weak eyesight, etc.	20.99	44.44	34.57	1.86
Too much information on one page	19.75	43.21	37.04	1.83
Lack of awareness regarding e-health services	22.22	37.04	40.74	1.81



Lack of English competency	23.46	28.4	46.91	1.76
Lack of awareness for health-related media	18.52	38.27	43.21	1.75
Use of complex medical terminology	23.46	27.16	49.38	1.74
Logging and navigation problem	8.64	53.09	38.27	1.70
Fear of the wrong operation	13.58	40.74	45.68	1.68
Privacy and trust issues	13.58	38.27	48.15	1.65
Lack of face-to-face communication	13.58	38.27	48.15	1.65
High cost of digital media	13.58	33.33	53.09	1.60
Lack of technical support	6.17	33.33	60.49	1.46
Misuse of personal information	7.41	27.16	65.43	1.42
Lack of electricity supply	1.23	29.63	69.14	<b>1.32</b>

This table shows item-wise intensity indices for items related to problems faced by elderly citizens while using Digital Media, ranging from 1.96 to 1.32. this means that the elderly face internet-related problems sometimes, rarely, or never.

Problems like getting authentic information, pop-up menus, low internet speed, large amounts of information, small font size, old age-related issues, too much information on one page, and lack of awareness regarding e-health services are some problems they face sometimes. Problems like technical support, misuse of personal information, and lack of electricity supply were faced by the elderly rarely or never.

The investigation produced a number of important conclusions regarding the demographic profile and digital media usage of senior adults in Vadodara for health purposes:

1. Demographic Profile: • The majority of respondents were males, predominantly in the age group of 60-70 years. • Common health issues reported among the participants included diabetes, arthritis, and hypertension.
2. Digital Media Usage: • A significant portion of the respondents were active digital media users, with smartphones being the most commonly used device. • The internet was frequently accessed to obtain health-related information.
3. Health-Related Purposes: • The principal objectives of digital media included: • Looking up information about various diseases and medical conditions. • Finding and accessing healthcare services and facilities. • Monitoring and managing ongoing health conditions through apps and online platforms.
4. Challenges: • Many respondents reported difficulties using technology, such as navigating apps and websites. • There was a notable lack of trust in the reliability and accuracy of online health information, which hindered more extensive usage. These findings indicate a high prevalence of digital media usage among senior adults for health-related purposes despite some significant challenges

## **CONCLUSION**

The study concludes that digital media is an increasingly important tool for senior adults in Vadodara to manage their health. Most elderly participants actively use digital devices, particularly smartphones, to seek information about diseases, access healthcare services, and monitor their health

conditions. However, the adoption of digital media is hindered by technological difficulties and skepticism regarding the accuracy of online health information. It is essential to address these barriers to enhance the effectiveness of digital media as a resource for senior adults. Providing targeted training programs to improve digital literacy among the elderly and ensuring the credibility of online health information through reliable sources can significantly improve their confidence and competence in using digital media for health purposes.

### **FUTURE IMPLICATIONS**

Based on the results, the researcher offers suggestions for future implications, such as raising elderly citizens' awareness, comprehension, and proficiency in using digital media for health purposes; educating them about e-health services and health-related media; and properly incorporating digital media into older people's everyday life, elements that impact their adoption and desire to utilize it should be evaluated. Only information was gathered from Vadodara City, so the study's conclusions cannot easily be generalized for other cities because of the variations in their socio-economic structures. Thus, future studies might concentrate on the following: 1. Investigating the impact of digital literacy training programs on the efficacy of digital media usage among senior adults. 2. Exploring the role of family members and caregivers in facilitating digital media usage for health purposes. 3. Examining the potential of emerging technologies, such as telemedicine and wearable health devices, in improving health outcomes for elderly populations. 4. Conducting longitudinal studies to understand the long-term effects of digital media usage on the health and well-being of senior adults. These recommendations can guide further studies to develop more effective strategies and interventions to support the health management of senior adults through digital media.

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## BEYOND POINTS AND BADGES: THE NUANCES OF GAMIFICATION IN UNDERGRADUATE EDUCATION

H. Malsawmhlui<sup>1</sup> Dr R. Jansi Rani<sup>2</sup>

<sup>1</sup>Research scholar, <sup>2</sup>Assistant Professor (SG)

Department of Home Science Extension Education, Avinashilingam Institute for Home Science and Higher Education for Women. Coimbatore-641043, Tamil Nadu, India

Email ID: somihrahseel@gmail.com, jansirani\_ext@avinuty.ac.in

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### ABSTRACT

Gamification, the method of combining game-based learning with other elements to increase student engagement and motivation, has become a popular trend in the domain of education. To assess the impact of gamified learning applications on undergraduate students' education, a research study was conducted in Aizawl, Mizoram, India, involving 100 participants selected through purposive sampling. The study's descriptive analysis revealed that gamification had a profound effect on student learning, motivation, and collaboration. However, it also highlighted that gamification may not be suitable for all students and could face resistance from stakeholders. The study focused on student acceptance and engagement with gamified learning, and the findings suggested that students were moderately accepting and engaged with the approach, and it effectively enhanced their learning experience. However, students expressed concerns about an over-emphasis on competition or rewards. Additionally, the study found that gender and course were significant factors for the educational impact of gamification. The study concludes that gamification can be a powerful tool for enhancing the learning experience and improving learning outcomes. However, careful implementation and integration with other teaching strategies are essential to its effectiveness. While gamification can enhance learning outcomes, it should be used alongside other effective teaching methods and aligned with learning objectives to support the learning process. It should be used in moderation, keeping in mind the needs of all learners. Careful planning and integration with other teaching strategies are crucial for effective gamification in education.

**Keywords:** Education, gamification, gamified applications, learning outcome

### INTRODUCTION

Gamification in education is an efficient method to increase student engagement and improve learning outcomes. It injects fun into the curriculum, fosters analytical thinking and problem-solving skills, and enables tailored instruction and teamwork. This innovative teaching approach is particularly relevant in the 21st century, which is characterized by digital and knowledge-based economies powered by rapid ICTs. "Gamification involves integrating game elements, such as competition and scoring, into non-game contexts, such as education. Interactive exhibitions can use gamification to attract visitors and enhance engagement, flow, and learning, particularly when multiple groups share the experience" (García-Jurado et al., 2021). "Gamification has been shown to have positive impacts on cognitive abilities, interaction, and prosocial behavior. Despite concerns, gamification has proven to be effective in the tourism and hospitality industry. Using gamification elements such as points, badges, and leaderboards can increase motivation and

engagement in learning environments” (Tobón et al., 2020). Popular gamification tools include Kahoot and ClassDojo.

### **Statement of the problem**

Gamification has been identified as a potential strategy for enhancing student engagement in educational environments. However, the effectiveness of this approach is influenced by a number of factors, including the specific characteristics of the students involved. Ascertaining whether gamified activities are achieving desired educational goals can be a difficult task. Additionally, the use of gamification tools and platforms can create differences in educational opportunities among students (Welbers et al., 2019). Although previous studies have focused on game-based learning applications developed by researchers exclusively for their research, the present study aims to evaluate the impact of gamification applications that have already been widely used by learners. This approach is anticipated to provide valuable insights into the effectiveness of gamification in educational settings.

### **Significance of the study**

The significance of studying gamification in education stems from its potential to transform teaching and learning experiences into more engaging, efficacious, and adaptable processes for diverse learners. This field continuously leads researchers and educators on a quest to leverage gamification's advantages for enhancing educational methods (Chen & Liang, 2022). Gamification in education is imperative for the advancement in an educational setting where the world is moving towards digitalization in every aspect. It is crucial to know how gamification influences the learners in terms of improvement in academics or personal skills. The study is significant because it aims to provide additional information on the importance of gamification in education.

### **Research Questions**

- R1. What are the types of gamified learning apps used?
- R2. What is the influence of gamified learning apps on education?

### **OBJECTIVES OF THE STUDY**

- To know the socio-economic background of the respondents
- To identify the type of gamified learning apps used by the respondents.
- To analyze the influence of gamified learning apps on education

### **HYPOTHESIS**

- H<sub>0</sub>- The influence of gamification applications on education is not affected by Age, Gender, Course and Year

### **LIMITATION OF THE STUDY**

Gamification in education has limitations in terms of its generalizability, duration, participant selection bias, and effectiveness based on various factors such as subject matter, student age, technology used, and limited resources. Additionally, external factors like home environment,

socioeconomic status, and student motivation can impact its effectiveness, making it challenging to isolate its effects.

## **REVIEW OF LITERATURE**

Numerous research studies have consistently proven the effectiveness of gamification in education for students, teachers, and parents. For instance, students tend to exhibit increased motivation, engagement, and knowledge gain when educational content is gamified. This is supported by the findings of Ebrahimi (2023) and Russell et al. (2023). Similarly, teachers have reported positive student engagement and feedback in response to gamified learning experiences (Ebrahimi, 2023). Parents have expressed a preference for educational games for their children, highlighting the potential appeal of gamification in learning (Ebrahimi, 2023).

E-learning platforms stand to benefit from the integration of gamification techniques, but it is essential to carefully select the appropriate elements and design approach. Common gamification elements such as points, badges, leaderboards, levels, and feedback have been widely recognized (Khaldi et al., 2023). Furthermore, deeper elements such as challenges and storytelling are gaining prominence in the gamification of educational content (Khaldi et al., 2023). It is recommended to incorporate motivational theories and gamification frameworks into the design process, and there is a growing emphasis on customization and personalization in gamified e-learning (Khaldi et al., 2023). While faculty members acknowledge the potential of gamification in education, they also face challenges in its effective implementation. Motivators include attracting attention, engaging in learning, motivation, and entertainment, while obstacles encompass time constraints, digital skills, technical issues, lack of resources, and indifference (Alzahrani & Alhalafawy, 2023). Research also suggests that careful design and consideration of context are vital for the success of gamification as an educational tool. It is advisable to share failures and lessons learned to inform future gamification efforts, and tailoring gamification to the specific context and target audience is essential for its effectiveness (Adams & Du Preez, 2021). Moreover, gamification's impact on learning may vary depending on factors such as learner familiarity with the topic (Rodrigues et al., 2021). Specific platforms like Kahoot! have been identified as effective tools for gamifying learning and increasing student enjoyment. Studies have demonstrated positive impacts on competitiveness, challenge, enjoyment, perceived usefulness, satisfaction, and individual impact associated with the use of platforms like Kahoot! (Wirani et al., 2022). Furthermore, combining gamification with flipped classroom approaches shows promise in fostering student engagement. For example, interactive gamified elements like e-quizzes can stimulate engagement, especially during online learning (Zainuddin et al., 2021). The integration of gamification in flipped classrooms has been linked to higher motivation, participation, and better learning performance (Ekici, 2021).

In summary, there is a growing body of research that supports the positive impact of gamification in education. However, careful design, consideration of context, and ongoing research are crucial to optimize its effectiveness.

## **METHODOLOGY**

### **Locale of the study**

The term "research locale" pertains to a specific area or subject being studied in a research project, also known as the study's setting. This encompasses both laboratory and field studies (Cloud,

2023). The location where the research was implemented was in Aizawl, Mizoram which is one of the states in India.

### **Population and Sample size**

“A population is the entire group of people or things being studied, while a sample is a smaller group that represents the population. The study population is the group of people or things that are available to study, which may be smaller than the entire population” (Bhandari, 2023). The population consists of undergraduate students from Aizawl, Mizoram. According to the *Department of Higher and Technical Education*, June 2023 report there are about 13 colleges in Aizawl specifically under the Government of Mizoram and the total population of the study was 12865 students which was then selectively sorted out. A sample size refers to the total number of participants in the study. “A sample count is frequently divided into subgroups based on demographic factors such as age, gender, and location to ensure that the overall sample truly reflects the entire population” (Testbook, 2023). The sample size for the study was 100 with an 8% margin of error and a 90% confidence level. (Indeed, 2023)

### **Research method**

Descriptive research designs serve as valuable tools in uncovering insights related to the who, what, when, where, and how of a research problem. Although they offer a wealth of information, they may not provide conclusive answers to the question of why. This approach is primarily used to gather data on the current state of phenomena and to describe variables or conditions within a specific situation. By identifying and analyzing what currently exists, this research is based on a descriptive survey-style design. “A purposive sampling technique was utilized and the criteria for selection was the gamification users. Purposive sampling is a method used in qualitative research to select a specific group of individuals or units for analysis. Instead of choosing participants randomly, they are selected intentionally and with purpose. This method is also known as judgmental or selective sampling” (Nikolopoulou, 2023).

### **Research Tool**

“The term research instrument/tool refers to any tool that you may use to collect or obtain data, measure data, and analyze data that is relevant to the subject of your research” (DiscoverPhDs, 2020). A self-structured questionnaire was employed for the study. “Questionnaires are lists of questions to gather data from the target group. It is mainly used in surveys to collect quantitative data” (Longe, 2023).

### **Reliability and Validity**

“Validity and reliability in research are distinct, but related concepts. Reliability refers to a study's replicability, while validity refers to a study's accuracy” (Carroll, 2022). The questionnaires were tested for Internal consistency reliability and validity, and Cronbach alpha for influence was 0.84 which is  $>0.70$  which is the required value, and face validity was carried out to validate the questions. The sample size was adequate for exploratory factor analyses, as confirmed by KMO (0.829) and Bartlett's tests ( $p=0.000$ ). These tests are used to measure the proportion of variance in variables that can be attributed to common factors and for checking correlation (necessary for factor analysis). Thus, the collected data was suitable for factor analysis in an academic setting. “Factor analysis is

an essential statistical procedure that is utilized to condense a vast number of variables into a smaller set of factors. This technique is critical as it simplifies complex data sets, making them more comprehensible” (Alkarkhi & Alqaraghuli, 2019). The correlation between questionnaire items and underlying constructs was tested. High factor loadings (>0.50) suggest strong correlation and good measurement. Factor loadings were also examined for significance using confirmatory factor analysis, and all average variance extracted values exceeded 0.50, indicating high reliability.

**Analysis of data:** Frequency, Percentage, Mean, Standard Deviation, Regression analysis

## **RESULTS AND DISCUSSIONS**

### **Socio-demographic profile**

A socio-demographic profile consists of social and demographic characteristics. Social characteristics relate to social status, while demographic characteristics relate to population statistics.

**Table 1: Socio-demographic profile**

**(n=100)**

<b>S.no</b>	<b>Content</b>	<b>Category</b>	<b>Frequency</b>	<b>Percentage</b>
1.	Age	18-20	54	54
		21-23	38	38
		24-26	8	8
2.	Gender	Male	58	58
		Female	42	42
3.	Course	Science	43	43
		Arts & Humanities	34	34
		Commerce	23	23
4.	Year	I <sup>st</sup>	30	30
		II <sup>nd</sup>	40	40
		III <sup>rd</sup>	30	30

The socio-demographic profile of the respondents can be seen from Table 1 which shows that 54 percent were aged between 18-20 which is the normal age range of undergraduate students (Reyes, 2023), and 58 percent were male which concluded the study of Jha (2023) which stated that there was more men enrolment in colleges of India. In terms of academic details, most of the respondents which were 43 percent were from a science background, 34 percent from arts & humanities, and 23 percent from commerce. About 40 percent of the respondents were in their 2<sup>nd</sup> year of college and 30 percent each from 1<sup>st</sup> year and 3<sup>rd</sup> year respectively.

### **Gamification details**

“Gamification is the use of game-like elements, such as competition, points, rewards, and challenges, in non-game contexts to motivate and engage people. It is often used in various fields, including education, marketing, employee training, and customer engagement, to make tasks or processes more enjoyable and interactive” (Dichev & Dicheva, 2017). Gamification leverages principles from game design and psychology to encourage desired behaviors and improve user engagement. Table 2 shows the type and features of gamification used by the respondents.



**Table 2: Types of Gamification**

(n-100)

S.no	Content	Category	Frequency	Percentage
1.	Encountered gamification in applications		100	100
2.	Features of gamification commonly seen	Points Systems	45	45
		Levelling Up	41	41
		<b>Badges and Achievements</b>	<b>50</b>	<b>50</b>
		Leaderboards	35	35
		Progress Bars	31	31
		Quests and Challenges	35	35
3.	Type of gamification used	Kahoot	16	16
		Duolingo	88	88
		Quizlet	34	34
		Byju's	79	79
		Khan Academy	48	48

The study Table 2 found that all respondents have encountered gamification in applications. According to the results, badges and achievements were the most common features, followed by points systems and leveling up. Duolingo was the most widely used gamification app, followed by Byju's. Other commonly used apps included Khan Academy, Quizlet, and Kahoot. These findings support a previous study by Bagdi, et al. (2023).

**Gamification Influence in Education**

**Table 3: Mean Score sheet**

Likert Scale	Interval	Difference	Verbal Interpretation
1	1.00-1.49	0.49	Highly Acceptable (HA)
2	1.50-2.49	0.49	Acceptable (A)
3	2.50-3.49	0.49	Moderately Acceptable (MA)
4	3.50-4.49	0.49	Fairly Acceptable (FA)
5	4.50-5.00	0.49	Not Acceptable (NA)

Table 3 depicts the mean score sheet on a Likert scale of 1 to 5, with a difference of 0.49 which is followed in Table 4; Table 4 shows the descriptive statistics on the influence of gamification in education.

**Table 4: Descriptive statistics of Gamification Influence in Education**

(n-100)

S. No	Statement	Percentage					Mean	SD	I
		SA	A	N	D	SD			
Gamification Awareness									
1.	Familiarity with Gamificatio in Education	13	23	44	14	6	2.56	1.07	M A
2.	Definition of Gamification in Education	10	51	25	8	6	2.49	.99	A

3.	Sources of Knowledge about Gamification in Education	17	43	27	9	4	2.40	1.00	A
4.	Experience with Gamified Educational Tools or Platforms	24	55	6	11	4	2.16	1.04	A
Impact of Gamification on the Learning Experience									
5.	Enjoyment and Engagement with Gamified Learning	7	33	46	8	6	2.60	.95	M A
6.	Effectiveness of Gamification in Enhancing Learning	11	25	43	16	5	2.61	1.04	M A
7.	Meaningfulness and Relevance of Gamified Learning	18	50	18	10	4	2.32	1.01	A
8.	Active Participation in Gamified Learning	14	23	40	15	8	2.63	1.14	M A
9.	Collaboration in Gamified Learning	16	56	22	4	2	2.20	.829	A
10.	Timeliness and Constructiveness of Feedback in Gamified Learning	23	37	23	13	4	2.38	1.09	A
11.	Identifying Strengths and Weaknesses through Gamified Learning	31	36	21	5	7	2.21	1.14	A
12.	Motivation for Learning through Gamification	26	36	25	4	9	2.34	1.17	A
13.	Information Retention through Gamified Learning	20	35	32	10	3	2.41	1.01	A
Effectiveness of Gamification in Enhancing Learning Outcomes									
14.	Applying Learned Knowledge and Skills in Real-World Situations through Gamification	15	53	21	6	5	2.33	.97	A
15.	Development of Critical Thinking Skills through Gamification	26	47	14	8	5	2.19	1.07	A
16.	Enhancement of Problem-Solving Abilities through Gamification	13	56	21	7	3	2.31	.89	A
17.	Nurturing Creativity Skills through Gamification	9	58	25	4	4	2.36	.85	A
18.	Overall Improvement in Learning Experience with Gamification	11	26	46	10	7	2.56	1.04	M A
Gamification Perceptions									
19.	Motivation and Goal Achievement through Gamification	17	41	34	5	3	2.36	.92	A
20.	Educational Benefits of Gamification	26	48	14	8	4	2.16	1.03	A
21.	Potential Drawbacks of Gamification	8	54	31	5	2	2.39	.79	A
22.	Factors Influencing the Effectiveness of Gamification in Learning	31	43	13	8	5	2.13	1.09	A
23.	Key Factors for Successful Gamification in Education	11	28	47	10	4	2.68	.942	M A

24.	Value of Gamified Learning in Enhancing Learning Outcomes	39	27	25	4	5	2.09	1.12	A
25.	Integrating Gamification with Effective Teaching and Learning Strategies	19	42	27	8	4	2.36	1.01	A
26.	The Transformative Potential of Gamification in Education	24	46	15	11	4	2.25	1.06	A
27.	Challenges of Implementing Gamification in Education	21	41	28	5	5	2.32	1.02	A
I- Interpretation A- Acceptable MA- Moderately Acceptable									

Table 4 presents the Descriptive Statistics of Gamification's Impact on Education, comprising 27 questions across 4 categories. The table displays the percentage, mean, standard deviation (SD), and the collective interpretation of the descriptive statistic. The outcomes are thoroughly examined, and it's important to note that "strongly agree" and "agree" were merged to create a positive affirmation towards the matter.

The study found that 44% of respondents were familiar with gamification in education. 61% agreed with the definition of gamification in education. Half of the respondents acquired their knowledge of gamification in education through research articles, online courses, or professional development workshops. About 55% of respondents reported having experience with gamified educational tools or platforms. Overall, the data indicates that respondents had a good awareness of gamified applications for education. the result support the study of Ekunola et al. (2022).

According to the Gamification Impact on the Learning Experience study, gamification can make learning more enjoyable, engaging, and effective. Around 46% of participants found gamified learning moderately enjoyable and engaging, while 43% found it moderately effective in enhancing their learning experience. Gamification also helped learners collaborate more effectively and retain information more effectively. Overall, gamification was found to be a useful tool for enhancing the learning experience.

Gamification skills and knowledge have a positive impact on learning outcomes. According to data, 68% of participants agreed with this assertion. Furthermore, 73% of participants acknowledged that gamification had enhanced their critical thinking abilities and 69% agreed that it had augmented their problem-solving prowess. Additionally, the use of gamification was found to have improved creativity skills for 67% of participants. However, further research is required to ascertain the prolonged outcome of gamification in learning.

The impact of gamification on learning outcomes depends on various factors. A majority of respondents reported that gamification motivated them to achieve their goals more effectively. Gamification can benefit education through increased engagement, motivation, and learning outcomes. However, over-emphasis on competition or rewards is a concern for some. Gamified learning is seen as a valuable tool for enhancing the learning experience, but it should be carefully implemented and integrated with other effective teaching and learning strategies. The study revealed

that gamification can foster engagement, motivation, and overall satisfaction with the learning experience, but its effectiveness hinges on careful implementation and integration with other effective teaching strategies.

**Hypothesis testing**

**Table 5: Testing of hypothesis (Multi regression analysis)**

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	26.11	2.263	-	11.536	.000
Age	.079	.792	.007	.100	.921
Gender	6.843	1.009	.472	6.784	.000*
Course	4.887	.633	.538	7.726	.000*
Year	.304	2.206	.021	.138	.891

\*-Significant

Table 5 shows the analysis of hypothesis testing. “Multi-linear regression estimates the relationship between independent and dependent variables. It helps researchers and data analysts model complex variable relationships and make informed decisions” (Bevans, 2023). A multiple regression analysis revealed that gender and course had a statistically significant influence on the impact of gamification in education. This means changes in gender and course can reliably predict changes in the influence of gamification in education, even when considering the effects of other variables.

**SUMMARY AND CONCLUSION**

The study found that the majority of respondents were male, Christian, and belonged to the scheduled tribe. 48% came from nuclear families and were predominantly middle-class. All participants reported encountering gamification in various applications, with Duolingo being the most popular gamification app, followed by Byju's. The most common gamification features were badges and achievements, points systems, and leveling up. Other frequently used features included leaderboards, progress bars, and quests and challenges. These findings corroborate the study conducted Bagdi, et al. (2023). The study found that gamification can be a valuable tool for enhancing learning outcomes and making the learning process more relevant and meaningful. However, careful implementation and integration with other effective teaching strategies are required for its effectiveness. The findings support the study of Ekunola et al. (2022) and Smiderle et al., (2020).

The reliability of the sample size was checked through KMO and Bartlett's tests before conducting factor analysis. All CR and CA values were above the recommended threshold of 0.70, indicating high reliability. Confirmatory factor analysis showed significant loadings and AVE values greater than 0.50, affirming item reliability. Multiple regression analysis was used to determine the impact of gamification in education based on gender, age, course, and year.. The results showed that gender and course had a statistically significant influence on the impact of gamification in education. This suggests that changes in gender and course can predict changes in the impact of gamification in education, even when considering other variables included in the analysis.

## SUGGESTIONS

Gamification can be a powerful tool to engage and motivate students, but it is important that it aligns with learning objectives and supports the learning process. To achieve this, it is recommended to use a variety of gamification features such as badges, points, leader boards, quests, and challenges. In addition, giving students timely and specific feedback and encouraging collaboration can enhance the effectiveness of gamification. However, it is important to use gamification in moderation, taking into account the needs of all learners. Therefore, careful planning and integration with other teaching strategies are crucial. It is essential to remember that gamification should not replace other teaching strategies, but be used as an additional tool to achieve better learning outcomes.

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## CHALLENGES AND OPPORTUNITIES ASSOCIATED WITH MICROFINANCE PROGRAMS AIMED AT WOMEN'S EMPOWERMENT

**Kritika<sup>1</sup> and Dr.Rajni Pandey<sup>2</sup>**

Department of Home Science,  
Magadh Mahila College, Patna University Patna-800001  
ritikathakur1713@gmail.com; vijay.rajni3@gmail.com

### ABSTRACT

This research paper investigates the importance of microfinance in encouraging women's empowerment is a critical aspect of its impact. Factors influencing women's empowerment, including education level and monthly income, were also explored. Microfinance participation emerged as the most significant factor, underscoring its critical role in enhancing women's empowerment, particularly among those with lower educational attainment. Microfinance participation shows a significant positive association with empowerment. The intersectionality of education and microfinance participation highlighted nuanced variations, emphasizing the importance of tailored interventions that consider the diverse needs and capacities of beneficiaries. Recognizing the transformative potential of microfinance, especially in regions with lower educational attainment, can inform more effective and inclusive policies and program design. By addressing disparities and fostering women's empowerment, microfinance programs can contribute significantly to gender equality and socio-economic development.

**Keywords:** Microfinance, Women Empowerment, Impact Assessment, Challenges, Opportunities

### INTRODUCTION

Women, especially in developing regions, have traditionally faced barriers to financial services and economic opportunities. Microfinance programs often prioritize women as clients due to their proven track record of repayment and their potential to utilize financial resources to benefit their families and communities. The concept of microfinance gained significant momentum in the 20th century, particularly through the pioneering work of individuals like Muhammad Yunus and institutionalisation of business of the Grameen Bank during 1970s in Bangladesh., The weaker section, particularly women, who failed to access to traditional financial institutions were main target beneficiaries of this institution aimed to provide small loans to give opportunity to develop to individuals. The success of the Grameen Bank and similar initiatives in other countries led to the broader acceptance and expansion of microfinance as a means of financial inclusion and poverty reduction. There is different action taken by the Government such as Regional rural bank; It was established to banking needs of rural population. Private sector lending; It provides a portion of the bank loans to different sectors such as agriculture given by the Reserve bank of India to the bank,

JanDhan ,Aadhaar and Mobile; It is based on digital technologies for banking, biometric identity and transactions.



### OBJECTIVES

1. To explore the effect of microfinance on empowerment of women in different regions considering cultural, economic, and social factors.
2. To identify the differential impacts of diverse microfinance models on empowerment of women.
3. To isolate the factor affecting the socio-economic status in relation to microfinance.
- 4.

### LITERATURE REVIEW

#### Literature Review Table:

Here is a table summarizing 7 relevant scholarly works on microfinance and women's empowerment:

Year	Authors/Theme	Key Variables	Key Findings
2016	Ghosh, J.	Financial literacy, empowerment	Financial literacy interventions within microfinance programs enhance women's financial decision-making capabilities.
2018	Mallick, D., Husain, Z.	Savings, empowerment	Women's participation in microfinance programs with a savings component leads to increased financial security and empowerment.
2019	Ahsan, A., Rahman, M. T.	Education, empowerment	Microfinance positively affects women's ability to invest in education, resulting in improved literacy and socio-economic empowerment.
2020	Ngo, T. L., Nguyen, H. V.	Rural women, entrepreneurship	Microfinance interventions in rural areas promote women's entrepreneurship, thereby enhancing their economic and social empowerment.
2021	Haider, Z.	Digital finance, women's agency	The adoption of digital financial services within microfinance contributes to women's agency and financial inclusion in the digital era.
2022	Kumar, A., Sharma, R.	Microfinance institutions, impact	An examination of the impact of different microfinance institutions on women's empowerment and economic outcomes.
2023	Ongoing Research (Author Names)	Varied	Ongoing studies addressing emerging aspects of microfinance and women's empowerment, exploring additional variables and nuanced findings.

### Identified Gap

The existing literature provides valuable insights into the strong correlation between microfinance and empowerment of women. However, there are several gaps that this research paper aims to address:

1. **Contextual Variation:** Many existing studies primarily focus on specific geographical regions or cultural contexts. This paper seeks to explore how the positive effect of microfinance on different sectors of empowerment of women.
2. **Long-Term Effects:** While previous research often captures short-term effects, there is a need to examine the long-term consequences of microfinance programs on women's empowerment. This research aims to provide insights into sustained empowerment and any potential reversals over time.
3. **Diverse Microfinance Models:** Microfinance encompasses various models, such as group lending, individual lending, and digital finance. This study aims to assess the differential impacts of these models on women's empowerment.
4. **Intersectionality:** The literature often treats women as a homogeneous group, but their experiences and outcomes can significantly vary based on factors like age, education, and socio-economic status. This research paper aims to explore the intersectionality of these variables in the context of microfinance.
5. **Emerging Technologies:** With the advent of digital financial services, there is a need to understand how these technologies influence women's empowerment within microfinance programs.

## RESEARCH METHODOLOGY

### Data Collection

Data Source Table:

Source	Description	Data Collection Method	Sample Size	Timeframe
Survey	Household surveys conducted across multiple regions in India	Structured questionnaires	300 households	3 Months
Interviews	In-depth interviews with microfinance beneficiaries	Semi-structured interviews	30 participants	3 Months

1. **Structured Surveys (Quantitative):** The primary data collection method involves structured household surveys conducted across diverse regions in India. These surveys aim to gather quantitative data on various aspects, including socio-economic characteristics, access to microfinance, women's empowerment indicators, and socio-economic outcomes. The sample size for the surveys is set at 300 households, ensuring a representative and statistically significant dataset. The timeframe for data collection will be specified in the research plan.
2. **In-depth Interviews (Qualitative):** To complement the quantitative findings and gain deeper insights into women's experiences, in-depth interviews will be conducted with approximately 30 microfinance beneficiaries. These semi-structured interviews will allow participants to share their narratives and perspectives regarding their involvement in

microfinance programs, changes in their lives, and the factors influencing their empowerment.

### **DATA ANALYSIS TOOLS**

For data analysis, the following tools and methods will be employed:

1. **Quantitative Data Analysis:** Statistical software, such as SPSS or STATA, will be used to analyze the quantitative survey data.
2. **Qualitative Data Analysis:** In this analysis software, such as NVivo. Thematic analysis will be employed to identify recurring themes, patterns, and narratives related to women's experiences with microfinance and empowerment.

### **RESULTS (SECTION 4)**

Our research in tabular format, providing explanations and interpretations for each table.

**Table 1: Factors Influencing Women's Empowerment**

Factor	Coefficient (p-value)
Microfinance Participation	0.83 (p < 0.001)
Education Level	0.17 (p < 0.05)
Monthly Income	0.22 (p < 0.01)

*Explanation:* Table 1 displays the regression coefficients and p-values of factors influencing women's empowerment. Microfinance participation shows a significant positive association with empowerment (p < 0.001), indicating its importance. Education level and monthly income also have significant positive effects on women's empowerment, albeit to a lesser degree.

**Table 2: Long-Term Impact of Microfinance**

Time Period	Women's Decision-Making Score (Mean)	Economic Empowerment Score (Mean)
Year 1	7.5	45.0
Year 5	7.8	47.2
Year 10	8.2	49.8

*Explanation:* Table 2 demonstrates the long-term impact of microfinance on women's empowerment. Over time, there is a noticeable increase in decision-making scores and economic empowerment scores among beneficiaries, suggesting that the positive effects of microfinance endure and may even strengthen over the years.

**Table 3: Intersectionality of Education and Microfinance Participation**

Education Level	Microfinance Participation	Women's Decision-Making Score (Mean)
Low ( $\leq 8$ years)	Yes	7.4
	No	6.3
High ( $> 8$ years)	Yes	8.2
	No	6.7

*Explanation:* Table 3 explores the intersectionality of education and microfinance participation. Among women with low education levels, those who participate in microfinance exhibit higher decision-making scores compared to those who do not. However, the impact is more pronounced among women with higher education levels.

These tables present a comprehensive overview of the research findings, highlighting the relationships between microfinance participation, women's empowerment, and other relevant factors. The results suggest a positive impact of microfinance on women's empowerment, with variations based on education levels and long-term effects.

## DISCUSSION

In this section, we analyze and interpret the results presented in Section 4, discussing their implications for microfinance programs and women's empowerment.

### Interpretation of Results

1. **Factors Influencing Women's Empowerment:** Table 1 reveals that microfinance participation, education level, and monthly income significantly influence women's empowerment. Microfinance participation has the strongest positive effect, followed by education and income.
2. **Long-Term Impact:** Table 2 demonstrates that the positive impact of microfinance on women's empowerment is sustained over time. This long-term effect suggests that microfinance programs contribute not only to immediate empowerment but also to its sustainability and potential enhancement.
3. **Intersectionality of Education:** Table 3 highlights the intersectionality of education and microfinance participation. It shows that microfinance positively impacts decision-making power of women across education levels, the effect is more pronounced among women with higher educational attainment. This indicates the importance of tailoring microfinance interventions to the specific needs and capacities of beneficiaries with varying education levels.

## CONTRIBUTION TO OBJECTIVES

These findings significantly contribute to achieving the objectives:

**To investigate the challenges and opportunities associated with microfinance programs aimed at women's empowerment:** The discussion of factors influencing women's empowerment (Table 1) and the sustained impact of microfinance (Table 2) shed light on the opportunities. Challenges may include addressing disparities in educational attainment (as seen in Table 3) and ensuring long-term program effectiveness. Overall, the findings provide a nuanced understanding of both challenges and opportunities.

### Implications for Microfinance Programs and Women's Empowerment:

1. **Policy and Program Design:** Policymakers and microfinance institutions should recognize the vital role of microfinance in promoting women's empowerment. Targeted interventions and support mechanisms should be designed to enhance the accessibility and effectiveness of microfinance programs, especially for women with lower education levels.
2. **Long-Term Focus:** Microfinance programs should adopt a long-term perspective, understanding that the effects of empowerment may take time to manifest fully. Ensuring continued support and engagement with beneficiaries can help maximize the long-term impact.
3. **Intersectional Approaches:** To address disparities in the impact of microfinance, a more nuanced approach is needed. Microfinance programs should consider the intersectionality of factors such as education, income, and geographic location when tailoring interventions to beneficiaries.
4. **Further Research:** While this study provides valuable insights, further research is necessary to explore specific programmatic elements and regional variations. Acknowledging the multidimensional nature of empowerment and the intersectionality of influencing factors is crucial in ensuring the success and sustainability of microfinance programs aimed at empowering women in diverse contexts.

## CONCLUSION

In summary, this research paper has sought to comprehensively examine the effect of microfinance on women's empowerment in context of India. Through a mixed-methods approach involving surveys and interviews, we have uncovered several key findings that contribute significantly to the understanding of this critical issue.

The implications of these findings are far-reaching. They underscore the vital role that microfinance programs play in fostering women's empowerment, particularly in regions with lower educational attainment and limited financial resources. Policymakers, microfinance institutions, and development practitioners should take note of the potential for microfinance to drive positive socio-economic change among women.

To harness this potential, interventions should be designed with a keen understanding of the diverse needs and capacities of beneficiaries, including education levels and long-term program engagement.

For policymakers, these results highlight the significance of supporting and expanding microfinance initiatives that target women in India and beyond.

In practice, microfinance institutions can use these insights to tailor their programs, ensuring that they are accessible and beneficial to women across varying socio-economic backgrounds and educational levels. By doing so, they can contribute not only to women's economic well-being but also to their broader empowerment, thereby promoting positive change in households and communities.

In conclusion, this research underscores the transformative potential of microfinance in empowering women and driving socio-economic progress. By recognizing the multifaceted nature of women's empowerment and considering the intersectionality of factors that influence it, we can work toward more effective, inclusive, and impactful microfinance programs that benefit women and society as a whole.

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## FOOD CONSUMPTION PATTERNS AMONG WOMEN TEA PLANTATION WORKERS- A STUDY IN SALKATHONI TEA ESTATE, ASSAM

Shikhamoni Gogoi<sup>1</sup> and Dr. T. Radha<sup>2</sup>

<sup>1</sup>Ph.D Scholar, <sup>2</sup>Assistant Professor

Department of Home Science Extension Education,  
Avinashilingam Institute for Home Science and Higher Education for Women

Coimbatore, Tamil Nadu

Email ID: sikhamg90@gmail.com

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### ABSTRACT

The eating habits of a community's residents have a big impact on the quality of life in that community. The types, quantity, and quality of food consumed are fundamentally referred to as dietary habits, and consumer demographics have a significant impact on these habits. This study examined the food consumption patterns and spending habits, both on food and non-food items, of female tea plantation workers in Salkathoni tea estate, Assam during the months of July and August in the year 2023. A purposive sample strategy was employed to select 100 women workers. A well-designed interview schedule was created to gather primary data via direct interpersonal interaction, while secondary data was acquired from journals, books, published papers, and websites. The study examined the dietary habits and spending patterns of female tea plantation workers in their everyday life. The study revealed that a significant majority of 22% of the respondents fell within the age category of 36-45 years. 54% respondents live in joint families. Educational levels are low, with 46% respondents are illiterate and 38% of the respondents attained minimal education. Most of the workers earn below 10,000 rupees per month. In terms of meal consumption pattern mainly consists of grains, pulses, and vegetables, with occasional non-vegetarian items. Cereals, pulses, and vegetables are daily staple food. Consumption of milk products, nuts, and green leafy vegetables are less common among the respondents. A substantial correlation between food and non-food consumption expenditures, with a significant relationship observed at the 1% level.

**Keywords:** Consumption expenditure, food expenditure, women tea plantation workers, meal pattern

### INTRODUCTION

Tea is a significant agro-industrial crop in India and serves as a major source of income through exports to other nations. The consumption of India tea is widespread, both domestically and internationally, due to its popular flavour. Based on data from the Tea Board (The Economic Times 2023), the CIS block countries maintained their position as the leading tea importers, with an increase in imports from 36.95 million kilogrammes during the first ten months of 2021 to 43.65 million kilogrammes over the same period in 2022. Although tea is a significant cash crop in



Bangladesh, the living conditions of the workers on the many tea estates are quite unpleasant. Despite limited opportunities, individuals are compelled to adhere to a traditional way of life as a result of intentional social isolation, poverty, lack of knowledge, and illiteracy (Ahmad et al., 2015).

The tea business offers substantial employment prospects in rural areas, notably for women, with more than 118,000 individuals employed as tea workers in this sector (ITC 2011). This sector plays a vital role in alleviating poverty in rural regions. The labour force necessary for the functioning of Bangladesh's tea industry mainly consists of individuals who are not from the local area. These individuals come from locations such as Assam, Bihar, Madras, Orissa, and other parts of India. They were introduced to Bangladesh by the Duncan brothers some 150 years ago. The majority of these workers are tribal individuals who experience social marginalisation (Redmond 2014; Alcock 2012). The majority of them are predominantly uneducated, marginalised, and socially isolated from the mainstream population (Hossain 2015). Although the owners are well acknowledged for their exploitation and deprivation, the workers' limited options for other employment beyond the tea gardens prevent them from addressing these problems (Pervin et al. 2011).

The dietary patterns of a community's inhabitants exert a significant influence on the overall well-being and standard of living within that community. The demographic characteristics of consumers have a profound influence on their dietary habits, which mostly pertain to the types, variety, and qualities of food that they consume (Saha et al., 2017). By utilising data on the types of food products ingested, their proportions in overall consumption, the frequency of intake, and their nutrient content, it is possible to generate comprehensive evaluations of household dietary patterns.

Dietary diversity is a commonly used indicator to evaluate the objectivity of healthy eating habits. It quantifies the range of different items included in a food basket. The studies conducted by Das et al. in 2022 and Mango et al. in 2014 are referenced. Dietary diversity refers to the range of foods, including those from different dietary groups, that can provide the necessary nutrients for maintaining optimal health (WHO 2017 and Ruel 2002). The level of dietary variability across households is a direct indicator of the quality of their diet, or how well a household's nutritional requirements are being fulfilled. A diet that incorporates a greater diversity of foods or food types is linked to increased consumption of nutrients and calories (Kant 2004, Rose et al. 2002, and Mohammed et al. 2017).

This research was aimed to assess the food consumption patterns of women workers in Salkathoni Tea Estates, Assam, who are employed in the Assam tea plantation.

## **OBJECTIVES**

The current study has been framed with the following objectives,

- To study the profile of selected women respondents
- To examine the food consumption pattern for the respondents
- To explore the association between family type and expenditure on food and non-food consumption of the respondents.

## **SCOPE OF THE STUDY**

Women comprise 50% of the tea plantation workforce, and our research focuses on the Salkathoni Tea Estates in Assam, India. We analyze the demographics, employment statuses, and roles of female plantation workers within a specific timeframe. Our mixed-methods approach, combining surveys, interviews, and observational data, reveals crucial insights into the food habits of these women. Understanding their food consumption patterns is vital for their nutrition, health, work conditions, and broader socio-economic dynamics. The study suggests potential policy recommendations and practical interventions to address food security and nutritional challenges among these workers. By improving their food security and nutrition, we aim to enhance their overall health. Additionally, our research sheds light on labor conditions and gender dynamics in the tea industry, better working conditions. Study respect and incorporate local traditions and culture in our interventions. Beyond the community, our findings have regional and local policy implications, promoting a sustainable tea industry and improving the lives of marginalized workers. This research is a crucial contribution to labor conditions, food habit, and food security discourse, with the potential to drive positive change in the tea industry and workforce well-being.

## **REVIEWS AND LITERATURE**

The research conducted by Hossain et al. (2017) examines the socio-economic position, food patterns, and nutritional condition of female workers in the Fulchara tea estate located in the Moulvibazar District of Bangladesh. A survey was carried out on a group of 96 specifically chosen female workers. The results show that 68.8% of them were unable to read or write, and 87.5% had a monthly income ranging from BDT 1501 to 2000. 83.3% of individuals did not consume meat in the previous week, making pulses the main source of protein. Based on the Body Mass Index (BMI), 64.6% of the individuals were classified as underweight. In addition, a mere 55.2% of individuals utilised hygienic latrines, but just 54% practiced proper hand hygiene by washing their hands with soap after defecation. While pregnant, 77.1% of women engaged in physically demanding work, and 85.4% gave birth at their residence. The study emphasises the unfavourable socio-economic situations, food patterns, nutritional status, and sanitation practices among these workers.

**Dave et al. (2019)** the study in Sabarkantha district, Gujarat, highlights the difficult conditions faced by tribal farm women in India. These women, playing vital roles as mothers, housekeepers, wage earners, and farmers, belong to one of India's poorest and least healthy groups. They rely mainly on local crops for food, which often leads to diets lacking in variety and essential nutrients. The research used BMI measurements and dietary assessments to reveal that many are illiterate, have low incomes, and suffer from poor nutrition, evident in their lower average height, weight, and BMI compared to other Indian women. The findings emphasize the urgent need for targeted efforts in education, economic support, and nutritional guidance tailored to their cultural needs to improve their health and well-being.

**Kumari (2013)** study on the food habits of 120 married rural women of reproductive age provides valuable insights into their dietary practices and nutritional challenges. The research highlights a predominant consumption of essential food items such as milk, ghee, curd/buttermilk, and pulses on a daily basis, aligning closely with recommendations for adult women's diets. However, notable deficiencies were observed in the intake of fruits, green leafy vegetables, and animal proteins like

eggs and meat, with only a small minority consuming these items regularly. This shortfall is attributed to economic constraints and a lack of awareness about balanced nutrition among rural women. Additionally, the study reveals that many women prioritize serving food to family members before eating themselves, potentially compromising their own nutritional intake. A significant percentage also reported infrequent access to quality food. These findings underscore the urgent need for educational interventions aimed at improving nutritional knowledge and promoting healthier dietary practices among rural women to enhance their overall safety.

### **METHODOLOGY**

The researcher conducted the study in the state of Assam during July and August, 2023, the Salkathoni tea estate was selected as the study area, since data showed that Upper Assam are predominantly found in larger number of tea garden in this part.

The Salkathoni tea estate was chosen from the Charaideo district in Assam. Out of the 54 tea estates in the Charaideo district, the Salkathoni tea plantation was chosen at random for the study. The study has a sample size of 100. Primary data was collected through interviews and observations. The major data collection involved conducting interviews using a face-to-face interaction approach with the respondents. The researcher collected secondary data from various sources such as journals, books, published papers, and websites. The data was gathered, categorised, and subsequently analysed using SPSS.

### **FINDINGS AND DISCUSSION**

The importance of food to human life cannot be overstated. It is regarded as an essential requirement for life. Foods give nutrients necessary for the production of the new substance as well as the necessary energy for the chemical reactions involved (Weininger et.al, 2022). People's food consumption is greatly influenced by their socio-demographic profile. With this context, the researcher attempted to highlight the socio-demographic traits of the chosen women tea workers from Assam in the current study. Table 1 displays the outcome.

**Table – 1 Socio-Demographic characteristics**

<b>Particulars</b>	<b>Variables</b>	<b>Percentage (In %)</b>
Age (In years)	Below 25	18
	26 – 35	21
	36 – 45	22
	46 – 55	21
	Above 55	18
Marital Status	Married	57
	Unmarried	32
	Other	11
Family Type	Nuclear	46
	Joint	54
Family Size	Small	28
	Medium	32
	Large	40

Education	Illiterate	46
	Schooling	38
	High Education	12
	Graduate	2
	Others	2
Monthly Income (In Rs.)	Below 10,000	29
	10,001 – 20,000	27
	20,001 – 30,000	19
	30,001 – 40,000	15
	Above 40,000	10

According to the respondents' age distribution, roughly 22% of them were between the ages of 36 to 45, followed by 21% of respondents between the ages of 46 to 55 and 21% of respondents ages 26 to 35. The analysis of the respondents' marital status indicated that approximately 57% of them were married, while 54% were residing in their family homes, suggesting a background of living in a joint household. This also caused them to fall into the large family background category, which was represented by 40% of the group sample. The respondents' educational backgrounds revealed that the 46% were illiterate, followed by 38% who had completed their education, indicating that the sample only possessed extremely minimal educational credentials. In terms of income, it was discovered that the majority made monthly below 10,000 rupees.

The majority of the participants in the sample were young adults aged between 36 and 45 years. A significant proportion of the respondents belonged to a younger age group, which suggests their inclination towards experimenting with new food patterns and consuming more food due to increased work demands. Additionally, the participants were predominantly married and preferred a joint family background with a large family size, as indicated by their social demographic characteristics. The majority of them were illiterate or had only received a very rudimentary education, and it was determined that there were earning monthly below 10,000 rupees. The majority of tea estates are situated in rural areas.

The study's main findings indicate a diverse age distribution among tea plantation workers, with a significant proportion in the 36-45 age range. The majorities of workers are married and live in either nuclear or joint families, with varying family sizes. Education levels are generally low, with a focus on basic schooling, and income disparities exist among workers and this was similar to the study made by Goduka and Das (2023). These findings emphasise the necessity of implementing specific measures to tackle issues related to education, income equality, and family assistance among the tea plantation labour.

The tea garden area has one of the lowest rates of literacy in Assam, especially among women and girls. Illiteracy or ignorance is impeding their daily existence. Due to the lack of proficiency in languages such as Assamese, Hindi, or English, the tea garden workers often face public shame and have difficulties in their daily communication. They are having trouble adjusting to the current technology world as a result of their illiteracy. They are unable to meet their most basic demands, such as completing bank or other government forms. People who work in tea gardens on low incomes frequently encounter difficulties in their daily lives. Tea Garden residents are missing out on opportunities to benefit from governmental programmes and efforts aimed at

their elevation because of their ignorance and illiteracy. This was comparable to a study by Sharma (2022), in which the researcher claimed that the socio-demographic background of women tea plantation workers affected how they performed at work.

### **Meal Pattern of the respondents**

Meal pattern refers to the overall profile of food and nutrient intake based on consistent eating habits. A comprehensive understanding of a population's food practices can be achieved by examining these meal patterns. Because the combined effects of the different nutrients involved would be more clearly detected, it may be more accurate at predicting the risk of diseases than the analysis of single nutrients or diets. Additionally, because dietary patterns are frequently linked to nutrient intakes, single-nutrient analyses may be complicated by their impact (Omage 2018). In light of this background information, the researcher endeavoured to ascertain the eating habits of the selected participants. The results are organised and presented in table 2.

**Table – 2 Meal Pattern**

<b>Particulars</b>	<b>Type of Meal</b>
Early Morning	Black tea/ biscuits/ laddoo/ pitha/ green tea
Breakfast	Jolpan/ rice, dal, bhaji/ chappati with sabji
Lunch	Rice, dal, bhaji, salad/ chutney, papad/ pickles, any non-veg item
Evening tea	Black tea/ milk tea/ cheera mixture/ but bhoja/ pani-pitha/ malpua/ pantua
Dinner	Rice, dal, bhaji, fish/ meat

The respondents' lunch patterns were discovered from table 2. Early in the morning, it was discovered that the respondents were drinking either black tea along with cookies, laddoo, or pitha. This was discovered to either change or maintain respondents' preferences. While they typically ate jolpan, rice with dal, or bhaji cooked from basic vegetables produced at home or bought from the market for breakfast, other people chose to have chapati with handmade sabji made from a variety of vegetables. The majorities of the vegetables used in their preparation originate from the neighborhood market or are homegrown. Their typical lunch consisted of rice, dal, and bhaji with a salad of their choice and chutney with papad or pickles. On the basis of their accessibility and persuasion, they were also discovered to be consuming non-vegetarian foods like chicken, mutton or fish. They once more liked black tea or milk tea with a cheera mixture for their evening tea, along with bhoja, panipitha, malpua, or panuta. Where the tea is a constant but the munchies vary dependent on the individual's taste and choice. They had plain rice for dinner along with dal, bhaji, and any meat or fish their family members preferred.

The observed meal pattern among tea plantation workers has both positive and negative health implications. On the positive side, it offers a balanced diet by incorporating a variety of food groups, including grains, legumes, vegetables, and occasionally non-vegetarian items, providing essential nutrients and energy necessary for the physically demanding work in the plantations. Additionally, the inclusion of vegetables, salad, and chutney contributes to fiber intake, promoting

digestive health. However, there are also potential negative health impacts to consider. The pattern may lead to a high carbohydrate intake, primarily from rice and grains, which could increase the risk of weight gain and related health issues if not balanced with adequate physical activity. The presence of processed foods like biscuits, laddoo, and papad introduces potential risks associated with excessive sugar consumption. Furthermore, the absence of fruits in the diet may result in a shortfall of essential vitamins and antioxidants. The health impact can vary based on individual dietary choices, cultural preferences, and portion sizes. To promote the well-being of tea plantation workers, it is essential to assess and, if needed, modify the meal pattern to ensure it aligns with a balanced and nutritious diet, taking into account both cultural considerations and the health needs of the workforce.

The meal pattern followed by tea plantation workers exhibits a certain degree of alignment with the dietary guidelines put forth by the World Health Organization (WHO). Notably, it embraces dietary diversity by incorporating a range of food groups, encompassing grains (such as rice and chappati), legumes (dal), vegetables (bhaji and salad), and, occasionally, non-vegetarian items like fish or meat. This diversity aligns with WHO's recommendation for a varied diet rich in nutrients and the findings also meets up the study of Nyhus, (2022).

As a result, their eating habits revealed that the respondents consistently drank tea and that their full meals consisted of chapati rice and a meat sabji.

**Consumption expenditure pattern of the respondents**

All living things, including humans, depend on consumption to maintain their existence. Consumption, however, has a dynamic aspect due to the shifting nature of human desires. Because there are differences in the environmental, social, economic, and cultural circumstances, consumption varies between societies. The consumption and spending habits of the tea workers' women were investigated, and the results are shown in table 3.

**Table – 3 Consumption expenditure patterns**

Variables	Daily	Weekly	Often	Occasionally
	(In %)			
Cereals	78	12	16	11
Pulses	96	21	19	12
Vegetables	87	23	18	16
Green Leafy Vegetables	36	28	36	45
Fruits	45	32	36	48
Milk and Milk Products	36	32	45	41
Nuts and Oil	25	45	48	38
Non-Veg	8	12	85	7

\*Multiple Response

The study analysed the consumption expenditures of the participants on a range of food items, such as cereals, pulses, vegetables, green leafy vegetables, fruits, milk and milk products, nuts and oil, and non-vegetarian foods including eggs, meat, and fish. The survey revealed that 78% of the respondents reported consuming cereal daily, whereas 96% of the samples indicated regular consumption of pulses, which was comparable to the consumption of vegetables (87%).

Conversely, milk and milk products, almonds, and oil were regularly consumed in people's diets, whereas only approximately 45% of individuals were observed to consume green leafy vegetables seldom. The participants incorporated non-vegetarian foods such as eggs, fish, and meat into their normal dietary intake. The study offers unique insights into the dietary patterns of the participants, highlighting the significant importance of cereals and pulses in their everyday meals. Additionally, it reveals that vegetables are consumed regularly, with occasional inclusion of green leafy vegetables and fruits. Although milk and milk products are not consumed as frequently in daily meals, they nevertheless constitute a substantial portion of their diets. Nuts and oil are consumed to a lesser extent, whereas non-vegetarian products are rarely eaten on a daily basis but are added sporadically. The findings reveal a varied and intricate dietary environment, underscoring the significance of comprehending and valuing the dietary preferences and choices within the community. These findings also provide a foundation for customised nutritional interventions aimed at improving overall well-being, which is also connected to Hajra (2021). Based on the respondents' consumption and spending habits, the majority of the sample's diet comprised of grains, pulses, vegetables, fruits, and non-vegetarian foods. The shower in this sample adhered to a well-balanced food regimen.

### **Consumption Expenditure**

The consumption expenditure of the sample respondents was given in table 4.

**Table – 4 Consumption Expenditure**

<b>Particulars</b>	<b>Variables</b>	<b>Percentage (In %)</b>
Food Consumption	Upto Rs.3000	10
	3001 – 4000	34
	4001 – 5000	38
	Above 5000	18
Non-Food Consumption	Upto Rs.3000	49
	3001 – 4000	23
	4001 – 5000	19
	Above 5000	9

According to the respondents' consumption expenditures on food, around 34% spent between 3,000 and 4,000 rupees per month on food, followed by 38% who spent between 4000 and 5,000 rupees. For non-food expenses including rent, transportation, health, education, clothing, and entertainment, about 49% of the respondents spent up to Rs.3,000 each.

As a result, the research revealed that the selected respondents' primary source of revenue is their food consumption.

### **Family Size and Consumption expenditure pattern**

Table 5 presents the correlation between family size and the consumer expenditure pattern of the sample.

**Table – 5 Association between family size and consumption expenditure pattern**

Variable		Mean	SD	f-value	.Sig
Food Consumption	Small	2.56	1.52	4.598	.000*
	Medium	2.98	1.69		
	Large	2.78	1.59		
Non-Food Consumption	Small	2.19	1.12	3.569	.001*
	Medium	2.36	1.26		
	Large	2.29	1.21		

Food consumption costs are significantly influenced by family size. Due to a significant link between food expenditure ( $p=0.000$ ) and nonfood expenditure ( $p=0.001$ ) at the one percent significance level, the current study demonstrated a high correlation between food and nonfood consumption among the selected respondents. This demonstrated that large families also have significant food consumption expenses. This was consistent with Basumathary's (2015) findings. The best way to define household consumption expenditure (HCE) is the amount of money spent by households on goods and services that are used for consumption, i.e., goods and services that are used to directly satisfy the needs and wants of each individual household member or the needs of the community as a whole, as opposed to being used for additional production transformation. There is a considerable association between family sizes and spending patterns.

### **SUMMARY, CONCLUSION AND IMPLICATIONS**

The study on Assam women tea plantation workers highlights the consumption patterns and nutritional habits of married women from joint families, typically aged over 25 years. They consume grains, legumes, vegetables, fruits, and often include eggs, meat, or fish. Most of the households spend for food between the ranges of Rs. 4000 to 5000 on monthly basis. The study indicates generally healthy eating habits among the tea plantation women workers. The researcher proposes the necessity of increasing awareness regarding the nutritional advantages of various grains and species in order to achieve better health results.

### **SUGGESTIONS FOR FUTURE RESEARCH**

To further enhance the well-being and health of women tea workers, it is recommended to implement a comprehensive awareness program focusing on the importance of diversifying their diets with various species and grains. This program should aim to educate and empower women about nutrition, emphasizing the significance of incorporating a wide range of foods to meet their dietary needs adequately. Here are some strategies to consider:

1. Nutrition Education Workshops: Conduct frequent training or seminars that are specifically customised to address the nutritional requirements and preferences of female tea workers. These sessions should cover topics such as the nutritional value of different foods, the benefits of diversifying their diets, and practical tips for incorporating a variety of species and grains into their meals



2. Cooking Demonstrations: Conduct cooking demonstrations where women can learn how to prepare nutritious meals using locally available ingredients, including different species of grains, legumes, vegetables, and fruits. Encourage them to experiment with new recipes and cooking techniques to make their meals more flavorful and nutritious.
3. Community Gardens: Establish community gardens or small-scale agricultural projects near tea estates where women can grow a diverse range of crops, including various grains, vegetables, and fruits. This not only provides them with access to fresh, nutritious produce but also promotes sustainable agriculture practices within the community.

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## ANALYTICAL STUDY ON HEALTH, NUTRITION AMONG SOCIAL NETWORKING USERS IN A SELECTED POPULATION

<sup>1</sup>Sinjitha.V and <sup>2</sup>Dr. R. Jansi Rani

<sup>1</sup>Ph.D. Scholar, <sup>2</sup>Assistant Professor,

Department of Home Science Extension Education,  
Avinashilingam Institute for Home Science and Higher Education for women,  
Coimbatore-641043.

Email Id:Sinjithasinjusingh@gmail.com

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### ABSTRACT

In social media people achieve many things by using social networking. Therefore, health problems may often occur in individuals who engage in social networking. Lifestyle changes may often affect health and eating habits. They may be an addition to daily life and may even be merged into the lives of some. They did not recognise the situation they had gotten into. Therefore, this study aims to analyse whether social networking activity affects the health and nutrition of the respondents in any way. The primary data was collected using face-to-face interaction, and the interview method was used. The study period runs from March 2022 to May 2022 in Nedumangadu Taluk of Thiruvananthapuram district, Kerala. The researcher collected data from the area at random and also suggested counselling and guidance needs for social networking users. The study resulted from social networking habits affecting the respondent's health and nutrition, such as tension and headaches in high social networking users. However, significant differences were found between health and occupation. They fail to make a balanced diet a complete part of their diet. It may lead to nutritional deficiency in the respondent.

**Keywords:** Health, Nutrition Status, Social networking.

### INTRODUCTION

The advancement of technology has changed the field of communication. People rely on social networking websites for communication and other activities. Social networking websites are a part of social media. Social media is a web-based service that helps individuals create a healthy profile, connect with others, and create and articulate content (Stewart, 2017). Most people have social networking websites like Facebook, WhatsApp, Instagram, Twitter, etc. There has been a massive expansion in communication technology adoption, and free accessibility attracts people (Müngen et al., 2021).

According to Merriam-Webster, health is defined as a person having a state of sound body, a good mind, and a good spirit. If want to have good health, must get proper nutrition. Proper nutrition is the foundation of a healthy body. Nutrition means the science of food. The nutrients and other factors, their action, interaction, and balance concerning health and disease: the processes by which the organism ingests, digests, absorbs, transports, and utilizes nutrients and disposes of

end products (Srilakshmi,2010). Whether food intake was proper or following a balanced diet, due to social networking, various health problems have emerged; many people's daily routines have begun to change: late-night chatting, late sleeping, sleep breaking, and so on.

Similarly, meal planning was changed when more time was spent on social networking activities. The food that should be eaten in the morning is eaten at another time. Sometimes, it may not be eaten. Due to this, nutrients were lost (Kolhar et al.,2021). According to David Lee (2022), he said that social media use leads to high levels of CRP, or C-reactive protein. Therefore, it may cause cardiovascular diseases and cancer, while high-level social networking use harms physical health due to increased screen viewing. All these could cause health problems in the future.

**Significance of the study:** The social media landscape has transformed the way people live in society. The use of social media has both positive and negative effects. Respondents' health study helps to gain insight into people's living conditions and solutions to issues.

## **OBJECTIVES**

The present study focused the below mentioned objectives:

1. To know the socio demographic profile of the respondents
2. To identify the social networking habituation of the respondents
3. To find out the health status and nutritional status of the respondents

## **METHODOLOGY**

Trivandrum district in Kerala is a technical hub. Therefore, the researcher selected Nedumangadu taluk for study. Through random selection, people between the ages of 18 and 42 who use social networking were found in the study. face-to-face meetings were conducted and 60 data were collected by using the interview schedule. Therefore, the interview method was used to find primary data. For collect secondary data, journals, books and Articles were followed. Percentage analysis and ANOVA test was used for data analysis and interpretation.

## **HYPOTHESES OF THE STUDY**

H0: There has no significant differences between health and occupation of the respondents.

## **RESULT AND DISCUSSION**

**Table-1: Socio demographic profile of the respondents**

<b>S.no</b>	<b>Aspects</b>	<b>Frequency (n=60)</b>	<b>Percentage (%)</b>
	<b>Gender</b>		
1	Male	20	33.3
2	Female	40	66.7
	<b>Age</b>		
1	18-24	16	26.7
2	25-30	32	53.3

3	31-36	4	6.7
4	37-42	6	13.3
	<b>Religion</b>		
1	Hindu	46	76.7
2	Muslim	4	6.7
3	Christian	10	16.7
	<b>Type of the family</b>		
1	Nuclear	56	93.3
2	Joint	4	6.7
3	Extended		
	<b>Educational qualification</b>		
1	Plus two	14	23.3
2	Graduation	26	43.3
3	Post graduation	20	33.3
	<b>Occupation</b>		
1	Student	22	36.7
2	Jobseeker	24	40.0
3	Home maker	2	3.3
4	Unemployed	12	20.0
	<b>Income of the family</b>		
1	Less than 1 lakh	34	56.7
2	1-2 Lakh	18	30.0
3	2-3 Lakh	4	6.7
	Above 3 Lakhs	4	6.7

Table 1 revealed the respondents' socio-demographic profiles. The table shows that most study participants (66.7%) were female. However, 33.3 percent of respondents were male. Most of the study's respondents (53.3 percent) were between 25 and 30. The majority, 76.7 percent of the respondents who participated in the study belonged to the Hindu religion. The rest were very few. Judging by the educational qualifications of the respondents from the table, 43.3% have completed graduation. But 33.3 percent of those who have passed post-graduation and 23.3 percent of those who have passed plus two were part of this study. When analysing the occupation of the respondents, it should understand that most of the people, 40 percent of the respondents, were job seekers. Here, 36.7 percent of respondents were students, 20 percent were unemployed, and 3.3 percent of respondents were homemakers. The majority, 93.3 percent, of the respondents belong to nuclear families. Significantly few people were in joint families. Regarding income, the majority of people, 56.7 percent, earn less than a lakh rupee.

Understanding Internet habits expands media behaviour models to include both automatic and habitual consumption patterns and active selection processes. It was assumed that problematic

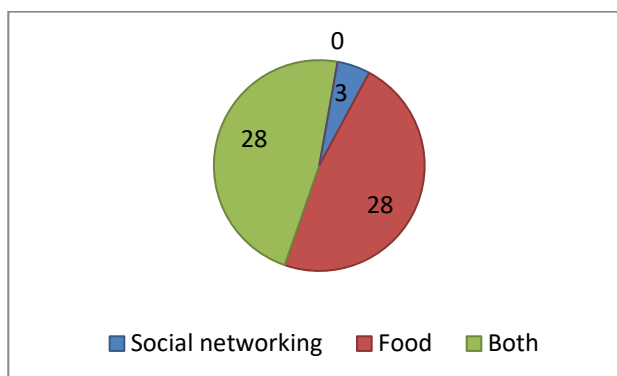
media habits were routines that had become uncontrollable (Larose et al.). Table 2- Social networking habit of the respondents

**Table-2: Social networking habit of the respondents**

S.no	Aspects	Frequency(n=60)	Percentage (%)
<b>Respondents daily social networking usage</b>			
1	Regularly	50	83.3
2	Not regularly	10	16.7
<b>Intervals where the respondent checks for social networking updates</b>			
1	In between the day	28	46.7
2	When ever need	20	33.3
3	Full time active	6	10
4	When they get time	6	10
<b>Time of the day respondents start using social networking</b>			
1	Late night to morning	2	3.3
2	From morning to late nights	36	56.7
3	Early morning	4	6.7
4	Mid night	4	6.7
5	When get time	14	26.7

Table 2 revealed three main things. This study discussed the habit of using social networking among the respondents. The majority of respondents, 83.3 percent, use social networking accounts daily or weekly. However, 16.7 percent of respondents had accounts but only used them occasionally. However, since social networking accounts were always accessible, the respondents checked the message notifications and information from them at intervals. 46.7 percent of respondents checked the updates they received between days; they were the majority. At the same time, 33.3 percent check the updates they receive only when necessary. But 10 percent of respondents were full-time active. As shown below, 10% of respondents only check their social networks when they have time. The amount of time spent on social networking was one of the most common, with 56.7 percent reporting that they spend time on social networking activities from early morning to late at night. However, 26.7% of the respondents spend time on social networking sites whenever they have spare time amidst all their busy schedules. But very few people found time for social networking in other ways. Although a small percentage, 3.3 percent of respondents' late-night to morning usage may cause health problems. However, those who used social networking in the early morning (6.7%) and late at night (6.7%) were in this group. The networking journey of those who use social networking from morning to late at night is the same. If not reduced, late-night usage must affect the physical and mental well-being of the respondents.

**Graph- I: Analysis the user priority in social networking or food.**



Graph-1 analyses the respondents' priorities toward social networking and food. Twenty-eight percent of the respondents prioritise their food only, while another 28 percent give equal importance to food and social networking. However, 3% of respondents only prioritised social networking. It was significantly less.

**Table-3: Analyse the differences of the respondents health status and occupation. Using \*ANOVA test**

S.no	Aspects	Frequency	Percentage	Mean	SD	F	Sig.
<b>Respondent getting proper sleep</b>							
1	Getting enough sleep	50	83.3	1.17	.376	74.667	*.000
2	Not getting enough sleep	10	16.7				
<b>Specified hour to get enough sleep</b>							
1	5 hrs	14	23.3	2.07	.733	51.649	*.000
2	6 hrs	28	46.7				
3	Above 6 hrs	18	30.0				
<b>Judging the breakfast on time</b>							
1	Morning 7 o'clock to 9	44	73.3	1.33	.601	69.827	*.000
2	Mid time	12	20.7				
3	Not having	4	6.7				
<b>Judging the avoidance of the dinner</b>							
1	Skip the dinner	6	10	1.90	.303	4.433	*.007
2	Do not skip	54	90				

Respondent dinner pattern after 12 pm							
1	Yes	22	36.7	1.63	.486	-	-
2	No	38	63.3				
Getting proper appetite on time							
1	Yes	48	80	1.20	.403	-	-
2	No	12	20				

\*Level of significance at 0.05.

The data examined the difference between social networking users' health and occupation. Two aspects have been used to evaluate the health status of social networking users—their food and sleep. Here, we can check whether most respondents were getting proper sleep. 83.3 % of the respondents said they were also getting proper sleep. However, 16.7% of respondents stated that they could not sleep properly due to their involvement in social networking. Here, ANOVA was used to test the differences between the job and occupation. The mean value = 1.17, SD = .376, F = 74.667, P < 0.005 = .000, then the p-value is less than the significant value. It was statistically significant and rejected the null hypothesis.

An average person should sleep 7-9 hours. Sleeping is a natural process that occurs in everyone. If sleep is reduced, it should harm the body. Sleep deprivation affects body function, including immunity, weight, and metabolism. Table 3 reveals how many hours social networking users sleep in a day. Most of the respondents (46.7 percent) above 60 % is majority received 6 hours. However, 30% of respondents slept for longer than 6 hours. But 23.3% of people sleep 5 hours a day. The results indicated that all respondents need to know the exact time they should sleep. Here, ANOVA was used to check whether there were any differences between those who could not complete a specified hour of sleep and their occupation. The mean value = 2.07, SD=.733, the F value = 51.649, and P< 0.05 =.000), where the P value was less than its significant value, it was statistically significant and rejected the null hypothesis.

Breakfast is something that comes after a long break after the evening meal. Based on this proper consumption need. The vast majority of respondents, 73.3%, eat breakfast between 7 and 9 a.m. But eating in the middle of the day was done by 20.7% of the population, and 6.7 % of the respondents needed to eat properly. Here, an ANOVA test was used to find the differences between the respondents' occupation and breakfast intake. The Mean value=1.33, SD=.601, F=69.827, P 0.05 =.000, then the p-value is less than the significant value, it was statistically significant, and hypothesis was rejected.

Food avoidance is often seen among social networking users. When asked how much importance they place on dinner, a majority of 90 percent of respondents stated that they would not skip dinner. But 10 percent skipped dinner. An ANOVA test was used to find the differences between the dinner avoidance of the respondents and their occupations. Then mean value =1.90, SD =.303, F value =1.90, p < 0.05 =.007, then the p-value less than the significant value. It rejected the null hypothesis.

When checking whether social networking users eat dinner at midnight, the majority was 63.3% of the respondents could judge that they do not eat dinner after midnight. Check whether they have felt the correct appetite. The majority of the 80 respondents had a healthy appetite. But 20 percent of the respondents said they didn't feel the proper appetite due to social networking.



**Table-4: Health problems experienced by social networking users**

S. no	Aspects	Frequency (n=60)	Percentage (%)
<b>Respondents had health problems</b>			
1	Yes	44	73.3
2	No	16	26.7
1	Sleep breaking	4	3.8
2	Eye strain	10	9.6
3	Head pain	16	15.4
4	Migraine	10	9.6
5	Neck pain	4	3.8
6	Joint pain	2	1.9
7	Back pain	14	13.5
8	Tension	28	26.9
9	Stress	10	9.6
10	Depression	6	5.8

**Multiple responses\***

Health issues experienced by social networking users are discussed here. Majority 73.3 % of the respondents revealed health problems due to social networking, but 26.7 % of respondents admitted they have no health problems. Here, the leading health problems faced by the respondents were assessed. Most of the 26.9% respondents also had tension—however, 15% experienced headaches. Then, Back pain (13.5%), eye strain (9.5%), migraine (9.5%), stress (9.5%), neck pain (3.8%), depression (5.7%), joint pain (1.9%) diseases were also seen among social networking users. All of the information and problems arising from the use of social networking would affect the respondent's mental state, causing tension. However, continuous usage and lack of sleep and rest can cause headaches. However, there were other health issues to watch out for.

**Table-5: Analysis of nutritional status of social networking users through balanced diet.**

S.no	Consume food item in daily diet (n=60)						
	Item	Every day F)	%	Sometimes F	%	Not consume F	%
1	Milk	20	31.7	18	12.7	20	31.7
2	Egg	6	12.7	44	68.3	4	6.3
3	Rice	50	79.4	10	15.9	2	3.2
4	Meat/fish	14	22.2	36	57.1	8	12.7
5	Vegetables	44	69.8	8	12.7	4	6.3
6	Fruits	10	15.9	32	52.4	20	31.7
7	Sugar and oil	12	19	24	38.1	26	41.3

**Multiple responses\***

Those who follow a balanced diet can maintain a healthy body, and the diet is a model of healthy food in the daily diet. A person with a balanced diet would have a robust immune system, and consuming fruits and vegetables would reduce the risk of illness. These foods were full of antioxidants. They also protect against inflammatory diseases by protecting the body's cells. Fish and nuts can support brain health. Likewise, a balanced diet with the proper amounts of vitamins, minerals, carbohydrates, protein, etc. was important (kerkar, 2017).

Table 5 revealed that 79.4 % of respondents said they have rice daily. However, 15.9 % of respondents have rice only sometimes, and 3.2 % do not eat rice at all. The vast majority of respondents (69.8 percent) consume vegetables daily. However, 12.7 % of respondents said they only eat vegetables sometimes, and 6.3% said they never eat vegetables at all. This table revealed that in the case of fruit consumption, most respondents (52.4 percent) had fruits sometimes only, but a tiny (15.9 percent) had fruits every day. However, 31.7 percent of respondents do not consume fruits. Other food, meats, and fish consumption by most respondents, 57.1% of the respondents sometimes consumed only. However, 22.2 percent of respondents said they consumed meat and fish daily. But 12.7 % of the respondents included fish in their diet. While evaluating milk consumption, the majority (31.7 percent) of the respondents eat the same daily, and another 31.7% of the respondents do not consume milk. However, 12% of respondents enjoy consuming it sometimes. Regarding sugar and oil consumption, 41.3% of respondents do not consume sugar and oil. 38.1% respondents consumed sugar and oil sometimes only. However, 19% of respondents consume it daily.

## **CONCLUSION**

The whole world uses social networking and seeks benefits. However, networking people's health status assassination is needed. Analysing the study, we found that social networking was a regular habit among the respondents. Most people can't avoid social networking. Constantly being updated, it was discovered that they were believed to be getting their sleep correctly. However, they were not getting enough sleep when considering the time spent on rest. They were unaware of the significance of sleep. However, the majority were those who gave importance to food. However, health problems were seen among social networking users, the main ones being tension and headaches and significant difference was found between health and occupation. Social networking users need to make a balanced diet a complete part of their diet was reduced the nutritional deficiency in the respondent.

## **FUTURE IMPLICATION OF THE STUDY**

A study will be conducted on user tension and mental health. Another is to find out whether such activities affect the user's brain development and learning, study more effectively to extend to a large population and a large sample size, and proper guidance and counselling will improve the user's health.

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## WOMEN FARMERS PARTICIPATION IN MARKETING ACTIVITIES ON VEGETABLES: ANALYZING THE MOTIVATIONAL FACTORS AND CHALLENGES CONFRONTED

Sushmita Deori<sup>1</sup>, Dr. S Rajalakshmi<sup>2</sup>

<sup>1</sup>Research Scholar, <sup>2</sup>Associate Professor

Dept. of Home Science Extension Education

Avinashilingam Institute for Home Science and Higher Education for Women,  
Coimbatore, Tamil Nadu, India

E-mail: sushmitadeori2@gmail.com

HSAI Membership No. <sup>1</sup>HSAI-2024-TN-1759-LF

### ABSTRACT

Women are largely involved in vegetable marketing, contributing substantially to generate additional income to support their families financially. The study was carried out in 2022 within the Barbaruah development block of the Dibrugarh District in Assam, and the primary focus was to comprehensively examine the participation of women farmers in marketing activities. In the context of women farmers marketing activities, the place of sale for their vegetable produce holds the highest mean value of 2.74, indicating its significant importance whereas, the time for harvesting has a lower mean value of 1.79, indicating it is less of a concern in comparison. The study identified motivational factors participating in marketing activities that depicts majority 96% of the women farmers mainly participate due to the 'Contribution for additional household income'. Remarkably, significant differences were observed between various age groups and the nature of marketing activities engaged in by these women farmers. All four selected attributes of women farmers showed a positive and significant relationship with motivational factors while participating in marketing activities, with a coefficient of determination ( $R^2$ ) of 0.794. The key challenges confronted by these women farmers, particularly revolving around intermediaries and traders in the marketing process was ranked I with a mean score of 6.16.

**Keywords:** Activities, Challenges, Farmers, Marketing, Motivations, Women

### INTRODUCTION

Women are essential contributors to agriculture, actively participating alongside men within farm families. They play a vital role and are heavily involved in cultivating crops, managing livestock and ensuring agricultural sustainability and productivity. From the initial stages of soil preparation to post-harvest activities and marketing, rural women play a crucial role, engaging with full passion and commitment (Satyavathi et al., 2011).

Despite their significant contributions, many rural women are unskilled, illiterate and bound by traditional roles, limiting their productivity. In many farming communities, women farmers are

driven to sell vegetables for several reasons, including the desire for financial independence and the need to support their families. Moreover, by engaging in vegetable sales, women often aspire to assume leadership roles within their communities. Through their entrepreneurial endeavors, they not only enhance their social standing but also exert influence in decision-making processes, thereby shaping community development initiatives and fostering positive change.

Even though their contributions are significant, they often go unnoticed and they face numerous challenges. These include societal restrictions, restricted mobility and time constraints which results in lower productivity compared to men. Despite these challenges, women farmers show remarkable determination and adaptability. They leverage personal networks, develop innovative marketing strategies and continually seek to enhance their farming knowledge. Addressing the challenges, women face in marketing forms the basis for advocating gender-sensitive policies. This analysis becomes instrumental in promoting equal opportunities and dismantling challenges that impede women's active participation in the agricultural sector. The full potential of women farmers can be unlocked to create a more inclusive and prosperous agricultural community.

The motivational factors that encourage women farmers for participation in marketing activities encompass the desire to achieve economic independence, generate additional household income and secure a better future for their families which contribute to local economic growth. By supporting women through training, exposure visits and group activities, women can be empowered to take on more significant decision-making roles in agriculture.

### **OBJECTIVES**

1. Investigate the Socio Demographic characteristics of Women Farmers.
2. Analyze the Marketing Activities adopted by the women farmers.
3. Identify the Motivational factors in adopting marketing activities among the women farmers.
4. Evaluate the Challenges confronted by the Women Farmers.

### **REVIEW OF LITERATURE**

Agriculture stands as a fundamental sector crucial for human survival, and the undeniable contribution of women. In both small and large-scale farms, women are essential contributors to food production, dedicating themselves to cultivating crops that sustains not only their households but also extending beyond local boundaries (**Gabriela Lozano, 2023**). Women represent approximately 43% of the global agricultural labor force (**Doss, 2011**).

**Swamikannan D et al, (2015)** stated that in the economies of many developing countries, including India, rural women form a vital part of the workforce. About four-fifths of women are economically active in the country are engaged in the agricultural sector.

**Monalisa Patra et al. (2018)** explained that in the agricultural sector, women serve as farmers, workers and entrepreneurs, which ensures the smooth operation and productivity of farms, forming the foundation of India's rural and agricultural economy. Even though women play a crucial role in farming and rural economies, their work often goes unnoticed and undervalued. In addition to women indispensable contributions to households and communities by supplying food, water and fuel, and tending to the needs of children, the elderly, and the ill, women also play a crucial role in agriculture. Women play direct or indirect roles in agriculture and related activities, with a primary

focus on vegetable production. The establishment of gender equality is vital for the development of a nation because it ensures that all individuals, regardless of gender, have equal opportunities to contribute to and benefit from the nation's progress. Acknowledging women's contributions and granting them access to knowledge, extension services, credit facilities, land, facts, resources, advanced technologies, and other innovations are crucial measures. These measures not only attract women to agricultural pursuits but also contribute to reducing poverty among women farmers

Achieving gender equity is essential for realizing sustainable development goals and ensuring the overall well-being of women and their families (C. Leigh Anderson, 2019). Despite constituting nearly half of the agricultural workforce comprises women in many developing nations, their production potential faces constraints due to barriers related to financial access, inputs, extension services and issues surrounding land ownership and rights (World Bank, 2018).

(Patil, Basavaraj, 2018) informed that women encounter various challenges that hinder their productivity and full participation in agricultural development. Obstacles such as limited mobility, a lack of information and gender-based discrimination often impede women in agriculture from accessing markets. Facilitating access to markets and providing market-related information can empower women to enhance their income, reduce reliance on subsistence farming and contribute significantly to economic growth.

## **HYPOTHESIS**

H01: There is no significant difference among age group with respect to marketing activities.

H1 : There is association between attributes i.e., Age, Marital status, Educational qualification and Income with the motivational factors for participation in marketing activities among the women farmers

## **METHODOLOGY**

### **Area Selection:**

The study focused on Rajabheta Gram Panchayat and Bagibill Gram Panchayat within the Barbaruah development block in the Dibrugarh District of Assam. Within Rajabheta Gram Panchayat, the study selected two villages, namely Bagibill and Tekela Chiring, and within Bagibill Gram Panchayat, two villages—Walkhabi and Lengapather—were chosen. This chosen area is characterized by conducive climate and soil conditions, especially suitable for crop cultivation, particularly in the domain of vegetable farming, establishing it a key vegetable-growing area in the district.

### **Sample Size:**

The study encompassed a sample size of 200 women vegetable farmers, with 50 women farmers selected from four villages using simple random sampling method.

### **Methods and Tools:**

The researcher employed methods such as face-to-face interactions and observations, utilizing a well-structured interview schedule as the primary tool. This schedule covered sections on socio-demographic aspects, adopted marketing activities, motivation behind involvement of marketing activities by women farmers and challenges confronted by women farmer in vegetable marketing.

**Data Analysis:**

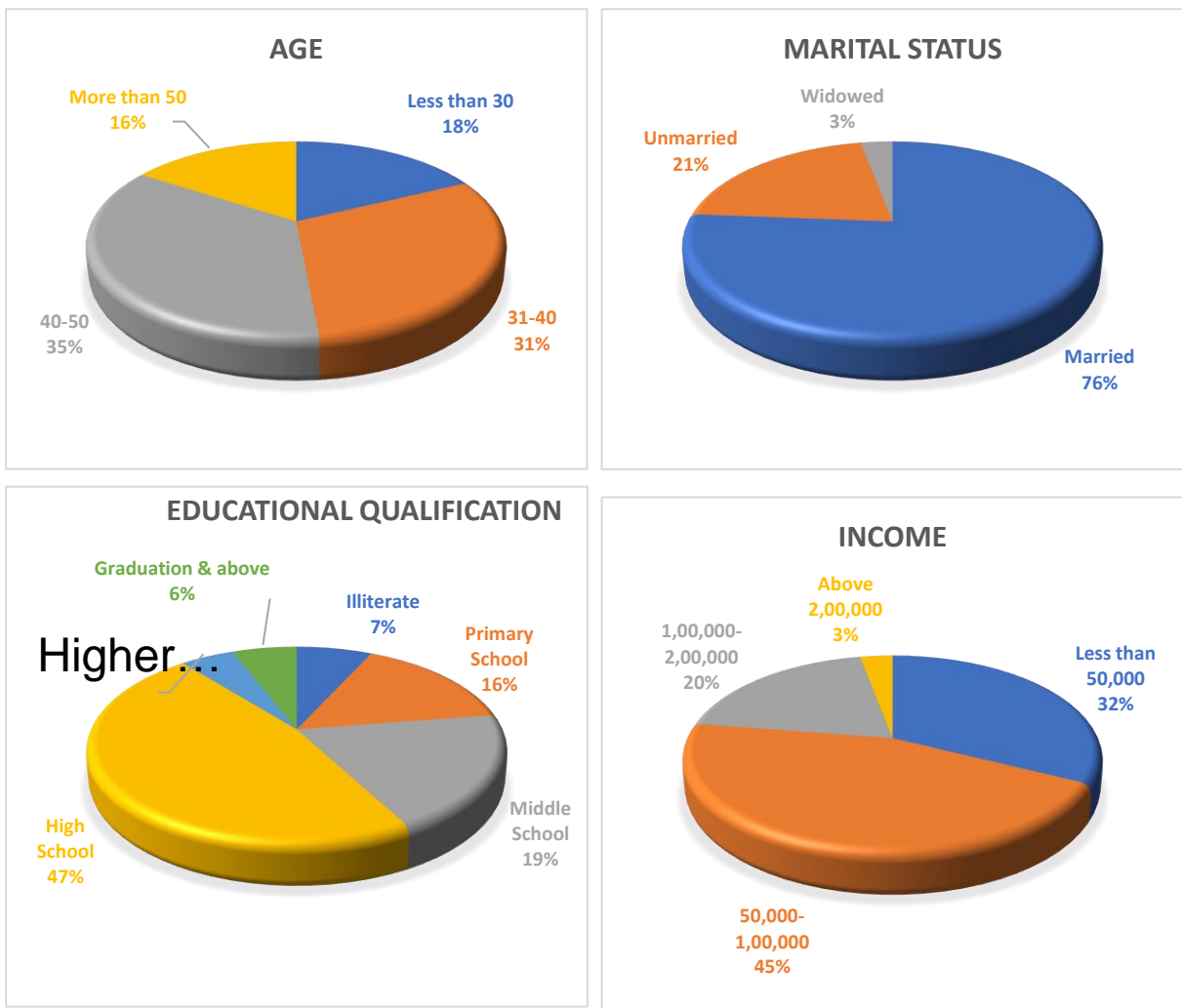
Following data collection, responses were analyzed in alignment with the study's objectives. Statistical methods, including frequency distributions, percentages, means, standard deviations one-way ANOVA tests, Correlation and Multiple Regression were employed to describe the study variables. The data underwent analysis using the Statistical Package for the Social Sciences (SPSS version 29).

**Study Variables:**

The Independent Variables chosen to examine the characteristics of rural women farmers include age, marital status, educational qualification, and income. Dependent variables encompass marketing activities, motivation behind women farmers' involvement in vegetable marketing, and challenges encountered by women farmers in vegetable marketing.

**FINDINGS AND DISCUSSION**

**Socio-Demographic Characteristics of the Women Farmers**



**Fig- 1 Socio demographic Characteristics of the farmers**

Regarding the age of farmers, the distribution reveals that 35 per cent of women farmers are in the 41-50 age group, 31 per cent falls in the 31-40 age group, 18 per cent are under 30 years, and 16 per cent are above 50 years. The diversity in age signifies a mix of experience levels, older women farmers bring traditional knowledge and skills, while younger ones may introduce innovative approaches. Examining marital status, the majority (76%) of women farmers, are married, while 21 per cent are unmarried, and three percent are widowed. Married women farmers actively participate in agricultural activities and have access to additional social support networks through their families.

Educational qualifications show that 47 per cent of women farmers completed high school, 20 per cent completed middle school, 16 per cent completed primary school, seven per cent are illiterate, six per cent have a graduation degree or above, and five percent completed higher secondary education. Educated women farmers inclined to adopt innovative and sustainable farming techniques, contributing to increased productivity and environmental sustainability. Income details indicate that 45 per cent of women farmers earn between Rs (50,000 and 1,00,000), 32 per cent earn less than Rs 50,000, 20 percent earn between Rs (1,00,00 and 2,00,000), and three percent earns above Rs. 2,00,000. These income disparities reflect different economic levels among farmers, a stable income ensures their financial well-being. Higher incomes provide women farmers with the capacity to invest in improved agricultural inputs, technologies, and training, leading to increased productivity and contributes to the overall economic development.

**Marketing Activities Adopted by the Women Farmers**

The marketing activities adopted by women farmers encompass various actions to promote and sell their agricultural produce are displayed in the table 1.

**Table 1. Marketing Activities Adopted by the Women Farmers**

S. No.	Marketing Activities	N=200			
		F	%	Mean	SD
<b>1</b>	<b>Time for Harvesting</b>				
	Dawn (4 am to 9 am)	111	56	1.79	1.088
	Dusk (5 pm and 7 pm)	54	27		
	Late evening (7 pm to 9 pm)	2	1		
Nighttime (10 pm and extending until 3 am)	33	16			
<b>2</b>	<b>Distance of market</b>			2.74	.585
	Within 10 kilometers	15	8		
	Between 11 and 20 kilometers	21	10		
	Between 21 and 30 kilometers	164	82		
<b>3</b>	<b>Place of sale of the Vegetables produce</b>			2.74	.796
	Within the Village	13	7		
	Local Market	56	28		
	Weekly Market	100	50		
	Distant Market	31	16		
<b>4</b>	<b>Details of sales to consumers</b>			2.18	.991
	Directly sales to consumers	54	27		
	Village-level intermediaries	85	43		



	Commission agents (Intermediaries)	32	16		
	Sales through Local shops	29	15		
<b>5</b>	<b>Storage for preserving of Vegetables</b>			1.98	1.307
	Household storage	123	61		
	Warehouses	7	4		
	Cooperatives store	21	11		
	Shared storage facilities near market	49	24		
<b>6</b>	<b>Package of Vegetables</b>			2.15	1.498
	Jutebags (Gunnybags)	112	56		
	Bamboo Baskets	23	12		
	Wooden Boxes	12	6		
	Polythene bags	30	15		
	Plastic trays	23	11		
<b>7</b>	<b>Transport used to carry the vegetables</b>			2.47	1.207
	Bicycle	56	28		
	Bike	58	29		
	Mini truck	22	11		
	Tempo	64	32		

Table 1 outlines about the marketing activities adopted by the women farmers. Regarding the Time for Harvesting, it shows highest fifty six percent of the farmers harvest vegetables in the dawn i.e. early morning (between 4 am to 9 am). This shows women farmers harvest early morning, indicating factors such as cooler temperatures or a strategic approach to ensuring freshness and quality of the vegetable for market sales.

Majority 82 % of the farmers predominantly sell their produce in markets situated within a distance ranging from 21 to 30 kilometres which may be associated with better economic returns and ease of transport for the farmers.

Place of Sale of the Vegetables Produce depicts fifty percent of the women farmers prefer selling their produce in the weekly market, potentially due to factors like increased foot traffic or better sales opportunities. About details of sales to consumers, it shows that forty three percent of the farmers sell to village-level intermediaries due to convenience and established relationships. Storage for Preserving Vegetables indicates that sixty one percent of the women farmers store at house which indicate limitations in external storage facilities for more immediate access to their harvested vegetables.

Fifty-six percent of women farmers prefer packaging their vegetables in jute bags (also known as Gunny bags) due to factors such as durability, affordability, or their eco-friendly nature which reflect environmental consciousness. Regarding the transport used to Carry the Vegetables it indicates thirty two percent of the women farmers preferred mode of transport for carrying vegetables is tempo due to suitability for smaller quantities of produce, accessibility in rural areas, cost-effectiveness for transportation.

H01: There is no significant difference among age group with respect to marketing activities.

**Table 2. Anova for significant difference among Age group with respect to Marketing Activities**

S.No.	Marketing Activities	N=200					
		Age (In Years)				F Value	P Value (Sig)
		Less than 30	31 – 40	41 – 50	More than 50		
		Mean & SD	Mean & SD	Mean & SD	Mean & SD		
1	Harvesting Time	1.00 (.000)	1.00 (.000)	2.44 (.857)	2.72 (1.464)	65.271	.000 **
2	Distance of market	3.00 (.000)	3.00 (.000)	2.28 (.796)	3.00 (.000)	34.796	.000 **
3	Place of sale of the Vegetables produce	3.00 (.000)	3.00 (.000)	1.86 (.487)	3.94 (.246)	380.428	.000 **
4	Details of sales to consumers	2.00 (.000)	2.21 (.410)	1.69 (1.260)	3.41 (.499)	33.555	.000 **
5	Storage for preserving of vegetables	1.00 (.000)	1.00 (.000)	3.66 (.559)	1.22 (.420)	746.483	.000 **
6	Package of Vegetables	1.00 (.000)	1.00 (.000)	3.97 (.956)	1.56 (.504)	341.115	.000 **
7	Transport used to carry the vegetables	4.00 (.000)	3.06 (1.114)	1.86 (.457)	1.00 (.000)	144.278	.000 **

1. The value refers to mean and within bracket refers to SD

2. \*\* denotes significant at 1% level

As the data in the table 2 shows that the P value is below 0.01, the null hypothesis is rejected at a significance level of 1% with regard to marketing activities and signifies that among women farmers, there are significant differences across age groups in their approaches to various marketing activities related to vegetable farming such as harvesting time, distance of market, place of sale of vegetables produce, selling details to consumers, Storage for preserving of vegetables, package of Vegetables and transport used to carry the vegetables.

Regarding harvesting time, distance of market, place of sale of the vegetables produce, storage for preserving of vegetables and package of vegetables it shows that there is no difference mean between less than 30 and 31-40 years but there is slight difference mean in selling details to consumers and transport used to carry the vegetables between less than 30 and 31-40 years. The age group between 41-50 years and more than 50 years shows that there is significant difference between the means of all the activities i.e harvesting time, distance of market, Place of sale of the Vegetables produce, selling details to consumers, storage for preserving of vegetables, Package of Vegetables and transport used to carry the vegetables.

The results suggesting that age groups have an influence on various marketing activities related to vegetable produce, as indicated by the significant differences in mean responses across different age categories and age plays a significant role in shaping how women farmers approach and execute their marketing activities. Younger farmers (less than 30 and aged 31-40) may exhibit different marketing practices and tendencies compared to those in the middle age (41-50) and older farmers (above 50). Women farmers do different activities compared to the men farmers with varying degrees of age have distinct strategies and preferences when engaging in vegetable marketing.

**Motivational Factors for Participation in Marketing Activities**

Participation in marketing activities for women in the vegetable industry can bring about several positive outcomes, contributing to both individual empowerment and the growth of the agricultural sector.

**Table 3. Motivational Factors for Participation in Marketing Activities**

S. No.	Motivational Factors	N=200			
		Yes		No	
		F	%	F	%
1	Contribution for additional household income	191	96	9	4
2	Based on own interest	174	87	26	13
3	Desire for financial independence	159	80	41	21
4	Encouragement from others (family, friends or other members)	152	76	48	24
5	Presence of Financial support	112	56	88	44

*\*Multiresponse*

Table 3. illustrates the motivational factors for participation in marketing activities by women farmers. The data indicates that majority (96%) of the women farmers primary reason for participation is the desire to contribute for additional household income. This emphasizes the economic importance of engaging in marketing activities as a method to improve the financial resources of families. Following, 87% of women farmers are engaged in marketing based on their personal interest as women farmers derive fulfilment and satisfaction from the marketing dimension of their agricultural pursuits, aligning economic activities with individual interests. While 80% of the women farmers expressed involvement due to the desire for financial independence which signifies women farmers' aspiration to achieve self-sufficiency by actively participating in the marketing domain and least fifty six percent of the women farmers involved due to the presence of financial support which shows the role of external financial support in participation of women farmers in marketing activities for the broader economic advancement.

**H1 :** There is an association between attributes i.e., Age, Marital status, Educational qualification and Income with the motivational factors for participation in marketing activities among the women farmers

**Table 4. Correlation Coefficient of Motivation behind Involvement of Marketing Activities with their selected Attribute**

S.No.	Attribute	Correlation Coefficient ‘r’ Value
1	Age	-.619**
2	Marital status	-.802**
3	Educational qualification	.272**
4	Income	.600**

\*\* denotes significant at 1% level

The study aimed to examine the association between various attributes of women farmers and their motivational factors for participation in marketing activities, as indicated by the zero-order correlation coefficients presented in Table IV. The analysis revealed that certain variables significantly impact women farmers motivations behind adopting marketing activities. **Age;** Age is a key factor impacting the motivations and decisions of women farmers when it comes to adopting marketing activities. Older women farmers tend to prioritize the preservation of family traditions and the maintenance of stability, while younger women are increasingly inclined towards embracing innovative marketing strategies to achieve economic independence. **Marital status;** Married women view marketing activities as a means to contribute to the household income ensuring a brighter future for their families. Additionally, being married provides them with decision-making flexibility and has the potential to mold the responsibilities, priorities, and individual aspirations of women farmers, shaping their approach to embracing marketing activities. **Educational qualification;** Educational qualifications play a crucial role in shaping the knowledge, skills, and confidence to exploring new avenues among women farmers. Education acts as a pivotal factor, broadening an individual's horizon of thinking and action. Consequently, it can be inferred that education is a highly critical variable in this context (Maratha, P., 2017). **Income;** For women with lower household incomes, the adoption of effective marketing strategies becomes a necessity for economic survival and livelihood enhancement. Resource full farmers with higher incomes may feel compelled to explore new technologies, aiming for both profit maximization and increased security.

**Table 5. Multiple Regression Analysis of Predictor Variables with motivational factors for participation in Marketing Activities among the Women Farmers**

S.No.	Attributes	‘b’ value	S.E. (b)	‘t’ value	Sig.
1	Age	-.668	-.416	-10.635	<.001
2	Marital status	-1.527	-.512	-11.187	
3	Educational qualification	-.339	-.259	-7.342	
4	Income	.684	.348	7.794	
<b>Multiple R2 (Coefficient of determination) = .794 **</b>					

Multiple regression analysis was conducted to determine the contribution of selected attributes i.e., age, marital status, educational qualification and income of women farmers with motivational

factors for participation in marketing activities. The study utilized motivational factors for participating in marketing activities as the dependent variable, while age, marital status, educational qualification, and annual income served as independent variables. Results from the regression analysis, as presented in Table 5, demonstrated that 79.40 per cent of the variation in motivations behind adopting marketing activities among women farmers was accounted for by these four attributes. A multiple R<sup>2</sup> value of 0.794, with a highly significant 'F' value, revealed the significance of the regression equation in predicting motivations. All four attributes—age, marital status, educational qualification, and income—showed positive and significant relationships with the motivational factors for participating in marketing activities among the women farmers.

**MAJOR CHALLENGES CONFRONTED BY THE WOMEN FARMERS**

The Challenges are barriers that affect the livelihoods, productivity, and well-being of women engaged in farming activities. The challenges confronted by the women farmers are presented in the table 6.

**Table 6. Major Challenges Confronted by the Women Farmers**

SL NO.	Challenges Confronted	Mean Score	Rank
1	Exploited by the middleman and traders	6.16	I
2	Non- membership of women’s group	3.57	II
3	Lack of cold storage and warehousing facilities	2.77	III
4	Limited access to information and communication technology	2.64	IV
5	High cost of input	1.35	V
6	Inadequate Banking and Credit facilities	1.22	VI
7	Lack of a proper transportation system	.72	VII

*\*Multiresponse*

Table 6 indicates the challenges confronted by the women farmers were assessed based on the mean scores. The highest mean score of 6.16 was attributed to the challenge of being exploited by middlemen and traders. This implies that unfair dealings and exploitative behaviour severely impact their agricultural activities, potentially affecting their income, market access, and overall autonomy in trade transactions. (Raahinipriya & Jansi Rani, 2018) The lack of institutional markets and the prevalence of private markets have facilitated the middlemen to flourish in marketing the product of the farmers.

Following the second highest challenge reported by these farmers was non-membership in women's groups with a mean score of 3.57, This indicates that the absence of membership in these groups was considered a substantial hurdle impacting their farming activities and Women's groups often serve as vital platforms for knowledge sharing, access to resources, and mutual support within agricultural communities. The lack of membership might hinder their access to crucial resources, support networks, and agricultural information, and impacting their overall agricultural productivity.

The third challenges confronted by the women farmers was Lack of cold storage and warehousing facility with a mean score of 2.77. As access to proper storage solutions is helps to preserve their produce, reducing wastage, and maintaining quality, all of which directly impact their economic returns and market participation.

## **SUMMARY AND CONCLUSION**

Women farmers participating in vegetable marketing are primarily motivated by the need to contribute additional income to their households and to pursue their individual interests. These motivations drive their active involvement in marketing activities, seeking financial stability and personal fulfilment. However, they face significant challenges that hinder their efforts. Exploitation by middlemen, non-membership in supportive women's groups and the lack of essential infrastructure like cold storage facilities are major obstacles that limit their effectiveness and profitability in the market.

The study conducted a multiple regression analysis, revealing a significant association between specific attributes—such as age, marital status, educational qualification and income and the motivational factors driving these women farmers. These attributes play a crucial role in shaping their motivations and participation in marketing activities. To address these challenges and enhance the participation and success of women farmers, the study emphasizes the need for targeted interventions. These include organizing workshops for skill development, promoting the adoption of relevant technologies, providing financial support, and fostering strong community networks. Such measures are essential to overcome the identified barriers and empower women farmers, leading to sustainable agricultural development in the region.

## **SUGGESTIONS**

- Conduct training cum capacity-building programs for the women farmers to improve their marketing skills and financial literacy
- Vegetable growers association for women should be strengthened in village level.
- Create platforms for connections between farmers and potential buyers (wholesalers, retailers and food processing companies).
- Educate farmers on digital tools usage to access market information and sell their produce online.

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## AN ERGONOMIC STUDY OF SITTING POSTURE OF STUDENTS IN CLASSROOM

**Dr. Aprajita kumari<sup>1</sup> and Arunima Rai<sup>2</sup>**

Assistant professor<sup>1</sup> and Research Scholar<sup>2</sup>

University Department of Home Science,

L. N. Mithila University, Darbhanga, Bihar

Email: aprajieeta@gmail.com<sup>1</sup> & triptirai35@gmail.com<sup>2</sup>

HSAI Life Membership Number: 15/PB/A-1/LF<sup>1</sup> & HSAI-2023-UP-1405-LF<sup>2</sup>

### ABSTRACT

Students tend to develop poor sitting postures as their class routine requires prolonged sitting on benches and chairs for attending lectures. Prolonged sitting in the classroom results in various types of musculoskeletal discomforts. The main reasons for developing musculoskeletal discomforts among students are inappropriate bench dimensions and poor sitting postures. The present study aims to identify the sitting postures of students while attending class, find out the effect of bad sitting postures on body part discomfort of the students and suggest measures to reduce musculoskeletal discomfort of the students while attending classes. The Target group of the study was the students of various departments of Lalit Narayan Mithila University, Darbhanga. The study was conducted with the help of a self-structured questionnaire, observation and still pictures. The collected data were coded, tabulated, and analyzed using various statistical techniques for drawing valid conclusions. Still pictures were analysed to study the posture of students while attending the class. Results revealed that around half of the students (52%) adopted the right sitting posture, whereas, the remaining half of the students (48%) were adopting poor sitting posture. Major reasons for poor sitting posture were their unawareness regarding sitting postures, habitual postures and lengthy classes as students tend to spoil their posture either in search of comfort or due to fatigue.

**Keywords:** Bench, Classroom, Ergonomics, Posture, Sitting

### INTRODUCTION

Students spend long hours a day sitting in their classroom without thinking about its impact on their bodies. They physically stress their bodies daily without realizing it by extending their wrists, slouching, sitting with crossed legs and stringing to look at boards either due to its placement or poor visibility. These practices can lead to cumulative trauma disorders or repetitive stress injuries, which create a lifelong impact on health. Symptoms may include pain, muscle fatigue, loss of sensation, tingling, and reduced performance.

Ergonomics is a field of study that attempts to reduce strain, fatigue, and injuries by improving product design and workspace arrangement. The goal of ergonomics is to provide comfortable and relaxed posture. Poor posture while working is a major cause of back and cervical pain. Workplace stress can lead to repetitive strain injuries. This can result in poor student health



and low morale which will ultimately lead to reduced learning and lost time which ultimately may affect higher education.

Many researchers report that working 5.41 hours sitting at a desk and 7 hours sleeping at night had a great impact on physical and mental health. According to government regulations such as the Kroemer & Grandjean (1997) Occupational Safety and Health Administration (OSHA) standards, an ergonomically fit workstation is required to decrease injury risk, increase productivity, have healthier vision and joints, reduce tension, and headaches, improve job satisfaction, work quality, and improved morale of workers.

We need an ergonomically fit and modular-designed lifestyle that is free from injuries and risks. There are a large number of facts and shreds of evidence desk ribbing the number of risk factors like repetitive strain injuries, awkward posture, forceful sitting on the bench and static posture which may lead to work-related musculoskeletal disorders (WMSDs). Dembe *et al.* (2005), and Strazdins and Bammer (2004) stated that WMSDs are the primary causes of absenteeism and disability. Garvan (1997), and Berge *et al.* (2002) reported that prolonged sitting in static posture results in pain in the neck, back, shoulder, wrist, prolapsed intervertebral disc, visual fatigue, and mental stresses. The correct posture not only maintains the natural curve of the spine but also minimizes stresses on the other body parts. Therefore, more emphasis should be given to adopting a correct sitting position in which the body weight is transferred to the supporting areas mainly by the ischial tuberosities of the pelvis and their surrounding tissues.

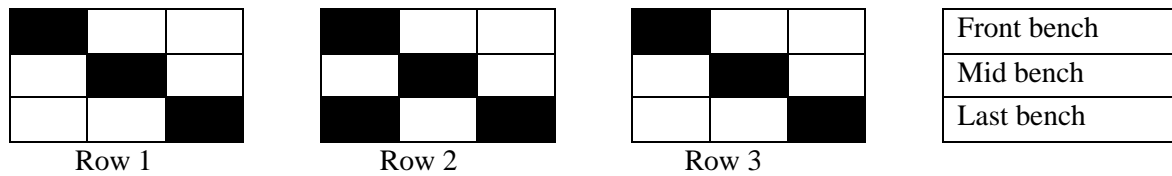
Seating on a chair is one of the most common positions adopted by humans. Matthews *et al.* (2008) epidemiological study in the United States report reveals that children and adults spend approx. 55% of their working hours or 7.7 hours/day are in sedentary postures. Keeping the above aspects in view, this study entitled “Effect of classroom environment of physical and mental stress of students and teachers “was taken up with the following objective:

- 1) To identify the sitting posture of students while attending the class.
- 2) To find out the effect of prolonged sitting on the body part discomfort of students
- 3) To provide suggestions to reduce the musculoskeletal discomfort of students while attending the class

## **METHODOLOGY**

**Locale of the study:** The study was conducted in 10 randomly selected postgraduate departments of Lalit Narayan Mithila University, Darbhanga. The lottery method was used to select the departments.

**Sample selection:** Ten students from each postgraduate department were selected making a total of 100 students. The selection of students was done with the help of systematic random sampling technique in which the pattern of selecting students is shown in Fig 1. There were three rows of benches in the classrooms. Three students were sitting on each bench. Students sitting on the first, mid and last bench were selected as shown in the figure. Darkened boxes represent the selected students for the study.



**Fig 1: Pattern of selecting students for the study**

**Data collection:** Questionnaires and still photographs were used to collect the data. The postural study was done 10 minutes before the end of class timing. The duration of one class was 50 minutes. Postural data were collected at the 40th minute of the class time. It was assumed that students generally sit in good posture at the start of class but after 40 minutes they get tired and tend to sit in awkward posture.

**Tools of data collection:**

- **Questionnaire:** For collecting the required information in light of objectives, Corlett & Bishop’s Body Part Discomfort Scale (1976) was used with slight modification to assess the type of musculoskeletal discomforts and identify the body parts facing discomfort due to prolonged sitting in the classroom. Additional body parts were added to the scale as per the response of the students.
- **Still Photographs:** Still photographs were clicked to analyse the posture of students while attending the class.

**FINDINGS AND DISCUSSION**

Data obtained from the field study, using the questionnaire and still photographs was tabulated, interpreted, and discussed for analytical purposes. The details of the results obtained are presented under the following major headings;

- **Section A:** Sitting posture of students while attending the class
- **Section B:** Effect of prolonged sitting on the body part discomfort of students
- **Section C:** Suggestions to reduce the musculoskeletal discomfort of students while attending the class.

**Section A: Sitting posture of students while attending the class**

Table 1 indicates the body posture of the postgraduate students while sitting in the classroom. Different body parts like back, legs, hands and neck were observed minutely to conduct the study. The result of postural variation of the back revealed that out of the total respondents, the maximum number of students (52%) were sitting in an upright posture, followed by the students sitting down with a well-supported back on the backrest (28%). A very small number of students were sitting in flexed back postures (12%) and slouching position (8.0%). In the language of ergonomics, it is said that back bending means back-breaking. Although the percentage of students sitting with awkward back posture was less, all of them were putting themselves at risk.

Among the observed two postural variations of legs, more than two-third of the students were sitting with parallel legs (68%), whereas the rest of them were sitting with crossed legs. Crossing the legs while sitting hampers the blood circulation as well as increases contact pressure which results in a lack of sensation, tingling and swelling of the legs.

Students were putting undue pressure on their wrists, upper arms and shoulder joints while attending the class. They were sitting with extended wrists with an extra load of their head and face (14%) on it resulting in an increased risk of developing musculoskeletal disorders of the wrist. Some of the students (8%) were leaning on the desk while attending the class. Leaning on the desk puts pressure on the upper arm, elbows, shoulder joint as well as spine, especially at the cervical region.

Generally, at the start of the lecture, students tended to sit in good posture but as the class advanced, they spoiled their posture. At the 40th minute of class duration, more than one-third (38 %) of students were sitting with flexed necks, around one-fourth (22 %) of them were sitting with extended necks and 18 per cent of them had bent their necks at either side while attending the class. Whereas, around one-fourth of them (23%) kept their neck straight till the end of the class.

The best posture while attending the class is sitting with a straight well-supported back, straight neck, parallel legs and arms either on the armrest or the lap or on the desk at an elbow angle being 90°. But very few of them were adopting this posture while attending the class. It was reported by the students that back and neck pain triggered after attending extra classes or back-to-back classes.

**Table 1: Sitting posture of students while attending the class**

Sitting posture of students*	Respondents (n=100)	
	Number of students	Percentage%
<b>Back</b>		
Upright posture	52	52.0
Well supported back on the back rest	28	28.0
Flexed back	12	12.0
Slouching	08	8.0
<b>Legs</b>		
Parallel legs	68	68.0
Crossed legs	32	32.0
<b>Hand</b>		
Extended wrists	14	14.0
Leaning on the desk	8	8.0
<b>Neck</b>		
Flexed	38	38.0
Straight	23	23.0
Extended	22	22.0
Bent sideways	18	18.0

Postural variation of students while attending the class is shown in plate 1 which displays the position of neck, back, legs and hands while attending the class.

Plate 1: Postural variation of students while attending the class



### Section B: Effect of prolonged sitting on the body part discomfort of students

Fig 2 depicts the effect of prolonged sitting on the body part discomfort of students. Sensations like tingling, pain and heaviness were included to assess musculoskeletal discomfort. The mean score was calculated for the discomfort level of different body parts reported by the students. It was observed that the highest discomfort was reported in the leg (1.18), followed by the shoulder (1.14), lower back (1.02), upper back (1.0), neck (0.91), and foot (0.90). The level of discomfort in aforesaid body parts was around 1 which indicates very mild discomfort. Other body parts like mid back (0.88), upper arms (0.87), buttock (0.83), thigh (0.83), lower arms (0.70), and wrist (0.69) were also affected to some extent.

Fig 2: Effect of prolonged sitting on the body part discomfort of students

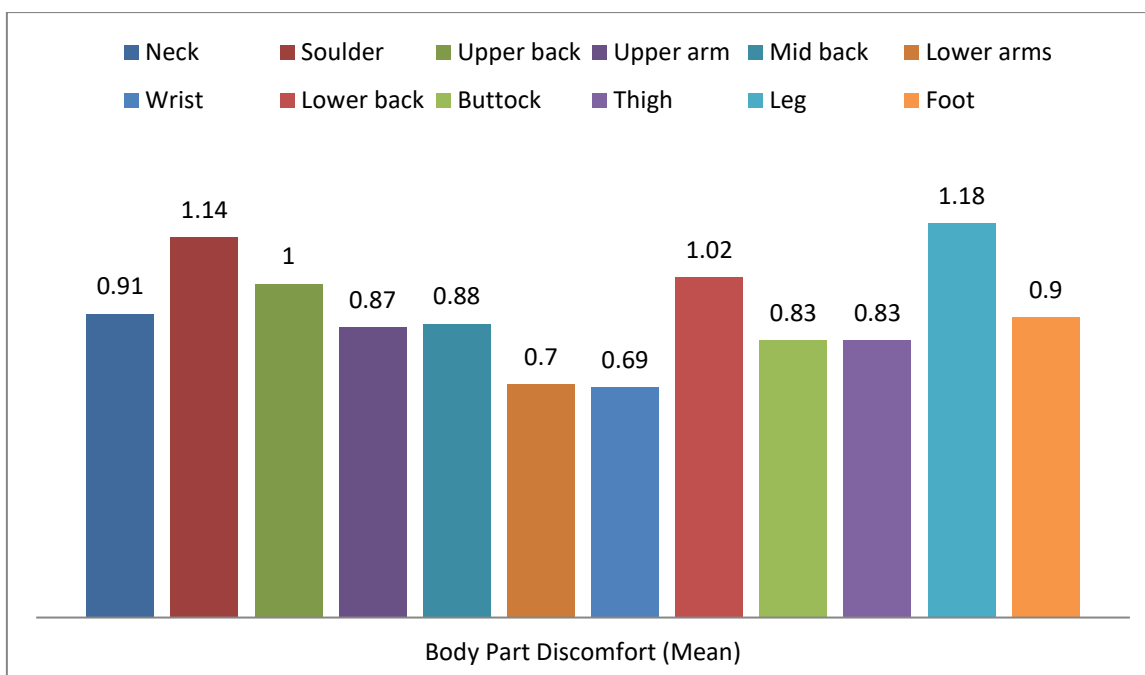


Table 2 reveals the number of students having discomfort in various body parts. It was observed that the maximum number of students had discomfort in the shoulder (63), neck (60), lower back (55), upper back (53), leg (49), foot (48), upper arm (48), buttocks (46), thigh (46), lower arms (45), wrist (45) and mid back (43).

The reason for the highest discomfort in the shoulders and neck may be the heavy weight of their bags or the wrong posture while sitting. Leaning on the desk puts pressure on the upper arm, shoulder, elbows and neck. Discomfort in the neck was also due to sitting with a bent neck on the side, flexion or extension to look at the board or habitual posture. The student’s back pain was due to improper positioning of the backrest of the benches. Pain, and /or numbness in the foot after prolonged sitting may be due to improper blood circulation or fluid build-up due to, being inactive, sitting for a long time, wearing tight stockings or jeans, or being overweight. Discomfort in arms was due to the lack of arms rest in their seats or extra pressure due to wrong sitting posture. The main reason for discomfort in the buttocks and thigh was the contact pressure due to continuous sitting while attending back-to-back classes.

Table 2: Affected body parts of the students due to continuous sitting in the class

Body parts	No of students (n=100)
Shoulder	63
Neck	60
Lower back	55
Upper back	53
Leg	49
Foot	48
Upper back	48

Buttocks	46
Thigh	46
Lower arms	45
Wrist	45
Mid back	43

\*Multiple responses

### Section C: Suggestions to reduce the musculoskeletal discomfort of students while attending the class.

Based on the above findings, some suggestions are given below that would help in reducing the musculoskeletal discomfort of the students while attending class:

#### Suggestions for students:

- Change sitting positions often.
- Take brief walks around the classroom
- Gently stretch muscles after every class to help relieve muscle tension
- Don't cross the legs, keep the feet on the floor, with ankles in front of knees.
- Make sure that feet touch the floor or if that is not possible, use a footrest.
- Shoulders should be at normal position, neither rounded nor pulled backwards.
- Keep elbows close to the body, they should be bent between 90 to 120 degrees.
- The back should be fully supported by a backrest to support the lower back curve.
- Thighs and hips should be well supported by the well-padded seat, and thighs and hips should be parallel to the floor.

#### Suggestions for institution

- Students should be provided with an Ergonomic sitting arrangement which has the following attributes:
  - Cushioned back support
  - Cushioned seat
  - Armrest
  - Proper height so that both of their legs rest parallelly on the ground
  - Arrange desk bench in better dimension
- A rest break of at least 5 minutes should be provided after each class so that students can stretch their body and walk in between two classes to relieve muscle tension
- To avoid the glare on smart boards, thick curtains should be placed on windows.
- The seating arrangement should be according to the height of students to avoid unnecessary bending of the neck and back.
- Awareness regarding right body posture and ergonomics should be generated with the help of workshops and training programmes.

## CONCLUSIONS

Students spend long hours a day sitting in their classroom without thinking about its impact on their bodies. A bad posture in the classroom usually begins when students sit for a prolonged period. A study on the subject revealed that around half of the respondents were identified with the right posture, whereas, the other half of the respondents adopted the wrong posture while attending the class. It was observed that in the classroom after attending class for 40 minutes, students tend to sit with awkward back posture, crossed legs, bent neck and extended wrists with an extra load of

their head on it. This resulted in the musculoskeletal discomfort of various body parts like the shoulder, neck, back, buttock and thighs. Body part discomforts were associated with awkward body posture, prolonged sitting and improper furniture. Based on the above findings, some suggestions are given for students as well as institutions that would help in reducing the musculoskeletal discomfort of the students while attending the class. A negative attitude towards the correct postures and not willing to adopt the same in activities of daily life is a serious matter of concern. Being habitual postures can have unhealthy effects on the health of college students shortly. Therefore, knowledge of ergonomics and the study of various postures are the needs of the present time.

### **SUGGESTION FOR FUTURE RESEARCH**

- Similar study can be done for comparing the postural discomfort of students in private and government institutions.
- Anthropometric measurements of the students of different regions can be taken for designing student specific classroom accessories.

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## NOISE SENSITIVITY, PERCEIVED IMPACT AND NEED BASED SUGGESTIONS FOR OVERCOMING NOISE DISTURBANCE IN INTERIOR DESIGN CLASSROOMS

**Himani Shah<sup>1</sup>, Kavita Shah<sup>2</sup>, Fatema Dahodwala<sup>3</sup> and Dr. Sarjoo Patel<sup>4</sup>**

Ph.D. Scholar <sup>1</sup>, Ph.D. Scholar<sup>2</sup> Ph.D. Scholar<sup>3</sup> & Assistant Professor<sup>4</sup>

Department of Family and Community Resource Management

Faculty of Family and Community Sciences

The Maharaja Sayajirao University of Baroda, Vadodara<sup>1,2,3,4</sup>

Email: himani.shah-fcrm@msubaroda.ac.in <sup>1</sup>, kavita.s-fcrm@msubaroda.ac.in <sup>2</sup>,

fatemaqahed@gmail.com<sup>3</sup> & sarjoo\_patel@yahoo.com<sup>4</sup>

HSAI Membership number: 13/GJ/S-5/LF <sup>1</sup>, HSAI-2023-GJ-1526-LF <sup>2</sup> & 12/GJ/P-2/LF <sup>4</sup>

### ABSTRACT

Noise pollution is considered a major problem in cities around the world. Noise is defined as undesirable sound. Environmental noise consists of all the unwanted sounds in our communities except that which originates in the workplace. Noise adversely affects general health and well-being in the same way as does chronic stress. It adversely affects future generations by degrading residential, social, and learning environments with corresponding economic losses. Therefore, it is essential to assess noise sensitivity, perceived impact and provide need-based suggestions for overcoming noise disturbance in classrooms. The research design was descriptive in nature. The data were gathered through questionnaire on a sample of 120 Interior designer students from Vadodara city selected through purposive sampling technique. The questionnaire contained three sections wherein, Section – I focused on the background information of the respondents, Section – II contained information regarding perceived impact of noise disturbance and its source, as experienced by the respondents and Section – III focused on level of noise sensitivity of the respondents using the Weinstein's Noise Sensitivity Scale (WNSS). The findings revealed that the noise levels in the classrooms were found to be on the higher side and so the respondents perceived the impact of noise to be higher. The perception of noise of the respondents was also influenced by their sensitivity to noise, as revealed in the present study. Thus, various corrective measures for reducing noise entering the classrooms and coping strategies for the respondents with noise sensitivity were suggested based on the results of the present research. The study would be beneficial to interior design students, architects, interior designer and educational institution.

**Keywords:** Classroom, Noise pollution, Noise sensitivity

### INTRODUCTION

Noise pollution is considered a major environmental problem in India caused by rapid urbanization, industrialization and development of infrastructure. Noise refers to the high sound levels created by people, of different sound generating sources causing physical and mental health



effects (Singh, N and Davar, S., 2004). The major causes of noise pollution in India are traffic, industries, construction, religious events etc. The impact on health of these noises is a major contribution in stress, disturbed sleep cycle, cardiovascular risks as well as on ongoing education.

These external noises have a disturbing influence on the academic performances of students. Some studies have indicated that prolonged exposure to noise has a negative impact on the attention span, overall cognitive abilities and reading and concentrating (Xie, H et.al., 2011). The physical environment around the educational institutions should promote the academic achievement, psychological health and overall behaviour of the students. According to Cohen, L. et.al., (1996) "Physical environment provides a frame for learning, it can also improve and prevent learning." Therefore, in order to promote healthy education, the surrounding environment should be calm, peaceful, healthy and quiet. According to Varis, F. (1998), "The school must have a physical structure that offers an effective communication environment in order to accomplish its goals." Increased levels of noise in educational institutions promotes lack of manners, discipline and signs of disrespect.

### **Noise Assessment in Educational Institutions**

According to the Noise Pollution (Regulation and Control) Rules, 2000, a 100-meter area around educational institutions is designated as "Silence Zone" with lower permissible noise levels as 50dB during daytime and 40dB during nighttime. However, measurements carried out to measure noise level near educational institutions were found to be higher than the permitted limits. A study conducted in Assan by Debnath. D, et.al., (2012) found that the noise levels in the educational institutions were significantly higher than the recommended limits. The causes of noise around were found to be vehicle traffic (46%), students (40%), trespassers (9%), construction workers and other sources of noise (5%). According to Kumar et.al., (2013), the traffic passing by the educational institutions with parks nearby showed high levels of noise pollution. In Pakistan, a study was conducted by Farooqi et al., 2019, revealed that the noise levels around educational institutions were found to be 97 dB, which is much higher than the permissible limits of 50 db.

### **Noise and Teaching Learning Process**

Noise is a sign for a person's or society's overall physical and mental health and stability. It is widely acknowledged that noise exposure above a certain level - depending on its intensity, frequency, duration, and individual susceptibility - can harm human health and thus must be controlled. Much attention is needed in educational institutions for students to concentrate in their studies and to be mentally present with full alertness during the lectures. Overcoming noise from out-sources affects the education of the students. The effects of noise entering the classrooms in educational institutions also has impacts on students' physical health, psychological health, physiological health and class performance. Overcoming noise also reduces the performance and productivity by causing tiredness, loss of concentration and attention, less focus and sometimes sleepiness and weakness. It is necessary to keep the classroom noise level within a specific limit. According to Avsar, Y. and Gonullu, M., (2000) "Any noise level that exceeds determined limits negatively affects the quality of education and teaching by leading to the following adverse consequences:

- Masking of the speech and reduction in perception capability,
- Loss of psychological and physical attention,
- Longer duration of learning by reading,
- Bad temper and less interest in lessons among students,

- Teachers raise their voices due to noise and thus getting tired in a short period of time.

According to Ismail et.al., (2015), students suffer from several complexities like decreased attention, social adaptability and increased opposite behaviour compared to other people because of exposure to elevated noise levels. Overcoming noise has a negative impact on the students reading and concentration levels, problem solving strategies, and learning memory. It has been reported by Obot. O, & Ibang. S, 2013 that, noise pollution in colleges results in annoyance, lack of concentration, speech interface, stress, low productivity, increased absenteeism and other negative effects on the overall education of the students. The learning environment of students has a big influence on their learning outcomes, and noise has been found to be one of the main things that distracts students, makes it harder for them to focus and pay attention, and gives them physical and mental stress.

In order to reduce the noise in educational institutions, any obstacle working as a noise barrier should be included around the premises. If the educational institutions are built on a busy road, a wide buffer zone is to be considered. According to Kumar, M. et.al. (2022), Educational institutions should have criteria of good planning for an institute and it should be located away from main road, busy PWD roads and further noise sources, buildings should have acoustic insulation system and high fence using RCC walls which protects outside noise from entering, should be know about plantation of trees and vegetation buffer zones, as trees and vegetation can absorb 4dB to 6dB of noise intensity based on their characteristics and restricting vehicular passage within or nearby the educational institutions by applying speed limits for vehicles around the educational institutions.

Several studies were conducted on the outdoor noise levels from the different workplaces of the Arati steel plant of Odisha, the assessment of hearing loss among school teachers and students exposed to highway traffic near Jalgaon city, the occupational exposure in 13 stone crusher industries located at Seragarh, Nilgiri, Remuna, and Mitrapur with special reference to noise and noise pollution in Silent zones, dearth of researches were found specifically for Interior design classrooms. As much concentration was needed for students to design, draft and generate new ideas and solutions in interior designing it is necessary to identify the sources of noise disturbance in interior designing classrooms, assess the noise sensitivity of the students and to suggest corrective and coping strategies to reduce the noise entering in the classrooms. Therefore, the present study was undertaken to fill the gap of assessing and evaluating the noise sensitivity of the students in interior designing classrooms and to suggest coping strategies.

## **OBJECTIVES**

1. To record the level of noise entering the classrooms of the Interior Design wing.
2. To identify the sources of noise disturbance experienced by the respondents in the classrooms of Interior Design wing.
3. To study the perceived impact of noise entering the classrooms by the respondents.
4. To assess the noise sensitivity of the respondents.
5. To suggest corrective measures for reducing noise entering the classrooms.
6. To suggest coping strategies to respondents with high noise sensitivity.

## METHODOLOGY

The present study focused on describing various characteristics of the selected population in relation to noise disturbances. Thus, this research was descriptive in nature. The locale of the study was Interior Design wing of selected institute of Vadodara city. The unit of enquiry were students of Interior Design course. A sample size of 120 respondents was selected from population size of 160 Interior Design students based on their willingness to participate in the study. Purposive sampling technique was used for the present study. A record sheet was prepared to report the noise-levels in the classrooms Interior Design wing, using a Sound Level Metre (Lutron Electronic SL-4001). The noise levels were recorded at three different times of the day (10:00 am, 01:00 pm and 03:00 pm) in every classroom, with ceiling fan kept “on” and “off”. This was based on the class schedules of the Interior Design students. A questionnaire was developed to collect data from the respondents regarding noise sensitivity, perceived impact of noise and its sources as experienced by the respondents. It comprised of three sections wherein, Section – I focused on the background information of the respondents. In Section – II information regarding perceived impact of noise disturbance and its sources, as experienced by the respondents, were collected. Section – III focused on level of noise sensitivity of the respondents using the Weinstein’s Noise Sensitivity Scale (WNSS). It was a unidimensional self-report measure of noise sensitivity, created by Weinstein in 1978, to assess individual variances in noise sensitivity. The scale consisted of twenty-one items that measured emotional responses and attitudes towards everyday ambient noises as well as general noise (Worthington, 2017).

## FINDINGS

The study revealed the following results:

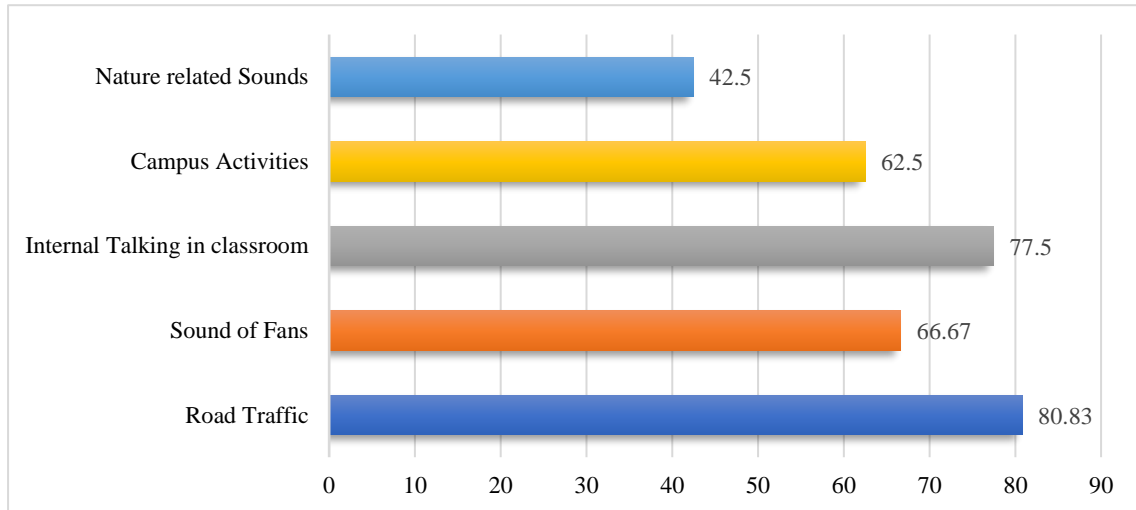
1. Level of Noise entering the classrooms of the ID wing: The Noise Levels in the classrooms of the ID wing were recorded for the present study, at selected time points in the working day and with the ceiling fan kept “On” and “Off”. The data revealed that overall average Noise Level was 79.10 dB in the ID wing. The average Noise Level with the ceiling fan kept “On” was 80.59 dB and with the ceiling fan kept “Off” was found to be 77.62 dB The Noise Level in ID wing ranged between 70 dB to 88 dB The average Noise Levels were found to be higher at 01:00 PM (Table – 1). The World Health Organization (WHO) recommends that noise exposure levels should not exceed 70 dB over a 24-hour period, and 85 dB over a 1-hour period to avoid hearing impairment<sup>(1)</sup>. Silence zones have been established surrounding courts, hospitals, and educational institutions that are at least 100 metres in radius. During the day, these zones should not have noise levels higher than 50 db.

**Table – 1 Average Noise Levels at different Time Points**

Time Points	Average Noise Level with Fan “On”	Average Noise Level with Fan “Off”
10:00 AM	80.54 dB	77.15 dB
1:00 PM	80.92 dB	78.23 dB
3:00 PM	80.31 dB	77.46 dB

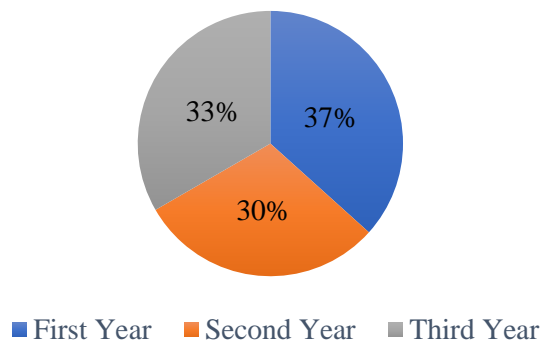
2. Sources of noise disturbance experienced by the respondents in the classrooms of ID wing: The findings revealed that more than 50.00 percent of the respondents found Campus Activities, Internal Talking in classroom, Sound of Fans and Road Traffic to be the major sources of noise disturbance experienced in the classroom (Fig. – 1).

**Fig.-1 Sources of noise disturbance experienced by the respondents.**



3. Perceived impact of noise entering the classrooms by the respondents:

3.1. Background Information of the respondents: The background information i.e. age, gender, and year in the graduate programme of the respondents was collected. It was found that the mean age of the respondents was 19.47 years. 84.17 percent of respondents were females and 15.83 percent were male. It was revealed that more than one-third of the respondents were from first year and third year level of the graduate programme (Fig. – 2).



**Fig 2: Distribution of the respondents as per their Year in Graduate Programme**

3.2. Extent of Perceived Impact of Noise: The findings revealed that 27.50 percent of respondents perceived the impact of noise to high. 25.00 percent of respondents perceived its impact to be low (Fig. -3). The questions related to impact of noise included aspects related to perceived sources of noise in the classroom, classroom defects, lack in concentration, creative block, stress, headaches, and annoyance. A 3-point scale was used with response structure, “Always”, “Sometimes” and “Never”.

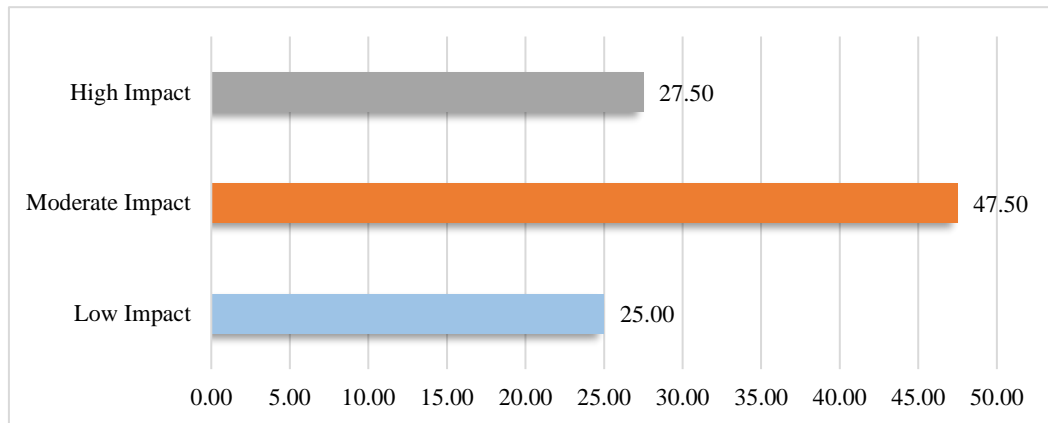


Fig. - 3 Extent of Perceived Impact of Noise by the respondents

4. Noise sensitivity of the respondents: The noise sensitivity of the respondents was computed for the present study using Weinstein noise sensitivity scale (WNSS). The WNSS comprised of 21 statements to which the responses were collected as “Strongly Agree”, “Agree”, “Undecided”, “Disagree” and “Strongly Disagree”. It indicates higher noise sensitivity when the score of WNSS is higher. The data of the said study revealed that the average score of the interior design students was 71.81. The noise sensitivity score of the selected sample ranged between 52 to 93. 46.67 percent of the respondents scored higher than the average noise sensitivity score. Fig – 4 reveals that 23.00 percent of the respondents had Higher sensitivity of noise.

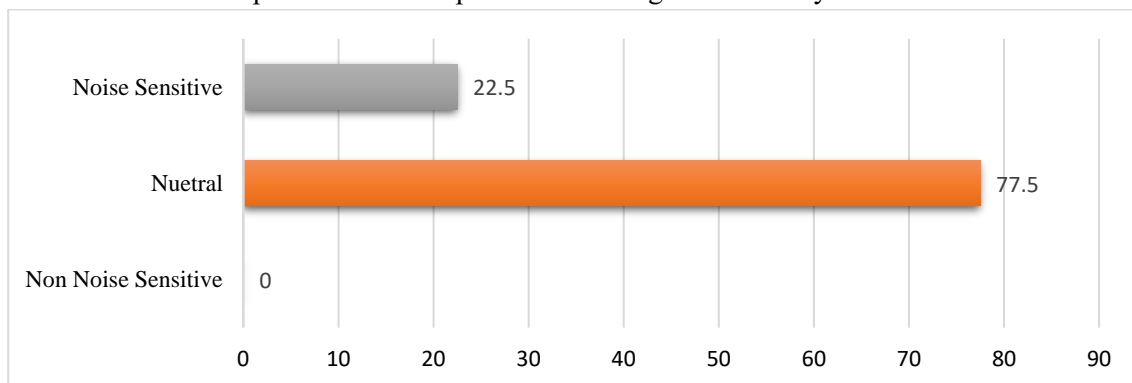


Fig. – 4 Distribution of the respondents as per Noise Sensitivity scores (WNSS)

Corrective measures for the classroom to reduce noise disturbance



Plate 1: Existing windows of the classroom



Plate 2: Suggested soundproof windows seals.

In the existing windows of the classroom there were more space between the windows and window frames from which the outdoor noise was entering so to minimize the outdoor noise in the classroom, the researchers suggested to place rubber pads on the window's edges and proprietary anti vibration mounts.



Plate 3: Existing door of the classroom



Plate 4: Suggested soundproof door seals.

As shown in the plate 3 the existing doors of the classroom, there were space below the bottom of the doors from which the outdoor noise was entering inside the classroom therefore to minimize the noise from the outsource, the researchers suggested to place a door seal on the bottom of the door.



**Plate 5: Existing black board wall**



**Plate 6: Suggested sound absorber panels near the black boards.**

As shown in the plate 6 the researchers suggested sound absorber panels near the black boards, which will help to absorb noise in the classroom.



**Plate 7: Existing windows**



**Plate 8: Suggested Soundproof Curtains**

As shown in the plate 8 the researchers suggested soundproof curtains, which will help to reduce the movement of the sound waves travelling through windows in the classroom.



**Plate 9: Existing walls of the classroom**



**Plate 10: Suggested Soundproof paint on the walls of the classroom**

As shown in the plate 10 the researchers suggested soundproof paint, which will aid to reduce sound reflections and transmissions in the classroom.

**Suggested coping strategies for the interior design students:**

- Using noise-cancelling headphones which help to turn down the volume and block out external sounds.
- To plant more trees as they are good noise absorbents, and it reduces the noise by 5 to 10 decibels Db around them.
- Use headphones or earplugs to protect your hearing and reduce exposure to loud noises.
- Maintain and regularly service machinery and equipment to minimize noise emissions.
- Implement noise-reducing measures such as acoustic panels or sound-absorbing materials in architectural and interior design areas.
- Encourage responsible behaviour, such as avoiding unnecessary honking or loud music in public spaces.
- Promote the development and use of quieter technologies and appliances to reduce noise pollution.
- Controlling human activities like minimum use of loudspeakers or amplifiers and repeated honking in traffic areas.
- Hanging curtains and blinds on the windows, which can be used to help to absorb the noise occurring in the classroom.
- Adding soft tips to the bottoms of furniture can decrease indoor noise significantly.
- Hanging various materials on the walls of the Educational Institutes corridors or using different materials to absorb the noise, noise could be prevented and the noise in the classroom could be reduced.

The present study would be beneficial for the interior design students and will help to reduce the noise level, disturbance experienced and the noise sensitivity. Thus, various corrective measures were suggested for reducing noise entering in the classroom of interior design wing of higher



education institution and the coping strategies were suggested for the respondents with noise sensitivity based on the results of the current research.

## **CONCLUSION**

The present study was undertaken to record the level of noise entering the classrooms, identify the sources of noise disturbance experienced, perceived impact of noise entering the classrooms and noise sensitivity of the respondents. The findings discovered that the noise levels in the classrooms were found to be on the higher side and so the respondents perceived the impact of noise to be higher. The perception of noise of the respondents was also influenced by their sensitivity to noise, as revealed in the current study. Thus, various corrective measures for reducing noise entering the classrooms and coping strategies for the respondents with noise sensitivity were suggested based on the results of the present research.

## **IMPLICATIONS OF THE STUDY**

- For Interior Design students: Findings of the present study will be useful to the students of Interior Design to understand issues related to noise disturbance and coping strategies to be adopted for such issues.
- For Interior Designers/ Architects: Through the present study, the Interior Designers and Architects will understand impact of noise disturbance on occupants of a space and will be able to give solutions for the same.
- For Educational Institutions: The results of the present study will be helpful to educational institutions in designing and providing better classroom experience to their students in context of noise levels in the classroom and impact of noise disturbance.

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## HOUSEHOLD COMPOST: A SUSTAINABLE WAY OF TRANSFORMING KITCHEN AND GARDEN WASTE INTO ORGANIC FERTILIZER FOR RESIDENTIAL GARDEN

**Dr. Khyati Trivedi**

Temp. Assistant Professor, Department of Family and Community Resource Management, Faculty of Family and Community Sciences, The Maharaja Sayajirao University of Baroda, Vadodara, Gujarat, India  
E-mail: khyati.doshi-ihmct@msubaroda.ac.in  
HSAI Membership No.: HSAI-2023-GJ-1568-LF

### ABSTRACT

As the world's population grew, urbanization and industrialization grew, the consequent massive amount of garbage of all types grew beyond the limits of humans posing a serious dilemma of managing this huge amount of waste. This necessitates efforts such as reducing waste generation to lessen the negative consequences and challenges associated with solid waste disposal and disposing waste in a way that allows for resource recovery through recycling. Major waste generation at household level is bio-degradable waste, which can be minimized by taking proper measures. One such measure is preparing household compost from the bio-degradable waste generated in the kitchen and garden. Household compost is a great substitute for the chemical fertilizers available in the market. Using household compost is an incredible means to grow healthy and nutritious organic vegetables and fruits in one's own garden. Researchers were keen on collecting data related to the knowledge of the homemakers regarding household compost, with an aim to solve the issue of management of solid biodegradable household kitchen and garden waste. The major objective of the present research was to assess the extent of knowledge of the respondents regarding the household compost. A descriptive research design was considered the most appropriate. The locale of the study was Vadodara city. The unit of inquiry were the homemakers. Those homemakers having their own garden and who gave consent for the study were purposively selected as sample. The total sample was 200 homemakers residing in Vadodara city. The data collection tool for pre and post-test was questionnaire. Data analysis was done using descriptive statistics. The knowledge of the respondents regarding the household compost was divided in four different categories, namely, benefits of household composting, types of household composting, materials for household composting and process and preparation of household composting. Major findings of the study showed that 46 per cent of the respondents were in the low score category having low extent of knowledge regarding the household compost. One of the objectives of the present research was to conduct an intervention program for the respondents' for improving knowledge regarding the household compost. The purpose of the intervention program was to give more information and motivate the homemakers to prepare the household compost at their home with kitchen and garden waste and to resolve their queries through one-on-one interaction.

**Keywords:** Compost, Waste, Sustainable, Homemaker

## **INTRODUCTION**

India faces a truly formidable challenge in managing the rapid process of urbanization and the growth of its cities (Ballaney, 2008). Due to rapid rise in migration from rural areas to cities, there is an increasing pressure on land as a resource. As population increases, more land is required for providing the basic human needs like food and shelter. Everything around is changing at a faster rate than one can predict. Previously, when the population was small, needs were few, and resources were plentiful, garbage was primarily biodegradable and spontaneously recycled. Handling urban garbage is a big issue that is given little attention. In the natural sinks of the atmosphere, land, streams, oceans, and soil, nature has proved their ability to disseminate, degrade, absorb, or otherwise dispose of undesired leftovers. These served the public by transporting everything one didn't want to a place where one didn't care what it did. However, as the world's population grew, urbanization and industrialization grew, the consequent massive amount of garbage, of all types, grew beyond nature's capabilities. As a result, rising waste levels are concerning. This necessitates efforts such as reducing waste generation to lessen the negative consequences and challenges associated with solid waste disposal and disposing waste in a way that allows for resource recovery through recycling (Beniwal, 1999). Bio-degradable waste generated at household level can be minimized by taking proper measures. One such measure is preparing household compost from the bio-degradable waste generated in the kitchen or garden. Household compost is a great substitute for the chemical fertilizers available in the market. Using household compost is an incredible means to grow healthy and nutritious organic vegetables and fruits in one's own garden.

Compost is best for improving the texture of the soil, so that it can hold the water and air for the betterment of the plants. For healthy root development in the plants the compost is good as it adds nutrients to the soil. The benefits of composting are free fertilizer, no harmful chemicals, less waste, and a cleaner planet. Any kind of kitchen waste which includes the vegetable and fruit scrapes can go into the compost pile. Even actual plants and its parts also can be used in the compost pile, such as paper, sawdust, dryer lint if it is made from natural fibre. The household compost can be created using a mixture of brown and green waste (Livingston, 2021).

Composting is best done with kitchen and garden wastes. To generate effective compost, one needs a combination of nitrogen and carbon-rich ingredients. Nitrogen is found in lush, green materials like grass clippings. Brown material, such as woody stems and cardboard, are the sources of carbon. Green material for composting can be fruit/vegetable scrape, eggshells, coffee grounds, grass and plant clippings, tea leaves/bags, flower/garden waste, and green leaves. Brown materials in the other hands are dry leaves, finely chopped wood and bark chips, shredded newspaper, straw, sawdust from untreated wood, cardboard, paper towels/bags and dead house plants. There are also other non-bio-degradable things which does not go into compost bin for composting, such as anything containing meat, oil, fat, grease, diseased plant, glossy/coloured/printed paper, weeds with seed, dairy products, sawdust or chips from pressure-treated wood, cooked food, and dog or cat faeces. <sup>(1)</sup>

Types of composting depends on the several factors like; the availability of space, amount of organic waste generated, type of organic waste generated (kitchen waste or garden waste) and the composting process time. There are basically three types of composting, i.e., cold composting, hot composting, and vermicomposting. <sup>(2)</sup>

Household compost is healthy and chemical free option for kitchen garden. The existing kitchen garden owner should have a good knowledge about the preparation and use of the

household compost in their kitchen garden. One needs to have a good knowledge about various aspects of household compost, such as benefits, materials, types, and preparation process. Without having proper knowledge of the process, one cannot prepare good compost. Thus, it becomes important to enhance the knowledge of the respondents regarding the different aspects of household composting.

Rapid urbanization and industrialization are responsible for increase in pollution at all the levels viz., land, air, and water pollution. The factories and mills are disposing their waste into the river and ponds, which is polluting the water. The land is polluted with a lot of solid waste deposited at landfill and on the streets as well. One of the land wastes is the household waste. Every year tons of household waste ends up in the landfill. This household waste contains lots of biodegradable waste, which can be segregated at household level and can be utilized to create household compost. The kitchen and garden waste generated at home can be used to create household compost which can be used in the garden itself. Researcher was keen on collecting data related to the knowledge of the homemakers regarding household compost, with an aim to solve management of solid biodegradable household kitchen waste issues. Homemaker being the backbone of the family and managing the house, it is important to educate them regarding the waste management and how the bio-degradable waste can be managed at household level. So, they can be part of improving the environment by minimizing the waste. Major objective of the present research was to assess the extent of knowledge of the respondents regarding the household compost.

### **OBJECTIVES**

1. To assess the extent of knowledge of the respondents regarding the household compost.
2. To conduct an intervention program for imparting knowledge regarding household compost.
3. To conduct a post test for assessing the enhanced knowledge of the respondents after conducting intervention program.

### **METHODOLOGY**

The present research aimed to assess the knowledge of the homemakers who are the respondents of the study regarding the household compost. Therefore, a descriptive research design was considered the most appropriate. The locale of the study was Vadodara city. The unit of inquiry were the homemakers. Those homemakers having their own garden and who gave consent for the study were purposively selected as sample. The total sample was 200 homemakers residing in various areas of the Vadodara city; such as, Ellora Park, Subhanpura, Gotri, Karelibaug, Manjalpur, Shiyabagh, Dandiya Bajar, Waghodiya road through snow-ball sampling method. The data collection tool was questionnaire for pre and post-test. Data analysis was done using descriptive statistics.

### **FINDINGS**

The findings of the present study are discussed below.

#### **Section I: Demographic profile of the respondents:**

Homemakers having their own garden and who gave consent for the study were purposively selected as sample for the present study. The total sample was 200 homemakers residing in Vadodara city. The age of the homemakers ranged from 35 to 56 years.

**Section II: Extent of knowledge of the respondents regarding the household compost**

The knowledge of the respondents regarding the household compost was divided in four different categories, namely,

1. benefits of household composting,
2. types of household composting,
3. materials for household composting and
4. process and preparation of household composting.

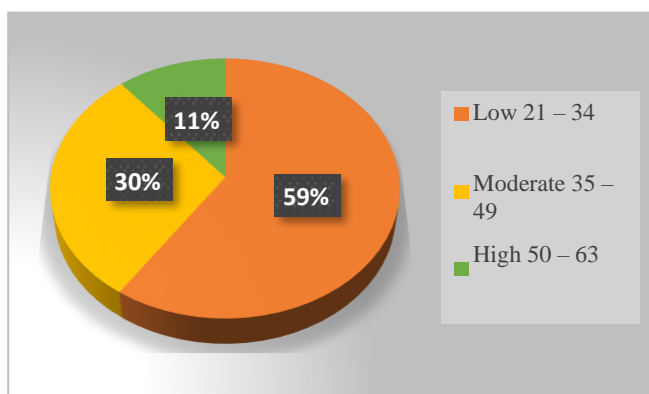
Under this scale, various aspects of knowledge regarding the household compost in their kitchen garden were considered for the statements. The respondents were asked to respond to a 3-point continuum in terms of “Aware”, “Undecided”, “Unaware” and the scores from 3 through 1 were given to the respondents for each of the statements respectively. The possible range of score was divided into three categories having a nearly equal interval of number. Findings for each of the sub aspect and overall knowledge scale regarding Household Compost are presented here.

**A. Extent of knowledge of the respondents regarding benefits of household composting.**

In this section, the respondents were asked to respond on the knowledge scale regarding the benefits of household composting in kitchen garden in terms of aware, undecided, and unaware. The data revealed that majority of the respondents were unaware that composting is an eco-friendly activity, household compost is chemical free option for fertilizer, household compost can be prepared from garden waste household compost can be prepared from kitchen waste. More than half of the respondents unaware that household compost can keep the vegetables and fruit plants chemical free, household compost helps to reduce the house waste dumping into the landfills. The data further revealed that half of the respondents were undecided that waste decaying in compost pile produces far less methane compared to decaying in landfill.

**Table 1: Extent of knowledge of the respondents regarding benefits of household composting.**

Sr. No.	Extent of Knowledge	Range of Score	Distribution of Respondents (n=200)	
			f	%
1.	Low	21 – 34	119	59.50
2.	Moderate	35 – 49	59	29.50
3.	High	50 – 63	22	11.00



**Figure 1: Extent of knowledge of the respondents regarding benefits of household composting**

The data in Table 1 revealed that more than half of the respondents had low extent of knowledge regarding the benefits of household composting, more than one third of the respondents had moderate extent of knowledge and less than one third of the respondents had high extent of knowledge regarding the benefits of household composting.

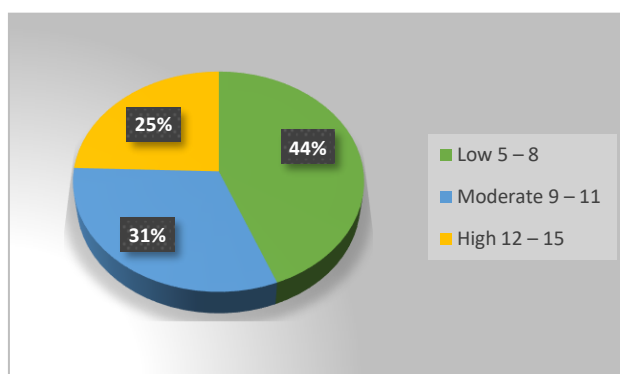
**B. Extent of knowledge of the respondents regarding types of household composting.**

In this section of the knowledge scale, Regarding the many types of household composting in kitchen gardens, the respondents were asked to categorize their responses as "aware, undecided, and unaware."

The data showed that less than half of the respondents were unaware that vermi -composting is one of the systems to prepare compost at home, in vermicomposting, in enclosed bin the vegetable waste is filled with worms called red wigglers, whereas less than half of the respondents were undecided that cold composting takes one growing season to prepare and hot composting takes six to eight weeks to prepare.

**Table 2: Extent of knowledge regarding types of household composting.**

Sr. No.	Extent of knowledge	Range of Score	Distribution of Respondents (n=200)	
			f	%
1.	Low	5 – 8	88	44
2.	Moderate	9 – 11	63	31.50
3.	High	12 – 15	49	24.50



**Figure 2: Extent of knowledge regarding types of household composting**

Table 2 revealed that less than half of the respondents had low extent of knowledge regarding the types of household composting, more than one third of the respondents had moderate extent and nearly less than one third of the respondents had high extent of knowledge regarding the types of household composting.

**C. Extent of knowledge regarding materials for household composting in kitchen garden.**

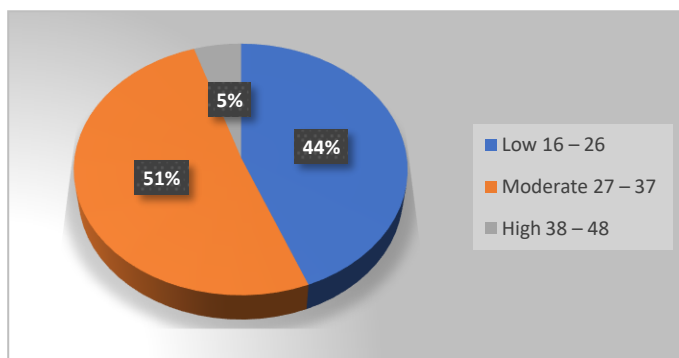
In this section, the respondents were asked to respond regarding the materials for household composting in kitchen garden in terms of aware, undecided, and unaware.

The data revealed that more than half of the respondents were unaware that fruit and vegetable peels, coffee grounds, tea bags, nut shells, and crushed eggshells can go in compost, peels from oranges, peaches, or bananas can go to compost pile, green leaves, stems, flowers, and

grass clippings with herbicides can be compost, brown materials are dry and rich in carbon, whereas less than half of the respondents were undecided that meat, bones, and fish scraps should not be added to compost pile as they attract pests to it and nearly less than half of the respondents were aware that dairy products and greasy or oily foods should not go into compost.

**Table 3: Extent of knowledge regarding materials for household composting.**

Sr. No.	Extent of knowledge	Range of Score	Distribution of Respondents (n=200)	
			f	%
1.	Low	16 – 26	88	44.00
2.	Moderate	27 – 37	102	<b>51.00</b>
3.	High	38 – 48	10	05.00



**Figure 3: Extent of knowledge regarding materials for household composting**

Above Table uncovered that half of the respondents had moderate extent of knowledge regarding the materials for household composting, less than half of the respondents had low extent of knowledge, and less than one tenth of the respondents had high extent of knowledge regarding the materials for household composting.

**D. Extent of knowledge regarding process and preparation of household composting in kitchen garden.**

In this last section of knowledge scale, the respondents were asked to respond regarding the process and preparation of household composting in kitchen garden in terms of aware, undecided, and unaware.

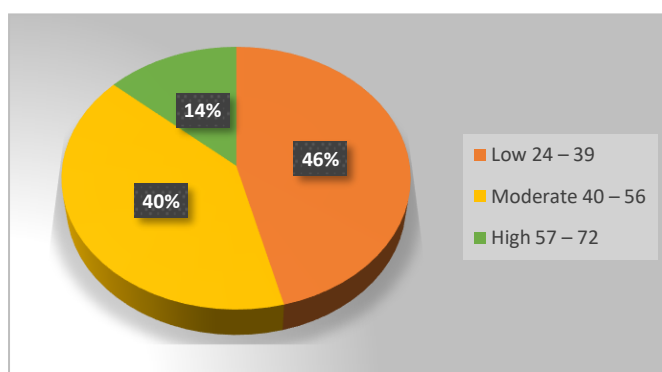
The data revealed that more than half of the respondents were unaware that compost bins are readily available in the market, DIY options for compost bins are available, making compost at home doesn't require much space in the house or garden, plastic bucket or containers can be used as compost bins, and in open bins, fruits and vegetable scrapes can attract small flying insects and fruit flies and less than half of the respondents were undecided that open pile & enclosed bins and cold composting & hot composting are the methods of preparing compost at home, composting bins should be three feet away from buildings, if the pile is taking too long to prepare compost, then the pile is too small or too compressed or too dry, and composting bins should be protected from



direct winds.

**Table 4: Extent of knowledge regarding process and preparation of household composting.**

Sr. No.	Extent of Knowledge	Range of Score	Distribution of Respondents (n=200)	
			f	%
1.	Low	24 – 39	92	<b>46.00</b>
2.	Moderate	40 – 56	81	40.50
3.	High	57 – 72	27	13.50



**Figure 4: Extent of knowledge regarding process and preparation of household composting**

Data in Table 4 proved that nearly half of the respondents had low extent of knowledge regarding the process and preparation of household composting, less than half of the respondents had moderate extent of knowledge, and nearly one tenth of the respondents had high extent of knowledge regarding the materials for household composting.

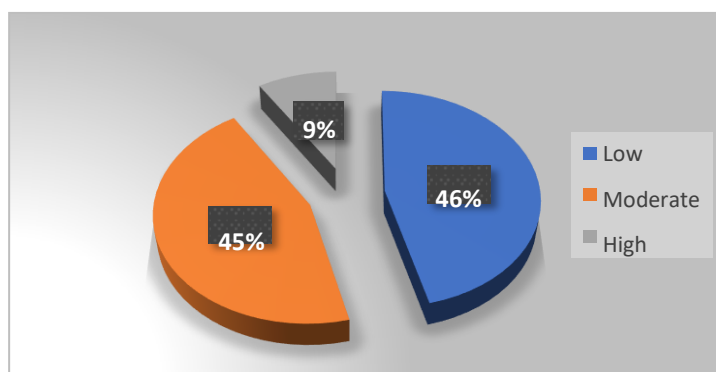
**E. Overall extent of knowledge of the respondents regarding the household composting in kitchen garden.**

This section dealt with the extent of knowledge of the respondents regarding household composting in kitchen garden. This was a summated rating scale. The respondents were asked to respond to a 3-point continuum in terms of “Aware”, “Undecided”, “Unaware” and the scores from 3 through 1 were given to the respondents respectively. The possible score ranged from 66 to 198 of which three categories having almost equal intervals were made for total 66 statements of knowledge scale. Lower scores indicated low extent of knowledge of the homemakers.

**Table 5: Frequency and percentage distribution of the respondents according to their knowledge regarding household composting in kitchen garden.**

Sr. No.	Extent of Knowledge	Score	Distribution of the Respondents (n=200)	
			f	%
1	Low	66 - 109	92	46
2	Moderate	110 - 154	90	45
3	High	155 - 198	18	09

The sample surveyed showed that nearly half of the respondents were in the low score category having low extent of knowledge, less than half of the respondents were having moderate extent of knowledge and less than one tenth of the respondents were having high extent of knowledge regarding the household compost.



**Figure 5: Extent of knowledge of the respondents related to household composting in kitchen garden**

### Section III: Intervention Program for the Respondents

One of the objectives of the present research was to conduct an intervention program for the respondents for enhancing their knowledge regarding household compost. For this purpose, the PowerPoint presentation was prepared in Gujarati language for better understanding of the respondents. The development and implementation of the intervention program was done in four stages, i.e., preparation of material, contacting the beneficiaries, implementation, post-test administered on the respondents.

#### Stage 1: Preparation of material

The educational material developed for the intervention program was shown through the PowerPoint presentation to the respondents. The PowerPoint presentation contained the meaning of household compost, its uses and importance, preparation of compost from the kitchen and garden waste at household level and compost makers available in the market. The content was reviewed and translated in Gujarati for the presentation.

The Gujarati language content was given for validation to the Director of Horticulture, Vadodara district. As per the suggestions given, changes were made to the content.

**Stage 2: Contacting the beneficiaries**

The beneficiaries for the intervention program were contacted, who were the respondents of the study, having residential garden in their residences were contacted through Snow-ball technique. A total of 200 beneficiaries participated in the intervention program.

**Stage 3: Implementation**

A suitable time and place were decided for the beneficiaries to attend the intervention program. Two intervention programs were conducted in the Sabha Hall of Swaminarayan Temple, IT Road, Diwalipura, Vadodara and Shantanu Society, Harni Road, Vadodara. The beneficiaries were gathered there, and they were given knowledge about the household compost through PowerPoint presentation.



Plate 1 - Intervention Program Conducted by Researcher at Sabha Hall of Swaminarayan Temple, IT Road, Diwalipura, Vadodara



Plate 2 - Intervention Program Conducted by Researcher at Shantanu Society, Harni Road, Vadodara

Stage 4: Post-test administered on the respondents after the intervention program.

After the presentation the question answer session was done for discussion followed by their post-test. It was observed that majority of the respondents who had plenty of kitchen and garden waste and they were throwing it in the dustbins were motivated for the utilizing it for the preparation of household compost for their residential garden. Also, the respondents who had queries regarding the methods of preparation were solved by discussion in the question-answer session.



Plate 3 - Question – Answer Session Conducted by Researcher at Sabha Hall of Swaminarayan Temple, IT Road, Diwalipura, Vadodara



Plate 4 - Question – Answer Session Conducted by Researcher at Shantanu Society, Harni Road, Vadodara



Plate 5 - One on One Discussion Session Conducted by Researcher at Sabha Hall of Swaminarayan Temple, IT Road, Diwalipura, Vadodara

## **CONCLUSION**

The major findings of the present study focused on the knowledge of the homemakers regarding the household compost was very low. It is important to impart knowledge regarding the household compost to the homemakers as they being the backbone of the house, can make a change at household level, which will be leading to the better community. The intervention program executed for the homemakers proved to be successful as many of the homemakers are in favour of preparing the household compost and helping in reducing the waste ending in the landfills. The



family and community resource management offers extension courses and field work to the students which can be a good opportunity to make the homemakers aware about utilization of kitchen and garden waste for organic compost in rural and urban areas. This will decrease the load of waste on the landfill which is creating environmental issues for disposal of waste. Utilizing bio-degradable waste to prepare organic compost at household level will also help Municipal Corporation in better management of waste. If each homemaker is made aware about the utilization of the waste created by her household, and she takes the responsibility of managing her own kitchen and garden waste, that will help the community and society at large in dealing with solid waste disposal problem. Therefore, home science as a field can make a major impact on the mindset of the homemakers through extension activities and in-turn help in making the world a better place to live.

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## A STUDY ON THE PERCEPTION AND PROBLEMS FACED BY LECTURERS DURING ONLINE TEACHING

**Dr. Mona Mehta<sup>1</sup>, Ms. Rutu Modi<sup>2</sup> and Ms. Rakhi Dasgupta<sup>3</sup>**

Assistant Professor<sup>1</sup>, Temp. Assistant Professor<sup>2</sup> and Temp. Assistant Professor<sup>3</sup>  
Department of Family and Community Resource Management, Faculty of Family and  
Community Sciences, Vadodara

The Maharaja Sayajirao University of Baroda, Vadodara

Email Id: mona.mehta.map@gmail.com, rutumodi4690@yahoo.com,  
rakhidasgupta2@gmail.com

HSAI Membership Number: HSAI-2021-GJ-906-LF, HSAI-2022-GJ-1154-LF, HSAI-  
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### ABSTRACT

Every aspect of education and learning in higher education is altered by online learning. This work sought to understand how teachers perceived and dealt with the challenges associated with teaching online. Participants included teachers who were engaged in online mode of teaching since last 6 months and those who had an average of 15 years of experience in teaching. The tool used was a questionnaire which was converted into a google form to gather the data for the present study. There are also problems in online teaching which provide the foundation for a seamless transfer from traditional learning modes to e-learning delivery, staff training, well-prepared online courses, and learning materials. The result is a paradigm shift of the professional educator 's role from presenter to facilitator/coach; a compilation of instructional competencies for effective online environments distinctly emerging from online instruction and student learning environments.

**Keywords:** Online teaching, Perception, Students, Teaching practices, Technological infrastructure

### INTRODUCTION

Education has evolved in the data and communication knowledge era. The proliferation and explosion of knowledge has had a profound impact on people's lives, and this has also affected the field of education. With the ease with which ICT has connected the world, finding any information is today a straightforward effort. In our digital age, younger generations are quite adept at handling, regulating, and utilising technology. Even younger children and toddlers can operate smartphones and other modern technologies because of genetic inheritance. These gadgets have become a necessary part of modern people's daily lives as a result (Singh, 2016).

There is disagreement among specialists over the possibility of educators replacing computers in light of this change. However, the proportion of people who think instructors are important compared to those who think technology is vital is significantly higher. It is commonly

known that educators can improve their teaching strategies by using information and communication technologies into their lessons. The role that teachers play throughout the teaching-learning process cannot be understated (Singh, 2016).

With the current state of technology, information is readily available. Here, the teacher adopts a facilitator and guidance role to help pupils make the best decisions in this technologically complicated environment and manage a wealth of information to their best advantage. Teachers play an increasingly important role in today's tech-savvy society by teaching students how to critically evaluate the wealth of information available, separate fact from fiction, recognise ethical, legal, and moral dilemmas surrounding the access and use of information, and interpret data. All of these inquiries place education within the broader framework of contemporary society, enabling students to become adept at solving real-world issues and ready for an uncertain future. In the age of e-learning, the teacher's function has completely changed to that of a facilitator and a guide, helping students distinguish between accurate and inaccurate information and selecting the best and most relevant content from the wealth of technologically accessible knowledge (Singh, 2016).

Teachers have many difficulties when utilising ICT. Education was never intended to prepare students for the higher level and diverse collection of skills that society now requires. Teachers must overcome a variety of obstacles brought about by ICT. Above all, there is a requirement for sufficient technology to be available in schools, which entails significant expenses for purchasing, setting up, running, maintaining, and replacing ICTs. Second, confirming that all teachers are proficient in using ICT tools for teaching and learning processes is crucial. Another difficulty is that educators must grow personally in order to effectively employ the various ICTs in various contexts. The fact that English is the primary language connected to contemporary technology presents teachers with additional difficulties. This is problematic as many states have a low level of English proficiency. We refer to this as the "Digital Divide" since technology has somewhat mitigated the effects that teachers have on one another. It is uncomfortable for teachers to use these contemporary gadgets and technical devices. Generating meaningful learning experiences that teach students how to use their knowledge to solve real-world problems is the task for educators, not to ignore or stay up with students' latest technical process.

Mishra, Gupta and Shree (2020) conducted research on A greater understanding of the criticalities and time-bound significance of online teaching and learning has arisen throughout the COVID-19 lockout period, as evidenced by the use of online teaching and learning in higher education. This validates the finding of (Lim, 2020) that adopting online teaching-learning platforms without pre-configuring some essential features might end up being a horrible experience, even with best efforts to build a relationship with the students via digital technology. One worrying point raised by the professors was that conducting online practical sessions during the lockdown was difficult because it necessitated a thorough explanation of the entire procedure in front of the students.

Shaista, N., Filzah, I., Mazhar & Farid (2020) conducted research on Online Teaching Practices during the Covid-19 Pandemic listed the problems and difficulties faced by educators when delivering online lessons through Google Classroom, Zoom, and Microsoft Teams. These problems included expensive Internet packages, disobedient students, low student attendance, teachers' lack of confidence in technology, a shortage of instructional resources, a lack of ICT

expertise, and inadequate network infrastructure. Nonetheless, the school instructors' inventiveness, commitment, and sense of camaraderie in making do with so little resources was admirable.

Mohebi, L. & Meda, L. (2021) researched on Perceptions of Trainee Teachers of Online Teaching during Field Experience with Young Children. The main aim of the study was to investigate the attitudes of trainee teachers and faculty supervisors towards virtual field experiences with young children. The research was carried out using a qualitative case study within an interpretivist paradigm. Twelve internship students and five supervisors were specifically selected to answer open-ended questions about their virtual field experiences. Three themes emerged from the data: expanding the repertoire of teaching methods, resolving classroom management concerns, and integrating technology into lesson planning. It is concluded that the virtual field experience was a major success for the trainee instructors in terms of the preparation it provided to carry out the country's plan of integrating technology into the curriculum.

Tuba, K. and Illiyan, A. (2021) conducted research on Perception of school teachers and challenges towards online teaching during Covid-19 pandemic in India. To look into how educators feel about teaching online and the difficulties they run across while doing so through this pandemic. The research uses a quantitative approach and a sample survey. In March and April of 2021, data on 200 Delhi school teachers was gathered via a Google Form Questionnaire. The findings showed that, in general, educators believed that virtual instruction may assist bridge the achievement gap and have an effect on students' post-COVID-19 prospects. They did, however, run into a number of challenges when teaching remotely, including technology issues and issues with online tests and assessments.

The objective of the paper is to explore how educators view online learning and the issues that arise for them in this regard. It attempts to offer a variety of suggestions for improving instructors' understanding, comfort level, and capacity to apply online learning in their teaching-learning processes.

### **OBJECTIVES OF THE STUDY**

1. To study the perception of teachers and the problems of teachers with regards to online mode of teaching.

### **METHODOLOGY**

This study looked into how teachers saw teaching online and the issues they encountered. A descriptive quantitative design was employed in this study to gather respondents' thoughts. The study's participants comprised of educators from several colleges located in Vadodara city. These educators came from a variety of academic backgrounds, including the humanities, sciences, arts, and commerce. The sample was chosen using straightforward random sampling methods. There are 120 teachers in the sample size. Teachers facilitating online classes were asked for their opinions using a three-point rating system. To gauge the opinions of educators who provide online instruction, a three-point rating system was developed, and the response categories of "Agree," "Undecided," and "Disagree" were exposed. For the scale, statements that were both positive and



negative were generated. In addition, response categories consisting of Always, Sometimes, and Never were developed for the challenges that the respondents faced. After creating a questionnaire, a pilot research was carried out and the questionnaire was examined to determine the questionnaire's viability. For educators who use online instruction, a survey instrument with demographic questions was available. Participants were advised that all comments expressed would be kept secret and that questionnaires would be delivered using Google form. Data were systematically gathered, entered, and then examined using SPSS version 20, the statistical package for social science. The data collected was divided into three categories: perception, tools used, and demographics.

## FINDINGS AND DISCUSSION

### Demographic data of the Respondents

This section includes information with reference to the demographic data of the respondents. It includes the personal data and the data related to online teaching and technologies used by the respondents. The findings associated to the personal data of the respondents included their age, gender, educational qualification and their affiliation and teaching category.

**Table-1: Personal Demographic characteristics of the Respondents**

Demographic Data		n	%
<b>Age (in Years)</b>	25-36	60	50
	37-48	40	33.33
	49-60	20	16.66
<b>Gender</b>	Male	105	87.5
	Female	15	12.5
<b>Education Qualification</b>	Bachelors	30	25
	Masters	85	70.83
	PhD	5	4.167
<b>Teaching Category</b>	School	75	62.5
	Under Graduate	25	20.8
	Post Graduate	20	16.7
<b>Affiliation</b>	Public	85	70.83
	Private	35	29.17

Note: (n=120 for each condition)

The data in the Table-1 revealed that one-half (50 per cent) of the respondents were aged between 25 years to 36 years. The remaining one-third (33.33 per cent) of respondents were aged between 37-48 years. The findings (Table-1) on the gender of respondents discovered that majority (87.5 per cent) of the male teachers outnumbered the females. It was found that less than three fourth (70.83 per cent) of the respondents were Masters pass out as educational qualification. More than one half (62.5 per cent) of the respondents were teaching in school. The findings in table -1

also revealed that less than three fourth (70.83 per cent) of the respondents were found to be affiliated with public sector.

**Table-2: Online mode of teaching used by the respondents**

Online Mode of Teaching	n	%
WhatsApp	5	4.17
WhatsApp; Zoom; Google Classroom; YouTube	5	4.17
Zoom	30	25.00
WhatsApp; Zoom	10	8.33
Microsoft Teams	15	12.50
WhatsApp; Zoom; YouTube	5	4.17
Google Meet	15	12.50
Learning Management System (LMS)	5	4.17
Learning Management System (LMS); WhatsApp; Zoom; YouTube	5	4.17
Microsoft Teams; Zoom; Google Meet	5	4.17
Zoom; Google Meet	5	4.17
WhatsApp; Telegram; Google Meet; YouTube	5	4.17
WhatsApp; Microsoft Teams; Google Meet	5	4.17
Microsoft Teams; Zoom; Google Classroom	5	4.17

Note: (n=120 for each condition)

The findings (Table-2) on the online platform utilized by educators for online teaching revealed that one fourth (25 per cent) of the respondents were using Zoom and more than one tenth (12.50 per cent) of the respondents were using Microsoft teams and Google meet.

**Table-3: Technological tool of choice by the respondents for online instruction**

Technological device	Yes		No	
	n	%	n	%
Desktop	20	16.67	100	83.33
Laptop	95	79.17	25	20.83
Smart phone	60	50.00	60	50.00
Android Phone	90	75.00	30	25.00
Tablet	20	16.67	100	83.33

Note: (n=120 for each condition)

The findings (Table -3) revealed majority of the respondents were using Laptop (79.17 per cent) and Android phone (75 per cent) for online teaching.

**Table-4: Respondents had a pace of delivery of during online teaching**

Pace of Delivery	Yes		No	
	n	%	n	%
Fast	65	54.17	55	45.83
Slow	45	37.50	75	62.5

Note: (n=120 for each condition)

More than one half (54.17 per cent) of the respondents had fast pace of delivery through online teaching.

**Table-5: Used to make the online class more interesting by the respondents**

Teaching Aid	Yes		No	
	n	%	n	%
<b>Presentations</b>	100	83.33	20	16.67
<b>Videos</b>	105	87.50	15	12.50
<b>Photos</b>	80	66.67	30	25.00
<b>Posters</b>	50	41.67	70	58.33

Note: (n=120 for each condition)

From the (Table-5) it was revealed that Majority of the respondents were using Videos (87.50 per cent) and Presentations (83.33 per cent) to make online class more interesting.

**Table-6: Perception of teachers for using an online mode of teaching**

Sr. No.	Perception of teachers for using an online mode of teaching	Agree		Undecided		Disagree		Weighted Mean Score
		n	%	n	%	n	%	
1.	Sufficient computer knowledge and IT skills to conduct online lectures	105	87.50	15	12.50	0	0.00	2.88
2.	Training on conducting online lectures	80	66.67	30	25.00	10	8.33	2.58
3.	Training / guidelines on preparation of online lecture materials	100	83.33	15	12.50	5	4.17	2.79
4.	Give proper breaks in classes so that the students will have the time to think about the topic and frame their questions as doubts.	115	95.83	0	0.00	5	4.17	2.92
5.	Online tools are easy to use when conducting lectures	85	70.83	25	20.83	10	8.33	2.63
6.	Online lectures are more flexible	70	58.33	35	29.17	15	12.5	2.46
7.	Gained lot of knowledge by conducting online lectures.	115	95.83	0	0.00	5	4.17	2.92
8.	Online lectures are effective than traditional/live classroom lectures.	25	20.83	65	54.17	30	25.0 0	1.96
9.	Online lectures lack direct contact with students.	90	75.00	20	16.67	10	8.33	2.67
10.	Students are motivated during online lectures.	30	25.00	65	54.17	25	20.8 3	2.04
11.	Happy and satisfied about the student-teacher interaction during online teaching.	45	37.50	45	37.50	30	25.0 0	2.13
12.	Students do ask questions and clear their doubts completely during online lectures.	80	66.67	30	25.00	10	8.33	2.58

13.	Face difficulties of conducting practical session in certain courses for my online lectures.	105	87.50	10	8.33	5	4.17	2.83
14.	Find it difficult to teach some subjects online.	80	66.67	25	20.83	15	12.50	2.54
15.	Better to keep short lectures online.	85	70.83	30	25.00	5	4.17	2.67
16.	Difficult to get immediate feedback from students on what was being taught online.	100	83.33	10	8.33	10	8.33	2.75
17.	Online lectures simply take more time than a face-to-face class.	90	75.00	20	16.67	10	8.33	2.67
18.	Home environment is more suitable for conducting online lectures.	30	25.00	65	54.17	25	20.83	2.04
19.	During online lectures there is a possibility of distractions from other family members during online lectures.	105	87.50	10	8.33	5	4.17	2.83
<b>Average Weighted Mean Score</b>								<b>2.57</b>

Note: (n=120 for each condition)

The respondents were found to have an opinion that proper breaks of classes should be given so that the students had time to think about the topic and frame their questions as doubts (2.92) and they also opined that they gained lot of knowledge (2.92) by conducting online lectures. The overall average weighted mean score was 2.57.

**Table-7: Problems faced by respondents during online teaching**

Sr. No.	Problems faced by the Respondents during online teaching	Always		Sometime		Never		Weighted Mean Score
		n	%	n	%	n	%	
1.	Poor network connectivity and lack of funds to buy data or bundle	85	70.83	25	20.83	10	8.33	2.63
2.	Errors or mistakes when typing	23	19.17	80	66.67	17	14.17	2.05
3.	Difficult to assemble all the students for the class.	25	20.83	70	58.33	25	20.83	2.00
4.	Lack of cooperation from parents.	20	16.67	60	50.00	40	33.33	1.83
5.	Difficult to follow up the learning of students.	30	25.00	80	66.67	10	8.33	2.17
6.	Lack of in-service Training	20	16.67	70	58.33	30	25.00	1.92
7.	Took time in order to adjust to technology	20	16.67	65	54.17	35	29.17	1.88
8.	Nervous about conducting online classes	15	12.50	30	25.00	75	62.50	1.50

9.	Difficult to ensure 100 per cent participation for students in online classes	35	29.17	75	62.50	10	8.33	2.21
10.	Difficult to conduct experimental activities in online lectures	40	33.33	70	58.33	10	8.33	2.25
11.	Online classes do not have the concept of end of class in the self-paced format	35	29.17	65	54.17	20	16.67	2.13
12.	Online teaching demands a different set of skills to teach different subjects.	60	50.00	60	50.00	0	0.00	2.50
13.	Sense of disconnectedness in online teaching	35	29.17	60	50.00	25	20.83	2.08
14.	Online teaching reflects having a one-way delivery of Knowledge	25	20.83	80	66.67	15	12.50	2.08
15.	Difficulties of online teaching is to keep students engaged	35	29.17	70	58.33	15	12.50	2.17
16.	Unable to give individual attention to each student	40	33.33	60	50.00	20	16.67	2.17
17.	Impossible to gauge responses (facial expression) from the students	50	41.67	55	45.83	15	12.50	2.29
18.	Not flexible to write and erase on the screen easily in case of online teaching.	30	25.00	60	50.00	30	25.00	2.00
<b>Total Mean Score</b>								<b>37.84</b>
<b>Average Weighted Mean Score</b>								<b>2.10</b>

Note: (n=120 for each condition)

The findings on the problems faced by the respondents revealed that poor network connectivity and lack of funds to buy data or bundle (2.63) during online teaching was found to be the highest amongst all problems. The overall average weighted mean score was 2.10.

**Table-8: Characteristics of selected dimensions of online teaching**

Sr. No.	Characteristics of selected dimensions of online teaching	Agree		Undecided		Disagree		Weighted Mean Score
		n	%	n	%	n	%	
1.	Discussion method used as a teaching tool for the topics.	105	87.50	10	8.33	5	4.17	2.83
2.	Encourage students' independence and inventiveness.	115	95.83	5	4.17	0	0.00	2.96

3.	Encourage and oversee acceptable student interaction	105	87.50	15	12.5 0	0	0.00	2.88
4.	Student – centred learning supported by teacher	110	91.67	10	8.33	0	0.00	2.92
5.	Flexible in dealing with students need (due dates, absences, make up exams)	100	83.33	15	12.5 0	5	4.17	2.79
6.	Students need to be able to think critically and solve problems.	115	95.83	5	4.17	0	0.00	2.96
7.	Employ techniques that promote engagement, active learning, communication, and teamwork among students.	115	95.83	5	4.17	0	0.00	2.96
8.	Useful methods and approaches that actively include students in the educational process (e.g., group problem-solving, writing assignments in class, analysis, synthesis, and evaluation in place of boring lectures)	115	95.83	5	4.17	0	0.00	2.96
9.	Encourage learning in a group setting.	105	87.50	15	12.5 0	0	0.00	2.88
10.	Provide students prompt, helpful comments on their assignments and inquiries.	110	91.67	10	8.33	0	0.00	2.92
11.	Use appropriate strategies designed to accommodate the varied talents and skills of students.	105	87.50	15	12.5 0	0	0.00	2.88
12.	Provide student-centred lessons and activities that are grounded in the ideas of active learning and have a practical application	115	95.83	5	4.17	0	0.00	2.96
13.	Different student learning styles are addressed by teaching objectives and strategies.	115	95.83	5	4.17	0	0.00	2.96
14.	Teacher viewed as facilitator.	115	95.83	5	4.17	0	0.00	2.96
15.	Students should be consulted right away to fix issues and maintain focus.	115	95.83	5	4.17	0	0.00	2.96
<b>Total Mean Score</b>								43.75
<b>Average Weighted Mean Score</b>								2.92

Note: (n=120 for each condition)

In Table 8 results showed which aspects of teaching received the highest scores independence and inventiveness. (2.96), think critically and solve problems (2.96), using strategies to encourage active learning, interaction, participation, and collaboration among students (2.96), using effective strategies and techniques that actively engage students in the learning process (e.g., team problem-solving, in-class writing, analysis, synthesis, and evaluation instead of passive

lectures) (2.96), providing student-centered lessons and activities that are based on concepts of active learning and that are connected to the real world (2.96), providing student-centered lessons and activities that are based on concepts of active learning and that are connected to real-world situations (2.96), teaching goals and methods address a variety of student learning styles (2.96), and viewed as facilitator (2.96). 2.92 was the weighted average score overall.

## **CONCLUSION**

It can be concluded from the findings that the one half (50 per cent) of the respondents were aged between 25 years to 36 years. The remaining one-third (33.33 per cent) of respondents were aged between 37-48 years. The findings on the gender of respondents discovered that majority (87.5 per cent) of the male teachers outnumbered the females. It was found that less than three fourth (70.83 per cent) of the respondents were Masters pass out as educational qualification. More than one half (62.5 per cent) of the respondents were teaching in school. It was also revealed that less than three fourth of the respondents were found to be affiliated with public sector. Online platform used by the teachers for online teaching revealed that one fourth (25 per cent) of the respondents were using Zoom and more than one tenth (12.50 per cent) of the respondents were using Microsoft teams and Google meet. It was revealed majority of the respondents were using Laptop (79.17 per cent) and Android phone (75 per cent) for online teaching. More than one half (54.17 per cent) of the respondents had fast pace of delivery during online teaching. Majority of the respondents were using Videos (87.50 per cent) and Presentations (83.33 per cent) to make online class more interesting. The respondents were found to have an opinion that proper breaks of classes should be given so that the students had time to think about the topic and frame their questions as doubts (2.92) and they also opined that they gained lot of knowledge (2.92) by conducting online lectures. The overall average weighted mean score was 2.57. The findings on the problems faced by the respondents revealed that poor network connectivity and lack of funds to buy data or bundle (2.63) during online teaching was found to be the highest amongst all problems. The overall average weighted mean score was 2.10. It was also reflected that the various dimensions of teaching having highest scores were independence and creativity, critical thinking and problem solving, use strategies to encourage active learning, interaction, participation and collaboration among students, use active strategies and techniques that actively engage students in the learning process (e.g., team problem-solving, in class writing, analysis, synthesis and evaluation instead of passive lectures), provide student-centered lessons and activities that are based on concepts of active learning and that are connected to real world, Teaching goals and methods address a variety of student learning styles, viewed as facilitator and immediately consult with students to correct problems and keep them on task. The overall average weighted mean score was 2.92.

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## INCULCATING ENTREPRENEURIAL SKILLS THROUGH TRAINING PROGRAM AMONG SELECTED MIDDLE-INCOME HOMEMAKERS

R. Rayshme<sup>1</sup> and Dr. K. Manimozhi<sup>2</sup>

Research Scholar<sup>1</sup>, Professor<sup>2</sup>

Department of Resource Management, School of Home Science,  
Avinashilingam Institute for Home Science and Higher Education for Women,  
Coimbatore-641043

Email-id <sup>1</sup> rayshmerajendhran@gmail.com ,

<sup>2</sup> manimozhi\_rm@avinuty.ac.in

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### ABSTRACT

Studies revealed that the middle-income groups were the most severely affected during COVID-19 pandemic. There is a need to look for an alternative to cope with the situation post-pandemic. Women's employment has boosted economic growth and lifted millions of families out of poverty. The nation's social and economic demography has been significantly impacted by the rising number of female entrepreneurs in our country. Therefore, in this present study, an attempt was made to empower the selected 50 middle-income homemakers by inculcating entrepreneurship. This study also assessed their interest to get additional sources of income and to improve their financial status of their family through the interview -cum- observation method. The Data was collected using a 5-point Likert scale. Both positive and negative responses were collected from the selected middle-income homemakers and the collected data before and after the training program was transferred into Microsoft Excel version 10 and coded, and then statistically analysed using SPSS Version 20 software to assess the knowledge gained about entrepreneurship. Inferential Statistics such as the one-way analysis of variance, independent t-test and correlation were performed. The analysis projects that there exists a significant difference between the mean scores before and after providing knowledge about entrepreneurship accepting the alternative hypothesis at a significance level of 1%. Based on the current study it could concluded that there is a need for entrepreneurship which paves a way to empower women. Thus, creating awareness about the importance and benefits of being an entrepreneur in the right way will definitely motivate the people to become an entrepreneur.

**Keywords:** Entrepreneurship, Knowledge Intervention, Middle- Income Homemakers, Training Program, Women Empowerment

### INTRODUCTION

*“A healthy middle class is necessary to have a healthy political democracy. A society made up of rich and poor has no mediating group either politically or economically.”*

*-Lester Thurow*

## The Indian Journal of Home Science 2024: 36(2)

India had around twelve crores middle-class families in 2016 with average yearly gross incomes ranging from six lakhs to twelve lakhs. By 2025, it is projected that this number would increase to fourteen crores families, giving the middle class in India a substantial portion of the population in terms of wealth and standard of living (Das et al., 2022).

In India, the middle class often has a higher percentage of people with college degrees than the working class, according to the circle of Western societies (Baviskar and Ray, 2020). The definition of "**Middle Class**" has changed through time. It used to refer to people who were trying to compete with patricians, but today it more closely resembles the upper end of the working class (Marx and Engels, 2019).

The middle classes in all countries have been a major force behind the global frugality over the last century. Growing middle-class consumption in the US, Europe, and other developed countries has been a major factor in the past few decades' global economic expansion (Roy, 2018).

Based on an UN report, India's population is predicted to surpass China's by 2022 as it continues to grow. In the upcoming ten years, the number of middle-class citizens in the nation is projected to rise. The group's size is projected to surpass that of the United States, China, and Europe by 2027. Recent projections indicate that India's contribution to global GDP would primarily rise from 7.6% in 2017 to 8.5% in 2020. Both couples must unavoidably work, and one pay check over a 20-year period is used to pay back this EMI. Additionally, they put money aside for their children's education, assist out with a parent's child's wedding, their own children's weddings, and retirement period. The country has very minimum safety nets (Indian Express, 2022).

According to multinational professional services company Ernst and Young, China will have more middle-income group consumers than any other country by the year 2030. The middle class in China, which accounted for roughly 50 million individuals in 2015, or about 5% of the total population, is projected to increase to 20 crores individuals by 2020 and to 47.5 crores individuals by 2030. Up until 2030, there will likely be a major increase in the world middle class. The estimated growth rate for India's middle-income group is 5% to 10% of the population in 2005 to 90% in 2039, when a billion more individuals have entered this class. In 2005, only a small percentage of houses had daily incomes above \$5 US, while the average household expenditure per person was only \$3.20 US. Nevertheless, 50% of the population had done so by 2015. By 2025, it is anticipated that half of the Indian population would make more than \$10 per day (Roy, 2018).

India's economy will continue to grow significantly between 2016 and 2050, and a further billion consumers could join the global middle-income group. Our nation is presently the 3<sup>rd</sup> largest middle-income group market, behind the US and China.; in another twelve years, it is predicted to overtake them (Pandey, 2016). The Middle-Income population outside of those who work for the government or the huge organised sector has been devastated by the lockdown (WHO, 2020).

The middle-class gains most directly from entrepreneurship because it is responsible for a net increase in jobs in our nation. After the pandemic, the middle class lost a significant portion of its relative position in the income distribution, which means that mill workers now make less than they did in the past. Families with salaries close to or below the median have actually seen a stagnation in their earnings (Ayandibu and Houghton, 2017).

The 2013 Global Development Report on Jobs projects that during the next 15 years, 600 million more jobs will be needed worldwide. In India, women make up 23.3 percent of the labour force and own 20.37 percent of MSMEs. McKinsey Global estimates that by increasing women's labour force participation, India may boost the global GDP by \$700 billion. Compared to men, women have a higher likelihood of working in industry and agriculture. These industries are frequently credited with assisting families in escaping poverty and raising household income. Also,

female literacy rates improved by 8.8% in FY21, highlighting the country's bright future (Times of India, 2022).

Women establish the foundation of the family, which strengthens society and the country. Any community or nation's total economic advancement depends on the social and economic advancement of women. Identifying different opportunities, encouraging creativity and innovation in the production process, and creating new business models and enterprises are all part of being an entrepreneur. A nation like India, which is developing quickly, depends heavily on entrepreneurship. In comparison to other nations, the level of women's entrepreneurship is notably low in India. Nonetheless, middle-class women are hesitant to change their roles due to the fear of negative societal repercussions. The progress is more noticeable among affluent families in urban areas. Rural women often bear the main responsibility for agricultural production, in addition to taking care of household duties and childcare. In countries undergoing development such as India, where women's economic status is dire and earning opportunities are scarce, women are drawn towards entrepreneurship as a means to gain self-esteem and social recognition. To survive in the demanding market, women-led businesses primarily rely on internal resources and their abilities, through which they face challenges in competing with the external environment (Khare, 2019).

Entrepreneurship education and training have seen growing demand as both practitioners and academics recognize their critical role in fostering innovation, economic development, and job creation. In today's dynamic global economy, entrepreneurship is not only about starting businesses but also about cultivating an attitude of entrepreneurship that encourages imaginative thinking, problem-solving, and versatility. Programs in entrepreneurship are being added to educational institutions more often, and professionals are looking for ongoing education to help them deal with the changing corporate environment. This demand is driven by the need to equip individuals with the necessary skills to launch and sustain successful ventures, contributing to broader economic growth and empowerment (Schneider et al., 2017).

The idea that training program about entrepreneurship improves the primary awareness-raising function of entrepreneurship education highlights the essential relationship between theory and practice. Although the primary objective of entrepreneurship education is to cultivate an entrepreneurial mindset, inspire ideas, and increase awareness, it frequently fails to provide the necessary hands-on experience for practical application. This is where entrepreneurship training is instrumental—it offers the practical skills and resources that aspiring entrepreneurs require to transform their ideas into viable businesses. In order to effectively navigate the changing business environment, practitioners pursue ongoing entrepreneurial education (Idrus et al., 2014).

Therefore, the aim of this study is to assess the effectiveness of entrepreneurship education and training which empower middle-income group homemakers by improving their financial position and entrepreneurial skills. It evaluates how practical training complements homemakers with the skills necessary to start and sustain their own businesses.

## **OBJECTIVES**

1. To access the existing money management practices among middle-income group homemakers.
2. To assess the homemakers' interest in gaining an additional source of income and their willingness to become entrepreneurs.
3. To create awareness on entrepreneurship among selected middle-income group homemakers through training program.

4. To analyse the changes in knowledge about entrepreneurship before and after the training program.

## **HYPOTHESIS**

### **Null Hypothesis (H<sub>0</sub>):**

There is no significant difference in the level of knowledge about entrepreneurship among selected middle-income group homemakers before and after the training program.

### **Alternative Hypothesis (H<sub>1</sub>):**

There is a significant difference in the level of knowledge about entrepreneurship among selected middle-income group homemakers before and after the training program.

The hypothesis seeks to assess the impact of training program on the awareness and understanding of entrepreneurship among selected middle-income homemakers. Training program on benefits of being an entrepreneur to selected middle-income homemakers will definitely motivate them to be an entrepreneur.

## **METHODOLOGY**

The study was conducted among 50 homemakers in KK Puthur, Coimbatore, in 2021 after post COVID-19 pandemic. This is a residential area where the population of middle-income homemakers is more and it was easy to combine all the homemakers for the training program at a time. Purposive sampling method was used to select the homemakers who belong to middle-income group for the present study. The current study was carried out through a questionnaire-based interview schedule. The researcher asked about the willingness to be an entrepreneur in the questionnaire. The homemakers were contacted personally one at a time, at their convenience. Rapport was developed by explaining the purpose of the study. The required information was then elicited following the schedule and recorded side by side. Face to face contact with the homemakers helped to build confidence, developed good will, established rapport and explained the objectives of the study. It was a platform to know homemaker's interest towards entrepreneurship and their willingness to improve their financial status. 5-point Likert scale has been used to collect data. Both positive and negative responses have been collected from the selected middle-income homemakers and the collected data before and after the training program was transferred into Microsoft Excel version 10 and coded, and then statistically analysed using SPSS Version 20 software to assess the knowledge gained about entrepreneurship. Inferential Statistics such as the one-way analysis of variance, paired sample t-test and correlation were performed. Fig-1 illustrates the research design through a schematic representation.

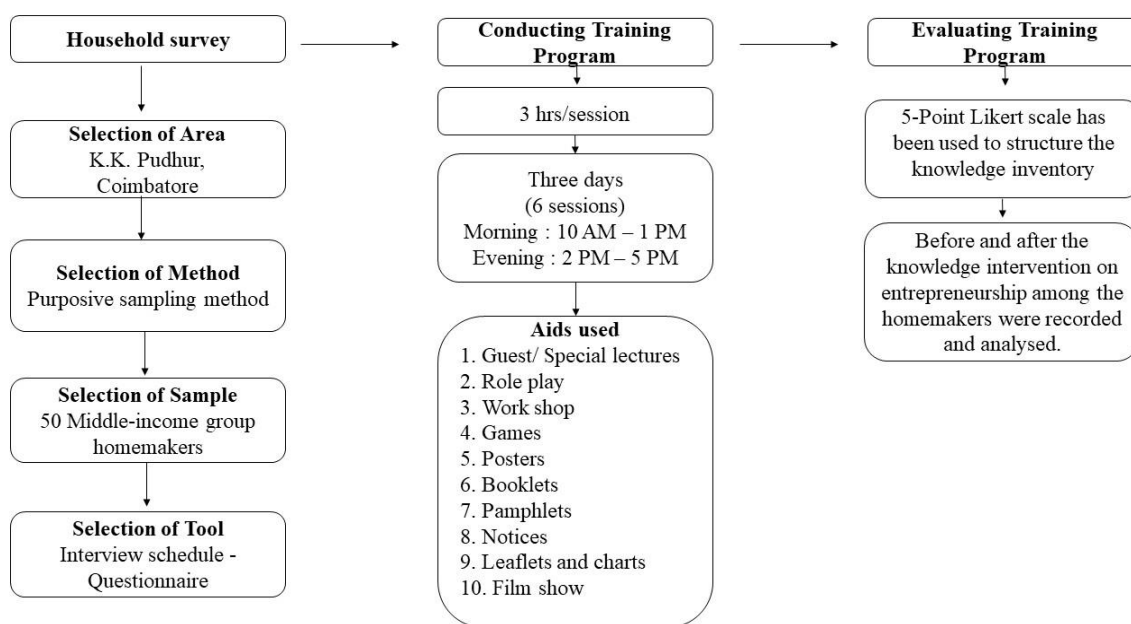


Figure 1- Schematic Representation of the Research Design

## RESULT AND DISCUSSION

The major findings of this study include the socio demographic profile of the homemakers, the existing money management practices among selected households and a significant focus of this research is knowledge intervention on entrepreneurship which deals with the changes in their entrepreneurial knowledge, both before and after participating in the training program to selected middle-income group homemakers. By comparing the before and after training knowledge levels, the study evaluates the effectiveness of the intervention in bridging the gap between theoretical understanding and practical application in entrepreneurship.

### Socio-demographic profile of the selected homemakers

The socio-demographic profile provides a comprehensive overview of the selected homemakers, detailing their age, educational background, occupational status, family life cycle stage, size of the family, annual income, family structure, and housing situation. This profile helps to contextualize the financial and social characteristics of the participants, offering insights into their overall living conditions and economic circumstances.

TABLE-1 Socio-demographic profile of the selected homemakers

(n=50)

Characteristics	Category	Percentage (%)
Age(years)	15-24	-
	25-34	58
	35-44	24

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	Above 45	12
Education status (Homemakers)	Illiterate	-
	Higher secondary	28
	Graduate	54
	Diploma	18
Occupation (Head of the family)	Business	22
	Gov. employee	10
	Private employee	32
	Any other	6
Family life cycle	Beginning	50
	Expanding	38
	Contracting	12
Size of the family	Small (1-4 Individuals)	28
	Medium (5-6 Individuals)	56
	Large (Above 6 Individuals)	16
Annual Income (in Rs)	Below 3,00,000	8
	3,00,001-6,00,000	22
	Above 6,00,000	70
Family structure	Nuclear family	50
	Joint family	50
Housing situation	Rented	50
	Own house	50

A person's social status often shapes their values, attitudes, and decision-making processes, influencing their economic behaviours and lifestyle choices (Seetharaman et al., 2015). In this study, the socio-demographic profile of the homemakers reflects this dynamic. The Table 1 clearly shows that all participants are over the age of 25 and none are illiterate, indicating a higher level of educational attainment and maturity, which typically correlates with more informed decision-making and financial management. The distribution of family types, with an equal split between nuclear and joint families, suggests diverse household structures that can impact financial strategies and resource allocation. The fact that 50% of the families are in the expanding stage highlights a period of growth and increasing financial needs, which may influence their economic behaviour and aspirations.

Furthermore, with 40% of the families earning less than ₹6,00,000 annually, the socio-economic status of these homemakers reflects a significant portion of the middle-income group. This income bracket is crucial for understanding their financial management practices and their readiness for entrepreneurship, as their economic situation often drives their need for supplementary income sources and financial stability.

**Existing money management practices among selected households**

Existing money management practices among selected households reveals the practise of saving money, money saved and money spent in a month. The Table 2 also reveals the selected

homemaker’s interest to get additional source of income to improve their financial status of their family and their willingness of the homemakers to be an entrepreneur.

**TABLE-2 Existing money management practices among selected households**

(n=50)

S.no	Aspects	Activities	Percentage (%)
01	Practise of saving money	Yes	92
		no	08
02	Money saved in a month other than expenses	Below 1000	08
		1001-5000	68
		Above 5000	24
03	Money spent on home in a month	Below 1000	00
		1001-5000	16
		Above 5000	84
04	Amount saved satisfies the households	Yes	12
		No	88
05	Willing to get additional source of income to improve their financial status	Yes	98
		No	02
06	Additional Source of income expectation	Searching for a job	14
		To be an entrepreneur	86

Saad et al. (2023) highlighted that a clear understanding of the importance of saving can significantly improve money management habits. This aligns with the findings presented in Table-2, where 92% of the homemakers reported having the practice of saving money. However, only 12% of them were satisfied with the amount they saved, indicating a gap between saving habits and financial satisfaction. Furthermore, a significant majority (98%) of the selected homemakers expressed a willingness to pursue additional sources of income to improve their financial status. Interestingly, 86% of the homemakers were interested in becoming entrepreneurs, while the remaining 14% preferred seeking employment. These findings underscore the need for promoting better money management practices and exploring entrepreneurial opportunities to enhance financial well-being.

**Effect of awareness program on entrepreneurship among the selected homemakers**

According to European union "Skill" refers to the capacity to employ knowledge and know-how to carry out specific activities. In general, it shows that a person is capable of doing something in a particular situation. Before creating awareness program, the homemakers were not aware of the importance of entrepreneurship. They have poor knowledge about entrepreneurial development program. After the training program the knowledge score of the homemakers have increased. It is referred from the study that training program has a positive impact of knowledge on entrepreneurship. Table 3 represents the knowledge gained by the selected homemakers and has been categorized as low, moderate and high before and after the training program. To find low, moderate and high knowledge about entrepreneurship among middle income homemakers, 30<sup>th</sup> and 70<sup>th</sup>



percentiles were found out for awareness scores before and after. Table 3 represents the percentile values.

**TABLE-3 Percentile values to find low, moderate and high-level knowledge among middle income homemakers before and after the training program**

		Awareness score-Before	Awareness score-After
Percentiles	30	44.0000	66.9000
	70	57.0000	89.0000

The homemakers having awareness score (before) being 44 and below were considered having low awareness and those having awareness score 57 and above were considered as having high awareness. The homemakers having awareness scores between 30<sup>th</sup> and 70<sup>th</sup> percentile values were considered as having moderate awareness. Similarly, Table 4 presents the analysis of the awareness levels before and after training.

**TABLE-4 Analysis of low, moderate and high level of knowledge among middle income homemakers before and after the training program**

Awareness score before and after the training program				
	Before		After	
	(n=50)	%	(n=50)	%
Low ( $\leq 44$ )	16	32	15	30
Moderate (45 -56)	17	34	17	34
High ( $\geq 57$ )	17	34	18	36
Total	50	100	50	100

It can be concluded from the table 4 that all type of knowledge can be gained and improved if proper training is provided in suitable environment.

**Comparative analysis of effect of awareness program on entrepreneurship among selected middle-income homemakers.**

The paired-samples t-test can be used to assess whether there is a significant difference between two means when both sets of values are obtained from the same individuals. In this study paired sample t-test was employed to evaluate if the awareness and knowledge of entrepreneurship among selected middle-income homemakers showed a statistically significant difference. The statistical procedure of the t-test was used to assess the efficiency of the knowledge given to the homemakers as a part of the intervention. A descriptive analysis was conducted before and after the intervention, using a 5-point Likert scale to assess scores. Following this, a t-test was carried out to evaluate the difference in entrepreneurial knowledge among homemakers before and after the training. In order to find whether the awareness scores on entrepreneurship have significantly improved before and after the training, the following hypothesis was framed and tested.

**Null Hypothesis (H<sub>0</sub>):**

There is no significant difference in the level of knowledge about entrepreneurship among selected middle-income group homemakers before and after the training program.

**Alternative Hypothesis (H<sub>1</sub>):**

There is a significant difference in the level of knowledge about entrepreneurship among selected middle-income group homemakers before and after the training program.

**TABLE-5 Statistical analysis of impact of training program about entrepreneurship among selected middle-income group home makers**

	Mean	Std. Deviation	t-test	df	Sig.
Awareness score-Before	51.3000	8.98127	8.544	49	**
Awareness score-After	77.5200	14.51142			

(n=50)

\*\* - Significant at 1% level

The awareness score was found out by adding the ratings given by the respondents for all the 20 statements. Higher the score, higher will be awareness level on entrepreneurship. It is seen from the table 5 that the average awareness score before training on entrepreneurship was 51.3 which has increased to 77.52 after training. Thus, the paired sample t-test was applied to test the hypothesis. The calculated t-value is 8.544 which is greater than the critical value of 2.68. Since the calculated value is greater than the critical value it is inferred that there is significant difference before and after the awareness program.

The t-value found from the analysis of the mean scores of the before and after providing knowledge on different factors of entrepreneurship among home makers who belongs to middle income group state that there exists a mean difference after providing knowledge on entrepreneurship. It was also revealed that the “p” value or value of significance is found to be 1% for all the factors ( $p < 0.01$ ) stating that there is a significant difference among the home makers after providing knowledge on entrepreneurship. The analysis projects that there exists a significant difference between the mean scores of before and after providing knowledge at 1% level of significance rejecting the null hypothesis and accepting the alternative hypothesis. Thus, there is a significant difference in the level of knowledge about entrepreneurship among selected middle-income group homemakers before and after the training program.

**CONCLUSION**

This study highlights the importance of entrepreneurship awareness training for middle-income group homemakers. The program was adapted to the homemakers’ specific requirements and backgrounds after examining their socio-demographic profile. The analysis projects that there exists a significant difference between the meanscores before and after providing knowledge at a 1% level of significance accepting the alternative hypothesis. The significant increase in knowledge scores following training demonstrates the program's efficacy in providing homemakers with necessary abilities for entrepreneurial activities. From the present study it could be concluded that there is a need for entrepreneurship which paves a way to empower women. This study's overall findings emphasize the value of entrepreneurship education in enabling middle income group homemakers to raise their own financial standing and support the stability of their families. It makes the case for the expansion of comparable initiatives to promote greater economic development and women's economic empowerment Hence it is proved that by creating awareness about the

importance and benefits of being an entrepreneur in a right way will definitely motivate the people to become an entrepreneur.

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## INNOVATIVE HOME TECHNOLOGY A BOOM OF THE 3<sup>rd</sup> MILLENNIUM: A FOCUS ON ITS AWARENESS AND UTILIZATION

**Dr Sheeba Gopalakrishnan.U<sup>1</sup> and Dr M. R Thilakam<sup>2</sup>**

<sup>1</sup>Assistant Professor, Department of Home science and Centre for Research, St Teresa's College for women, Ernakulam, Kerala, India, E mail : sheebagn@gmail.com,

<sup>2</sup>Retd. Professor and Head, Department of Resource Management, Avinashilingam Institute for Home Science and Higher education for women, Coimbatore, Tamil Nadu, India, E mail: dr.m.r.thilakam57@gmail.com

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### ABSTRACT

This report examines homemakers' awareness, use, and adoption of intelligent devices that simplify household tasks. Smartphones to "smart houses." new technology has revolutionised our personal and professional lives. Awareness of this modern technology is needed to save time, energy, and effort by offering quick access to routine activities due to our changing lifestyle. A suitable sampling strategy was used to survey chosen houses in Coimbatore. Primary data was collected using a highly structured questionnaire with awareness level Likert scale responses. It states that respondents were less aware of innovative home products, and those with high monthly incomes were more aware of their benefits. Smart homes and IoT research is ongoing, but homemakers' use and understanding of smart items must be considered. Limitations of this study include sample size and data gathering time.

**Keywords:** Artificial Intelligence; Home makers; Household Chores; Innovative home technology; IoT; SHT; Smart homes; Smart products

### INTRODUCTION

Technological advances have improved our ability to complete tasks, revolutionising personal and professional lives since the 1990s. Smartphones have simplified video conferencing, emailing, banking, shopping, and meal ordering. Advances in technology are creating "smart homes" that save time, energy, and effort. Smart home gadgets improve interactions by removing manual operation (Poola, 2017; Guo et al., 2019). A 2021 study by Arar et al., (2021) examined customer demands, preferences, and attitudes towards smart home technologies. Many factors influence SHT adoption, and such technologies help manage daily life and health, promoting a healthy lifestyle. Younger consumers have more technology needs than older consumers, according to the survey. Since 67 percent of seniors have chronic ailments, smart home technology helps them manage their health. Our homes are now becoming more efficient. Thanks to technology, for saving time, energy, and labour. AI in home automation has become more relevant since the early launch of home

automation systems 50 years ago, which were initially unpopular. Recent smart homes allow remote and local control, making household management easier.

Home is a personal space where occupants assume various roles throughout their everyday lives. Although smart homes have been around for a while, they have just recently taken shape. Keeping this in mind, a study was done to increase household awareness and utilization of this technology.

## **OBJECTIVES**

The objectives of the study were to

- Elicit personal information about the households,
- Assess the awareness, knowledge, and perception of smart home technology among household members and
- Evaluate the current implementation of smart home technologies in selected households

## **METHODOLOGY**

The study took place in Coimbatore district, located in the state of Tamil Nadu, India. Coimbatore is renowned as the most industrialized district in Tamil Nadu. The sampling method adopted was convenient sampling, and the samples selected for the study were 100 households. Survey methods were used for the study, with a highly structured questionnaire for collecting primary data. The awareness level of the benefit of smart home technologies was assessed using a Likert scale with 5,4,3, 2 and 1, respectively. Each respondent's total scores were computed and categorized into low, medium, and high based on mean and standard deviation obtained, with 46.21 and above as high scores and below 33.63 as low scores. The gathered data underwent coding, classification, tabulation, and analysis utilizing SPSS 21, alongside employing the appropriate statistical tests. For the present study, there was percentage analysis, t-test and ANOVA (Post hoc – Scheffes test).

## **RESULTS AND DISCUSSION**

The results and discussion of the study ‘Innovative Home Technology a Boom of the 3rd Millenium: A Focus on its Awareness and Utilization’ were discussed and interpreted as below under the given topics

- **Personal information about the households**
- **Awareness, knowledge and perception of smart home technology among homemakers**
- **Implementation of smart home technologies in selected households**
- **Personal information about the households**

Information about the population, including their age, marital status, location of their residence, monthly income, occupation, and type of homeownership, are discussed under this topic. A majority of about 65 percent of respondents were found to be between the ages of 41 and 50. Ninety-one percent of respondents were from nuclear households, and the data also shows that 59 percent were from metropolitan areas and 36 percent were from semi-urban areas. When the income

of respondents was analyzed, it was found that 35 percent of respondents earned less than Rs. 12,000 per month, while 17 percent of those surveyed samples made at least Rs. 62,000 per month. (Fig 1).

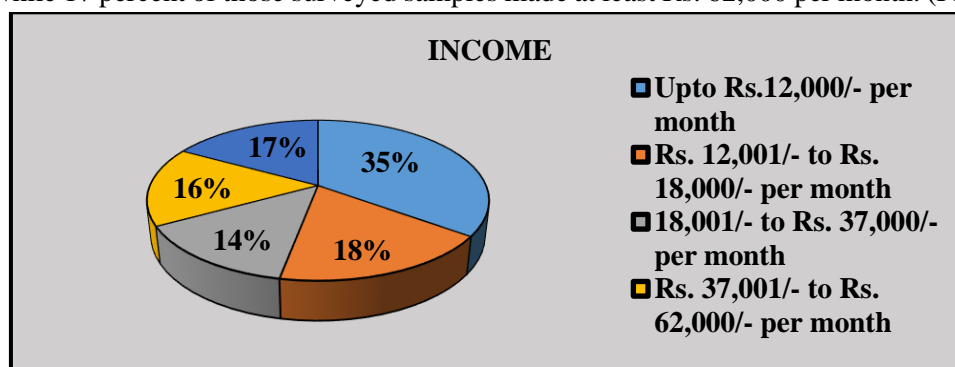


Figure 1 Income range of the selected respondents

The data shows that the respondents' incomes were well spread amongst the various brackets (except those earning up to Rs 12000/) and that 33 percent lived in rented accommodations.

#### Awareness, knowledge and perception of smart home technology among homemakers

- Information on this topic is discussed under the headings given below.
- Awareness of Smart Home Technologies among Homemakers
- Perception of homemakers' and the purpose of implementing smart home technologies in households
- Knowledge of the kind of tasks for which smart home devices are useful
- Consciousness level of benefit of smart home technologies

#### Awareness of smart home technologies among homemakers

Data collected from homemakers indicate that 74 percent of the respondents were aware of innovative home technologies, whereas 26 percent had no notion about this perspective. They also specified their awareness in detail, as 57 percent have a general idea, and nine per cent have a vague idea about this perception. In comparison, eight per cent of homemakers indicated that recognising the importance, they were already adopting innovative home technologies in their respective homes. Wozart (2022) specifies that even though the devices are user-friendly, the technology behind the smart home device still needs to be grasped by the average. Also, minimal awareness about products is one of the significant challenges home automation faces in India. Many people in India need to be made aware of the availability of smart home technologies in the market. Therefore, it is crucial to educate the public about these innovations, as many might only recognize them with proper knowledge. After providing the chosen samples with an in-depth explanation of smart home technologies, the researcher inquired about their perspectives on implementing such technologies.

#### Perception of Homemakers' and the purpose of implementing Smart Home Technologies in Households

The perception of the homemakers' purpose of using innovative home technologies in the household is represented in Table 1.

**Table 1 The Purpose of Implementing Smart Home Technology in Households**

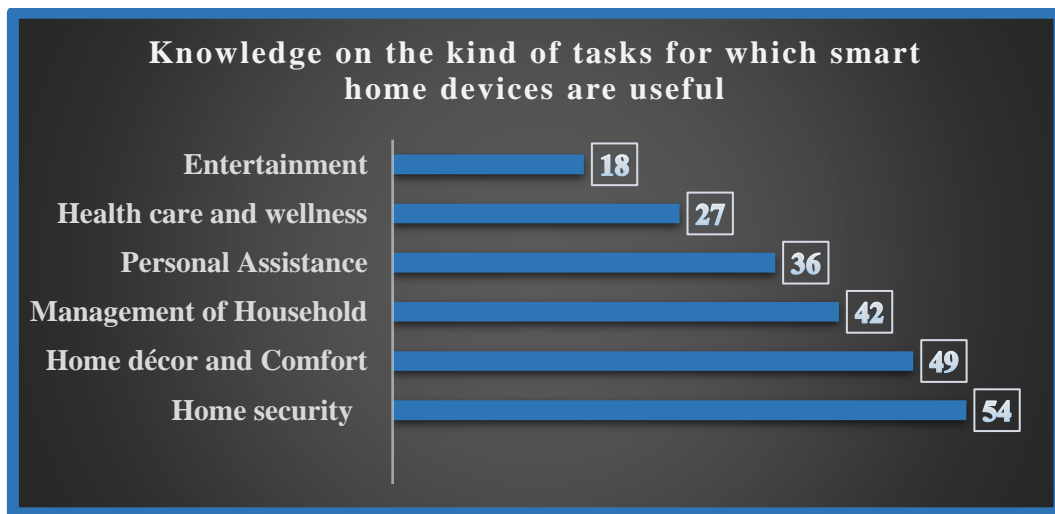
<b>Purpose of smart home technologies</b>	<b>N = 100 (Multiple Response)</b>
Making life convenient	71
Improve security and safety measures	52
Enhancing entertainment and communication	38
Control appliances	32
Conserve energy usage	31
Temperature regulation	17

Based on the information gathered, 71 percent of respondents view innovative home technologies primarily as tools to increase convenience. Additionally, 52 percent believe these technologies enhance security and safety, while 38 percent see their value in improving entertainment and communication. Remote control of appliances is valued by 32 percent, and 31 percent think these technologies help conserve energy, with 17 percent noting benefits for temperature regulation. A study by Staff (2022) observed that 92 percent of respondents said voice control has made smart home setup easier, indicating a trend in Indian smart home acceptance and use. Life is complicated, and living in a smart house can simplify work and provide them peace of mind while away from home. Thus, most respondents found it convenient.

Awareness of the use of smart home devices was assessed among 74 respondents. The data showed that 66 percent recognized these technologies' application in cooking, while lower percentages were aware of their use for cleaning (45 percent), washing (35 percent), door or window sensors (34 percent), and monitoring cameras (33 percent). Other specified uses included relaxing, using a smart oven, and preparing food, though these were less commonly cited. Additionally, only eight percent knew that smart home technologies could aid in parenting. A study by Robles, Kim, and T.-Hoon (2010) found that AI-powered home automation systems are particularly beneficial for elderly or disabled individuals, enabling them to live independently rather than in supported living institutions.

**Knowledge of the Kind of Tasks for which Smart Home Devices are Useful**

The respondents' knowledge of the kind of task for which smart home devices are useful was also assessed. The data indicated that 54 percent of respondents were aware of smart home security systems. Forty-nine percent of respondents stated that they were aware of home décor and comfort products, whereas only 18 percent were aware of entertainment products.



**Figure 2 Knowledge Of The Kind Of Tasks For Which Home Device are Useful**

Kaul (2022) claims that tech-savvy clients are aware of new technologies and willing to spend on linked home solutions that improve and simplify their lives. In response to modern lifestyles, smart household appliance makers are introducing smart water heaters and cleaners. These appliances promote health and safety. The information is represented in Fig;2.

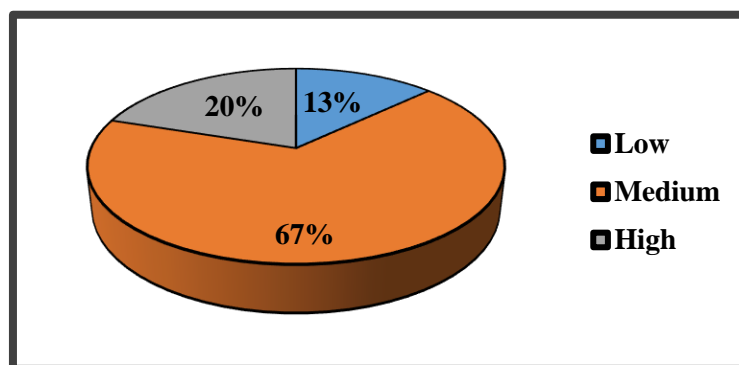
The awareness of smart home devices was assessed among homemakers. The survey revealed that 86 percent of respondents were aware of the Amazon brand, while 41 percent recognized Philips Hue. Some respondents also mentioned being aware of brands like Google, Xiaomi Mi, and LG. Brand awareness stems from a customer's familiarity with a brand. A study by Laricchia (2022) found that 59 percent of participants were familiar with Amazon's smart speakers, while awareness of Google Home devices was lower. This study aligns with the current research on awareness of Amazon's smart products.

The data on sources of information about installed smart home technologies were analyzed. Among the respondents, 85 percent received information from the Internet. In comparison, 46 percent, 42 percent, and 35 percent got their information from friends or relatives, news and magazines, and home and electrical stores, respectively and additionally, 22 percent learned through word of mouth. A study by Amazon (Staff, 2022) indicated that family and friends primarily influence smart home consumers in India to learn about new products, features, and reviews.

### **Consciousness Level on Benefit of Home Technologies**

The awareness regarding the benefits of smart home technologies was classified into three levels: low, medium, and high. Data analysis revealed that 67 percent of the respondents fell into the medium category. Conversely, 20 percent demonstrated a high level of awareness, while 13 percent exhibited a low level of consciousness regarding these benefits. PricewaterhouseCoopers (2017) reported that 81 percent of consumers are familiar with smart homes. Despite the widespread awareness of the technology, adoption rates have been sluggish.





**Figure 3 Conscious Level on Benefit of Smart Home Technologies**

When comparing respondents' ages based on their understanding of the advantages of innovative home technology, it was found that those aged 51 to 60 had the highest awareness, with a mean value of 41.13. The F value obtained was 0.720, and the p-value was greater than 0.05, indicating no significant association between age and awareness. The study also revealed that respondents aged 30-40 needed to be made aware of the advantages of smart home technology. Singh et al. (2018) suggest that older individuals are more willing to track and share information than younger demographics, especially when it benefits their physicians and caregivers. The study emphasizes the need to understand young adults' resistance to using smart home technology to address their concerns and aspirations.

The study compared respondents' awareness of smart home technologies based on location and gender. It found that urban respondents had higher awareness (Mean: 40.75) compared to those in rural areas (Mean: 38.44). Male respondents also showed slightly higher awareness than female respondents, with mean values of 40.32 and 39.83, respectively, but this difference was not statistically significant (t-value: 0.303). The higher awareness in urban areas may be due to the ease of adopting new products driven by busy lifestyles. This finding aligns with Chang and Nam's (2021) research, which suggests that the type of dwelling affects the demand for and willingness to use home automation services..

The analysis of smart home technology benefits related to annual income showed that respondents with monthly incomes above Rs. 62,001 had higher awareness (Mean: 43.76) compared to those earning up to Rs. 12,000 per month (Mean: 38.14), with a statistically significant difference (F = 2.522). A study by Coopers (2017) found that high-income individuals were more likely to engage with smart devices and were willing to invest more for enhanced security features. Comparisons of awareness levels revealed that users of smart home technologies had greater awareness of their benefits (Mean: 42.63) than those with only a vague understanding (Mean: 37.67). However, this difference was not statistically significant. Additionally, those willing to live in a smart home had higher awareness (Mean: 40.68) compared to those not interested (Mean: 34.89), with a significant difference found in the one-way ANOVA analysis (F = 3.487).

Three different comparisons on willingness to live in an intelligent home were made using the Scheffe multiple comparisons (Post hoc test). While comparing the awareness, it was discovered that there is a significant difference between people who are and are not willing to live in smart homes. According to the data, it is evident from the statistics that people who want to adopt new technologies have a thorough understanding of intelligent home gadgets, in contrast to those not interested in living in an intellectual house.

**Implementation of artificial intelligence in selected households**

The data on the willingness to live in a smart home shows that 60 percent of respondents were open to the idea, while nine percent were not, and 31 percent were uncertain. Among those surveyed, 37 percent already used innovative home technologies, while 34 percent did not, and 29 percent were unsure. A study by Staff (2022) noted that those using smart home technologies were more aware of their benefits (Mean: 41.62) compared to non-users (Mean: 38.88), though the difference was statistically insignificant. Interest in smart home applications was high, with 68 percent of respondents interested in innovative cleaning and 59 percent in security applications. However, only 16 percent showed interest in pet feeding control systems and eight percent in disabled nursery care, reflecting varied preferences influenced by individual traits and circumstances, as noted by Chang and Nam (2021), that several cognitive elements influence users' decisions to adopt smart homes.

**Table 2 Use of Smart Products among Surveyed Households**

Usage of smart home Products	Less than 1 year	1-3 years	3-5 years	More than 10 years	Not yet used
Smart lighting	13	18	11	14	44
Smart Cleaning	14	17	11	11	47
Alarms	13	11	18	28	30
Security camera	11	16	13	13	47
Video intercom	9	8	14	11	58
Sensors	9	15	14	8	54
Wifi video door bell	11	11	14	7	57
Heating system	15	17	13	18	37
Smart Air purifier	9	18	15	7	51
Universal remote control	9	14	14	5	58
Smart refrigerator	8	14	23	23	32
Smart Vacuum cleaner	7	15	9	13	56
Smart Pet feeds	10	14	6	7	63
Smoke detector	10	9	6	7	68
Smart lock	10	15	12	9	54
Home security	13	12	13	16	46

The study on smart home product usage revealed that 28 percent of respondents had used alarms, and 23 percent had used smart refrigerators for over ten years. Among all respondents, 63 percent used heating systems, 56 percent used bright lighting, and 54 percent used home security

systems. Smoke detectors were used by only 32 percent of respondents, while intelligent pet feeders were used by 37 percent, and video intercoms by 42 percent.

Smart home technologies offer creative and practical benefits but face adoption challenges. Chang and Nam's (2021) study identified obstacles, including usability issues, high costs, control uncertainties, and security concerns. These factors, along with user preferences and attitudes, significantly influence adoption intentions. Despite these challenges, awareness of smart home products has sparked interest among consumers in planning future purchases. Their plans to buy these products in future are represented in Table 3.

**Table 3 Future Plan in Buying Smart Home Products**

<b>Planning to buy these products</b>	<b>Between 1-3 (%)</b>	<b>Between 3-5 (%)</b>	<b>Between 5-10 (%)</b>	<b>More than 10 yrs (%)</b>	<b>Not yet planned (%)</b>	<b>Already have (%)</b>
<b>Smart lighting</b>	41	26	6	2	19	6
<b>Smart Cleaning</b>	36	25	9	3	21	6
<b>Security camera</b>	34	21	14	2	20	9
<b>Video intercom</b>	18	27	15	3	32	5
<b>Sensors</b>	26	21	14	1	33	5
<b>Wifi video door bell</b>	20	22	17	2	32	7
<b>Heating system</b>	27	18	11	1	28	15
<b>Smart Air purifier</b>	26	17	16	2	31	8
<b>Universal remote control</b>	19	19	13	7	37	5
<b>Smart refrigerator</b>	26	22	12	3	20	17
<b>Smart Vacuum cleaner</b>	22	18	18	4	25	13
<b>Smart Pet feeds</b>	21	19	12	4	40	4
<b>Smoke detector</b>	19	23	8	4	40	6
<b>Smart lock</b>	26	21	16	8	21	8
<b>Home security</b>	28	27	9	3	24	9

Survey results indicate a growing interest in smart home devices among Indian consumers. Within the next three years, 41 percent plan to purchase smart lighting, 36 percent smart cleaning devices, and 34 percent security cameras. Over a longer 3-5 year period, 27 percent intend to buy video intercoms and home security equipment. Most respondents expect to acquire smart devices within the next decade, with convenience (45 percent) being the primary motivator. While 21 percent find the technology appealing, 13 percent still need to be more interested. The data suggests a

potential surge in demand for smart home gadgets in India, particularly among the financially flexible working population seeking to enhance their quality of life.

The data on obstacles to purchasing smart home products show that 57 percent of respondents find them too expensive, and 20 percent view them as unnecessary. Major drawbacks include high cost, cited by 40 percent of respondents, followed by concerns about practicality or usability (23 percent) and privacy issues (21 percent). Georgiev and Schlögl (2018) found that many perceive smart home automation as a luxury for the wealthy. The data suggest that cost is a significant barrier for consumers. Due to their innovative nature, smart home devices are still in the early development stages, requiring substantial industry investment in research and development.

The data on the perception of when the smart home will become a part of our everyday life shortly was accessed, and the details are given in Table 4

**Table 4 When the Smart Homes will Enter our Daily Lives.**

<b>Smart home will become a part of our everyday life</b>	<b>N</b>	<b>Mean</b>	<b>df</b>	<b>F</b>	<b>Sig.</b>
5 to 10	54	41.41	3	2.864	.041
11 to 20	26	39.19			
More than 20	16	36.81			
Never	4	37			

Data on smart home adoption timelines revealed that 54 percent of respondents expect smart homes to become fundamental within 5-10 years, while 26 percent predict 11-20 years and 16 percent estimate over 20 years. Those predicting shorter timelines showed greater awareness of smart home benefits. The results were deemed significant at the 5 percent level,  $p < 0.05$ , and the  $f$  value was 2.864. Due to rapid home automation and sensor development, Juntunen and Sissonen (2022) say "the smart house of the future" is now a reality. Smart home adoption is the biggest issue. Homeowners need easy-to-use, secure smart home solutions. Coopers (2017) showed that 65 percent of participants were optimistic about smart technology. However, there was a significant difference between consumers who adopted a single smart device, like a thermostat and those who embraced a fully interconnected lifestyle. The study also suggested that consumers are just starting to understand the potential benefits of integrating smart home devices into their daily lives.

### **CONCLUSION**

India is undergoing a substantial digital transition across various industries, and this upheaval may only be the beginning of what is to come. The "smart home" sector, which has emerged due to the digital revolution, is currently all the rage. The field of home automation, which focuses on enhancing home safety and comfort through technological advancements, is experiencing rapid growth and expansion. Users may remotely control and monitor several home features, such as lighting, entertainment, security, temperature controls, etc.

The results of this study detail how people's knowledge of innovative home technologies compares to other characteristics, demonstrating that their primary goal is to make a living more convenient. Age and location play a significant role in awareness, and data also indicates that as annual income rises, so does understanding. High awareness was also observed among those who

stated that living in a smart home would become a part of their daily lives within the next five to ten years. Most people were willing to live in a smart home that could enhance their quality of life by offering various services to help them with their daily activities. It has been observed that homemakers' awareness and use may influence the purchasing behaviour of those who update or convert their dwellings into smart homes. It won't be long before every urban homeowner can brag about living in a smart home.

### **FUTURE SCOPE**

A longitudinal survey can be conducted with an emphasis on IoT service users.

As product development progresses, one can also conduct a market study on the current availability of products.

The difference in product use can be determined by comparing the usage of smart home devices among households with varying income levels.

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## NATURE HARMONY: REDEFINING CONNECTION BETWEEN FURNITURE DESIGN THROUGH BIOPHILIC INTEGRATION AND EMOTIONS

Dr. Shilpi Saraswat<sup>1</sup> and Ms. Bansari Panchal<sup>2</sup>

<sup>1</sup>Assistant Professor,

<sup>2</sup>M.Sc. Student,

Department of Family and Community Resource Management,

Faculty of Family and Community Sciences,

The Maharaja Sayajirao University of Baroda, Vadodara

Email: <sup>1</sup>shilpi.saraswat-fcrm@msubaroda.ac.in

<sup>2</sup>bansaripanchal99@gmail.com

HSAI Membership no.: <sup>1</sup>12/GJ/S-1/LF

### ABSTRACT

Nature has long served as a vital source of inspiration in design, providing endless ideas for creating innovative products. Understanding the impact of the environment on people's emotions is important in building better interactions between humans and their surroundings. This research aimed to explore the emotional responses of designers, educators, and students toward furniture incorporating the Biophilic Concept. The study employed a descriptive research design, with five furniture pieces (Wall Partition, Dining Table, Café Chair, TV Unit, and Coffee Table) designed using SketchUp and Lumion software, based on biophilic principles. Respondents from Vadodara City, categorized into designers, educators, and students, were selected using a stratified random sampling technique, participants were asked to reflect on their emotional responses to furniture. The research findings showed that all five pieces were perceived as interesting, with respondents showing positive emotional reactions. The most favored aspects of the biophilic furniture included promoting a healthy indoor environment, enhancing beauty, introducing a new concept, and reducing stress levels. Although many biophilic furniture designs are currently promoted through eco-design and sustainable trends, this study suggests that Biophilia theory significantly influences designers' motivations and users' emotional experiences. The research highlights the benefits of incorporating nature into built environments, demonstrating how biophilic design positively impacts health and wellbeing.

**Keywords:** Furniture design, Emotional responses, Emotions in design, Biophilic, preference for furniture

### INTRODUCTION

Biophilia, derived from the Greek roots "bio" (life) and "philia" (affection), refers that humans are naturally drawn to nature and living organisms (Wilson, 1984). This concept underpins biophilia theory, which explores the natural human tendency to connect with life and life-like processes in our surroundings, influencing our emotions and behaviors. Wilson (1984) defined biophilia as "the innate tendency to focus on life and lifelike processes." This theory evolved into "biophilic

design," a concept introduced by Kellert et al. (2008), which seeks of integrating natural components into developed spaces can enhance human well being. Biophilic design involves a deliberate attempt to integrate nature into architecture and interiors, enhancing the physical, mental, and emotional health of individuals.

Research has demonstrated that environments enriched with natural elements, such as plants, can positively impact human health. Studies in various fields, including psychology and human behavior, have shown that exposure to nature, even in built environments like hospitals and offices, can aid recovery, reduce stress, and improve productivity (Baun et al., 1984; Kaplan, 1995; Gray & Birrell, 2014; Grinde & Patil, 2009). Pot plants, small aquariums, or images of greenery have been shown to enhance attitudes, behaviors, and overall quality of life (Kaplan, 1995; Gray & Birrell, 2014; Grinde & Patil, 2009).

Furniture design, the creation of functional, movable objects like tables, chairs, and beds, is increasingly influenced by biophilic principles. However, the intersection of biophilic design and furniture design remains underexplored. This study investigates how furniture that combines natural elements and plant life influences consumers' emotions and shopping behavior, shedding light on a previously unexplored aspect of interior design. Scholars in design, consumer behavior, and marketing have increasingly recognized the role of emotions in shaping user experiences. Products can evoke emotions through their usability, context, and aesthetic appeal, influencing satisfaction and interaction (Russell, 1992; Desmet, 2000, 2012; Dazkir & Read, 2011).

This research highlights the compatibility of biophilic design principles with furniture design, emphasizing elements such as natural materials, colors, and botanical motifs. The study explores how integrating plants into furniture design can evoke positive emotional responses and contribute to health and well-being. Current trends in design and architecture emphasize reconnecting with nature, driven by environmental consciousness. Furniture designs incorporating plants align with this trend, promoting green living and offering significant benefits for health, education, and productivity. This study aims to popularize the concept of furniture with plants, providing valuable insights for designers, educators, and students interested in sustainable and environment-friendly design practices.

### **Statement of Problem**

The present research aims to design furniture with plants and to assess emotional responses, of designers, educators and students towards them and reasons for their preference.

### **OBJECTIVES OF THE STUDY**

1. To design furniture with plants.
2. To ascertain the emotional responses of designers, educators and students towards furniture with plants designed by the researchers.
3. To find out the reason for preferring furniture with plants.



## METHODS AND MATERIALS

### Study design

To gather insights into the emotional connections of educators, designers, and students with the specially designed plant-infused furniture, the study adopted a descriptive research design, allowing for a comprehensive collection of data.

### Study area and Sample

The study was conducted in Vadodara, the third-largest city in Gujarat, known for its cultural and natural heritage. The research focused on educators, designers, and students from the design field. The study used a stratified random sampling approach to select a diverse group of 224 participants, categorized into three main groups: design professionals, educators, and students. For the designer group, 15 Members of the Institute of Indian Interior Designers (IIID) who were actively practicing interior design were randomly selected for participation. Additionally, 15 furniture designers were chosen randomly from local furniture firms following a market survey. Among the four universities in Vadodara offering Interior Design courses—The Maharaja Sayajirao University, Parul University, Navrachna University, and ITM University—only Parul University granted permission for data collection. From this university, 12 educators and 30 students were selected randomly. At the Maharaja Sayajirao University, 8 educators and 67 students from the regular program, along with 10 educators and 67 students from the higher payment program, were randomly selected from the Department of Family and Community Resource Management. Each chosen participant was asked for their consent to take part in the study, and all 224 agreed, forming the final sample size.

### Inclusion criteria

1. The current study had a scope limitation, focusing on the design of only 5 furniture pieces.
2. SketchUp and Lumion software was for designing furniture with plants.
3. Respondents were those educators and students who were teaching and pursuing degree in designing field.

### Exclusion criteria

1. Individuals who declined to participate or did not provide consent were excluded from the study.
2. The scope of this research was limited to interior design professionals, educators, and students, and did not extend to other design disciplines like landscape, product, graphic, or web design.

### Instrument

For the present study, a questionnaire was developed as the data collection tool, informed by a review of related literature, expert consultations, and guidance from field specialists. Care was taken to include questions that would effectively capture the information needed to meet the study's objectives. The PrEmo scale, a pre-validated instrument designed to assess people's emotions, was

adapted for this research. The original PrEmo scale includes 14 emotional responses—7 positive (Desire, Hope, Pride, Joy, Admiration, Satisfaction, Fascination) and 7 negative (Boredom, Dissatisfaction, Contempt, Sadness, Shame, Fear, Disgust). The researcher selected seven relevant emotions for this study: five positive (Interesting, Appreciable, Inspiring, Preferring, Amazing) and two negative (Boring, Displeasing). Respondents were shown colored pictures of furniture with plants, which included details about patterns, textures, and materials. The participants' emotional responses and reactions were recorded after they viewed each image of the furniture design. Additionally, the respondents were requested to select reasons for preferring specific pieces of furniture (Wall partition, Dining table, T.V. unit, Cafe chair, Coffee table). The reasons provided were: "Will be very useful," "Looks beautiful," "Promotes healthy indoor environment," "New concept," "Brings greenery inside," "Innovative design," "Improves indoor air quality," "Can Reduce stress levels," "Requires less maintenance," "Can be durable," and "Can be comfortable in use." The scales developed for the study were reviewed by experts, and no modifications were deemed necessary. An 80% consensus among the judges was used as a benchmark for finalizing the tool. The reliability of the scales was established through a pilot study with 30 respondents, using the split-half method. The reliability coefficients for emotional responses towards furniture with plants and reasons for preference were found to be 0.843 and 0.768, respectively. The questionnaire was then administered to collect data, where respondents identified the emotions and reasons that best matched their responses to the furniture designs, providing insightful feedback.

### **Data Collection**

The researcher personally collected data, explaining the research purpose and building rapport to ensure authentic responses. Consent was obtained, and only willing participants provided the needed information. Respondents were notified of their right to withdraw from the study at any time, without incurring any negative consequences or repercussions, to ensure their comfort and autonomy.

## **RESULTS AND DISCUSSIONS**

The designs of Furniture with Plants were developed using Sketchup and Lumion software. An attempt was made to assess emotional responses of the respondents towards furniture with Plants designed by the researcher.

### **i. Emotional responses of Designers, Educators and Students towards Furniture with Plants:**

For assessing emotional response, PrEmo emotional scale was used. There were seven emotional responses, two were negative emotional response i.e. Boring and Displeasing where other five were positive emotional response i.e. Interesting, Appreciable, Inspiring, Preferring, Amazing. Respondents were asked to examine the furniture designs featuring plants, reflect on their emotional reactions and identify and choose the emotions that best described their feelings after viewing the images (Wall partition, Dining table, T.V. unit, Cafe chair, Coffee table).

**Table 1: Emotional responses of Designers, Educators and Students towards Furniture with Plant**

Respondents	Emotional Responses	Furniture				
		Wall Partition (%)	Dining table (%)	Cafe chair (%)	T.V. Unit (%)	Coffee table (%)
<b>Designers (n=30)</b>	Interesting	16.70	<b>30.00</b>	13.30	23.30	13.30
	Boring	3.30	00	6.70	00	10.00
	Appreciable	20.00	20.00	10.00	20.00	20.00
	Displeasing	00	00	10.00	00	00
	Inspiring	23.30	13.30	6.70	10.00	<b>23.30</b>
	Preferring	6.70	13.30	16.70	20.00	10.00
	Amazing	<b>30.00</b>	23.30	<b>36.70</b>	<b>26.70</b>	<b>23.30</b>
<b>Educators (n=30)</b>	Interesting	25.00	16.70	16.70	8.30	16.70
	Boring	8.30	16.70	<b>25.00</b>	<b>33.30</b>	16.70
	Appreciable	<b>33.30</b>	<b>33.30</b>	<b>25.00</b>	25.00	<b>33.30</b>
	Displeasing	8.30	8.30	00	00	8.30
	Inspiring	25.00	16.70	8.30	8.30	16.700
	Preferring	00	8.30	8.30	16.70	0
	Amazing	00	00	16.70	8.30	8.30
<b>Students (n=164)</b>	Interesting	<b>36.00</b>	<b>31.10</b>	<b>32.30</b>	<b>34.80</b>	<b>33.50</b>
	Boring	0.60	0.60	2.40	2.40	1.80
	Appreciable	25.00	18.30	17.10	20.70	17.70
	Displeasing	0.60	00	2.40	0.60	00
	Inspiring	16.50	25.00	20.10	15.90	18.30
	Preferring	8.50	8.50	9.80	8.50	11.00
	Amazing	12.80	15.90	15.90	17.10	17.70

**Wall Partition:** The wall partition was designed for residential use, measuring 1'-6" wide, 10'-0" long, and 7'-6" high. The base, made of rosewood, features an opaque glass fence (6" high, 1.5" thick) and supports four potted plants: Spider Plant, Areca Palm, Boston Fern, and Aglaonema Pearl. Three opaque glass panels, 7'-6" high and 2'-0" wide, are spaced evenly with flat aluminum batten strips in front. Marble pillars with geometric display boxes for artifacts and plants were placed between the glass panels. A rosewood section, 1'-0" high, was added 8'-0" above the floor.



**Figure 2: Front Elevation of Wall Partition**



**Figure 3: Back Elevation of Wall Partition**

Table 1 reveals that the majority of students found the wall partition "Fascinating," educators expressed "Admiration," and designers felt "Surprised." Negative responses like "Boring" and "Disgusting" were minimal across all groups. Overall, the wall partition received the highest approval, particularly from students, indicating strong support for the design among key respondents.

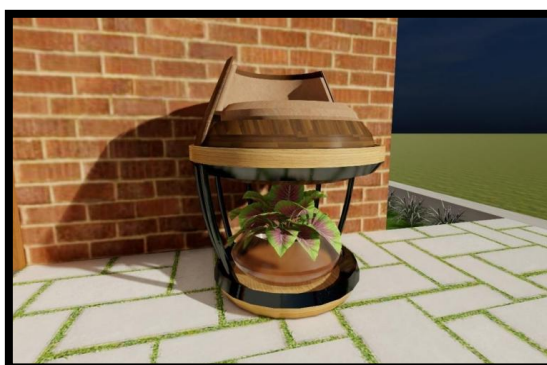
**Dining table:** A six-seater dining table was designed with dimensions of 6'-0" in length, 3'-6" in width, and 2'-6" in height, suitable for residential or commercial use. Two wooden legs (3.5" thick, 2'-4" high) and two metal legs (3" thick, 2'-4" high) support the table. A 4'-0" long, 1'-0" wide, and 3" thick footrest connects the legs. The table features a 2" thick glass top, with a central rectangular section of 7" depth, 8" height, and 1" width for added functionality.



**Figure 4: Elevation of Dining table**

The results showed that educators found the dining table "Appreciable," while students and designers found it "Interesting." Few respondents expressed negative emotions like "Boring" or "Displeasing." Overall, the dining table received the highest positive emotional responses from all key groups (Table 1).

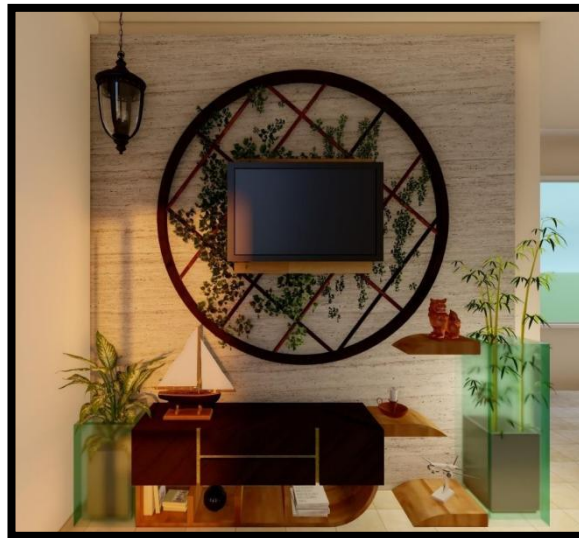
**Cafe chair:** The café chair, designed for café use, features a round wooden base enclosed in a metal frame, with a diameter of 1'-10" and a height of 2'-6". It includes a round acrylic pot with an artificial Stromanthe Triostar plant. The seating height is 2'-0", with a 2'-3" diameter wooden frame and a round cushion upholstered in beige linen fabric. The backrest is semi-circular, 11" high, and the cushion thickness is 3".



**Figure 5: Elevation of Café chair**

More than a third of designers were "Amazed" by the café chair, while slightly fewer students found it "Interesting." A quarter of designers found it "Appreciable." Few respondents described the chair as "Boring" or "Displeasing." The results show a consistent and strong positive emotional connection to the design among students, educators, and professionals, demonstrating its emotional impact and effectiveness (Table 1).

**T. V. Unit:** The T.V. unit, designed for residential use, features a dual-section layout. At 8 feet from the floor, a circular wooden frame with a 6-foot-3-inch diameter is adorned with eight diagonal wooden batten strips in a checkered pattern. An artificial creeper is mounted on the frame, supported by the strips. At the floor level, a teak wood storage unit measuring 4 feet-11 inches in length, 1 foot-6 inches in width, and 2 feet-6 inches in height provides ample storage. It includes two drawers, each 2 feet-3 inches in length and 5 inches in height, positioned one above the other, and two shutters, each 1 foot-3 inches in length and 1 foot in height, at the ends. The unit features open shelves at the bottom for accessories. Additionally, three wooden planks, square and 3 inches thick, are arranged in a zigzag pattern on the right side. Potted plants are placed at the unit's ends, with artificial bamboo on the right and pearl plants on the left, covered with tinted glass.



**Figure 6: Elevation of T.V. unit**

The data indicated a notable difference in opinion between students, who found the TV unit 'Interesting', and educators and designers, who were more effusive in their praise, characterizing it as 'Amazing'. Negative responses were minimal, with few describing it as "Boring" or "Displeasing." The results show a unanimous positive emotional response to the TV unit design, with all three groups - students, educators, and designers - expressing strong enthusiasm and admiration for it. (Table 1).

**Coffee table:** The octagon-shaped coffee table, suitable for both residential and commercial spaces, measures 1'-9" in height and 1'-6" in width. It features metal legs of 20mm thickness and a sal wood table top with a 3" high wooden frame. The table top is covered with artificial grass, and a corner section made of acrylic holds a potted African violet plant.



**Figure 7: Elevation of Coffee Table**

The data indicated that students were intrigued by the coffee table, finding it 'Interesting', whereas educators had a more pronounced appreciation for it, characterizing it as 'Appreciable'. A portion of designers found it "Amazing" or "Inspiring." Negative responses were minimal across all groups. The coffee table design elicited overwhelmingly positive emotional reactions across the board, with designers, educators, and students all expressing strong enthusiasm and admiration for it (Table 1).

ii. **Overall emotional responses of the respondents towards Furniture with Plants:** The scores of frequency for emotional responses of all the three key respondents were totaled up for each furniture in order to find out the emotional responses for each furniture piece separately.

**Table 2: Overall emotional responses of the respondents towards Furniture with Plants**

Furniture (Respondents n=224)					
Emotions	Wall Partition (%)	Dining Table (%)	Café Chair (%)	T.V. Unit (%)	Coffee Table (%)
Interesting	32.50	30.00	28.60	31.50	29.60
Boring	1.40	1.40	4.30	3.80	3.80
Appreciable	24.70	19.40	16.50	20.80	18.90
Displeasing	0.97	0.40	3.30	00	00
Inspiring	17.90	22.80	17.40	14.50	18.90
Preferring	7.70	9.20	10.60	10.20	10.10
Amazing	14.50	16.00	18.90	17.90	17.90

**Wall Partition:** The data in table 2 indicated that most respondents found the wall partition “Interesting” or “Appreciable,” with some describing it as “Inspiring.” A smaller portion perceived it as “Amazing” or “Preferring,” while very few found it “Boring” or “Displeasing.”

**Dining Table:** Most respondents found the dining table “Interesting” or “Inspiring,” with others considering it “Appreciable” or “Amazing.” Few rated it as “Preferring,” “Boring,” or “Displeasing.”

**Café Chair:** Most respondents found the café chair “Interesting,” with others considering it “Amazing,” “Inspiring,” or “Appreciable.” Few viewed it as “Preferring,” “Boring,” or “Displeasing.”

**T.V. Unit:** Most respondents found the T.V. unit “Interesting” or “Appreciable,” with some rating it as “Amazing,” “Inspiring,” or “Preferring.” A small number considered it “Boring.”

**Coffee Table:** Most respondents found the coffee table “Interesting,” with others considering it “Appreciable,” “Inspiring,” or “Amazing.” Very few saw it as “Preferring” or “Boring.”

iii. **Reasons behind preference for furniture with plants**

Here the respondents were asked to state the reasons for their preference of furniture with plants. The reasons were categorized as “it will be useful”, “Looks beautiful”, “Promotes healthy indoor environment”, “New concept”, “Bring greenery inside”, “Innovative design”, “Improves indoor air quality”, “Can reduce stress levels”, “Require less maintenance”, “Can be durable”, “Can be comfortable inuse”.

**Wall Partition:** According to Table 3, the majority of respondents expressed a preference for the furniture design featuring plants, suggesting a clear trend towards embracing natural elements in design.

**Dining Table:** Table 3 reveals that the majority of respondents favored the dining table with plants, citing its aesthetic appeal, health advantages, creative design, incorporation of greenery, ability to reduce stress, and capacity to purify the air as the primary reasons for their preference.

**Table 3: Reasons behind preference for furniture with plants**

Reasons for preference	Furniture with plant (n=224)				
	Wall partition	Dining table	Café chair	T.V. unit	Coffee table
	%	%	%	%	%
Very useful	24.72	20.35	22.14	18.04	20.44
Looks beautiful	46.70	40.11	38.92	40.72	40.88
Promotes healthy indoor environment	<b>50.00</b>	<b>49.70</b>	<b>46.97</b>	<b>53.60</b>	35.35
New concept	27.47	35.32	44.29	39.69	<b>43.64</b>
Bring greeneryinside	40.10	32.33	37.58	3.60	33.70
Innovative design	32.96	35.92	40.93	40.72	35.35
Improves indoor air quality	38.46	35.32	38.92	36.08	34.25
Can reduce stresslevels	41.20	35.32	41.61	34.53	36.46
Requires lessmaintenance	9.89	10.17	11.40	9.79	14.91
Can be durable	11.53	15.56	16.77	15.46	16.57
Can be comfortablein use	26.37	23.35	28.18	19.07	26.51

*\*Multiple responses*

**Café Chair:** Most respondents preferred the café chair with plants for its beauty, new concept, stress reduction, innovative design, and health benefits. It also improved air quality and added greenery indoors.

**T.V. Unit:** Most respondents preferred the T.V. unit with plants for its beauty, innovative design, health benefits, new concept, improved air quality, and stress reduction.

**Coffee Table:** Most respondents favored the coffee table with plants for its new concept, beauty, stress reduction, innovative design, and health benefits. It also improved air quality and added greenery indoors.

The most favored reasons for preferring furniture with plants were promoting a healthy indoor environment, enhancing beauty, presenting a new concept, and reducing stress levels.

## DISCUSSION AND CONCLUSION

The emotional dimension is a crucial factor in shaping individual interactions with their environment, as emotions significantly influence how people perceive, respond to, and connect with their physical and social contexts. Positive emotions such as joy and tranquility are often linked to natural settings like parks or green spaces, while negative emotions such as stress and anxiety can arise in urban areas with high pollution and noise levels. Historically, humans have



integrated natural elements into their built environments to not only serve practical purposes but also enhance overall well-being. This integration is supported by the concept of “biophilia,” which suggests an innate human affinity for nature. Integrating indoor plants into interior spaces is a powerful tool for enhancing human health and happiness, as it not only purifies the air and reduces toxins but also fosters a sense of calm, improves focus, and supports overall well-being by bridging the gap between nature and built environments. This emphasizes the positive impact of indoor plants on human health, cognitive function, and environmental quality, making a strong case for incorporating them into indoor spaces. The incorporation of biophilic design principles has been a common practice in architecture and landscaping to create natural, human-centered environments. However, there is significant potential to extend these principles into interior and furniture design. Furniture, being a central component of interior spaces, can benefit from biophilic elements to create a more immersive and holistic experience. The fusion of green elements into furniture design represents a convergence of ecological responsibility and the fundamental human need for nature connection, as espoused by the biophilia theory, allowing individuals to cultivate a sense of well-being and tranquility in their daily lives. This highlights the synergy between sustainable design, biophilia, and human well-being, emphasizing the importance of integrating natural elements into our built environments.

Recent studies have shown that furniture designs incorporating plants are increasingly popular, driven by their aesthetic appeal, sustainability, and potential benefits to users’ well-being. The incorporation of plants into furniture has been proven to have a therapeutic effect, promoting relaxation, reducing anxiety, and enhancing mood, ultimately contributing to a greater sense of well-being and life satisfaction. This emphasizes the scientifically-backed benefits of combining plants with furniture, showcasing the potential for biophilic design to positively influence human health and happiness. This trend highlights the growing recognition of the positive impact of biophilic design on user experiences and emotions. In India, where research on this topic is still emerging, there is substantial scope for further exploration. Future studies could investigate how furniture incorporating plants or other natural elements affects user experiences and emotions. Additionally, research could explore designers’ motivations for creating such pieces and the influence of biophilia theory on their creative processes. This area of study presents an exciting intersection of biophilia and furniture design, offering opportunities for innovation and improved well-being through the integration of natural elements.

The study emphasizes the significance of understanding users’ emotional responses to furniture design, particularly when incorporating plants. Emotional engagement can foster long-lasting relationships with furniture, enhancing users’ satisfaction and attachment. Participants in the research found furniture designs with plants to be interesting, suggesting that natural elements can evoke positive emotional reactions. This emotional connection is a powerful factor in design, influencing users’ perceptions and decisions. The results emphasize the crucial role of environmental responsibility in furniture design, demonstrating that pieces crafted with eco-friendly materials and practices are highly regarded for their beauty, functionality, and positive impact on indoor air quality and overall well-being. This highlights the growing importance of sustainability in furniture design, where environmental considerations are increasingly valued alongside traditional factors like beauty and functionality. Designers must balance creating sustainable products with meeting other consumer needs, fulfilling not only functional and aesthetic requirements but also spiritual and emotional needs. Emphasizing sustainability can help

mitigate the "buy it today, throw it away tomorrow" consumer cycle, benefiting both the environment and consumer satisfaction.

Ultimately, the study underscores the importance of returning to fundamental design principles to create furniture that meets users' needs and fosters emotional connections. Furniture should be considered as art, incorporating elements like color, texture, and form to become objects of beauty and desire. Designers should be mindful of the risk of over technologizing products, which can strip them of their emotional resonance and create a sense of alienation, instead aiming for a harmonious fusion of technology and human-centered design that nurtures meaningful connections between people and their belongings. This emphasizes the importance of balancing technological advancements with human needs and emotions, ensuring that products remain relatable, intuitive, and emotionally engaging. Addressing fundamental human needs such as relationships and emotional pleasure can foster long-term attachments and reduce consumption, contributing to both sustainability and product satisfaction.

### **ETHICAL APPROVAL**

The study was approved by the institutional ethics committee for human research (IECHR), Faculty of Family and Community Sciences, The Maharaja Sayajirao University of Baroda, Vadodara with the ethical approval number IECHR/FCSc/M.Sc./2021/166.

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## POSTURAL ANALYSIS OF ROSE FARM WORKERS: AN ERGONOMIC STUDY

**Dr. Urvashi Mishra<sup>1</sup>, Ms. Eliza Upadhyaya<sup>2</sup>, Ms. Poripurna Goswami<sup>3</sup>**

<sup>1</sup>Assistant Professor

Department of Family and Community Resource Management,  
Faculty of Family and Community Science, The Maharaja Sayajirao University of Baroda

Email id: urvashi.mishra-fcrm@msubaroda.ac.in

HSAI life membership Number: (09/U-3/LF)

<sup>2</sup>Ph.D Scholar

Department of Family Resource Management and Consumer Science  
College of Community Science, Assam Agricultural University

Email id: elizaupadhyaya941@gmail.com

<sup>3</sup>Teaching Assistant

Department of Family and Community Resource Management,  
Faculty of Family and Community Science, The Maharaja Sayajirao University of Baroda

Email id: poripurna.g-fcrm@msubaroda.ac.in

HSAI life membership Number: (HSAI-2023-AS-1515-LF)

### ABSTRACT

The cultivation of roses plays a crucial role in the floral industry due to its high demand and profitability. However, rose farm workers often experience physical discomfort from maintaining awkward postures during the harvesting process, affecting their overall well-being. This study aimed to analyze the postures adopted by workers during rose harvesting. Using a descriptive research design, 60 workers were selected through purposive sampling. Data were collected via interviews and observations, with descriptive statistics used for analysis. The findings showed that most workers were male (76.67%) with an average age of 39 years. Despite having 2-6 years of work experience, none reported medical-related health issues. The study found that the duration of maintaining adopted postures varied, with less than one-third working for short durations (90-133 minutes) and over one-fourth for long durations (178-221 minutes). Statistical analysis indicated a positive relationship between posture duration and situational variables, with age significantly affecting posture, while BMI and work experience did not. Recommendations included introducing rest breaks to reduce exhaustion and improve workers' mobility and flexibility, thereby reducing the risk of musculoskeletal disorders.

**Keywords:** rose farm, workers, posture, rose harvesting

### INTRODUCTION

“Postures means the carriage of the body as a whole, the attitude of the body, or the position of the limbs, the arm, and the legs”. (Bridger1995)

A person's posture during tasks is influenced by the relationship between body dimensions and workplace demands. According to Pheasant (2001), the degree of postural constraint is determined by the connections between the individual and their environment. Ideal, balanced postures maintain mechanical body balance, preventing dysfunction and pain by allowing relaxed positioning and releasing unnecessary tension.

In flower cultivation, harvesting poses significant postural hazards. The main postures during this process are standing and forward bending. Poor posture can lead to postural stress, fatigue, and pain, potentially halting work until recovery. This is particularly true when continuous movement or a forward-leaning posture is required. Pheasant (2001) emphasizes that varied working postures are preferable, as fixed positions increase the risk of harm due to static work demands.

Correct posture, or a neutral posture, minimizes stress on joints and muscles, keeping the body aligned and supported. For instance, when standing, a straight line should ideally be drawn from the earlobe through the shoulder, hip, knee, and ankle, which allows muscles and joints to function efficiently (Schafer, 1983). Poor posture, especially without adequate back support, can strain muscles and stress the spine, potentially leading to significant issues such as constricted blood vessels, muscle problems, and even organ complications.

Prolonged standing or forward bending increases spinal pressure, especially when slouching or bending with straight legs, which disrupts natural spinal curves and stresses the lower back. Wagner (2013) recommends keeping the back straight and bending at the knees and hips to mitigate these effects, reducing strain on muscles and discs.

#### **The Factors Which Place the Rose Farm Workers at A Higher Risk**

Rose farm workers face numerous work-related risks due to repetitive and stressful tasks, including twisting, standing, and forward bending for long periods. Key factors contributing to their higher risk include:

- **Repetitive Motion Disorder:** Repeated trauma to soft tissues, often from using hand or vibrating tools, leads to repetitive motion disorders. This type of injury can be caused by forceful work activities, awkward or static postures, and mechanical pressure. Movements such as repetitive hand or arm actions, wrist bending, grasping objects, and frequently raising the arm or shoulder are common culprits (Bernard et al., 1993).
- **Hand Grips:** The human hand performs a variety of gripping actions, broadly classified into power grips and precision grips. Power grips involve clamping objects against the palm using fingers and sometimes the thumb, while precision grips manipulate objects between the tips of the fingers and thumb. The distinction between gripping and non-gripping actions is crucial as it influences the strain placed on the hands during work (Napier, 1956).
- **Hand and Wrist Postures:** Tools that force the wrist into awkward positions increase stress on tendons, especially as the wrist deviates from its neutral position. Ulnar deviation (bending the wrist toward the little finger) and radial deviation (bending toward the thumb) are particularly stressful, reducing the effective strength of the wrist's muscles and increasing the risk of injury (Khayal, 2019).
- **Rest Pauses:** Rest is essential for balancing energy consumption and replacement, particularly during heavy work. Introducing rest pauses helps prevent fatigue, enhances performance, and reduces absenteeism. Scheduled breaks improve efficiency by speeding up work and decreasing unplanned pauses. Rest breaks also provide opportunities for refreshment and social interaction, which contribute to maintaining overall well-being.

Despite the risks associated with rose farm work, there is a lack of studies focusing on the postural analysis of these workers, both in India and internationally. Recognizing this gap, the current study titled "Postural Analysis of Rose Farm Workers" was initiated to address these concerns.

### **Statement of the Problem**

The present study aims to analyze the working posture adopted during the Rose harvesting process by the Rose farm workers of selected farms in Vadodara District.

### **Objectives of the Study**

1. To collect background information on Rose farm workers engaged in Rose harvesting process.
2. To examine the duration of maintaining the adopted postures by the Rose farm workers during Rose harvesting process.
3. To analyse the frequency and duration of rest pauses taken; distance covered; time spent; and frequency of repetition of the task done by the Rose farm workers during Rose harvesting process.

### **Delimitations of the Study:**

The present study was limited

1. to the selected Rose farms of Vadodara districts having a minimum of ten farm workers engaged in Rose harvesting process (Plucking, Gathering and Heaping) and having minimum production of Rose crops above 70 kg per day.
2. to those Rose farm workers who were above 18 years, have minimum two years of work experience, physically and mentally normal and females, not in the pregnancy stage.

### **Hypotheses of the Study**

1. There exists a relationship between the intervening variable (duration of maintaining adopted posture during Rose harvesting process) and the situational variables (viz. time duration spent, distance covered, the quantity of Rose harvested and frequency of repetitive task performed while Rose harvesting process).
2. There exists a difference in the intervening variable (duration of maintaining adopted posture during Rose harvesting) due to personal variables (viz. age and work experience) of the Rose farm workers.

## **METHODOLOGY**

For the present study, descriptive research design was adopted. The study was conducted among the 60 male and female Rose farm workers of Vadodara district, who are engaged in the rose harvesting process including plucking, gathering and heaping and had minimum two years of experience with the same crop. For the present study, purposive sampling technique was used for the selection of rose farm and rose farm workers. Out of the five major rose-growing districts in Gujarat, Vadodara was selected for the present study, because it has the largest number of Kashmiri rose farms. Only workers over the age of 18, with at least two years of experience with the same crop, who were physically and mentally, and especially females who were not in the pregnancy stage, were chosen to participate in the research study. The information was gathered using a pre-tested and pre-validated structured interview schedule and observation sheet and was analysed by applying descriptive statistics.

### FINDINGS AND DISCUSSIONS

The present study revealed that, more than three-fourths (76.67%) of the respondents were males with a mean age of 39 years. 80% of the respondents were from a nuclear family. 91.67% of the respondents had 2- 6 years of work experience in the field of Rose harvesting and their mean family monthly income was ₹9500 (Table 1). None of the respondents had medical-related health problems are also not pregnant. The land area of the Rose farm ranged between 3-4 Bigha having production up to 101-131 kg per day.

<b>Table1:Background information of the respondents</b>			
SR.NO	Background information	Respondents(N=60)	
		<i>f</i>	%
<b>Age (in years)</b>			
	21-36	28	46.67
	37-52	22	36.67
	53-68	10	16.67
	<b>Mean</b>		39.36
	<b>Standard Deviation</b>		11.74
<b>Gender</b>			
	Male	46	76.67
	Female	14	23.33
<b>Family Type</b>			
	Nuclear	48	80
	Joint	12	20
<b>Family Monthly Income</b>			
	₹5000 – 10000	47	78.34
	₹11000 – 16000	11	18.33
	₹17000 - 22000	2	3.33
	<b>Mean</b>		₹9500
	<b>Standard Deviation</b>		3191.13
<b>Work Experience</b>			
	2 – 6 years	55	91.67
	7 – 11 years	3	5
	12 – 17 years	2	3.33
	<b>Mean</b>		4.06
	<b>Standard Deviation</b>		2.35

- **Postures Adopted, Frequency of Rose Harvesting Task (Plucking, Gathering and Heaping) and Overall Time (in hrs.) spent on Rose Harvesting Process by the Rose Farm Workers.**

Table 2 showcased that, all (100%) of the respondents performed the task (Plucking, Gathering and Heaping) by adopting standing and forward bending posture as the main posture during Rose harvesting process. Further, it can be observed that 100 percent of the respondents performed the

Rose harvesting task (Plucking, Gathering and Heaping) daily and a majority (83.33%) of the respondents spent 3-4 hrs. for Rose harvesting.

**Table 2: Distribution of the Respondents according to the Postures Adopted, Frequency of Performing the task and Actual Time (in hrs.) Spend on Rose Harvesting Process (Plucking, Gathering and Heaping) of selected Rose Farms.**

Main Postures Adopted for Rose Harvesting	Respondents (n=60)	
	<i>f</i>	%
Standing and Forward bending	60	100
Only Standing	0	0
Frequency of Rose Harvesting		
Daily	60	100
Alternate Days	0	0
Actual time spent (in hrs.) for Rose Harvesting		
1-2	10	16.67
3-4	50	83.33

• **Duration of Maintaining Adopted Postures (in seconds per plant) by the Rose Farm Workers During Rose Harvesting Process (Plucking, Gathering and Heaping).**

Analysis of results given in table 3, reveals that during task “Picking” of the Rose cent per cent of the respondents adopted standing and forward bending posture. Wherein more than half (66.67%) of the respondents maintained the adopted posture for 10-12 second (sec/plant), one-fourth (25%) of the respondents maintained the adopted posture for 7-9 seconds (sec/per plant) and less than the tenth (8.33%) of the respondents maintained the adopted posture for 4-6 second (sec/plant) during the picking of Rose crops.

Similarly, regarding the task “Gathering” of Rose crops into the Rose collecting bag cent per cent of the respondents adopted a standing posture. Wherein, more than half (65%) of the respondents maintained the adopted posture for 4-6 seconds (sec/plant), less than one-third (26.67%) of the respondents maintained the adopted posture for 10-12 (sec/plant) and less than the tenth (8.33%) of the respondents maintained adopted posture for 7-9 seconds (sec/plant) during the Rose crops Gathering process (table 3).

Whereas, for moving from one plant to another plant for picking and gathering Rose it was found that less than three fourth (73.33%) of the respondents took 4-6 seconds time for moving, one-fifth (20%) of the respondents took 10-12 second time for moving and less than the tenth (6.67%) of the respondents took 7-9 second time for moving from one plant to another plant (table 3).

**Table 3: Distribution of Respondents according to the duration of maintaining the Adopted Postures (in seconds per plant) by the Rose Farm Workers during Rose Harvesting Process (Plucking, Gathering and Heaping).**

Time Duration of Maintaining the Adopted Posture (in sec/plant)	Standing and Forward Bending		Only Standing		Moving	
	<i>f</i>	%	<i>f</i>	%	<i>f</i>	%
4-6	5	8.33	39	65	44	73.33

7-9	15	25	5	8.33	4	6.67
10-12	40	<b>66.67</b>	16	<b>26.67</b>	12	20

• **Time Duration Taken (in min) Per Trip and Extent of Body Discomfort Experienced (Measured by Extent of Exhaustion) by the Rose Farm Workers During Rose Harvesting**

The information given in table 4, describes the time duration taken for harvesting Rose crops per trip and Extent of Body Discomfort experienced by the Rose Farm workers during each trip.

**Table 4: Distribution of Respondents according to the time duration taken (in min) per trip and Extent of Body Discomfort (Measured on Extent of Exhaustion) Experienced during Rose Harvesting Process (Plucking, Gathering and Heaping).**

Time Duration (in min)		The extent of Body Discomfort (Extent of Exhaustion)										(n=60)	
		Not Exhausted		Little Exhausted		Moderately Exhausted		Extremely Exhausted		Completely Exhausted			
	<i>f</i>	%	<i>f</i>	%	<i>f</i>	%	<i>f</i>	%	<i>f</i>	%	<i>f</i>	%	
<b>Bag 1 = 1 Trip (n=60)</b>													
30-40	38	<b>63.33</b>	28	<b>46.67</b>	22	36.67	4	6.67	6	10	0	0.00	
41-50	14	23.33											
51-60	8	13.33											
<b>Bag 2 = 2 Trip (n=60)</b>													
30-40	22	36.67	0	0.00	18	30	22	<b>36.67</b>	13	21.67	7	11.67	
41-50	28	<b>46.67</b>											
51-60	10	16.67											
<b>Bag 3 = 3 Trip (n=50)</b>													
30-40	0	0.00	0	0.00	0	0.00	11	22	24	<b>48</b>	15	30	
41-50	41	<b>68.33</b>											
51-60	9	15											
<b>Bag 4 = 4 trip (n=30)</b>													
30-40	0	0.00	0	0.00	0	0.00	0	00	4	13.33	26	<b>86.67</b>	
41-50	3	5											
51-60	27	<b>45</b>											

In the rose harvesting process, all respondents were able to make four trips, with each trip carrying a 4 kg bag of roses. For the first trip, 63.33% of respondents took 30-40 minutes, while 46.67% took 41-50 minutes for the second trip. During the third trip, 68.33% took 41-50 minutes, and 45% took 51-60 minutes for the fourth trip.

Regarding body discomfort and exhaustion, among the 60 respondents, 10% were extremely exhausted, and 6.67% were moderately exhausted after the first trip, while 36.67% were slightly exhausted, and 46.67% felt no exhaustion. During the second trip, 36.67% were moderately



exhausted, 30% slightly exhausted, 21.67% extremely exhausted, and 11.67% completely exhausted, with 10 respondents unable to continue.

By the third trip, out of 50 respondents, 30% were completely exhausted, 48% extremely exhausted, and 22% moderately exhausted, with 20 respondents unable to proceed. During the fourth trip, among the remaining 30 respondents, 86.67% were completely exhausted, and 13.33% were extremely exhausted, with all unable to continue harvesting (table 4).

- **Distribution of the Respondents (Rose Farm Workers) according to the Time Duration Taken for the overall (4 trips) Rose Harvesting Process (Plucking, Gathering and Heaping).**

According to table 5, the results revealed that less than one-third (30%) of the respondents took short duration (90-133 minutes) time, less than half of the respondents took moderate duration (134-177 minutes) time and more than one-fourth of the respondents took long duration (178-221 minutes) time for overall (4 trips) process of Rose harvesting.

Time Duration	Range Score (in minutes)	<i>f</i>	%
Short Duration	90-133	10	16.67
Moderate Duration	134-177	20	33.33
Long Duration	178-221	30	<b>50</b>

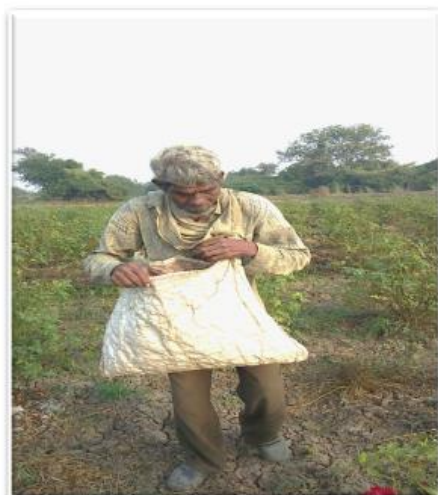
- **Spontaneous Rest Pauses and Recommended Rest Pauses taken by Rose Farm Workers**  
Regarding the spontaneous rest pauses and the recommended rest pauses during rose harvesting process, it was observed that none of the selected farm workers took spontaneous rest pauses and nor was prescribed recommended rest pauses during the Rose harvesting process (Plucking, Gathering and Heaping)

- **Distribution of the Respondents (Rose Farm Workers) according to the Distance Covered for the overall (4 trips) Rose Harvesting Process (Plucking, Gathering and Heaping)**

According to table 6, the results revealed that less than one-fifth (16.67%) of the respondents covered short distances (643-871 meters), one-third (33.33%) of the respondents covered moderate distances (872-1100 meters) and a half (50%) of the respondents covered long distance (1101-1329 meter) for overall (4 trips) Rose harvesting process (Plucking, Gathering and Heaping) with the Mean of **1088.35** in meters.

Distance Covered	Range Score (in meter)	<i>f</i>	%
Short Distance	643-871	10	16.67

Moderate Distance	872-1100	20	33.33
Long Distance	1101-1329	30	<b>50</b>
<b>Mean</b>	<b>1088.35</b>		



**Plate 1: Adopted posture by Rose Farm workers while covering distance during rose harvesting process with rose collecting bags hanged on their neck**

### Testing of the Hypotheses

To test the hypotheses ANOVA and the Coefficient of Correlation was computed to analyze the findings statistically.

**HO<sub>1</sub>:** There exists no significant relationship between the intervening variable (duration of maintaining adopted posture during Rose harvesting process) and the situational variables (viz. time duration spent, distance covered, the quantity of Rose harvested and frequency of repetitive task performed while harvesting process).

**Table 7: Coefficient of correlation between the intervening variable (duration of maintaining adopted posture) with the situational variables (viz. time duration spent, distance covered, quantity of Rose harvested and frequency of repetitive task performed)**

Situational Variables	Duration of maintaining adopted posture		
	N	'r' values	Level of Significance
Time duration spent on the Rose harvesting process	60	.579	*0.01
Distance covered during the Rose harvesting process	60	.649	*0.01
The quantity of rose harvested	60	.674	*0.01
Frequency of repetitive tasks performed during the Rose harvesting process			
Plucking	60	.709	*0.01

Gathering	60	.584	*0.01
Heaping	60	.584	*0.01
<i>*Level of Significance = 0.01 level</i>			

The coefficient of correlation was calculated between the duration of maintaining posture by rose farm workers during harvesting and various situational variables, such as time spent, distance covered, quantity harvested, and frequency of repetitive tasks. The data in **Table 7** shows a positive relationship between the duration of maintaining posture and these situational variables. Consequently, the null hypothesis (H01) was rejected at the 0.01 level of significance. This indicates that the time spent on harvesting, distance covered, quantity harvested, and the frequency of repetitive tasks significantly affected the duration of posture maintenance by the workers during the rose harvesting process.

**HO<sub>2</sub>: There exists no significant difference in the intervening variable (duration of maintaining adopted posture during Rose harvesting) due to personal variables (viz. age and work experience) of the Rose Farm workers**

<b>Table 8: Analysis of variance for selected intervening variables (duration of maintaining adopted posture during Rose harvesting) with personal variables (viz. age and work experience) of the Rose Farm Workers.</b>					
Personal Variables	Sum of Square	Mean Square	df	F <sub>(Cal)</sub>	Level of Significance
<b>Age</b>					
Between Group	726.654	363.327	2	27.578	*0.01
Within Group	764.133	13.175	58		
<b>Work Experience</b>					
Between Group	80.655	40.328	2	1.659	N. S.
Within Group	1410.132	24.313	58		
<i>N.S. = Not significant *Level of Significance = 0.01 level</i>					

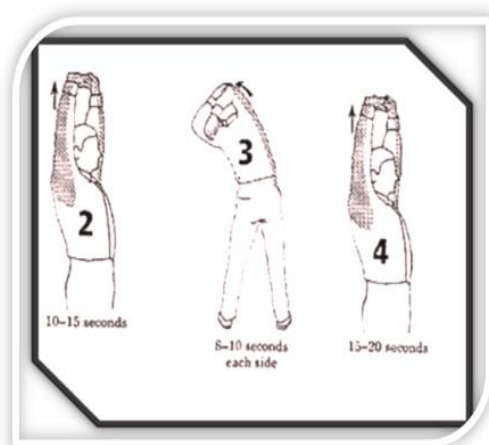
ANOVA was used to assess the variation in the duration of maintaining posture among rose farm workers based on their age and work experience. The results in Table 8 show that the computed F-value for the duration of maintaining posture during the rose harvesting process was significant at the 0.01 level concerning the workers' age. This suggests that the duration of maintaining posture significantly varies with age. However, the F-ratio for work experience was not significant, indicating no variation in posture duration based on work experience. Therefore, the null hypothesis (H02) was partially accepted.

**Conclusion**

The findings, clearly highlighted that the duration of maintaining adopted posture by the Rose farm worker during Rose harvesting process was significantly affected only due to age of the respondents but not due Work Experience of the respondents.

## COPING STRATEGY

It was observed that during rose harvesting process farmers do not take rest due to which they are exhausted. Therefore, it is suggested that farmers should take rest pause after every short interval and do some stretching of the body during the rose harvesting process because rest periods are the perfect time to improve mobility and stretching is necessary for body flexibility.



**Plate 2: Suggested rest pause and body stretching after every short interval during the rose harvesting process to improve flexibility**

## CONCLUSION

Rose is one of the top-selling flowers in the global flower trade and stands first among the commercial cut flowers. As far as in Gujarat state, the majority of the land area is under traditional flower cultivation like Desi Rose, Kashmiri Rose, Marigold, Lily and Jasmine. The major Rose growing districts of Gujarat are Bharuch, Vadodara, Ahmedabad, Kheda, and Chota Udaipur, where Roses are Cultivated in 4178 hectares and production is 38865 MT.

Vadodara being the second-highest district known for Rose production mainly cultivate two types of Roses such as Kashmiri Rose and Desi Rose which are very much in demand. Rose farm workers of Floriculture Industry performs numerous labour-intensive jobs such as land preparation, removing of stalks and stubbles, levelling, making of field compartment, preparation of channels for irrigation, digging of Rose crop into land, manuring, weeding (plant to plant), pruning and budding, spraying of pesticides on Rose crop and lastly, harvesting of Rose crops in which Rose farm workers are involved in the task like of plucking, gathering, heaping of the Rose crop. Therefore, Rose cultivation and harvesting is considered to be a drudgery prone activity.

During Rose harvesting activity from morning till evening, workers usually adapt squatting posture and they continue to work in this posture for a long duration without adapting any other posture due to which they face severe pain in lower back and knees. It was observed that cent per cent (100%) of the respondents performed the task (Plucking, Gathering and Heaping) daily by

adopting standing and forward bending posture during Rose harvesting process and the majority (83.33%) of the respondents spent 3-4 hrs. for harvesting.

Regarding maintaining the adopted posture, it was observed that more than half (66.67%) of the respondents maintained the adopted posture for 10-12 second (sec/plant), during the picking of Rose crops. Similarly, more than half (65%) of the respondents maintained adopted posture for 4-6 second (sec/plant) during Gathering of Rose crops into the Rose collecting bag. Whereas, for moving from one plant to another plant for picking and gathering Rose it was found that less than three fourth (73.33%) of the respondents took 4-6 second time for moving.

### **Implications of the Study**

The findings of the investigation brought out several implications for the field of Family and Community Resource Management, Floriculture Industry, Krishi Vigyan Kendra, Ergonomic tool and Equipment designers which are described as follow.

- **For the Floriculture Industry:** it will be helpful to the Rose farm workers and owners to increase productivity and eliminated postural discomfort by following effective posture.
- **For the Field of Family and Community Resource Management:** the present research will add literature of studies and also will also be helpful to develop a need-based extension education program on farm ergonomics for farmers of the floriculture industry to enhance their productivity at workplace.
- **For the Krishi Vigyan Kendra:** present study can be helpful to Krishi Vigyan Kendra in developing educational programs on postural difficulties and effective posture for the floriculture industry workers.

### **Recommendations for Future Researches**

1. A Comparative study on discomfort or health problem faced by the farm workers dealing with different flower crops can be undertaken.
2. A research study can be carried out to know the farming activities performed by women farm workers during the harvesting of flowering crops.
3. A research study can be carried out to know the health consequence of pesticide used in different flowering crops
4. A research study on mechanical injuries experienced by the farm workers dealing with different flowering crops can be undertaken.

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## NUTRITIONAL KNOWLEDGE, ATTITUDE AND PRACTICES (KAP) OF THE YOUNG SPORTSPERSONS IN THE THIRUVANANTHAPURAM DISTRICT, KERALA

**Aishwarya. R<sup>1</sup>, Dr Mini Joseph<sup>2</sup>**

<sup>1</sup>PhD Research Scholar,<sup>2</sup>Assistant Professor

Food and Nutrition, PG Department of Home Science and Research Centre, Govt.  
College for Women, Thiruvananthapuram.

Email Id: luckyaish@gmail.com, minijoseph66@yahoo.in

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### ABSTRACT

Athletes and sportspeople must have an adequate diet to perform at their best and stay healthy. There is a significant impact of nutritional knowledge, attitudes, and practices on the performance, recovery, and health of sportspersons. This study examined the Nutritional Knowledge, Attitude, and Practices (KAP) of young sportspersons in Thiruvananthapuram, Kerala. The study involved 100 sportspersons aged 13-24 years ( $18.73 \pm 2.35$ ). This study used descriptive statistics (mean, frequency, and standard deviation) along with paired sample t-tests. According to the results, the mean score of nutritional knowledge before the session was  $69.30 \pm 16.530$ , immediately after the session ( $75.20 \pm 13.742$ ), after 1 month ( $73.50 \pm 14.933$ ) and after 3 months ( $72.30 \pm 16.197$ ). The score increased following the session ( $t = -5.030$ ,  $p = .000$ ) while the score declined as time passed. The mean score of the attitude after the session was  $78.48 \pm 7.718$ , after 1 month was  $83.86 \pm 6.788$  and after 3 months was  $80.66 \pm 8.195$ . After three months, scores showed a decline ( $t = -3.733$ ,  $p = .000$ ) compared with after 1 month. After the session, the practice scored  $63.80 \pm 10.774$ , after 1 month was  $66.26 \pm 11.609$  and after 3 months was  $65.98 \pm 10.520$ . When compared with the after 1 month, the scores declined after 3 months ( $t = -1.002$ ,  $p = .177$ ). In all of the above situations, the amount of retention decreased over time. It was concluded that providing continuous nutrition education through seminars, workshops, educational materials, and consultation with nutrition professionals can ensure that athletes are knowledgeable and equipped to make informed dietary choices throughout their careers, contributing to long-term health and athletic success.

**Keywords:** Nutritional Knowledge-Attitude-practices-nutrition education-performance

### INTRODUCTION

Athletes always seek ways to improve their performance in the dynamic world of sports, where milliseconds can make the difference between victory and defeat. While rigorous training and skill development are integral components, one aspect that often takes centre stage is nutrition. The importance of nutritional knowledge for sportspersons cannot be overstated, as it serves as the foundation for optimal physical and mental well-being, crucial for achieving peak athletic

performance. It is important for any sports player, but it is especially important for elite sports players, to have good nutritional knowledge. Nutrition-based food choices can be achieved by consolidating the rationales behind improved dietary behaviour (Vázquez-Espino et al., 2022).

The nutritional knowledge of sportspersons is crucial to their performance and mental well-being. Almost everyone recognizes the link between nutrition and athletic performance, and understanding the importance of proper nutrition is crucial for any athlete. Nutrition knowledge helps sportspeople meet their nutritional needs more effectively (Werner et al., 2022).

Athletes require micronutrient (macro) and nutrient (micronutrient) supplementation, as well as fluids, including timing of meals. It is crucial to maintain an appropriate body mass index (BMI) and body fat percentage as well as meet energy requirements. Poor nutritional literacy is associated with poor nutrition education, which can lead to poor eating habits (Escribano-Ott et al., 2022).

To ensure optimal physical and mental well-being, student-athletes must comprehend the fundamental concepts of sports nutrition, which will enable them to manage their body weight and maintain their health while simultaneously enhancing their training outcomes. It is crucial to achieve a harmonious equilibrium between their practice and competition routines, academic coursework, personal choices, cultural and religious factors, and the motivation to modify their conduct. (Heaney et al., 2011). It is though necessary to understand nutrition knowledge and behavior before setting up any counselling or educational program.

Research indicates that youth athletes possess limited nutritional knowledge, with much of their nutritional information coming from illegitimate sources like coaches, teachers, other athletes, the internet, and social media (Spendlove et al., 2012). Surveys and questionnaires have been used to assess athletes' nutrition knowledge through either a general nutrition assessment or a sport-specific nutrition assessment (Alaunyte et al., 2015). Nutrition knowledge needs to be measured with high-quality research that uses validated tools (Heaney et al., 2011).

When a specific health reason requires physical activity, athletes and physical activity professionals need nutritional knowledge to improve their performance (Alahmadi & Albassam, 2023). Prior studies have demonstrated that athletes have a poor understanding of nutrition. Some athletes only want to perform at their best every day, while others aim to advance to higher competition levels or even become pros in their field (Khan et al., 2021). Nutritional KAP can be evaluated to increase athletes' performance through improved nutritional quality (Vázquez-Espino et al., 2022).

Relative energy deficiency in sport (RED-S) is a condition that can develop when an athlete fails to meet these demands for an extended period. Due to low energy intake, low performance, and poor health associated with low energy availability, this condition can negatively impact bone mineralization, performance, and health (Klein et al., 2021). The majority of participants got low scores for both poor nutrition practice and knowledge (54.3% and 55.3%, respectively) (Sunuwar et al., 2022). It was determined that student-athletes with a sports nutrition knowledge score of 63.54% need to improve their sports nutrition knowledge (average of 75%) (Serhan et al., 2022). The lack of nutrition awareness, however, can negatively affect athletes' nutritional status and performance (Janiczak et al., 2022). Because of this lack of knowledge, athletes often turn to nutritional supplements to improve their performance. Athletes can, however, be harmed by nutritional supplements that are not prescribed by a doctor (Khan et al., 2021).

Dietary behaviours are determined by nutrition knowledge, which affects food intake levels. Sportspeople can make informed health decisions with the right nutrition knowledge, as with all individuals (Jenner et al., 2018). Nutrition knowledge increases athletes' performance



levels by improving their dietary habits, and better dietary habits lead to higher performance levels. The level of nutrition knowledge is affected by a variety of factors, including gender, age, socio-demographic characteristics, and educational background.

There are not many evidence-based studies on factors influencing nutritional knowledge, attitudes and practice among sportspersons in Kerala. Furthermore, sports nutrition awareness, attitudes and practices among sportspersons in the state of Kerala are still unknown. During three months, this study examined nutrition knowledge, attitudes, and practices among sportspersons in Kerala.

### **OBJECTIVES**

- To assess the socio-demographic and sports profile of the young sportspersons.
- To evaluate the nutritional knowledge, attitude and practices of the young sportspersons

### **HYPOTHESIS**

H<sub>A</sub>: There is a significant relationship between the Knowledge, Attitude and Practices (KAP) of the young sportspersons in Thiruvananthapuram district, Kerala about nutrition awareness on pretest, immediately after session, after one month and after three months.

### **METHODOLOGY**

#### **Study design**

In this study, young athletes of different sports disciplines were analyzed. It included 13-24-year-old participants.

#### **Questionnaire Design and Scoring**

To develop the questionnaire, a search summary of peer-reviewed publications was combined with a panel discussion with a subject expert to gain information on nutritional knowledge, attitude, and practice. There were several questions developed about basic nutrition, sports nutrition, and hydration. Further testing and modifications were made to the structured interviewer-administered questionnaire. Questions were given to the subject expert and non-subject expert (Physical Education) for evaluation. Once the questions with the highest scores had been selected, they were put into the final form. The questionnaire was revised to make it more user-friendly and minimize the burden on respondents. Furthermore, several experts were consulted to minimize confirmation bias. The knowledge, attitude, and practice questionnaires were translated into Malayalam after being tailored to the local context. In all three components, knowledge, attitude, and practice, the questions were closed-ended (yes or no, Likert scale), so confirmation bias was minimized.

A comprehensive scoring system was devised to assess the participants' knowledge, attitude, and practices (KAP) related to nutrition based on their responses. The system was developed to provide a detailed description of the findings obtained from the study. The section on knowledge comprised ten assertions that could be answered as either "true" or "false." Each correct response elicited a score of "1," while an incorrect response resulted in a score of "0." The set of ten statements associated with the attitude aspect was designed to be assessed using a Likert scale with responses ranging from "strongly agree" to "strongly disagree." The ratings ranged between "1" and "5", with "5" being the most favourable and "1" being the most unfavourable. In the practice part, 10 statements were created with Likert scale responses ranging from "strongly agree" to "strongly disagree". The scores ranged from "1" to "5", with "5" being the most favourable and

"1" the most negative. The following scoring was calculated by adding the scores for all of the responded questions for Knowledge, Attitude, and Practice. The result suggests that the participant's knowledge, practice habits, and positive attitude improve as the score increases. Overall, a positive attitude shows that you believe nutrition and food have an impact on athletic performance. People with positive attitudes are more likely to remain ambitious and aware of the nutritional value of the food they consume.

#### **Nutrition education**

Participants were inquired whether they had ever participated in a nutrition session before. Most participants (65%) did not know about nutrition, whereas 35% had attended nutrition sessions previously. There was a session on various aspects of sports nutrition. During the session, basic sports nutrition was covered and the questionnaire questions were addressed.

#### **Interview and data collection**

The researcher visited the study area and arranged short meetings with corresponding coaches before data collection. The researcher and the assistant were involved during the data collection process. Informed written consent is obtained from each participant after the researcher and assistant inform them of the study's objectives, relevance, confidentiality, and participant's rights. Before the session, a knowledge pretest was given, then the session was conducted for the athletes, then the data was collected after the session, and the athletes took around 5-10 minutes to complete the form. Data was collected again after one month and three months from the same participants.

#### **Statistical analysis**

The information was inputted into an Excel spreadsheet and subsequently examined utilizing the Statistical Package of Social Sciences (SPSS) version 20. An analysis of paired sample t-tests was performed to compare knowledge, attitude, and practice scores. The descriptive statistics were calculated using the Mean, the Standard Deviation (SD), and the Standard Error. Statistical significance was determined by a probability value of 0.05.

## **RESULTS AND DISCUSSIONS**

### **Socio-demographic profile of young sportspersons in Kerala**

**Table 1: Socio-demographic profile of young sportspersons in Kerala**

<b>Age</b>	
<b>13-16 yrs</b>	<b>8%</b>
<b>16-20 yrs</b>	<b>63%</b>
<b>20-24 yrs</b>	<b>29%</b>
<b>Gender</b>	
<b>Males</b>	<b>71%</b>
<b>Females</b>	<b>29%</b>
<b>Educational Qualification</b>	
<b>08-10<sup>th</sup> class</b>	<b>4%</b>
<b>10-12<sup>th</sup> class</b>	<b>42%</b>
<b>Degree</b>	<b>54%</b>
<b>PG</b>	<b>0%</b>
<b>Type of family</b>	

<b>Joint</b>	<b>30%</b>
<b>Nuclear</b>	<b>69%</b>
<b>Extended</b>	<b>1%</b>
<b>Area of residence</b>	
<b>Rural</b>	<b>59%</b>
<b>Urban</b>	<b>15%</b>
<b>Coastal</b>	<b>25%</b>
<b>Tribal</b>	<b>1%</b>
<b>Economic Status</b>	
<b>Yellow card</b>	<b>10%</b>
<b>Pink Card</b>	<b>60%</b>
<b>Blue Card</b>	<b>21%</b>
<b>White Card</b>	<b>9%</b>

Table 1 displays the socio-demographic characteristics of young sportspersons in Kerala. The study included participants aged 13 to 24. In a study, the distribution of participants' ages was as follows: 8% were between 13 and 16 years old, 63% were between 16 and 20 years old, and 29% were between 20 and 24 years old. There were 71% males and 29% females. The proportion of students who attend 8-10th and secondary school is approximately 4% and 42%, respectively. The degree was attended by 54% of the students. Households are made up of 69% nuclear families and 30% joint families, respectively. The extended family contributes 1%. The study found that 59% of the 100 participants lived in rural areas, 15% in urban areas, 25% in coastal areas, and 1% in tribal areas. Out of 100, 10% were in the yellow card category (the most economically backward section of society), 60% were in the pink card category (Below Poverty Line (BPL)), 21% were in the blue card category (Above Poverty Line (APL)) and only 9% were in the white card category (Non - Priority).

### Personal/sports profile of young sportspersons in Kerala

**Table 2: Personal/Sports profile of young sportspersons in Kerala**

PARAMETERS	PERCENTAGE
<b>Sports Specialization</b>	
<b>Cricket</b>	<b>5%</b>
<b>Wrestling</b>	<b>2%</b>
<b>Archery</b>	<b>2%</b>
<b>Football</b>	<b>39%</b>
<b>Wushu</b>	<b>6%</b>
<b>Handball</b>	<b>2%</b>
<b>Hockey</b>	<b>10%</b>
<b>Kho-Kho</b>	<b>6%</b>
<b>Athletics</b>	<b>15%</b>
<b>Karate</b>	<b>6%</b>
<b>Decathlon</b>	<b>4%</b>
<b>Kabbadi</b>	<b>3%</b>

Level of Participation	
School	24%
Inter-collegiate	4%
s-district	2%
District	10%
State	33%
Revenue	2%
South	2%
National	22%
Khelo-India	1%
Nutrition Class	
Yes	35%
No	65%
Special Diet	
Yes	17%
No	83%
Sleep	
4-6 hrs	5%
6-8 hrs	44%
8-10 hrs	39%
10-12 hrs	12%

Table 2 illustrates the personal/sports profile of a young sportsperson from Kerala. The study indicated that 17% of the 100 participants had a particular diet, whereas 83% did not. Out of 100 individuals, 5% slept 4-6 hours per day, 44% slept 6-8 hours per day, 39% slept 8-10 hours per day, and 12% slept more than 10 hours per day. Cricket (5%), Wrestling (2%), Archery (2%), Football (39%), Wushu (6%), Handball (2%), Hockey (10%), Kho-Kho (6%), Athletics (15%), Karate (6%), Decathlon (4%) and Kabbadi (3%) were among those who took part in the survey. The study included 24% of participants who participated at the school level, 4% at the intercollegiate level, 2% at the s-district level, 10% at the district level, 33% at the state level, 2% at the revenue level, 2% at the south level, 22% at the national level, and 1% at the Khelo-India level. 35% of individuals attended nutrition classes, whereas 65% did not.

### Gender

**Table 3: Gender-wise distribution of the young sportspersons**

Gender	Frequency	Per cent
Male	71	71.0
Female	29	29.0
Total	100	100.0

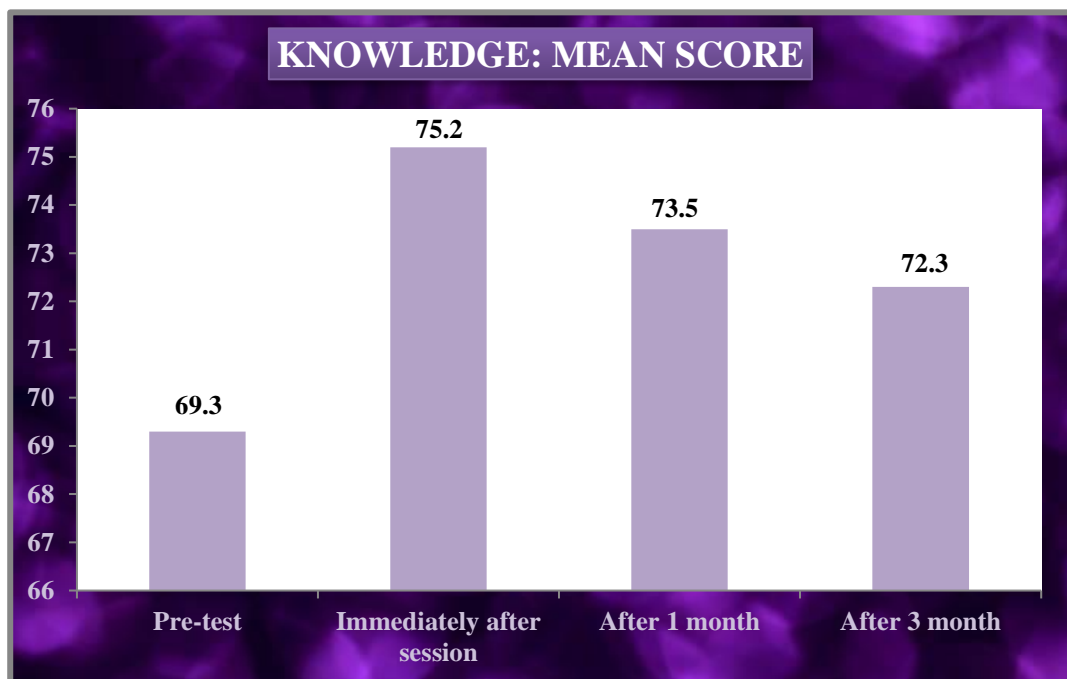
For the present study, gender-wise distribution of the young sportspersons shows that there were 71 Males and 29 Females.

### Knowledge

**Table 4: Knowledge: Mean score of the young sportspersons**

Pair	Period	Mean±SD	t-value	Sig
<b>K-Pair 1</b>	Pretest	69.30±16.530	-5.030	.000
	Immediately After Session	75.20±13.742		
<b>K-Pair 2</b>	Immediately After Session	75.20±13.742	.861	.391
	After 1 month	73.50±14.933		
<b>K-Pair 3</b>	After 1 month	73.50±14.933	1.053	.295
	After 3 month	72.30±16.197		
<b>K-Pair 4</b>	Pretest	69.30±16.530	-1.476	.143
	After 3 month	72.30±16.197		

A paired samples t-test showed that the sportsperson’s knowledge increased from pre-test (M = 69.30, SD = 16.530) to immediately after session (M = 75.20, SD = 13.742;  $t = -5.030, p < .001, d = .50$ ). This also showed that the sportsperson’s knowledge decreased from immediately after session (M = 75.20, SD = 13.742) to after 1 month (M = 73.50, SD = 14.933;  $t = .861, p < .001, d = 0.08$ ). It is also evident that the sportsperson’s knowledge decreased from after 1 month (M = 73.50, SD = 14.933) to after 3 months (M = 72.30, SD = 16.197;  $t = 1.053, p < .001, d = .10$ ). The sportsperson’s knowledge increased from pre-test (M = 69.30, SD = 16.530) to after 3 month (M = 72.30, SD = 16.197;  $t = -1.476, p < .001, d = 0.14$ ).



**Fig 1: Knowledge: Mean score of the young sportspersons**

**Table 5: Knowledge: Gender-wise distribution of the mean score of the young sportspersons**

Pair	Period	Male			Female		
		Mean±SD	t-value	Sig	Mean±SD	t-value	Sig
K-Pair 1	Pretest	68.17±16.929	-4.229	.000	72.07±15.441	-2.726	.011
	Immediately After Session	74.37±14.115			77.24±12.789		
K-Pair 2	Immediately After Session	74.37±14.115	-.552	.583	77.24±12.789	2.521	.018
	After 1 month	75.63±15.188			68.28±13.112		
K-Pair 3	After 1 month	75.63±15.188	-.563	.575	68.28±13.112	1.864	.073
	After 3 month	76.20±15.433			62.76±14.116		
K-Pair 4	Pretest	68.17±16.929	-3.462	.001	72.07±15.441	2.969	.006
	After 3 month	76.20±15.433			62.76±14.116		

From Table 5, the mean score of the young male sportspersons showed that they had higher scores immediately after the session. They were statistically significant. They had an increase in the scores obtained immediately after the session after 1 month and after 3 months. The score marked after three months showed an increase in the scores and was statistically significant. The mean score of the young female sportspersons showed that they had higher scores immediately after the session. There were statistically significant differences in the scores obtained immediately after the session and after 1 month. There was a decrease in the scores after 1 month and after 3 months. The score marked after three months showed a decline when compared with after 1 month and 3 months.

**Attitude**

**Table 6: Attitude: Mean score of the young sportspersons**

Pair	Period	Mean±SD	t-value	Sig
A-Pair 1	After Session	78.48±7.718	-12.977	.000
	After 1 month	83.86±6.788		
A-Pair 2	After 1 month	83.86±6.788	7.713	.000
	After 3 month	80.66±8.195		
A-Pair 3	After Session	78.48±7.718	-3.733	.000
	After 3 month	80.66±8.195		

A paired samples t-test showed that the sportsperson’s attitude increased from after session (M = 78.48, SD = 7.718) to after 1 month (M = 83.86, SD = 6.788;  $t = -12.977, p < .001, d = 1.29$ ). The sportsperson’s attitude decreased from after 1 month (M = 83.86, SD = 6.788) to after 3 month (M = 80.66, SD = 8.195;  $t = 7.713, p < .001, d = 0.77$ ). It shows that the sportsperson’s attitude decreased from after the session (M = 78.48, SD = 7.718) to after 3 months (M = 80.66, SD = 8.195;  $t = -3.733, p < .001, d = .37$ ).

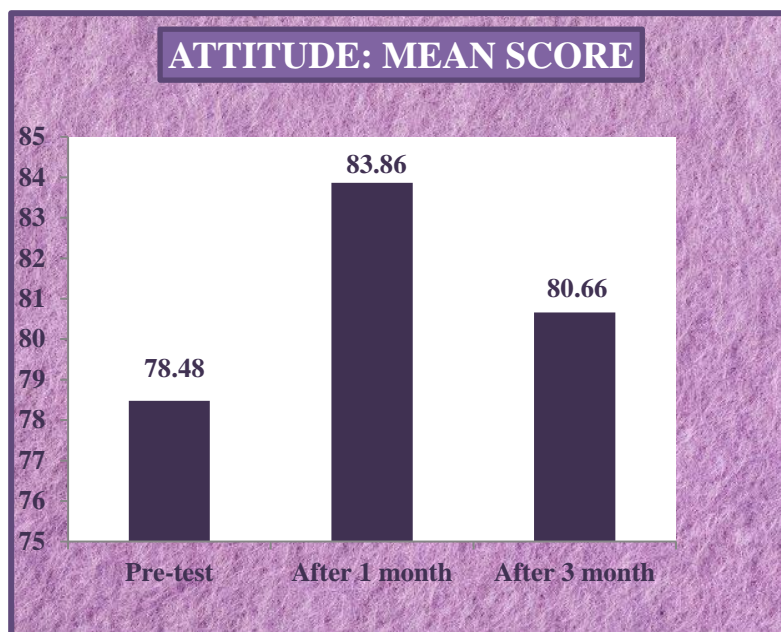


Fig 2: Attitude: Mean score of the young sportspersons

Table 7: Attitude: Gender-wise distribution of the mean score of the young sportspersons

Pair	Period	Male			Female		
		Mean±SD	t-value	Sig	Mean±SD	t-value	Sig
A-Pair 1	After Session	78.62±7.758	-10.460	.000	78.14±7.745	-7.734	.000
	After 1 month	83.94±6.633			83.66±7.272		
A-Pair 2	After 1 month	83.94±6.633	6.587	.000	83.66±7.272	5.477	.000
	After 3 month	80.28±8.454			81.59±7.585		
A-Pair 3	After Session	78.62±7.758	-2.280	.026	78.14±7.745	-3.793	.001
	After 3 month	80.28±8.454			81.59±7.585		

From Table 7, the mean score of the young male sportspersons in the perspective of attitude showed that they had higher scores after 1 month. They were statistically significant. They had an increase in the scores after 1 month and after 3 months which was statistically significant. The score marked after three months showed an increase in the scores and was statistically significant. The mean score of the young female sportspersons showed that they had higher scores after 1 month and was statistically significant. There were statistically significant differences in the scores obtained after 1 month and after 3 months. The score marked after three months showed an increase when compared to after the session.

**Practice**

Table 8: Practice: Mean score of the young sportspersons

Pair	Period	Mean±SD	t-value	Sig
P-Pair 1	After Session	63.80±10.774	-3.371	.001
	After 1 month	66.26±11.609		
P-Pair 2	After 1 month	66.26±11.609	.170	.866
	After 3 month	65.98±10.520		

<b>P-Pair 3</b>	After Session	63.80±10.774	-1.002	.177
	After 3 month	65.98±10.520		

A paired samples t-test showed that the sportsperson’s practice increased from after session (M = 63.80, SD = 10.774) to after 1 month (M = 66.26, SD = 11.609;  $t = -3.371, p < .001, d = .33$ ). The sportsperson’s practice decreased from after 1 month (M = 66.26, SD = 11.609) to after 3 month (M = 65.98, SD = 10.520;  $t = .170, p < .001, d = 0.02$ ). It is also evident that the sportsperson’s practice decreased from after the session (M = 63.80, SD = 10.774) to after 3 months (M = 65.98, SD = 10.520;  $t = -1.002, p < .001, d = 0.15$ ).

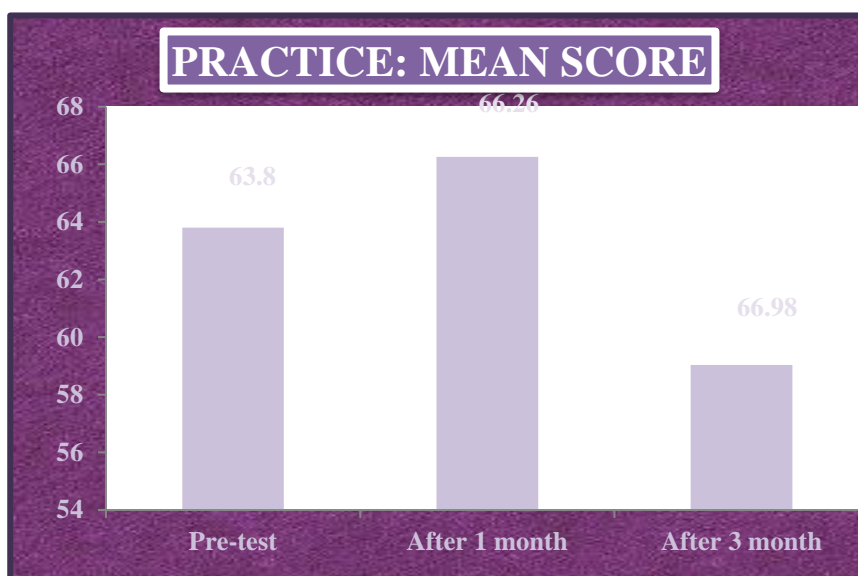


Fig 3: Practice: Mean score of the young sportspersons

Table 9: Practice: Gender-wise distribution of the mean score of the young sportspersons

Pair	Period	Male			Female		
		Mean±SD	t-value	Sig	Mean±SD	t-value	Sig
<b>P-Pair 1</b>	After Session	63.97±10.088	-3.437	.001	63.38±12.480	-1.011	.321
	After 1 month	66.82±11.738			64.90±11.371		
<b>P-Pair 2</b>	After 1 month	66.82±11.738	.169	.866	64.90±11.371	.046	.963
	After 3 month	66.48±10.482			64.76±10.696		
<b>P-Pair 3</b>	After Session	63.97±10.088	-1.310	.195	63.38±12.480	-.462	.648
	After 3 month	66.48±10.482			64.76±10.696		

From Table 9, the mean score of the young male sportspersons in the perspective of practice showed that they had higher scores after 1 month. They were statistically significant. They had a slight decrease in the scores after 1 month and after 3 months. The score marked after three months showed an increase in the scores when compared with after the session. The mean score of the young female sportspersons showed that they had higher scores after 1 month. There was a slight decline in the scores obtained after 1 month and after 3 months. The score marked after three months showed an increase when compared to after the session.



## SUMMARY AND CONCLUSIONS

Walsh et al. discovered that a lack of nutritional knowledge and attitudes contributes to poor eating habits. This study found that athletes with limited nutrition knowledge had poor nutrition practice scores (Walsh et al., 2011). These findings were consistent with prior research, which found a statistically significant relationship between athletes' dietary knowledge and practice scores. One of the possible barriers to optimal nutrition practices among athletes is a lack of information about nutrition in sports (Folasire et al., 2015).

The results showed that the mean score of nutritional knowledge before the session was  $69.30 \pm 16.530$ , immediately after the session ( $75.20 \pm 13.742$ ), after 1 month ( $73.50 \pm 14.933$ ) and after 3 months ( $72.30 \pm 16.197$ ). The score increased following the session ( $t = -5.030$ ,  $p = .000$ ) while the score declined as time passed. The mean score of the attitude after the session was  $78.48 \pm 7.718$ , after 1 month was  $83.86 \pm 6.788$  and after 3 months was  $80.66 \pm 8.195$ . After three months, scores showed a decline ( $t = -3.733$ ,  $p = .000$ ) compared with after 1 month. After the session, the average score was  $63.80 \pm 10.774$ , followed by  $66.26 \pm 11.609$  after one month, and  $65.98 \pm 10.520$  after three months. When compared with the after 1 month, the scores declined after 3 months ( $t = -1.002$ ,  $p = .177$ ). In all of the above situations, the amount of retention decreased over time.

Based on the above findings, it is established that the null hypothesis  $H_0$  is rejected and alternative hypothesis  $H_A$  has been accepted. There is a significant relationship between the Knowledge, Attitude and Practices (KAP) of the young sportspersons in Thiruvananthapuram district, Kerala about nutrition awareness on pretest, immediately after session, after one month and after three months.

A combination of solid nutritional knowledge, positive attitudes toward food, and effective dietary practices is essential for sportspeople to maximize their performance and health. By assessing the KAP of athletes, nutrition education programs and interventions can be developed that address the nutritional needs of those athletes. Through its efforts, it addresses knowledge gaps, reshapes attitudes and practices about nutrition, and promotes positive dietary habits, all of which contribute to increased athletic performance, recovery, and overall well-being.

In conclusion, the importance of nutritional knowledge for sportspersons transcends the simplistic view of food as mere sustenance. It becomes a strategic tool, a performance enhancer, and a key determinant of overall well-being. As athletes strive for excellence, the fusion of cutting-edge training methodologies with a nuanced understanding of nutrition becomes the winning formula, propelling them towards their goals and ensuring a sustainable, successful athletic journey.

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## PHYTOCHEMICAL, ANTIOXIDANT, AND ANTIDIABETIC PROPERTIES ON NATURAL BUTTERFLY PEA (*clitoria ternatea l.*) COLORED FOOD

Ms. Anila Augustine<sup>1</sup>, Dr. S. Janaki Alias Priya<sup>2</sup>

<sup>1</sup>PG scholar, <sup>2</sup>Assistant Professor,  
Department of Home Science, Women's Christian College,  
Chennai – 600 006 India

<sup>2</sup>Email: drjanakipriya@gmail.com  
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### ABSTRACT

The most essential organoleptic characteristics that impacts customer acceptability and choice and is connected to overall food quality is color. This study compares the phytochemical, antioxidant, and antidiabetic potential of Butterfly pea plant flower (*Clitoria ternatea*) extract and artificial food-colored Indian food. Develop Fryums, Ladoo, and Likstick ice cream recipes with Butterfly Pea Flower extract as a coloring agent to determine and compare the phytochemical properties, antioxidant components, DPPH assay, in vitro antidiabetic activity by inhibition of alpha-glucosidase enzyme of food products with butterfly pea flower extract and synthetic food color and assess selected micronutrients like vitamins A, C, and E. The phytochemicals like terpenoids, alkaloids, glycosides, tannins, steroids, phenols, flavonoids, proteins, and carbohydrates have been existing in both the ethanol extract of Butterfly pea extract and artificial food color. The phytochemical analysis shows that phenolic compounds are present at significantly higher levels than in the artificial food color extract. When comparing the inhibition concentration in both sections, the butterfly pea extract was free-radical at a minimum level concentration than the artificial food color. Ethanolic extracts of Butterfly pea plant flowers proved to possess higher antidiabetic activity than artificial food color. The quantitative phytochemical analysis reveals that the Butterfly Pea Plant Flower sample's micronutrient concentration is higher than that of the artificial food color. The butterfly pea plant flower showed a much greater association with RSA (Radical Scavenging Activity) and decreasing power. The antioxidant activity of sample extracts was directly proportional to the phenolic contents. According to this study, butterfly pea flower extract has significant amylase inhibitory properties and could be helpful in treating diabetes.

**Keywords:** Butterfly pea leaves, food color, phytochemical, antioxidant, anticarcinogenic, antidiabetic.

### INTRODUCTION

The plant is an enormous source of natural colors such as carotenoids, chlorophyll, anthocyanins, and betalains, which have proven to be alternatives to synthetic colorants. Color significantly increases the ultimate attractive value and customer acceptability of meals and beverages (Dey et al., 2022). The market's selection of foods and drinks may include both excessive usage of approved synthetic colors and non-permitted synthetic colors (Dilrukshi et al., 2019). Artificial food coloring is often made by a chemical process including aniline, formaldehyde,

hydroxides, and sulphuric, and typically involves petroleum. Lead, mercury, and arsenic are occasionally possible contaminants (Bakthavachalu & Kannan, 2020). However, consumer perception & demand have driven the synthetic colorants replacement with naturally derived alternatives (Sigurdson & Tang, 2017). The plant *Clitoria ternatea*, also referred to as the "butterfly pea," has long been utilized in Ayurvedic medicine. Butterfly pea blossoms have the potential to prevent the body from forming fat cells. (Chayaratanasin et al., 2019). Traditionally used as food coloring, flowers of *Clitoria ternatea* have been shown to contain a variety of phytochemicals, including anthocyanins, kaempferol, and myricetin glycosides. It has been discovered that floral extracts from *Clitoria ternatea* have cytotoxic, antibacterial, antioxidant, anti-inflammatory, and antidiabetic properties that are good for human health (Jeyaraj et al., 2021). The secret behind the color is the phenolic pigments, anthocyanins. These pigments are responsible for orange, red, purple, blue, and pink colors in plants and are often associated with antioxidant properties. In 2021, the FDA approved the commercial use of butterfly peas as a color additive. It is exceptionally heat stable and can be used in beverage products, food and sports drinks, ice cream, chewing gum, and yogurt. The butterfly pea flower extract's lipophilic phase contained terpenoids, alkaloids, and fatty acids. The butterfly pea blossom is promoted as a source of functional food and nutraceuticals due to its numerous bioactive components and demonstrated health benefits (Marpaung et al., 2020).

### **SIGNIFICANCE OF THE STUDY**

Since several intervention studies have shown that significant increase of food toxicity due to usage food colour, allergies and health problems due to the uses of artificial food colour, the present study will analyse a comparative study on the extract of Butterfly pea plant flower and artificial food colour incorporated in food products. The butterfly pea plant flower is used to natural food colour extract which can be used to make as a colouring agent that is highly nutritional rich and have lots of other health benefits. This study seeks to determine whether the Butterfly pea plant flower help to improve nutritional benefits and reduce disease conditions by analysing physiochemical properties such as phytochemical nutrients, antioxidant and antidiabetic properties along with micronutrient analysis.

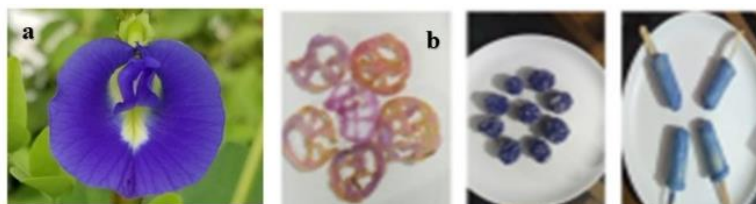
### **OBJECTIVES**

- To create and standardize recipes using Butterfly Pea Flower extract as a colouring ingredient, and to evaluate the sensory evaluation using a Hedonic scorecard.
- Using butterfly pea flower extract and a food product that has been artificially coloured, to ascertain and compare the phytochemical and Antioxidant (DPPH assay) qualities of food products.
- To assess and contrast the alpha-glucosidase enzyme inhibitory effects of food products containing butterfly pea flower extract and artificially coloured foods on in vitro antidiabetic activity and to evaluate specific micronutrients.

## MATERIALS AND METHODS

### Sample collection and identification:

Blue-colored, fully bloomed, disease-free *Clitoria ternatea* L. (Figure 1a) was collected from the local market and stored at 4°C. The faculty of Women's Christian College, Chennai's Department of Plant Biology and Plant Biotechnology assisted in the identification of the species.



**Figure 1:** 1a) Butterfly pea (*Clitoria ternatea* L.). 1b) Fryums, Ladoo, Likstick ice cream

### Preparation of extract:

Approximately 3 g of the cleaned flower steeped in 25 ml of hot water boiled by stirring well.

### Ethanolic extract:

Approximately 10 g of edible butterfly pea plant flower extract containing ladoo and artificial color ladoo (Figure 1b) was soaked in 100ml of ethanol for 72h. After passing through the Whatman filter paper, the blue-greenish liquid supernatant was condensed at 50 degrees Celsius on a hot plate.

### Qualitative Phytochemical analysis

#### Detection of alkaloids:

500  $\mu$ L of extract, a few drops of con. HCl has been added & shaken well. A drops of Dragendorff's reagent have been added, indicate a prominent orange-to-red precipitate.

#### Detection of Terpenoids:

500  $\mu$ L of extract and 1 mL of chloroform have been added and mixed well. Then, fewer drops of H<sub>2</sub>SO<sub>4</sub> were added to the test tube sides to form a reddish-brown layer

#### Detection of phenolic compounds:

500  $\mu$ L of extract was diluted in 1 mL of distilled water for the ferric chloride test, and then a few drops of neutral 5percent ferric chloride solution have been added. Phenolic compounds are specified by a dark green or violet color.

#### Detection of flavonoids:

500  $\mu$ L of extract and fewer drops of NaOH solution were added & shaken well. A bright yellow color appears, and the addition of excess con. H<sub>2</sub>SO<sub>4</sub>, the yellow color disappears, indicating the existence of flavonoids.

#### Detection of saponins Foam test:

500  $\mu$ L of extract has been diluted with distilled water & made up to 5mL. The suspension has been shaken vigorously. A persistent foam indicated the existence of saponins.

#### Detection of Tannins

After dissolving 500 $\mu$ L of extract in distilled water, 1mL of a 10% lead acetate solution has been added. The existence of tannins was indicated by a large, white precipitate.

**Detection of glycosides**

To 500 µL of extract, 500 µL of pyridine and 500µL of sodium nitroprusside solution was added, followed by a few drops of NaOH solution to make the solution alkaline. The creation of the blood red color specified the existence of glycosides.

**Detection of carbohydrates**

500 µL of extract and 2 drops of alcoholic α-naphthol solution have been added & shaken well. A few drops of conc. H<sub>2</sub>SO<sub>4</sub> was applied to the test tube's sidewalls. Carbohydrates were present because a violet ring started to form.

**Detection of Quinone**

To 500µL of extract and 1 mL of methanol have been added & mixed well. After carefully adding a few drops of concentrated H<sub>2</sub>SO<sub>4</sub>, the test tube's sides developed a red ring, signifying a successful result.

**Detection of Protein**

When 1 ml of extract is mixed with 500µL of extract and a tiny drop of Conc. Nitric acid, a yellow hue forms, signifying the presence of proteins.

**b) Quantitative analysis of phytochemicals**

**Estimation of total phenol:**

A 1:10 diluted folate Ciocalteu reagent and 900µl of methanol were added to 100µl of extract from a 1mg/ml solution. This was combined with 1ml of a 20 percent sodium carbonate solution, thoroughly shaken, and allowed to sit at room temp in the dark for 30mins. At 765 nm, the supernatant's absorbance was measured.

**Estimation of total flavonoids:**

500µl of methanol and 1 ml of a 5 percent sodium nitrite solution were added to 500µl of the extract from the 1 mg/ml solution. Following a thorough shake and a 5-minute room-temperature incubation period, 1 milliliter of 10% aluminum chloride has been added. 1 milliliter of a 1 M NaOH solution was added to this, and it was left to incubate at room temp for 30 mins. The supernatant's absorbance has been calculated at 510nm.

**Estimation of total tannins:**

A 1:10 diluted Folin-Ciocalteu reagent and 900 µl methanol were added to 100 µl of the extract from the 1 mg/ml solution. After that, 1ml of 35% sodium carbonate was added, thoroughly shaken, and allowed to sit at room temp for 30mins. At 725nm, the supernatant's absorbance has been measured.

**In vitro antioxidant assay**

**a) DPPH radical scavenging assay:**

The 2,2-diphenyl-picryl-hydrazyl-hydrate (DPPH) free radical approach is an electron-transfer-based antioxidant assay that outcomes in a violet solution in ethanol. 1ml of 0.1 ml DPPH solution was combined with 1ml of flower and artificial color extract at different concentrations (1-6 mg/mL). After that, the mixture has been left to stand in the dark for 30mins. The controls consisted of one ml each of DPPH solution and methanol. A spectrometer set at 517 nm was used to quantify the absorbance decrease. Three separate tests were conducted to replicate the experiment. The standard reference was ascorbic acid. This is how the percentage of inhibition was computed:

$$\% \text{ Of DPPH radical inhibition} = \frac{\text{Control-Sample}}{\text{Control}} \times 100$$

**Inhibition concentration (IC 50):**

The IC 50 parameter was used to interpret the DPPH assay. It was described as the volume of synthetic and natural samples required to reduce DPPH absorbance by half. The sample's discoloration was plotted against sample concentration to determine the IC50 value.

**b) Ferric (Fe 3+)-reducing antioxidant power assay:**

The basis for the ferric reducing power assay method is the notion that when reaction mixture absorbance rises, antioxidant activity also rises. The reducing power of the laddoo incorporated with the extract of both the samples has been determined by the Fe 3+ reducing approach with slight change. Laddoo extracts ranging in concentration from 1 to 6 mg/mL were combined with 1 ml of potassium ferricyanide [K<sub>3</sub>Fe (CN)<sub>6</sub>] and 1ml of phosphate buffer (0.2M, Ph 6.60) in a milliliter. The concentrations of the combined ingredients were 1 percent w/v. After that, the combinations were incubated for 30 minutes at 500°C in a water bath. Each mixture received one milliliter (10 percent w/v) of trichloroacetic acid added to it. After adding 1 mL of freshly made FeCl<sub>3</sub> (0.1 percent w/v) solution, the absorbance has been calculated in a UV-Vis spectrophotometer at 700nm. 3 independent tests were conducted to repeat the experiment. The standard reference has been ascorbic acid. The decreased % was computed as

$$\% \text{ Of Fe}^{3+} \text{ reduction} = \frac{\text{Sample-Control}}{\text{Sample}} \times 100$$

**Reducing concentration (RC 50):**

To interpret the FRAP results, the decreasing concentration (RC 50), or the volume of sample essential to decrease the free radicals (Fe<sup>3+</sup>) by 50percent, was computed. The sample's absorbance was plotted against its concentration to determine the RC50 value.

**In vitro antidiabetic activity**

Artificial color extract and flower extract of the butterfly pea plant (*Clitoria ternatea*) in varying doses (1-6 g/mL) made up the entire assay mixture. The alpha-amylase enzyme was produced in ten microliters and incubated for ten minutes at 37°C in 0.02M sodium phosphate buffer (Ph 6.9 containing 6mM sodium chloride). Subsequently, one percent w/v soluble starch was added to each reaction set, and the mixture has been incubated at 37°C for 10 mins. After adding 100 microliters of 1 M HCL to halt the enzymatic reaction, 200 µL of iodine reagent was added (5mM I<sub>2</sub> & 5mM KI). At 595nm, the absorbance was measured and the color shift was seen. There was no plant extract present in the control reaction, which reflected 100% enzyme activity. In the reaction mixture, starch is indicated by a dark blue color when it is present, a yellow color when it is absent, and a brownish color when it is partially degraded. When extracts contain inhibitors, the starch added to the enzyme assay mixture does not break down as a dark blue color complex. Conversely, when the inhibitor is not present, no color complex forms, meaning that α-amylase has completely hydrolyzed the starch. The IC50 value has been computed to interpret the outcomes.

$$\% \text{ of } \alpha\text{-amylase enzyme inhibition} = \frac{\text{Sample - Control}}{\text{Sample}} \times 100$$

**Determination of Micronutrient Analysis of Vitamins A, C and E**

**a) Vitamin A – Carotenoid:**

To 1 ml of the sample, add 8 ml of acetone (80% acetone) along with 2ml of distilled water and shake well. Centrifuge for 5 mins at 5000rpm. At 480, 510, 645, and 663nm, the optical density

of the extracted solution has been calculated. Based on the measurements, carotenoid pigment concentrations by formula

$$\text{Carotenoid mg/g tissue} = \frac{7.6(A_{480}) - 1.49(A_{510}) \times V}{1000} \times W$$

**b) Vitamin C – Ascorbic Acid:**

To a 100ml conical flask, add 10 ml sample and 10 ml distilled water. A starch solution of 1 or 2 ml was added as an indicator. Fill the 50 ml burette with the prepared iodine solution. Titrate the iodine solution in the 50 ml burette against the sample solution in the conical flask drop by drop until the endpoint reaches a dark blue color.

**c) Vitamin E – Tocopherol:**

100 µL standard test sample solution is made up of 1 ml sample and 1 ml ethanol. Add 1 ml distilled water and 1 ml xylene. Centrifuge for 3000 rpm for 5 min. After this, add 500 µL of 2 – 2' bipyridyl and 100 µL ferric chloride. After 2 min, the absorbance has been read at 492 nm. 2 – 2' Bipyridyl - (0.12%), Ferric chloride - (0.12%).

## RESULTS AND DISCUSSION

### Phytochemical analysis

**a) Qualitative phytochemical analysis:**

The ethanolic extract of both the samples indicates the existence of phytochemicals like terpenoids, alkaloids, glycosides, tannins, steroids, flavonoids, carbohydrates quinone, phenols, and proteins, except for saponins.

**Quantitative phytochemical analysis:**

Qualitative phytochemical evaluation of the ethanolic extract of both the samples showed the existence of various phytonutrients, like phenols, flavonoids, steroids, carbohydrates, proteins, chlorophyll, carotenoids, and ascorbic acid.

**Estimation of total phenols:**

Estimation of phenols, gallic acid has been utilized as a standard. Fig 4 shows that the total phenol content in an ethanolic extract of both the samples was estimated to be 215.4 µg/mg and 126.1 µg/mg, respectively. Thus, the total phenol content in the extract of natural butterfly pea plant flower extract was found to be significantly higher than that in the artificial food color extract. There is a total difference of 89.3% in phenol content when comparing the natural and artificial color extracts, which indicates that Butterfly pea plant flower extract is superior in phenolic content, with 71%.

**Estimation of total flavonoids:**

From Table 1, it is evident that the total flavonoid content in an ethanolic extract of both the samples was estimated to be 14.5µg/mg and 4.8µg/mg, correspondingly. Thus, the total flavonoid content in the extract of natural butterfly pea plant flower extract has been majorly greater in comparison to that in the artificial food color extract. There was a total variance of 10.22% in flavonoid content when comparing the natural and artificial color extracts, which indicates that Butterfly pea plant flower extract is superior in flavonoid content, with 23%.

**Estimation of total tannins:**

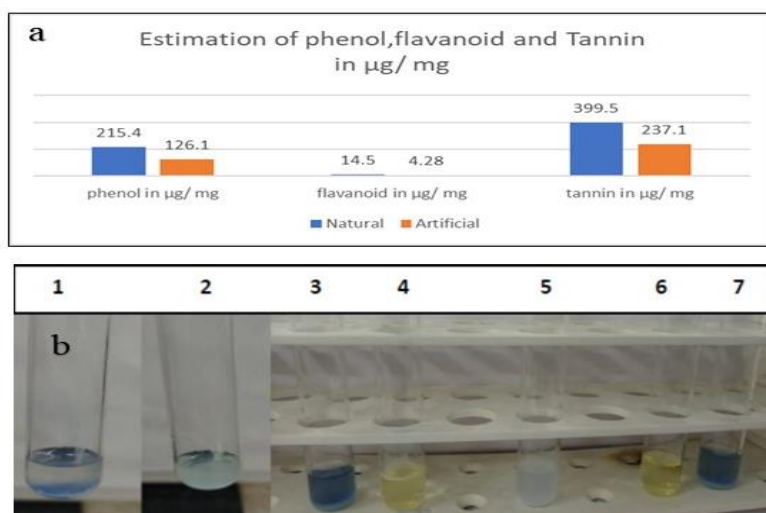
Tannin mg Quercetin Equivalent (QE)/g of Sample in an ethanol extracts of both the samples were presented. For the estimation of tannins, quercetin has been utilized as a standard.



**Table 1: Estimation of total phenol, flavonoid, and tannin natural and artificial food color**

	Natural	Artificial	Percentage
<b>phenol in <math>\mu\text{g}/\text{mg}</math></b>	215.4	126.1	71%
<b>flavanoid in <math>\mu\text{g}/\text{mg}</math></b>	14.5	4.28	239%
<b>tannin in <math>\mu\text{g}/\text{mg}</math></b>	399.5	237.1	68%

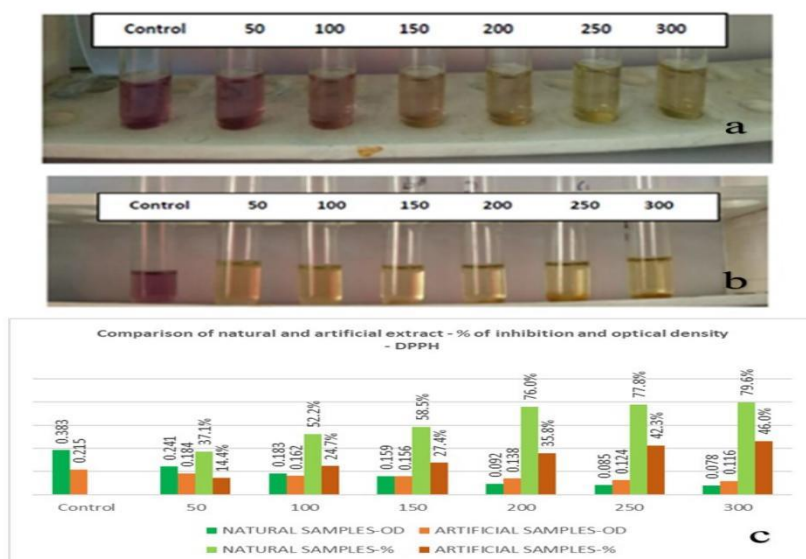
From Table 1, it is evident that the total phenol, flavonoid, and tannin contents in an ethanolic extract of both the samples were estimated to be 399.5 $\mu\text{g}/\text{mg}$  and 237.1 $\mu\text{g}/\text{mg}$ , correspondingly. As a result, the natural butterfly pea plant flower extract had a substantially higher total tannin concentration than the artificial food color extract. Butterfly pea plant flower extract is superior, with a tannin content of 68%. Figures 2a and 2b show that the percentage inhibition in an ethanol extract of the Butterfly pea plant flower at incremental of 50 $\mu\text{g}/\text{mL}$  from 50 $\mu\text{g}/\text{mL}$  to 300 $\mu\text{g}/\text{mL}$  concentrations was approximately 37.1, 52.2, 58.5, 76.0, 77.8 and 79.6%, respectively. Thus, the ability to scavenge free radicals for Butterfly pea plant flowers increased with concentration and was statistically significant.



**Figure 2: a) Estimation of total phenol, flavonoid, and tannin natural and artificial food color. b) Quantitative estimation of phytochemicals –flavonoid, tannin, and phenol. (1- Natural phenol 2- Artificial phenol 3- Estimation of phenol natural sample 4- Estimation of phenol artificial sample 5- Estimation of tannin natural 6- Estimation of flavonoid natural sample 7- Estimation of flavonoid artificial sample)**

**Comparison between natural v/s artificial extract % of inhibition with optical density:**

Both the test samples show the inhibition percentage of free radicals increased with an increase in concentration and was statistically significant. From Figure 3c, it is evident that an ethanolic extract of the Butterfly pea plant flower had more significant RSA than the artificial food color. There is a significant difference in the percentage of inhibition at 22.7, 27.5, 31.1, 40.2, 35.5, and 33.6, and the natural sample is superior to the artificial sample at a concentration level of 200 (g/mL) (Figure 3c).

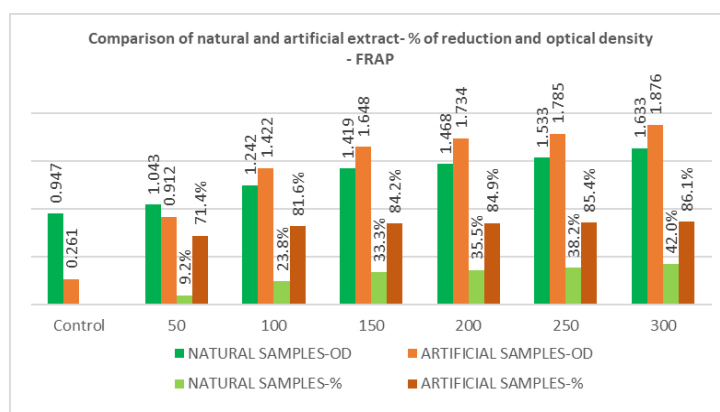


**Figure 3: a) Natural sample – DPPH. b) Artificial sample – DPPH. c) RSA of butterfly pea plant flowers and artificial samples (ethanol extract) by DPPH assay**

The natural extract outperforms the artificial food color by 40.2 g/mg in terms of its ability to scavenge free radicals. By using the DPPH assay, it is evident from the study that butterfly pea plant flower extract has better antioxidant properties than synthetic extract. While comparing with standard ascorbic acid IC50 value (2.88 g/mL), the test samples need a greater conc to inhibit free radicals by 50%. The IC50 values of an ethanolic extract of both the samples needed to inhibit 50% of free radicals were 19.95µg/ml & 21.72µg/ml, correspondingly. By comparing the ability of both the extract to scavenge 50 percent of free radicals in an ethanol extract, it was found that Butterfly pea plant flower (19.95) is highly active even though it has a lower IC50 value when compared with artificial food color extract (21.72). Thus, the natural food color scavenging effect is higher than that of the artificial food color extract.

**Ferric (Fe 3+)-reducing antioxidant power assay:**

From Figure 4, the percentage reduction in an ethanol extract of the Butterfly pea plant flower at incremental of 50µg/mL to 300µg/mL concentrations was approximately 9.2, 23.8, 33.3, 35.5, 38.2, and 42.0%, respectively. It is evident that the radical-reducing activity of Butterfly pea plant flower extract raised with increasing concentration and was statistically significant. It is also evident that the radical-reducing activity of the artificial food color extract raised with increasing concentration.



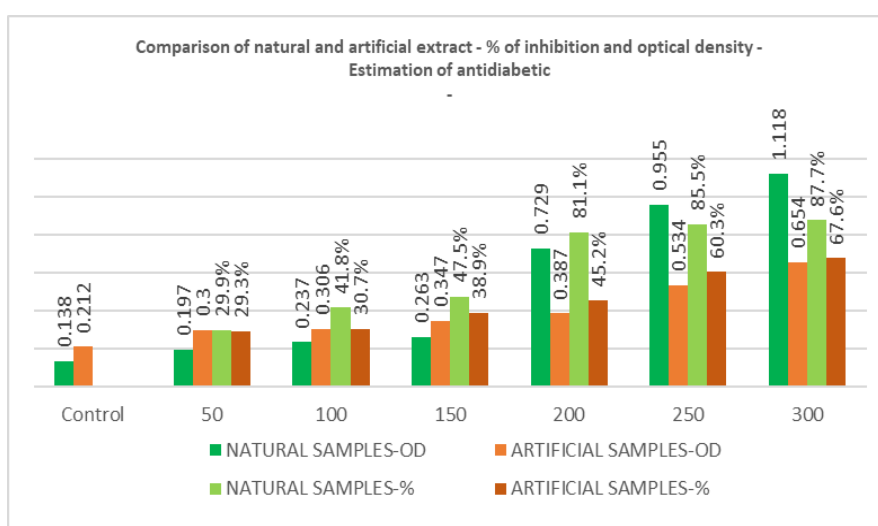
**Figure 4: Ferric radical reducing activity of natural and artificial samples (ethanol extract) by FRAP assay.**

**Comparison of samples and standard RC50 value (µg/mL):**

The outcomes of an ethanolic extract of butterfly pea plant flower (14.0 µg/ml) and artificial food color (23.8 µg/ml), ferric reducing radical activity analysis performed using the FRAP assay. The reduction capacity is increased because the artificial color is a synthetic colorant. If the reduction is greater, it is more toxic.

**Alpha-amylase enzyme inhibition assay:**

Figure 5 shows that the inhibitory power of the ethanolic extract of Butterfly pea flowers at incremental of 50 µg/mL from 50 to 300 was approximately 29.9, 41.8, 47.5, 81.1, 85.5 and 87.7%, respectively. By comparing the antidiabetic properties of both the samples in the ethanolic extract, it was found that in both test samples, the antidiabetic inhibition percentage increased with an increase in concentration and was statistically significant.



**Figure 5: Alpha-amylase enzyme inhibition activity of natural and artificial samples**

Carotenoid concentration in Butterfly Pea Plant Flower sample's is higher than that of the artificial food color. At an optical density of 480, the natural ethanol extract of butterfly pea plant flowers had a carotenoid concentration of 0.036. In contrast, the artificial food color extract had a

carotenoid concentration of 0.016. The concentration difference of the sample is 0.02 µg/mg. Thus, the results show that the natural extract is superior to the artificial extract by 1.25%. The Butterfly pea plant flower extract had a higher ascorbic acid content (2.3) than the artificial food color (1.5). The Butterfly pea plant flower extract had better tocopherol content (0.478) than the artificial food color (0.314).

## **CONCLUSION**

*Clitoria ternatea* belonging to the Fabaceae family was proven to be an abundant source of phenol, flavonoids, terpenoids, tannins, and micronutrients as compared with artificial food color. The butterfly pea plant flower showed a much high association with decreasing power and RSA. The antioxidant activity of these extracts was directly proportional to the phenolic contents. According to this study, butterfly pea plant flower extract has significant -amylase inhibitory properties and could be helpful in the treatment of diabetes. There is a small number of minerals, flavonoids, terpenoids, etc., in artificial food coloring. However, its impact is relatively small when compared to the nutritional properties of Butterfly pea plant flower extract. These bioactive compounds present in the butterfly pea plant extract may be helpful in the future development of new alternative therapeutic drugs. Butterfly pea plant extract can be used as a natural food colorant at the household level. In the present study, the butterfly pea flower extract used is in a crude form; there is a possibility that inhibitory activities may cause synergistic effects between the phytochemical components. Instead, isolated compounds from the butterfly pea flower extract will be more potent. Due to time and money restrictions, the quantification of other phytochemicals, antimicrobials, anticarcinogens, and shelf-life studies of the developed food product could not be performed. Other phytochemical compounds can be identified in the butterfly pea flower by GC–MS methods. To isolate bioactive compounds from the butterfly pea plant flower to uncover their potential medicinal properties. Commercially, food products can be produced incorporating natural extract from Butterfly pea flowers.

## **RECOMMENDATIONS FOR FURTHER STUDIES**

Further phytochemical compounds that can be identified in the Butterfly pea plant flower by GC-MS methods. To isolate the bioactive compounds from the Butterfly pea plant flower to uncover their potential medicinal properties. Commercially food products can be produced incorporating the natural extract from Butterfly pea flowers.

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## NUTRIENT COMPOSITION AND ANTIOXIDANT PROFILE OF *FICUS BENGHALENSIS* L. BARK

Anupriya Mamgain<sup>1</sup> and Dr. Swati Dhruv<sup>2</sup>

<sup>1</sup>Ph.D. scholar, <sup>2</sup>Assistant Professor,

Department of Foods and Nutrition, Faculty of Family and Community Sciences,  
The Maharaja Sayajirao University of Baroda, Vadodara, 390002, Gujarat, India.

E-mail: mamgainanupriya@gmail.com ; swati.dhruv-fn@msubaroda.ac.in

<sup>2</sup> HSAI Membership No.: 13/GJ/D-2/LF

### ABSTRACT

The *Ficus benghalensis* L., commonly known as the Banyan tree, holds sacred significance and has been traditionally utilized for medicinal purposes. The bark of *Ficus benghalensis* L. has demonstrated promising therapeutic potential in animal model studies, exhibiting properties such as antidiabetic, hypolipidemic, antioxidant, anti-inflammatory, hepatoprotective effects, and many more. However, despite its recognized medicinal uses, there is a dearth of comprehensive data regarding its nutritive value. To address this gap, the study aimed to ascertain the nutrient composition and antioxidant activity of *Ficus benghalensis* L. bark. The bark powder was procured from a wholesale dealer in Navsari and subjected to analysis in an NABL-accredited laboratory. The study examined the proximate composition, vitamin C, and mineral content, which included sodium, phosphorus, potassium, calcium, iron, and magnesium. Furthermore, the bark's antioxidant capacity was assessed through 1,1-diphenyl-2-picrylhydrazyl (DPPH) radical scavenging activity and ferric reducing antioxidant power (FRAP) assays. The results revealed that the bark was rich in crude fiber and minerals. The most abundant mineral found in the bark was potassium, followed by phosphorus, calcium, iron, and magnesium. Additionally, it exhibited strong antioxidant activity, indicating its potential in combating various chronic ailments. In conclusion, the study highlights the considerable nutritional value and potent antioxidant properties present in *Ficus benghalensis* L. bark, suggesting its promising potential as a nutraceutical choice for promoting disease prevention and enhancing overall health.

**Keywords:** Antioxidant, *Ficus benghalensis*, Nutraceutical, Nutrient composition

### INTRODUCTION

Plants harbor an array of both nutrients and non-nutrient components that are crucial for overall health. Nutrients like vitamins, minerals, proteins, carbohydrates, and fats sustain bodily functions and organ health, while non-nutrient compounds such as phytochemicals, and dietary fiber contribute to disease prevention and overall well-being. Research indicates that adequate intake of specific nutrients is not only necessary for body functioning but also correlates with the reduced risk of chronic diseases (Cheng et al., 2019). For instance, low magnesium levels are associated with type 2 diabetes mellitus (T2DM), hypertension, cardiovascular disease, migraine, stroke, and Alzheimer's disease (Volpe, 2013). Furthermore, calcium supplementation is related to T2DM risk, while iron and zinc intake are associated with a reduced risk of major depressive disorder (Cheng et al., 2019). Several other researches prove that nutrients and phytochemicals are vital for sustaining health and

reducing the risk of diseases. Together, the combination of nutrients and non-nutrients in plants forms a powerful arsenal for maintaining optimal health and vitality.

*Ficus benghalensis* L. is one of the medicinal plants mentioned in Ayurveda for its various therapeutic uses. It is a large, evergreen tree characterized by hanging roots from the branches. It belongs to Moraceae family and is distributed throughout India. *Ficus benghalensis* L. is commonly known as the Banyan tree (in English) and other local names are bargad, barh, vat, vatgach, vad, bata, bara, wad, Alada, alai, aalam, khongnang taru and marri chettu. The Banyan tree is a sacred tree that has been utilized since Vedic times for addressing various ailments including obesity, diabetes, ulcers, skin diseases, wound healing, vaginal disorders, hemorrhagic disorders, etc (Varanasi & Narayana, 2007). Traditionally, all parts of the tree- leaves, stem bark, aerial roots, latex, and fruits are used for different medicinal purposes.

Bark of *Ficus benghalensis* L. contains several phytoconstituents such as bengalenosides (i.e., glycosides or flavonoids), alpha-D glucose, mesoinositol, ketones, esters, etc (Abdul Khaliq, 2017; Ahmad et al., 2011). In-vitro and in-vivo studies have shown various pharmacological properties of the bark like hypoglycaemic, hypolipidemic, anti-inflammatory, wound healing, analgesic, antibacterial, antifungal, larvicidal, hepatoprotective, anti-diarrhoeal, anti-arthritic, antimutagenic, antioxidant, antiallergic, immunostimulatory effect, and action against inflammatory bowel disease (Abdul Khaliq, 2017). In addition to studying the phytochemical substances and medicinal properties of banyan tree bark, understanding its nutritional content is essential to unlock its full potential as a natural resource. Unfortunately, there is no literature related to the nutritive value of the bark that has been studied so far. This knowledge gap presents an opportunity for further research, which could enrich our understanding and utilization of the bark's nutritive value, thus maximizing its potential in holistic healthcare.

Since there is no available data regarding the nutrient composition of *Ficus benghalensis* L. bark, the present study aims to explore the macro and micronutrients present in the bark, thereby enhancing our understanding of its potential health benefits. Additionally, antioxidant capacity was assessed in this study to further elucidate its effects on health.

## **OBJECTIVES**

- To determine the nutrient composition of the bark of *Ficus benghalensis* L. (Banyan tree).
- To analyze the antioxidant profile of the bark of *Ficus benghalensis* L. (Banyan tree).

## **METHODOLOGY**

*Ficus benghalensis* L. bark powder was procured from the wholesale dealer, Navsari and authenticated by College of Forestry, Navsari Agriculture University, Gujarat. The analysis was done using standard methods in an NABL accredited laboratory.

**Moisture:** It was determined by drying the sample in an air oven at  $105 \pm 2^\circ\text{C}$  until constant weight, then calculating the difference between initial and final weights to obtain the moisture percentage (FSSAI Manual of Methods of Analysis of Foods, 2016).

**Ash:** The sample was dried and incinerated in a muffle furnace at  $525 \pm 250^\circ\text{C}$  until grey ash was obtained. It was then treated with dilute hydrochloric acid, filtered, and washed until chloride ions were absent. Subsequently, the residue was incinerated again, cooled, and weighed to accurately determine the ash content (FSSAI Manual of Methods of Analysis of Foods, 2016).

**Crude fiber:** It was determined as the loss on ignition of the dried residue after digesting the sample with 1.25% (w/v) H<sub>2</sub>SO<sub>4</sub> and 1.25% (w/v) NaOH solutions. The residue was separated by filtration, dried, and then subjected to ashing. The weight loss during ashing indicated the crude fiber content of the sample (FSSAI Manual of Methods of Analysis of Foods-Cereal and Cereal Products, 2023).

**Protein:** It was determined using the Kjeldahl method, where nitrogen content was measured experimentally and multiplied by the conversion factor 6.25. The sample was oxidized in sulfuric acid, converting nitrogenous compounds into ammonium sulphate, facilitated by the addition of mercury as a catalyst and alkali sulphate. Ammonia was released upon adding excess alkali, then quantitatively back-titrated with standardized hydrochloric acid. The remaining acid was neutralized with standard alkali (Indian Standards Institution, 1974).

**Fat:** The fat content was determined through extractions using a petroleum hydrocarbon solvent via a Soxhlet extraction apparatus (Bureau of Indian Standards, 1967).

**Carbohydrates:** Total carbohydrate was computed by subtracting the combined quantities of moisture, fat, total protein, and total ash from 100 (Bureau of Indian Standards, 2007).

**Energy:** Energy was calculated by summing the values obtained from multiplying the protein, fat, and carbohydrate content by their respective energy conversion factors of 4, 9, and 4 (Ch et al., 2020).

**Vitamin C:** It was determined using the 2,6-dichlorophenol Indophenol Method. As ascorbic acid is a strong reducing substance, its oxidizable properties were measured. A portion of the filtrate was titrated with indophenol solution, with the endpoint indicated by a persistent pink coloration after dye addition (Indian Standards Institution, 1971).

**Minerals and heavy metals:** The determination of sodium, calcium, iron, potassium, magnesium, lead, mercury, and arsenic was conducted by measuring absorbance at different wavelengths using a spectrophotometer (FSSAI Manual of Methods of Analysis of Foods- Metals, 2016). Phosphorus content was determined by using the volumetric method (Bureau of Indian Standards, 1969).

**Antioxidant assays:** The antioxidant activity of the methanol extract of the bark was assessed by using 1,1-diphenyl-2-picrylhydrazyl (DPPH) radical scavenging activity (Tadhani et al., 2007) and ferric reducing antioxidant power (FRAP) assay (Benzie & Strain, 1999).

## **FINDINGS AND DISCUSSION**

### **Screening for heavy metals**

The concentration of heavy metals such as lead, mercury, and arsenic were reported to be less than 0.1 mg/Kg of the sample of *Ficus benghalensis* L. bark powder (Table-1). This suggests that the bark powder is safe for human consumption and complies with regulatory standards for heavy metal contamination (Ministry of Health and Family Welfare (FSSAI), 2011).



**Table 1. Levels of Heavy Metals in the *Ficus benghalensis* L. Bark**

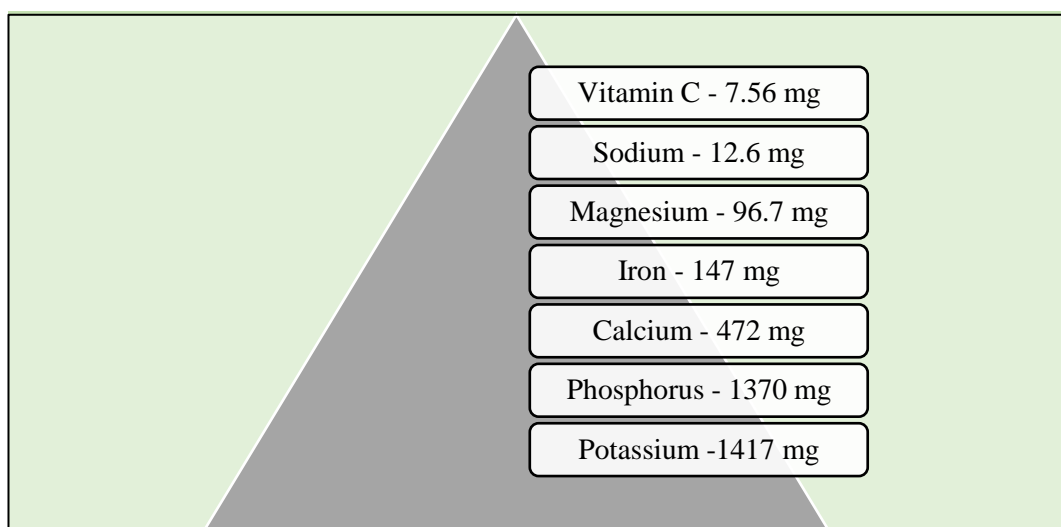
S. No.	Heavy Metals	Results
1.	Lead	< 0.1 mg/Kg
2.	Mercury	< 0.1 mg/Kg
3.	Arsenic	< 0.1 mg/Kg

**Nutrient composition**

The proximate composition of *Ficus benghalensis* L. bark is presented in Table-2. It shows that the bark contains a high amount of fiber, ash, and carbohydrates, a moderate amount of protein, and a low amount of fat. Additionally, fig.-1 depicts that bark is abundant in minerals such as potassium, phosphorus, calcium, iron, and magnesium while maintaining low levels of sodium. A previous study conducted on *Ficus benghalensis* seeds revealed similar results regarding fiber, fat, and vitamin C content (Govindan & Shoba, 2015). However, the seeds contained lower amounts of carbohydrates, ash, potassium, phosphorus, and iron, while exhibiting higher levels of protein, calcium, magnesium, and sodium in comparison to the bark analyzed in the present study.

**Table 2. Proximate Composition of the *Ficus benghalensis* L. Bark**

S. No.	Nutrients	Results
1.	Moisture	7.58%
2.	Ash	6.29%
3.	Crude Fiber	21.86%
4.	Protein	5.14%
5.	Fat	3.13%
6.	Carbohydrate	77.86%
7.	Energy	360 Kcal/100 gm



**Figure 1: Micronutrient Composition of *Ficus benghalensis* L. Bark**  
(\*values are given as per 100 gram of the sample)

In-vivo studies on *Ficus benghalensis* L. bark have demonstrated therapeutic properties including hypoglycemic (Gayathri et al., 2008; Sharma et al., 2007), hypolipidemic (Shukla et al.,

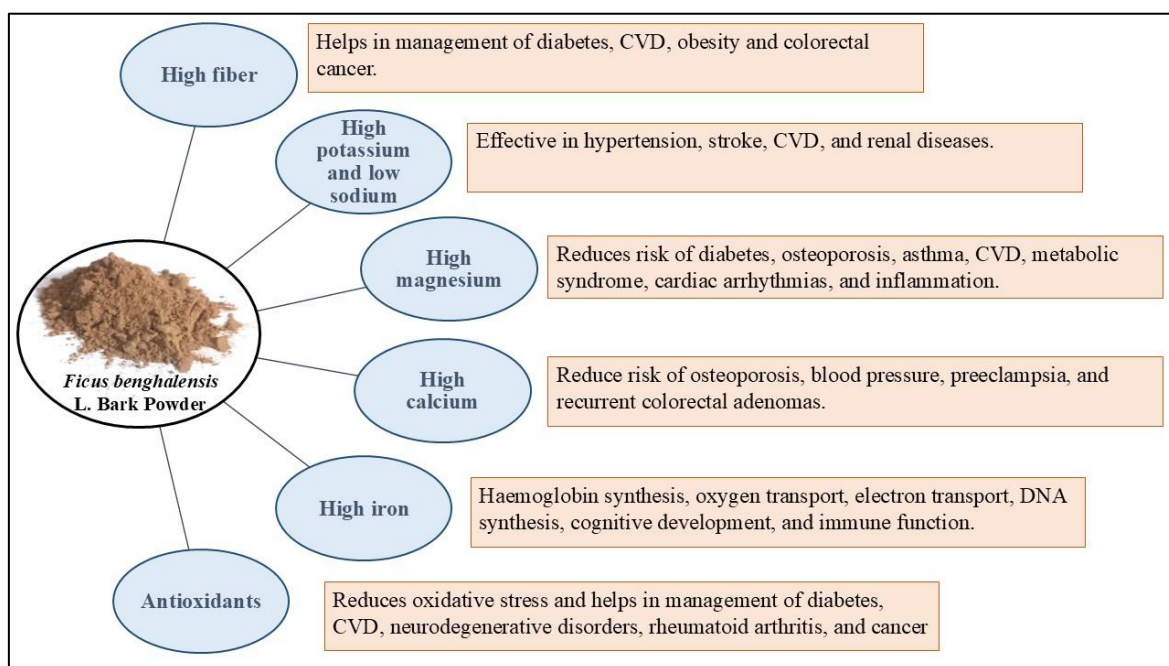
1995), and antimutagenic effect (Satish et al., 2013), which may be attributed to its high fiber content. Various studies associate increased fiber intake with a statistically significant reduction in the risks of obesity, cardiovascular disease, type 2 diabetes, colorectal cancer, and breast cancer. The proposed mechanism includes improved digestion, hormone regulation, appetite control, and metabolism modulation via various enzymes and receptors (Waddell & Orfila, 2023).

The findings showed high levels of potassium (1417 mg/100 gm) and low levels of sodium (12.6 mg/ 100 gm) in banyan tree bark, potentially offering beneficial effects for hypertension. Studies suggest a significant link between potassium intake and decreased blood pressure in adults, subsequently impacting the risk of stroke and coronary heart disease. Lower ratios of potassium to sodium intake are more closely associated with the risk of cardiovascular disease than either nutrient individually. It is also evident from the studies that the consumption of an adequate amount of potassium helps in the prevention of bone loss and a decrease in renal stones (Weaver, 2013).

The bark was found to be a good source of phosphorus (1370 mg/100 gm). It is an essential component of bone health, cell membrane, nucleic acid (DNA and RNA), energy metabolism (in ATP as phosphate), signal transmission, and redox catalysis (Awuchi et al., 2020; Tian et al., 2019).

High calcium and iron content were found in the banyan tree bark powder (472 mg/100 gm and 147 mg/100 gm, respectively). Calcium exhibits multiple health benefits beyond its crucial role in bone health. It aids in reducing blood pressure in young adults and the risk of preeclampsia in pregnant women, improves lipid profile, and prevents osteoporosis and recurrent colorectal adenomas (Cormick & Belizán, 2019). Iron is vital for metabolic processes such as haemoglobin synthesis, oxygen transport, electron transport, and DNA synthesis in living organisms. Anaemia represents a significant global health challenge, with mild to moderate iron deficiency having detrimental effects on cognitive development, immune function, and work capacity. Additionally, it is linked with an increased risk of maternal and perinatal mortality, low birth weight, and morbidity rates (Abbaspour et al., 2014).

The findings revealed that *Ficus benghalensis* L. bark contains 96.7 mg/100 gm of magnesium, indicating potential benefits in the prevention of chronic diseases. Studies reported that hypomagnesemia is associated with various chronic diseases, such as diabetes, osteoporosis, asthma, and cardiovascular issues (Al Alawi et al., 2018). Low magnesium intake correlates with reduced insulin-dependent glucose uptake, poor glycemic control, diabetic nephropathy risk, altered lipid profiles, hypertension, metabolic syndrome, inflammation, cardiac arrhythmias, seizures, and stroke. Fig.-2 summarizes the potential therapeutic benefits of *Ficus benghalensis* L. bark, based on the nutrient analysis conducted in this study.



**Figure 2: Potential Health Benefits of *Ficus benghalensis* L. Bark**

**Antioxidant activity**

The DPPH scavenging activity and FRAP assay of the sample indicate that *Ficus benghalensis* L. bark possesses significant antioxidant properties (Table-3.). Similar findings were found in other studies, which reported that the methanol extract of *Ficus benghalensis* L. bark demonstrated high antioxidant activities across various assays, including DPPH, hydroxyl, superoxide, hydrogen peroxide, and ABTS radical scavenging, as well as reducing power assessment (Mohan et al., 2015; Manocha et al., 2011). Previous studies have reported the presence of total phenols, flavonoids, tannins, and other phytochemical compounds in the banyan tree bark extracts (Navale et al., 2019; Patel et al., 2017; Ogunlowo et al., 2013; Singh et al., 2012), suggesting that these compounds may contribute to the observed antioxidant capacities.

**Table 3. Antioxidant Profile of the *Ficus benghalensis* L. Bark**

S. No.	Antioxidant Assays	Results
1.	DPPH	75.37% scavenging activity
2.	FRAP	0.461 μM of ferric equivalents/ gm

Oxidative stress is closely associated with the development and advancement of diabetes and its complications, resulting in insulin resistance, β-cell dysfunction, impaired glucose tolerance, and mitochondrial dysfunction, ultimately leading to diabetes (Rains & Jain, 2011). Higher levels of dietary total antioxidant capacity (DTAC) were associated with reduced odds of prediabetes prevalence and lower HOMA-IR index in a multivariate analysis (Cyuńczyk et al., 2022). Various antioxidant agents have shown positive effects in the prevention and management of chronic diseases such as cardiovascular disease (CVD), neurodegenerative disorders, rheumatoid arthritis, and cancer by scavenging the free radicals causing damage to DNA, lipid membranes and proteins (Mirmiran et al., 2022; Rani, 2017). Thus, the banyan tree bark's strong antioxidant capacity suggests its

effectiveness against oxidative stress, a key factor in the pathogenesis of diabetes mellitus, CVD, inflammatory diseases, and others.

### **CONCLUSION AND SUGGESTIONS FOR FUTURE RESEARCH**

The bark of *Ficus benghalensis* L. offers commendable nutritive value and mineral content, suggesting it may be a valuable addition to the diet as a nutraceutical for disease prevention and management. The content of fiber, phosphorus, calcium, iron, and magnesium in the bark may contribute to supporting various physiological functions and promote overall well-being and health. The ideal combination of high potassium and low sodium in the bark makes this botanical particularly useful for maintaining blood pressure levels. The bark has shown notable antioxidant capacity, highlighting its medicinal value and potentially aiding in preventing chronic oxidative stress-related diseases such as CVD, cancer, complications of diabetes, neurodegenerative diseases, autoimmune disorders, and others.

Further scientific inquiry is crucial to fully grasp the diverse health benefits of banyan tree bark, potentially leading to innovative therapeutic interventions and advancements in the field of holistic health care. Isolating more phytochemicals from the bark and studying their mechanisms will help in identifying the roles of novel bioactive compounds in its medicinal properties. To further validate its use, dose-dependent clinical trials must be conducted to evaluate the efficacy and safety of banyan bark as a nutraceutical. Additionally, studies are required to investigate potential drug interactions with food and existing medications to ensure the safe integration of *Ficus benghalensis* L. bark into treatment regimens.

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## NUTRIENT ENRICHMENT OF CHAKLI USING BAMBOO (*DENDROCALAMUS STRICTUS*) SHOOT POWDER: DEVELOPMENT AND NUTRITIONAL ANALYSIS

**Bhanu Pratap Nayak<sup>1</sup>, Dr. Aruna Palta<sup>2</sup>**

<sup>1</sup>Assistant Professor, Govt. Rajeev Lochan P. G. College, Rajim,  
Gariaband, Chhattisgarh

<sup>2</sup>Vice Chancellor, Hemchand Yadav State University, Durg, Chhattisgarh  
bh.nayak63@gmail.com , arunapalta@rediffmail.com

HSAI Membership: <sup>1</sup> HSAI-2021-CG-835-LF , <sup>2</sup> 88/P-4/LF

### ABSTRACT

The study focuses on enriching the nutritional profile of Chakli, a traditional Indian fried snack, through the incorporation of Bamboo Shoot Powder (BSP). Chakli, made from a mixture of rice flour and gram flour, is a popular deep-fried product. The research investigates the sensory attributes, moisture content, and nutritional composition of Chakli fortified with different levels of BSP. Sensory analysis revealed that the 10% BSP-fortified Chakli achieved the highest overall acceptability, excelling in aroma, texture, and taste. Moisture analysis demonstrated a slight increase in moisture content with higher BSP fortification levels, impacting the product's stability and shelf life. Protein content increased gradually with fortification, with the 15% fortification level yielding the highest protein content. Fat analysis indicated a gradual decrease in fat content with higher fortification levels, providing options for those seeking reduced-fat snacks. Fiber content consistently increased with higher BSP fortification, contributing to improved digestive health. Ash content, representing mineral composition, showed a continuous increase with higher fortification, suggesting enhanced mineral content. Carbohydrate content decreased with increased fortification, offering a lower-carbohydrate option for health-conscious consumers. Total calorie content followed a similar trend, decreasing with higher fortification levels, providing a strategy for developing lower-calorie Chakli variants without compromising nutritional value. These findings offer valuable insights for both consumers and manufacturers, allowing informed decisions about dietary choices and promoting the development of healthier snack options aligned with consumer preferences.

**Keywords:** Bamboo, Bamboo Shoot, *Dendrocalamus Strictus*, Chakli, Fortified Products.

### INTRODUCTION

Traditional foods play a pivotal role in shaping local identity, influencing consumer behavior, preserving cultural heritage for future generations, and fostering global cultural exchange. "Chakli" stands as a quintessential example of a traditional fried snack, adaptable to various ingredient combinations. The process of preparing these traditional delicacies not only showcases the ingenuity and culinary heritage of local communities but also reflects their ongoing efforts to sustain both life and the ecosystem (Bhosale et al., 2021). Originating as a classic dish in South

India, Chakli has also found its way into Western Indian cuisine, known as "chakali," where it incorporates Chana dal and is readily available in local markets (**Jagdale & Ghodke., 2020**). This culinary evolution exemplifies the dynamic nature of traditional foods as they adapt to regional preferences and ingredients, thereby enriching cultural diversity and culinary traditions.

Chakli is one of the traditional fried snacks that can be produced using different combination of ingredients. Chakli is popular product and at present they are mostly made from gram, rice etc (**Poul et al., 2019**). Chakli is a crispy and it is made from a dough mixture of rice flour and gram flour, extracted through a mould into twisted coils and deep fried in oil. Deep fat frying is a widely practiced method of processing foods all over the world. Deep frying helps in reducing moisture content of foods, thereby increasing shelf life, and also imparts a characteristic texture and flavor to the product. This technique is commonly used for the production of snack items both commercially and at household level. This has also contributed tremendously to the ever-growing convenience food market (**Sebastian et al., 2005**).

A large number of fried products are made from cereals such as wheat and rice, and legumes such as Bengal, green and black grams. "Chakli" is a rice and Black gram dhal-based deep-fried product, which is a common snack item in whole India. It is available commercially in different forms and is prepared in households (**Sebastian et al., 2005**).

In recent years, there has been a growing emphasis on fortifying food products to enhance their nutritional value and promote healthier dietary choices. Among the array of natural ingredients gaining recognition for their fortifying properties, bamboo shoot powder has emerged as a promising candidate. Derived from the edible shoots of bamboo species such as *Dendrocalamus Strictus*, bamboo shoot powder offers a wealth of nutritional benefits that can significantly enhance the nutritional profile of various food products (**Nayak & Palta, 2022**).

Bamboo shoot powder is renowned for its exceptional protein content, making it a valuable source of essential amino acids necessary for human health. Additionally, it boasts a high fiber content, which not only aids in digestion but also plays a crucial role in lowering blood cholesterol levels, thus contributing to cardiovascular health (**Satya et al., 2010; Choudhary et al., 2012**).

Beyond its nutritional ability, bamboo shoot powder possesses practical advantages that make it an ideal fortifying agent. With its ease of storage and preservation, attributed to its low moisture content, bamboo shoot powder ensures the longevity of its nutritional properties, making it a convenient and reliable ingredient for food fortification efforts.

In this paper, we delve into the potential of bamboo shoot powder as a fortifying agent, exploring its nutritional composition, health benefits, and applications in enhancing the nutritional profile of various food products. Through comprehensive analysis and evaluation, we aim to shed light on the significance of bamboo shoot powder in fortification strategies aimed at improving public health and well-being.

## **OBJECTIVES**

1. Investigate the potential of bamboo shoot powder (BSP) as a fortifying agent in traditional Chakli.
2. Examine the impact of BSP fortification on sensory attributes such as color, taste, aroma, texture, and overall acceptability of Chakli.
3. Evaluate changes in the proximate composition of Chakli, including moisture, protein, fat, fiber, ash, carbohydrate, and calorie content due to BSP fortification.



### HYPOTHESES

1. Fortification of Chakli with bamboo shoot powder will positively influence its sensory attributes, including color, taste, aroma, texture, and overall acceptability.
2. Fortification with BSP is expected to improve the nutritional profile of Chakli.

### LIMITATIONS

1. Regional Specificity: The study focuses on Chakli, a traditional Indian snack, which may limit the generalizability of findings to other cultural contexts.
2. Sample Size: The sensory evaluation is conducted using a panel of judges, but the size of the panel and its representativeness may impact the reliability of sensory assessments.
4. Storage Conditions: The study evaluates the sensory and nutritional characteristics of Chakli immediately after preparation, without considering potential changes that may occur during storage.

### DELIMITATIONS

1. Ingredient Selection: The study specifically focuses on fortification with bamboo shoot powder, excluding exploration of other potential fortifying agents.
2. Sensory Evaluation: While sensory attributes are assessed using a panel of judges, factors such as individual preferences and biases are not controlled for.
3. Duration of Study: The study provides a snapshot of the sensory and nutritional characteristics of Chakli fortified with BSP, but long-term effects of fortification on product stability and consumer acceptance are not investigated.

### MATERIALS AND METHODS

#### a) Ingredients:

- 1.) **Bamboo shoot powder:** Edible shoots of the *Dendrocalamus strictus* sample was collected from local market of Bastar, Chhattisgarh, India. The sample was carefully cleaned, washed, cut into circular pieces. They were dried in a tray drier at 70 °C and processed into powder (Nayak & Palta, 2022). The bamboo shoot powder will be used for formulation of Chakli.
- 2.) **Chakli:** Ingredients required for formulation of chakli such as rice flour, Bengal gram flour, refined oil, chili powder, salt, cumin seed were purchased from local market of Raipur, Chhattisgarh.
- 3.) **Chemicals and reagents:** All chemicals and standard reagents utilized in this experimental design were of analytical grade.

#### b) Formulation and standardization of chakli recipe:

The traditional chakli recipe underwent food fortification to enhance their nutritional content, appearance, flavour, and taste, with bamboo shoot powder serving as the fortifying agent for all products. All experimental samples were prepared according to traditional recipes, with each set consisting of one control sample labeled T0 and three fortified samples labeled T1, T2, and T3, fortified at levels of 5%, 10%, and 15%, respectively.

Table: 01 List of ingredients with various treatment levels.

Ingredients	Treatments			
	T0	T1	T2	T3
Rice flour (g)	60	55	50	45
Gram flour (g)	40	40	40	40
BSP (g)	--	5	10	15
Oil (ml)	40	40	40	40
Sesam seed (g)	20	20	20	20
Chilli powder (g)	5	5	5	5
Salt: to taste	--	--	--	--

### c) Preparation Procedure

Step 1: In a large mixing bowl, combine rice flour, gram flour and BSP. Add heated oil and thoroughly mix the ingredients together.

Step 2: Incorporate cumin seeds, sesame seeds, red chili powder, turmeric powder, and salt into the flour mixture. Ensure that all components are evenly distributed.

Step 3: Gradually add water in small increments and knead the mixture until a smooth, firm, and pliable dough is formed. Adjust the water quantity as necessary to achieve the desired consistency, avoiding excessive softness or stickiness.

Step 4: Take a portion of the dough and shape it into a cylindrical log. Insert the dough log into a Chakli maker or a piping bag equipped with a star-shaped nozzle.

Step 5: Heat oil in a deep-frying pan or kadai over medium heat.

Step 6: Once the oil reaches the desired temperature, carefully press the Chakli dough directly into the hot oil in a spiral shape. Exercise caution during this step to prevent any splattering of hot oil.

Step 7: Fry the Chaklis until they attain a golden-brown color and become crispy. Flip them occasionally to ensure uniform cooking. Depending on the size of your frying pan, fry them in batches.

Step 8: Using a slotted spoon, remove the cooked Chaklis from the oil and allow excess oil to drain on a paper towel.

Step 9: Allow the Chaklis to cool completely before transferring them to an airtight container. This will help preserve their crispness.



Figure:1 Chakli ready for deep-frying



**Figure:02 Chakli being deep fried in kadai**

**c) Proximate analysis of chakli:**

Fresh chakli samples were analyzed for moisture, fat, protein, ash content and crude fibre by standard methods (AOAC, 2019). Value for carbohydrates was measured by subtracting moisture, fat, protein, fibre and ash content from the total gram weight of the sample. Calorie was measured by multiplying standard calorie values of Carbohydrates (4 Kcal/g), Protein (4 Kcal/g), and Fats (9 Kcal/g).



**Figure: 03 Chakli packaged in airtight bags**

**d) Sensory and organoleptic evaluation of chakli:**

The sensory quality characteristics of the developed products such as colour, taste, texture, flavor and overall acceptability were evaluated by panel of judges using nine-point hedonic scale. The score were assigned from extremely liked (9) to disliked extremely (1).

## RESULT AND DISCUSSION

### Sensory Analysis

The sensory analysis of chakli samples fortified with Bamboo Shoot Powder (BSP) compared to the control chakli is presented in Table 1, offering valuable insights into the participants' perceptions and preferences, which are essential for evaluating the sensory attributes of the products.

**Table: 02 Sensory comparison of control and different formulations of BSP fortified chakli using 9-point hedonic scale (1-Extremely dislike to 9-Extremely like)**

S. No.	Biscuit	Colour	Aroma	Texture	Taste	Overall
1	T0	7.41±1.32	6.75±0.86	6.24±1.14	7.12±1.18	6.76±1.11
2	T1	7.25±0.86	6.68±0.59	6.43±0.44	7.26±1.24	6.82±1.16
3	T2	7.14±0.94	6.82±0.80	6.47±0.87	7.15±0.79	6.84±1.52
4	T3	6.58±1.29	5.12±1.64	5.82±1.44	6.07±0.87	5.78±0.74

The sensory analysis compared chakli samples fortified with Bamboo Shoot Powder (BSP) to a control chakli. The control chakli was rated highest for color, indicating it was visually appealing, while the 5% BSP fortified chakli was rated highest for taste. The 10% BSP fortified chakli scored highest for aroma, texture, and overall acceptability, suggesting strong sensory appeal. However, the 15% BSP fortified chakli received the lowest overall acceptability score, indicating it was perceived less favorably. Ultimately, the 5% and 10% BSP fortified chakli samples were found to be preferred choices among the tested variations due to their superior overall acceptability.

### PROXIMATE ANALYSIS

The proximate analysis of chakli samples, both fortified with Bamboo Shoot Powder (BSP) and the control, revealed significant insights into their nutritional composition.

#### Moisture content

The control group exhibited the lowest moisture content, while fortified samples showed slightly higher levels ranging from 4.62g/100g to 5.79g/100g dry weight (dr. wt.), corresponding to fortification levels of 5% to 15%. Fortification with bamboo shoot powder influenced moisture levels, with the control chakli having remarkably lower moisture content at 3.25g/100g dr. wt. Fortified samples showed slightly higher moisture content compared to the control, with variations attributed to fortification levels, suggesting that higher fortification levels led to increased moisture content. Lower moisture content is generally preferred for enhanced product stability and shelf life, maintaining texture and crispness.

### Protein content

Protein analysis of both control and fortified chakli samples showed a gradual increase in protein content across fortification levels from 5% to 15%. The control group had the lowest protein content at 9.87g/100g dry weight (dr. wt.), while fortified chakli ranged from 10.56g/100g to 12.62g/100g dr. wt. for fortification levels of 5%, 10%, and 15%, respectively. This indicates that fortification positively impacted protein content, with higher fortification levels resulting in increased protein content, highlighting the potential of fortification to enhance the nutritional profile of chakli products.

### Fat content

Fat analysis compared fat content between control and fortified chakli samples, revealing that the control had the highest fat content at 33.28g/100g, while fortified chakli samples showed a gradual decrease in fat content with increasing fortification levels. Specifically, fortified chakli samples with fortification levels of 5%, 10%, and 15% had fat contents of 33.07g/100g, 32.85g/100g, and 32.42g/100g, respectively. This trend indicates that higher levels of fortification correlate with lower fat content in chakli.

### Fibre content

Fibre analysis of both control chakli and Bamboo Shoot Powder (BSP) fortified chakli samples revealed that the control had the lowest fiber content at 1.5g/100g dry weight (dr. wt.). However, as the level of BSP fortification increased, the fiber content of fortified chakli samples also increased. Specifically, fortified chakli samples with BSP fortification levels of 5%, 10%, and 15% exhibited fiber contents of 2.03g/100g dr. wt., 2.63g/100g dr. wt., and 2.89g/100g dr. wt., respectively. This trend demonstrates a clear increase in fiber content with higher levels of BSP fortification.

### Ash Content

Ash content analysis of both control chakli and fortified chakli samples showed a consistent increase in ash content as the fortification level of chakli increased. The control chakli had the lowest ash content, while the chakli fortified with 15% BSP had the highest ash content among all evaluated products. Ash content represents inorganic mineral components in food, including calcium, magnesium, and phosphorus. The increase in ash content in fortified chakli samples suggests incorporation of these minerals from BSP into the product. This provides valuable insights into the mineral composition of fortified chakli, crucial for various physiological processes and overall health.

**Table: 03 Proximate analysis of Chakli products**

S. No.	Samples	Moisture	Protein	Fat	Fibre	Ash	Carbohydrate	Calorie
01	<b>T0</b>	3.25 ± 0.32	9.87 ± 0.08	33.28 ± 0.44	1.50 ± 0.08	2.1 ± 0.10	50	539
02	<b>T1</b>	4.62 ± 0.03	10.56 ± 0.10	33.07 ± 0.21	2.03 ± 0.06	2.21 ± 0.02	47.51	529.91

03	<b>T2</b>	5.32 ± 0.03	11.24 ± 0.09	32.85 ± 0.09	2.63 ± 0.05	2.46 ± 0.04	45.50	522.61
04	<b>T3</b>	5.79 ± 0.12	12.62 ± 0.02	32.42 ± 0.05	2.89 ± 0.06	2.71 ± 0.03	43.57	516.54

Value reported are measurement replication mean ± standard deviation (n = 03 replicates)

### Carbohydrate content

Carbohydrate content of chakli samples was analysed. The control chakli had the highest carbohydrate content at 50g per 100g of the product. However, as fortification levels increased, a consistent decrease in carbohydrate content was observed in fortified samples, with contents of 47.51g/100g, 45.50g/100g, and 43.57g/100g for fortification levels of 5%, 10%, and 15%, respectively.

### Total calorie

The total calorie content of both control and fortified chakli samples was determined using standardized values: 4 Kcal/g for carbohydrates, 4 Kcal/g for proteins, and 9 Kcal/g for fats. The control chakli had the highest calorie content at 539 Kcal/100g, while fortified chakli samples with 5%, 10%, and 15% fortification levels showed lower total calorie values of 529.91 Kcal/100g, 522.61 Kcal/100g, and 516.54 Kcal/100g, respectively.

## CONCLUSION

In conclusion, this research explored the fortification of traditional Chakli with Bamboo Shoot Powder (BSP) and its impact on sensory attributes and nutritional composition. The sensory analysis revealed that fortification with BSP influenced color, taste, aroma, texture, and overall acceptability of Chakli, with 5% and 10% fortification levels being preferred among the tested variations. Proximate analysis provided valuable insights into the nutritional composition of fortified Chakli, showing increases in protein, fiber, and ash content with higher fortification levels, while fat and carbohydrate content decreased. These findings suggest that fortification with BSP not only enhances the sensory appeal but also improves the nutritional profile of Chakli, making it a promising strategy for enhancing the health benefits of this traditional snack. Further research and development in this area could contribute to the production of fortified snacks that cater to both cultural preferences and nutritional requirements, thereby promoting the consumption of healthier traditional foods.

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## DIETARY HABITS AND NUTRITIONAL RISK IN COLLEGE GIRLS: A STUDY IN THRISSUR, KERALA

Jolly T T<sup>1</sup> and A Thirumani Devi<sup>2</sup>

<sup>1</sup>Research Scholar, <sup>2</sup>Professor,

Department of Food Science and Nutrition,

Avinashilingam Institute for Home Science and Higher Education for Women,

Coimbatore-641043,

annviajollycmc@gmail.com, thirumanidevi\_fsn@avinuty.ac.in

HSAI life membership Number: <sup>1</sup> HSAI-2024-KL-1758-LF , <sup>2</sup> 93/T-6/LF

### ABSTRACT

Young adult women's health is a multidimensional and dynamic component that includes physical, mental, and social well-being. Lifestyle choices, access to healthcare, social level, and cultural influences all have an impact on their overall health. Assessing young adult women's health demands a comprehensive approach that takes into account the interconnectivity of physical, mental, and social aspects. Promoting a complete awareness of their health requirements helps to establish tailored treatments and healthcare policies that benefit their well-being. This study investigates the food habits, lifestyle patterns, and nutritional risk factors of college girls in Thrissur, Kerala. A detailed investigation was carried out to determine the influence of lifestyle choices on nutritional well-being. The findings include a wide spectrum of dietary choices and lifestyle patterns, with a special emphasis on identifying possible risk factors for nutritional disorders. This study's findings help us better understand the particular issues that this group faces, opening the path for successful solutions to improve their overall nutritional health and well-being.

**Keywords:** College students, Dietary habits, Lifestyle pattern, Nutritional problems, Physical Activity, Exercise

### INTRODUCTION

The shift from youth to adulthood is a crucial time for the establishment of behavioural habits that influence the risk of chronic diseases and long-term health (Meg et al, 2012). Young adulthood is distinct from adolescence and elder adulthood. When given new roles and urged to emulate adult behavior, young women go through a transitional period. Their nutrition greatly affects young women's health. Limiting high-calorie foods and encouraging girls and young women to exercise can balance the energy equation. They form a lifelong healthy eating habit early on. College students, considered young adult women, can make bad eating choices that harm their health (S. Abraham et al., 2018). Most undergraduates eat in university dining halls with few healthy options (S. Abraham et al., 2018). Long-term cohort research shows that most US college freshman consume more added sugar, processed carbohydrates, salt, and saturated fat than advised (George Mason University, 2022). According to the results of another research, only one in five pupils exhibit "favourable eating behaviours," which include eating a lot of fruit and vegetables, eating little fast food, and snacking moderately <sup>(1)</sup>. Additionally, researchers have discovered that students are more prone to acquire weight <sup>(1)</sup> compared to others their age who do not attend university.



College students' lifestyles vary greatly, according to studies in the International Journal of Indian Psychology, college students are trend-seeking, academically oriented, career-focused, socially focused, health-conscious, and family-focused (Int. jr of Ind. Psychology, 2015). Another study in the same population discovered a small but significant relationship between physical activity and college students' overall quality of life, as well as a link between physical activity and the quality of life domains of physical health, social relationships, mental health, environment, and vitality<sup>(2)</sup>.

Exercise is essential for a healthy lifestyle, even for college students. Research suggests that exercise may improve undergraduate students' mental health <sup>(2)</sup>. Recreational physical exercise on campus increased grades by 0.14 standard deviations, according to the Centre for Education Policy Analysis (Fricke H, 2017). Another study found a weak but positive correlation between physical activity and college students' quality of life in the environment, vitality, mental health, social relationships, and physical health domains (Fricke H, 2017).

Poor eating habits and limited food selections put college students at risk for nutritional difficulties <sup>(3)</sup>. "Food insecurity," or the inability to get enough food, especially healthful meals, affects many college students <sup>(4)</sup>. Racial and ethnic minorities miss more meals or go hungry, however the amount varies by institution and student group <sup>(4)</sup>. College students often lack zinc, calcium, and vitamin B12 <sup>(3)</sup>. Insufficient exercise and poor diets are connected to obesity and osteoporosis (Majem L et al, 2006).

The current study set out to examine college students' lifestyles in Kerala's Thrissur area. Specifically, lifestyle patterns, eating habits, and nutritional issues risks were taken into account.

### **OBJECTIVES**

1. Evaluate college girls' eating habits, including meal frequency, food types, and unhealthy practices like skipping meals and fast food consumption.
2. Determine potential nutritional risk factors, focusing on obesity, underweight, anemia, and nutrient deficiencies.
3. Investigate how lifestyle factors, including physical activity and sleep patterns, impact nutritional health.
4. Analyze how age, religion, and family characteristics influence dietary habits and nutritional status.

### **HYPOTHESES**

1. College girls with poor dietary habits, such as frequent fast food consumption and meal skipping, are more likely to have nutritional deficiencies compared to those with balanced diets.
2. Higher physical activity levels among college girls correlate with a lower risk of obesity and nutritional disorders.
3. Age, family type, and socio-economic status significantly influence the dietary choices and nutritional status of college girls.

## **METHODS AND MATERIALS**

### **Study Design**

A cross-sectional study was carried out to better understand the dietary habits, lifestyle patterns, and likelihood of nutritional problems among college-going students in Thrissur, Kerala, ages 18 to 21. The research was conducted from June to August of 2023.

### **Study Population**

The research population includes students from Little Flower College Guruvayur, St. Joseph College Irinjalakkuda, Carmel College Mala, Vimala College Thrissur, and St. Mary's College Thrissur. Young adult women between 18 and 21 who were enrolled in the colleges and gave a written consent were eligible to participate. Exclusion criteria included students with other health issues, expecting and nursing mothers, and those who rejected consent.

### **Sample Size Calculation**

It was decided to use the Daniel Formula [ $Z^2P(1-P)/d^2$ ] to calculate the sample size (1250) (Daniel, 1978). The Prevalence rate (P) is 16% and the margin of error (d) is 0.02 when the Z score is assumed to be 95%.

### **Sampling Technique**

Purposive sampling was utilized in the study to choose the colleges, and random sampling was employed to choose individuals from the chosen institutions.

### **Data Collection Method**

The current study collected data by systematic questionnaire. Self-administered questionnaires collected sociodemographic, lifestyle, dietary, and nutritional data. Each questionnaire recipient had a unique number. The questionnaire collected these data:

The study analyzed socio-demographic characteristics, lifestyle patterns, and anthropometric measurements of selected students. It assessed nutritional risk using six risk indicators for five nutritional issues: anemia, obesity, underweight, osteoporosis, and prediabetes. Data was collected on dietary patterns, daily meals, skipping meals, eating outside habits, taste preferences, food allergies, and fat-dense food consumption. The questionnaire was pretested by distributing it to 10% of the study subjects (125) from five colleges in the Thrissur district. The Human Ethical Committee of Vimala College (Autonomous) Thrissur provided ethical clearance (VC/REC/23- 24-1) for this study, and respondents gave informed consent.

## RESULTS AND DISCUSSION

A self-administered questionnaire was used to analyse the food patterns and nutritional condition of college students in the Thrissur area. The study involved 1,250 female students. Information on socio-demographic traits, lifestyle patterns, eating habits, and nutritional concerns was collected.

Only 69 (5.5%) responders were between 21 and 19, with 570 (45.6%) falling between those ages. Hindus dominated with 745 (59.6%), Christians with 270 (21.6%), and Muslims with 235 (18.8%). 87.6% (1095) were nuclear families, while 155 (12.4%) were joint families. According to respondents' family size evaluation, 743 (59.4%) were from 1 to 4 families, 484 (38.7%) from 5 to 8, and 23 (1.8%) from more than 8 families.

A multi-disciplinary expert group organized by the National Sleep Foundation suggested 7-9 hours of sleep each day for young adults (18-21 years) (Hirshkowitz M et al,2015). In this present study, 804 (64.2%) subjects were getting 6

**Table 1 Socio Demographic characteristics of respondents**

Variables	Frequency (n=1250)	Percent
<b>Age group</b>		
18	400	32
19	570	45.6
20	211	16.9
21	69	5.5
<b>Religion</b>		
Hindu	745	59.6
Muslim	235	18.8
Christian	270	21.6
<b>Type of Family</b>		
Nuclear	1095	87.6
Joint	155	12.4
<b>Family size</b>		
1-4	743	59.4
5-8	484	38.7
>8	23	1.8

**Table 2 Lifestyle of respondents**

Variable	Frequency (n=1250)	Percent
<b>Sleep duration</b>		
<4 hrs.	7	0.6
4-6 hrs.	334	26.7
6-8 hrs.	804	64.2
>8 hrs.	105	8.5
<b>Do you exercise regularly?</b>		
Yes	289	23.2
No	961	76.8
<b>Time of exercise</b>		
Morning	186	64.4
Evening	103	35.6

to 8 hours of sleep and only seven (0.6%) of them were getting less than 4 hours of sleep. Shorter sleep duration, or poor sleep, has been linked to obesity during the past decade. This connection is greater among children and young adults than among older persons (Nielsen, 2011).

People aged 18 to 64 should engage in moderate to vigorous physical activity (MVPA) at least 5 days a week, preferably for 60 minutes for health advantages, according to the CDC<sup>(5)</sup>. The WHO (2013) recommends reducing insufficient physical activity by 10% by 2025. Only 23.2% (289) people took regular exercise, and 200 (69.2%) exercised 30 minutes daily. 41 (14.2%) had more

than an hour of exercise daily. Most (88, 30.6%) chose brisk walking as their daily workout, while 12.8% (37) chose yoga. Morning exercise was done by 186 (64.4%) respondents and evening exercise by 103 (35.6%).

Figure 1 Type of Exercise (n=289)

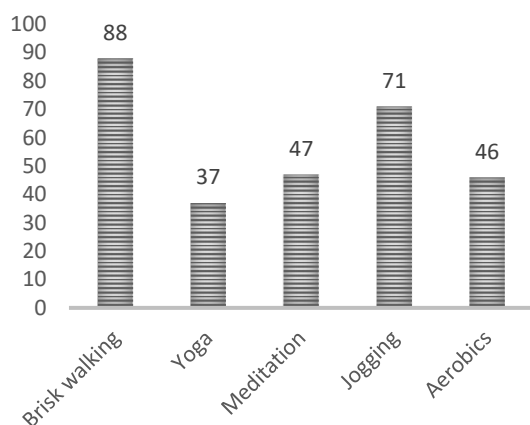
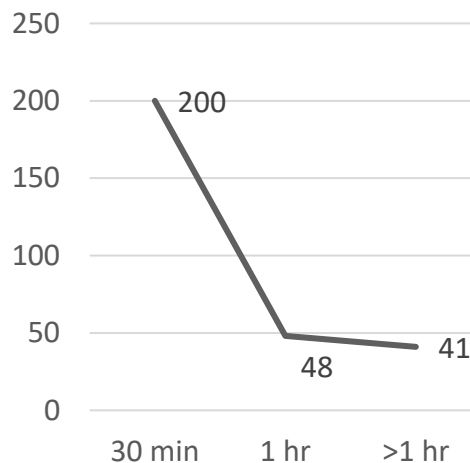


Figure 2 Time spent daily on Exercise (n=289)



Dietary practice affects several aspects of diet variation and adolescent nutrition. Young people are more likely to miss meals, eat fast food and dine out, consume too much sugar, and eat less fruit and vegetables than other age groups (Zhou et al., 2015). Most responders (1095, 87.6%) were non-vegetarian. Six hundred and ten (48.8%) respondents ate three main meals and one snack per day, while 61 (4.9%) ate more. 52% (651) skipped meals. Most respondents (1095, 87.6%) were non-vegetarian. Six hundred and ten respondents (48.8%) ate three main meals and one snack daily, whereas 61 (4.9%) ate more. 52% (651) occasionally skipped meals.

Figure 3 Causes for skipping meal

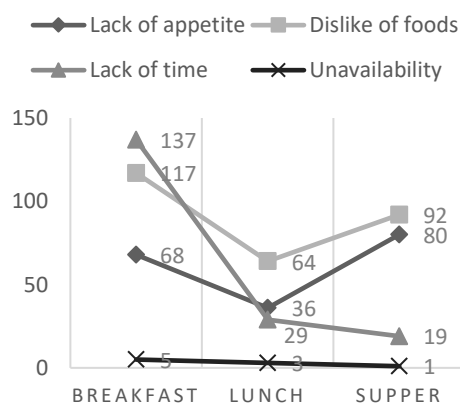


Table 3 Dietary pattern of respondents

Variable	Frequency (n=1250)	Percent
<b>Dietary pattern</b>		
Vegetarian	95	7.6
Non- Vegetarian	1095	87.6
Ovo- vegetarian	37	2.9
Lacto-Vegetarian	23	1.8
<b>Meals per Day</b>		
2 full meals only	352	28.2
3 full meals only	227	18.2
3 meals & 1 snack	610	48.8
More than 3 meals	61	4.88
<b>Habit of Skipping meals</b>		

Yes	651	52
No	599	48
<b>Habit of eating outside</b>		
Yes	968	77
No	282	23
<b>Food Allergy</b>		
Yes	162	13
No	1088	87

Supper 41.7%) was another reason for skipping meals. The majority of respondents (968) ate outside food. Among them, 53.8% eat outside food monthly. About 2.5% of participants ate outside food daily. In order of preference, 48% favored spicy dishes, followed by Sweet (31%), Fried (8%), Cold (5%), Hot (4%), and Salty (4%). Early study on taste preferences, food intake, and obesity found that high flavor intensity increases food palatability, leading to overconsumption and obesity (Nasser J, 2001).

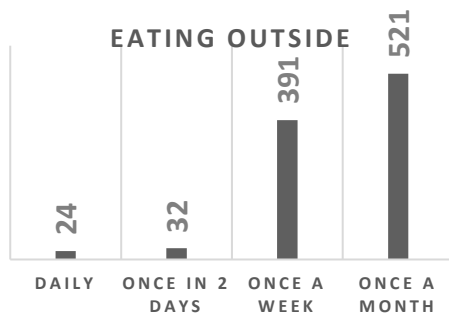


Figure 4 Eating from the outside

overall nutritional quality” (6). Research on young adult diets shows that fast-food outlets are visited two to three times a week (Niemeir, 2006). Table 4 illustrates respondents' fat-dense meal consumption. 18.9% of respondents eat fried snacks every day and 58.3% weekly. Data showed 13.4% of individuals never drank fizzy drinks.

Healthy diet benefits general health and prevents cardiovascular disease, diabetes, high blood pressure, stroke, cancer, dental caries, and asthma. Children and teens' physical and cognitive development depends on healthy diet. Fig. 6 shows food frequency table analysis. Over 75% (947) of respondents eat cereals every day, while 44.2% (553) eat pulses occasionally. 23% (287) occasionally ate roots and tubers. Milk and milk products are never consumed by 101 participants (8%).

Half of the respondents (327, 50.2%) among them skipped the breakfast, mainly because of the lack of time (137, 42%). Food dislike was the main reason for skipping lunch (64%) and dinner (48%). The food was scarce, thus some individual skipped breakfast (1.6%), lunch (2.2%), and dinner (0.5%). Lack of Appetite (Breakfast 20.8%, Lunch 27.8%, and

NHANES says “young people (20-29 years old) spend more than 40% of their daily energy away from home; hence, restaurant meals and beverages may have a major effect on

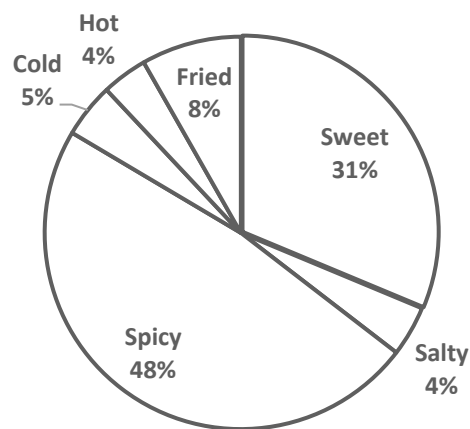


Figure 5 Taste preference of the respondents

Table 4 Consumption of fat dense foods

Food Items	Daily	Percent	Weekly	Percent	Monthly	Percent	Yearly	Percent	Never	Percent
<b>Fried snacks</b>	237	<b>18.96</b>	729	<b>58.32</b>	229	<b>18.32</b>	17	<b>1.36</b>	38	<b>3.04</b>
<b>Non Veg snacks</b>	76	<b>6.08</b>	660	<b>52.8</b>	403	<b>32.24</b>	38	<b>3.04</b>	73	<b>5.84</b>
<b>Carbonated drinks</b>	26	<b>2.08</b>	262	<b>20.92</b>	630	<b>50.4</b>	164	<b>13.12</b>	168	<b>13.44</b>
<b>Sweet items</b>	262	<b>20.96</b>	652	<b>52.16</b>	266	<b>21.28</b>	41	<b>3.28</b>	29	<b>2.32</b>
<b>Bakery Items</b>	<b>301</b>	24.08	<b>624</b>	49.92	<b>264</b>	21.12	<b>33</b>	2.64	<b>28</b>	<b>2.24</b>

Participants received a checklist with six physical indications of anemia, obesity, underweight, osteoporosis, and prediabetes. The findings showed that 74 respondents had more than three obesity symptoms, 47 had anemia symptoms, and 44 had prediabetes symptoms. 25 respondents had three or more underweight symptoms, whereas 17 had three or more osteoporosis symptoms. Nutrition is one of the most effective and adaptive environmental variables for reducing illness across a lifetime. A healthy diet and metabolism offer the substrates the body requires for its daily functions. In a balanced diet, macronutrients provide energy, whereas micronutrients are needed for practically all metabolic and developmental processes. Poor nutrition increases the risk of diabetes, heart disease, and cancer (Kiani et al., 2022).

Figure 6 Food Frequency table Analysis

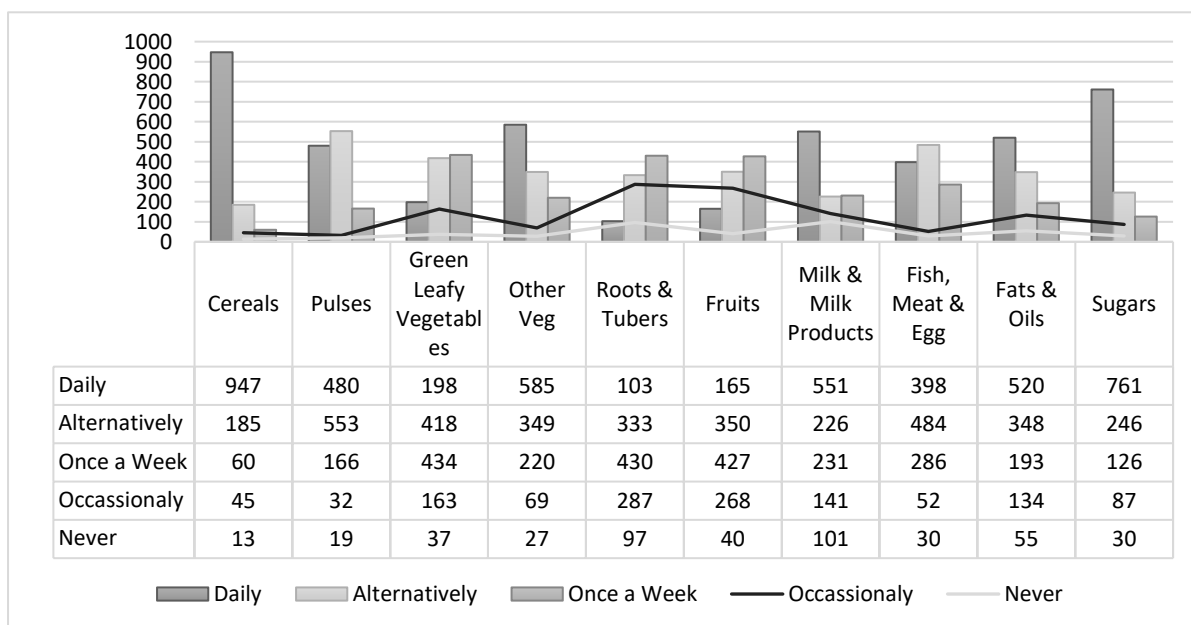
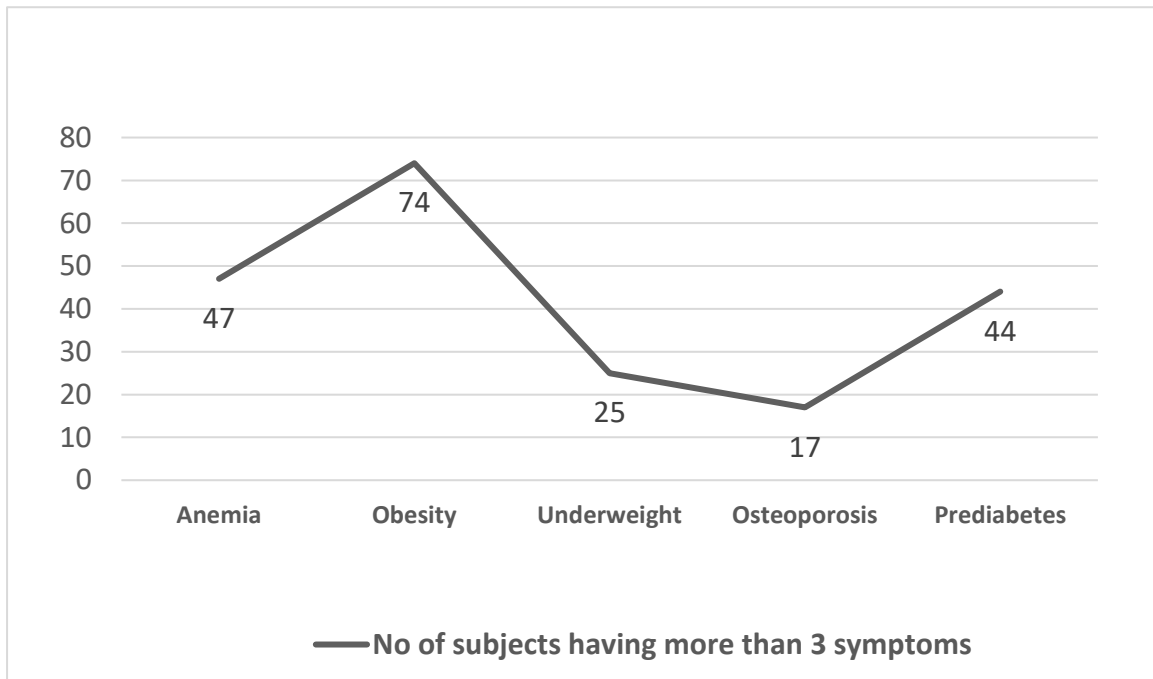


Figure 7 Risk of Nutritional Problems



**Table 5 Assessment of nutritional problems**

<b>PHYSICAL SIGNS</b>	<b>YES</b>	<b>Percent</b>	<b>NO</b>	<b>Percent</b>
<b>ANAEMIA</b>				
Dizziness and fatigue after physical activity	299	23.92	951	76.08
Pale nails	83	6.64	1167	93.36
Frequent minor infections	109	8.72	1141	91.28
Shortness of breath	194	15.52	1056	84.48
Headache	590	47.2	660	52.8
Angular stomatitis	64	5.12	1186	94.88
<b>OBESITY</b>				
Breathlessness	130	10.4	1120	89.6
Increased sweating	268	21.44	982	78.56
Snoring	34	2.72	1216	97.28
Difficulty doing physical activity	162	12.96	1088	87.04
Often feeling tired	372	29.76	878	70.24
Joint and back pain	379	30.32	871	69.68
<b>UNDERWEIGHT</b>				
Fatigue and lethargy	141	11.28	1109	88.72
Low heart rate	34	2.72	1216	97.28
Night sweats	86	6.88	1164	93.12
Having cold fingers and toes	186	14.88	1064	85.12
Muscle problems	206	16.48	1044	83.52
Nausea	88	7.04	1162	92.96
<b>OSTEOPOROSIS</b>				
Change in posture	81	6.48	1169	93.52
Shortness of Breath	104	8.32	1146	91.68
Frequent Bone fracture	31	2.48	1219	97.52
Pain in the lower back	229	18.32	1021	81.68
Receding gums	79	6.32	1171	93.68
Weaker grip strength	53	4.24	1197	95.76
<b>PREDIABETES</b>				
Increased Thirst	177	14.16	1073	85.84
Frequent Urination	157	12.56	1093	87.44
Increased hunger	234	18.72	1016	81.28
Fatigue	133	10.64	1117	89.36
Unintended weight loss	81	6.48	1169	93.52
Blurry vision	104	8.32	1146	91.68

This table (Table 6) shows substantial associations between health factors and health outcomes. Anaemia and obesity are most correlated ( $r=0.519$ ), suggesting a relationship. Anaemia often coexists with underweight, osteoporosis, and pre-diabetes, as shown by moderate positive



relationships. Obesity has moderate connections with osteoporosis and pre-diabetes, supporting research on the complicated relationship between body composition and metabolic health. Underweight condition is linked to osteoporosis and pre-diabetes, highlighting its health hazards.

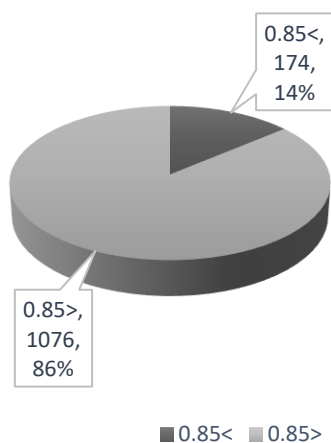
**Table 6 Significant Correlations among Health variables**

Variable Pair	Pearson Correlation (r)	Significance (2-tailed)
Anaemia - Obesity	0.519	0.000
Anaemia – Under Weight	0.452	0.000
Anaemia – Osteoporosis	0.464	0.000
Anaemia – Pre diabetes	0.434	0.000
Obesity – Osteoporosis	0.499	0.000
Obesity – Pre diabetes	0.488	0.000
Underweight – Osteoporosis	0.466	0.000
Under weight – Pre diabetes	0.437	0.000
Osteoporosis – Pre diabetes	0.454	0.000

These findings support literature linking dietary status, bone health, and metabolic diseases. Anaemia and obesity owing to chronic inflammation are linked, as is low body weight and osteoporosis. The obesity-pre-diabetes link matches metabolic syndrome research. These results emphasize the need for comprehensive health assessments and interventions that target various, linked health issues.

One of the biggest nutritional and health issues affecting young adults in both industrialized and developing nations is obesity, a multifactorial metabolic syndrome linked to excess adipose tissue.

Obesity and overweight are becoming increasingly common as a result of urbanization, lifestyle changes, and decreasing physical activity (Jebeile, 2022). In addition to the detrimental psychological implications of obesity, study data indicate that around 70-80% of obese teenagers develop into obese adults. Obesity and overweight throughout early adulthood might raise the chance of acquiring chronic illnesses (Anderson et al, 2014).



**Figure 8 Waist Hip ratio**

The

respondents were assessed for Body Mass Index and waist-hip ratio. 30.32% of the subjects were categorised as under-weight, 59.44% as Normal, 8.8% as Overweight and 1.44% in the obese category (1.3% Class I, 0.08% Class II and Class III). According to WHO classification Waist hip

**Table 7 Categorisation of Subject on the basis of Body Mass Index**

Body Mass Index	Percent of subjects
Below 18.5 (Under-weight)	30.32
18.5 – 24.9 (Normal)	59.44
25.0 – 29.9 (Overweight)	8.8
30.0 – 34.9 (Obese II)	1.3
35.0 – 39.9 (Obese II)	0.08
Above 40 (Obesity III)	0.08

ratio less than 0.85 is less risk for metabolic diseases and greater than 0.85 is substantially increased risk for metabolic diseases. 86% of the subjects who attended the present study had less risk for metabolic diseases and 14% of the respondents had increased risk for developing metabolic diseases.

The analysis of dietary habits and BMI in our study holds particular relevance for young adult women, a demographic often concerned with weight management and body image. Our findings suggest that this group may benefit significantly from adopting healthier eating patterns. For young women, the correlation between diets high in fruits, vegetables, and low-fat foods and lower BMIs offers a promising path for weight management without resorting to extreme dieting. The observed link between irregular eating habits, such as meal skipping, and higher BMIs is especially pertinent, as busy lifestyles common among young adult women can lead to erratic eating schedules. Additionally, the association between frequent consumption of meals prepared outside the home and increased BMI is crucial, given the social nature of dining out in this age group. These insights can inform targeted interventions for young adult women, emphasizing balanced, regular meals and mindful choices when eating out, potentially leading to improved body composition and overall health outcomes in this population.

**Table 8 Correlation Coefficients and significance Levels for BMI, Lifestyle Factors, and Dietary Habits**

<b>Factors</b>	<b>Correlation coefficient</b>	<b>P value</b>
<b>Correlation of BMI with WHR, Sleep duration and Habit of doing exercise</b>		
WHR	0.191	0.000
Sleep duration	-0.131	0.000
The habit of doing exercise	0.109	0.000
<b>Correlation of Habit of Skipping meals with Meals per day, Eating from the outside and Taste preference</b>		
Meals per day	0.142	0.000
Habit of eating from the outside	0.068	0.016
Taste preference	-0.027	0.332

## CONCLUSION

In conclusion, this study throws light on the importance of lifestyle, eating habits, and nutritional patterns among college students. The findings highlight the importance of specific interventions and educational initiatives to encourage healthy behaviours and nutritional choices among this population. According to the study, many students struggle to maintain a balanced diet, which can lead to nutritional deficits and long-term health consequences.

- The hypothesis stated that college girls with poor dietary habits would have a higher likelihood of nutritional deficiencies. The study confirmed this, showing that a significant portion of participants engaged in unhealthy eating practices, such as frequent fast food

consumption and meal skipping, which correlated with signs of nutritional deficiencies and health issues.

- The hypothesis suggested that higher physical activity levels would be associated with a lower risk of obesity and nutritional disorders. The findings supported this, indicating that only a small percentage of participants engaged in regular exercise, and those who did reported better overall nutritional health compared to their less active peers.
- The hypothesis proposed that socio-demographic factors would significantly influence dietary choices and nutritional status. The study validated this hypothesis by revealing variations in dietary habits and nutritional risks based on age, family type, and socio-economic status, indicating that these factors play a crucial role in the health outcomes of college girls.

Overall, the study's findings align well with the proposed hypotheses, highlighting the interconnectedness of dietary habits, physical activity, and socio-demographic influences on the nutritional health of college girls. Comprehensive wellness activities, both within educational institutions and via community outreach, are critical for instilling a culture of health and well-being among college students. By proactively treating these concerns, we can improve this population's overall physical and mental well-being, laying the groundwork for long-term health and success. More research and collaboration among educators, health experts, and policymakers are required to create successful techniques that enable college students to make educated decisions and prioritize their health in the face of academic and social pressures.

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**PERSONAL HEALTH AND HYGIENE PRACTICES AMONG PEOPLE: A STUDY  
OF URBAN PATNA, BIHAR**

**Dr. Kavita Kumari**

Senior Assistant Professor

Department of Home Science

Magadh Mahila College, Patna University, Patna.

Email id: drkavitakumarisingh@gmail.com

Membership No. HSAI-2019-BH-352-LF

**ABSTRACT**

Sudden outbreak of COVID -19 changed priorities of human beings which could be seen through health hygiene and dietary practices prevalent among the population. Prior to the pandemic most of us were very ignorant to our health. But, uncounted death during COVID -19 taught us the importance of health. Everyone was in dilemma how to save life during the pandemic? Since reason and prevention of infection were not obvious. But most of the scientists and doctors had been suggesting to maintain personal hygiene behaviour, social distancing and boosting up immunity. Personal health and hygiene practices, yoga and good diet became part of daily life. Even majority of population used to drink warm water, turmeric milk, kadha and started taking immunity booster medicines etc. People started taking some vitamin supplements also. Another important practice of personal hygiene was care of used clothes. During pandemic people used to store worn clothes separately after coming from outside and this practice is being practiced by many of us till now. Another change in hygiene behaviour was observed regarding cleaning of hands, feet and face after returning home from outside. Thus, there were many positive changes took place which could have been seen if we go through studies done during or just after the pandemic. It has been more than three years since the pandemic got over but various health and hygiene practices that had been followed during the pandemic became part of daily life and are being practiced by many health-conscious people.

Therefore, this study has been conducted to analyse different types of personal health and hygiene practices prevalent among the people of urban Patna, Bihar.

**Keywords-:** Health, hygiene practices, dietary, immunity, pandemic.

**INTRODUCTION**

COVID-19 witnessed many behavioural changes in different domain such as health, hygiene and dietary pattern. Unexpected outbreak of pandemic made us realise importance of personal hygiene for overall health. Since good diet, personal health and hygiene practices are vital to maintain good health but since pandemic a good proportion of population became more particular and conscious. Some personal hygiene practices like hand wash, face wash and feet wash after coming from outside

developed in regular habits. People also used to keep their worn clothes separately and these clothes had been used only after washing with soap or detergent. People became more conscious and started to give more attention to their health and this brought some changes in food habits also. Drinking warm water, turmeric milk, herbal kadha have also been adopted by the population to some extent. Intake of fruits specially citrus fruits, green vegetables and green leafy vegetables in daily diet have been increased. Personal health and hygiene practices always play important role in maintenance of good health and are essential for all age groups. If we go through various studies, results show that many infectious diseases occur due to poor hygiene practices which cause high rate of morbidity among people of various age groups specially among children. Singh et al. (2023) in their study on Assessment of Personal Hygiene Practices Among Young Adults documented that a rigorous program of awareness and education regarding this subject was the need of the hour to facilitate an improvement in predictive and preventive health care and reduce morbidity and mortality. Though changes in these domains are in the process but still many studies focus on need of personal health and hygiene practices for overall health.

Present study has tried to tap into the various aspect of personal health and hygiene practices prevalent among the people of urban Patna, Bihar.

### **NEED OF THE STUDY**

Personal health and hygiene behaviour always remained important for good health of human being. Sudden outbreak of COVID -19 made people understand the essentiality and importance of personal health and hygiene behaviour. Almost three years of the pandemic have passed and most of us have returned in our normal life. COVID -19 brought many transformations in our lifestyle. Many studies have been conducted on personal health and hygiene practices prevalent among the population but mostly cover hand wash practice, safe drinking water, hygiene during cooking etc. Very few data are available on such aspects which have been covered in present investigation. So, it is important to analyse the various common personal health and hygiene practices prevalent among the population. These include various aspects like putting off footwear, hand wash, feet wash, storage of used clothes, drinking of warm water, turmeric milk and many other practices.

### **OBJECTIVES OF THE STUDY**

1. To study the socio -demographic profile of the sample under study.
2. To assess different types of personal hygiene practices prevalent among the study sample.
3. To analyse various health and dietary practices prevalent among the respondents under study.

### **HYPOTHESES**

1. Majority of the respondents do not give attention to health and healthy dietary practices.
2. Personal hygiene behaviours are not in practice by majority of the respondents.

## **REVIEW OF LITERATURE**

Hareesh et al. (2024) in their meta-analysis study on Prevalence and determinants of hand hygiene behaviour among Indian population found that the overall prevalence of HH before food was 55% (95% CI = 31-78), and after the toilet was 84% (95% CI = 65-96). Further,

Subgroup analysis showed that before-food HH prevalence pre- and post-COVID-19 was 61% and 36%, respectively, whereas after-toilet HH prevalence was 91% and 74%, respectively. This systematic review highlights various demographic, psychosocial, and environmental determinants of HH behavior. The results offer the potential for a deeper comprehension of the key factors influencing HH in India and could find implications for developing viable interventions.

Ahsan et al. (2022) studied Impact of general hygiene behaviours on oral hygiene among adolescents of Ghaziabad - A cross-sectional study and reached to conclude that more than 50% of the study participants had a low level of general hygiene. Further, the present study demonstrates significant association between general hygiene and oral hygiene behaviors among adolescents.

Singh et al. (2023) in their study on Assessment of Personal Hygiene Practices Among Young Adults: A Cross-Sectional, Descriptive Study documented that a rigorous program of awareness and education regarding this subject is the need of the hour to facilitate an improvement in predictive and preventive health care and reduce morbidity and mortality.

Agarwal et al. (2017) studied on water, sanitation, and hygiene practices among population living in slums, Jhansi, Uttar Pradesh and reported that out of 768 sample size only one-third women used to wash hands before eating and cooking and out of them only 38 % used soap for hand washing. Personal health and hygiene practices are very important to maintain good health and the pandemic perhaps caused many transformations in this regard.

## **RESEARCH MATERIALS AND METHODS**

The present study was conducted in urban Patna, Bihar. This is a cross sectional study and sample was selected through convenient purposive sampling. Total 160 respondents aged between 15 to 70 years have been selected. Data was collected in the year 2022. For data collection self-administered schedule was prepared. Schedule consisted of two parts, first part dealt with questions related to demographic profile of the respondents while second part covered questions based on personal health and hygiene practices of the respondents. Answers of health and hygiene practices have been recorded on five-point Likert scale. Age, sex, social category, education, working status and average monthly family income of the respondents have been taken as independent variables while personal health and hygiene practices have been considered as dependent variables. Data was collected through personal interview and after collection and appropriate treatment of the data, it was tabulated for statistical analysis so that appropriate inferences could be drawn.

Percentage, frequency, five-point Likert scale and Pie diagrams have been used to analyse and interpret the results.

**RESULTS**

**Table-1: Socio demographic profile of the Respondents**

Particulars	No (n=160)	Percentage(%)
<b>Age(years)</b>		
15-30	18	11.25
30-45	10	6.25
45-60	71	44.38
60 and above	61	38.12
<b>Sex</b>		
Male	81	50.63
Female	79	49.27
<b>Social Category</b>		
General	89	56.0
Backward	58	36.0
Schedule caste	13	08.0
<b>Educational Level</b>		
Illiterate	9	5.62
Matriculation	21	13.13
Intermediate	10	6.25
Graduation and above	120	75.00
<b>Working status of the respondents</b>		
Government job	36	22.50
Private job	38	23.75
Business	16	10.00
Home managers	30	18.75
Others	40	25.00
<b>Monthly income of the family (Rs)</b>		
Up to 50,000	21	13.12
50,000-100000	50	31.25
100000-200000	35	22.88
More than 200000	54	32.75

Table 1 depicts socio –demographic profile of the respondents under study. Out of the total sample size, 11.25 per cent respondents are in the age group between 15 to 30 years followed by 6.25 per cent who fall in the category of 30 to 45 years age while 44.38 per cent and 38.12 per cent respondents lie in the category of 45 to 60 years and more than 60 years old respectively. Sex wise data shows that male and female respondents constitute 50.63 per cent and 49.27 per cent of the sample size respectively. Out of total respondents 56.0 per cent belong to general category followed by 36.0 per cent who represent backward caste and rest 8.0 per cent respondents represent schedule caste category.



Educational profile of the respondents depicts that 75.0 per cent respondents are graduate or above while 6.25 per cent are intermediate pass. However, 13.13 per cent respondents have completed their matric level education only.

Occupation wise data reveals that 22.5 per cent, 23.75, 10.0 per cent and 18.75 per cent of respondents are government employees, private employees, business personnel, home managers and associated with some other professions respectively.

Again, data pertaining to average monthly family income of the respondents under study shows that 32.75 per cent respondents have more than 2 lacs monthly income followed by 31.25 per cent, 22.88 per cent and 13.12 per cent having monthly income between Rs 100000-Rs 20000, Rs. 50,000-100000 and up to Rs 50,000 respectively. Thus, nearly one third of the respondents have an average monthly family income more than 2.0 lacs.

**Table -2: Personal Hygiene Practices Prevalent Among the Respondents**

Particulars	Number (n)=160	percentage
<b>Put off footwear outside home</b>		
Always	79	49.38
Often	14	8.75
Sometimes	11	6.87
Rarely	40	25.00
Never	16	10.00
<b>Wash hands after coming from outside</b>		
Always	48	30.00
Often	60	37.50
Sometimes	10	6.25
Rarely	14	8.75
never	28	17.50
<b>Wash feet after coming from outside</b>		
Always	52	32.50
Often	38	23.75
Sometimes	21	13.13
Rarely	37	23.12
never	12	7.50
<b>Keep clothes separately when return home from outside</b>		
Always	44	27.50
Often	27	16.87
Sometimes	10	6.25
Rarely	42	26.25
never	37	23.13

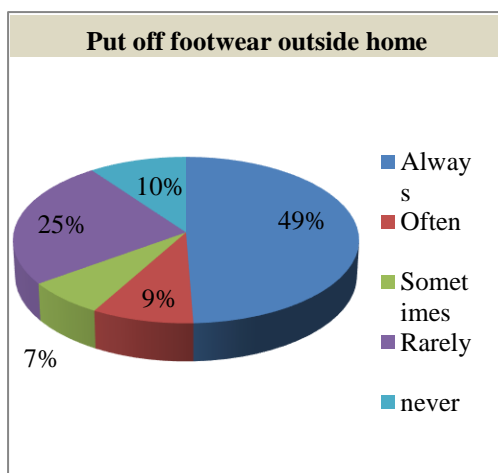


Figure 2.1

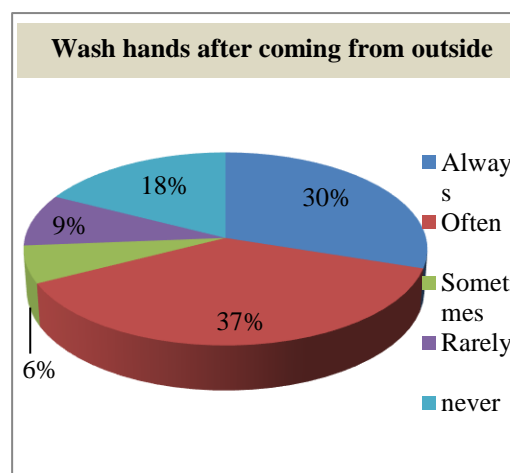


Figure 2.2

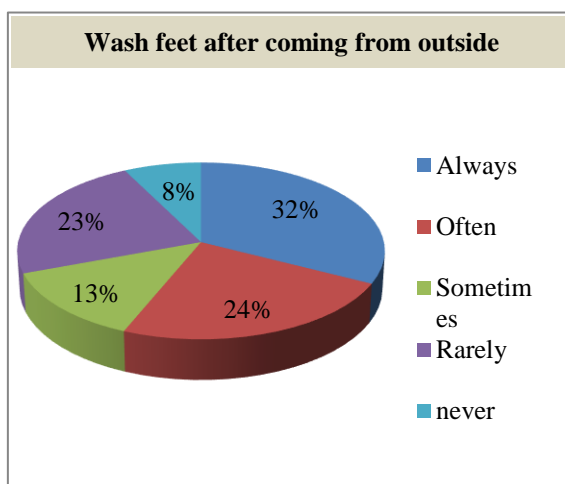


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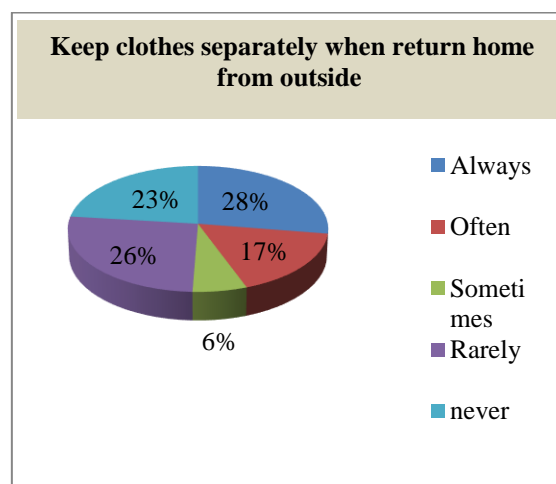


Figure 2.4

Table 2 depicts data on personal hygiene practices of the respondents under study which have been measured on five-point Likert scale. Data clearly shows that 49.38 per cent respondents always put off their footwear and 25.0 per cent respondents rarely put off their footwear after coming from outside. Respondents who often put off their footwear constitute only 8.75 per cent and those who sometimes put off footwear are 6.87 per cent of the total. Again, 10.0 per cent respondents report that they never put off footwear after coming from outside. Thus, nearly 58.0 per cent respondents put off footwear always or often when return home from outside which might be due to majority of the respondents are educated.

Washing hands after coming from outside is another hygiene-based practice which has been studied and data depicts that 30.0 per cent, 37.5 per cent, 6.25 per cent and 8.75 per cent respondents wash their hands always, often, some times and rarely respectively after coming from outside. But it is also obvious that 17.5 per cent respondents never wash hand when they return home from outside. Thus, majority of respondents (67.5 per cent) wash their hands most of the time when come home from outside. Though still nearly one fifth of the study participants don't wash hands when return home from outside.

Further data pertaining to respondents who wash their feet after coming from outside shows that 32.5 per cent respondents always wash their feet, 23.75 per cent do often and 13.13 per cent wash sometimes. But, 23.12 per cent respondents admitted that they rarely wash their feet after coming from outside and 7.5 per cent respondents never wash feet. Again, it may be said that more than half of the total respondents wash their feet always or often when return home from outside.

Information regarding care of clothes discloses that 27.50 per cent respondents keep clothes separately once come from outside while those who do this practice often constitute 16.87 per cent and 6.25 per cent keep their clothes separately sometimes.

Further 26.25 per cent respondents rarely keep their clothes separate when return home from outside and rest 23.23 per cent respondents don't keep their clothes separate after coming from outside.

Thus, overall, more than 40.0 per cent respondents keep their clothes separately when come from outside and this might be due to better education and average family income of the respondents

**Table -3: Health and Dietary Practices of the Respondents Under Study**

**N=160**

Particulars	number	percentage
<b>Give attention to health</b>		
Yes	104	65.00
No	50	31.25
No response	06	3.75
<b>Do exercise/yoga</b>		
Always	22	13.75
Often	20	12.50
Sometimes	25	15.62
Rarely	22	13.75
never	71	44.38
<b>Drink warm water</b>		
Always	-	-
Often	42	26.26
Sometimes	36	22.50
Rarely	23	14.38
Never	59	36.88
<b>Take milk with turmeric</b>		
Always	-	-
Often	30	18.75
Sometimes	64	40.00
Rarely	48	30.00
Never	18	11.25
<b>Take fruits in diet</b>		
Always	32	20.00
Often	44	27.50
Sometimes	54	33.75
Rarely	30	18.75
Never	-	-

Do you take kadha when catch cough and cold		
Always	-	-
Often	13	8.12
Sometimes	83	51.88
Rarely	29	18.12
Never	35	21.88

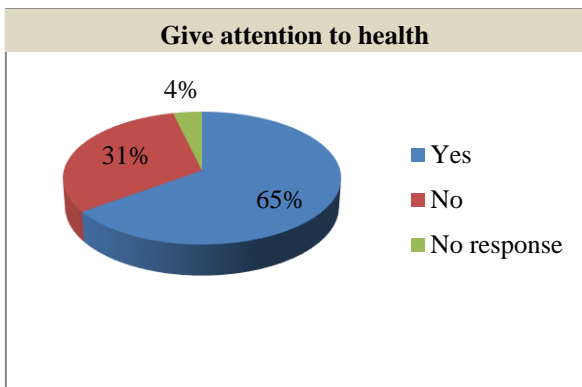


Figure 3.1

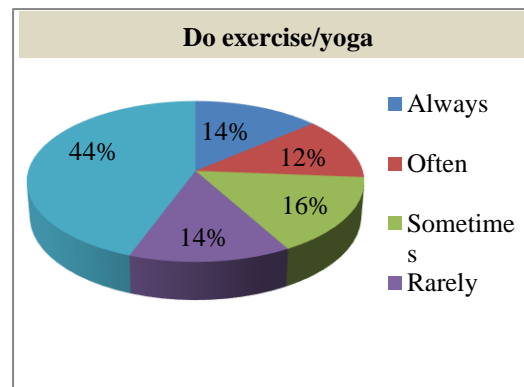


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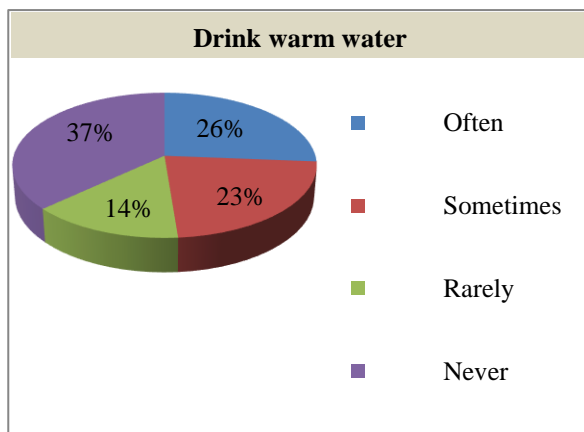


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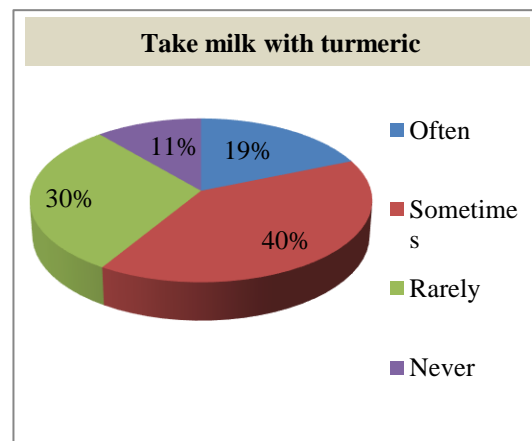


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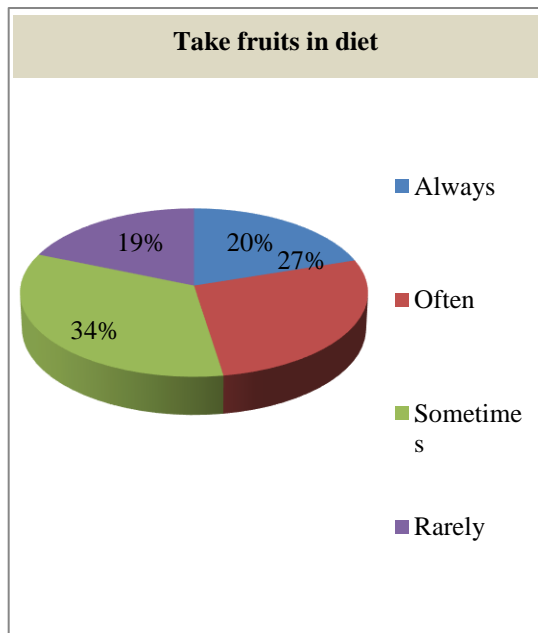


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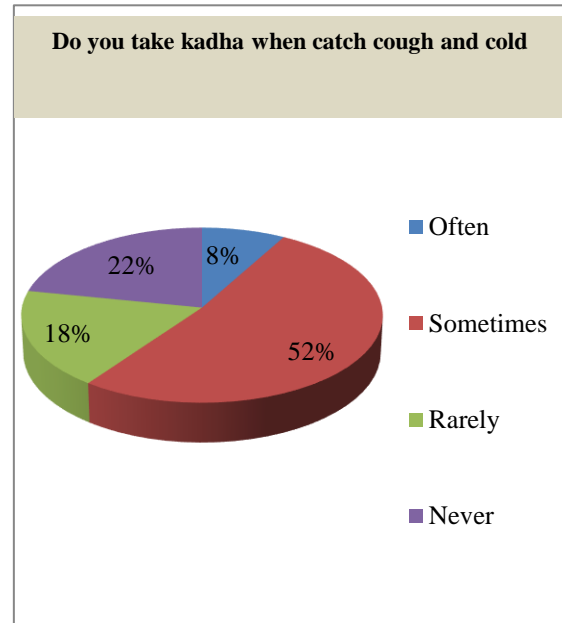


Figure 3.6

Perusal of table 3 depicts health and dietary Practices of the respondents under study and data shown above reveals that out of 160 respondents 52.5 per cent admit that they give attention to their health while 43.75 per cent do not give attention to their health. However, no response was recorded from 3.75 per cent of the total respondents.

It is very surprised to know that only 13.75 per cent respondents do exercise always while 12.50 per cent do often and 15.62 per cent respondents answer that they do sometimes. Further 13.75 per cent respondents do exercise/yoga rarely for their wellbeing and 44.38 per cent never do exercise /yoga.

Therefore, it may be concluded that despite knowing the importance of exercise/yoga for good health very less proportion of the population do exercise/yoga on regular basis.

Data pertaining to intake of warm water shows that 26.26 per cent respondents used to drink warm water often while 22.50 per cent and 14.38 per cent respondents used to drink warm water sometimes and rarely respectively. But 36.88 per cent respondents never used to drink warm water. Further, 18.75 per cent respondents reported that they used to take turmeric milk on often basis if suffered from cough and cold followed by 40.0 per cent and 30.0 per cent who consume turmeric milk on sometimes and rarely basis respectively. But respondents who never used to consume turmeric milk constitute 11.25 per cent of total. Thus, nearly one fifth of the respondents often used to consume turmeric milk if catch cough and cold while more than one third respondents take turmeric milk on often basis. These practices have become more common since the outbreak of the pandemic.

Data pertaining to fruit consumption among the respondents reveals that only 20.0 per cent respondents eat fruits always followed by 27.5 per cent and 33.75 per cent who used to consume fruits sometimes and rarely respectively. Thus, proportion of respondents who consume fruits always constitute only one fifth of the total. It may be said that percentage of study sample who consume fruits

on regular basis is very less. Data related to use of kadha during cough and cold shows that 8.12 per cent respondents often take kadha followed by 51.88 per cent and 18.12 per cent who used to take kadha sometimes and rarely while 21.88 per cent respondents never use any kind of kadha if catch cough and cold. Though proportion of respondents who consume kadha often is less but more than half of the respondents take kadha sometimes when suffer from cough and cold.

### **SUMMARY AND CONCLUSION**

Present investigation studies personal health and hygiene practices prevalent among the people of urban Patna, Bihar. Certainly, the pandemic brought some changes in the lifestyle of people which included personal health and hygiene practices such as putting off footwear, hand wash, feet wash, drinking warm water, turmeric milk etc.

Socio-demographic profile of the respondents shows that majority of respondents are in the age of 45 to 60 years followed by those who are 60 years or more. Sample under the study included both sexes male (50.0 per cent) and female (49.0 per cent). Again, more than 50.0 per cent of the respondents belong to general caste. Further 75.0 per cent respondents are graduate or higher education and nearly 46.0 per cent are job holders either in government sector or private sector. Only 13.0 per cent respondents have monthly income less than 50 thousand and rest 87.0 per cent respondents' monthly family income are more than 50 thousand.

Data related to personal hygiene practices shows that nearly 58.0 per cent respondents put off their footwear outside home either always or often if return from outside and only 10.0 per cent respondents report that they never put off foot wares if return home from outside.

Further 67.50 per cent respondents used to wash hands either always or often after coming from outside while 17.50 per cent respondents never used to wash hands and 56.25 per cent respondents wash their feet if return home from outside. Only 7.50 per cent respondents report that they never wash their feet after coming from outside.

Again, 44.37 per cent respondents reported that they keep their clothes separately either always or often after coming from outside while 23.13 per cent never keep clothes separately after coming home from outside.

Thus, it may be concluded that a sizeable section of the respondents maintain personal hygiene in the area of footwear, hand wash, feet wash and storage of used clothes which may be due to better education, more employment and higher monthly family income of the respondents. The study also reveals that 65.0 per cent respondents give more attention to their health while 31.25 per cent never give attention to their health. It is very surprised to know that nearly 26.0 per cent respondents do exercise always or often but 44.38 per cent samples never do any exercise. Further, data also depicts that around 48.76 per cent respondents drink warm water either often or sometimes. Not a single respondent reports about drinking of warm water on always basis. Present investigation also reveals that 18.0 per cent respondents always take haldi milk (turmeric milk) and 40.0 per cent consume sometimes if suffer from cough and cold. Again, more than half of the total respondents take kadha sometimes if suffer from cough and cold. Thus, it may be said that few personal health and hygiene practices developed during pandemic still persist among the selected population.

### **IMPLICATIONS OF THE STUDY**

Present study analyses prevailing health and hygiene practices of the respondents residing in urban Patna. Some important aspects of personal health and hygiene practices have been studied here but

the present survey missed to make a comparative change in behaviour of the respondents in pre and post COVID -19 era. So, this kind of studies can be carried out in coming years to analyse whether the pandemic caused few transformations in personal health and hygiene behaviour of the population and how socio-demographic variables are associated with personal health and hygiene practices.

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## INVESTIGATION OF INTERPLAY BETWEEN WORKPLACE STRESS AND DIETARY BEHAVIOUR AMONG GARMENT WORKERS OF TIRUPUR

K. K. Shanmukapriya<sup>1</sup> and Dr. V. Premala Priyadharsini<sup>2</sup>

PhD Scholar<sup>1</sup> and Professor<sup>2</sup>

Avinashilingam Institute for Home Science and Higher Education for Women,  
Coimbatore, India

Email: shanmukapriya1807@gmail.com, premala\_fsmd@avinuty.ac.in

Home Science Membership ID: <sup>1</sup> HSAI-2014-TN-1785-LF

### ABSTRACT

Tirupur is known as the "knitwear capital of India". A favourable climate, abundant cotton production, and a large pool of talented workers contribute to the region's thriving knitting industry. According to the World Health Organisation (WHO), job-related stress is generally defined as an individual's response to pressures and demands at work that are not appropriate for their level of expertise and knowledge and that make it difficult for them to manage. The focus of the current study was to investigate the association of workplace related stress on dietary behaviours among garment workers of Tirupur. A total 250 garment workers of both the sex between the age group of 25 to 45 years selected thorough purposive sampling. A well-structured interview schedule was developed and validated. Information on demographic profile was collected using Modified Kuppaswamy scale and nature of work were elicited using a validated interview schedule. The workplace stress level of garment workers was investigated with the help of "The Workplace Stress Scale", the dietary habit of the selected subjects was studied using food frequency questionnaire, 24 hours dietary recall and dietary behaviours for meal pattern, types of meal consumed and stress related behavioural compromises made by the garment workers. Majority of garment workers were in the age group of 30-40 years. Forty-two and forty-three percentage of male and female garment worker were found to be having moderate workplace related stress. Ninety-nine percentage of workers had the habit of compromised eating behaviour (skipping of meals). Pearson Chi square analysis revealed a significant association between workplace stress and junk foods intake at 99% confidence interval (p value <0.01, chi square-8.450, Workplace related stress greatly affects the dietary behaviour of individuals in garment industry which calls for sustainable strategies to provide a healthy environment to foster health and wellbeing among the workers.

**KeyWords:** Stress, Diet, Occupational Hazard, Nutrition, Food, Garment Workers

### INTRODUCTION

Tirupur "knitwear capital of India", located 60 kilometres from Coimbatore is known as "Manchester of the South". Tirupur is the seventh-largest town in Tamil Nadu. A favourable climate, abundant cotton production and a large pool of talented workers contribute to the region's thriving knitting industry. Tirupur's business community is expanding steadily, bringing with it year-round work opportunities for those with varying levels of education, training and experience. In the last



financial year 2021-22, Knitwear Exports from Tirupur clocked Rs. 33,525 Crore, US \$ 4.5 Bn, which is 1.08% of Merchandise Exports from our Country. (Tirupur's Exporter Association, 2021-2022)

The global garment industry employs millions of workers worldwide, contributing significantly to employment opportunities in various regions. According to the International Labour Organization (ILO), approximately 60 million people are employed in the garment and textile industry globally. The garment industry plays a significant role in India and Tamil Nadu employment landscape. In India, the sector employs over 12 million workers, contributing substantially to the country's economy and providing livelihoods to a diverse workforce. In Tamil Nadu, 10,000 garment manufacturing centres are housed in Tirupur, employing over 600,000 people in the production of knitwear, sportswear, hosiery, and casual clothing.

The garment industry's work nature frequently involves long working hours, rigorous quality standards, tight deadlines, and repetitive duties, all of which can significantly stress out employees. Employees usually have to work under pressure to achieve deadlines without sacrificing the quality of their output, typically in poor sanitary conditions with inadequate ventilation. Stress levels are also increased by paying low wages, uncertain work stability and little prospects for professional growth, which leads to mental and physical health.

Work-related stress is generally defined by the World Health Organisation (WHO) as an individual's response to pressures and demands at work that are not appropriate for their knowledge and skill level and make it difficult for them to manage. [WHO 2019].

Previous studies have shown that cultural orientation, the type of job being done, and nature of work all affect the likelihood, intensity and effects of work-related stress. Working in shifts, using psychoactive substances, social support, socio professional characteristics, and demographic factors including age were some of the reasons that contributed to employees becoming victim for work related stress. (Biron *et al* 2014).

Male garment workers encounter various challenges within the industry, ranging from working conditions to societal perceptions. Physically demanding tasks, such as lifting heavy loads and standing for long hours, pose risks of musculoskeletal injuries. Furthermore, job insecurity and low wages exacerbate financial stress among male workers. Addressing these challenges necessitates improving workplace safety, ensuring fair wages, and challenging stereotypes to foster a supportive environment for male garment workers. (Saha *et al.*, 2009)

As per The American Heart Association, the workplace nutrition intervention yielded the greatest favourable impact on health habits. Van Horn *et al.*, (2016) Further AHA describes guidelines for workplace nutrition intervention that include eating well-balanced meals (low-fat dairy products, avoiding trans-fat, low-saturated fat, whole grains, seafood, lean meats, and poultry). Improvements in workers' diet and physical activity were seen in at least two studies, suggesting that workplace nutrition interventions could lower risk factors (Colkesen *et al.*, 2011). Additionally, a nutrition education program at the workplace has been shown by Hochart and Lang (2011) to improve productivity, reduce absenteeism and save healthcare costs for employees.

Stress and eating behaviour are always interlinked. Stress greatly influence attitude towards eating choice and type of food consumed. As rightly pointed out by Lyzwinski *et al.*, 2018 workplace

stress not only results in unhealthy consumption of foods loaded with sugars, carbohydrates and fats but also it reduces the intake of healthy foods such as fruits and vegetables.

Though modulated dietary habits can distress and improve the quality of living among garment workers besides boosting their nutritional status, studies relating to the impact on health and wellbeing among garment workers is less explored and the present study was conducted with the following objectives.

### **OBJECTIVES**

The primary objective of the study is to investigate the interplay between workplace stress and dietary behaviour among garment industry worker of Tirupur.

The secondary objectives of the present investigations is to

1. Understand the demographic profile of the selected garment workers of Tirupur district.
2. Study the workplace stress level of the selected garment workers of Tirupur District.
3. Investigate the dietary behaviour of selected garment worker and
4. To test the interplay of workplace stress on the dietary behaviour of the selected garment workers.

### **METHODOLOGY**

#### **Selection of sample:**

The sample size was arrived at 656 with a confidence interval of 99% using Cochran's formula ( $N = z^2(pq)/e^2$  for sample calculation. A total of five garment industry from the city of Tirupur was selected using purposive sampling. This current paper focus on the finding of one garment industry with a sample size of 250 garment workers comprising 164 male and 86 females selected through convenient sampling.

#### **Demographic Profile**

A well-structured interview schedule was developed and validated. Information on demographic profile was collected using Modified Kuppuswamy scale 2022, Nature of work, working hours, workplace environment and level of physical exhaustion were elicited using a self-developed validated interview schedule.

#### **Assessment of workplace stress:**

The workplace stress level of garment workers was investigated with the help of the workplace Stress Scale (2001). A total of eight question relating to unpleasant working environment, physical and emotional wellbeing, unreasonable deadlines, difficulties in expressing opinions with superiors, influence of job pressure on family life, duties and performance appraisal were asked and rated on a scale of five. Based on the scores the stress levels were rated as low stress (less than 15), fairly low stress (16-20), moderate stress (21-25), severe stress (21-25) and potentially dangerous stress.

#### **Dietary behaviour:**

In order to understand the physiological dimension of food intake, the nature of quality, types, quantum of food Consumption based on the socio-cultural aspect of garment workers, the dietary

behaviour was studied. The dietary habit of the selected subjects was studied using three dietary assessment tools namely food frequency table, 24 hr dietary recall and a pretested interview schedule on dietary behaviour. The food frequency table was given to the participants and they were asked to fill the quantum and frequency of consumption of the different groups. The collected data was then compared with NIN guideline for recommended intake of food groups. Using 24-hour Dietary recall the garment workers were asked to recall the type and quantity of cooked volume food consumed for the past 24 hours on three consecutive days. Based on the response the cooked volume of the food was converted into its raw equivalent. The nutritive value of cooked food was calculated using nutritive value table of NIN. The mean nutrient intake was calculated and was compared with RDA by NIN for nutrient adequacy and inadequacy (2024). The dietary behaviour of the selected subjects for type and timings of meal consumption, their food preference and choice, habits of dining out and skipping of meal was elicited. The observation was consolidated and were tested with suitable statistical analysis.

**Testing interplay between workplace stress and dietary behaviour:**

The data collected were cleaned, edited and were consolidated. Consolidated data were analysed using SPSS Statistic Version 22 and Microsoft Excel. Descriptive statistical analysis for, frequency, mean and Standard deviation. Pearson Chi Square was used to test the association between workplace stress and dietary habit.

**FINDINGS AND DISCUSSION**

**Demographic profile of Garment Workers**

**Table 1: Demographic profile of Garment Workers**

Variables	Male n=164	Female n=86	Total N	Percentage
	Frequency	Frequency	Frequency	%
<b>Age</b>				
20-30	76	19	95	38
30-40	57	37	94	38
40-45	31	30	61	24
<b>Marital status</b>				
Married	129	71	200	80
Unmarried	35	15	50	20
<b>Types of family</b>				
Nuclear family	131	68	199	80
Joint family	33	18	51	20
<b>Educational qualification</b>				
Honors	-	-	-	-
Graduate	15	10	25	10
Intermediate or Diploma	5	5	10	4
High School Certificate	59	28	87	35
Middle school certificate	40	15	55	22
Primary school certificate	30	19	49	20

Illiterate	15	9	24	10
<b>Monthly Income</b>				
≥1,84,376	-	-	-	-
92,191-1,84,370	-	-	-	-
68,967-92,185	-	-	-	-
46,095-68,961	-	-	-	-
27,654-46,089	-	-	-	-
9,232-27,648	152	62	214	86
≤9,226	12	24	36	14

(Modified Kuppuswamy Scale 2022)

Of the 250 garment workers 164 respondents were male and 86 were female. Majority of the garment workers were in the age group of 30-40 years and more than 80 percent of the workers were married (male – 129 female -71) and lived in nuclear families. Only ten percent of male and female garment employees completed their degree, the rest had an educational qualification up to higher secondary level. Eighty-six percentage of male and female earned between Rs 9232 and 27,648 respectively. While male workers slightly outnumber female workers, both genders had similar educational qualification and income status within the garment industry.

#### Nature of Work

**Table 2: Job performed by the selected garment workers**

Nature of work	Male n =164	Female n=86	Total	Percentage
	Frequency	Frequency	Frequency	%
Sewing	81	47	128	51
Cutting	17	5	22	9
Laying	-	3	3	1
Checking	2	6	8	3
Packaging	15	5	20	8
Ironing	18	2	20	8
Machine operators	7	1	8	3
Helper	24	17	41	17

In garment industry, job performed are such as sewing, cutting, laying, checking, packaging, ironing, machine operators and helpers. Sewing involves stitching of clothes and cutting fabrics according to the designs. Laying involves spreading the fabric in layer on a cutting table and preparing it for cutting process. Here the Packaging refers to finishing the garment and packing for the shipment. Above mentioned Machine Operators are involved in work such as buttoning, kaja operators etc., Thus from the above table 2 it is inferred that Sewing was taken up by nearly 50% of selected garment workers (male 81, female 47). Also observed majority of the male worker to be involved in task such as cutting (17), packaging (15) and ironing (18) compared to female workers. Thus, from this table it can infer that the male worker had more possibility for physical and musculoskeletal stress compared to female.

Workplace Stress of Garment Workers

Table 3: Workplace stress of Garment Workers

Nature of work	Male n=164					Female n=86				
	L <15	FL 16-20	M 21-25	S 26-30	PD 30-40	L <15	FL 16-20	M 21-25	S 26-30	PD 30-40
Sewing	-	40	36	5	-	-	25	18	4	-
Cutting	-	8	8	1	-	-	-	3	2	-
Laying	-	-	-	-	-	-	-	2	-	1
Checking	-	1	1	-	-	-	-	6	-	-
Packaging	-	8	5	2	-	-	2	2	1	-
Ironing	-	10	8	-	-	-	1	1	-	-
Machine operators	-	5	2	-	-	-	1	-	-	-
Helper	-	13	10	1	-	-	8	8	1	-
<b>TOTAL</b>	-	<b>85</b>	<b>70</b>	<b>9</b>	-	-	<b>37</b>	<b>40</b>	<b>8</b>	<b>1</b>
<b>%</b>	-	<b>52</b>	<b>42</b>	<b>6</b>	-	-	<b>46</b>	<b>43</b>	<b>9</b>	<b>2</b>

The workplace stress scale

As rightly opined by Nazrul Islam (2019) Stress at work is a serious concern, leading to different physical and mental health problems. Table 3 shows the workplace stress of garment workers. Fifty-two percentage of male and forty-six percentage female respondents were found to be experiencing fairly low level of stress with a score ranging between 16 and 20. Also we observed a moderate level of stress among 42 and 43 percent of male and female garment worker with a score ranging between (21 and 25), Six and Nine percentage of garment workers with severe workplace related stress levels was witnessed. Potentially dangerous stress level was observed among two percent of female garment workers necessitating the need for professional counselling.

Dietary behaviour of Garment Workers

Table 4: Dietary behaviour of Garment Workers

Dietary Habits	Male n =164	Female n = 86	Total	Percentage
	Frequency	Frequency	N	%
<b>Food habits</b>				
<b>Pescatarian</b>	-	-	-	-
<b>Lactovegetarian</b>	2	-	2	1
<b>Ova vegetarian</b>	3	-	3	1
<b>Non vegetarian</b>	156	74	230	92
<b>Vegetarian</b>	3	12	15	6
<b>Meal pattern</b>				
<b>One meal</b>	-	-	-	-

2 meals	-	1	1	1
3 meals	164	85	249	99
>4 meal	-	-	-	-
<b>Skipping of meals</b>				
Once a weak	28	23	51	20
Twice a weak	70	59	129	52
>2times/month	17	34	51	20
Daily	8	11	19	8

The majority of garment workers, (male 156 female 74) were non-vegetarians. Three meal patterns were observed among 99% of male and female and majorly 52 % of male and female garment workers had the habit of skipping of meals twice a weak.

**Mean Nutrient intake 24-hour Dietary Recall of Garment workers**

**Table 5: Mean Nutrient intake of Male Garment workers**

Nutrients	Male				
	RDA (ICMR,2024)	Mean intake± SD	Excess /Deficit	%	t-value
Energy (Kcal)	2710	3180±369	+470	17	16.40**
Carbohydrate (g)	130	173±51.96	+43	33	10.68**
Protein (g)	54	37.86±6.9	-17	31	30.94**
Fat (g)	30	25±5.2	-5	25	12.72**
Fibre (g)	30	30.6±6	-0.6	2	0.081 <sup>ns</sup>
Calcium (mg)	1000	199±52.8	-801	80	195.26**
Iron (mg)	19	8.5±2.5	-10.5	55	53**
Vitamin C (mg)	80	15±8.6	-65	81	97.31**

\*\* Significant at 1 % level, \* Significant at 5 % level, NS-No significance  
Source: RDA - The nutrient requirement for Indians, ICMR 2024- NIN

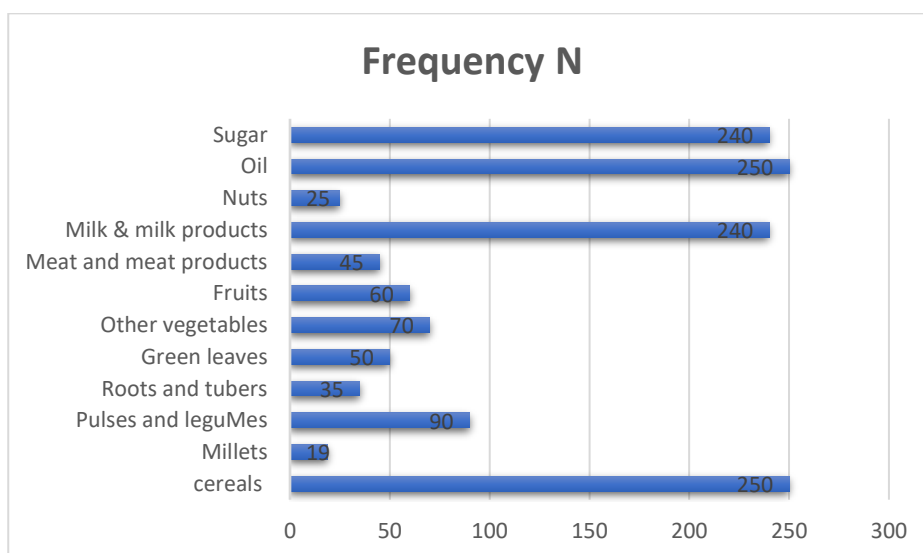
**Table 6: Mean nutrient intake of Female Garment workers**

Nutrients	Female				
	RDA (ICMR,2024)	Mean intake± SD	Excess /Deficit	%	t-value
Energy (Kcal)	2130	2542±283	+412	19	3.7**
Carbohydrate (g)	130	192±52.5	+62	48	10.81**
Protein (g)	46	37±3.5	-9	20	23.39**
Fat (g)	20	23±7	-3	15	4.43**
Fibre (g)	40	14.5±5.3	-24.5	64	42.73**
Calcium (mg)	1000	191±81	-809	81	80.22**

<b>Iron (mg)</b>	29	8±2.6	-21	72	72.59**
<b>Vitamin C (mg)</b>	65	24±16.84	-41	63	22.15**

\*\* Significant at 1 % level, \* Significant at 5 % level, NS-No significance  
 Source: RDA - The nutrient requirement for Indians, ICMR 2024- NIN

An excess intake of calorie and carbohydrate was observed irrespective of the sex among garment workers. The excess intake of calorie and carbohydrate by the male and female garment workers in comparison to the Recommended Dietary Allowance was significant at 99% confidence interval (t value-MALE, Energy-16.40\*\*, Carbohydrate-10.68\*\*, FEMALE, Energy 3.7\*\*, Carbohydrate 10.81\*\*). Deficit intake for protein, iron, calcium and vitamin C was observed. The deficit intake of above nutrients was significantly lower than Recommended Dietary Allowance at 1 % level of Significance. However, no significance difference between the RDA and mean nutrient intake for fibre was observed among male garment workers. The observation is in tune with the finding of study conducted by Lyzwiniski *et al.*, 2018 who reported a high intake of calorie, fat and carbohydrate and poor intake of fruits and vegetables.



**Fig 1: Mean intake of Food Group by the Selected Garment workers**

Parboiled and raw rice were found to be the most popular staple cereals consumed by garment workers. Millets were occasionally eaten, particularly ragi and finger millet. Although other pulses were consumed on a weekly basis, Toor dal and green gram dhal were the most popular pulses consumed. Nuts, fruits and green leafy vegetables were taken in limited quantities depending on their availability. Milk and milk products consumption was high, particularly the consumption of milk, curd, and buttermilk was observed on a daily basis.

Regression analysis between workplace stress and nutrient intake

Table 7: Regression analysis between workplace stress and nutrient intake

Variables	Model Fit			Coefficients	
	R <sup>2</sup>	F	sig	t value	Sig
Energy	133.46	34.485	<0.01	32.75	<0.01
Carbohydrate	.007	1.008	.317	9.562	.317
Protein	.009	1.225	.270	12.834	.270
Fat	.005	.622	.432	11.223	.432
Fiber	.002	.291	.591	14.443	.591
Calcium	.020	2.726	.101	8.195	.101
Iron	.000	.035	.851	8.411	.851
Vitamin C	.003	.371	.543	5.102	.543

The regression analysis model demonstrated a significant overall fit, as indicated by a high R-squared value of 0.133. Among the dependent variables, energy notably had higher coefficient value 133.46, indicating a strong positive association with stress scores (t-value = 32.75, p < 0.01). Carbohydrate, protein, fat, fibre, calcium, iron, and vitamin C showed varying degrees of association with stress scores and were not statistically significant, as indicated by their relatively higher p-values. Thus, we can infer that while stress levels may significantly influence energy intake, the relationship with other nutritional factors appears to be less pronounced in this study. Since only calorie intake showed a significant association with workplace stress and no significant association was observed for carbohydrate, protein, fat, calcium, fibre, iron and vitamin C the null hypotheses 1 was accepted.

Association between stress and dietary behaviours

Table 8: Association between stress and dietary behaviours

Variables	Likelihood Ratio	Linear by -Linear Association	Pearson Chi square
Association between stress and skipping of meals	16.053	5.920	14.527
P value	.013	.015	.024*
Association between stress and Junk foods	9.160	6.052	8.450
P value	.010	.014	.015*
Association between stress and in-between meals	5.521	1.798	5.553
P value	.479	.180	.475 <sup>ns</sup>

\*significant <0.05 <sup>ns</sup> not significant



Workplace stress and habit of skipping of meal among the selected garment workers at 5 % level of significance (p value-.024, chi square value-14.527) which can be attributed to long working hours, lack of personal time, poor earning and demanding work schedule. Similarly, a significant association between workplace stress and intake of junk food at one percent level of significance (p value-.015, chi square value-8.450), from this it can be inferred that there is significant association between stress, skipping of meals and Junk foods thus rejecting the null hypothesis ( $H_{02}$ ). However, no significant association between stress and intake of in between meals was observed. The above result is in concurrence with the findings of Mikolajczyk RT 2019 who reported an intake of unhealthy foods during stressful situation.

### **SUMMARY AND CONCLUSION**

- The study focused on 250 adults aged 25 to 45 in Tirupur. A notable percentage of both male and female garment workers were in the age group of 30-40 years.
- Dietary behaviours were examined using a food frequency questionnaire and 24-hour dietary recall. Majority of workers exhibited compromised eating behaviours which include skipping of meal intake and calorie dense food.
- Forty-two percent of male garment workers and forty-three percent of female garment workers reported moderate stress with a score ranging from 21 to 25, while six and nine percent of male and female garment workers reported severe workplace stress.
- A significant association was found between stress and skipping meals (p value <0.01, chi square-14.527).

Findings of this study showed a significant association between stress and dietary pattern. Workplace related stress greatly affected the dietary behaviour of garment workers which calls for customized dietary behaviour to provide a healthy workspace and positive dietary habit to foster health and wellbeing among the workers is the need of the hour.

### **SUGESTIONS FOR FUTURE RESEARCH**

- A study on examining the interplay between occupational hazard and bone health will be taken up.
- An intervention study on promoting healthy eating behaviour in garment industry can be taken up in future.
- Physical activity, food and Nutrition audit can be taken to explore the dietary risk for Non-Communicable Diseases.

### **LIMITATIONS OF THE STUDY**

This is an ongoing study and hence only a part of data collected is projected in the paper.

### **ACKNOWELEDGEMENT**

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## FORMULATION, ORGANOLEPTIC AND NUTRITIONAL EVALUATION OF A SORGHUM-BASED SNACK

**Dr. Ritu Pradhan<sup>1</sup>, Dr. Bhavneet Kaur<sup>2</sup>, Nishtha Danwer<sup>3</sup>, Anupreet Kaur Sobti<sup>4</sup>**

<sup>1</sup>Head and Associate Professor, <sup>2</sup>Assistant Professor,

<sup>3</sup> Post Graduate Student, <sup>4</sup> Ph.D. Research Scholar,

Department of Foods and Nutrition,

Government Home Science College (Affiliated to Punjab University),

Chandigarh (India)-160011

<sup>1</sup>sharmapritu@yahoo.com, bhavneetkaurmatharoo@gmail.com,

nishtha123danwer@gmail.com, anupreetsobti@gmail.com,

<sup>1</sup> HSAI Membership Number- HSAI-2020-UA-642-LF

### ABSTRACT

This research paper aims to formulate a sorghum-based snack and evaluate its nutritional value and conduct comprehensive sensory evaluation to determine their sensory attributes and consumer acceptability. Sorghum, a versatile and nutritionally dense grain, has received considerable interest lately owing to its potential to replace conventional grains. Energy rich sorghum (Jowar) crunchy strips were prepared. Three variations of the product were prepared for standardization. Organoleptic evaluation of all three variants of the recipe were conducted using the 9-point hedonic scale. Most acceptable recipe was evaluated for its nutritive value using a software for accuracy. The recipe (sorghum crunchy strips) is a good source of carbohydrate as well as calcium and phosphorus. It also provides decent amounts of protein and fibre and provides some amount of iron. The findings of this research contribute to the development of innovative sorghum-based product with enhanced sensory qualities.

**Keywords:** Organoleptic evaluation, sorghum-based products, acceptability, sensory evaluation, sensory attributes.

### INTRODUCTION

#### Background

In recent decades, nutrition and eating habits have undergone a significant transition (Tak et al., 2019) due to various factors, including globalization, urbanization, changing lifestyles, and increased awareness of the importance of healthy living. Globalization and urbanization have led to the proliferation of fast-food chains and processed food products (Casari et al., 2022). This transition in nutrition and eating habits can be attributed to several factors including increased availability and accessibility (Casari et al., 2022), changing lifestyles and time constraints (Popkin, 2006), influence of marketing and advertising (Wood et al., 2021), globalization (Hassi & Storti, 2012), urbanization (Oostenbach et al., 2022), cultural influence and westernization and economic factors (Satterthwaite et al., 2010).

The proliferation of fast-food chains and processed food products has raised concerns about the negative health impacts associated with these dietary choices. Consuming excessive amounts of refined foods, which are often high in added sugars, unhealthy fats, and sodium, has been linked to various metabolic health problems, including obesity, diabetes, cardiovascular disorders, and various types of cancers.

To address these issues, there has been a growing movement towards promoting healthier eating habits, emphasizing whole foods, and raising awareness about the importance of nutrition. Governments, health organizations, and advocacy groups are actively working to educate the public about the risks of unhealthy diets and the benefits of consuming balanced, nutrient-rich meals. Efforts are being made to improve food labelling, regulate marketing practices, and promote the availability of fresh, healthy food options in urban areas.

In recent years, there has been a notable shift towards the consumption of millets as part of a healthier diet. Millets offer several advantages over other whole grains, making them a compelling choice for individuals seeking a healthier diet.

Sorghum, often referred to as "jowar" in India, is a versatile and nutritious millet that has been a primary food source for millions of people worldwide for centuries. This ancient cereal crop is gaining popularity globally due to its plentiful health advantages and adaptability to various culinary uses. Sorghum is a nutritional powerhouse. It is a rich source of essential nutrients, including carbohydrates, proteins, and dietary fiber. Unlike some other grains, sorghum does not contain the protein gluten, making it an admirable choice for individuals with allergy from gluten. It also contains significant levels of B complex vitamins such as niacin (B3), riboflavin (B2), and thiamine (B1), which play vital roles in energy metabolism and overall well-being. One of the standout features of sorghum is its high fiber content. The dietary fiber in sorghum can cause lower cholesterol levels and better blood sugar control, making it an excellent choice for diabetics or for individuals seeking to improve heart health (Singh et al., 2022). Sorghum contains various antioxidants, including phenolic compounds and tannins. These antioxidants assist in battling oxidative stress and inflammation, thus reducing the risk of persistent conditions such as CVDs (Gowda et al., 2022), cancer, and neurodegenerative conditions. Consuming sorghum as part of a balanced diet can contribute to a healthier, more resilient body. Sorghum boasts a protein content of approximately 10-12% by weight, making it a valuable source of plant-based protein. What sets sorghum apart is its relatively high profile of essential amino acids particularly lysine and leucine. This makes sorghum an outstanding possibility for vegetarians and vegans to meet their dietary protein demands while maintaining a well-balanced diet. Sorghum also has a low glycaemic index (GI) (Singh et al., 2022; Mounika & Devi, 2019), meaning it has a negligible influence on blood glucose levels. This property is particularly beneficial for diabetic individuals and those aiming to maintain stable energy levels throughout the day. Consuming sorghum can help prevent rapid spikes and crashes in blood sugar, promoting sustained energy and better overall health (Hassan et al., 2021).

### **SIGNIFICANCE OF STUDY**

The present research titled holds significance as it contributes to the current corpus of knowledge by exploring the organoleptic evaluation of a sorghum-based snack. Conducting an organoleptic evaluation of a sorghum-based snack helps in understanding its sensory attributes such as taste, aroma, appearance, and texture. Understanding the factors that influence consumer

acceptance. This knowledge can be used to develop healthier snack options or cater to specific target markets. It can contribute to promoting the use of sorghum as an alternative and sustainable ingredient, encouraging diversification in the food industry.

### OBJECTIVES

The present study was planned with the following objectives:

- To develop and standardize a nutritious Sorghum based snack
- To evaluate the acceptability of the developed recipes for sensory attributes using organoleptic testing
- To assess the nutrient composition of the standardized sorghum snack

### ASSUMPTION

Developed recipe will be acceptable based on organoleptic evaluation. The standardized recipe will be nutritious and will contribute in promoting consumption of Sorghum as an alternative grain.

### METHODOLOGY

#### Raw Materials and Sample Preparation

The ingredients which were used for the preparation of the recipes were purchased locally from the nearest general store. Dehusked Sorghum (jowar) was procured from the local market and was cleaned of all the foreign materials (Fig-1).

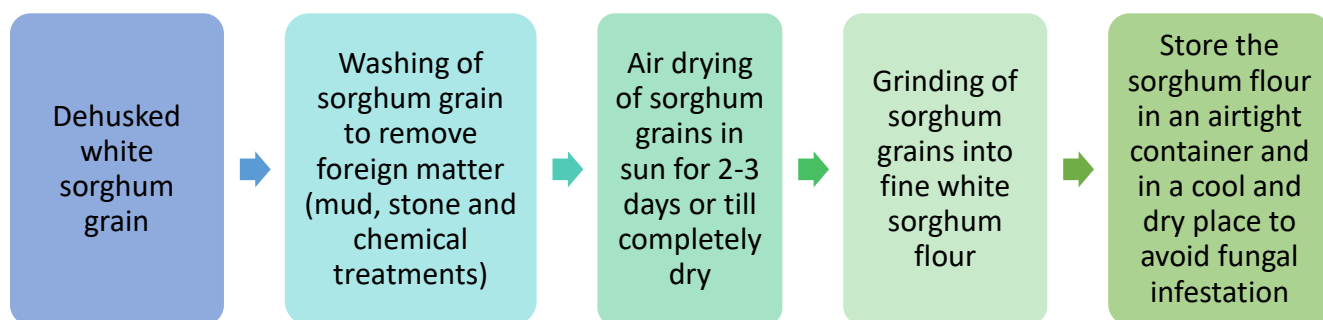


Figure 1: Sorghum procurement and cleaning process

#### Development of Sorghum-Based Product

The selection of the recipe was made keeping the following points in mind;

1. Sorghum flour/seed should be incorporated in substantial amounts.
2. The selected recipe should be easy to prepare and acceptable to masses.
3. The raw materials used for the recipes should be easily available and economically feasible.
4. Selected recipes should be easily modified so as to increase the nutritive value of the product.

**Recipe prepared-** Sorghum (Jowar) Crunchy strips are long strips that are crunchy in texture originally made from refined flour and chickpea flour; however, the recipe is modified to fulfil our requirements and develop innovative millet-based product

**Preparation and Standardization of Recipe**

The following proportions were found acceptable for further evaluation.

**Table 1: Proportions of Jowar crunchy strips**

SAMPLE	JOWAR FLOUR	WHEAT FLOUR
A	80%	20%
B	65%	35%
C	50%	50%



**Figure 2: Jowar Crunchy Strips (in different proportions)**

**Table 2: Detailed Ingredients of Jowar Crunchy Strips**

	Preparation time-10 mins	Cooking time-20 mins	Makes- 140 servings
INGREDIENTS	SAMPLE A	SAMPLE B	SAMPLE C
Jowar Flour	80 gm	65 gm	50 gm
Wheat Flour	20 gm	35 gm	50 gm
Refined Flour	2 tbsp	2 tbsp	2 tbsp
Oregano	2 tsp	2 tsp	2 tsp
Red Paprika	1 tsp	1 tsp	1 tsp
Chilli Flakes	1 tsp	1 tsp	1 tsp
Garlic Powder	1 ½ tsp	1 ½ tsp	1 ½ tsp
Onion Powder	1 tsp	1 tsp	1 tsp
Sesame Seeds	1 tsp	1 tsp	1 tsp

<b>Oil</b>	1 ½ tsp	1 ½ tsp	1 ½ tsp
<b>Salt</b>	1 tsp	1 tsp	1 tsp
<b>Water</b>	20 ml	20 ml	20 ml
<b>Oil For Frying</b>	50 gm	50 gm	50 gm

**Method:**

1. In a large bowl, sieve all flour to ensure even mixing. Add sesame seeds, oregano, chilli flakes, chilli powder, onion powder, garlic powder and salt and mix well.
2. Add oil and mix the flour well. Add water and make a stiff dough.
3. Take the dough and put in inside the similar press used for chakli with a different pattern mould.
4. Push the press and take out the long strips and fry them on medium flame.
5. Cool them down and store in air tight container.

\*Repeat the same method for recipe B and recipe C.



**Fig a)**  
**Ingredients required for the recipe**



**Fig b)**  
**Step 1- Add the ingredients in the sieved flour and mix**



**Fig c)**  
**Step 2- Press the dough through kitchen press and make long strips**



**Fig d)**  
**Step 3- Fry the strips on medium flame till they turn golden.**

### Sensory Evaluation Techniques

Organoleptic or sensory evaluation (Kemp, 2008) refers to the assessment of the sensory attributes of a food or beverage using human senses, including taste, smell, appearance, texture, and overall sensory perception. It is a systematic process that aims to objectively evaluate the sensory characteristics of a product such as flavour intensity, aroma, appearance appeal, mouthfeel, and overall sensory experience. Organoleptic evaluation (Drake, 2022) involves trained panellists or sensory experts who are skilled in discerning and describing sensory attributes. These experts follow specific protocols and utilize sensory evaluation techniques to analyse and rate the product based on its sensory properties. It also includes untrained panellists for their evaluation on various sensory attributes (IASRI, 2012). In the present study, 6 untrained and 9 trained panellists were included.

The hedonic scale (Everitt, 2009) is a commonly used tool in sensory evaluation to measure and quantify the overall liking or preference for a product. The scale used in the study is a 9-point scale, ranging from 1 (dislike extremely) to 9 (like extremely). Respondents are asked to select the point on the scale that represents their overall liking or preference for the product being evaluated. The average scores obtained from multiple participants are used to determine the product's overall acceptability or preference level.

### Calculation of Nutritive values of standardized recipes

Nutritive value of all the recipes was calculated per serving by DietCal software version 13.0, a tool for dietary assessment and planning developed by Registered Dietitian Gurdeep Kaur, Department of Dietetics, AIIMS, New Delhi. All values in the software were updated according to IFCT 2017.

## RESULTS AND DISCUSSION

### Sensory Attributes of Sorghum Crunchy strips

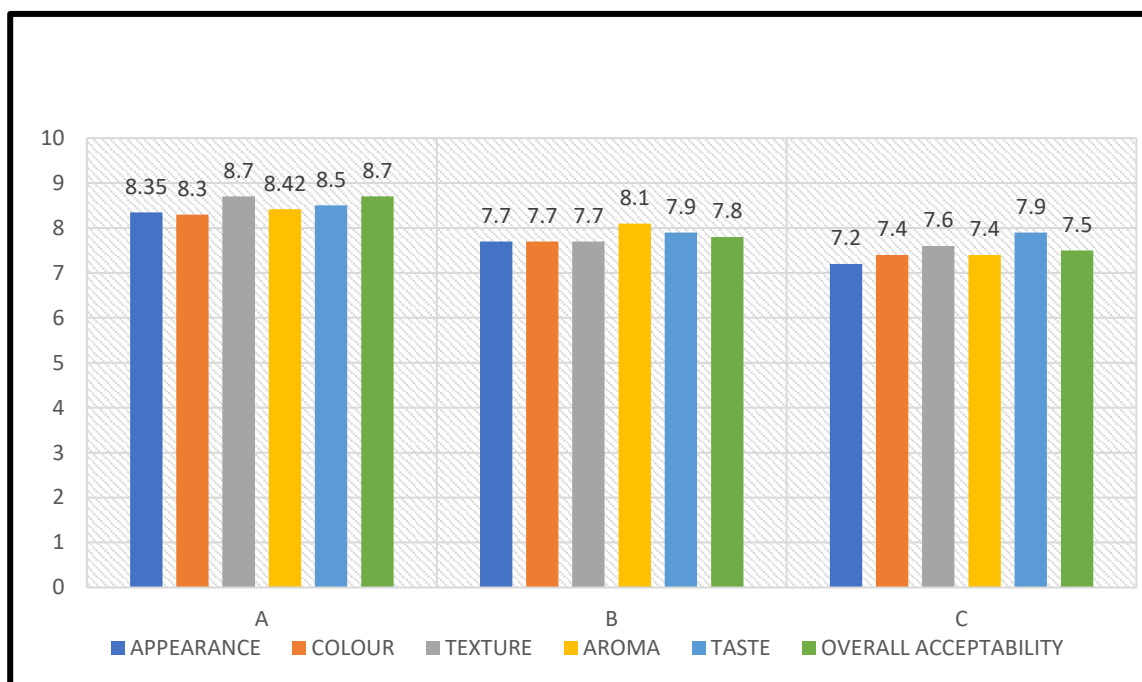
Sample A (jowar- 80%; wheat flour- 20%) was more acceptable than sample B and sample C in all aspects like appearance, texture, colour, taste, aroma and over all acceptability. Sample B (jowar-65%; wheat flour-35%) and sample C (jowar-50%; wheat flour- 50%) had very similar comments and there was little difference of scores given by the panellists.

Sample A (jowar-80%; wheat flour- 20%) was more acceptable as its texture was crispier, the colour was dark and rich as compared to other samples and the panellists observed its taste better as compared to other samples.

**Table 3: Mean score of organoleptic evaluation of three variations of jowar crunchy strips**

Sample	Appearance	Colour	Texture	Aroma	Taste	Overall Acceptability
A (Jowar-80%; wheat flour-20%)	8.35	8.3	8.71	8.42	8.5	8.7
B (Jowar-65%; wheat flour- 35%)	7.7	7.7	7.7	8.1	7.9	7.8
C (Jowar-50%; wheat flour- 50%)	7.28	7.4	7.6	7.4	7.9	7.5





**Figure 3: Graphical representation of organoleptic evaluation of three variations of jowar crunchy strips**

### Nutritive value of Sorghum Crunchy strips

The recipe is an adequate source of carbohydrate, calcium and phosphorus. In addition, it also provides reasonable levels of protein, dietary fibre and iron. Overall, this recipe provides a good source of energy and essential micronutrients required for daily dietary requirements.

Jowar crunchy strips is a recipe developed as a healthy alternative to the regular fried foods available in the market as jowar crunchy strips is made from sorghum as its main ingredient along with wheat flour. The recipe provides carbohydrates which is similar to the recipe developed by Dahatonde (2018).

**Table 4: Nutritive value of the ingredients of the most acceptable recipe of jowar crunchy strips sample A (jowar- 80%; wheat flour- 20%)**

Energy (kcal)	447.10
Protein (grams)	12.9
Carbohydrate (grams)	87.0
Fat (grams)	6.8
Iron (mg)	4.61
Calcium (mg)	34.4
Dietary Fibre (grams)	11.7
Phosphorus (mg)	323.6

## **CONCLUSION AND FUTURE RESEARCH DIRECTIONS**

Sorghum is a versatile, nutrient-rich cereal grain that is highly valued for its resilience in harsh climates and poor soils (ICRISAT, 2018). It is a principal food in many parts of Indian subcontinent with Maharashtra and Karnataka leading the sorghum production followed by Madhya Pradesh, Tamil Nadu, Rajasthan and Andhra Pradesh. It is known for its high fiber content, essential minerals like iron and phosphorus, and beneficial antioxidants. Sorghum is gluten-free with versatile culinary applications, making it a considerable choice for people who are intolerant to gluten protein. The sorghum crunchy strips prepared using 80% sorghum and 20% whole wheat was the most acceptable among all the combinations with the highest overall acceptability score (8.7). The positive sensory feedback further supports the commercial viability of these products, making them suitable as health foods for all age groups. The value-added healthy recipe-jowar crunchy strips prepared by incorporating sorghum flour as the basic ingredient in favourable ratios showed improvement in nutritive value. The standardized recipe is providing a good source of energy and essential micronutrients with decent amounts of protein and dietary fibre. The products developed by incorporating sorghum millet flour are advised as health foods for all ages as intake of nutrient dominant foods will assist in improving the nutritional status, providing health benefits thereby strengthening nutrition security. There is a huge market opportunity for the commercial development of sorghum based value-added nutritious products due to advanced perception towards health among people for prevention of chronic degenerative diseases.

For future studies, comparative products could be developed by incorporating sorghum into various consumer preferred market products. Evaluation of the nutritional benefits and sensory qualities of sorghum based value-added products will enable researchers and industry experts to identify the most effective combinations for determining consumer acceptance and improving health outcomes.

## **Funding Acknowledgement**

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## AVAILABILITY OF MILLETS AND MILLET BASED PRODUCTS IN COMMERCIAL SHOPS OF VIRUDHUNAGAR DISTRICT

**S. Krishnaveni<sup>1</sup> and Dr.S.Thilakavathy<sup>2</sup>**

<sup>1</sup> Ph.D Research ScholaAssociate Professor ,

Department of Food Science and Nutrition,

Avinashilingam Institute for Home Science and Higher Education for Women,

Coimbatore-641043, Tamil Nadu, India.

<sup>1</sup> krishnavenisubburaj2568@gmail.com, <sup>2</sup>thilakavathy\_fsn@avinuty.ac.in,

HSAI life membership Number: HSAI-2024-TN-1805-LF <sup>1</sup> , 93/s-11/LF <sup>2</sup>

### ABSTRACT

Millet, small-grained cereals from various botanical species, originated from wild grasses in Africa's Nile Valley and Sahel zone before spreading to China and India. They thrive in arid conditions and are highly nutritious with a long shelf life. Addressing dietary diversity is crucial for combating malnutrition and preventing non-communicable diseases such as diabetes, heart disease, and obesity. Incorporating millets into ready-to-eat or ready-to-cook products can improve nutritional security. A study conducted in the Virudhunagar district of Tamil Nadu, specifically in Thiruthangal and Sivakasi, found that 79 out of 100 different types of grocery shops carried millets and millet products, while 11 petty shops did not. Among the surveyed shops, 32% of departmental stores had millets and millet-based products for sale. It was observed that finger millet is the only type of millet available in all the shops surveyed. Finger millet, sorghum, little millet, and pearl millet are sold the most, while kodo millet, foxtail millet, and barnyard millet are sold the least. The major reason for high sales is that 81% of consumers purchase millets for traditional recipe preparation. Poor sales were attributed to 91% and 72% of consumers who did not purchase millets due to their high cost compared to other cereals and their unappealing taste, respectively. In terms of ready-to-cook (RTC) millet products, most consumers 85% purchased millet flour, which can be used to prepare various recipes such as puttu, idiyappam, and kozukattai. Among ready-to-eat (RTE) millet products, health mix had the highest sales. Consumers bought millets to prepare supplementary foods for babies and health mixes for elders, as indicated by the reasons expressed by shop owners regarding millet sales. The low availability of millet and millet-based products in the marketplace highlights the need for increased production. Consuming millet can also help in controlling various health conditions.

**Keywords:** Millets, Nutritional security, Ready-to-eat (RTE) products, Virudhunagar district, Consumer preferences.

### INTRODUCTION

Millets are classified as small-grained cereals that encompass a wide range of botanical species. Originating from the domestication of wild African grasses in the Nile Valley and the Sahel zone, millets were later introduced to China and India. These cereals can tolerate arid conditions and produce a small, highly nutritious grain with a long shelf life. Millets are used locally both as food

and as livestock feed, and they are also used as feed for birds. Additionally, in all areas where they are cultivated, millets are utilized in traditional beer brewing. (FAO, 1995).

India is the largest producer of millets, which are often referred to as coarse cereals. However, due to their nutrient composition, these grains are now considered 'nutri-cereals.' The millet family includes sorghum (*Sorghum bicolor*), pearl millet (*Pennisetum glaucum*), and a group of six small millets: finger millet (*Eleusine coracana*), kodo millet (*Paspalum scrobiculatum*), foxtail millet (*Setaria italica*), proso millet (*Panicum miliaceum*), little millet (*Panicum sumatrense*), and barnyard millet (*Echinochloa frumentacea*). The mean annual planting area for small millets is approximately 3.5 million hectares, with finger millet accounting for 50 percent of the area and two-thirds of the total production. (Hariprasanna K., 2016).

These crops, known by different names in local languages, have traditionally been a vital component of the dry farming system in India, supporting millions of poor and food-insecure people. The largest producer of small millets is Karnataka, which accounts for 56.7 percent of the total production, followed distantly by Uttarakhand (11.4 percent), Tamil Nadu (8.0 percent), and Maharashtra (6.5 percent). The remaining states together contribute less than one-fifth of the total production. (Rezwanullah Rafed, Jamuna K.V., 2017).

Millets are among the most nutritious foods known to mankind and were historically the primary cereal grain used for household purposes. In India, a lack of dietary diversity is a key factor contributing to malnutrition and the prevalence of non-communicable diseases such as diabetes, heart disease, and obesity. Processing millets using both traditional and contemporary methods to create value-added and convenience products could significantly diversify their food uses. This would help expand the utilization of millets among non-millet consumers, thereby enhancing nutritional security. Millets are rich in nutrients, providing 14.0 mg of calcium, 0.535 mg of copper, 3.94 mg of iron, 119.0 mg of magnesium, 1.002 mg of manganese, 32.7 mg of selenium, 224.0 mg of potassium, and 285.0 mg of phosphorus per 100 grams. Additionally, they contain vitamins such as niacin, riboflavin, pantothenic acid, folate, vitamin B6, vitamin C, vitamin E, and vitamin K, making millets storehouses of essential nutrients. (Deepak Kumar E.K., et al., 2021).

The demand for convenience products is increasing due to changing lifestyles, socio-economic patterns, a rising number of working women, and modified food habits. In recent years, there has been growing recognition of the importance of millets and various processed millet products. Today, millets and millet products are available in wholesale markets, supermarkets, departmental stores, retail stores, and small shops. People are becoming more health-conscious and prefer to buy healthier processed foods. With this in mind, a study was undertaken to assess the availability of different processed millets and millet products in various types of grocery shops.

### **OBJECTIVES OF THE STUDY**

- To study the availability of millets in different types of grocery stores.
- To determine the minimum and maximum sales of various millet and millet-based products.
- To identify the reasons for good and poor sales of millets in the stores.
- To assess the availability of ready-to-cook (RTC) and ready-to-eat (RTE) millet products in the stores.

- To evaluate the factors influencing the sales of millet and millet products in the stores.

### METHODOLOGY

The study was conducted in selected cities of the Virudhunagar district in Tamil Nadu, specifically Thiruthangal and Sivakasi. One hundred different types of grocery shops were chosen for the survey, and the owners, managers, or salespersons of these shops were interviewed to study the availability of millets and details about their sales. A well-structured questionnaire was designed for the survey. The questions covered topics such as the availability of millets, minimum and maximum sales, reasons for high and low sales, details of ready-to-eat (RTE) and ready-to-cook (RTC) sales, and factors influencing regular sales of millets. The collected data were tabulated and analyzed, and the results were presented. The analytical tools used to evaluate the study's objectives, based on the nature and extent of the data, are as follows:

- ✚ Descriptive statistics
- ✚ Garrett's Ranking Technique

### FINDINGS AND DISCUSSIONS

The objectives of the study were to determine the availability of millets and millet-based products, analyze the factors influencing the minimum and maximum sales of these products, and understand the reasons consumers select millets. These objectives were examined using techniques such as descriptive statistics and Garrett's Ranking Technique. The results of the analysis are discussed in detail in the following tables.

In most of the shops, millets were sold in the form of millet flour, flour-incorporated products (such as rava, vermicelli, noodles, pasta, health mix, cookies, biscuits, traditional sweets and savorys, bread, and rusk), and chocolate bars made from millet by-products.

#### PLACE OF PURCHASE

Millet products are available in almost all the shops across the study area, with availability being a major factor influencing their purchase. Some producers of millet products have their own shop outlets. A study conducted in the Virudhunagar district of Tamil Nadu, specifically in Thiruthangal and Sivakasi, found that 56% of the shops in Sivakasi and 44% of the shops in Thiruthangal sold millet and millet-based products, respectively.

#### TYPES OF SHOPS SURVEYED

Table-1: Types of shops surveyed (N=100)

Types of shop	No of shops	Availability of millets and millet products in shops Yes /No
Whole sale market	11	Yes
Super markets	16	Yes
Departmental stores	32	Yes
Retail stores	20	Yes
Petty shops	21	No

Table 1 reveals that, out of the 100 shops surveyed to study the availability of millets and millet products, 32% were wholesale markets, 20% were supermarkets, 21% were departmental stores,

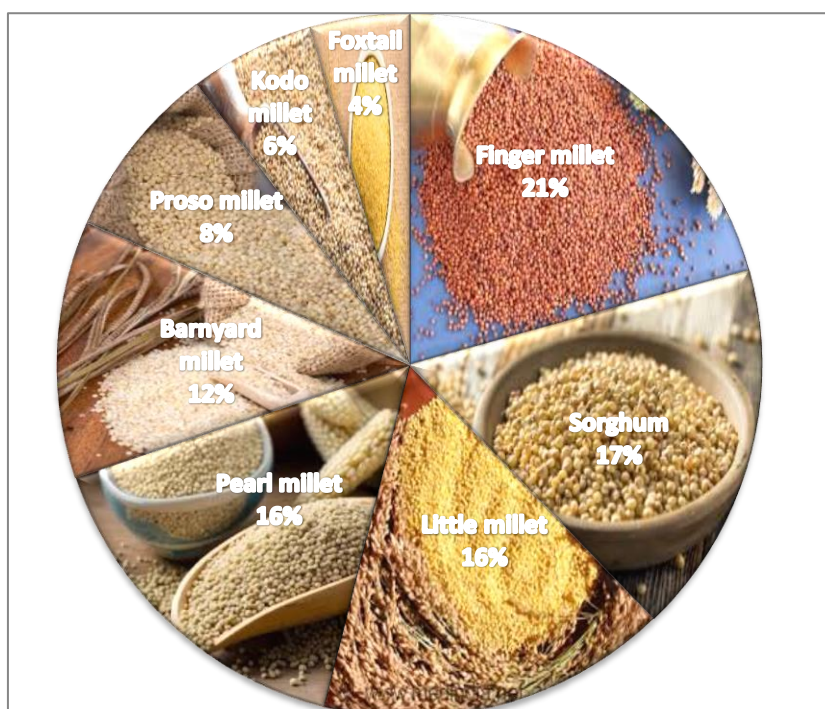
and 16% were retail stores. Additionally, eleven petty shops did not have any millet or millet products available.

### TYPES OF MILLETS AVAILABLE IN THE SHOPS

**Table-2: Types of millets available in the shops (N=79)**

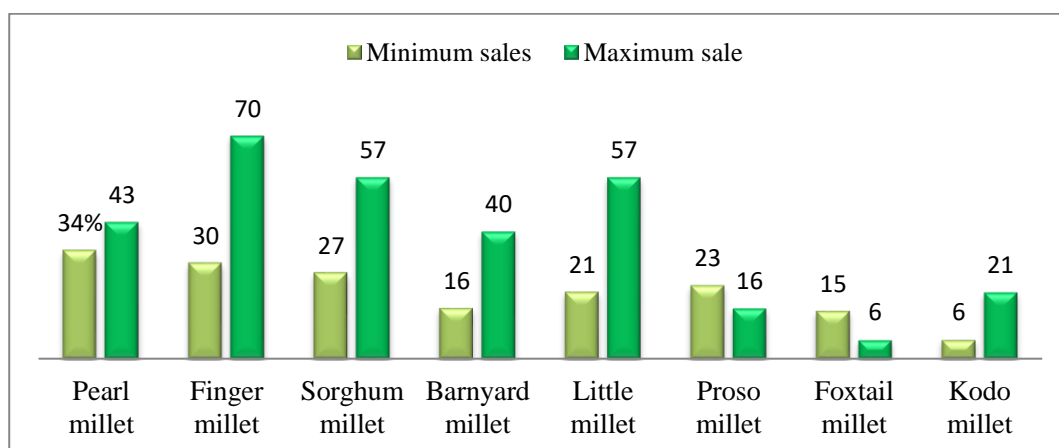
Types of millets	No of shops	%	Rank
Finger millet	79	100	I
Sorghum	66	83	II
Little millet	62	78	III
Pearl millet	61	77	IV
Barnyard millet	45	57	V
Proso millet	31	39	VI
Kodo millet	22	28	VII
Foxtail millet	17	22	VIII

The results presented in Table 2 and Fig. 1, based on the Garrett score, reveal that finger millet is available in the majority of the shops and is ranked first among the eight types of millets surveyed, followed by sorghum, little millet, pearl millet, and barnyard millet. Proso millet and kodo millet are also available, with foxtail millet ranked the lowest. The results indicate that millets have good sales and are available in almost all the shops.



**Fig-1:Types of millets available in the shops**

### Minimum And Maximum Sales Of Millets And Millet Products And Rationale



**Fig-2: Minimum and maximum sales of millets and millet products**

Fig. 2 represents the minimum and maximum sales of various millet and millet-based products. Finger millet, sorghum, little millet, and pearl millet were preferred by consumers, with these millets having the highest sales quantities in the shops. Conversely, kodo millet, foxtail millet, and barnyard millet had the lowest sales.

**Rationale for good and poor sale of millets in the shops**

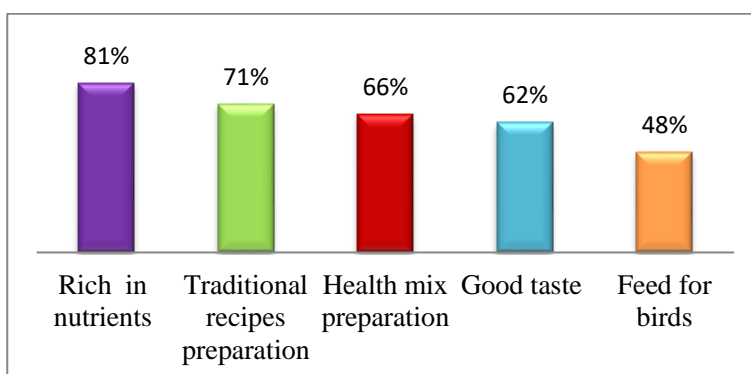
**Table-3: Rationale for good and poor sale of millets in the shops (n=79)**

Rationale for good sale			Rationale for poor sale		
Reasons	No of shops	%	Reasons	No of shops	%
Rich in nutrients	64	81	Costly ( Costly compared to other cereals Dislike taste Not aware of millet based recipe preparation	72	91
Traditional recipes preparation	56	71		57	72
Health mix preparation	52	66		38	48
Good taste	49	62			
Feed for birds	38	48			

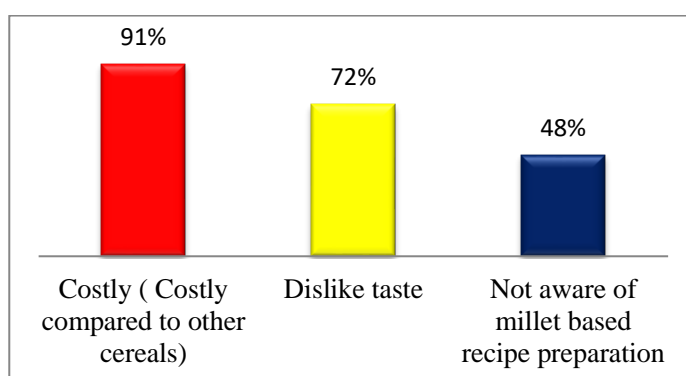
Table 3 and Fig. 3 and 4 present the reasons for both good and poor sales of millets in the surveyed shops, as well as the factors influencing the sale of millets and millet-based products. The major reasons for good sales, as expressed by the owners, managers, or salespersons, are as follows: 81 percent noted that millets are rich in nutrients; 71 percent mentioned that consumers buy millets to prepare traditional recipes at home; 66 percent purchase them for health mixes; 62 percent found the taste of millets to be good; and 48 percent buy millets to feed their pet animals (such as love birds, doves, and parrots) that they breed at home.

Regarding poor sales, the owners, managers, or salespersons observed that 91 percent of consumers did not purchase millets because they are considered too costly compared to other cereals, while 72 percent disliked the taste of millets as reported by their family members. Additionally, 48 percent of consumers stated that they were unfamiliar with how to prepare millet-based recipes, leading them to avoid purchasing millets.





**Fig-3: Rationale for good sale of millets in the shops**

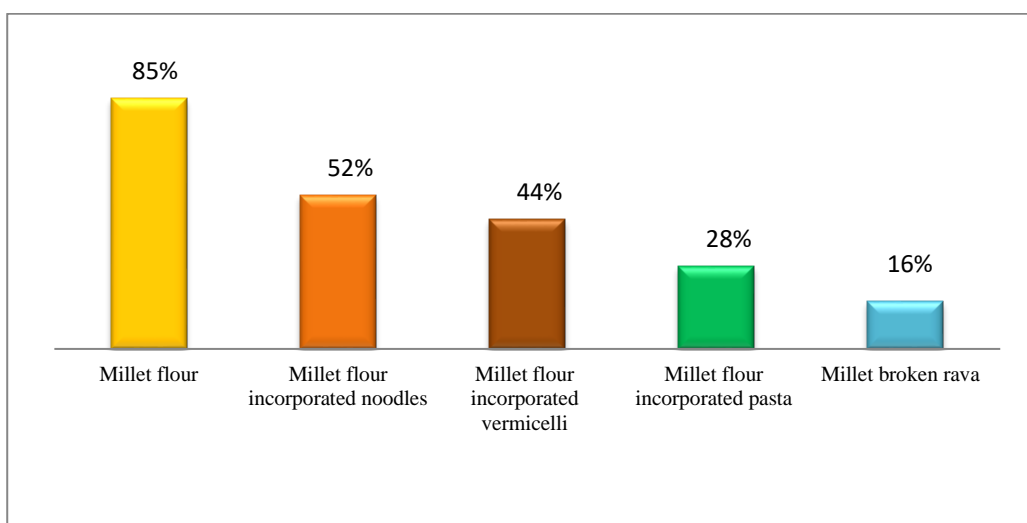


**Fig-4: Rationale for poor sale of millets in the shops**

### Availability Of Ready- To –Cook (Rtc) Ready-To-Eat (Rte) Millet Products In The Shops

**Table -4: Availability of ready- to –cook (RTC) millet products in the shops (n=79)**

Food items	No of shops	%
Millet flour	67	85
Millet flour incorporated noodles	41	52
Millet flour incorporated vermicelli	35	44
Millet flour incorporated pasta	22	28
Millet broken rava	13	16

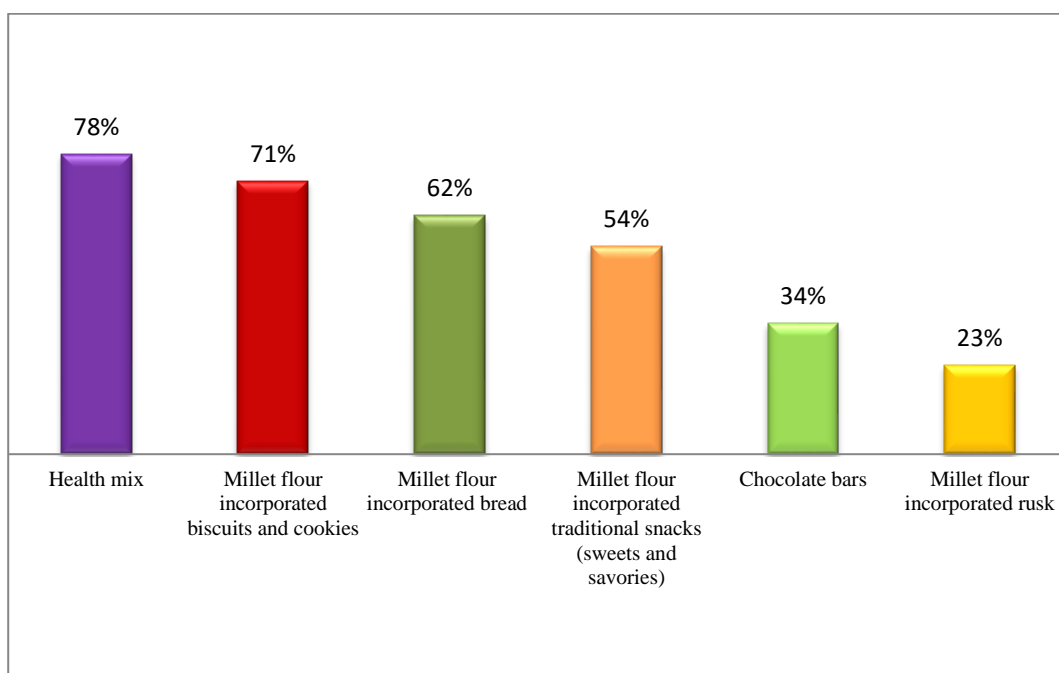


**Fig-5: Availability of Ready- To –Cook (RTC) millet products in the shops**

From Table 4 and Fig. 5, it is evident that among the Ready-To-Cook (RTC) millet products sold in the surveyed shops, most consumers 85 percent purchased millet in the form of flour, which can be used to prepare various recipes such as puttu, idiyappam, and kozukattai. Noodles and pasta made with millet flour were purchased by 52 percent and 28 percent of consumers, respectively. Millet broken rava and millet flour-incorporated vermicelli were purchased by 16 percent and 44 percent of consumers, respectively. It can be concluded that processed millet flour was favored by more consumers because it can be used in many recipes with minimal cooking effort. Table 5 presents data on the availability of ready-to-eat (RTE) millet products in the shops.

**Table -5: Availability of Ready- To –Eat (RTE) millet products in the shops (N=79)**

Food items	No of shops	%
Health mix	62	78
Millet flour incorporated biscuits and cookies	56	71
Millet flour incorporated bread	49	62
Millet flour incorporated traditional snacks (sweets and savories)	43	54
Chocolate bars	27	34
Millet flour incorporated rusk	18	23



**Fig-6: Availability of Ready- To –Eat (RTE) millet products in the shops**

It was observed from Tables 5 and Fig. 6 that the ready-to-eat millet products available in the surveyed shops were predominantly baked goods, traditional snacks, and health mixes. Millet flour-incorporated biscuits and cookies were available in 71 percent of the shops, bread in 62 percent, traditional snacks in 54 percent, and rusk in 23 percent. The largest number of shops (78 percent) sold health mixes, which also had the highest sales.

### **Rationale For Regular Sales Of Millets**

The shop owners, managers, and salespersons were asked to rank the reasons for the regular sales of millets. The major reasons identified include the use of millets to prepare supplementary foods for babies and health mixes for the elderly, doctors' recommendations to include millets in daily diets to prevent lifestyle diseases, and consumers who regularly consume millets as part of their traditional food habits. Garrett's ranking technique was used to analyze the reasons for the regular sales of millets among the sample respondents. The results are presented in Table 6.

**Table -6: Rationale for regular sales of millets (n=79)**

Reasons	NO of shops	%	Ranks
To prepare special foods like nutritious powder, supplementary foods for babies and health mix for elders.	71	90	I
Doctors recommendation to include millets in the diet	65	82	II
Individuals who consume millet regularly in their diet	56	75	III
Including millet in diet for disease conditions	54	68	IV

The Garrett score reveals that millets are regularly used to prepare special foods such as nutritious powders, supplementary foods for babies, and health mixes for the elderly, which were ranked

highest among the reasons for millet consumption. This is followed by doctors' recommendations to include millets in the diet. Individuals who regularly consume millets as part of their diet were also considered, while the least important reason was including millet in the diet for specific disease conditions.

## **CONCLUSION**

Out of the 100 shops surveyed to study the availability of millets and millet products, 79 were wholesale markets, supermarkets, departmental stores, or retail stores. Eleven petty shops did not have millets or millet products available. Of the surveyed shops, 32% of departmental stores offered millets and millet-based products for sale. It was observed that finger millet is the only type of millet available in all the shops surveyed. Among the millets, finger millet, sorghum, little millet, and pearl millet are sold the most, while kodo millet, foxtail millet, and barnyard millet are sold the least. The major reason for high sales is that 81% of consumers buy millets for traditional recipe preparation. Poor sales are attributed to 91% and 72% of consumers who do not purchase millets due to their high cost (compared to other cereals) and unappealing taste, respectively. Ready-to-cook (RTC) millet products showed that most consumers (85%) purchased millet in the form of flour, which can be used to prepare various recipes such as puttu, idiyappam, and kozukattai. Among ready-to-eat (RTE) millet products, health mix had the highest sales. Consumers purchased millets to prepare supplementary foods for babies and health mixes for elders, as expressed by the shop owners regarding the reasons for millet sales. The low availability of millet and millet-based products in the marketplace indicates a need for increased production. Millet products should be marketed as utility items, and government subsidies should support farmer yields. Consuming millet can help in controlling body diseases.

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## CONTRIBUTION OF MID DAY MEAL TO THE DIETARY QUALITY OF CHILDREN STUDYING IN GOVERNMENT PRIMARY SCHOOLS OF RURAL PETROCHEMICAL AREA OF VADODARA

Shweta Patel<sup>1</sup>, Prof. Uma Iyer<sup>2</sup> and Dr.Swati Dhruv<sup>3</sup>

<sup>1</sup> Temporary Assistant Professor <sup>2</sup> Professor, <sup>3</sup> Assistant Professor  
Department of Foods and Nutrition, Faculty of Family and Community Sciences,  
The Maharaja Sayajirao University of Baroda, Vadodara, 390002, Gujarat, India.

E-mail: <sup>1</sup>shweta.p-fn@msubaroda.ac.in, <sup>2</sup>uma62@yahoo.com,  
<sup>3</sup>swati.dhruv-fn@msubaroda.ac.in

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### ABSTRACT

Mid-Day Meal programme (MDMP) of India is the World's largest school feeding programme. Studying diet pattern and MDM consumption among the beneficiaries can help understand the effectiveness of MDMP. Present study was conducted with an objective to study dietary adequacy and contribution of MDM to nutrient intakes among primary school children of rural petrochemical area of Vadodara. The study area was divided into three geographical regions. One Government primary school from each region was randomly selected. Every fifth child from 5<sup>th</sup>-8<sup>th</sup> standard was included in study after taking their parent's consent. Data on three day diet recall, meal pattern, MDM consumption and anthropometry was collected on 61 children. More than one third (34.5%) children were stunted (HAZ<-2SD) and half (50.8%) were thin (BAZ<-2SD). Mean dietary intakes of energy, carbohydrates, protein and fat were significantly higher in boys as compared to girls. Only 6.5% children met EER (for energy) as well as EAR of iron and calcium. However, 70.4% children could meet EAR for protein, mainly due to considerable average intake of protein (18.0±7.5 gm) through MDM. Nutrient adequacy ratio for energy (0.63±0.20), protein (0.93±0.13), calcium (0.46±0.24), iron (0.36±0.19) and mean adequacy ratio (0.60±0.16) did not show significant difference across the genders or age groups. Although, many (83.6%) children were consuming MDM with 49.2% consuming it 5-6 times/week, only 37% and 46.3% children consumed sufficient quantity to meet nutritional norms for energy and protein respectively. MDM contributed to the number of meals apart from contributing to the nutrient intake. There is a strong need to create awareness regarding healthy diets and importance of MDM among the beneficiaries.

**Keywords:** Dietary Adequacy, Mid-Day Meal, Nutrient Intake, School Children, School Feeding

### INTRODUCTION

India is home to over 359 million children between 5 to 19 years of age which makes almost 30% of the total national population. (CENSUS 2011) According to the State of World's Children (SOWC) Report (2019), there are over 441 million children between 5 to 18 years of age in India, out of which 27% children are thin and severely thin.

High prevalence of undernutrition among children including school children and adolescence is a major challenge for India. Providing optimum nutrition to school age children and adolescents is important to prepare them for a better future. School feeding is an effective strategy for ensuring food security and nutritional wellbeing of these children. WHO has identified school feeding as an effective intervention for improving nutrition of children in 5-15 years age group. (WHO 2013)

India's Mid-Day Meal programme (MDMP) is the world's largest school feeding programme (Kingdon G G, 2007; WFP, 2013) which has been implemented as a national programme since 1998 by the Ministry of Human Resource Development of Government of India (MHRD 2006). The programme has been converted into a legal entitlement as per The Supreme Court of India's Interim Order dated 28th November, 2001. The food security bill passed in the year 2013 also covers MDMP under food security act (Government of India 2013). MDMP aims at serving hot cooked meals to provide 450 Kcal energy and 12 gm protein to primary children (MHRD 2006) and 700 Kcal energy and 20 gm protein to upper primary children (MHRD 2007).

According to NPNSPE (National Programme for Nutrition Support to Primary Education) guidelines, MDM can be prepared in a centralised kitchen in urban areas where a centralized kitchen setup is possible for a cluster of schools and cooked hot meals may then be transported under hygienic conditions through a reliable transport system to various schools (MHRD 2006). MDM is served in many places in Gujarat through NGO run centralised kitchens, including Vadodara.

The Commissionerate of Mid-Day Meal, Gujarat (2018) has mentioned in their Annual Work Plan and Budget of 2018-19 that the amount of cooked MDM that needs to be consumed is too much to be consumed by children in one meal. Hence, from the year 2018, the state Government has decided to divide the meal into two parts: breakfast and lunch (to be given at 11:30 AM and 2:00 PM respectively in school).

Studying the dietary intake of children studying in Government primary schools of rural Vadodara will help to understand the contribution of MDM to their diets. It will also throw light on effectiveness of the 'split meals' served through centralized kitchen model.

## **OBJECTIVE**

To study dietary adequacy and contribution of MDM among primary school children of rural petrochemical area of Vadodara.

## **METHODS**

This study was carried out in the petrochemical area of rural Vadodara which consists of villages in the closer vicinity of the petrochemical industry. There are total 47 Government primary schools in the area out of which 30 schools have both primary (1<sup>st</sup> to 5<sup>th</sup> standard) and upper primary (6<sup>th</sup> to 8<sup>th</sup> standard) sections. This region was divided into three geographical areas with 10 schools in each area. One school from each area was randomly selected for inclusion in the study. Every fifth child from 5<sup>th</sup>-8<sup>th</sup> standard from these three schools was included in the study after obtaining written consent from their parents. Data on three-day diet recall, meal pattern, MDM consumption, Dietary Diversity Score (DDS) and anthropometry was collected on 61 children.

A flexible fibre-glass tape was used to measure the height of the children. Weight was measured using a bathroom weighing balance. Height was measured to the nearest 0.1 cm and weight was measured to the nearest 500 gm. Nutritional status was assessed using WHO, 2007 growth reference

for height for age and BMI for age for all the children. WHO AnthroPlus software was used for calculating the z-scores based on the standards. Cut-offs used for undernutrition were  $<-2SD$  and  $<-3SD$  for undernutrition and severe undernutrition for stunting (low height for age) and thinness (low BMI for age). (WHO 2009) Three-day 24-hour diet recall was taken to study their dietary intakes. Nutritive values of home foods were calculated using nutritive value of raw foods given in Indian Food Composition Table (Longvah et al. 2017) and Nutritive Value of Indian Foods (Gopalan et al. 2014). Nutritive values of processed foods consumed by children were taken from the nutrition labels given on their packets. All the food items of weekly cyclic menu served under MDM were analysed for carbohydrates, protein, iron and calcium. The age specific estimated average intakes (EAR) given by ICMR-NIN (2020) were used for comparing the dietary intakes of children. Nutrition Adequacy Ratio (NAR) and Mean Adequacy Ratio (MAR) for energy, protein, iron and calcium were calculated for one day. NAR was calculated as the ratio of actual intake to the Estimated Average Requirements (EAR). The Mean Adequacy Ratio (MAR) was calculated as the average of NAR. NAR was truncated at 1 so to prevent a nutrient with a high NAR compensating for a nutrient with a low NAR (Madden et al., 1976; Nithya and Bhavani, 2018).

## RESULTS

Data was collected on 61 children out of which 26 were boys and 35 were girls. Age of the children ranged from 9 years to 14 years. Mean weight, height and BMI of children was found to be  $27.7 \pm 7.6$  kg,  $135.4 \pm 10.1$  cm and  $14.9 \pm 2.6$  kg/m<sup>2</sup>. The data revealed that 34.5% children were stunted (HAZ  $< -2$ ) with 6.6% severely stunted (HAZ  $< -3$ ). Thinness (BAZ  $< -2$ ) prevalence was reported to be 50.8% among children out of which 16.4% children were severely thin. More girls than boys were found to be stunted whereas, thinness was more among boys compared to girls. (Figure 1)

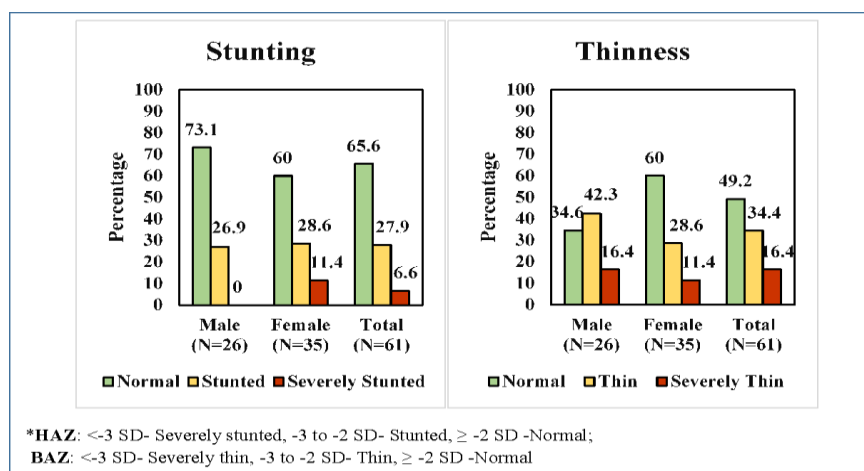


Figure 1 Undernutrition Among Children

MDM is served by a centralised kitchen run by an NGO in Government primary schools of the study area. The cyclic menu of MDM provided by the NGO kitchen to the schools is given in Table 1. The menu consisted of a snack (breakfast) and a meal (lunch). The food items served in the lunch were mainly curry based items such as dal or subji, rice based items and roti or thepla.

**Table 1: Weekly Mdm Menu Provided By Centralised Kitchen Of Ngo To The Government Primary Schools Of Rural Vadodara**

Day	Menu
Monday	Mix Dal, Peas Pulao, Roti
Tuesday	Aloo Subji, Jeera Rice, Thepla
Wednesday	Dal Dhokali, Chana Rice
Thursday	Chana Dal, Jeera Rice, Roti
Friday	Mix Veg, Khichdi, Thepla
Saturday	Mix Dal, Veg Pulao, Roti
<b>Daily snacks:</b> Fried Groundnuts, Sukhadi, Aloo Poha (Any one snack everyday); Idlis provided to a small number of schools everyday as a snack	

**Dietary Intakes and Meal Pattern among Children:** Data on three-day diet recall was analysed for calculating average daily nutrient intake. It was seen that boys had significantly higher intake of energy and macronutrients ( $p < 0.05$ ) (Table 2). However, no significant difference was observed in calcium and iron intakes of boys and girls. Further, the meal pattern of the three days reference period showed that most of the children reported to be consuming 4-6 meals with 31.1% consuming 6 meals per day, 32.8% consuming 5 meals per day and 24.6% having 4 meals per day.

A large number (91.8%) of children reported consuming outside food during the reference period of three days. Packaged processed foods were consumed by 88.5% children which were mainly consumed in breakfast (rusk, biscuits, etc.) or as snacks around school hours (packed fried snacks of local brands). Almost 30% of the children consumed cooked foods available outside such as samosa, panipuri, bhajiya (pakoda).

**Table 2 Average Genderwise Nutrient Intake (3 Day Diet Recall) Among Children (Mean±Sd)**

	Boys (N=26)	Girls (N=35)	Total (N=61)	't' value
<b>Energy (Kcal)</b>	1418 ±483	1150±397	1264±452	2.377*
<b>Carbohydrates (gm)</b>	183±58	149±52	163±57	2.438*
<b>Protein (gm)</b>	40.9±15.7	31.8±13.9	35.7±15.3	2.411*
<b>Fat (gm)</b>	54.2±20.9	44.5±17.1	48.6±19.2	2.013*
<b>Calcium (mg)</b>	247±138	223±134	233±135	0.676
<b>Iron (mg)</b>	6.9±3.9	5.9±3.5	6.3±3.7	1.036

\* $p < 0.05$

**Dietary Intakes through MDM:** Average dietary intake through MDM was calculated to understand contribution of MDM to dietary intakes among children. Mean nutrient intake among children through MDM was higher among boys as compared to girls. The difference was statistically significant for protein, fat and iron. Comparison of nutrient intake through both the meals showed that lunch provided higher energy, protein and fat compared to breakfast/snack. Mean calcium intake through breakfast items among children was higher than that through lunch. Further, the mean



nutrient intake through split meals, that is breakfast and lunch, showed that boys consumed higher quantities in both the meals compared to girls. Though the difference in gender wise nutrient intake through breakfast was not statistically significant, boys consumed significantly higher energy, protein, fat, iron and calcium through lunch as compared to girls. (Table 3)

**Table 3 Average Gender wise Nutrient Intake Through Mdm Among Children (Mean±Sd)**

	Boys (N=26)	Girls (N=35)	Total (N=61)	't' value
<b>MDM (Breakfast+Lunch)</b>				
<b>Energy (Kcal)</b>	569±203	475±198	515±204	1.706
<b>Carbohydrates (gm)</b>	47.5±22.8	44.8±21.7	45.9±22.0	0.440
<b>Protein (gm)</b>	20.6±7.0	16.0±7.3	18.0±7.5	2.364*
<b>Fat (gm)</b>	33.0±10.9	25.3±11.5	28.6±11.8	2.505*
<b>Calcium (mg)</b>	49.7±21.4	45.7±22.1	47±21	0.666
<b>Iron (mg)</b>	1.2±0.5	0.8±0.6	0.9±0.6	2.569*
<b>Breakfast</b>				
<b>Energy (Kcal)</b>	264±169	250±139	256±151	0.336
<b>Carbohydrates (gm)</b>	34.0±22.2	32.8±18.8	33.4±20.1	0.214
<b>Protein (gm)</b>	9.8±6.3	8.6±4.9	9.1±5.5	0.767
<b>Fat (gm)</b>	9.9±7.2	9.8±6.0	9.9±6.5	0.043
<b>Calcium (mg)</b>	32.0±22.8	33.3±21.9	32.7±22.1	-0.219
<b>Iron (mg)</b>	0.0±0.0	0.0±0.1	0.0±0.1	-0.850
<b>Lunch</b>				
<b>Energy (Kcal)</b>	399±187	281±172	331±186	2.397*
<b>Carbohydrates (gm)</b>	21.6±16.2	16.7±10.6	18.8±13.3	1.333
<b>Protein (gm)</b>	14.2±5.0	9.5±6.6	11.5±6.4	2.798**
<b>Fat (gm)</b>	28.5±12.2	19.1±12.4	23.1±13.1	2.779**
<b>Calcium (mg)</b>	27.5±15.1	18.9±12.2	22.6±14.1	2.310*
<b>Iron (mg)</b>	1.3±0.8	0.8±0.6	1.0±0.7	2.613*

\*p<0.05, \*\*p<0.01

The nutrient intake through MDM contributed to 41.9±18.3 percent of total caloric intake among children. Around half of the daily total protein (48.1±16.5 percent) and fat (54.6±19.9 percent) intake was through MDMs among these children. MDM contributed to almost one fourth (26.8±15.3 percent) of total calcium intake and one fifth (21.0±16.2 percent) of iron intake among children. The average percent contribution of MDM to the daily nutrient intake was higher among boys as compared to girls. However, the gender wise difference was not found to be statistically significant. (Table 4)

**Table 4 Percent Contribution Of Mdm To The Daily Nutrient Intake (Mean±Sd)**

	Male (N=23)	Female (N=31)	Total (N=54)	't' value	Significance p
	Mean±SD	Mean±SD	Mean±SD		
<b>Energy (Kcal)</b>	42.4±20.3	41.5±17.0	41.9±18.3	0.186	0.853
<b>Carbohydrates (gm)</b>	27.4±12.7	30.4±15.8	29.1±14.5	0.737	0.464

<b>Protein (gm)</b>	50.1±13.1	46.6±18.7	48.1±16.5	0.755	0.454
<b>Fat (gm)</b>	60.3±15.3	50.4±21.9	54.6±19.9	1.864	0.068
<b>Calcium (mg)</b>	27.9±11.2	26.0±17.9	26.8±15.3	0.445	0.658
<b>Iron (mg)</b>	23.4±13.1	19.1±18.1	21.0±16.2	0.965	0.339

**Adequacy of the Diets:** The dietary intake was further compared with the Estimated Average Requirements (EAR) for Indians for their age and sex (ICMR-NIN 2020), to study whether the diets of the children were adequate to meet their daily requirements. The intakes were compared for energy, protein, calcium and iron (Table 5). It was seen that the diets of children were deficient in energy, iron and calcium. On average, only 61.5±22.0 percent energy requirement, 48.6±30.7 percent iron requirement and 37.2±21.5 percent calcium requirement was met through children’s diets. However, a higher mean percentage of EAR of protein (140.6±63.3 percent) was met through the diets as reported in the recall.

To assess the adequacy of diet, Nutrient Adequacy Ratio (NAR) was calculated using age and gender specific EARs. The NAR for energy, protein, calcium and iron was 0.63±0.20, 0.93±0.13, 0.46±0.24 and 0.36±0.19 respectively. The Mean adequacy ratio (MAR) was 0.60±0.16; which for higher (0.64±0.13) for boys as compared to girls (0.56±0.17). These NAR and MAR values were higher for boys than girls as a result of higher nutrient intake among them. This difference was statistically significant for protein (p<0.05) and calcium (p<0.05). However, NAR and MAR values showed that the diets of children were insufficient to meet their daily requirements. Only 6.5% children met EER as well as EAR for iron and calcium, whereas 70.4% children could meet EAR for protein.

Energy from MDM met almost one fourth EAR (22.4%) on average. With reference to minerals, MDM contributed to a very small percentage of EAR of calcium and iron in the children’s diet. Mean percent energy and calcium through daily diets as well as MDM were slightly higher in boys compared to girls, but the difference was not significant. It was noteworthy that girls’ dietary intakes (both daily and through MDM) met significantly lower percent EAR for iron as compared to boys.

The mean protein intake (140.6±63.3) was higher than the EAR. Protein intake through MDM was found to be meeting more than 60% of the EAR, which contributed to the higher average consumption of protein as compared to EAR. Due to this, nearly three fourth (70.4%) of the children met EAR or protein. However, a higher standard deviation in percent EAR of protein met through daily diets as well as MDM indicate that the intakes varied largely among the children.

A comparison of the dietary intake between MDM breakfast and MDM lunch revealed that breakfast contributed to the mean EAR of energy, protein and iron more than the MDM lunch. Breakfast consumption in boys contributed to higher average EAR of protein (p<0.05), calcium (p<0.05) and iron (p<0.01) as compared to their female counterparts.

**Table 5 Percent Ear Met By Children’S Diet And Mdm- A Genderwise Comparison (Mean±Sd)**

		<b>Boys (N=26)</b>	<b>Girls (N=35)</b>	<b>Total (N=61)</b>	<b>‘t’ value</b>
<b>Energy (Kcal)</b>	<b>Daily diet</b>	66.4±22.9	57.8±20.8	61.5±22.0	1.526
	<b>MDM</b>	24.0±13.2	21.2±12.5	22.4±12.8	0.863
<b>Protein (gm)</b>	<b>Daily diet</b>	160.7±66.4	125.6±57.4	140.6±63.3	2.205*

	<b>MDM</b>	73.2±42.3	56.4±35.6	63.6±39.2	1.682
<b>Calcium (mg)</b>	<b>Daily diet</b>	38.5±18.2	36.3±23.8	37.2±21.5	0.397
	<b>MDM</b>	7.1±4.2	6.5±4.3	6.8±4.2	0.507
<b>Iron (mg)</b>	<b>Daily diet</b>	58.5±33.4	41.3±26.7	48.6±30.7	2.165*
	<b>MDM</b>	8.8±5.3	4.9±4.6	6.5±5.2	3.060*

\*p<0.05

**Table 6 Percent Ear Met By Breakfast And Lunch Served Under Mdm- A Genderwise Comparison (Mean±Sd)**

		<b>Boys (N=26)</b>	<b>Girls (N=35)</b>	<b>Total (N=61)</b>	<b>'t' value</b>
<b>Energy (Kcal)</b>	<b>Breakfast</b>	19.0±8.7	14.4±9.4	16.4±9.3	1.851
	<b>Lunch</b>	12.6±8.5	12.5±6.9	12.6±7.6	0.021
<b>Protein (gm)</b>	<b>Breakfast</b>	56.4±20.9	38.9±29.7	46.3±27.5	2.415*
	<b>Lunch</b>	39.3±29.2	34.4±20.6	36.5±24.5	0.728
<b>Calcium (mg)</b>	<b>Breakfast</b>	4.4±2.3	3.1±2.2	3.7±2.3	2.096*
	<b>Lunch</b>	5.1±3.7	5.4±3.6	5.3±3.6	-0.260
<b>Iron (mg)</b>	<b>Breakfast</b>	11.3±6.5	6.0±5.3	8.3±6.3	3.316**
	<b>Lunch</b>	0.1±0.1	0.2±0.6	0.2±0.5	-0.678

\*p<0.05, \*\*p<0.01

The nutritional norms of MDMP suggest that primary school children (1st-5th standard) should get 450 Kcal energy and 12 gm protein from MDM. The norms for upper primary school children are 700 Kcal energy and 20 gm protein per day. Although, MDM was considerably contributing to the total daily intake of children, only 37% and 46.3% children consumed sufficient quantity of MDM to meet the nutritional norms of the programme.

Many (83.6%) children reported to be consuming MDM at school. With respect to MDM consumption frequency, only half 49.2% of the children reported to be consuming MDM 5-6 times a week and followed by 16.9% consuming it 4 times a week.

## DISCUSSION

Results of this study revealed that children's diet met on an average 140.6±63.3% EAR of protein. The average energy, calcium and iron intakes met only 61.5±22.0%, 37.2±21.5% and 48.6±30.7% EER/EAR respectively. Thus, average EAR for protein met by the dietary intake was higher than energy, iron and calcium. The mean intakes were higher among boys as compared to girls. These findings were in lines with another study conducted on MDM beneficiaries by Patel et al. (2016) in Patan and Ahmedabad. Patel et al. (2016) reported that dietary intakes among male MDM beneficiaries met 60% of energy requirements, 78% of protein requirements and 50% calcium requirements whereas among female beneficiaries, the dietary intakes met 59% energy requirements, 67% protein requirements and 44% calcium requirements.

Mehta et al. (2013) also reported that dietary intakes among children studying in Government primary schools of Ludhiana, Punjab were largely inadequate to meet their requirements. The study reported that 28.2% of energy intake, 51.7% of protein intake and 27.5% of fat intake were

contributed by Mid Day Meals. Almost one fourth of the calcium (27.7%) and iron (25.7%) intake among children was met through supplementary foods served under MDM. Present study reported higher contribution of MDM to total dietary intake of energy (41.9%) and fat (54.6%) among children. Percent daily nutrient intake of protein (48.1%), calcium (26.8%) and iron (21%) through MDM as reported in the present study were comparable to the findings reported by Mehta et al. (2013). The higher intake could be due to two meals being provided to children from 2018 in Gujarat, resulting in consumption of more quantity of school meals.

Results of the present study also reported that the MDM menu served by the NGO run centralised kitchen comprised of various recipes made using not only cereals and pulses but also vegetables as well as nuts and oilseeds. Hence, MDM was reported to be contributing to the overall quality of diets by contributing to variety of food groups and total number of meals in children's diet. However, the average consumption of MDM was not found to be sufficient to meet the nutrient norms of 450 Kcal and 12 gm protein for primary (1<sup>st</sup> – 5<sup>th</sup> standard) students and 700 Kcal and 20gm protein for upper primary (6<sup>th</sup> – 8<sup>th</sup> standard) students. Similar findings suggesting inadequate intake of MDM to meet the nutrient norms among beneficiaries in Vadodara, were also reported in a report of the tenth Joint Review Mission of Gujarat State published by MHRD (2018).

Chatterjee et al. (2021) also reported in a study conducted in Nadia, West Bengal that the MDM intake among upper primary school children provided 663 Kcal energy and 17.54 gm protein, which was lower than the nutrient norms of 700 Kcal energy and 20 gm protein. The intakes were slightly higher than reported in the present study (515 Kcal energy and 18.0 gm protein). Chatterjee et al. (2021) also found that the intakes through MDM were not sufficient to meet the nutrient norms of the programme.

Kantawala and Iyer (2015), in their study conducted in Municipal Schools of Urban Vadodara, recorded the actual quantity of MDMs consumed by school children. Results of their study revealed that provision of MDM through centralised kitchen run by an NGO under Public Private Partnership model was an effective strategy to improve nutritional status of school children. MDM recipes prepared at the centralized kitchen were also reported to be nutritious by Kantawala and Iyer (2015). However, the average consumption of MDM by children was insufficient in meeting MDM norms. The average nutrient intake through MDM was higher among boys than girls. These results are in line of findings of the present study carried out in rural Vadodara.

## **CONCLUSION AND RECOMMENDATIONS**

Mid-Day Meal plays an important role in improving the dietary quality among children studying in Government primary schools. However, the diets of children still largely lack in nutrients. Children are not consuming sufficient quantity of MDM to meet the programme's nutritional norms. The frequency of consumption of MDM by children also needs to be improved. Awareness generation activities at school level on regular basis can be an effective strategy to enable children for making healthier food choices and consume a balanced diet. There is a need to educate them about the programme and create awareness regarding the entitlement (in terms of quantity of MDM). Capacity building of functionaries, especially the helpers who serve MDM can also bring positive results.

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## ALCOHOL USE AND ITS IMPACT ON EATING HABITS AND PSYCHOSOCIAL WELLBEING IN ADULT MALES

Sobana R.M<sup>1</sup> and Jishnu Deva B<sup>2</sup>

<sup>1</sup>Associate Professor, Department of PG Studies and Research in Home Science,  
JBAS College for Women, Chennai, Tamil Nadu.

<sup>2</sup>MBBS Student, Sri Ramachandra Institute of Higher Education & Research, Chennai.

Email Id: jishnudeva@gmail.com

<sup>1</sup> HSAI Membership No.- HSAI-2020-TN-555-LF

### ABSTRACT

Alcohol consumption on an excessive and regular basis is a major risk factor for various non-communicable diseases and injuries, both intentional and unintentional. It also negatively affects an individual's eating patterns, mental and social health, and relationships with others as well as with society at large. This research aimed to explore alcohol use and its association with, eating habits and psychosocial wellbeing in adult males. A total of 120 male participants aged 30–40 and 41–50 working full-time or part-time with habitual alcohol consumption were selected purposively. To assess eating habits and psychosocial wellbeing, a self-designed questionnaire along with the AUDIT-10 tool for hazardous drinking were used. The findings showed that most participants had risky alcohol use, particularly among part-time workers and those aged 30–40. There was a higher prevalence of overweight and obesity, especially among 41–50years-old men. Full-time employees generally had significantly better dietary habits than part-timers ( $p = 0.0015^{**}$ ), especially among 30- to 40-years old full-time working men ( $p = 0.006$ ), and no notable difference was found in part-time working men of both ages. Poor psychosocial wellbeing was observed across all groups, with full-time employees aged 41–50 showing slightly better wellbeing. Eating habits and psychosocial wellbeing were significantly correlated with higher alcohol use, particularly among those with harmful level of drinking habits ( $r = 0.250, 0.322$ ), and at 1% level of significance among men consume alcohol at high risk level ( $r=0.433, 0.469$ ). Hence, this study recommends interventions to promote healthy eating, exercise, enhance psychosocial support and enforce stricter laws to mitigate alcohol consumption among adult males.

**Keywords:** Alcohol; Eating habits; Full-time and Part-time employment status; Psycho social well-being

### INTRODUCTION

Alcohol, derived from the fermentation of grains, fruits, or sugars, is a widely consumed psychoactive substance with potential addictive properties. Approximately two billion people globally consume alcohol, with 76.3 million suffering from alcohol use disorders, causing 3.3 million deaths annually (WHO,2022). Prolonged use leads to physical dependency, increasing the

risk of diseases like cardiovascular diseases and cancer. Alcohol abuse also carries significant social and economic costs, including fatalities and reduced productivity (Rehm,2011). In India, alcohol consumption is rising with over 663 million liters annually (Thivakar et al.2019) and prevalence of alcohol consumption among adult males in Tamil Nadu was found to be 46.5% raising serious public health concerns (NFHS 2015-16).

Excessive alcohol consumption disrupts eating patterns and increases cravings for fatty foods, raising the risk of abdominal obesity (Traversy & Chaput, 2015; Morris, 2023). It is associated with higher intake of simple carbohydrates and animal products, while decreasing the consumption of essential nutrients like complex carbohydrates, beta-carotene, retinol, iron, folic acid, and vitamin E (Kesse,2001). These poor eating habits worsen nutritional deficiencies, potentially leading to eating disorders and micronutrient deficiencies linked to chronic illnesses such as cancer and liver diseases (WHO, 2018).

"Psychosocial wellbeing involves the interplay of psychological and social factors (Kumar, 2020). Alcoholism will not only affect the person consuming alcohol but also the entire family and society at large (Eashwar et al.2019). Seather et al. (2019) found that heavy alcohol consumption among students is linked to poorer social integration, slightly lower life satisfaction, and more mental health complaints. Alcoholics often face significant psychosocial challenges, including conflicts with loved ones, psychological distress, diminished life satisfaction, impaired judgment, social isolation, and health issues (Ali and Elkins, 2023).

### **SIGNIFICANCE OF THE STUDY**

Numerous studies have explored alcohol's impact on physical and mental health, yet research on its connection to eating habits and psychosocial wellbeing in Indian adult males is scarce, despite rising alcoholism rates. This study aims to fill this gap by examining how alcohol intake relates to eating habits and psychosocial wellbeing in adult men. Insights from this study to develop strategies to enhance mental, social, and physical health by reducing alcohol consumption among adult males.

### **OBJECTIVES**

- To investigate the frequency and extent of alcohol consumption among adult male
- To compare the eating habits and psychosocial wellbeing of adult males consuming alcohol based on age and employment status.
- To assess the relationship between eating habits and psychosocial wellbeing in adult males with varying alcohol use.

### **HYPOTHESES**

The alternate hypotheses framed for the study were,

- H1: There is a significant difference in eating habits and psychosocial wellbeing between full-time and part-time employed adult men aged 30–40 and 41–50 years.
- H2: There is a significant association between alcohol use with eating habits, and psychosocial wellbeing.



## METHODOLOGY

### Selection of the Respondents:

This study included nearly 200 adult males aged 30 to 50 from Chennai. Initially, all participants were briefed about the study, and 120 habitual drinkers with at least six months of drinking history were selected based on willingness. They were categorized into full-time and part-time workers, 60 in each group with 30 males from age ranges, 30–40 and 40–50 years in each employment category were selected.

### Collection of data

The data was collected using an interview schedule with a pretested questionnaire that elicited demographic details and self-reported body measurements. The Alcohol Use Disorder Identification Test (AUDIT-10) by Babor et al. (2001) comprised of 10 items, scored from 0 to 36, categorizing drinking patterns into four risk levels: low risk (0–7), risky/hazardous (8–15), harmful (16–19), and high risk (>20) was employed to assess risky drinking levels. The eating habits were examined through frequency of food consumption over the previous month on a scale from daily to never, scored from 5 to 0 for healthy foods and 0 to 5 for unhealthy ones. The psychosocial wellbeing was assessed using questions adapted from the DUSI-R by Tarter (1991) and the Psychosocial and Lifestyle Questionnaire 2006–2016 by Smith et al. (2017) with responses rated on a scale from poor to excellent contributing to an overall score ranging from 0 to 40. Statistical analysis involved the student t-test and the Karl Pearson Correlation Coefficient test, with significance set at  $p \leq 0.05$ .

## RESULTS AND DISCUSSION

### Alcohol Consumption:

**Table 1. Level of Alcohol Consumption among adult men based on employment status and age**

Employment Status	Age (years)	Low Risk level	Risky level	Harmful level	High Risk level
<b>Full Time (N-60)</b>	30-40	7 (23.3%)	15 (50%)	6 (20%)	2 (6.7%)
	41-50	10 (33.3%)	12 (40%)	5 (16.7 %)	3 (10%)
<b>Part time (N-60)</b>	30-40	3 (10%)	14 (46.7%)	8 (26.7%)	5 (16.7%)
	41-50	6 (20%)	15 (50%)	5 (16.7%)	4 (13.3%)

\*Values in bracket indicates percentage

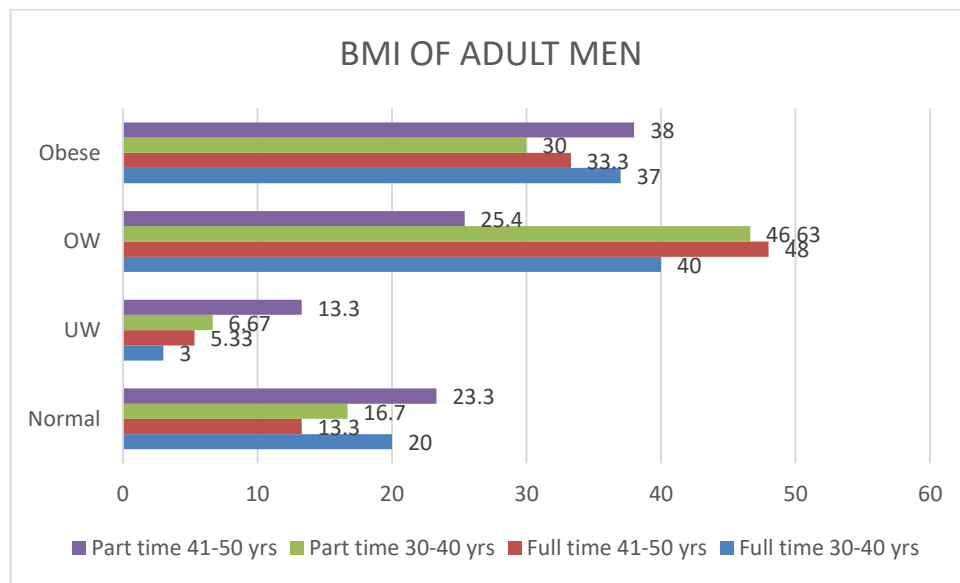
Based on the AUDIT-10 scores as shown in Table 1, the examination of alcohol consumption levels revealed that the majority of adult males, regardless of age or employment, consumed alcohol

at risky levels. Among the full-time workers, 30 and 40-year-old men had risky (50%) and harmful (20%) level of alcohol consumption, while 40-50-year-olds, 40% at risky and 16.7% at harmful level consumption. Among part-timers 50% of 40–50-year-olds had risky consumption compared to 47% of 30–40-year-old, with 27% at harmful and 17% at high-risk level. Frequent and increased drinking among part-time workers might stem from lower living standards and more idle time.

The findings of Alcohol Use Disorder in this study were consistent with Dutta et al. (2014) and Pillai et al. (2013), who reported higher alcohol consumption among adult males aged 30 to 40 compared to males aged 40 and above, often attributed to manual labor occupations. Tao et al. (2023) found alcohol misuse associated with male gender and lower education level.

**Anthropometric Measures of the Respondents:**

As seen in Figure 1, only 20% and 17% of males aged 30s to 40s working full-time and part-time, respectively, had a normal BMI. Part-time males aged 30–40 (46.6%) and full-time males aged 41–50 (48%) exhibited higher overweight rates. About 37% of full-time workers in their 30s to 40s and 38% of part-time workers were obese. French et al. (2009) and Orea et al. (2011) in their studies noted a similar rise in body weight among men linked to alcohol use.



\*OW- Overweight \*UW-Underweight

**Fig.1. BMI of the Respondents**

Table 2 shows that part-time employed men in both age groups (30–40 and 40–50 years) had higher mean body weights ( $86.77 \pm 8.1$ ,  $88.9 \pm 7.07$ ) than full-time workers in the same age groups ( $84.2 \pm 12.9$  and  $87.64 \pm 11.3$ ) with no significant differences in body height. The mean BMI was higher among part-time workers aged 40–50 years ( $31.4 \pm 2.11$ ) and 30–40 years ( $30.19 \pm 8.31$ ) compared to their full-time counterparts ( $28.89 \pm 4.45$  and  $29.76 \pm 6.6$ ) within the respective age groups. This finding aligns with Colditz et al. (1991), who found a U-shaped distribution of BMI, with increased BMI in heavy drinkers (>50 g ethanol/d), and AlKalbani & Murrin (2023), who noted binge drinking among Irish males positively associated with obesity and attributed it higher calorie intake, reduced energy expenditure, and hormonal imbalances.

**Table 2. Anthropometric Measures of the Respondents**

Anthropometric Measures	Fulltime (N=60)		Part time (N=60)	
	30-40 years (N=30)	41-50 years (N=30)	30-40 years (N=30)	41-50 years (N=30)
Weight (kg)	84.2 ± 12.9	87.64 ± 11.3	86.77 ± 8.1	88.9 ± 7.07
Height (cm)	170.98 ± 6.27	171.7 ± 8.33	170.31 ± 7.2	170.5 ± 6.9
BMI	28.89 ± 4.45	29.76 ± 6.6	30.19 ± 8.31	31.4 ± 2.11

**Eating Habits of the Respondents:**

Table 3 presents the eating habits of the respondents. All participants were non-vegetarians. About 78% of adult men reported having 3–4 meals daily, with full-time employees more likely to maintain fixed meal times due to structured lunch breaks compared to part-time workers. Part-time employees in both age groups showed a higher tendency to skip breakfast (57% and 63%), with high snacking between meals (57% in the 30-40 years and 47% in the 40-50 age group) compared to their full-time counterparts. Both full-time and part-time workers, especially in the 30–40 age group (80% full-time, 83% part-time), reported increased food intake after drinking particularly junk foods like fried items, attributed to heightened hunger sensations during and after drinking. The majority (90%) reported consuming less than 2 liters of water daily.

**Table 3. Eating Habits of the adult males based on employment status and age**

Details		EMPLOYMENT STATUS							
		FULL TIME				PART TIME			
		30-40 years		41-50 years		30-40 years		41-50 years	
		N	%	N	%	N	%	N	%
<b>Type of Diet</b>	Vegetarian	-	-	-	-	0	-	0	-
	Non-Vegetarian	30	100	30	100	30	100	30	100
<b>No. of meals per day</b>	3-4	24	80	27	90	18	60	25	83.3
	5-6	6	20	3	10	12	40	5	16.7
<b>Meal Time</b>	Fixed Time	29	97	30	100	7	23	10	33
	Any time	1	3.3	0	0	23	77	20	67
<b>Skip Breakfast</b>	Yes	4	13.3	2	6.7	17	57	19	63.3
	No	26	87	28	93.3	13	43.3	11	37
<b>Snacking In between meals</b>	Yes	6	20	4	13.3	17	57	14	47
	No	24	80	26	87	13	43	16	53
<b>Intake of Food after drinking</b>	High	24	80	23	77	25	83.3	20	67
	Less	6	20	7	23	5	17	10	33
<b>Water</b>	<2.0 litres	21	70	27	90	24	80	28	93

<i>Intake</i>	2.1–3 litres	9	30	3	10	6	20	2	7
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**Frequency of Food Intake:**

Table 4 illustrates the food frequency of adult men. Cereals were the main staple, consumed daily by 98% of respondents. Millets were eaten twice a week by 2% of participants, while 92% reported weekly consumption of pulses, especially red gram dhal and green gram dhal, with minimal sprouts intake. Over 50% of both full-time and part-time employed men reported eating vegetables twice a week, mainly other varieties besides greens. About 80% of full-time workers aged 40-50 years consumed fruits daily, with bananas being the most common. Dairy product intake was lower in both groups, with milk primarily consumed in tea. Red meat, junk foods, sweets/savories, and beverages were eaten daily by all respondents. Over 90% of participants, regardless of employment or age, reported eating outside mostly from roadside shops or restaurants. These findings are similar with Deitz et al. (1996), who observed a higher prevalence of fatty foods and salty snacks consumption among moderate to heavy drinkers, with younger men having the highest prevalence of eating out.

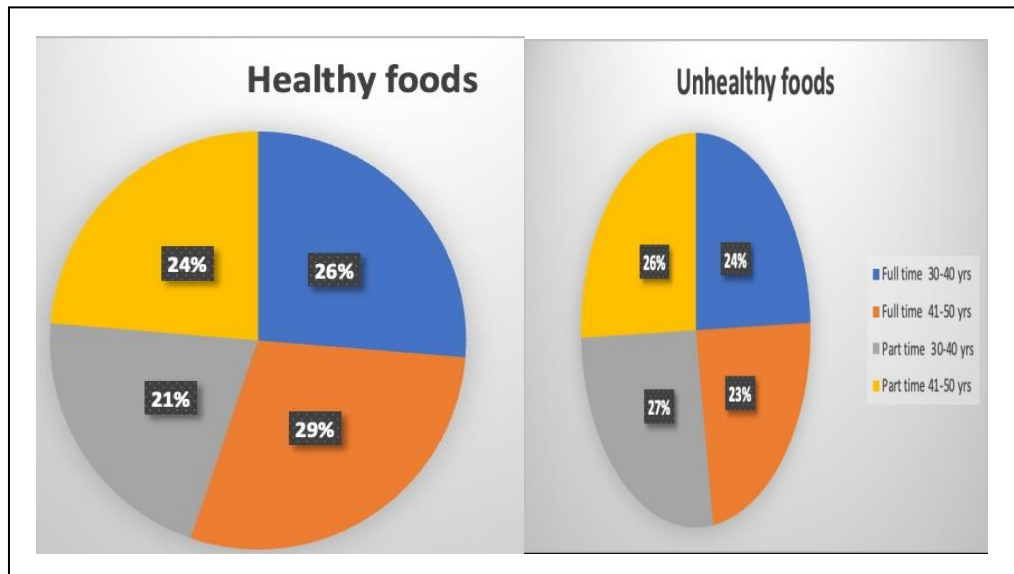
**Table 4. Frequency of food intake of adult men consuming alcohol (in percentage)**

Food Groups	Daily		Twice a week				Once a week				Never					
	Full Time	Part time	Full Time	Part time	Full Time	Part time	Full Time	Part time	Full Time	Part time	Full Time	Part time	Full Time	Part time		
Cereals, Millets	98	97	10	98	2	3	-	2	-	-	-	-	-	-	-	-
Pulses/ Dhal/ Sprouts	6	5	4	6	90	87	92	88	4	8	-	6	-	-	-	-
Vegetables/ greens/	2	8	11	7	64	79	58	66	27	10	28	17	7	7	-	3
Fruits	-	6	8	4	83	70	55	69	9	12	20	7	12	11	17	20
Milk & Milk	19	22	6	13	44	53	64	57	35	20	25	14	2	5	5	16

<b>Pro duct s</b>																
<b>Red Meat</b>	94	81	88	75	4	6	12	21	2	13	-	4	-	-	-	-
<b>Beve rage s</b>	10	10	10	10	-	-	-	-	-	-	-	-	-	-	-	-
<b>Swee ts &amp; snac ks</b>	87	80	67	82	-	-	-	-	-	-	-	-	-	-	-	-
<b>Junk food s</b>	10	10	10	10	-	-	-	-	-	-	-	-	-	-	-	-
<b>Out side food s</b>	96	91	10	98	4	5	-	2	4	-	-	-	-	-	-	-

### Healthy and Unhealthy Foods Consumption of the Adult males:

Figure 2 indicates that full-time workers exhibited slightly healthier food habits compared to part-time workers (26% vs. 29%). Among age groups, men aged 30-40 tend to consume unhealthy foods more frequently (24% vs. 27%). Overall, healthy foods such as cereals, pulses, vegetables, milk, and fruits were consumed less frequently, while unhealthy foods like chicken, beef, junk foods and processed items were commonly consumed among most respondents. These findings are consistent with Fawehinmi et al. (2012) and Joseph et al. (2022) who noticed higher consumption of calorie rich foods, animal products and processed foods and lower consumption of nutrient dense foods among heavy drinkers.



**Fig.2. Healthy and Unhealthy Foods Consumption of the Adult males**

**Comparison of eating habits:**

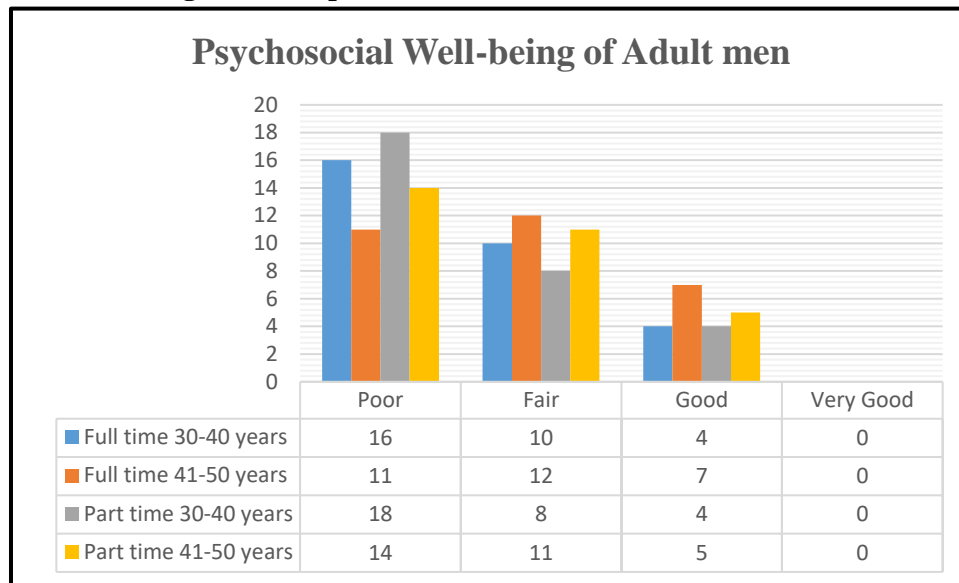
**Table 5. Comparison of eating habits between full time and part time alcoholic adult men**

Details		Sample Size	Mean	SD	't' value	P value
<b>Employment Status</b>	Full Time	60	5.98	2.20	3.26	0.0015**
	Part time	60	4.42	2.99		
<b>Full Time</b>	30-40 years	30	5.87	2.40	2.887	0.006**
	41-50 years	30	3.77	3.18		
<b>Part time</b>	30-40 years	30	4.10	2.33	0.806	0.423 NS
	41-50 years	30	4.68	3.18		

NS- Not Significant \*\* Significant at 0.01 level

Table 5 compares the eating habits between full-time and part-time employed adult men, revealing a significant difference (p=0.0015). Full-time male workers aged 30 to 40 exhibited better eating habits ( $5.87 \pm 2.40$ ) compared to those aged 40 to 50 ( $3.77 \pm 3.18$ ), with a significant difference (p=0.006). However, there was no significant difference among part-time employees across age groups. Thus, the hypothesis is partially supported, suggesting that part-time workers tend to have poorer food habits, possibly due to higher alcohol consumption. This agrees with Berro et al. (2021) findings, indicating a correlation between increased alcohol intake and more frequent disordered eating behaviors.

**Psychosocial Wellbeing of the Respondents:**



\* Values in Figure -3 indicates frequency

**Fig.3. Level of Psychosocial Well being of the Respondents**

From Figure 3, it's evident that none of the respondents scored very high in psychosocial well-being. Part-time employed men aged 30–40 (60%) and 40–50 (47%) showed poorer psychosocial wellbeing compared to full-time workers in the same age groups (53% and 37%, respectively). Fair levels of psychosocial well-being were observed among full-time workers in both age groups (33% and 40%, respectively), contrasting with part-time workers (27% and 37%). Diminished psychosocial well-being might result from factors like alcohol consumption, financial instability, and family issues.

**Comparison of Psychosocial wellbeing:**

According to Table 6, it's evident that men employed full-time exhibited significantly higher psychosocial wellbeing ( $32.88 \pm 12.2$ ) compared to their part-time counterparts ( $27.42 \pm 9.99$ ). Within full-time employment, men aged 41 to 50 showed significantly better psychosocial wellbeing ( $p = 0.028$ ), whereas this difference wasn't statistically significant among part-time workers in both age groups. Hence, the alternative hypothesis is partially confirmed.

**Table 6. Comparison of Psycho-social wellbeing between full time and part time alcoholic adult males**

Details		Sample Size	Mean	SD	't' value	P value
<b>Employment Status</b>	Full Time	60	32.88	12.20	2.689	0.008**
	Part time	60	27.42	9.99		
<b>Full Time</b>	30-40 years	30			2.26	0.028*
			24.73	9.43		
	41-50 years	30	29.87	8.181		

<b>Part time</b>	30-40 years	30	25.57	8.4	0.233	0.816
	41-50 years	30	26.10	9.18		NS
NS-Not Significant		*-Significant at 0.05 level	** Significant at 0.01 level			

**Relationship between alcohol consumption, eating habits and psycho social wellbeing**

Table 7 demonstrates the correlation between alcohol consumption, eating habits, and psychosocial wellbeing. It revealed that low and risky alcohol use had a positive but not significant link with these factors across employment statuses. However, harmful and high-risk alcohol intake exhibited significant negative correlations with eating habits and psychosocial wellbeing among full-time and part-time employed men. These findings confirm the hypothesis suggesting a notable association between alcohol use, eating habits, and psychosocial well-being, highlighting the detrimental impact of excessive alcohol consumption on male health.

**Table 7. Relationship between alcohol consumption, eating habits and psycho social wellbeing of Adult males**

<b>Level of Alcohol Consumption</b>	<b>Full Time Workers</b>		<b>Part time Workers</b>	
	Eating habits	Psycho social well being	Eating habits	Psycho social well being
<b>Low Risky level</b>	0.430	0.31	0.33	0.291
<b>Risky level</b>	0.12	0.18	0.10	0.15
<b>Harmful level</b>	-0.29 *	-0.27*	-0.34*	-0.322*
<b>High Risk level</b>	-0.433**	-0.37*	-0.469**	-0.38*

\*\* Correlation is significant at 0.01 level

\* Correlation is significant at 0.05 level

**CONCLUSION**

This research reveals the link between alcohol use, eating habits, and psychosocial wellbeing in adult males. It emphasizes the harmful effects of excessive alcohol consumption on physical and mental health, especially among men aged 30 to 40 emerged as a particularly vulnerable group. Proper interventions are necessary to promote healthier lifestyles and coping mechanisms to mitigate the negative impact of alcohol on overall well-being. Additionally, evidence-based policymaking is crucial to address societal challenges related to excessive alcohol use. Policies such as taxation, advertising restrictions, and awareness campaigns can foster healthier behaviors and enhance psychosocial wellbeing in adult males.

**FUTURE RESEARCH WORK**

Although this study focused solely on adult men in Chennai and examined only two variables, there is potential for future research to explore the broader impacts of alcohol consumption. Future investigations could consider additional factors such as income, locality, and pre-existing



health conditions. Long-term studies might uncover causal relationships and identify factors influencing or mediating these associations.

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## MICROBIAL ASSESSMENT OF STREET VENDED SUGARCANE JUICE SAMPLES FROM ANAND CITY, GUJARAT, INDIA

Disha P. Mall<sup>1</sup>, V. H. Patel<sup>2</sup>, Rema S.<sup>3</sup>

<sup>1</sup>Research scholar, <sup>2</sup>Head and professor, <sup>3</sup>Rtd. Professor

Post Graduate Department of Home Science,

Sardar Patel University,

Vallabh Vidyanagar – Anand, Gujarat

2411dshah@gmail.com

HSAI Membership ID: 01/S-4/LF

### ABSTRACT

Street foods offer convenience for the consumer, yet their quality and safety are two big concerns. Sugarcane (*Saccharum officinarum*) juice is a widely consumed beverage which is popular owing to its fresh flavour and low cost, especially in tropical countries. It can also be a source of microbial contamination due to inept hygienic practices followed by the juice vendors. Therefore, the aim of the present study was to evaluate the microbiological quality of sugarcane juice using conventional culture techniques with special reference to *Bacillus cereus* and *Escherichia coli*. Samples were collected from ten popular locations situated in five different zones [East (2), West (1), North (1), South (1) and Central (5)] of Anand city area and analyzed in triplicate (n = 30). For the microbial screening, bacteria were isolated and biochemically characterized. Results showed the presence of a considerable microbial load in the sugarcane juice samples. Total viable count ranged from 4.59 to 6.22 log CFU/mL while the yeast and mold counts varied from 3.87 to 6.25 log CFU/mL. The Highest total viable count, yeast and mold count as well as *E. coli* contamination were found in the samples procured from one of the central locations. Sample obtained from the south zone possessed higher *B. cereus* count. Out of the 30 samples of sugarcane juice analyzed, 19 (63.33%) *B. cereus* and 23 (76.66%) *E. coli* isolates were obtained. The study revealed the possibility of a microbial health risk to humans through the consumption of contaminated street vended sugarcane juice. Therefore, it is important to monitor and enhance hygienic practices among street food vendors.

**Keywords:** Street foods; sugarcane juice; microorganisms, hygienic practises

### INTRODUCTION

Foods and beverages prepared and sold by street vendors outside or in public locations for immediate consumption or later without any additional processing are referred to as street vended foods (SVF) as defined by Loukieh et al. (2018) and Amare et al. (2019). Fruit and vegetable-based beverages are popular worldwide because they are nutrient rich, non-alcoholic drinks that have positive health effects (Lee et al., 2021). In India, sugarcane juice is one of the most popularly consumed fresh beverages. The freshly extracted juice is prepared using a mechanical crusher and directly sold to the consumer by street vendors. Organic acids, saccharose and minerals such as iron, calcium, potassium, and magnesium are all abundant in sugarcane juice (Kaavya et al., 2019).

Contaminated juices of fruit and vegetables have been attributed to outbreaks of infectious diseases that cause high rates of morbidity and mortality all over the world. Typhoid fever, food poisoning, gastroenteritis, enteric fever, and diarrhoea are all caused by these bacteria and can frequently be life-threatening (Sharma et al., 2020). Major bacteria often detected in street juices are *Escherichia coli*, *Salmonella typhi*, *Staphylococcus aureus*, *Pseudomonas spp.*, *Vibrio cholerae*, *Klebsiella*, *Streptococcal spp.*, *Proteus spp.*, (Iqbal et al., 2015).

*B. cereus*, *S. aureus* and *E. coli* were detected in orange juice, sweet lime juice and carrot juice from Kurukshetra (Aneja et al., 2014). *Fecal coliforms*, *S. aureus*, *Shigella spp.* and *E. coli* were found in grape juice, sapota juice, pineapple juice and sweet lime juices from Hyderabad (Sabbithi et al., 2017). In the study by Reddy et al. (2016) *Salmonella spp.* was also detected in sapota juice from Hyderabad. Sugarcane juice from Bhilai city was contaminated with coliforms, fecal coliforms, *E. coli* and *S. aureus* (Reena et al., 2012). *B. cereus* and *E. coli* strains are significant among food-borne pathogens. *E. coli* is the predominant species of facultative anaerobe present in the gastrointestinal tracts of both humans and animals. Consequently, the detection of this organism in foods serves as an indication of fecal contamination (Rahman et al., 2018 and Jafari-Sales et al., 2020). *B. cereus* is ubiquitous in nature (Agwa et al., 2012) and also has the capacity to form endospores which confer a notable resilience to heat, desiccation, chemicals and radiation, allowing these bacteria to survive adverse conditions for extended periods. They are frequently present in milk and milk products, vegetables, rice, eggs, spices and ready-to-eat (Tewari and Abdullah, 2015). This reveals the possibility of microbial health risk to humans through foods contaminated with *B. cereus* and *E. coli*.

Based on literature reviewed, no study has been reported on microbial contamination in sugarcane juice from Gujarat state or from Anand city. Thus, the purpose of the present study was carried out with following objective.

### **OBJECTIVE**

The microbial evaluation of street vended sugarcane juice samples sold in Anand city, Gujarat by using the conventional culture technique with the focus on *Bacillus cereus* and *Escherichia coli*.

### **MATERIALS AND METHODS**

#### **Sample collection:**

Samples to be collected were identified from ten popular locations covering different geographical zones of Anand city (namely East (E), West (W), North (N), South (S) and Central (C) zones) in order to obtain extensive samples. From these ten locations (E1, E2, W1, N1, S1, C1, C2, C3, C4 and C5), ten representative sugarcane juice samples were collected in triplicate (a, b & c).

#### **Conventional culture technique:**

Samples were collected in their original packaging material (either a closed polythene bag or covered transparent plastic containers) and transferred to the laboratory in an ice box and processed within 2 hours. Samples were mixed thoroughly and then serially diluted in buffered peptone water (BPW) and 100uL aliquot samples were inoculated on respective media using the spread plate technique.

**Total viable count and yeast and mold count:**

For total viable count (TVC), plate count agar (TPC) was used. Potato dextrose agar (PDA) was selected for yeast and mold count (YMC). Plates were incubated at 37 °C for 24 to 48 hours. Colonies expressed in log colony forming units per mL (log CFU/mL).

**Enumeration of *Bacillus cereus* and *Escherichia coli***

Samples were inoculated on Polymyxin Pyruvate Egg Yolk Mannitol Bromothymol Blue Agar (PEMBA) for *B. cereus*. For *E. coli*, the sample was inoculated on Hicrome™ *E. coli* Agar (HEA). Plates were incubated at 37° C for 24 to 48 hours. After incubation, presumptive colonies of *B. cereus* appeared as blue colonies surrounded by a zone of opacity while colonies of *E. coli* appeared bluish green. *B. cereus* MTCC - 6840 and *E. coli* MTCC – 1692 respectively were used as positive control. Colonies were expressed in log colony forming units per mL (log CFU/mL).

**Isolation and preservation of microorganisms**

Single colonies from each plate were purified by subculturing on appropriate agar and incubated at 37° C for 24 h to obtain isolated pure colonies. These were preserved in 20% glycerol stock and stored at -20° C till further use.

**Phenotypic characterisation**

Bacteria were characterised on the basis of colony morphology, Gram's reaction, motility test and biochemical tests such as IMViC (Indole, Methyl red test, Voges–Proskauer test, and Citrate utilization test), hemolysin production test, carbohydrate utilisation tests (glucose, sucrose, lactose, mannose, arabinose, mannitol and dulcitol), triple sugar iron agar (TSI) test, and for enzyme production such as gelatinase, nitratase, urease, amylase, caseinase, catalase and oxidase (Patel et al., 2016).

All media and reagents required were procured from HiMedia, Mumbai, India and prepared in the laboratory.

**Statistical analysis**

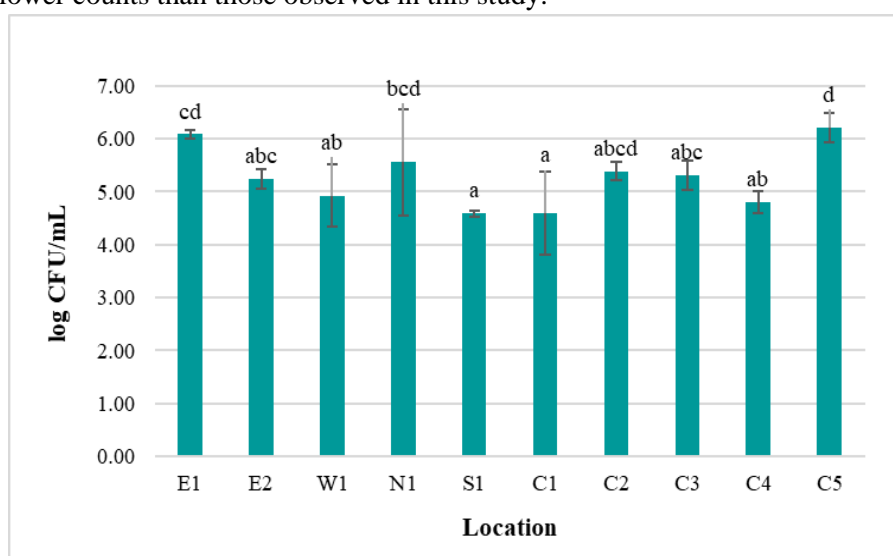
Mean ± SD and one way ANOVA were calculated for total viable count and yeast and mold count using SPSS, version 26.0.

## RESULTS AND DISCUSSION

Sugarcane juice is a delicious beverage that enjoys wide popularity due to its pleasant flavour, refreshing taste and easy availability especially during the summer months in India. Sugarcane is crushed using a roller crusher to obtain the juice, which can be consumed with or without ice cubes (Nisha et al., 2017). The beverage is primarily sold fresh by street food vendors and small eateries. If proper hygiene is not maintained it can cause several foodborne diseases. Consequently, an analysis of the microbiological quality of freshly squeezed sugarcane juice samples sold at various popular locations in Anand city area was undertaken.

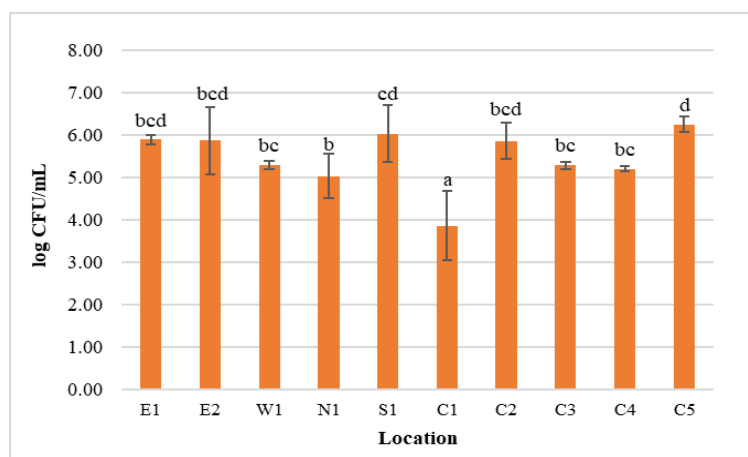
**Total viable count and yeast and mold count:**

The TVC ranged from 4.59 to 6.22 log CFU/mL (Fig. – 1). and YMC ranged from 3.87 to 6.25 log CFU/mL (Fig. – 2). Locations E1, N1, C2 and C5 showed significantly higher counts than other locations for TVC. For YMC, locations E1, E2, S1, C2 and C5 exhibited significantly higher counts than other locations. The calculated F values for TVC and YMC were 4.36 ( $p \leq 0.01$ ) and 6.38 ( $p \leq 0.001$ ), respectively. Ali et al.(2015) examined forty samples of sugarcane juice from Pakistan for total viable count, yeast and mold count, coliforms, fecal coliforms and *E. coli*. TVC ranged from 2 to 8 CFU/mL and YMC ranged from 2 to 7 CFU/mL, aligning with the findings in the present study. The study conducted by Agrawal & Garode, (2018) reported a narrower range for TVC (4.09 to 4.37 log CFU/mL) and YMC (2.54 to 2.81 log CFU/mL) for sugarcane juice, from Maharashtra, indicating lower counts than those observed in this study.



Values are Mean ± SD of 3 trials; Bars carrying similar superscripts are not statistically different ( $p \leq 0.05$ )

**Fig. – 1 Total viable count of sugarcane juice samples from different locations**



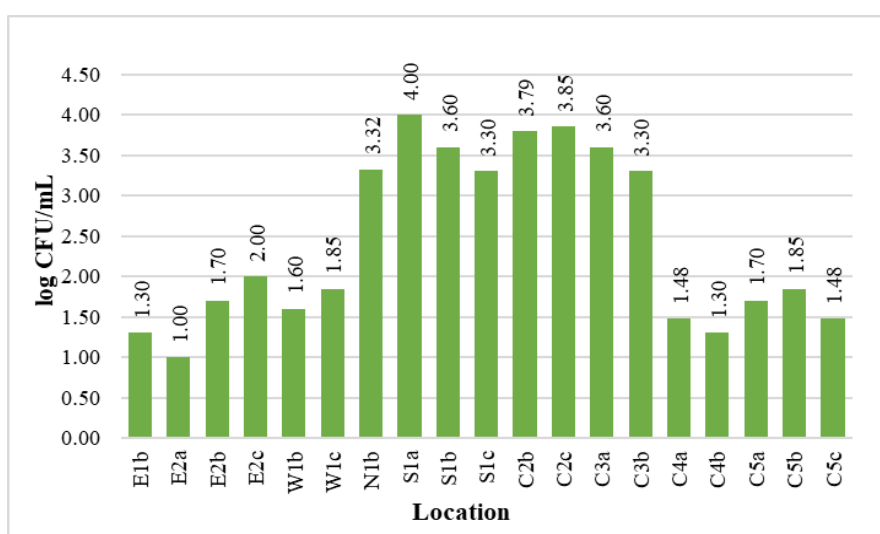
Values are Mean ± SD of 3 trials; Bars carrying similar superscripts are not statistically different ( $p \leq 0.05$ )

**Fig. – 2 Yeast and mold count of sugarcane juice samples from different locations**

Based on FSSAI guidelines for non-thermally processed fruit juices the acceptable limit for TVC should lie between  $1 \times 10^6$  to  $1 \times 10^7$  CFU/g. However, in the present study locations E1 and C5 showed higher TVC count than these figures. Further, for YMC nearly all the locations showed values above the FSSAI permissible limit between  $1 \times 10^2$ /g to  $1 \times 10^4$ /g. Fungi are extensively distributed in the soil and in the air (Okike et al., 2023) and thus may have easily entered the exposed juice samples in the present study.

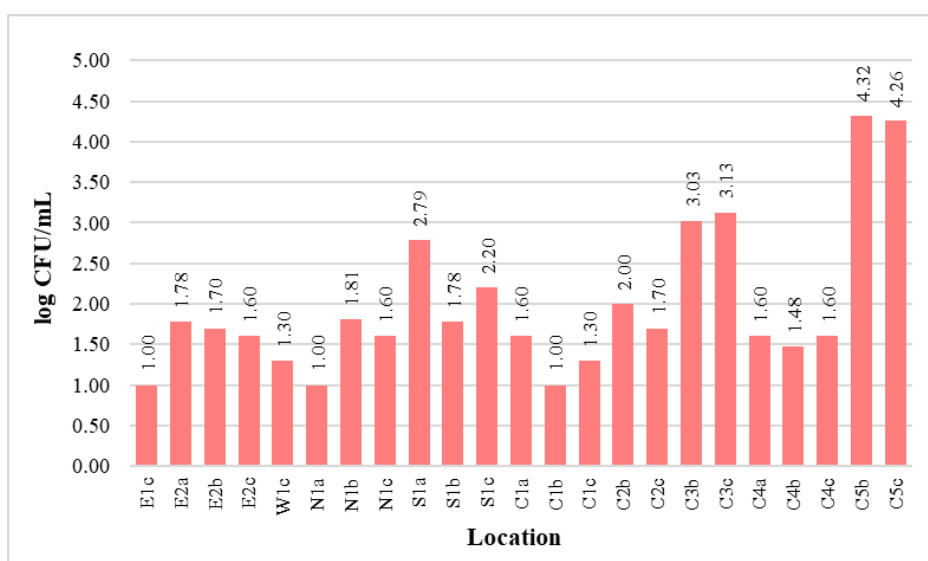
**Enumeration of *Bacillus cereus* and *Escherichia coli***

Counts of *B. cereus* ranged from 1.00 to 4.00 log CFU/mL while *E. coli* counts ranged from 1 to 4.32 log CFU/mL. Higher *B. cereus* counts were observed from the locations of S1, C2 and C3 while location C1 did not show any *B. cereus* contamination. High *E. coli* counts were detected in location C3 and C5 of central zones followed by the south zone (Fig. – 3 & 4).



E, W, N, S, C and 1, 2, 3, 4, 5 denote location; a, b & c represent trials

**Fig. – 3 Enumeration of *B. cereus* from sugarcane juice samples from different locations**



E, W, N, S, C and 1, 2, 3, 4, 5 denote location; a, b & c represent trials

**Fig. – 4 Enumeration of *E. coli* from sugarcane juice samples from different locations**

According to the guideline for ready to eat fresh fruit and vegetable by the Centre for Food Safety, Hong Kong (2001), the *E. coli* count should be <20 while *B. cereus* count should be <10<sup>3</sup>/g. In the present study, all the samples examined showed higher *E. coli* contamination except E1, N1a and C1b. Also, locations N1, S1, C2 and C3 showed a higher *B. cereus* count. However, the Commission of the European Communities (2007) has set a higher threshold for the presence of *E. coli* i.e., between 100 and 1000 CFU/g and in the present study locations C3 and C5 exceeded this permitted limit.

### **Phenotypic characterisation**

#### **Morphological characteristics**

Gram staining and motility tests were also carried out. The isolates were found to be gram-positive, rod-shaped bacteria with short or long chains for *B. cereus* while *E. coli* isolates were found to be gram-negative, rod-shaped, single or diplo. For the motility test both the strains showed a diffuse cloud of growth away from the line of inoculation indicating that both were motile organisms.

#### **IMViC:**

Results of biochemical characteristics are presented in Tables 1 & 2. All the *B. cereus* isolates were found to be negative while all the *E. coli* isolates were found to be positive for indole production. All the *B. cereus* and *E. coli* isolates were positive for MR test. *B. cereus* isolates showed variable results for VP test while all the *E. coli* isolates were negative for the same.

#### **Enzymatic test:**

Isolates of *B. cereus* showed the ability to hydrolyse substrates such as starch, casein, and gelatin, as shown by a zone of hydrolysis around the colonies (for starch and casein). Variation in the strains was observed for the production of urease and nitratase by *B. cereus*. These strains also showed positive reactions for catalase. *E. coli* isolates showed negative results for gelatinase, urease and oxidase while they showed positive results for catalase and variable results for nitratase.

#### **Hemolysin production test:**

Most of the *B. cereus* isolates were found to be positive for hemolysin production but none of the *E. coli* isolates were found to be positive.

#### **Carbohydrate utilization test:**

*B. cereus* showed moderate to high acid production with no gas formation while high acid production with gas formation was observed in *E. coli* isolates.

#### **Triple sugar iron agar:**

Variable results were found for *B. cereus* isolates with no gas formation and no H<sub>2</sub>S production whereas *E. coli* isolates depicted an acidic slant and butt with gas formation and no H<sub>2</sub>S production.

Morphological characteristics and biochemical tests revealed that out of the 30 samples tested, 19 isolates of *B. cereus* and 23 isolates of *E. coli* were obtained.



Mandal & Mandal (2018) reported of *Escherichia coli*, *Enterobacter cloacae* and *Micrococcus roseus* contamination in sugarcane juice sold in Malda town. In the study by Khan et al., (2015) *Proteus*, *Enterobacter*, *E. coli*, *Shigella*, *Citrobacter* and *Vibrio* were isolated from sugarcane juice in Bangladesh. Angbalaga et al., (2023) evaluated the microbial quality of sugarcane juice from Nigeria and the highest prevalence was observed for *E. coli* (55%) followed by *S. aureus*, *Shigella* spp., *Salmonella* spp., *Micrococcus* spp. and *Bacillus* spp. In the present study also, a high prevalence was noted for *E. coli* compared to *B. cereus*. Subedi et al., (2023) reported that out of 60 sugarcane juice samples tested from Kathmandu valley, Nepal, 40 samples showed microbial contamination and *E. coli* was isolated from 16 samples. In the present study also showed a high level of contamination with *E. coli*. In the study conducted by Aleem and Ramteke, (2017) at Allahabad, out of 40 sugarcane juice samples 11 samples were contaminated with *M. luteus* followed by *B. cereus* (10), *Klebsiella* spp. (09), *S. lactis* (07), *S. aureus* (02) and *E. coli* (01). The present study showed a higher percentage of *B. cereus* (19/30) and *E. coli* (23/30) contamination compared to the Allahabad study.

Sugarcane juice is susceptible to microbial contamination at various stages, including the contamination of sugarcane sticks, roller crushers, collection vessels, filter cloth, added ice and the hands of the vender etc (Panigrahi et al., 2021). In the present study, based on the investigator's observations, the sugarcane machine, utensils and hands of the vendors were not properly washed. Food handlers used only water to clean their hands and workplace. Sometimes vendors mixed leftover sugarcane juice with fresh juice, which could be a reason for the high microbial load.

**Table -1 Biochemical characterization of *Bacillus cereus* isolates**

No.	Isolate	IMViC				Enzymatic test						Sugar fermentation						TSI agar					
		Indole	MR	VP	Citrate	Gelatinase	Nitratase	Urease	Amylase	Caseinase	Catalase	Oxidase	Hemolysis	Glucose	Sucrose	Lactose	Mannose	Arabinose	Mannitol	Dulcitol	Slant	Butt	H <sub>2</sub> S
1	E1b	-	+	-	-	+	+	+	+	+	-	+	+	+	+	+	+	+	+	A	A	-	-
2	E2a	-	+	+	-	+	+	-	+	+	-	+	+	+	+	+	+	+	+	K	A	-	-
3	E2c	-	+	-	-	+	-	-	+	+	-	+	+	+	+	+	+	+	+	K	O	-	-
4	W1a	-	+	-	-	+	-	-	+	+	-	+	+	+	+	+	+	+	+	K	O	-	-
5	W1b	-	+	+	-	+	+	+	+	+	-	+	+	+	+	+	+	+	+	O	O	-	-
6	W1c	-	+	+	-	+	+	+	+	+	-	+	+	+	+	+	+	+	+	O	O	-	-
7	N1b	-	+	-	-	+	+	+	+	+	-	+	+	+	+	+	+	+	+	A	A	-	-
8	S1a	-	+	+	-	+	+	-	+	+	-	+	+	+	+	+	+	+	+	K	A	-	-
9	S1b	-	+	+	-	+	+	+	+	+	-	-	+	+	+	+	+	+	+	K	A	-	-
10	S1c	-	+	+	-	+	+	+	+	+	-	-	+	+	+	+	+	+	+	K	A	-	-
11	C2b	-	+	+	+	+	+	-	+	+	-	+	+	+	+	+	+	+	+	K	O	-	-
12	C2c	-	+	+	-	+	+	-	+	+	-	+	+	+	+	+	+	+	+	K	O	-	-
13	C3a	-	+	+	-	+	+	+	+	+	-	+	+	+	+	+	+	+	+	K	O	-	-
14	C3b	-	+	-	-	+	+	+	+	+	-	+	+	+	+	+	+	+	+	K	O	-	-
15	C4a	-	+	-	+	+	+	-	+	+	-	-	+	+	+	+	+	+	+	K	A	-	-
16	C4b	-	+	-	-	+	+	-	+	+	-	+	+	+	+	+	+	+	+	K	A	-	-
14	C5a	-	+	+	-	+	+	-	+	+	-	-	+	+	+	+	+	+	+	K	A	-	-
18	C5b	-	+	+	-	-	+	+	+	+	-	-	+	+	+	+	+	+	+	K	O	-	-
19	C5c	-	+	+	-	-	+	+	+	+	-	+	+	+	+	+	+	+	+	K	O	-	-

MR= Methyl Red; VP=Voges Proskauer; K = Alkaline; A = Acid, O = no colour change; First two letters = Location; a, b & c = trial

**Table-2 Biochemical characterization of *Escherichia coli* isolates**

No.	Isolate	IMViC				Enzymatic test						Sugar fermentation						TSI agar				
		Indole	MR	VP	Citrate	Gelatinase	Nitratase	Urease	Catalase	Oxidase	Hemolysis	Glucose	Sucrose	Lactose	Mannose	Arabinose	Mannitol	Dulcitol	Slant	Butt	H <sub>2</sub> S	Gas
1	E1c	+	+	-	-	-	+	-	+	-	-	+	+	+	+	+	+	+	AG	AG	+	-
2	E2a	+	+	-	-	-	+	-	+	-	-	+	+	+	+	+	+	+	AG	AG	+	-
3	E2b	+	+	-	-	-	+	-	+	-	-	+	+	+	+	+	+	+	AG	AG	+	-
4	E2c	+	+	-	-	-	+	-	+	-	-	+	+	+	+	+	+	+	AG	AG	+	-
5	W1c	+	+	-	-	-	+	-	+	-	-	+	+	+	+	+	+	+	AG	AG	+	-
6	N1a	+	+	-	-	-	+	-	+	-	-	+	+	+	+	+	+	+	AG	AG	+	-
7	N1b	+	+	-	-	-	+	-	+	-	-	+	+	+	+	+	+	+	AG	AG	+	-
8	N1c	+	+	-	-	-	+	-	+	-	-	+	+	+	+	+	+	+	AG	AG	+	-
9	S1a	+	+	-	-	-	+	-	+	-	-	+	+	+	+	+	+	+	AG	AG	+	-
10	S1b	+	+	-	-	-	+	-	+	-	-	+	+	+	+	+	+	+	AG	AG	+	-
11	S1c	+	+	-	-	-	+	-	+	-	-	+	+	+	+	+	+	+	AG	AG	+	-
12	C1a	+	+	-	-	-	+	-	+	-	-	+	+	+	+	+	+	+	AG	AG	+	-
13	C1b	+	+	-	-	-	+	-	+	-	-	+	+	+	+	+	+	+	AG	AG	+	-
14	C1c	+	+	-	-	-	+	-	+	-	-	+	+	+	+	+	+	+	AG	AG	+	-
15	C2b	+	+	-	-	-	+	-	+	-	-	+	+	+	+	+	+	+	AG	AG	+	-
16	C2c	+	+	-	-	-	+	-	+	-	-	+	+	+	+	+	+	+	AG	AG	+	-
14	C3b	+	+	-	-	-	+	-	+	-	-	+	+	+	+	+	+	+	AG	AG	+	-
18	C3c	+	+	-	-	-	+	-	+	-	-	+	+	+	+	+	+	+	AG	AG	+	-
19	C4a	+	+	-	-	-	+	-	+	-	-	+	+	+	+	+	+	+	AG	AG	+	-
20	C4b	+	+	-	-	-	+	-	+	-	-	+	+	+	+	+	+	+	AG	AG	+	-
21	C4c	+	+	-	-	-	+	-	+	-	-	+	+	+	+	+	+	+	AG	AG	+	-
22	C5b	+	+	-	-	-	+	-	+	-	-	+	+	+	+	+	+	+	AG	AG	+	-
23	C5c	+	+	-	-	-	+	-	+	-	-	+	+	+	+	+	+	+	AG	AG	+	-

MR= Methyl Red; VP=Voges Proskauer; AG = Acid & Gas production; First two letters = Location; a, b & c = trial

**Table -3 Location wise microbial contamination of samples.**

Location	Trial	Total viable count log CFU/g	Yeast and mold count log CFU/g	<i>B. cereus</i>	<i>E. coli</i>
E1	a	6.079	5.903	-	-
	b	6.176	6.000	P	-
	c	6.000	5.778		P
E2	a	5.017	4.973	P	P
	b	5.334	6.447	P	P
	c	5.350	6.204	P	P
W1	a	4.477	5.350	-	-
	b	4.699	5.362	P	-
	c	5.602	5.176	P	P
N1	a	4.602	5.643	-	P
	b	5.477	4.778	P	P
	c	6.602	4.699		P
S1	a	4.544	6.806	P	P
	b	4.568	5.602	P	P
	c	4.653	5.699	P	P
C1	a	4.301	3.000	-	P
	b	4.000	4.000	-	P
	c	5.477	4.602	-	P
C2	a	5.193	5.380	-	P
	b	5.531	6.215	P	P
	c	5.447	6.000	P	-
C3	a	5.000	5.362	P	-
	b	5.531	5.204	P	P
	c	5.398	5.301	-	P
C4	a	4.580	5.265	P	P
	b	4.982	5.146	P	P
	c	4.826	5.210	-	P
C5	a	6.041	6.079	P	-
	b	6.079	6.230	P	P
	c	6.531	6.447	-	P

P = Positive

Table – 3 depicted the location and trial wise microbial contamination in samples. High TVC was observed in locations E1 and C5, while YMC was higher in locations E2, C2 and C5. Location E2 showed high YMC and the presence of *B. cereus* and *E. coli* for all the three trials. In contrast location C1 showed low TVC as well as YMC and the absence of *B. cereus*.

**Table – 4 Detection of microbial contamination from different locations (n = 10)**

Bacteria	Positive	Negative
<i>B. cereus</i>	09 (90%)	01(10%)
<i>E. coli</i>	10 (100%)	0

Table - 4 illustrates the prevalence of microbial contamination which showed a high predominance of both bacteria.

### CONCLUSION

Overall, the 10 sugarcane juice samples tested revealed the presence of 09 (90%) *B. cereus* and 10 (100%) *E. coli* presence. The study revealed a heavy microbial load of *B. cereus* and *E. coli* in the sugarcane juice samples tested. Thus, there is a possibility of microbial health risk to humans through the consumption of street vended sugarcane juice samples. Therefore, it is crucial to consistently monitor and improve hygienic practices among street food vendors.

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## ACHIEVEMENT MOTIVATION AMONG HIGH SCHOOL STUDENTS

Dr. Arati Chakra <sup>1</sup> & Ms. P.Vasantha <sup>2</sup>

<sup>1</sup> Lecturer and Head, Department of Home Science, KVR Government College for Women, Cluster University, Kurnool

<sup>2</sup> Lecturer in Home Science (Guest), Department of Home Science, KVR Government College for Women, Cluster University, Kurnool

### ABSTRACT

Achievement motivation is a desire to excel and accomplish something difficult, and attain a high standard. The aim of the present research was to find out achievement motivation of high school students. It also studied the difference of selected students and family variables on achievement motivation. Systematic stratified purposive random sampling technique was used to collect sample from 120 high school students (60 Boys and 60 Girls) from various schools of Tirupati city of Andhra Pradesh. Deo Mohan Achievement motivation scale was used to assess the Achievement Motivation of the students. The results revealed that majority of the students are average in achievement motivation. There is significant difference in achievement motivation based on age, gender, grades of the study, types of family, family income of the students.

**Keywords:** Motivation, Achievement Motivation, High School Students

### INTRODUCTION

The term 'motivation' refers to any organismic state that mobilizes selective and directed activity. Motivation is based on emotions and needs. It is the driving force behind all the actions of an individual. There are various types or forms of motivation including extrinsic, intrinsic, and achievement motivation. Achievement motivation refers as the drive to accomplish tasks, achieve goals, and strive for success. It plays a significant role in influencing individuals' behaviors, choices, and efforts toward accomplishing challenging objectives.

Achievement motivation is an acquired tendency. Mc Clelland and his associates (1953) defined achievement motivation as a disposition to strive for success as per internalized standards of excellence set by the individual. Burger (1997) indicated that high achievers are moderate risk takers and have an energetic approach to work. Achievement motivation is plays a pivotal role in determining students' academic performance, personal development, and accomplishing challenging tasks and excels in various aspects of life (Bakar et.al. 2022; Erhuvwu and Adeyemi, 2019). It is a critical component in the academic journey of high school students, serving as a powerful driving force that propels them toward success. Parents' encouragement directly and indirectly plays a significant role in predicting academic achievement of their children. The more actively parent involve in their children's education, children's perceptions of competence is higher and better they perform in school and enhance their achievement motivation (Suvidha and Divya, 2019). Educated Parents have higher expectation from their children. They involve more in

their children's education than less educated parents which in turn facilitates greater educational attainment for their children (Hoff, 2003). Even the boys and girls differed significantly on achievement motivation (Veena and Shailaja, 2013; Santha and Chamundeswari, 2015; Maheswari and Aruna, 2016). The class of study (Aydin and Coşkun, 2011), locale of the school and type of management were found to have significant influence on achievement motivation of students (Vijayakumari and Rekha, 2014; Sangeeta Pawar 2017).

### **JUSTIFICATION OF THE STUDY**

In academic journey high school education is a crucial phase, laying the foundation for future educational and career opportunities. Achievement motivation plays an important role in the academic, social, and psychological development of high school students. Understanding achievement motivation among high school students is essential not only for educators but also for parents, policymakers, and stakeholders, as it provides valuable insights into fostering a supportive learning environment and facilitating the holistic growth of the younger generation. Hence in this study an attempt has been made to know the achievement motivation among high school students and identifying key determining factor.

### **OBJECTIVES**

1. To assess achievement motivation among high school students
2. To study the difference of selected student variables on achievement motivation of high school students.
3. To study the difference of selected family variables on achievement motivation of high school students.

### **HYPOTHESES**

- There was no significant difference in achievement motivation of high school students based selected student variables - gender, age, birth order, grades of study.
- There was no significant difference in achievement motivation of high school students based on selected family and parents' variables- namely types of family, Annual Income of the family, Education of father and mother, Occupation of father and mother.

### **METHOD AND MATERIALS**

The aim of the present research was to study achievement motivation of high school students. Ex-post-facto research design was adopted for conducting this study. The methodology adopted was mentioned hereunder.

**Method of data collection:** Systematic stratified purposive random sampling technique was used to collect sample from 120 high school students (60 Boys and 60 Girls) from various schools of Tirupati. Permission was taken from head of the institutions to collect data from the students.

**Tools Used:** The different independent variables included in the study are - age, gender, birth order, grade of study, locale of the school, Parents education and occupation, types of family, and family income. General information schedule was developed to collect personal and demographic information of the students.



The Achievement Motivation Scale developed by Professor Prathibha Deo and Dr. Asha Mohan (1985) was used for present study. The scale contains 50 items distributed among 15 factors underlying Achievement Motivation as suggested by McClelland and Atkinson. It is a standardised scale with good reliability and validity. It is a Likert scale with 5 modes of response provided for each item- Always, Frequently, Sometimes, Rarely and Never.

**Analysis of Data:** The data collected from 120 students was pooled and codes were given approximately. The coded data was entered into data sheet. Based on the raw score mean and standard deviation of achievement motivation scores were calculated. t- test, f-test and were conducted to assess significant difference among dependent and independent variables.

## **RESULTS AND DISCUSSION**

The raw data obtained were coded, tabulated and analyzed by SPSS software using appropriate statistical techniques. The t-test, f-test, were used to assess significant difference among independent and dependent variables. The results are presented and interpreted as follows:

- Profile of the students
- Achievement Motivation
- Relationship between Student Variables and Achievement Motivation
- Relationship between Family and Parent variables and Achievement Motivation

### **PROFILE OF THE SAMPLE**

The general profile of the sample includes child and school variables, family and parent variable. The descriptive statistics of these variables are discussed below.

#### **Distribution of the sample according to Student Variables**

The general profiles of the students included in this study are age, gender, and birth order, grade of study and locale of the school. The descriptive statistics of these variables are shown in table.1 and discussed below.

**Table 1 Distribution of the sample according to student variables (n=120)**

<b>S. No.</b>	<b>Variables</b>		<b>Number</b>	<b>Percentage</b>
1.	Gender	Boys	60	50.0
		Girls	60	50.0
2.	Age	12 years	19	15.8
		13 years	48	40.0
		14 years	34	28.4
		Above 15 years	19	15.8
3.	Birth order	First child	63	52.50
		Second child	44	36.7
		Third child& above	13	10.8
		7th	41	34.2

4.	Grade of study	8 <sup>th</sup>	39	32.5
		9 <sup>th</sup>	40	33.5

Table-1 shows the distribution of sample according to selected students' variables: gender, age, birth order and grade of study. The sample was selected to include equal number of boys and girls. Around 55 per cent of students were in the age group of below 13 years and 45 per cent were above 14 years. In the sample, 52 per cent were first born, 36 per cent were second born and 10 per cent were third or later born children. Nearly equal percentage of students was selected from 7<sup>th</sup>, 8<sup>th</sup> and 9<sup>th</sup> classes.

### Distribution of the sample according to Family Variables

Different family variables taken in this study are type of family, annual income, educational level of the parent and occupation of the parent. The distribution of sample according to family and parent variables is shown in table.2.

**Table- 2 Distribution of the Sample according to Family Variables (n=120)**

S.No.	Variables		Number	Per cent
1.	Type of family	Nuclear	74	61.7
		Single parent	22	18.3
		Joint Family	24	20.0
2.	Annual income of the Family (Rs.)	< 60,000/-	06	5
		60,000/-- 120,000/-	22	18.3
		Above 120,000/-	92	76.7
3.	Education of Mother	Illiterates & below 10 <sup>th</sup> std.	06	5.0
		Intermediate	85	70.8
		Degree and above	29	24.6
4.	Education of Father	Illiterates	05	4.2
		5-10 <sup>th</sup> class	74	61.7
		Intermediate	35	29.2
		Degree and above	06	5.0
5.	Occupation of mother	Daily labour	12	10.0
		Private employee	11	9.2
		Government employee	2	1.7
		Business	18	15.0
		Housewife	77	64.2
6.	Occupation of Father	Daily labour	40	33.3
		Private employee	12	10.0
		Government employee	13	10.8
		Business	16	13.3
		Other	39	32.5

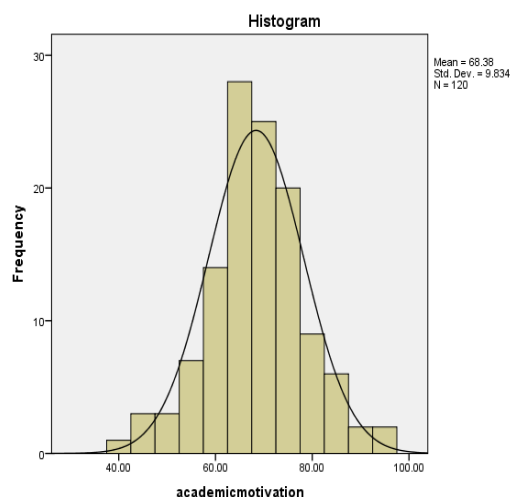
It is evident from table-2 that majority (61.7%) of the students were from nuclear family which shows the current trend of the breaking down of joint families to nuclear families. Majority of the sample families (76.7 per cent) had annual income of above Rs. 120,000/- followed by 18.3 per cent were from families whose income was between Rs. 60,000/-to 120,000/- and very few (5 per cent) were from families whose income was below Rs.60,000/-. It is clear from the table. 2, that majority of mothers (70.8%) and 29.2 per cent of fathers of sample students had educational qualification of intermediate. Majority of fathers of sample students (61.7 per cent) had high school education. It is good to observe that majority of mothers of sample students had education ranging from intermediate to degree and above educational qualification. With regard to occupation, majority of the mothers, (64.2 %) were housewives and 18 per cent were doing business like running small petty shops, 12 per cent of them are daily wage earner and only few of them are employee. With reference to father thirty-three per cent of the fathers of sample students were daily labours, 20 per cent students' father were doing job, 13.3 per cent were doing business.

### ACHIEVEMENT MOTIVATION

Achievement Motivation of the students was assessed by using Deo-Mohan Achievement Motivation scale (DAMS) developed by Prathibha Deo and Asha Mohan (1985). The mean scores and distribution of Achievement Motivation was presented in table.3 and fig.1.

**Table-3 Frequency Distribution of Sample according to Achievement Motivation Score (n=120)**

S. No	Achievement Motivation Score	Frequency	Per cent	Cumulative per cent
1.	<50	5	4.2	4.2
2.	50-59	13	10.8	15.0
3.	60-69	44	36.7	51.7
4.	70-79	39	32.5	84.2
5.	80-89	14	11.7	95.8
6.	>89	5	4.2	100.0



**Fig-1 Mean Achievement Motivation**

#### Score

#### Statistics:

Mean= 68.38

S.D= 9.83

Median=68.00

Skewness = -.033

Range = 55

Mode = 67.00

It is evident from the table-3 that the mean Achievement Motivation score of the sample was 68.38 (S.D=9.83). This shows that majority of students (69.2%) are average in Achievement

motivation. The result is similar to the previous research finding of Maheswari and Aruna (2016), Suvidha and Divya (2019).

**ACHIEVEMENT MOTIVATION OF HIGH SCHOOL STUDENTS BASED ON SELECTED STUDENT VARIABLES**

The student variables of the study were gender, age, birth order and grade of study and local of the school. The null hypothesis framed was, “sample students did not differ significantly in their Achievement Motivation score according to student variables”. To test the above hypothesis, t-test and f-test were conducted.

**Gender wise Distribution of Achievement Motivation Score of the Sample**

The studies conducted by Naik, A. (2021), Maheswari and Aruna (2016) reported that there was significant gender difference in level in achievement motivation. In this study the table no. 4 show the relationship between gender differences in Achievement Motivation score of the selected students.

**Table .4 Gender wise Distribution of Achievement Motivation Score and t- value.**

S. No.	Gender	Achievement Motivation score		t-value
		Mean	S.D	
1.	Boys (n=60)	65.75	8.99	3.033** P<0.003
2.	Girls (n=60)	71.01	10.00	

It is evident from the table 4 that the mean achievement score of girls was significantly higher than boys (p value< 0.003). The finding of this study is similar to the findings of previous of that the achievement motivation of girls is significantly higher than boys (Rana and Sharma 2019; Suvidha and Divya 2019). In contrary with this finding, many previous studies found that that the achievement motivation of boys was significantly higher than girls (Naik, A. 2021; Sujata Barot and Shradhha Rai, 2020; Sangeetha Pauer 2016).

**Age wise Distribution of Achievement Motivation Scores of the Sample**

The age differences in Achievement Motivation score of the selected students is shown in table. 5

**Table .5 Distributions of Achievement Motivation Scores based on their age.**

S. No.	Age	Achievement Motivation score		f-value
		Mean	SD	
1.	12 year (n=19)	66.76	8.76	2.146* P<0.05
2.	13 year (n=48)	69.64	9.50	
3.	14 year (n=34)	71.89	10.15	
4.	Above 15 year (n=19)	71.89	8.76	

It is clear from the above table that there was significant difference in the achievement motivation scale of sample students according to their age. The f-value is 2.146 was found to be significant at 0.05 level. As the age increased, the motivation of the student to achieve also improved.

**Distributions of Achievement Motivation Score of the Sample based on birth order**

The distribution of achievement motivation score based birth order was shown in table. 6

**Table.6 Distributions of Achievement Motivation Score of the Sample based on Birth Order**

S. No.	Birth order	Achievement Motivation		f-value
		Mean	S.D	
1.	Firth child (n=63)	69.68	8.24	1.433 @ P<0.243
2.	Second child (n=44)	66.43	9.91	
3.	Third child and above (n=13)	68.69	15.25	

It can be observed from the above table that there was no significant difference in the achievement motivation score of the sample students according to birth order (f-value, P<0.243). The mean achievement motivation score of first born was comparatively high followed by third and second born.

**Distributions of Achievement Motivation Score of the Sample based on Grade of Study**

The distribution of achievement motivation score based on grade of study was shown in table .7.

**Table -7 Distributions of Achievement Motivation Score of the Sample based on Grade of Study and f- Value**

S. No	Grade of study	Achievement Motivation score		f-value
		Mean	S.D	
1.	7 <sup>th</sup> class (n=41)	69.12	9.34	2.882* P<0.060
2.	8 <sup>th</sup> class (n=39)	65.50	9.05	
3.	9 <sup>th</sup> class (n=40)	70.56	10.57	

It is evident from table -7 that there was significant difference in the achievement motivation score of sample students according to grade of study. The f-value was 2.882\* (P<0.060). The mean academic achievement motivation score of 9<sup>th</sup> class student is significantly higher than 7<sup>th</sup> and 8<sup>th</sup> class students.

**ACHIEVEMENT MOTIVATION OF HIGH SCHOOL STUDENTS BASED ON SELECTED FAMILY VARIABLES**

Various family variables selected in this study are Types of family, annual family income of the family, Educational level of father and mother, Occupation of father and mother. The hypothesis framed was “sample student did not differ significantly in their achievement Motivation score according to family variables”. To test the above hypothesis f-test was conducted.

**Distributions of Achievement Motivation Score of the Sample based on Type of Family**

The relationship between type of family and achievement motivation score was shown in table no.8

**Table –8 Achievement Motivation Score of the Sample According to Type of Family and t-Value**

S. No.	Type of family	Achievement Motivation score		f-value
		Mean	S.D	
1.	Single parent family (n=22)	68.20	7.56	3.159* P<0.046
2.	Nuclear (n=74)	64.95	10.4	
3.	Joint Family (n=24)	72.08	8.86	

It is known from table - 8 that there was significant difference in the achievement Motivation score of sample students according type family. The f-value was 3.189, significant at 0.05 levels. The mean achievement motivation score of sample students from joint families (Mean = 72.08) as higher than those from nuclear and single parent families students. The above findings are similar to the findings of Muthaiyan (2021) that the mean achievement motivation score of students from joint family is significantly higher than student from nuclear family.

**Distributions of Achievement Motivation Score of the Sample based on Annual income of the Family**

The distribution of Achievement motivation score based on Annual Income is shown in table.9.

**Table .9 Achievement Motivation Score of the Sample based on Annual Income of the Family and f-Value**

S. No.	Annual Income (Rs.)	Achievement Motivation score		f-value
		Mean	S.D	
1.	<60,000/- (n=6)	76.5	15.82	2.945* P<0.036
2.	60,000 to 120,000/- (n=22)	69.54	11.21	
3.	Above 120,000/- (n=92)	67.46	9.22	

It is clear from the table.9 that there was significant difference in the achievement motivation score of students according to their annual family income and f-value was 2.945, significant at 0.05 levels. The mean achievement motivation score of students from lower family income is higher than middle- and higher-income families. It might be the reason that students from low family income desire to achieve better to come out of the cycle of the poverty.

**Distributions of Achievement Motivation Score of the Sample based on Educational level of Father**

Parental education and encouragement were found to contribute to the cognitive development and academic achievement of adolescents of the students (Francisco, 2007). The distribution of achievement motivation score based on Educational level of Father was shown in table no.10.

**Table.10 Achievement Motivation Scale of the Sample Based on Educational level of Father and f- Value**

S. No	Father's education	Achievement Motivation score		f-value
		Mean	S.D	
1.	Illiterate (n=5)	63.00	6.96	0.941@ P<0.423
2.	5 <sup>th</sup> -10 <sup>th</sup> class (n=74)	67.86	9.66	
3.	Inter-degree (n=35)	70.11	10.39	
4.	PG and above (n=6)	69.16	10.49	

It is evident from table.10 that there was no significant difference achievement score of sample students according to their father's educational qualification. The mean achievement motivation score of students whose father education level is up to inter and degree is higher, followed by Post graduation, 5<sup>th</sup> -10<sup>th</sup> class and illiterate. Though finding is not significant but it clearly indicates that educational level of father is determining factor of achievement motivation.

**Distributions of Achievement Motivation Score of the Sample based on Educational level of Mother**

The achievement motivation score based on Educational level of Mother shown in table. 11.

**Table 11 Educational level of Mother**

S. No	Mother's education	Achievement Motivation score		f-value
		Mean	S.D	
1.	Illiterate(n=6)	69.00	16.26	0.226@ P<0.878
2.	5 <sup>th</sup> -10 <sup>th</sup> class (n=85)	68.37	9.87	
3.	Inter-degree (n=25)	67.68	8.74	
4.	PG and above (n=4)	72.00	5.71	

It is clear from table.11 that there was no significant difference the achievement motivation score of sample students according to mother's educational qualification. The student's mothers whose educational qualification was PG and above scored high mean achievement motivation score when compared to mothers of less educational qualification.

**Distributions of Achievement Motivation Score of the Sample based on Occupation of Father**

The distribution of achievement motivation score based on Occupation of the Father was shown in table.12.

**Table.12 Achievement Motivation Score of the Sample Based on Occupation of father.**

S. No.	Father's Occupation	Achievement Motivation score		f-value
		Mean	S.D	
1.	Daily labour (n=40)	69.87	10.75	1.936 @ P<0.109
2.	Private Employee (n=12)	68.75	5.92	
3.	Government Employee (n=13)	72.84	10.51	

4.	Business (n=16)	64.00	8.27	
5.	Any Others (n=39)	67.05	9.63	

It can be observed the from table. 12 that there was no significant difference in the achievement motivation score of sample students according to their father’s occupation. The f-value was 1.936 which was not significant. From table.12 it is evident that comparatively, students who were children of Government employees have more achievement Motivation score than those students whose fathers were having other occupation like daily labour, business etc.

**Distributions of Achievement Motivation Score of the Sample based on Occupation of Mother.**

The distribution of Achievement Motivation Score of the Sample Based on Occupation of Mother and f- value was shown in table.13

**Table.13 Achievement Motivation score based on Occupation of the mother**

S. No.	Variables	Achievement Motivation Score		f-value
		Mean	S.D	
1.	Daily labour (n=17)	70.58	1.87	0.623@ P<0.647
2.	Private employee (n=11)	69.81	7.49	
3.	Government Employee (n=12)	65.66	10.81	
4.	Business (n=3)	64.33	12.09	
5.	House wife (n=77)	68.27	9.5	

It is evident from table -13 there was no significant difference in the achievement motivation score of sample students according to their mother’s occupation. The f-value (0.623) was not significant. The mean achievement motivation score of students who were children of daily labour is higher than achievement motivation score of students whose mothers were in other occupation like government and private employee, business, housewife.

**CONCLUSIONS AND IMPLICATIONS OF THE STUDY**

Achievement motivation refers to the drive or desire to accomplish tasks, achieve goals, and strive for success. It plays a significant role in the life of high school students to enhance their skills, acquire new knowledge, and continuously improve them to accomplish various challenges. The finding of the study indicated that the achievement motivation of the majority of the students is average. There is a significant age, gender, grades of study difference on the achievement motivation of the students. The achievement motivation of the students is improving with growing age and higher grades. In comparison to boy’s achievement motivation of girls is significantly higher. Among family variables there is significant difference in types of family, and family income on the achievement motivation of the students. The achievement motivation of students from joint family is higher than nuclear and single parent families. The achievement motivation of low family income students is higher in comparison to middle- and high-income families.



From these major findings, it can be inferred parent and family play very important role in developing achievement motivation among students. As high school is a crucial stage in life, awareness can be created among parents, teachers and policy makers to help students to overcome their limitations to achieve better. Students with low achievement motivation can be identified and appropriate intervention programmes can be planned by teachers with the involvement of parents and family members.

### **LIMITATIONS AND SUGGESTIONS FOR FURTHER RESEARCH**

This study is limited to only 120 students studying in high school in and around Tirupati, Andhra Pradesh. Similar studies can be taken up with large samples with different educational levels to understand the development of achievement motivation among children. The findings of the present study emphasized the role of parent and immediate environment, indicating future directions for epidemiological research to identify trends and correlates of achievement motivation among children.

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## PERSONAL VALUES OF LATE ADOLESCENTS IN ASSOCIATION TO THEIR ADJUSTMENT: A STUDY IN MEERUT CITY, UTTAR PRADESH

**Dr. Aqsa Habib Khan**

Assistant Professor,

Human Development,

Meerut city, Uttar Pradesh, India

[draqsahabibkhan@gmail.com](mailto:draqsahabibkhan@gmail.com), [aqsa.khan.aqsa@gmail.com](mailto:aqsa.khan.aqsa@gmail.com)

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### ABSTRACT

The present study is an attempt by the investigator to find the association between personal values and the adjustment of late adolescents. The investigation comprised a total sample of 550 undergraduate late adolescents aged 17-19 on the basis of a purposive random sampling technique selected from various colleges and universities situated in Meerut city, Uttar Pradesh, by applying psychological inventories, personal values, and adjustment. To analyze the association between two variables - personal values and adjustment- correlation coefficients were computed using "SPSS Statistics 29.0." A study conjointly revealed that personal value and its dimensions - social value, democratic value, aesthetic value, economic value, and hedonistic value - have no significant correlation with adjustment and its dimensions - home adjustment, health adjustment, social adjustment, emotional adjustment, and educational adjustment. A study pointed out that religious value, followed by power value, has a significant negative correlation with health adjustment. The study remarkably investigates the facts that knowledge value has a significant positive correlation with educational adjustments. Further investigation emphasizes that family value has a positive correlation with general adjustment. The study indicates that health value has a positive correlation with general adjustment, and educational adjustment. Study also claims that an increase in religious value and power value will decrease the health adjustment of adolescents.

**Keywords:** Adolescents, Adjustment, Personal values

### INTRODUCTION

Adolescence in developmental psychology is the new transition phase that ascends with crises and dilemmas and marked as well awakened in later life. Late adolescents refer to the socially active stage as it is one of the time periods where the adolescents are more influenced by their peer group and largely feel psychologically liberated from their parents, as their move to adulthood is just about to complete.

Eduard Spranger, a German Psychologist, outlines the term "adolescence" as the process of rebirth to reach maturity and develop physiological, physiological, and emotional maturity leads to a new beginning in the human life cycle.

Late adolescence refers to the period of discovery and disorientation; many changes occur as they grow and develop at this age. They get easily affected by the world around them and face a lot of challenges to interact and adjust in the social context. In reference to the stage of adolescence, famous psychologist Charles Darwin emphasizes that it is the most sensitive and peak emotional phase of life where adolescents need to be adjusted and adapt to the rapid changes in every aspect of life in the line: physical, social, emotional, cognitive, moral, and environmental to look mature and grow to their fullest.

Personal values are considered to be the person's beliefs, which reflect the actions and reactions in their life. Morris Massey; emphasis on adolescents human values and characterizes as imprinting, modeling, and socializing periods in the life of adolescence.

Adjustment in the life of late adolescence: as they transition from school life to a new career path called college life, they experience a lot more adjustment challenges along with parents expectations of them in various fields, i.e., academic achievement, communication, settling with peer groups, vocational interest, new social interest, changing habits. Late adolescence is a peer-oriented stage where conflicts occur between parents and peer views; create disagreement between parents and offspring, show mood swings and irritating behavior, etc. Well-founded and affectionate parenting helps the adolescent tackle difficult paths and well-adjust in presenting new concepts that acquire firm relationships and success in life.

(Behera and Samal, 2018) emphasized the link between personal value and adjustment. It was found that personal value dimensions, *i.e.*, religious, social, democratic, aesthetic, economic, knowledge, family, and health, are positively correlated with adjustment, although hedonistic and power are negatively related to adjustment. (Kemjika, 2017) investigated whether there is a positive relationship between family conflict, values, and school adjustment. (Behera and Samal, 2018) suggested that hedonistic value has no significant and low correlation with adjustment and its dimensions. The study also supports that religious value, family value, followed by health value, have a correlation with adjustments and their dimensions. (Ramaprabou and Johnson, 2014) concluded that adolescence belongs to highly communicative families shows better adjustments; therefore, strong family value in adolescence leads to a positive adjustment pattern in life.

## **OBJECTIVE**

- To find out the association between personal values and adjustment of adolescents.

## **HYPOTHESIS**

- There is no significant association between the personal values and adjustment of adolescents.

## **METHODOLOGY**

### **Sampling Technique**

Purposive random sampling technique comprised a total sample of 550 undergraduate late adolescents aged 17-19 years selected from various colleges and universities situated in Meerut, Uttar Pradesh.

**Tools**

Data collection was conducted by applying the psychological test: personal values constructed by Dr. G.P. Sherry, Prof. R.P. Verma, and the adjustment inventory for college students constructed by A.K.P. Sinha and R.P. Singh.

**Statistical Analysis**

Correlations were used to test the relationship between the two variables - personal values and adjustment by using Excel and IBM “SPSS Statistics 29.0.”

**RESULT AND DISCUSSION**

**Table-1: Relationship between personal value and adjustment of adolescents**

Variable	Adjustment	Home Adjustment	Health Adjustment	Social Adjustment	Emotional Adjustment	Educational Adjustment
Personal Value	0	-0.056	0.007	0.048	0.018	-0.023
Religious Value	0.079	0.076	.101*	-0.009	0.062	0.062
Social Value	-0.042	-0.041	-0.05	-0.033	-0.014	-0.028
Democratic Value	-0.037	-0.083	-0.081	0.05	-0.009	-0.027
Aesthetic Value	-0.006	-0.047	0.033	0.041	-0.006	-0.032
Economic Value	0.023	-0.004	-0.039	0.046	0.029	0.036
Knowledge Value	-0.047	-0.047	-0.074	0.018	0.003	-.086*
Hedonistic Value	0.034	0.013	0.052	0.009	0.035	0.016
Power Value	-0.024	0.004	.136**	-0.034	-0.051	0.011
Family Value	-.089*	0.041	-0.058	0.03	0.052	0.078
Health Value	-.090*	-0.065	-0.006	0.001	-0.074	-.116**

Correlation for entire sample (N= 550) with personal value and Adjustment

\* Correlation is significant at the 0.05 level (2-tailed) \*\* Correlation is significant at the 0.01 level (2-tailed)

Note: The high scores of adjustment indicate poor adjustment or maladjustment. So, interpreting adjustment score with variables in this investigation, negative relationship will indicate positive association with the variable. Positive relationship would give negative association)

The present study shows the correlation coefficient of the total and dimension-wise scores for personal values and adjustment of adolescents. The study indicates that personal value and adjustment ( $r = 0$ ) clearly imply no correlation between the two variables being compared. Therefore, if one value increases, there is no tendency for the other value to change in any specific direction, either increase or decrease. The study indicates the correlation coefficient between personal value and home adjustment reflects an almost negligible and negative correlation ( $r = -0.056$ ), which is positive but not significant at the 0.05 level. Further study reveals that the coefficient between personal value and health adjustment ( $r = 0.007$ ) is not significant at the 0.05 level. The study sought a correlation between personal value and social adjustment ( $r = 0.048$ ), which is not significant at the 0.05 level. Therefore, the study indicates that there is no significant relationship between personal value and social adjustment. A study suggests another correlation between personal value and emotional adjustment ( $r = 0.018$ ) is found to be no significant at the 0.05 level. The study also emphasizes that the correlation between personal value and educational adjustment ( $r = -0.023$ ) is positive, but it implies no significant at the 0.05 level, therefore there is no association between the two compared variables.

The investigation emphasizes that the correlation between religious value and adjustment ( $r = 0.079$ ) is negative and not found to be significant at the 0.05 level. Therefore, religious value and adjustment have no significant association. Further study emphasizes that the correlation between religious value and home adjustment ( $r = 0.076$ ) is negative and not significant at the 0.05 level. The study suggests that the correlation between religious value and health adjustment ( $r = -0.101^*$ ) indicates a very high but negative association between the compared variables of religious value and health adjustment; therefore, it determines that religious value has a negative influence on health adjustment and is found to be significant at the 0.05 level. The study investigates that the correlation between religious value and social adjustment ( $r = -0.009$ ) markedly low, and there is a positive association between religious value and social adjustment; therefore, it is not significant at the 0.05 level. Further study emphasizes that the correlation between religious value and emotional adjustment ( $r = 0.062$ ) is negative and is not significant at the 0.05 level. The study emphasizes that the correlation between religious value and educational adjustment ( $r = 0.062$ ) is negative and not significant at the 0.05 level.

The study indicates the correlation coefficient between social value and adjustment reflects that social value and adjustment found an almost negligible but positive correlation ( $r = -0.042$ ), which is not found to be significant at the 0.05 level. Another correlation coefficient between social value and home adjustment ( $r = -0.041$ ) is positive, but it is not significant at the 0.05 level. Further study depicts that the correlation coefficient between social value and health adjustment ( $r = -0.05$ ) is positive, but it is not found to be significant at the 0.05 level. The study seeks a correlation coefficient between social value and health adjustment ( $r = -0.033$ ), which indicates a negligible but positive correlation and is not found to be significant at the 0.05 level. The correlation coefficient between social value and emotional adjustment ( $r = -0.014$ ) is positive, but it is not significant at the 0.05 level. The present study depicts that the correlation coefficient between social value and educational adjustment ( $r = -0.028$ ) is positive but not significant at the 0.05 level.

Further research indicates the correlation coefficient between democratic value and adjustment ( $r = -0.037$ ) is negligible but positive, and it is not found to be significant at the 0.05 level. The study seeks a correlation between democratic value and home adjustment ( $r = -0.083$ ) that is positive but negligible, and it is not found to be significant at the 0.05 level. This indicates that there is no

significant association between democratic value and home adjustment. The correlation between democratic value and health adjustment ( $r = -0.081$ ) is positive, but it is not found to be significant at the 0.05 level. The study depicts that the correlation coefficient between democratic value and social adjustment ( $r = 0.05$ ) is almost negligible and negative, but it is not found to be significant at the 0.05 level. Investigation suggests the correlation coefficient between democratic value and emotional adjustment ( $r = -0.009$ ) is positive, but it is not found to be significant at 0.05 level. Research finds that the correlation coefficient between democratic value and educational adjustment ( $r = -0.027$ ) is markedly low but positive, and it is not found to be significant at the 0.05 level.

As the study proceeds, the correlation between aesthetic value and adjustment indicates ( $r = -0.006$ ) a markedly low but positive correlation, and it is not significant at the 0.05 level. Therefore, the study indicates that there is no significant association between aesthetic value and adjustment. Study shows the correlation coefficient between aesthetic value and home adjustment ( $r = -0.047$ ) is markedly low-positive and not significant at the 0.05 level. Further study suggests the correlation coefficient between aesthetic value and health adjustment ( $r = 0.033$ ) implies a weak and negative association between aesthetic value and health adjustment; therefore, it is not significant at the 0.05 level. Another correlation coefficient between aesthetic value and social adjustment ( $r = 0.041$ ) has a negative low and is not significant at the 0.05 level. The correlation coefficient between aesthetic value and emotional adjustment ( $r = -0.006$ ) showed a markedly low and positive association between the two compared variables. Therefore, it is not significant at the 0.05 level. The study depicts the correlation coefficient between aesthetic value and educational adjustment ( $r = -0.032$ ), a markedly low and positive relationship between the two compared variables. Therefore, it is not significant at the 0.05 level.

Investigation shows the correlation between economic value and adjustment indicates ( $r = 0.023$ ) a markedly low negative correlation, and it is not significant at the 0.05 level. Therefore, the study indicates that there is no significant association between economic value and adjustment. The data representing the correlation between economic value and home adjustment indicates that ( $r = -0.004$ ) is markedly low and positive, but it is not found to be significant at the 0.05 level. Therefore, the study indicates that there is no significant association between economic value and home adjustment. The study reflects another correlation between economic value and health adjustment indicates ( $r = -0.039$ ), which is low and positive, but not significant at the 0.05 level. Therefore, the study indicates that there is no significant association between economic value and health adjustment. Further investigation suggests that correlation between economic value and social adjustment indicates ( $r = 0.046$ ) is low-negative and is not significant at the 0.05 level. Therefore, the study indicates that there is no significant association between economic value and social adjustment. The correlation between economic value and emotional adjustment ( $r = 0.029$ ) implies a low negative association, and it is not significant at the 0.05 level. Therefore, the study indicates that there is no significant association between economic value and emotional adjustment. The study depicts the correlation coefficient between economic value and educational adjustment ( $r = 0.036$ ), which is markedly low. There is a negative association between the two compared variables and it is not significant at the 0.05 level.

The study seeks a correlation between knowledge value and adjustment ( $r = -0.047$ ), which is positive low but not significant at the 0.05 level. This indicates that there is no significant

association between knowledge value and adjustment. The present data depicts the correlation coefficient between knowledge value and home adjustment ( $r = -0.047$ ), which represents low positive association but is not found to be significant at the 0.05 level. Data shows the correlation coefficient between knowledge value and health adjustment ( $r = -0.074$ ) is markedly low positive and is not found significant at the 0.05 level therefore there is no association between the two compared variables. The investigation suggests the correlation coefficient between knowledge value and social adjustment ( $r = 0.018$ ) is negative low and not found significant at the 0.05 level therefore, there is no association between the two compared variables. Further study investigates that the correlation coefficient between knowledge value and emotional adjustment ( $r = 0.003$ ) reflects that knowledge value and emotional adjustment were found to be almost negligible and negative, and was not found significant at the 0.05 level therefore, there is no association between the two compared variables. The study proceeds with the correlation between knowledge value and educational adjustment ( $r = -.086^*$ ) suggest a high and positive association between knowledge value and educational adjustment; therefore, it is determined that a positive association between two compared variables reflects the increase in one variable, and the other variable increases as well. So, high knowledge value promotes high educational adjustment, and it is found to be significant at the 0.05 level.

The data shows a correlation between hedonistic value and adjustment ( $r = 0.034$ ), implies a low but negative correlation between hedonistic value and adjustment. It may be supposed that adolescents with more hedonistic value are low adoptable persons. Therefore, it is not found to be significant at the 0.05 level. The result suggests that the correlation between hedonistic value and home adjustment ( $r = 0.013$ ) indicates a low and negative correlation between the two compared variables, hedonistic value and adjustment. Thus, it is not found to be significant at the 0.05 level. The study sought a correlation between hedonistic value and health adjustment ( $r = 0.052$ ) is low-negative and not significant at the 0.05 level. Therefore, the study indicates that there is no significant association between hedonistic value and health adjustment. The present data depicts that the correlation coefficient between hedonistic value and social adjustment ( $r = 0.009$ ) is negative and low, indicating that it was not found to be significant at the 0.05 level. Another correlation coefficient between hedonistic value and emotional adjustment ( $r = 0.035$ ) is low-negative, and it is not found to be significant at 0.05 level. Data reveal the correlation coefficient between hedonistic value and educational adjustment ( $r = 0.016$ ) is negative low and it is not found to be significant at the 0.05 level.

Further research investigates that the correlation coefficient between power value and adjustment ( $r = -0.024$ ) reflects that power value and adjustment found almost negligible but positive association, and it was not found significant at the 0.05 level, therefore there is no correlation between the two compared variables. The study depicts the correlation coefficient between power value and home adjustment ( $r = 0.004$ ) as a markedly low negative association between the two compared variables, but it is not significant at the 0.05 level. The correlation between power value and health adjustment ( $r = .136^{**}$ ) implies a very high negative correlation between the two compared variables. It specifies that with the increase in power value, health adjustment will decrease, but it is found to be significant at the 0.01 level. Further data suggests that the correlation between power value and social adjustment ( $r = -0.034$ ) seeks a positive correlation between the power value and social adjustment and is not significant at the 0.05 level. Data suggest a correlation between the power value and emotional adjustment ( $r = -0.051$ ). It shows positive relationship between the



compared variables, but it is not found to be significant at the 0.05 level. The result shows the correlation between the power value and educational adjustment ( $r = 0.011$ ) it shows a low negative relation between the compared variables and it is not found to be significant at the 0.05 level.

The investigation seeks to determine the correlation between family value and adjustment ( $r = -.089^*$ ), which implies a high positive correlation between the compared variables and is significant at the 0.05 level. Thus, the study indicates that adolescents with high family value were strong in adjustment. From the above data, it appears that the correlation coefficient between family value and home adjustment ( $r = 0.041$ ) is not found to be significant at the 0.05 level. A study suggests the correlation coefficient between family value and health adjustment reveals a positive ( $r = -0.058$ ) association between family value and health adjustment, but it is not found to be significant at the 0.05 level. The data sought through the correlation coefficient between family value, and social adjustment reveals that ( $r = 0.03$ ) a markedly low and negative association between compared two variables family value and social adjustment; therefore, it is not found to be significant at the 0.05 level. Another correlation coefficient between family value and emotional adjustment reveals that ( $r = 0.052$ ) markedly low negative, and it is not found significant at the 0.05 level. The study depicts the correlation coefficient between family value and educational adjustment ( $r = 0.078$ ), which is not significant at the 0.05 level.

Further study proceeds the correlation between health value and adjustment indicates ( $r = -.090^*$ ) that it found a very high and positive correlation, and it is significant at the 0.05 level. Therefore, the study indicates that there is significant correlation between health value and adjustment. It may be said that adolescents with high health value have more adoptable individuals in their lives. The correlation between health value and home adjustment indicates ( $r = -0.065$ ) is low-positive, and it is not found to be significant at the 0.05 level. Further study reveals the correlation between health value and health adjustment indicates ( $r = -0.006$ ) reflect the almost negligible and positive association; therefore, an increase in health value directs the increase in health adjustment, but it is not found to be significant at the 0.05 level. The study seeks a correlation between health value and social adjustment ( $r = 0.001$ ), but it is not found to be significant at the 0.05 level. This indicates that there is no significant association between health value and social adjustment. The present data depicts the correlation coefficient between health value and emotional adjustment ( $r = -0.074$ ), a markedly low but positive correlation between the two compared variables, and it is not found to be significant at the 0.05 level. The study emphasizes that the correlation between health value and educational adjustment ( $r = -.116^{**}$ ) shows a very high positive correlation between the two compared variables. It also determines that health value promotes better educational adjustment. Therefore, it is stated that there is a high positive correlation between health value and educational adjustment, and it is significant at the 0.01 level. Thus, hypotheses, i.e., that there is no significant association between the personal value and adjustment of adolescents, are partially rejected.

## **CONCLUSION**

The present study seeks to investigate the personal values of late adolescents in association with adjustment. From the above investigation, it is concluded that personal value dimensions- religious value, power value, knowledge value, family value, health value, and adjustment- and their

dimensions health adjustment, educational adjustment, and general adjustment have a significant correlation. A study investigates that religious value followed by power value has a negative significant correlation with health adjustment; an increase in religious value and power value will decrease the health adjustment of adolescents. For this, spiritual and health awareness programs and counseling sessions might be followed within the educational curriculum.

Study promotes, Knowledge value has a positive significant correlation with educational adjustment. An increase in knowledge value may increase in educational adjustment. Late adolescents are the most career - oriented period in the human life span, so the attention towards theoretical approaches by various educational activities may be introduced by parents and teachers to help the adolescents discover new facts and seek knowledge.

Family value has a positive correlation with overall adjustment; therefore, an increase in adolescent family value will increase in their general adjustment. Based on the research findings, the investigator suggests that parents need to handle their offspring in a more mature and careful environment. It is important to give them space to learn and mature with their experience under parental guidance. Parental values and strong interpersonal relation between parents and offspring are a must to shape well-adjusted adolescents in every sphere of life. The study conjointly suggests that, health value has a positive correlation with overall adjustment and educational adjustment. For this, it is suggested that a healthy physique and mind promote holistic development in every stage of life. The investigator suggests that value must be imparted first at home to adolescents, and value-added programs must be framed in curriculum at both the school and college levels, along with that personal values and adjustment-based orientation sessions that must be introduced in academic activities. The investigator in the present study determined that personal value plays a vital role in the adjustment of adolescents. It is important to understand late adolescents as individual and help them grow and develop to their full potential without any peer pressure in a competitive and image-conscious society.

### **RECOMMENDATION FOR FURTHER STUDY**

Researches can be conducted on cross-cultural perspective with larger sample size and wider geographical area comprising of different cities and states.

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## IMPACT OF SMARTPHONE USAGE OF ADOLESCENTS AND YOUNG ADULTS ON THEIR SOCIAL WELLBEING

**Dr. K. Lavanya**

Lecturer in Home Science

A.S.D. Government Degree College for Women (A), Jagannaickpur, Kakinada

Affiliated to Adikavi Nannaya University, Rajamahendravaram

email: lkandiraju@gmail.com;

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### ABSTRACT

This present study investigated the relationship between smartphone usage patterns and social wellbeing among 400 adolescents and young adults (aged 16-25 years) in Kakinada, Andhra Pradesh. The findings revealed that dimensions of social wellbeing such as Social Coherence, Social Integration, and Social Acceptance were not significantly related to smartphone usage. However, negative correlation was found between Social Actualization and smartphone usage patterns. Similarly, Social Contribution showed a strong negative correlation with total smartphone usage, with ritualistic and problematic smartphone use also predicting decreased social contribution, though not significantly. Overall, the study did not find a strong impact of smartphone usage on the total social wellbeing of adolescents and young adults. The results obtained might be due to other intervening factors and hence there is a need for further research to explore the long-term effects of smartphone use as it decreases face-to-face relationships.

**Key words:** Smartphone usage, social wellbeing, Social Coherence, Social Integration, Social Acceptance, Social Contribution Social Actualization, Adolescents, Young Adults

### INTRODUCTION

Wellbeing refers to a state of positive functioning in physical as well as psychological and social domains. Keyes defines social wellness as people's experiences and views of their social conditions as well as their level of achievement in overcoming social obstacles (Keyes & Ryff, 2002). Social wellbeing facilitates an individual to be in coherence with self and the society and is affected by both individual and environmental factors. In the contemporary digital landscape, where adolescents and young adults have strong attachment to their smartphones and considering the time they spent on their phones, it is crucial to examine their effect on their wellbeing. Previous research indicated that excessive smartphone use can negatively affect social wellbeing, with increased feelings of loneliness and social anxiety and decreased social coherence (Caplan, 2006). Studies have also suggested that positive interactions on social networking platforms enhance users' wellbeing (Valkenburg, 2006). A study by Wang et al., (2017) found that higher smartphone usage was associated with decreased social well-being over time. Specifically, increased time spent on social media platforms was linked to lower levels of social connectedness and higher levels of perceived social isolation. Smartphones provide access to a vast virtual world for the younger generation and

can either positively or negatively impact social wellbeing. The present study is an attempt to understand how smartphone usage affects social wellbeing as there is dearth in studies with respect to social wellbeing and smartphone usage.

### OBJECTIVES

1. To research how teenagers and young adults use smartphones
2. To look at the connection between young adults' and adolescents' social wellness and their use of smartphones

### HYPOTHESIS

No relationship exists between smartphone usage and social wellbeing of adolescents and young adults.

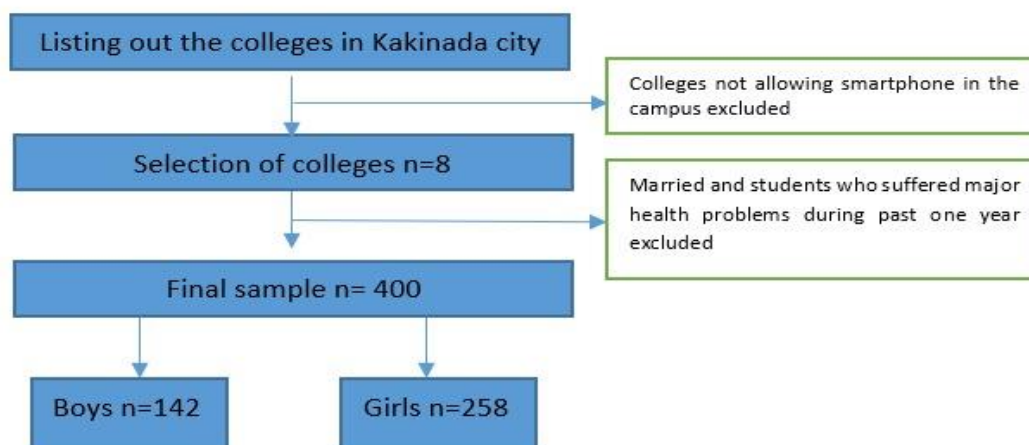
### METHODOLOGY

**Research design:** Correlational research design is used to study the relationship between smartphone usage of adolescents, young adults and social wellbeing.

**Location of the study:** The study is conducted in Kakinada, a centre for educational institutions serving students from villages and towns around. Kakinada is well-known for its seaport, Jamdani Uppada silk sarees, and the well-known sweet Kaja.

**Sample:** Purposive sampling was used to choose adolescents and young adults from intermediate, vocational, undergraduate, and postgraduate colleges.

Flow chart for Sample selection



### Research tools:

1. A general survey questionnaire to study the demographic factors.
2. The researcher developed a 42-item Smartphone Usage Questionnaire to examine smartphone usage patterns based on Katz, Blumler, and Gurevitch Uses and Gratification theory from 1974. The questionnaire assesses three types of use: ritualistic (involving stereotypical behaviour without any significance attached), instrumental (involving goal-

directed and purposeful behaviour) and problematic (involving excessive time and money spent on a smartphone, obsession with it, and use in situations that are socially and physically inappropriate). In order to examine the overuse smartphone usage, the investigator has added problematic use.

3. Keyes Social Wellbeing Scale (15 item) (Keyes, 1998)

**Statistical tools:**

Means, Pearson’s Correlation Coefficient and Multiple Regression Analysis

**FINDINGS AND DISCUSSION**

**Table 1: Demographic profile of the respondents:**

Variable	Category	Frequency (n=400)	Percentage
Age	16-20 years	209	52%
	21-25 years	191	48%
Gender	Male	142	34%
	Female	258	66%
Number of Siblings	0-1	239	57%
	2 or more	173	43%
Type of Family	Nuclear	338	82%
	Joint/Extended	74	18%
Mother’s Education	Illiterate/Schooling	354	86%
	College/Graduation/PG	58	14%
Father’s Education	Illiterate/Schooling	268	66%
	College/Graduation/PG	132	34%
Family Income	Less than 1 Lakh	276	69%
	1-7 Lakhs	108	27
	7 Lakhs and above	16	4%

The results from table 1 indicate that 52% (209) of the sample, are between the ages of 16 and 20. Those between the ages of 21 and 25 make up 48% (191). Females constitute 66% (258), whereas males 34% (142) providing an understanding about gender specific smartphone usage and its effect. Majority of participants (57%) stated they had either one or no siblings, while 43% said they had

two or more siblings. This data helps in studying the social interactions, potentially impacting social wellbeing. While (82%) come from nuclear families, joint or extended families constitute 18%. The respondents' socialization patterns may be impacted by the prevalence of nuclear households. A significant proportion of both mothers (86%) and fathers (66%) have low educational levels. When it comes to family income, the vast majority of respondents (69%) are from households with yearly income under one lakh. Out of the total sample, 27% had an income between 1 and 7 lakhs, while only 4% have an income of 7 lakhs or more.

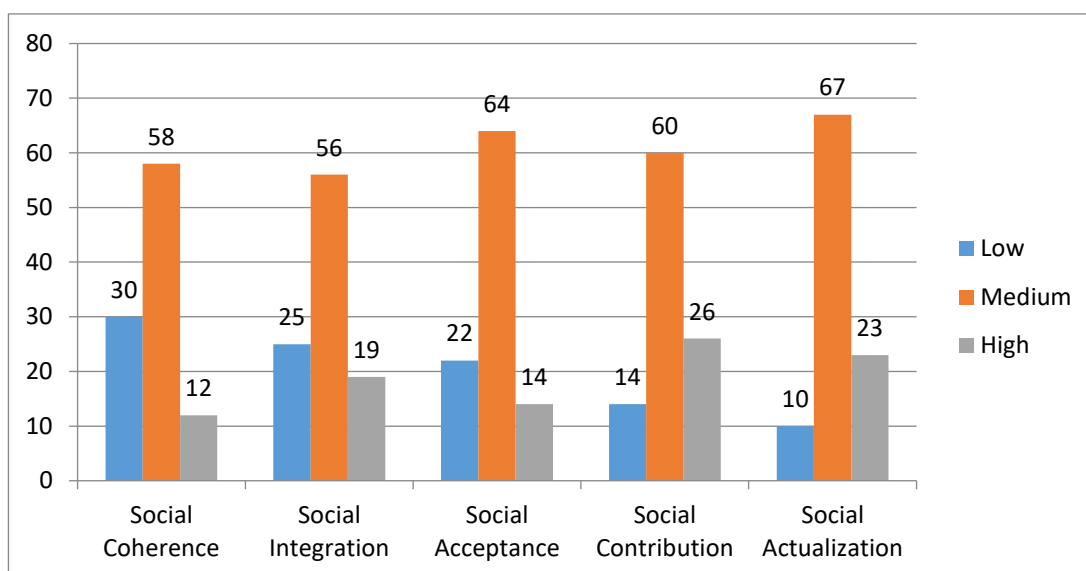
### Relationship between smartphone usage and social wellbeing of adolescents and young adults

Relating oneself positively to the family, neighbourhood and community is very crucial for sound social wellbeing. In the present study, social wellbeing in relation to smartphone usage was investigated taking the multidimensional model of Keyes Social Wellbeing. Keyes Social Wellbeing Scale was used for collecting the data. The results are tabulated in Table 2.

**Table 2. Social wellbeing of adolescents and young adults**

Dimensions of Social Wellbeing	Girls		Boys		Total	
	n	%	n	%	n	%
<b>Social Coherence</b>						
Low(3-6)	79	31	43	30	122	30
Medium(7-11)	145	56	86	61	231	58
High(12-15)	34	13	13	9	47	12
Mean Scores	8.64		8.57		8.62	
<b>Social Integration</b>						
Low(3-6)	59	23	42	30	101	25
Medium(7-11)	141	55	82	58	223	56
High(12-15)	58	22	18	12	76	19
Mean Scores	9.63		8.87		9.36	
<b>Social Acceptance</b>						
Low(3-6)	71	27	17	12	88	22
Medium(7-11)	147	57	109	77	256	64
High(12-15)	40	16	16	11	56	14
Mean Scores	9.06		8.94		9.02	
<b>Social Contribution</b>						
Low(3-6)	34	13	22	16	56	14
Medium(7-11)	149	58	93	65	242	60
High(12-15)	75	29	27	19	102	26
Mean Scores	9.70		9.14		9.50	

Social Actualization						
Low(3-6)	20	8	21	15	41	10
Medium(7-11)	177	68	90	63	267	67
High(12-15)	61	24	31	22	92	23
Mean Scores	9.94		9.37		9.74	
Total Social Wellbeing						
Low(15-34)	15	6	13	9	28	7
Medium(35-55)	207	80	120	86	327	82
High(56-75)	36	14	9	6	45	11
Mean Scores	46.98		44.72		46.25	



**Figure 1. Social wellbeing of adolescents and young adults**

Table 2 and Figure 1 indicates the that nearly 30 percent of both girls and boys had low social coherence, 13% girls and 9% boys had high Social Coherence and 56 percent and 61 percent of the boys had medium social coherence respectively. This indicates that very few were capable of accepting the unpredictable events in life. Mean scores indicate that there was not much difference between boys and girls.

On Social Integration, 23 percent of the girls and 30 percent of the boys had low scores. Nearly 50 percent of both girls and boys had medium levels of Social Integration and 22 percent of the girls and 12 percent of the boys had high social integration.

It was found that 27 percent of the girls and 12 percent of the boys had low social acceptance and 57 percent of girls and 77 percent of boys had medium level of self-acceptance and 16 percent and 11 percent had high social acceptance. Mean scores of girls (9.06) were higher compared to boys (8.94) showing higher social acceptance.



On social contribution, 13 percent of girls and 16 percent of boys had low scores while 29 percent of the girls and 19 percent of the boys had high scores. Mean scores of girls were higher compared to boys.

Only 8 percent of the girls and 15 percent of the boys had low social actualization and majority of them were in the medium range. 24 percent of girls and 22 percent of boys had high social Actualization. Mean scores indicate that there was no difference between the boys and girls.

Regarding total Social Wellbeing, majority of the girls (80%) and boys (86%) were in medium range while 6 percent of girls and 9 percent of boys had low social wellbeing and 14 percent of the girls and 6 percent of the boys were found to be having higher levels of social wellbeing. Mean scores indicate that girls (46.98) had higher social wellbeing compared to boys (44.72). Majority of boys and girls were in the medium range pertaining to all the dimensions of social wellbeing. These findings can be supported by the findings of Ahn (2011) that social networking sites provide a platform to express their identity and they learn social development skills through social networking sites. Wang et al., (2014) also found that participants who used social networking for social communication reported high levels of wellbeing than those who used less frequently. Brown et al., (2023) also reported that smartphone usage enhanced social cohesion, but excessive use had a negative impact reducing real time social engagement.

To understand whether long term smartphone use, and the purpose of use affects social wellbeing, Pearson correlation coefficients are calculated, and the results are presented in table 3.

**Table 3. Relationship between smartphone usage and social wellbeing of adolescents and young adults**

		Social Coherence	Social Integration	Social Acceptance	Social Contribution	Social Actualization	Total Social Wellbeing
Instrumental Usage	R value	.039	.065	.053	-.072	-.120	-.012
	P Value	.438	.193	.290	.153	.017*	.808
Ritualistic Usage	R value	.004	.037	-.017	-.117	-.169	-.088
	P Value	.931	.462	.735	.019*	.001**	.078
Problematic Usage	R value	.001	.008	.007	-.117	-.161	-.089
	P Value	.979	.869	.891	.019*	.001**	.076

\*p<0.5 level of significance

\*\*p<0.01 level of significance

Table 3 indicates that there is statistically no significant correlation between smartphone usage and Social Coherence, Social Integration and Social Acceptance. Social Actualization was found to be negatively correlated with all smartphone behaviours i.e., Instrumental (p value 0.017), Ritualistic (p value=0.001) and problematic Use (p value=0.001) with a high level of significance. Bian & Leung (2015) reported that those who used smartphones for information seeking and sociability were high on social capital.

Social contribution was found to be having strong negative correlation with smartphone usage at 0.05 level of statistical significance and no significant correlation was found between smartphone usage

and total social wellbeing. However, Gunjan & Kumar (2019) reported a significant negative correlation between technology usage and social wellbeing. Girls were found to be more techno savvy and boys preferred more outdoor activities. Rotondi & Stanca (2017) found that smartphone use negatively affected the social interactions especially reducing the face-to-face interactions. However, Tariq (2018) found that the smartphone usage negatively affected the social wellbeing and the family interactions but significantly increased the interactions with peers and outsiders.

**Prediction of social wellbeing with smartphone use**

Social actualization and social coherence show significant negative correlation with smartphone usage patterns. Multiple regression was carried out to study the magnitude and strength of relationship between smartphone usage patterns and social wellbeing.

**Table 4: Summary of Multiple Regression Analysis Predicting Various dimensions of Social Wellbeing with Smartphone Use**

Dependent Variable	R	R Square	Adj. R Square	Std. Error of Estimate	F	Sig. (ANOVA)	B (Constant)	Instrumental	Ritualistic	Problemtic	Sig. (Coefficients)
Social Coherence	.053	.003	-.005	2.62311	0.370	.775	8.448	.025	.001	-.014	.317, .961, .526
Social Integration	.097	.009	.002	2.74887	1.244	.293	8.725	.037	.023	-.035	.162, .328, .144
Social Acceptance	.107	.011	.004	2.56315	1.533	.205	8.846	.045	-.033	.007	.070, .131, .743
Social Contribution	.147	.022	.014	2.76531	2.912	.034*	10.772	.016	-.022	-.020	.554, .364, .395
Social Actualization	.191	.036	.029	2.56663	4.971	.002*	11.416	.007	-.026	-.020	.789, .244, .374
Social Wellbeing	.142	.020	.013	7.79038	2.704	.045*	48.207	.129	-.056	-.081	.085, .400, .224

Table 4 indicates that the smartphone usage patterns have very weak relationship with almost all the dimensions of social wellbeing. Regarding social coherence, The R Square value of 0.003 shows that only 0.3% of the variance in social coherence and F value of 0.370 with a significance level (Sig.) of 0.775 indicates that smartphone usage did not predict social coherence. However a study by Kopecký et al., (2021) reported significant negative correlation between smartphone addiction and social coherence. Similarly, on social integration, weak relationship is observed ( $R^2 = 0.009$ )

and none of the predictors are found to be statistically significant. 11 percent variation in the dependent variable social acceptance could be explained by the independent variable ( $R^2 = 0.011$ ) and R value 0.107 indicated that the correlation between the observed values and predicted values by the regression model was low. Comparatively a stronger relationship was found between social contribution and smartphone usage patterns with  $R^2$  value of 0.022. However, R value 0.147 indicated that the correlation between the observed values and the predicted values was very low and ANOVA table indicates that the regression model explained the variation in the dependent variable well at 0.5 level of significance. Ritualistic Smartphone Use and Problematic Smartphone use negatively predicted the variation in the dependent variable. But the prediction was not significant. With respect to social actualization,  $R^2$  value 0.036 indicates a variation of 3.6 percent in the dependent variable. R value 0.191 indicates that the correlation between the observed values and the predicted values was very low. The ANOVA table indicates that the regression model explained the variation in the dependent variable Social Actualization well as the p value=0.02 at 0.01 level of significance. Ritualistic and Problematic Smartphone use negatively predicted the dependent variable Self Actualization, but the relationship was not significant as the p value was greater than statistical value of significance. Rotonda (2017) also reported that excessive mobile phone usage negatively impacts social actualization and social contribution. On total social wellbeing, the model shows a weak relationship ( $R^2 = 0.020$ ), at the 0.05 level ( $p = 0.045$ ). However, the individual predictors are not significant. Gao et al., (2016) also reported that no significant relationship was found between social anxiety, loneliness and their use of social networking sites. Contrary to these findings, Tariq et al., (2018) found that smartphone usage has resulted in decreased social wellbeing and family interaction while it has increased interaction with friends and also outsiders. A longitudinal study by Valkenburg and Peter in 2011 also reported that online interactions enhanced social concept but only positive and supportive interactions contributed to self-concept compared to negative online interactions.

## **SUMMARY AND CONCLUSIONS**

This study examines the complex interplay between smartphone usage and social wellbeing among adolescents and young adults in Kakinada, Andhra Pradesh. While the majority of respondents showed moderate to high levels of social wellbeing, the findings reveal certain challenges. Smartphone usage reduced face-to-face interactions; but provided opportunities for virtual connectivity with family and friends, thereby mitigating certain adverse effects on social wellbeing. But, dimensions of social contribution and social actualization were adversely impacted, both of which are important for young adults to harmonize with societal norms. In the present scenario limiting smartphone is not possible but is necessary for young individuals to prioritize and enhance both quantity and quality of face-to-face interactions to foster and sustain their social wellbeing.

## **IMPLICATIONS OF THE STUDY**

1. Awareness programmes can be designed for adolescents and young adults, parents and teachers about the negative consequences of smartphone usage and the precautions to be taken to minimize negative effect.
2. The findings of present study would help the policy makers in education sector to design online education programmes without affecting the wellbeing of the students.

### RECOMMENDATIONS FOR FUTURE RESEARCH:

1. To investigate the cause-and-effect link between smartphone usage and wellbeing, longitudinal research can be conducted.
2. Studying perceptions of teachers and parents provides a broader picture of the problem.
3. Similar study can be taken up with different age groups to study how age groups are affected by smartphone usage.

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## JUGGLING TRADITIONAL AND MODERN EXPECTATIONS IN MARRIAGE PARTNER SELECTION: EXPERIENCES OF YOUNG WOMEN IN URBAN GUJARAT

Nidhi Shah<sup>1</sup> and Shagufa Kapadia<sup>2</sup>

<sup>1</sup> PhD Scholar, <sup>2</sup> Professor Emeritus

Department of Human Development and Family Studies

Faculty of Family and Community Sciences,

The Maharaja Sayajirao University of Baroda

E-mail: <sup>1</sup>nidhi.shah-hdfs@msubaroda.ac.in, <sup>2</sup>shagufa.kapadia-hdfs@msubaroda.ac.in

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### ABSTRACT

Marriage is an indispensable event in Hindu life. It is considered a critical turning point in the family lifecycle, affecting individuals and their well-being. The process of life partner selection involves rational and emotional considerations. The present study used a phenomenological approach to gain insight into the phenomenon of marriage partner selection. The data collection approach included in-depth interviews of fifteen educated emerging adult women from Vadodara. It involved an exploration of the hopes, disappointments, fears, and anxieties that a young woman experiences in the process of partner selection in an arranged marriage in the present urban context. The results suggest that women are deeply concerned about society's patriarchal views on marriage. They addressed their fear of losing their identity after marriage. Notably, young women and their families experienced societal pressure to marry "in time". Young women have gained decision-making power and have demonstrated resilience to compromise on their expectations for the sake of getting married. Research findings contribute to a deeper understanding of the complexities surrounding marriage partner selection for young women influenced by societal expectations, personal values, and individual preferences.

**Keywords:** Arranged marriage, Decision Making, India, Partner selection, Women

### INTRODUCTION

#### The Significance and Prevalence of Marriage in India

Marriage, an essential milestone and *samskara* (a personal sacrament traditionally observed at every stage of a Hindu's life), is regarded as a part of *Dharma*, highlighting the significance of every individual's religious duty (Gupta 2023). Being an important institution, marriage impacts people's lives and well-being with majority of the middle-class Indians believing that marriage should be arranged, and lifelong (Khandpur, 2017). Furthermore, India does not have a dating culture; and a marriage arranged by individuals and parents collectively is a prevalent practice (Banerji, Martin, & Desai, 2013).

### **Changing Trends of Indian Arranged Marriage: A Shift in Partner Selection Approach**

Arranged marriage partner selection is a collective endeavour with the entire family involved in assessing the suitability of the prospective partner in India. The traditional normative pattern prevented individuals from making decisions about partner selections; however, there is now a desirability among individuals for parent-arranged marriages with a choice of individuals (Allendorf, 2013; Allendorf & Pandian, 2016; Banerji and Deshpande, 2021). A nuanced perspective has emerged that incorporates both the traditional binary of arranged marriage vs love marriage (Allendorf, 2013; Netting, 2010), known as "semi-arranged marriage", "arranged love marriage" and "marriage by choice (Kalpagam, 2008). Corradini et al. (2023) and Sharangpani (2010) highlight the dynamic and adaptable nature of families in response to societal changes, which results in a more democratic attitude and approach to their children's marriage that allows women to exercise their choices (Pande, 2014). A study with IT professionals in India, highlighted the preference of the idea of love marriage along with the need and importance of parents' approval, reflecting the relevance of the balance between personal and social compatibility (Baas, 2007). Also, as Kakar (2007) stated in one of his interviews, perhaps the greatest attraction of an arranged marriage is that it takes away the young person's anxiety about finding a mate. Additionally, individuals believed they could easily seek support from the family if the family had arranged their marriage (Gopalkrishnan & Babacan, 2007).

### **Expectations and Factors Affecting Choice in Selecting a Life Partner**

The rise in education and geographic mobility, have influenced the attitudes of young people, especially women, towards traditional marriage arrangements with exposure to egalitarian ideals and greater autonomy in the partner selection process, which can significantly impact their roles and expectations within their natal and marital families (South, Trent, & Bose, 2016; Aasaavari, 2019; Banerji and Deshpande, 2021; Vikram, 2024). Although marriage is viewed as a social and religious duty for everyone, cultural rules related to age at marriage and boundaries of caste and class in marriage partner selection are invoked more strongly for women. Screening of the proposals is considered the crux of the whole process of marriage partner selection. Families focus on criteria such as horoscope, caste, and family background whereas individuals consider personal criteria like nature, education, and good looks (Shukla & Kapadia, 2007). It is interesting to know how families use the concept of *Sanjog* in the context of either moving further with the proposal or rejecting the unsuitable partner (Khandpur, 2017). Rejecting an unsuitable prospective life partner is common and acceptable, yet it still hurts since no one likes to be rejected even if it is for a valid reason (Kelly, Dubbs, Barlow, 2013). This can lead to individuals feeling miserable, and developing self-doubt questioning the ground of rejection alongside feelings of fear, reputation loss, depression, and loss of self-esteem (Perilloux & Buss, 2008). A decrease in kinship networks and caste associations has resulted in matrimonial advertisements and online matrimonial services being regarded as a beneficial strategy for spouse selection as they revolutionize the way people find life partners, offering more convenience, customization, and efficiency (Bhandari, 2020). It offers a greater range of options as per the particular needs of individuals, but it also has drawbacks, such as difficulties in establishing authenticity and providing a success guarantee (Shukla & Kapadia, 2007). Despite the increasingly flexible attitude of the family towards arranged marriages, the emotions surrounding marriage are complex and multifaceted, encompassing fear, confusion, and fun reflecting the diverse experiences and expectations of modern individuals as they navigate the institution of marriage (Adhikari, 2017).

## **OBJECTIVES**

- To explore the dilemmas experienced by women in urban settings related to marriage and partner selection.
- To understand the socio-emotional experiences including the hopes, disappointments, fears, and anxieties that arise during the process of partner selection in arranged marriages.

## **METHODOLOGY**

### **Research Design**

The study aimed to comprehend the socio-emotional experiences of women who are in the process of selecting their partners in an arranged setting in contemporary urban Gujarat using a qualitative research design. It adopted a phenomenological research approach with an interpretative perspective to produce in-depth narratives on the experiences of women looking for a partner.

### **Sample and Sampling Technique**

The participants of the study included fifteen single (never married) Upper-middle-class Gujarati women from Vadodara, Gujarat, India looking for a life partner through an 'arranged' setup, and having at least a bachelor's degree. Participants were chosen using purposive and snowball sampling techniques. Vadodara is referred to as the '*Sanskarinagri*' for its rich cultural heritage along with progressive mentality making it an iconic representation of a contemporary Indian city. This duality reflects the city's ability to embrace modernization while preserving its cultural roots. Limiting the study to only one city has helped to maintain uniformity in the participant group.

### **Tool for Data Collection**

The assessment measures were self-constructed which included a demographic form and in-depth interview schedule focusing on the following domains: need and significance of marriage, the role of individuals, their families and society in marriage partner selection, frustrations, and societal pressures to get married, dealing with acceptance and rejection in the partner selection process, associated emotions, and coping strategies. The research tools were translated into Gujarati. Experts in Human Development, Sociology, and Psychology assisted with content validity to ensure that the tool was relevant to the topic under research.

### **Data Collection and Analysis**

In-depth interviews with women were conducted to acquire a deeper understanding of their lived experiences within the partner selection process of arranged marriages. Most of the meetings took place in cafeterias as majority of the participants preferred to meet outside of their homes. All interviews were carried out in Gujarati language to create a comfortable context for the discussion; however, participants were free to respond in English or Gujarati as per their willingness and comfort.

All the data collected through in-depth interviews were first transcribed and later translated into the English language. Codes were developed through open, axial, and selective coding. The qualitative data were analyzed using the thematic approach to "...identify, analyze and report patterns within the data" (Braun & Clarke, 2006, p. 79). The participants' rights were protected by adhering to all necessary ethical considerations ensuring that participation in the study was completely voluntary and that no personal information about the participants would be disclosed.



## RESULTS

### Participant demographic profile

The demographic profile of participants included personal details such as age, education, occupation, and the duration of their involvement in choosing a spouse. The participants' ages ranged from 26 to 39 years old, with the majority (n=7) falling between 29 and 31. All study participants had a university education (post-graduates=9, graduates=5, and a company secretary degree=1). All fifteen participants were employed and financially independent (four doctors, three self-employed, and eight in the service sector). The majority of participants (n=12) had been involved in the selection process for more than two years, with seven searching for more than four years. Participants who had been searching for more than two years reported more negative experiences and disappointments than those who had been active for less than two years.

### Women juggling traditional and modern expectations related to marriage partner selection

Women shared multiple reasons in response to the question, “why opt for an arranged marriage”. They stated that choosing an arranged setting for life partner selection was not a choice, but rather the only option accessible to them given their age and societal pressure to marry on time. Majority (n=13) said that their parents have given them the freedom to choose their life partner and that they have considered all of their alternatives before entering into an arranged marriage. They have given their explanations for choosing the arranged system over other methods, including failed relationships in the past (n=6), inability to connect romantically (n=5), and lack of time to explore romantic relationships because of career (n=2). Additionally, two participants cited family pressure as a reason for considering arranged marriage despite having been in relationship.

*...My family never said that I had to do only an arranged marriage. But I've never met someone with whom I could fall in love. That way, this was the only way (Woman, 31yrs) .... At my home, there is quite a pressure for an arranged marriage. They don't want to consider or understand anything else. So doing a love marriage is not possible at all. It is clear no for love marriage. (Woman, 27yrs) .... I have not chosen this setup. I had 1-2 very serious relationships but they messed up and we parted. So, this is not my choice actually. (Woman, 30yrs) .... Earlier, I was highly focused on my career I had never been in a relationship before. And now, I don't have many opportunities to create a love bond with somebody in that way. (Woman, 30yrs)*

### Societal pressure to marry “on time, at the right time”

Women are deeply concerned about society's patriarchal attitude towards marriage, experiencing conflict between societal expectations and self-ideologies. They have stated (n=9) that they believe marriage is a significant life event and they hope to be married at some point in the future; nevertheless, they were resistant to the idea of getting married by a specific age or lowering their expectations to get married. Few participants (n=6) mentioned late 20s as the ideal time of marriage because by then they would have a clear understanding regarding their expectations out of marriage and a life partner.

*Simply put, I feel that I should take my time in searching for the ideal partner. Age is no longer a factor for me. Finding the right person is more important. (Woman,*

*29yrs) ... The right time is when you are ready to get married and when you meet your compatible match. (Woman, 31yrs) ...Everyone in our family has mostly got married late. My sibling also got married in his late 20s. and even my parents. So, this is an ideal age in our family (Woman, 29yrs) .... It was always the late 20s or early 30s for me since, by then, we are pretty much there in the world with our own eyes and views. So, by this time, we can go to the next phase. (Woman, 34yrs)*

Women felt pressure from society to marry on time and make compromises to adhere to social norms. Women have uttered that direct and indirect societal pressures bother and disturb them emotionally. They addressed their dissatisfaction with the approach of finding someone through arranged marriage while discussing the unpleasant feelings they experienced during the selection process.

*Yes, there is so much pressure from society. Right now, my father doesn't support me in things I like such as painting workshops, traveling etc. He would say, 'First get married, then do whatever you want to do'. I literally have to fight for doing the things I like or enjoy. (Woman, 30yrs) ...Of course, every single time, always! To be honest, I feel very uncomfortable meeting people. Because the obvious first question they will have when you meet them is, 'So, when are you getting married?' Nobody really asks you how you're doing in life, but instead, they begin advising you on what to do and what not to do without understanding what you are going through or how you are dealing (Woman, 33yrs)*

### **The ideological divide between self and patriarchal society**

Women expressed disappointment with the expectations placed on them to conform to patriarchal norms and customs imposed by prospective grooms and their families. Women highlighted the ideological divide between prospective brides and grooms noting that while grooms and their families prefer an educated and modern bride, their expectations are still rooted in patriarchal traditions. Women felt frustrated by the narrow-minded views of parents, the pressure and expectations of society, and the judgmental attitude of potential families. Furthermore, because women's independence is often viewed as frightening and needing to be controlled, their improving socio-economic status also puts them at a disadvantage in marriage markets.

*I am a strong-minded person. I have my own opinions but that does not mean I'm rigid. You know, people are unable to accept someone who comes with their own opinion. I have noticed that the guys consider themselves to be adaptive and flexible, but in reality, they are not. I think boys want someone who is a little timid. Even now, they hold old-fashioned notions about girls. I feel they are afraid of assertive and strong-minded women. They think that if I had strong opinions, there would be problems in the home after marriage. I am flexible. I am not disrespectful but they don't understand that. (Woman, 30yrs).*

*Hmmm, people are not interested in me because I'm a doctor. Specifically, the mothers of the boys would say that they do not want a doctor daughter-in-law or a doctor who works. They don't have this common sense that if I had studied so hard to become an MD, I would not be staying at home. I get quite angry when I have this kind of experience (Woman, 27yrs).*

*..... I was speaking with a guy. I asked him if he knows cooking or if he does anything independently in terms of household chores. That guy got offended that how could I ask him questions such as cooking and that too in the first meeting. Not only that, but he began arguing with me that it was the girl's duty. He said, "I can help sometimes if it's needed; I'm open to it." But based on our conversation, I know he won't do anything in the future, even if it is necessary. I find it disheartening that he doesn't even think he should share the load. And to hear this from a well-educated so-called doctor is another degree of irony (Woman, 26yrs)*

### **Fear of giving up self-aspirations and identity**

Women expressed fear of losing their own identities after marriage. They believed that all the opportunities and considerations their parents gave them had strengthened and empowered them and that they did not wish to return to a less progressive surrounding by making any wrong decision related to their life partner. They disclosed their nervousness regarding their post-marriage future. Their greatest fear was 'loss of self' which emerged as a crucial factor in their indecisiveness in making a final decision. They underlined the importance of other roles that women can play beyond becoming a wife.

*I think our parents have given us a lot of freedom because they want us to be stronger than they were especially the mothers who definitely want stronger daughters than they were. (Woman, 34yrs) .... I don't want to be restricted in what I can wear (Woman, 32yrs)*

*... I don't want to compromise on my clothing or on my lifestyle. I want to meet my friends and do things the same way I am doing now without any restrictions. I don't want to be told in terms of what to do, whom to meet, when to go out or not (Woman, 30yrs)*

*.... I've always had the freedom to choose my path and to do things how I want. My parents are worried that I should not lose that freedom once I get married (Woman, 29yrs)*

### **Choosing between loved ones and own happiness**

Young women are increasingly exercising their power in the decision-making when selecting their life partner yet they feel persistent sense of guilt about balancing between their own happiness and the happiness of their families. However, they are conscious of their moral responsibility to their parents, but rather than lowering their standards or making adjustment for family, women are taking stand without fear of implications, and taking accountability of subsequent consequences.

*My grandparents had this dream of seeing me married. My grandfather passed away sometime back and I know he was worried about my marriage. Every other day, he would try to convince me to get married. I regret not being able to provide him this happiness while he was still alive, but again, If I think practically, it is not appropriate for me to make any decision because of emotional pressure because it will ultimately affect my life forever. (Woman, 32yrs)*

*...I have this feeling of guilt. Being only child, I feel responsible for my parent's happiness. After all, there is no one else except me, right? And this kind of pressure constantly bothers me. 24 hours, I feel that I am breaking their hopes. Even though I have a job and a successful career, but their long-held desire to see me married has not been fulfilled yet. I feel bad about that. (Woman, 30years).*

## DISCUSSION AND CONCLUSION

Partner selection is a perpetual challenge of juggling between traditional and contemporary expectations. Women's status has significantly evolved (Kumari, 2004), particularly in terms of independent thinking and economic independence (Srivastava, 2020). Many Factors like improved access to education, economic opportunities, and flexible attitudes of families empowered women to make decisions and pursue their own goals and aspirations. Being more assertive and eloquent, women are less willing to compromise on aspects that are important to them. It was observed that changing power dynamics and family attitudes around the idea of marriage and partner selection, reflects shifting societal norms and values.

With changing trends and practices, parents have become flexible, providing their children, especially daughters, with considerable freedom and decision-making power. However, there are conflicting desires of parents wherein, they want to support their daughters' aspirations for education and independence, while feeling compelled to conform to societal marriage expectations with a strong sense of responsibility for their child's marriage, due to pressure from relatives or community members.

This imbalance within the social system creates frustrations, fear, disappointments, self-doubts, and even aggression among the involved individuals. Ultimately, addressing these dilemmas requires challenging and reshaping societal norms around marriage and gender roles, promoting gender equality, empowering girls and women to make life choices, and creating supportive environments that enable them to make decisions in marriage matters.

The study's findings have the potential to deepen our understanding of young women and their socio-emotional experiences during the marriage partner selection process. This will provide an opportunity for families, including men, to modify their expectations and attitudes that align with the evolving perspectives and roles of women. All women participants were urban, well-educated, and financially independent. Future research to determine if these findings apply to women from rural areas or lower socioeconomic strata will be beneficial.

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## EFFECTS OF FERTILITY ISSUES ON QUALITY OF LIFE AND OVERALL TREATMENT LEVEL AMONG MARRIED WOMEN

**Ms. Vanitha S<sup>1</sup> and Dr. Manjula G Kadapatti<sup>2</sup>**

<sup>1</sup>Post graduate student and <sup>2</sup>Associate professor

Department of Human Development and Research Centre,

Smt VHD Central Institute of Home Science,

Maharani Cluster University, Bangalore 560001

Email : <sup>1</sup>vanithasudhakumar733@gmail.com and <sup>2</sup>manjulakadapatti@yahoo.com

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### ABSTRACT

Child bearing is an important aspect in all women live but many factors and issues are interfering in women's life. Women who have these issues are facing difficulty to become pregnant and this intern increasing the rate of infertility among married women. This study mainly aimed to understand the quality of life of an infertile woman facing different hardships which are interfering in their lives and its effects on their treatment for fertility. A sample of 60 married infertile women was selected using purposive sampling methods during the year 2023. The result shows that 56.7 percent of respondents had moderate fertility problems. Women's quality of life was affected due to infertility issue. Respondents had more emotional problems which affected their emotions and feelings and they were also under social pressure which caused them to feel pressurized about getting pregnant. Majority of the respondents (51.7%) had low treatment level and mean percentage of 59.2 had tolerability aspect, which assesses the experience of mental and physical symptoms and disruption in daily life due to treatment. Quality of life was found to be correlated with fertility problems and treatment for fertility issues among the respondents.

**Keywords:** Fertility issues, Infertility, quality of life, treatment, women

### INTRODUCTION

Once the women get married moves to the next milestone which is motherhood, reproduction has always been considered as an important part in women's life and is prioritized over production. A woman's life is transformed when she becomes a mother. She faces a lot of hardships and surprises from the moment she becomes pregnant until she meets her child for the first time. This includes coming to terms with her role as a mother. In case a woman is not able to conceive, as to face many problems and challenges within herself, family and in the society.

According to WHO Infertility is a condition of the male or female reproductive system defined by the failure to achieve a pregnancy after 12 months or more of regular unprotected sexual intercourse. Infertility affects millions of people – and has an impact on their families and communities. (World Health Organization 2023)

Dac Teoli and Abhishek Bhardwaj. (2023) opines Quality of life is the degree to which an individual is healthy, comfortable, and able to participate in or enjoy life events. QoL include personal health (physical, mental, and spiritual), relationships, education status, work environment, social status, wealth, a sense of security and safety, freedom, autonomy in decision-making, social-belonging and their physical surroundings. Quality of life is defined by the World Health Organization as "an individual's perception of their position in life in the context of the culture and value systems in which they live and in relation to their goals, expectations, standards and concerns. Infertility has significant negative social impacts on the lives of infertile couples and particularly women, who frequently experience violence, divorce, social stigma, emotional stress, depression, anxiety and low self-esteem (WHO 2012). A study conducted by Zainab Ahmed *et al.*, (2019) on Quality of Life of Infertile Women. This study aimed to assess the quality of life (QoL) of infertile women and to explore the factors affecting it. The data found that infertile women have a significantly poor quality of life than fertile women, especially in the physical, psychological and social domains. Length of menstrual cycle emerged as a significant negative predictor of the overall quality of life and social QoL and duration of infertility emerged as the negative predictor of physical and psychological QoL. So, to understand the problems of women undergoing infertility issues and to know its effect on her quality of life, and treatment level for fertility the present study was undertaken.

### **OBJECTIVES**

1. To study the level of fertility problems
2. To study the effects of fertility issues on quality of life among married women.
3. To know the association of quality of life with fertility problems and its effect on treatment level.

### **NULL HYPOTHESES**

1. Fertility problems may not affect the quality of life among selected respondents.
2. There is no relationship between quality of life with fertility problems on treatment level among selected respondents.

**LIMITATION:** The study is confined to 60 infertile married women.

### **MATERIALS AND METHODS**

Loma linda infertility tool (Female infertility patient questionnaire), IUI- IDAHO UROLOGIC INSTITUTE (Infertility questionnaire) By Kevin Scharnhorst, 2014 was online tool used for the study which was modified according to the need of the study and sensitivity of the respondents, which was underwent expert validation. The tool consisted of 41 statements containing 6 core aspects such as Fertility History, Medical History, Contraceptive/sexual History, Family history, Menstruation/ Pregnancy history, social history/ Life style. Each core aspect contains 6-8 statements with different point scale and Fertility quality of life tool by ESHRE, ASRM and Merck-Serono S.A. 2002 was the second tool used for the study to know the association of infertility with quality of life among the selected respondents. This standardized tool consisted of 6



core aspects (emotions, mind and body, relation, social, environment and tolerability) and 36 statements having 5-point scale.

Structured interview method of research design was used for the study. The hospitals located in Bangalore urban, Karnataka were selected for the study. Tamara IVF Centre and Fortis hospital were selected for the study based on the cooperation and support extended from doctors and staff of the respective hospitals. The purposive sampling method was used to collect the data and study was carried out in the year 2023. A total of 60 samples were interviewed, among them twenty-five samples from Tamara IVF Centre and 35 samples were from Fortis hospital constituted the respondents for the study.

Prior to data collection, permission was sought from each hospitals authority. There was small introduction through which rapport was built by the researcher with the respondents and purpose of the study was briefed. Data collection was done by following hospital timings and availability of samples with prior permission on the day of data collection. The researcher collected the information with the respondents, whenever respondents are free and willing to answer on the day of hospital visits.

**Statistical Analysis:** Percentage, Standard Deviation, Mean Deviation Chi Square and Correlation were the statistical methods applied for the study.

### RESULTS AND DISCUSSION

Obtained results are discussed and interpreted in tabular and graphical representations as follows

**Table – 1 Classification of Respondents by Personal Characteristics**

N=60

Characteristics	Category	Respondents	
		Number	Percent
Age group (years)	26-30	28	46.7
	31-32	14	23.3
	33-39	18	30.0
Qualification	PUC	22	36.7
	Degree	38	63.3
Occupation	Housewife	24	40.0
	Private	31	51.7
	Self employed	5	8.3
<b>Total</b>		<b>60</b>	<b>100.0</b>

Table-1 and fig-1 reveals that 46.7 percentages of the respondents were belongs to age group of 26-30 years and 30.0% of the respondents (International online multidisciplinary journal) belongs to age group of 31-32 years and 23.3% of the respondents belong to 31-32 years of age. Majority of the respondents (63.3%) were graduates. And 36.7% of the respondents completed PUC. With related to the occupation 51.7% of the respondents were private employees, and 40.0% respondents were housewife whereas, 8.3% of respondent were self-employed.

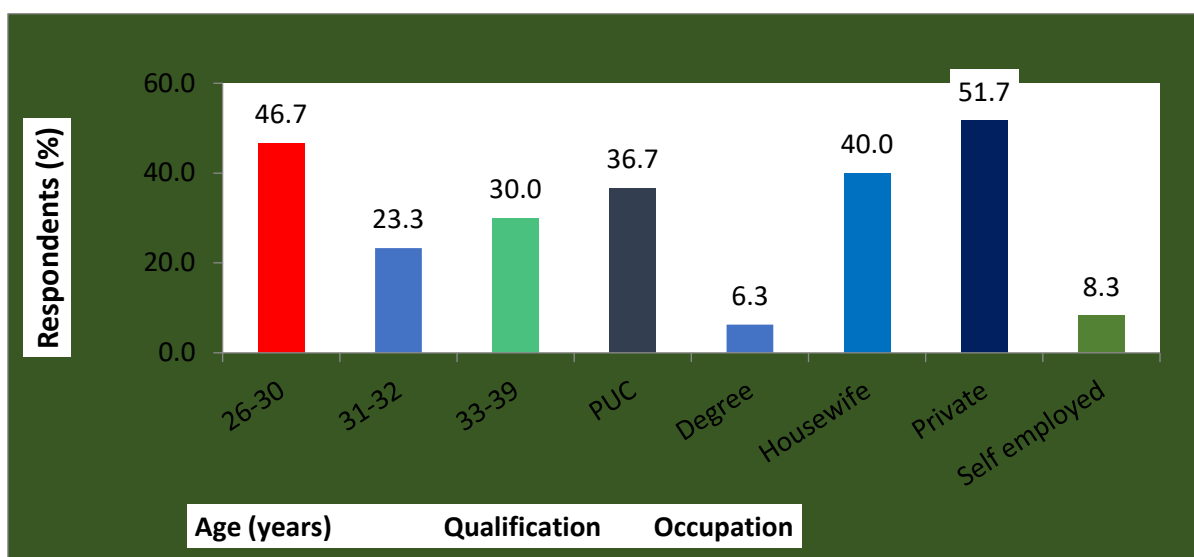


Fig. 1: Classification of Respondents by Age group, Qualification, and Occupation

TABLE – 2 Classifications of Respondents by Family Characteristics

N=60

Characteristics	Category	Respondents	
		Number	Percent
Type of Family	Nuclear	44	73.3
	Joint	16	26.7
Age of Husband (years)	30-32	27	45.0
	33-35	19	31.7
	36-43	14	23.3
Qualification of Husband	PUC	9	15.0
	Degree	48	80.0
	PG	3	5.0
Occupation of Husband	Business	10	16.7
	Government	20	33.3
	Private	23	38.3
	Self-employed	7	11.7
<b>Total</b>		<b>60</b>	<b>100.0</b>

Table-2 indicates that the type of family, age, qualification and occupation of respondents' husband. Majority of the respondents (73.3%) were belongs to nuclear family and 26.7% of the respondents belong to joint family. Most of the respondents (45.0%) husbands were belong to 30-32 years of age, 31.7% of the respondents belongs to age group of 33-35 and around 23.3% of the respondents belongs to 36-43 years of age. Highest percentage of the respondents (80.0%) husbands were completed degree, 15% of the respondents' husbands were completed PUC and very less (5.0%) percentage of the respondents' husbands were completed PG (Post graduation). Majority of the respondents (38.3%) husbands were private employees, about 33.3% of the respondents' husbands were government employees, around 17% of the respondents' husbands had

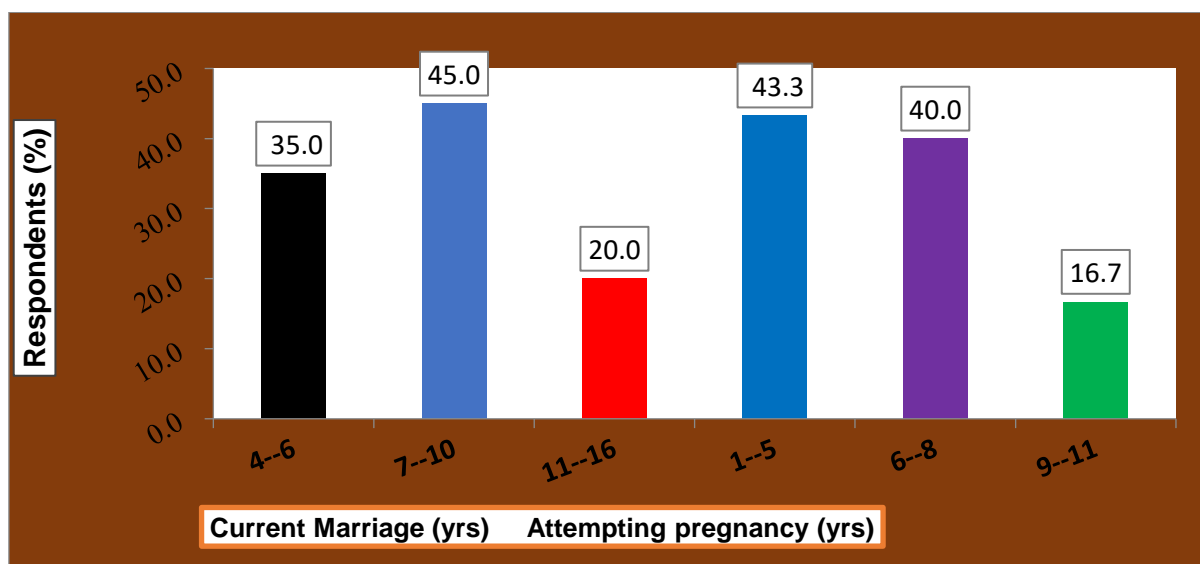
business and 11.7% of the respondents' husbands were self-employed. Figure 2 and 3 represents data in graphical method.

**Table – 3 Duration of current marriage/relationship and attempting to initiate a pregnancy**

N=60

Characteristics	Category	Respondents	
		Number	Percent
Duration of current marriage/relationship	4-6	21	35.0
	7-10	27	45.0
	11-16	12	20.0
How long have been attempting to initiate a pregnancy	1-5	26	43.3
	6-8	24	40.0
	9-11	10	16.7
<b>Total</b>		<b>60</b>	<b>100.0</b>

The table-3 represents the duration of current marriage/relationship and period of initiation of pregnancy. Majority of the respondents (45.0%) were married from 7-10 years back, whereas 35% of respondents were married from 4-6 years back and 20 percentage of respondents were completed 11-16 years of their married life. Most of the respondents (43.3%) were initiating pregnancy from 1-5 years, about 40 percentage from 6-8 years and 16.7 percentage of respondents from 9-11 years were initiating their pregnancy and the graph represents the same (Fig- 2).



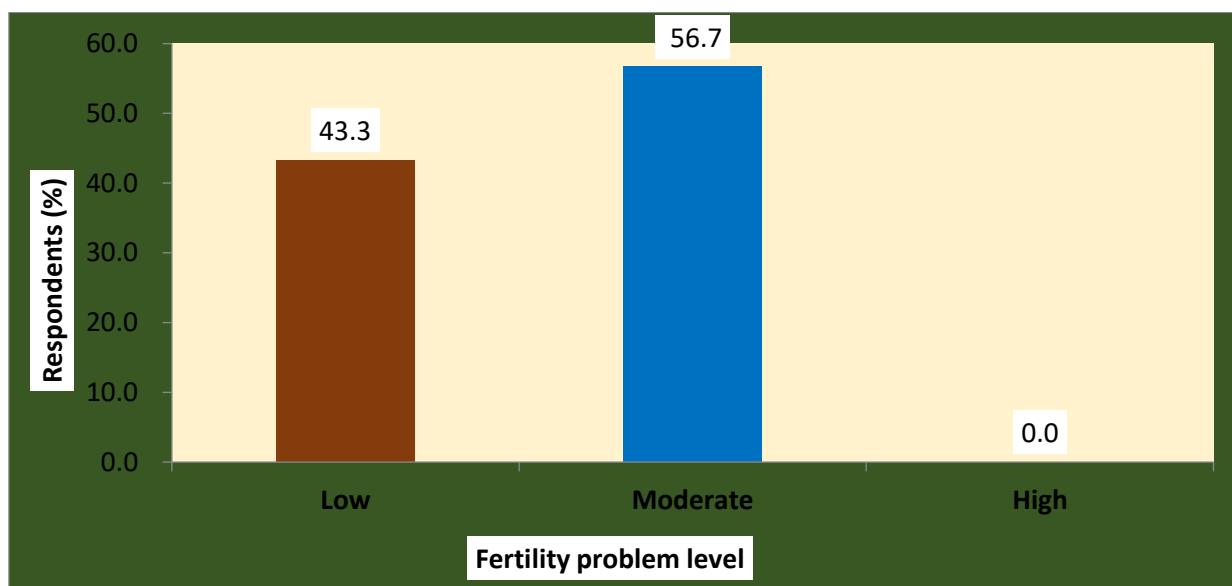
**Fig. 2: Duration of current marriage/relationship and attempting to initiate a pregnancy**

**Table – 4 Classification of Respondent on Fertility problems Level**

N=60

Fertility problems Level	Category	Respondents	
		Number	Percent
Low	24-60 Score	26	43.3
Moderate	61-90 Score	34	56.7
High	91-120 Score	0	0.0
Total		60	100.0

The table-4 and fig-3 indicates the classification of respondents on fertility problem. Most of the respondents (56.7) had moderate fertility problems and 43.3 percentage of respondents had low fertility problems. It may be due to age factor, health issues and having fertility history in the family and also may be because of life style of the respondents.



**Fig. 3: Classification of Respondent on Fertility problems Level**

**Table- 5 Association between Duration of infertility and overall Fertility problems Level**

N=60

Duration of infertility	Sample	Fertility problems Level				$\chi^2$ Value
		Low		Moderate		
		N	%	N	%	
2-4	28	9	28.6	19	71.4	6.48* (5.991)
5-7	14	6	42.9	8	57.1	
8-11	18	11	66.7	7	33.3	
<b>Total</b>	<b>60</b>	<b>26</b>	<b>43.3</b>	<b>34</b>	<b>56.7</b>	

\* Significant at 5% Level, Note : Figures in the parenthesis indicate Table value

The table-5 and fig-4 indicates the association between duration of infertility and overall fertility problems levels. Majority of the respondents had moderate fertility issues. With regard to this moderate level of fertility issues, the duration of 2-4 years of infertility had highest percentage of fertility problems, followed by duration of 5-7 years (57.1%) and 8-11 years infertility (33.3%) among the respondents. With regard to the low fertility problems and duration of infertility it is seen from the table that 66.7% had low fertility problems in the duration of 8-11 years of infertility, around 43 percentage of 5-7 years of infertility and 28.6% of the respondents had low fertility issues in the duration of 2-4 years of infertility. The data is found to be statistically significant at ( $\chi^2=6.48$ ) 5% level so the hypothesis is accepted. It may due do the life style and quality of life that respondents lead in the early adulthood years. The finding of the study is in line with the study conducted by Priyanka Sanjay Deshpande and et.al (2019) it reveals that in couples married for less than 5 years, PCOS was the main cause whereas later, male factor and unexplained infertility were the most common causes seen.

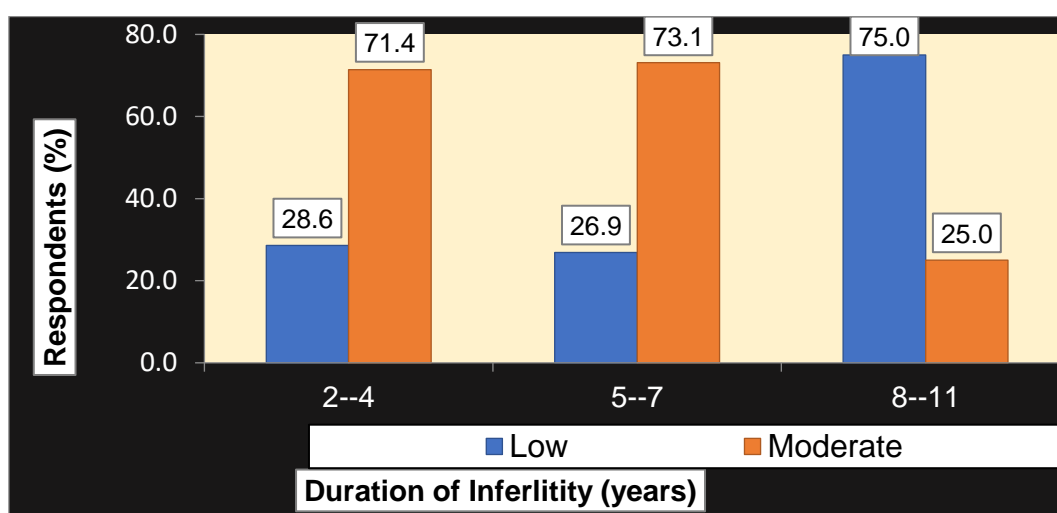


Fig. 4: Association between Duration of infertility and overall Fertility problems Level

Table -6 Aspect wise Mean quality of life of the respondents

N=60

No.	Quality of life Aspects	Statements	Max. Score	Scores			
				Mean	SD	Mean (%)	SD (%)
I	Emotion	6	30	18.90	2.78	63.0	9.3
II	Mind body	6	30	18.05	3.02	60.2	10.1
III	Relation	6	30	15.78	3.01	52.6	10.0
IV	Social	6	30	8.48	1.88	28.3	6.3
	<b>Combined</b>	<b>24</b>	<b>120</b>	<b>61.22</b>	<b>7.15</b>	<b>51.0</b>	<b>6.0</b>

The above table and figure depict the aspect wise mean fertility problems scores. Most of the respondents mean value (18.90) and mean percentage (63%) had emotional problems, mean value (18.05) and mean percentage (60.2%) of respondents had mind body problem, about mean value (15.78) and mean percentage (52.6 %) of respondents had relation problems and mean value (8.48) and mean percentage (28.3 %) of respondents had social problems. It can be concluded from the

above data that the quality of life of a married woman plays an essential role for the wellbeing of women to have a healthy fertility and pregnancy. The respondents had more emotional problems which affected their emotions and feelings, the mental health and physical health also had negative impact on the women, they were also under social pressure which caused them to feel pressurized about getting pregnant. They might have face low moods and anxiety due various reasons.

The results of the study were supported by the study conducted by the Adekemi E et.al (2022) findings shows that the women experienced a range of psychological and social issues ranging, societal stigma, social withdrawal and isolation among the women having infertility issues.

The study conducted by Mansoor Ahmad Dar *et al.*, (2022) it shows that the psychiatric morbidity was seen in 46.4% of infertile women. Fertility quality of life score for the infertile group was  $64.61 \pm 5$  with the lowest score in the emotional domain (45.10) and mind-body domain (54.86) ( $p < 0.0001$ ). The scores in the relational domain and social domain were higher (85.2 and 73.3, respectively).The scores in the mind-body domain and emotional domain were poor among the infertile women regardless of the presence of psychiatric morbidity.

Mubina Suleiman *et al.*, (2023), conducted a study on the Quality of Life and associated factors among infertile women attending infertility clinic at Mnazi Mmoja Hospital, Zanzibar. The quality of life increased significantly with increase in educational level. There was an average decrease in quality of life in women with secondary infertility compared to women with primary infertility. Every month increase in duration of infertility led to an average of decrease in FertiQoL scores. The overall quality of life in this population was positively associated with level of education but negatively affected with reason for infertility, type of infertility and duration of infertility.

All these reviews are in line with the data provided above which shows that infertile women were affected in different domain which made them to lead poor quality of life.

**TABLE – 7 Classification of Respondent Treatment fertility Level**

N=60

Treatment fertility Level	Category	Respondents	
		Number	Percent
Low	10-25 Score	31	51.7
Moderate	26-37 Score	29	48.3
High	38-50 Score	0	0.0
Total		60	100.0

Table-7 and fig-5 indicate the classification of respondents' treatment fertility level. Majority of the respondents (51.7%) had low treatment level and 48.3 percentage of respondents had moderate treatment levels. It could be the reason that frequently visiting the hospitals, having less success rate, undergoing medication and trauma so on may lead to lower treatment level.

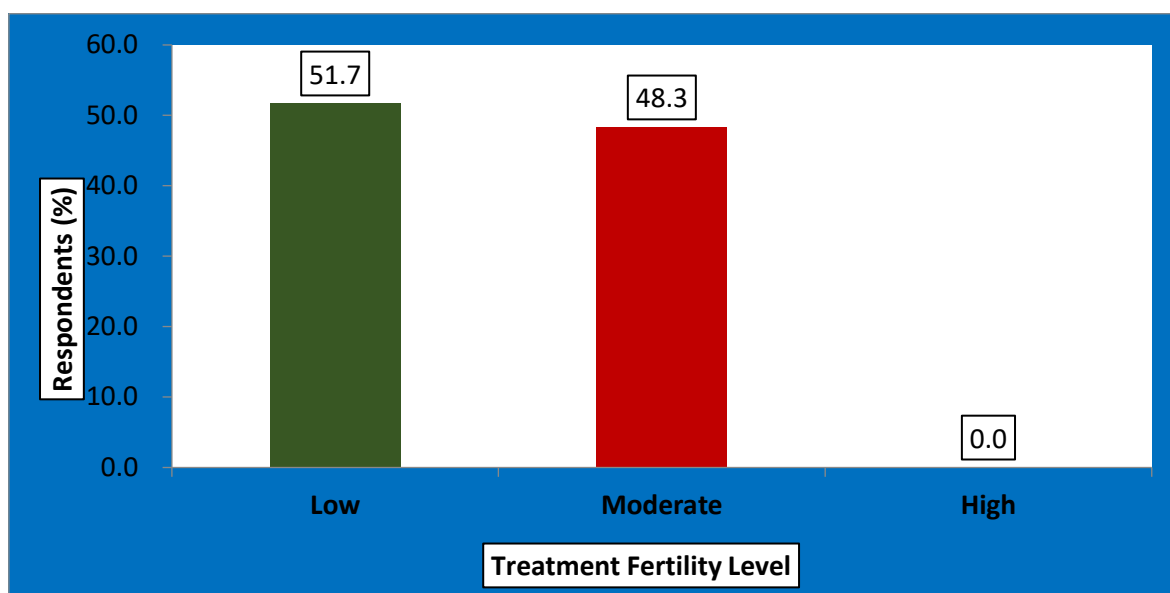


Figure. 5: Classification of Respondent Treatment fertility Level

TABLE -8 Aspect wise Mean Treatment fertility scores (n=60)

No.	Treatment fertility Aspects	Statem ents	Max. Score	Treatment fertility Scores			
				Mean	SD	Mean (%)	SD (%)
I	Environment	6	30	14.20	2.69	47.3	9.0
II	Tolerability	4	20	11.83	2.30	59.2	11.5
	<b>Combined</b>	<b>10</b>	<b>50</b>	<b>26.03</b>	<b>3.53</b>	<b>52.1</b>	<b>7.1</b>

The table-8 and fig-6 depicts Aspect wise Mean Treatment fertility scores which includes medical intervention or consultation, according to treatment environment and treatment tolerability. Most of the respondents, the mean percentage of 59.2 had tolerability aspect, which assesses the experience of mental and physical symptoms and disruption in daily life due to treatment.and 47.3 mean percentage of respondents had environment treatment fertility aspects, that assesses accessibility and quality of treatment and interactions with medical staff.

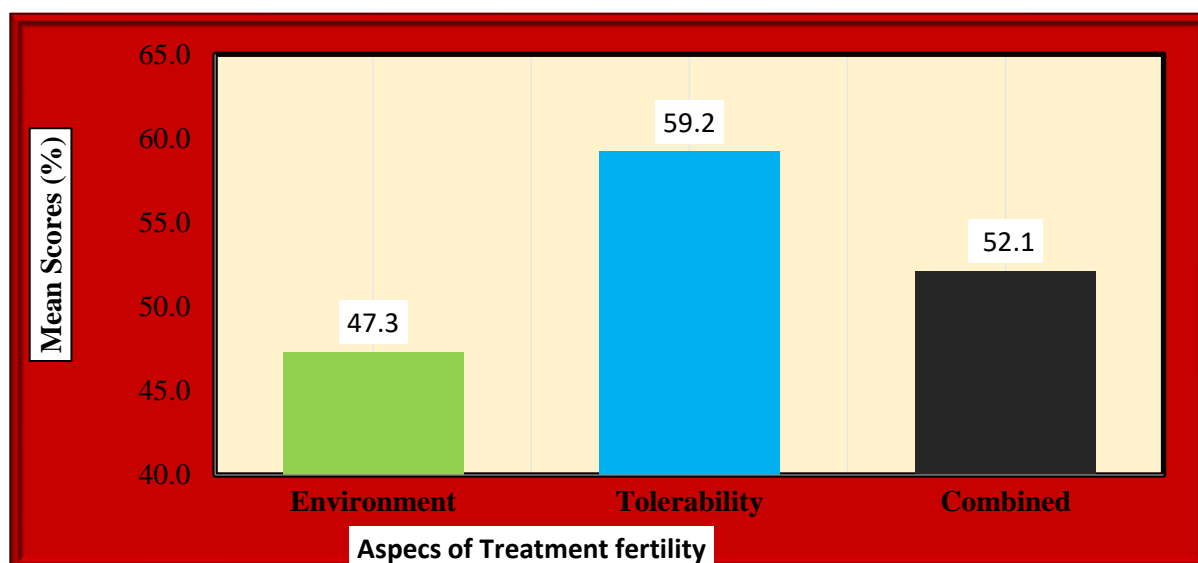


Fig. 6: Aspect wise Mean Treatment fertility scores

TABLE – 9 Inter Relationship of Fertility problems with quality of life and Treatment for fertility

N= 60

No.	Characteristics	Correlation coefficient ( r )	
		Fertility problems	Treatment for fertility
1	Quality of life	- 0.3952	- 0.0845

With regard to quality of life it was found negative correlation with fertility problems (- 0.3952) and with treatment for fertility issues (0.0845) among the respondents. It shows that as better the quality of life leads to less fertility issues and there will be less treatment for fertility and lower the quality of life will enhances more fertility issues which calls for more treatment for the same. It could be due to the reason that good mental health status, emotional wellbeing, physical health and improved or positive relationship in the family as impact on the quality of life, as it gets better the quality of life of a woman gets better which helps them to maintain a proper health that in-turn reduces the rate of fertility treatment.

### CONCLUSION

Infertility has till now been a private matter to be resolved individually. However, the World Health Organization (WHO) has recognised it as a public health issue worldwide. The study concludes that most of the respondents had moderate fertility problems and low fertility problems. It may be due to age factor, health issues and having fertility history in the family and also may be because of life style of the respondents. The respondent’s quality of life was affected due to infertility issue.

**Recommendations:** women having fertility issue has affected their quality of life and further affects their treatment for infertility. Quality of life of women is very important to have better wellbeing by physically, mentally and emotionally. Women having fertility issues have to be given priorities and need to conduct intervention program to enhance the quality of life.



**Need for future research:** Intervention programme to enhance the quality of life among the women having fertility issues from a long period.

**Acknowledgement:** Special thanks to the respondents who have openly and honestly given the information.

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## SOCIAL MEDIA ADDICTION AMONG COLLEGE-GOING STUDENTS IN COIMBATORE

Thongam Victory Khanganbi<sup>1</sup>, Dr. Priya, M<sup>2</sup>, Vaishali S<sup>3</sup>

<sup>1</sup>Research Scholar, <sup>2</sup>Assistant Professor (SS), <sup>3</sup>M. Sc Student

Department of Human Development

Avinashilingam Institute for Home Science and Higher Education for Women,  
Coimbatore

Email ID: victorykhanganbi@gmail.com,

mpriya10212@gmail.com,

vaishaliselva245@gmail.com

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HSAI-2017-TN-29-LF

### ABSTRACT

Social media addiction is a global consumer phenomenon with an exponential rise within the past few years. The use of social media websites is an everyday activity for today's college students; they are sometimes overused/misused, which has led to social media addiction. Nearly 71% of the world's internet users are constituted by young people aged 18-24. The primary use of the internet is to learn and share new information through google, work, g-mail, social media, etc. Active social media users were 197 million in India. In the present study, social media addiction among college students is 38.0% higher among male students. They have high usage in the number of platforms and frequency of social media usage, and they found an emotional imbalance on social media sites. In contrast, age and area of residence did not predict any significant difference in social media addiction.

**KEYWORDS:** social media, addiction, platform, frequency, emotional imbalance

### INTRODUCTION

Social media are web-based tools of electronic communication that allow users to interact with others individually or in groups. More than 210 million people worldwide abide from social media addiction. Consider that there are currently 4.48 billion social media users globally; that works out to be 4.69% of actual users who have a social media addiction. Experts in the US estimate that about 10% of social media users are addicted. With the fact that 78% of Americans check and use social media daily. Young adults tend to be the most affected by social media addiction.

In the Indian context, studies have shown the prevalence of internet addiction to be 1.3% in the general population. Higher rates of 11.8%, 8.8%, and 8% have been reported in college populations, and lower rates in adolescence (0.7%). Two studies using samples of health professionals in India have reported one showing the prevalence of severe internet addiction among

dental students (2.3%) to be higher relative to other medical students (1.2%), and the other showing a prevalence rate of 9.5% of internet addiction among medical college students collectively.

**Justification**

Excessive internet use among college students may increase the risk of internet addiction and be prone to distraction with smartphones, and we have a world of distractions at our fingertips. Considering this current study aimed to determine the prevalence and independent variables associated with social media addiction among college students in Coimbatore.

**OBJECTIVES**

1. To understand the socio-demographic profile of the respondents
2. To assess the prevalence of social media addiction among college students in Coimbatore
3. To analyze social media addiction among young adults based on age, gender, area of residence.

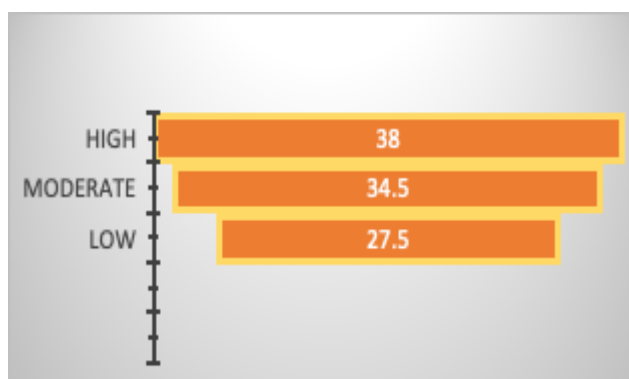
**MATERIALS AND METHODS**

The present study was conducted on 200 college-going youth aged 18-24 years, selected through a college-based, cross-sectional research design using simple random sampling. The study took place in Coimbatore, Tamil Nadu, and both undergraduate and postgraduate students participated. The assessment was conducted using a self-constructed questionnaire titled the "Social Media Addiction Scale," which comprised 34 statements designed to measure various aspects of social media addiction, including mindset, number of platforms, purpose, frequency, and emotions/feelings. Data collected from the participants were analyzed using descriptive statistics, including frequency, mean, standard deviation, t-test, and ANOVA, to conclude the level of social media addiction among the students.

**RESULTS AND DISCUSSION**

**Socio-Demographic Profile**

A total of 200 college youth in the age group of 18-24 years constituted the study population. Regarding age, the majority of respondents, i.e., 57.0%, are under 18-20 years, and the rest, 43.0%, come under 21-24 years. Concerning gender, female respondents have the majority, i.e., 56.5% and male respondents are 43.5%. Based on the area of residence, most respondents come under urban areas (39.5%), whereas 39.0% are under rural areas, and the rest 21.5% of respondents come under semi-urban 21.5%.



**FIGURE 1: Level of social media addiction among college students**

Figure 1 shows that most students (38.00%) face a high level of social media addiction, 34.50% are under a moderate level, and the rest, 27.50%, showed a low level of social media addiction. It can be said that the majority of college students were experiencing a high level of social media addiction.

**Table-1: Level of social media addiction by age**

SI.No	Age	Low		Moderate		High	
		N	%	N	%	N	%
1.	18-20(114)	44	38.5	29	25.4	41	36.0
2.	21-24(86)	25	29.0	26	30.2	35	40.7
	<b>Total (200)</b>	<b>69</b>	<b>34.5</b>	<b>55</b>	<b>27.5</b>	<b>76</b>	<b>38.0</b>

Table 1 depicts social media addiction among college students concerning age. From this, we could observe that most 18-20-year students are showing (38.5%) low level of social media addiction, 36.0% are under high addiction, and the remaining 25.4% predicted moderate social media addiction.

In the case of the 21–24-year age group, the majority, i.e., 40.7%, proved that they are highly addicted to social media, 30.2% showed moderate levels, and the rest, 29.0%, are under a low level of social media addiction.

**Table-2: Mean, Standard deviation and t-value of social media addiction by age**

SI.No	Age	Mean	SD	t-value
1.	18-20(114)	31.70	8.372	.302
2.	21-24(86)	32.95	8.599	NS

NS-Not significant

Table 2 shows that the mean of the 18-20 age group was 31.70 (SD = 8.37), while the mean of the 21-24 age group was slightly higher at 32.95 (SD = 8.59). The t-value of 0.302 indicates that there is no significant difference in social media addiction between the two age groups, with 21-24-year-olds being slightly more addicted.

**Table-3: Level of Social media addiction dimensions by age**

SI.No	Dimensions	Age	Low		Moderate		High	
			N	%	N	%	N	%
1.	Mindset	18-20(114)	33	29.0	35	30.7	46	40.3
		21-24(86)	28	32.5	24	27.9	34	39.5
		Total(200)	61	30.5	59	29.5	80	40.0
2.	No. of Platform	18-20(114)	47	41.2	29	25.4	38	33.3
		21-24(86)	31	36.0	20	23.2	35	40.5

		Total(200)	78	39.0	49	24.5	73	36.5
3.	Purpose	18-20(114)	47	41.2	15	13.1	52	45.6
		21-24(86)	32	37.2	13	15.1	41	47.7
		Total(200)	79	39.5	28	14.0	93	46.5
4.	Frequency	18-20(114)	40	35.0	30	26.3	44	38.5
		21-24(86)	18	20.9	21	24.4	47	54.6
		Total(200)	60	30.0	52	26.0	88	44.0
5.	Emotional imbalance	18-20(114)	18	15.8	19	16.7	77	67.5
		21-24(86)	8	9.3	13	15.1	65	75.5
		Total(200)	25	12.5	32	16.0	143	71.5

Table 3 represents the level of social media addiction dimensions by age.

**Mindset:** In case of 18-20 years of age, the majority are (40.3%) have a high mindset, 30.7% reported a moderate mindset in social media usage and the rest, 29.0% showed a low mindset. In the case of 21-24 years of age, a majority (39.5%) have negative mindset, as well as 32.5% are having a positive mindset and there 27.9% have moderate mindset

**Number of platforms:** Among 18-20 years of age, majority are using fewer platforms i.e. 41.2%, the higher platform usage is 33.3% and the rest 25.4 are under moderate usage. In the case of 21-24 years of age, the majority are higher users (40.5%), the less users are 36.0%, and the remaining 23.2% are under moderate.

**Purpose:** With respect to age 18-20 years, the purpose of using social media is high (45.6%), whereas 41.2% have less purpose of social media usage and 13.1% are at a moderate level. In case of 21-24 years of age, the majority (45.6%) are having the higher purpose of using social media, 37.2% have less purpose, and 15.1% have a moderate level of purpose.

**Frequency:** In case of 18-20 years of age, the majority of respondents have higher frequency level i.e., 38.5%, whereas 35.0% are having lower frequency level and the rest are having moderate frequency level. With respect to the age 21-24 years, the majority of respondents are shown under higher frequency level (54.6%), the respondents under moderate level are 24.4% and lower frequency level respondents are 20.9%.

**Emotional imbalance:** With respect to age, 18-20 years, the majority of respondents (67.5%) showed higher emotional imbalance, whereas 16.7% are facing moderate emotional imbalance and 15.8% are under lower emotional imbalance. In case of 21-24 years of age the majority of respondents i.e., 75.5% comes under higher emotional imbalance, 15.1% reported moderate and 9.3% showed lower emotional imbalance.

**Table-4: Mean, SD, and t-values of social media addiction dimensions by age**

Sl.No	Dimensions	Category	Mean	SD	t-value
1.	Mindset	18-20(114)	7.03	3.061	.725 NS
		21-24(86)	6.87	3.063	
2.	Number of Platform	18-20(114)	10.17	3.272	.179NS
		21-24(86)	10.85	3.879	
3.	Purpose	18-20(114)	9.93	2.390	.288NS
		21-24(86)	10.30	2.521	
4.	Frequency	18-20(114)	2.35	1.765	.091NS
		21-24(86)	2.77	1.657	
5.	Emotional imbalance	18-20(114)	2.23	2.297	.839NS
		21-24(86)	2.16	2.179	

**NS-Not Significant**

Table 4 indicates the mean,SD, and t-values of social media addiction dimensions by age.

There are five dimensions in social media addiction which shows the mean, SD, and t values with respect to age.

In the mindset dimension, the obtained mean and SD value samong18-20 years are 7.03 and 3.06. In case of 21-24 years, the values were 6.87 and 3.06, respectively. The obtained t value is 0.725 which is not significant.

In a number of platform dimension, among 18-20 years, the obtained mean and SD values are10.17and3.27, respectively. In the case of 21-24years, the values were 10.85 and 3.87 respectively. The calculated t value was 0.179 which is not significant.

In purpose dimension, among 18-20 years, the obtained mean and SD values are 9.93 and 2.390, respectively. In case of 21-24 years, the values were 10.30 and 2.521, respectively. The calculated t value was 0.288 which is not significant.

In the frequency dimension, among 18-20 years, the obtained mean and SD values are 2.35 and 1.765 respectively. In case of 21-24 years, the values were 2.77 and 1.657, respectively. The calculated t value was 0.091, which is not significant.

In dimension emotional imbalance, among18-20 years, the obtained mean and SD values are 2.23 and 2.297, respectively. Incaseof21-24years, the values were 2.16 and 2.179 respectively. The calculated t value was 0.839 which is not significant.

**Table-5: Level of social media addiction by gender**

Sl.No	Age	Low		Moderate		High	
		N	%	N	%	N	%
	Male(87)	22	25.2	23	26.4	42	48.2
2.	Female(113)	47	41.6	32	28.3	34	30.0

	<b>Total(200)</b>	<b>69</b>	<b>34.5</b>	<b>55</b>	<b>27.5</b>	<b>76</b>	<b>38.0</b>
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Table-5 depicts social media addiction among college students with respect to age.

From this, we could observe that the majority of male students show (48.2%) had a high level of social media addiction, 2.64 % under moderate addiction, and the rest 25.2% showed low social media addiction.

In case of female students, majority i.e.,41.6% proved that they are less addicted to social media, 30.0% showed higher level and the rest 28.3% are under moderate level of social media addiction.

**Table-6: Mean, SD and t-test of social media addiction by gender**

Sl.No	Gender	Mean	SD	t-value
1.	Male(87)	34.92	8.546	<b>0.000**</b>
2.	Female(113)	30.18	7.847	

\*\*Significantat0.01%

Table-6 depicts mean, SD and t-values of social media addiction by gender.

Among male students, the mean and SD values are 34.92 and 8.54, respectively. In the case of females, the values were 30.18 and 7.84.the obtained t-value was 0.000\*\* which is highly significant at0.01%.This proved that male respondents have high social media addiction compared to female college students.

This result supports the findings of Seyyed Mohsen Azizi et al. (2019), who discovered that students' social networking addiction was moderate, with male students having a higher level of addiction to social networking than female students. A significant and negative correlation was discovered between social networking addiction and Grade Point Average (GPA). Male students had a significantly higher mean social networking addiction ( $52.65 \pm 11.50$ ) than female students ( $49.35 \pm 13.96$ ), with a P-value of  $<0.01$ .

**Table 7: Level of Social media addiction dimension by gender**

Sl.No	Dimensions	Gender	Low		Moderate		High	
			N	%	N	%	N	%
1.	Mindset	Male(87)	24	27.5	22	25.2	41	47.1
		Female(113)	37	32.7	37	32.7	39	34.5
		Total(200)	61	30.5	59	29.5	80	40.0
2.	No. of Platform	Male(87)	24	27.5	15	17.2	48	55.1
		Female(113)	54	47.7	34	30.0	25	22.1
		Total(200)	78	39.5	49	24.5	73	36.5
3.	Purpose	Male(87)	33	37.9	11	12.6	43	49.4

		Female(113)	46	40.7	17	15.0	50	44.2
		Total(200)	79	39.5	28	14.0	93	46.5
4.	Frequency	Male(87)	18	20.6	25	28.7	44	50.6
		Female(113)	40	35.3	26	23.0	47	41.6
		Total(200)	58	29.0	51	25.5	91	45.5
5.	Emotional imbalance	Male(87)	3	3.4	14	16.09	70	80.4
		Female(113)	22	19.5	18	15.9	73	64.6
		Total(200)	25	12.5	32	16.0	143	71.5

Table 7 represents the level of social media addiction dimensions by gender.

**Mindset:** Respectfully, the majority of male respondents (47.1%) had a negative mindset, 27.5% had a positive mindset, and the remaining 25.2% had a moderate mindset. In the case of female respondents, the majority (34.5%) have a negative mindset, while an equal number of respondents, 32.7%, have both a positive and moderate mindset.

**Number of platforms:** In terms of gender, the majority of male (55.1%) respondents reported high usage of multiple platforms, 27.5% reported low usage, and the remaining 17.2% reported moderate usage on multiple social media platforms. In terms of female respondents, the majority (47.7%) reported lower platform usage, 30.0% moderate usage, and 22.1% high usage of multiple platforms.

**Purpose:** In terms of gender, the majority of male respondents (49.4%) reported using social media for multiple purposes, 37.9% for a single purpose, and the remaining 12.6% for moderate intentions. The majority of female respondents (44.2%) reported high use of social media for multiple purposes, while 40.7% reported less purpose and 15.0% showed moderate purpose.

**Frequency:** In terms of gender, the majority of male respondents (50.6%) reported higher frequency of social media usage, 28.7% reported moderate frequency, and the remaining 20.6% reported lower frequency of social media usage. In terms of female respondents, the majority (41.6%) reported using social media more frequently, while 35.3% reported using it less frequently, and 23.0% are showed moderate frequency in social media usage.

**Emotional imbalance:** With respect to gender, the majority of males (80.4%) showed high emotional imbalance, 16.09% have moderate emotional imbalance, and the remaining 3.4% showed less emotional imbalance for using social media sites. With respect to female respondents, majority are (64.6%) showed higher emotional imbalance after using social media sites where as 19.5% reported lower emotional imbalance, and 15.9% showed moderate emotional imbalance after using social media sites.

**Table-8: Mean, SD and t-value of social media addiction dimensions by gender**

Sl.No	Dimensions	Gender	Mean	SD	t-value
1.	Mindset	Male(87)	7.30	3.062	.169 NS
		Female(113)	6.70	3.038	



2.	Number of Platform	Male(87)	11.78	3.820	<b>.000**</b>
		Female(113)	9.44	2.970	
3.	Purpose	Male(87)	10.15	2.305	.764 NS
		Female(113)	10.04	2.561	
4.	Frequency	Male(87)	2.92	1.806	<b>.005*</b>
		Female(113)	2.23	1.609	
5.	Emotional imbalance	Male(87)	2.77	2.311	<b>.001**</b>
		Female(113)	1.76	2.093	

\*\*significant at 0.01% level, \*significant at 0.05% level, NS-Not significant

Table 8 shows the mean, SD, and t-values for social media addiction dimensions by gender. In terms of mindset dimension, the obtained mean and SD values among male students are 7.30 and 3.06. Female students scored 6.70 and 3.03, respectively. The obtained t-value is 0.169, which is insignificant.

The mean and standard deviation values for the number of platform dimensions among male students are 11.78 and 3.820, respectively. Female students showed values of 9.44 and 2.970, respectively. In addition, the obtained t value was 0.000%, which is significant at the 0.01% level. This demonstrated that male students use the most platforms compared to female students.

The mean and standard deviation values for the purpose dimension among male students were 10.15 and 2.305, respectively. Female students' scores were 10.04 and 2.561, respectively. The obtained t-value of 0.764 is not statistically significant.

In terms of frequency dimension, male students have mean and SD values of 2.92 and 1.806, respectively. Female students' scores were 2.23 and 1.609, respectively. The obtained t-value was 0.005%, which is significant at the 0.05 percent level. This suggests that male college students use social media more frequently than female students.

In the emotional imbalance dimension, the mean and SD values for male students are 2.77 and 2.311. Female students' values were 1.76 and 2.093. The calculated t-value was 0.001, indicating significance at the 0.01% level. This demonstrated that male college students experience greater emotional imbalance than females when using social media sites.

**Table 9: Level of social media addiction by area of residence**

Sl.No	Area of residence	Low		Moderate		High	
		N	%	N	%	N	%
1.	Rural(78)	29	37.1	17	21.7	32	41.0
2.	Semi-urban(43)	12	27.9	10	23.3	21	48.8
3.	Urban(79)	28	35.4	28	35.4	23	29.1
	<b>Total(200)</b>	<b>69</b>	<b>34.5</b>	<b>55</b>	<b>27.5</b>	<b>76</b>	<b>38.0</b>

Table-9 depicts social media addiction among college students with respect to area of

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residence

With respect to rural areas, the majority of them are showing (41.0%) a high level of social media addiction, 37.1% are under a low level of addiction, and the remaining 21.7% showed moderate social media addiction.

In case of semi-urban area, majority i.e., 48.8 % showed that they are highly addicted to social media, 27.9% showed lower level addiction and the rest 23.3% are under moderate level of social media addiction.

With respect to urban area, majority i.e., 35.4 % reported that they are less as well as moderately addicted to social media, 29.1% showed higher level of social media addiction.

**Table-10 Mean, SD, and F-value of social media addiction by area of residence**

Sl.No	Area of residence	Mean	SD	F-value
1.	Rural(78)	32.87	9.001	.262 NS
2.	Semi-urban(43)	33.27	9.720	
3.	Urban(79)	31.03	7.014	

NS-Not significant

Table 10 explains mean, SD and F-values of social media addiction with respect to area of residence

The mean and SD for social media addiction were 32.87 and 9.001 in rural areas, 33.27 and 9.720 in semi-urban areas, and 31.03 and 7.014 in urban areas. The F-value of 0.262 indicates no significant difference based on the area of residence.

**Table 11: Level of social media addiction dimension by area of residence**

Sl.No	Dimensions	Area of residence	Low		Moderate		High	
			N	%	N	%	N	%
1.	Mindset	Rural(78)	25	32.0	19	24.3	34	43.6
		Semi-urban(43)	12	27.9	12	27.9	19	44.1
		Urban(79)	24	30.3	28	35.4	27	34.1
2.	Number of Platform	Rural(78)	30	38.4	18	10.2	30	38.4
		Semi-urban(43)	17	39.5	12	27.9	14	32.5
		Urban(79)	31	39.2	19	24.0	29	36.7
		Total(200)	78	39.0	49	24.5	73	36.5
3.	Purpose	Rural(78)	28	35.8	11	14.1	39	50.0
		Semi-urban(43)	18	41.8	4	9.3	21	48.8

		Urban(79)	33	41.8	13	16.4	33	41.8
		Total(200)	79	39.5	28	14.0	93	46.5
4.	Frequency	Rural(78)	20	25.6	18	23.07	40	51.2
		Semi-urban(43)	10	23.2	11	25.5	22	51.1
		Urban(79)	28	35.4	22	27.8	29	36.7
		Total(200)	58	29.0	51	25.5	91	45.5
5.	Emotional imbalance	Rural(78)	10	12.8	11	14.1	57	73.0
		Semi-urban(43)	4	9.3	7	16.2	32	74.4
		Urban(79)	11	13.9	14	17.7	54	68.4
		Total(200)	25	12.5	32	16.0	143	71.5

Table-11 describes the level of social media addiction dimensions by area of living

**Mindset:** In rural areas, the majority (43.6%) reported a negative mindset, 32.0% reported a positive mindset, and 24.3% reported a moderate mindset regarding social media usage. In semi-urban areas, the majority (44.1%) reported a negative mindset while using social media, with 27.9% reporting both positive and moderate mindsets. In urban areas, the majority (35.4%) showed a normal mindset on social media sites, while 34.1% showed a negative mindset and 30.3% reported a positive mindset.

**Number of platforms:** Concerning rural areas, the majority (38.4%) reported both low and high levels of multiple platform usage, with the remaining 10.2% reporting a normal number. In semi-urban areas, the majority (39.5%) reported high platform usage, 32.5% reported low platform usage, and 27.9% reported normal platform usage on social media. In urban areas, the majority (39.2%) used social media platforms extensively, 36.7% infrequently, and the remaining 24.0% on a regular basis.

**Purpose:** In rural areas, the majority (50.0%) use social media sites for multiple purposes, followed by 35.8% for fewer purposes and 14.1% for moderate purposes. In semi-urban areas, the majority (48.8%) used social media for multiple purposes, 41.8% for minimal purposes, and 9.3% for moderate purposes. In urban areas, the majority (41.8%) use social media for both basic and multiple purposes, with 16.4% using it for moderate purposes.

**Frequency:** In rural areas, the majority (51.2%) of people use social media more frequently, 25.6% less frequently, and 23.07% moderately. In the semi-urban area, the majority (51.1%) reported higher frequency of social media use, 25.5% moderate frequency, and 23.2% lower frequency. In urban areas, the majority (36.7%) reported using social media more frequently, 35.4% less frequently, and 27.8% moderately.

**Emotional imbalance:** In rural areas, 73.0% reported high emotional imbalance on social media sites, 14.1% reported moderate emotional imbalance, and 12.8% reported low emotional imbalance on social networking sites. In semi-urban areas, the majority (74.4%) reported higher emotional imbalance on social media, 16.2% showed moderate emotional imbalance, and the remaining 9.3% experienced lower emotional imbalance while using social media. In urban areas, the majority (68.4%) reported higher emotional imbalance on social media, with 17.7% reporting

moderate emotional imbalance and 13.9% reporting lower emotional imbalance.

**Table-12: Mean,SD, and F-value of social media addiction dimensions by area of residence**

Sl.No	Dimensions	Area of residence	Mean	SD	F-value
1.	Mindset	Rural(78)	7.10	3.421	.247 NS
		Semi-urban(43)	7.45	3.114	
		Urban(79)	6.54	2.582	
2.	Number of Platform	Rural(78)	10.56	3.507	.938 NS
		Semi-urban(43)	10.45	3.843	
		Urban(79)	10.36	3.471	
3.	Purpose	Rural(78)	10.31	2.408	.597 NS
		Semi-urban(43)	10.00	2.779	
		Urban(79)	9.92	2.301	
4.	Frequency	Rural(78)	2.72	1.787	.084 NS
		Semi-urban(43)	2.80	1.746	
		Urban(79)	2.19	1.620	
5.	Emotions/feelings	Rural(78)	2.18	2.237	.422 NS
		Semi-urban(43)	2.57	2.564	
		Urban(79)	2.01	2.048	

NS-Not significant

Table-12 explains the mean, standard deviation, and F-value of social media addiction dimension by area of residence.

The study found no significant differences across rural, semi-urban, and urban areas in various dimensions of social media addiction. The mindset, number of platforms, purpose, frequency, and emotional imbalance dimensions all showed similar mean and SD values across these areas, with non-significant F-values ranging from 0.084 to 0.938.

### CONCLUSION

In the present study, the social media addiction among college students is 38.0% higher among male students. They have high usage in the number of platforms and frequency of social media usage and were found to be emotionally imbalanced on social media sites. In comparison, age and area of residence did not predict any significant difference in social media addiction. Researchers suggest that more studies focus on the health implications of social media usage and its correlation with frequency.

### **LIMITATIONS AND RECOMMENDATION**

The data for this study on social media addiction was collected solely from college students, which may not accurately reflect the social networking behavior of the general population. However, this study could serve as a foundation for future research into networking behavior in the general population in greater depth.

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## EXPLORATIVE STUDY ON RISKS AND RESILIENCE AMONG YOUTH – AN ANALYSIS OF SENSITISATION PROGRAMME

Fenny Leferty Kharpuri<sup>1</sup> and Ramya Bhaskar<sup>2</sup>

<sup>1</sup>Research Scholar, <sup>2</sup>Assistant Professor,

Department of Human Development,

Avinashilingam Institute for Home Science and Higher Education for Women,  
Coimbatore, Tamil Nadu, India-641043,

<sup>1</sup>fennysohklet@gmail.com, <sup>2</sup>ramya\_hd@avinuty.ac.in

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### ABSTRACT

Youth live in a society serene of social spheres influencing their belief, attitudes and behaviour. Youth lifestyles are of concern. Their lives today are galloped with stress, anxieties, depression, identity crisis, relationship break-downs, conflicts and sensuality. A sample of 1710 youth aged 18-22 years were selected for the study at random from Coimbatore city, Tamil Nadu. Youth Risk Behaviour Scale and Resilience Questionnaire was administered to study the risk behaviours and resilience among youth. Results revealed that risk behaviours were found to be moderate to high and resilience was found to be moderate to low. MANOVA demonstrated a significant effect of sensitisation programme on risks behaviours and resilience dimensions except for adaptability. The post data follow up scores highlighted the need for intervention programmes to sustain the effect and have a long term positive outcome in preventing risks and promoting resilience.

**Keywords:** Behaviour, Resilience, Risk, Youth.

### INTRODUCTION

Youths are the most energetic slice of the population in any country. They are the future nation builders yet the most vulnerable group in the society. World Health Organisation has defined 'Youth' as the age group between 15-24 years. They need to be taken good care of in the environment settings from within the family to the outside society. If youth are molded in their early ages they will have a better understanding of their future life. Youth fall into many diverse responsibilities where they rest their shoulders on wrong support to carry their future and fall into various types of risks.

Risk factors are state of affairs in a family, school and community that upsurge the probability that will be involved in unhealthy behaviour. Protective factors are the situations in a family, school or community that helps deal with life challenges. Protective factors are instrumental

in healthy development as they build resilience, skills and connections as indicated by Shaffer and Kipp (2014).

According to Terzian, Andrews, and Moore (2011), risky behaviour among adolescents is the leading cause of sexually transmitted infections, unintended pregnancies, cognitive damage, injuries and suicide attempts. Adolescents will engage in risky behaviour to please peers and for fear of rejection (Morojele, Brook, & Kachienga, 2006). Risky sexual behaviour and substance use are major health concerns for youth. Risky sexual behaviour include early initiation of sexual intercourse, high-risk partners or sex with a partner who has one or more partners at a time (Ma et al., 2009). For Taylor-Seehafer & Rew, 2000, inconsistent use of condoms and unprotected sexual intercourse are also risky sexual behaviours, leading to association with transmitted diseases, unplanned pregnancies and risk reputation. Dunn et al., 2008 reported heavy drinking adolescents were four times more apt to be sexually active at an earlier age and had 50% more sexual partners when compared to regular drinkers. These behaviours can lead to long-term consequences such as lifetime sexually transmitted diseases or teen pregnancy (Dunn et al., 2008).

Conversion is the exclusivity of “Youth” that occurs in the form of a journey from childhood dependency to adulthood independence. This period of evolution comprehends widespread alternations in their physical, cognitive, and psychosocial development affecting their personal preferences and priorities. Their roles and responsibilities will also see extreme modifications, considered to be critical as youth start establishing behaviours which can be health-promoting or risky that largely decide the existing and forthcoming well-being.

Risk and resilience tend to co-exist in many ways and inform one another, in the sense that it is not the absence of resilience for risk and vice-versa. Shaping the relationship between risk and resilience factors has significant implications to shape the youth’s future. Available literature focuses to a large extent on single behavioural outcomes such as substance abuse or unwanted sexual behaviours and lacks examination of multiple interrelated risk-taking behaviours. Inspecting the interrelation between different patterns of risk and resilience factors has become the need of the hour. It is beneficial to determine the diverse role of risk versus resilience factors to plan and execute intervention strategies for youth to educate them on hazardous risk behaviours and enrich resilience among youth in the interest of their wellbeing.

## **OBJECTIVES**

- To assess the incidence of risk behaviours among the selected youth
- To assess the levels of resilience among the selected youth
- To examine the effect of sensitisation programme on the levels of risk behaviours and resilience among the selected youth

## **METHODOLOGY**

A cross-sectional study was conducted on 1710 youth between 18-22 years. Both males (911) and females (799) were selected from the five zones of Coimbatore city using simple random sampling method.

Youth Risk Behaviour Survey (YRBS) and the Resilience scale were used to collect the data. The 2019 YRBS is a self-report questionnaire scale by the “Centers for Disease Control and Prevention” to track the adolescent risk behaviour over time, it was directed to a sample of youth planned to monitor health and risk-behaviours under five factors of risk namely safety, suicide, substance use, sexual behaviour and health issues. The Resilience Questionnaire 2017 is used to

assess the youth's response to resilience, dealing of resilience within self, in family, school, with peers and in community domains. There are eight components of resilience in this questionnaire namely- Self-belief, optimism, purposeful direction, adaptability, ingenuity, challenge orientation, emotion regulation and support-seeking. Items on both the questionnaire and scale are measured on a rating scale and the overall scores indicate the levels of risks and resilience as the ability to cope with risk effectively. Higher scores indicate high risks and the same pattern is followed to assess levels of resilience.

The institute human ethical clearance was obtained. Permission was obtained from schools and colleges, where English is the medium of instruction. Further, a sensitisation programme was conducted for the youth. A total of 122 youths were taken as the experimental group based on the willingness to participate in the programme and 62 youth were taken as control group (waitlist). The sensitisation programme was conducted for 6 days consisting of 15 sessions on various aspects of risks and resilience. Each session lasted for two hours duration including questioning and focus group discussion. The programme was conducted in Dr. G.R. Damodaran College of Science, Coimbatore, Tamil Nadu. Data was collected from experimental and control group before the sensitisation programme (pre-test) and after the sensitisation programme post data collection was done at two intervals. The first post data was collected after 10 days of the programme and follow-up data was collected after a gap of a month. Frequency and percentages were calculated to assess the levels of risks and resilience levels. The pre and post-data were analysed to assess the effect of sensitisation programme using MANOVA.

## RESULTS AND DISCUSSION

### Levels of Risk and Resilience Factors

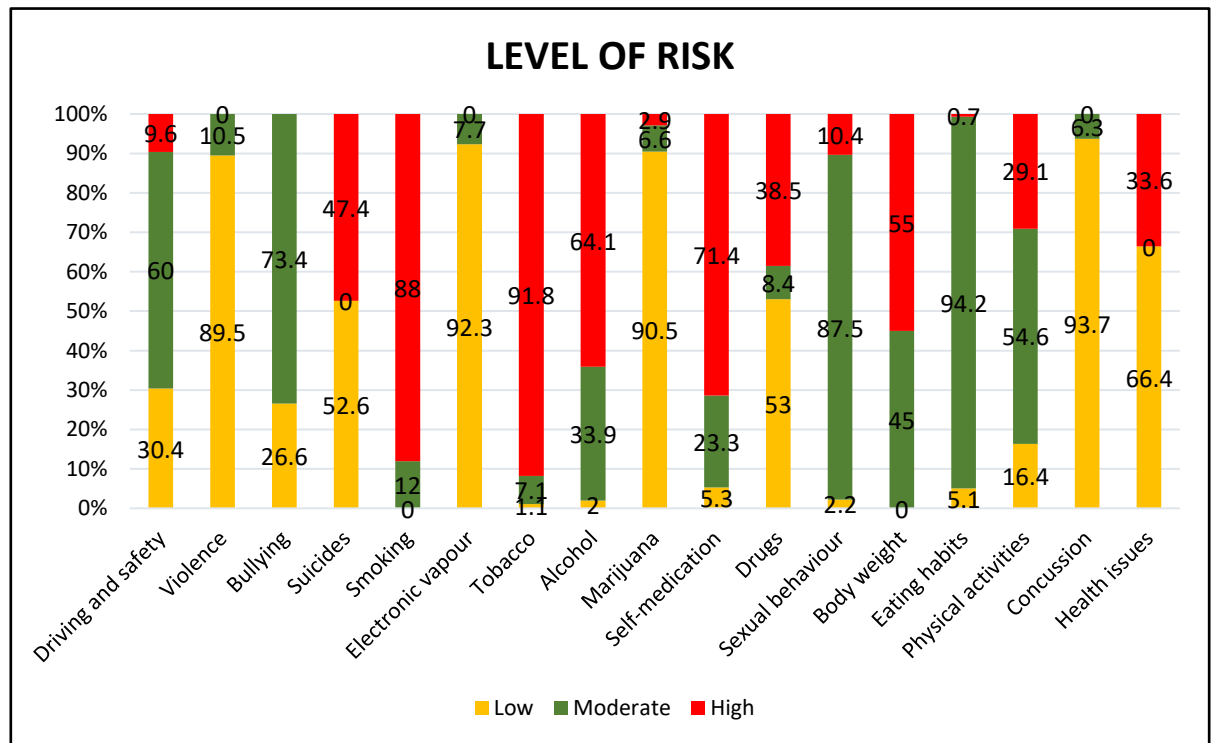


Figure-1



Figure-1 shows the level of risks among youth. Majority of the youth experienced moderate levels of risk behaviours. When it comes to driving and safety, the majority of youth experienced a moderate level of risk, low violent-related behaviours, moderate bullying, high smoking, low electronic vapour, high tobacco use, high alcohol consumption, low marijuana, high self-medication, high drugs, moderate sexual behaviour, high body weight, moderate eating-habits, moderate physical-activities, low concussions, and moderate health-related issues. The results highlighted that smoking, tobacco, alcohol and self-medication risks were seen to be higher, a worldwide problem that has affected many adolescents and youth. A report by WHO, 2022 brings out the fact that youth who start early with substance use are at higher risk during their adult life problems with developing dependency, also, compared to older people, younger people are unduly affected by substance use.

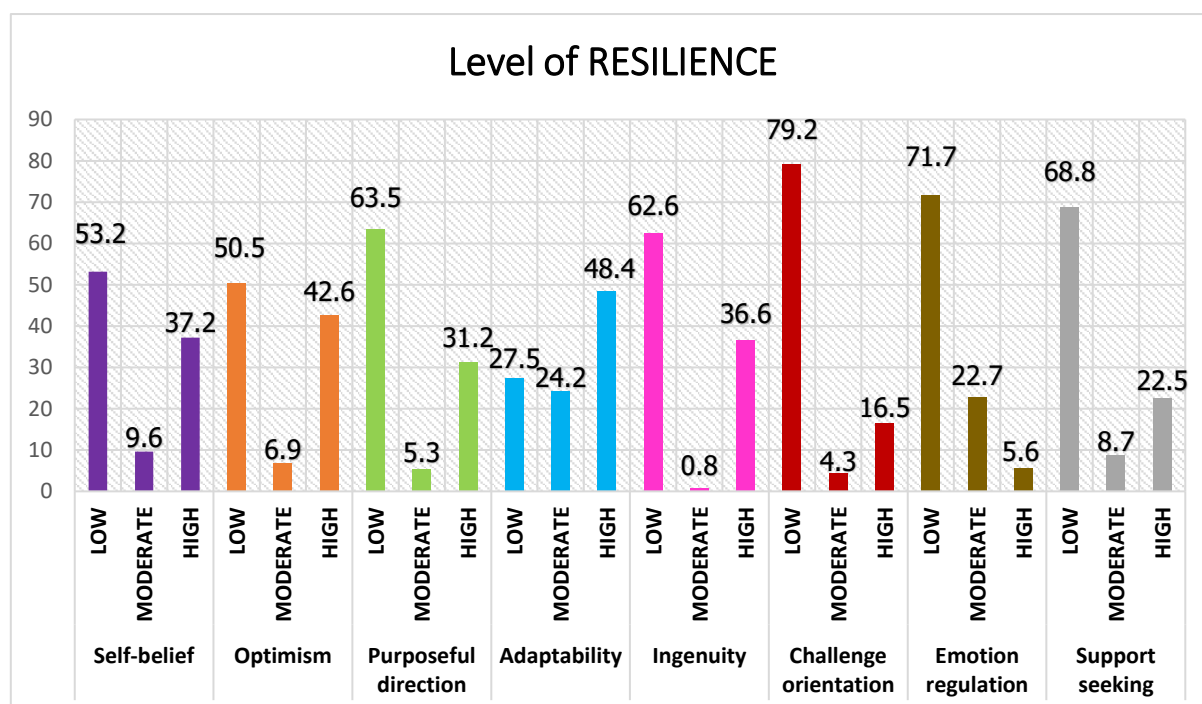


Figure-2

This study indicates that all eight dimensions of resilience can contribute to good coping with the aftermath of major potentially traumatic events and risky behaviours. Figure-2 shows the different levels of resilience factors. In the dimensions of self-belief, optimism, purposeful direction, ingenuity, challenge orientation, emotional regulation and support seeking the majority of the youth experienced a low level of resilience and only adaptability was found to be at high-level among youth.

### Results of MANOVA analysis

Multivariate analysis of variance was done to test the statistical significance of the effect of the independent variables on the set of dependent variables that is the effect of the sensitisation programme on risk factors among youth of the experimental group during the pre and post-sensitisation and follow-up data (after one month).

**Table-1(a): Descriptive Statistics**

Dependent Variable	Time of Measurement	Experimental Group (N=30)	
		M	SD
Safety	Pre sensitisation	28.61	4.583
	Post sensitisation	24.80	4.063
	Follow up 1	25.19	5.959
Suicide	Pre sensitisation	7.91	1.060
	Post sensitisation	7.64	.824
	Follow up 1	6.56	1.172
Substance use	Pre sensitisation	132.19	7.998
	Post sensitisation	109.60	16.517
	Follow up 1	90.39	15.833
Sexual behaviour	Pre sensitisation	24.23	4.987
	Post sensitisation	26.98	3.250
	Follow up 1	14.31	4.616
Health issues	Pre sensitisation	100.61	14.868
	Post sensitisation	93.62	16.838
	Follow up 1	82.06	18.033

The first step of the analysis is descriptive statistics (table 1a) showing the mean and standard deviation of the variables. The mean scores of pre-sensitisation, post-sensitisation and post-sensitisation follow up 1 are depicted and the test between the subject effects showed that the means were significantly different (as per Wilk's ( $\Lambda$ ) value).

**Table-1(b): Univariate Analysis of Variance for risk factors**

Measures	Sum of squares	F(df1,df2)	Mean	P	$\eta^2$
Safety	1072.180	23.949(2,242)	536.090	.000	.165
Suicide	124.967	53.551(2,242)	65.362	.000	.307
Substance use	106789.57	363.819(2,242)	53394.790	.000	.750
Sexual behaviour	10839.104	285.391(2,242)	5419.552	.000	.702
Health issues	21432.311	36.867(1.817,219.871)	11794.706	.000	.234

The univariate test results (table 1b) showed a significant interaction between the subject factors of all the risk behaviours namely safety, suicide, substance abuse, sexual behaviours and health issues ( $P < .000$ ) with 16.5%, 30.7%, 75%, 70.2% and 23.4% of variance respectively based on the given Partial Eta Squared value.

**Table-1 (c) Pair wise comparison of Risk measures on the post sensitisation factors of pre data, post sensitisation follow up one and follow up two**

Measure	(I) factor1	(J) factor1	Mean Difference (I-J)	Std. Error	Sig
Safety	Pre sensitisation	Post sensitisation	3.811**	.584	.000
		Follow up 1	3.418**	.662	.000
	Post sensitisation	Pre sensitisation	-3.811**	.584	.000
		Follow up 1	-.393	.567	1.000
	Follow up 1	Pre sensitisation	-3.418**	.662	.000
		Post sensitisation	.393	.567	1.000
Suicide	Pre sensitisation	Post sensitisation	.270.	.123	.088
		Follow up 1	1.352**	.147	.000
	Post sensitisation	Pre sensitisation	-.270	.123	.088
		Follow up 1	1.082**	.144	.000
	Follow up 1	Pre sensitisation	-1.352**	.147	.000
		Post sensitisation	-1.082**	.144	.000
Substance use	Pre sensitisation	Post sensitisation	22.590**	1.381	.000
		Follow up 1	41.795**	1.635	.000
	Post sensitisation	Pre sensitisation	-22.590**	1.381	.000
		Follow up 1	19.205**	1.624	.000
	Follow up 1	Pre sensitisation	-41.795**	1.635	.000
		Post sensitisation	-19.205**	1.624	.000
Sexual behaviour	Pre sensitisation	Post sensitisation	-2.754**	.539	.000
		Follow up 1	9.918**	.606	.000
	Post sensitisation	Pre sensitisation	2.754**	.539	.000
		Follow up 1	12.672**	.526	.000
	Follow up 1	Pre sensitisation	-9.918**	.606	.000
		Post sensitisation	-12.672**	.526	.000
Health issues	Pre sensitisation	Post sensitisation	6.992*	2.494	.018
		Follow up 1	2.097**	2.097	.000
	Post sensitisation	Pre sensitisation	2.494*	2.494	.018
		Follow up 1	1.918**	1.918	.000
	Follow up 1	Pre sensitisation	2.097**	2.097	.000
		Post sensitisation	1.918**	1.918	.000

Pair-wise comparison (table 1c) showed the difference between mean scores of the factors of the risk measures. Coming to safety aspect of risk, pre-sensitisation factor significantly differed with post-sensitisation and follow-up 1 with mean differences being MD= 3.811, P< .000, MD= -3.418, P<.000, and respectively. Further, the safety factors of pre-sensitisation significantly differed only with pre-sensitisation factor. There were no significant differences between the post-sensitisation scores and the scores of follow-up 1.

In measures of suicide risk there was a significant difference only between pre-sensitisation and follow up 1 with mean difference being MD= 1.352, P< .000. There was no significant difference found between the pre sensitisation and post sensitisation scores. The suicide risk factors of post-sensitisation were again seen to be significantly different only with follow up 1 and did not show any significant difference with pre-sensitisation scores. Further coming to the follow up 1 factor of suicide aspect of risk it was found to differ significantly with both pre-sensitisation and post-sensitisation with mean differences being MD= -1.352, P< .000, MD= -1.082, P<.000, respectively.

Coming to measures of substance use, sexual behaviour and health issues the pre-sensitisation scores showed a significant difference with post-sensitisation and follow-up 1 (P<.000). Similarly post-sensitisation scores differed significantly with pre-sensitisation scores and follow up 1 and same significant difference was noted between the scores of follow up 1 with pre and post-sensitisation scores.

The results of repeated measure indicated that the sensitisation program for youths on the measures of risk factors showed a significant effect during post-sensitisation, where the pre and post scores showed a significant difference with decreased scores in post-test. The post-sensitisation scores and the scores of the follow-up 1 explained that the effect was sustained with mean scores of follow up 1 persisting to be lower than pre-scores, but increased when compared to post-test scores.

**Results of MANOVA analysis on resilience**

Multivariate analysis of variance was done to analyze the statistical significance of the effect of the independent variables on the set of dependent variables that is the effect of the sensitisation programme on resilience among youths of the experimental group during the pre and post-sensitisation and follow up 1 data (after one month).

**Table-2(a): Descriptive Statistics**

Dependent Variable	Time of Measurement	Experimental Group (N=30)	
		M	SD
Self-belief	Pre sensitisation	22.19	9.217
	Post sensitisation	29.87	8.396
	Follow up 1	30.94	6.348
Optimism	Pre sensitisation	19.93	10.440
	Post sensitisation	32.64	9.579
	Follow up 1	31.16	4.184
Purposeful direction	Pre sensitisation	18.64	11.071
	Post sensitisation	31.77	10.246
	Follow up 1	34.70	8.161
Adaptability	Pre sensitisation	17.39	8.767
	Post sensitisation	19.30	8.376
	Follow up 1	17.33	8.057
Ingenuity	Pre sensitisation	18.87	8.124
	Post sensitisation	21.16	9.935
	Follow up 1	22.72	11.105
Challenge orientation	Pre sensitisation	17.50	8.941

	Post sensitisation	24.28	12.495
	Follow up 1	22.44	10.077
Emotional regulation	Pre sensitisation	17.84	9.879
	Post sensitisation	18.67	9.408
	Follow up 1	28.32	10.158
Support seeking	Pre sensitisation	18.93	10.228
	Post sensitisation	18.88	8.871
	Follow up 1	22.60	9.447

The first step of the analysis is descriptive statistics (table 2a) showing the mean and standard deviation of the variables. The mean scores of pre-sensitisation, post-sensitisation and follow-up 1 are depicted and the test between the subject effects showed that the means are significantly different (as per Wilk’s ( $\Lambda$ ) value) except for adaptability.

**Table-2(b): Univariate Analysis of Variance for resilience**

Measures	Sum of squares	F(df1,df2)	Mean	P	$\eta^2$
Self-belief	5562.169	44.199(1.848,223.646)	3009.326	.000	.268
Optimism	11774.377	73.576(1.434,173.574)	8208.037	.000	.378
Purposeful direction	17845.721	83.537(2,242)	8922.861	.000	.408
Adaptability	308.432	2.260(2,242)	154.216	.107	.018
Ingenuity	916.393	5.450(2,242)	458.197	.005	.043
Challenge orientation	29999.219	15.523(1.742,210.732)	1722.114	.000	.114
Emotional regulation	8282.989	42.360(2,242)	4141.495	.000	.259
Support seeking	1111.628	6.285(2,242)	555.814	.000	.049

The univariate test results (table 2b) showed a significant interaction between the subject factors of all the resilience ( $P < .000$ ) with 26.8%, 37.8%, 40.8%, 4.3%, 11.4%, and 25.9% of variance respectively based on the given Partial Eta Squared value except for adaptability that showed a non-significant interaction between the subject factors.

**Table-2(c) Pair wise comparison of Risk measures on the post sensitisation factors of pre data, post sensitisation follow up one and follow up two**

Measure	(I) factor1	(J) factor1	Mean Difference (I-J)	Std. Error	Sig
Self-belief		Post sensitisation	-7.680**	1.150	.000

	Pre sensitisation	Follow up 1	-8.754**	.915	.000
	Post sensitisation	Pre sensitisation	7.680**	1.150	.000
		Follow up 1	-1.074	.968	.808
	Follow up 1	Pre sensitisation	8.754**	.915	.000
Post sensitisation		1.074	.968	.808	
Optimism	Pre sensitisation	Post sensitisation	-12.705**	1.461	.000
		Follow up 1	-11.221**	.972	.000
	Post sensitisation	Pre sensitisation	12.705**	1.461	.000
		Follow up 1	1.484	.925	.334
	Follow up 1	Pre sensitisation	11.221**	.972	.000
		Post sensitisation	-1.484	.925	.334
Adaptability	Pre sensitisation	Post sensitisation	-1.918	1.096	.248
		Follow up 1	.057	.990	1.000
	Post sensitisation	Pre sensitisation	1.918	1.096	.248
		Follow up 1	1.975	1.084	.213
	Follow up 1	Pre sensitisation	-.057	.990	1.000
		Post sensitisation	-1.975	1.084	.213
Ingenuity	Pre sensitisation	Post sensitisation	-2.295	1.227	.191
		Follow up 1	-3.852**	1.097	.002
	Post sensitisation	Pre sensitisation	2.295	1.227	.191
		Follow up 1	-1.557	1.194	.584
	Follow up 1	Pre sensitisation	3.852**	1.097	.002
		Post sensitisation	1.557	1.194	.585
Challenge orientation	Pre sensitisation	Post sensitisation	-6.779**	1.313	.000
		Follow up 1	-4.943**	1.000	.000
	Post sensitisation	Pre sensitisation	6.779**	1.313	.000
		Follow up 1	1.836	1.424	.599
	Follow up 1	Pre sensitisation	4.943**	1.000	.000
		Post sensitisation	-1.836	1.424	.599
Emotional regulation	Pre sensitisation	Post sensitisation	-.836	1.278	1.000
		Follow up 1	-10.484**	1.340	.000
	Post sensitisation	Pre sensitisation	.836	1.278	1.000
		Follow up 1	-9.648**	1.175	.000
	Follow up 1	Pre sensitisation	10.484**	1.340	.000
		Post sensitisation	9.648**	1.175	.000
Support seeking	Pre sensitization	Post sensitisation	-.049	1.140	1.000
		Follow up 1	-3.672*	1.280	.015
	Post sensitisation	Pre sensitisation	-.049	1.140	1.000
		Follow up 1	-3.721**	1.188	.007
	Follow up 1	Pre sensitisation	3.672*	1.280	.015
		Post sensitisation	3.721	1.188	.007

Pair-wise comparison (table 2c) showed the difference between mean scores of the factors of resilience measures. Coming to self-belief aspect, the pre-sensitisation factor significantly differed with post-sensitisation and follow-up 1 ( $P < .000$ ). Further, self-belief factors of post-sensitisation significantly differed only with pre-sensitisation factor. There were no significant differences between the post-sensitisation scores and the scores of follow-up 1.

In the measures of optimism, there was a significant difference between pre-sensitisation with post-sensitisation and follow-up 1 ( $P < .000$ ). The optimism factor of post-sensitisation was again seen to be significantly different only with pre-sensitisation factor and shows no significant difference with post-sensitisation follow up 1 scores. Further coming to follow-up 1 it was found to differ significantly with pre-sensitisation whereas it showed no significant differences with post-sensitisation scores.

With regard to measures of adaptability, no significant difference was found between any of the factors of pre-sensitisation with post-sensitisation and neither with follow up 1.

In measures of ingenuity, there was a significant difference found only between pre-sensitisation and follow-up 1 ( $P < .000$ ). There was no significant difference between pre-sensitisation and post-sensitisation. The post sensitisation scores showed no significant difference with both pre-sensitisation and follow up 1 scores. But the follow-up 1 was found to differ significantly only with pre-sensitisation ( $P < .000$ ) and showed no significant difference with post-sensitisation scores.

With regards to measures of challenge orientation, there was a significant difference between pre-sensitisation and follow-up 1 ( $P < .000$ ). There was no significant difference between post-sensitisation and follow up 1 and was seen to be significantly different only with pre-sensitisation scores.

Coming to measures of emotional regulation, there was a significant difference only between pre-sensitisation and follow-up 1 ( $P < .000$ ). There was no significant difference between pre sensitisation and post sensitisation scores. The post-sensitisation was seen to be significantly different only with follow-up 1 and did not show any significant difference with pre-sensitisation scores. Further coming to follow-up 1 scores it was found to differ significantly with both pre-sensitisation and post-sensitisation scores.

In measures of support seeking, there was a significant difference only between pre-sensitisation and follow up 1 ( $P < .000$ ). There is no significant difference between pre sensitisation and post sensitisation scores. The post-sensitisation was seen to be significantly different only with follow up 1 and did not show any significant difference with pre-sensitisation scores. Further coming to follow up 1 it was found to differ significantly with both pre-sensitisation and post-sensitisation ( $P < .000$ ).

The results of repeated measure indicated that the sensitisation program for youths on the measures of resilient factors showed a significant effect during post-sensitisation as well as follow up 1 in certain dimensions with increased scores, indicating sustenance as the follow up 1 showed increased scores than post-sensitisation.

## **DISCUSSION**

The study explored a substantial rate of risk behaviours among youth in Coimbatore city. The observation in this study indicated substance use was one of the risky behaviour among youths. Regardless of the party culture in the city, the ignorance about the dangers coupled with easy availability of cheap products has directed to high tobacco use. Smoking is another factor of substance use which was observed to be high at 88 percent. The Centre for disease control and Prevention 2022 found that close to 1 of every 100 middle school children and nearly 3 of every 100 high school students testified that they had smoked cigars in the past 30 days. An article released by

Adyar Cancer Institute The Tamil Nadu Tobacco Survey 2015-16 predicted that there were about 17 lakh people in Coimbatore district and rural population covering up to 3.8 per cent in the urban areas consumed nicotine-rich products. Results also indicated that there was a positive effect of sensitisation programme on youth risks and resilience where risks showed a lower score and resilience increased during the post-sensitisation except for the dimension of adaptability. The post-sensitisation scores and scores of follow-up 1 explained that the effect was sustained persisting to be lower than pre-scores, but increased when compared to post-test scores, indicating the need for intervention as a continuous process keeping youth sustain their reduced risk behaviour and enriched resilience.

### **CONCLUSION**

Youths are exclusively vulnerable in their early years and they focus on unlimited deal of peer pressure adopting certain ethics, rules and actions. Low levels of resilience have an increased risk of substance use, health issues and attempting suicide indicating the importance of promoting preventive behaviours amongst a high-risk population. Awareness early in life may help decrease the burden of complications, injuries and even death. Attention to risk factors at both individual and social levels is essential to provide fullest understanding of living a healthy youth life with enhanced resilience.

### **RECOMMENDATION**

The study can be conducted on school dropouts too. The study recommends research on the impact of an intervention programme including parents and family members along with youth to have better coverage for reducing risk and enhancing resilience from all facets. Further, it is recommended for intervention and follow-ups rather than sensitisation for better reinforcement in sustaining the prevention of risks and promoting resilience.

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## EXPERIMENTAL STUDY ON LOTUS PETIOLES FOR ITS USE IN TEXTILES LEADING TO SOCIAL ENTREPRENEURSHIP

**Sumi Haldar<sup>1</sup> & Prof. (Dr.) Madhu Sharan<sup>2</sup>**

Ph.D Research Scholar<sup>1</sup> & Professor<sup>2</sup>

Department of Clothing and Textiles

Faculty of Family and Community Sciences

The Maharaja Sayajirao University of Baroda, Vadodara, Gujarat

Email: - sumihaldar924@yahoo.com<sup>1</sup> & sharan.madhu-ct@msubaroda.ac.in<sup>2</sup>

<sup>1</sup>Hsai membership number No - HSAI-2023-GJ-1501-LF

<sup>2</sup>Hsai membership number No - 07/S-14/LF

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### ABSTRACT

Lotus (*Nelumbo Nucifera Gaertn.*) is a popular cash crop of India. After picking the flowers, fruits and rhizomes, the petioles are considered as a waste which is further abandoned for the decay. The study aims to extract fibers from Lotus petioles, develop different counts of spun yarns for applications in woven fabrics. Seven different types of yarns were developed by three different techniques: a). hand extracted and hand spun b). yarns developed from fabricated machines c). yarns developed by rotor spinning technique. Seven different types of woven fabrics: Khadi, handloom and powerloom was developed using different types of Lotus yarns for various end uses. Results revealed that fabricated machine was found more effective than manual extraction process in terms of yield and quality. Yarns developed from fabricated machines can withstand strength on powerloom.

**Keywords:** Fabric, Fiber, Lotus, Petiole, Yarn

### INTRODUCTION

Lotus (*Nelumbo Nucifera Gaertn.*) is one of the most ornamental aesthetic indigenous species endowed with unique nutritional and biological traits. (Pandey, R., & Agrawal, A. (2021). Lotus cultivation generates considerable amount of petiole waste after harvesting. (Chen, Y., et.al. 2015). Lotus is widely cultivated in many countries of the world – India, China, Japan, Korea, South East Asia and Africa. In India, Lotus is widespread in Himalayan lakes, Assam, Kashmir, Madhya Pradesh, Tamilnadu, Uttar Pradesh, Maharashtra, Mysore and Kerala (Saraswathi, K., et.al.2019). Lotus is abundantly found in Central Gujarat – Ahmedabad, Anand, Kheda and Vadodara Districts and also in southern Gujarat – Valsad and Navsari districts. (<https://www.dnaindia.com/ahmedabad/column-flowers-of-some-wetland-plants-elegance-personified-2748658>)<sup>5</sup>.

Lotus cultivators sell flowers, seeds, fruits and rhizomes. But they are less aware about the petioles which are generally thrown away while cutting and bundling the flower and sometimes left in the pond during plucking flower. Thus, the research aims to experiment manual extraction process by varying number of petioles and further yarns were spun using *Ambar Charkha*. To increase the yield and obtaining the good quality of the Lotus fibers with the minimal time machine was designed and fabricated. Woven fabrics were developed using different types of yarns: - handspun, machine spun using fabricated machine and blended rotor spun yarns. Group of rural women were trained for fiber extraction and spinning. Hence the present study was conducted with following objectives:

### **OBJECTIVES**

1. To experiment the extraction process of Lotus fiber by hand (varying the number of petioles – one, two and three).
2. To experiment the spinning of extracted fibers by different techniques and test its properties.
3. To design and fabricate machine for fiber extraction and yarn spinning and study the yield with respect to speed and man power involvement.
4. To test the machine extracted yarn for Denier, Strength and Twist.
5. To develop rotor spun yarns from Lotus fibers.
6. To develop woven fabrics – handspun, handloom and powerloom fabrics and test its properties.
7. To train the group of women for fiber extraction and spinning.

### **METHODOLOGY**

#### **Procurement of Lotus petioles**

Petioles were collected from the Lotus flower vendors of Khanderao market of Vadodara district.

#### **Testing of Fibers**

Fiber properties

Physical properties like fiber length, fiber diameter, fiber fineness (ASTM D 7025-09), Moisture regain and content (**Booth, J.E. 1996**) and Bundle strength (ASTM D 1445), Fiber strength (ASTM D 3822-07) were tested. FTIR, XRD, TGA, whiteness index test was conducted at the laboratory of Bharat Ratna Prof. CNR RAO Research Centre, Avinashillingam Institute of Home Science and Higher Education for Women, Coimbatore, Tamilnadu.

#### **Extraction of fibers (manual, fabricated machine and rotor spinning)**

For achieving different counts of yarn and checking its feasibility in hand spinning and weaving, extraction was done manually by varying the number of petioles. The machine was fabricated in collaboration with the mechanical engineer. Yarns developed from the machines were weighted. Time taken to develop the yarns was noted. Bunch of five petioles were taken, slited and extracted fibers were laid on the woollen felt which were further subjected for rotor spinning.

### **Development and testing of yarn**

Three yarns developed by manual extraction process was further proceeded for spinning in *Ambar Charkha*, two yarns were developed from fabricated machines and rotor spinning respectively were further tested for tensile strength, twist and fineness (ASTM 885). Details of the yarn are mentioned in Table : 1.

### **Construction of Woven fabrics**

Seven different types of yarns were developed and tested. Based on the properties, 7 different types of woven fabrics were prepared. Details of fabrics are mentioned in Table: 2.

### **Testing of woven fabrics**

Constructed fabrics were tested for physical, dimensional stability, serviceability and handle properties (KAWABATA TEST) as per the standard test methods.

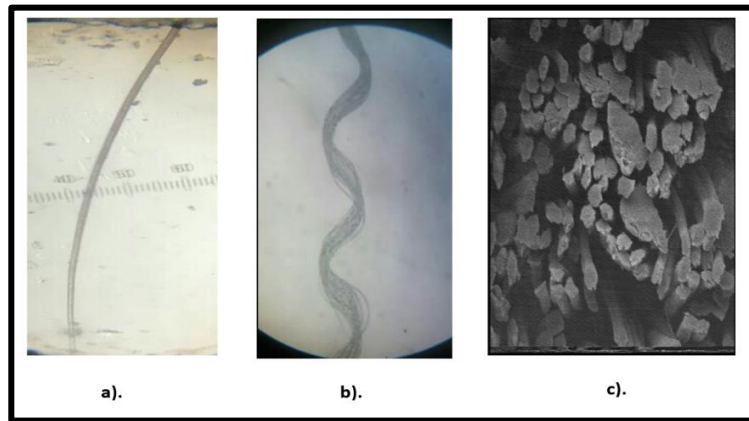
### **Training group of women**

Training programme was done in collaboration with NGO HAPPY FACES, Vadodara. Group of ladies were trained for fiber extraction and spinning. Hand woven stoles were developed and presented in different exhibitions.

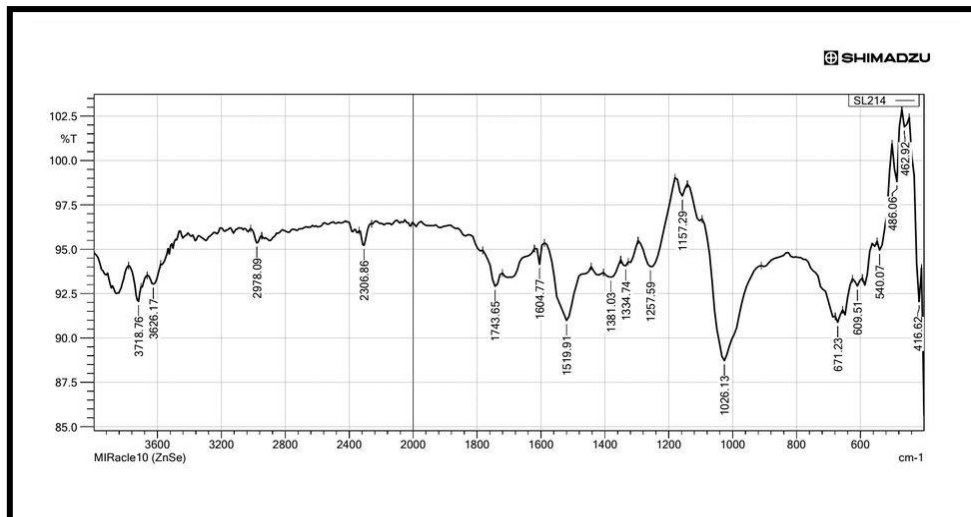
## **RESULTS AND DISCUSSION**

### **Properties of Lotus fiber**

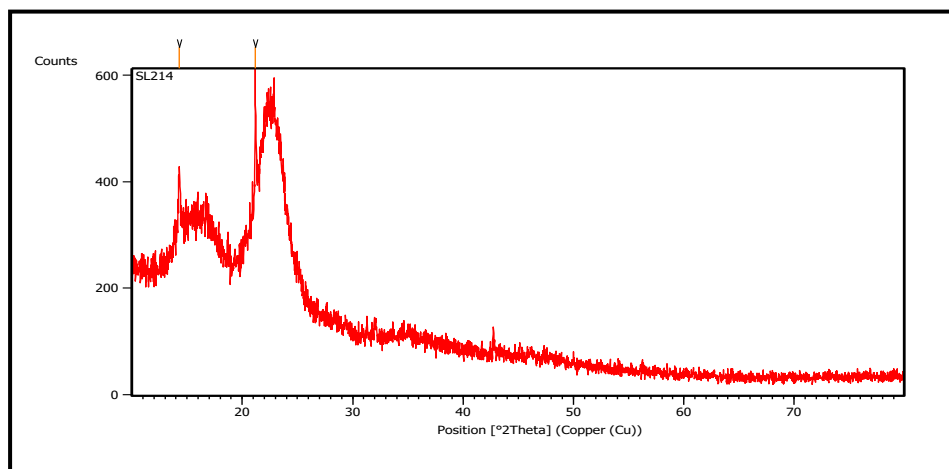
According to the test results, it was found that Length of the fiber was 60-150 Cm. and diameter of the fiber leading to 2-5  $\mu\text{m}$  which falls under the category of microfiber. Bundle strength of the fiber was 18.5 g/tex and extension was 4.2 mm. The whiteness, brightness and yellowish index of raw Lotus fiber was 15.028, 41.130 and 38.198 respectively. Single fiber strength was 161.5 g/f with the extension of 1.5589 mm. The moisture regain of the fiber was 11.8 %. FTIR analysis as shown in Graph-1, was observed that broad characteristic peaks were 3718-3628  $\text{Cm}^{-1}$  belong to the stretching of OH- groups of Cellulose – I. In the XRD analysis shown in Graph: 2 - a sharp peak was observed at 14° and wide peak was found at 21°. Peaks were not very sharp thus there were more amorphous region in Lotus fibers. Crystallinity index (CI) was 40 %. TGA curves of Lotus fiber is shown in Graph: 3 – it was observed that initial weight loss of the Lotus fiber was between 100 -200°C which may be due to the volatilization of oil and water. Second stage of weight loss was between 600-800 due to the depolymerization of hemicellulose. Thrid stage of weight loss was at 900 that causes breakdown of main chain groups of cellulose and leads to slow decomposition of complex chain-lignin. It was found the cross section was circular. Longitudinal view shows that several fibers are assembled in bundle which had a wavy structure shown in Figure: 1.



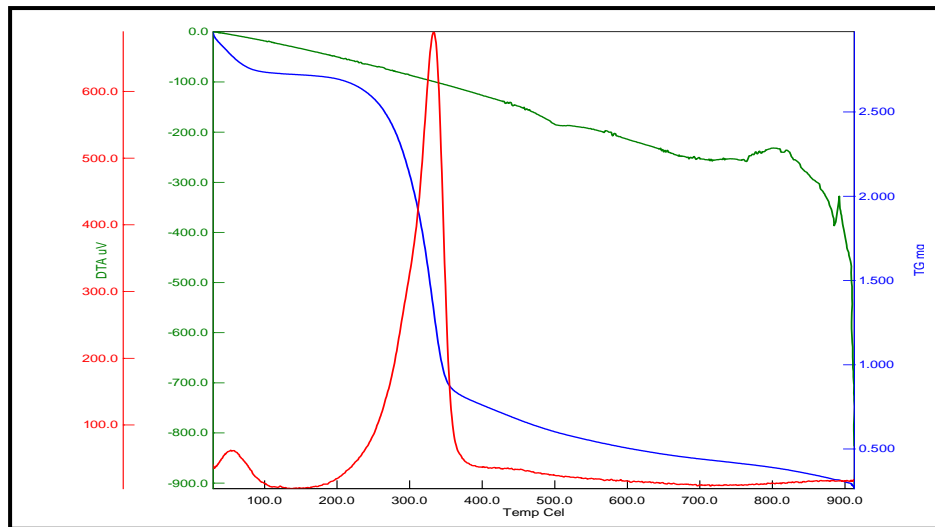
**Figure: 1** Microscopical view of Lotus Fibers a). Single Fiber -10 X (Longitudinal View). Bundle – 10 X (Longitudinal View) c). Cross sectional View of the fiber – 500 X



**Graph :1** FTIR Analysis



**Graph :2** XRD Analysis



Graph :3 TGA Analysis of Lotus Fiber

### Extraction of fibers

#### Manual extraction process for yarn making

For developing unspun yarn shown in Figure: 2, the petiole was laid on the wooden slab and slitted 5 to 8 times according to the length of the petiole with sharp knife. Extracted fibers were wound on the pern without twisting.

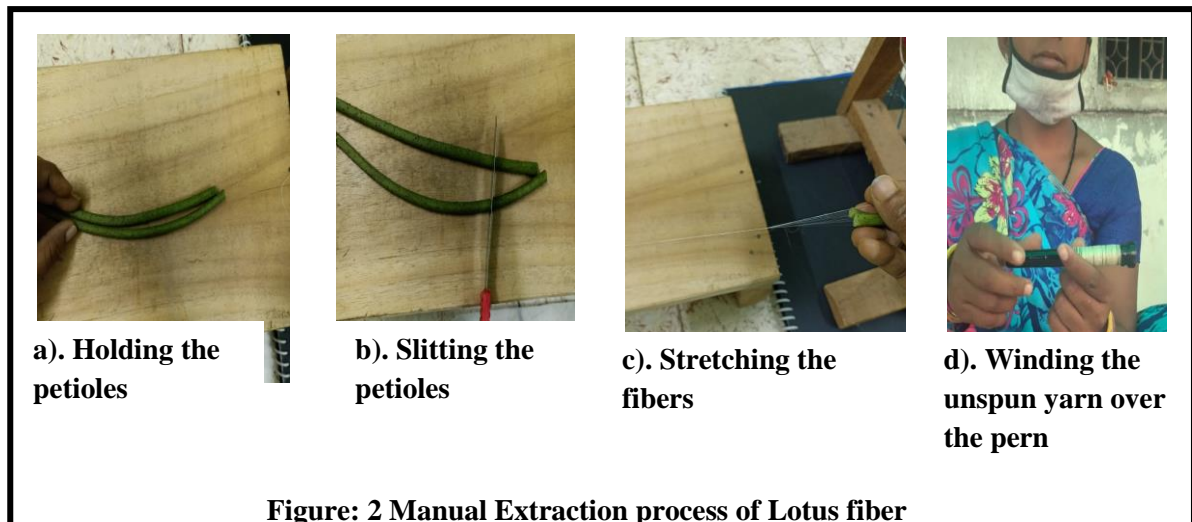


Figure: 2 Manual Extraction process of Lotus fiber

#### Extraction from the fabricated machine

There are two sections in the machine one is the input section (feeding device) and another is the output section (Winding device). The machine has got Indian patent (IN201921032058).

#### Extraction of fibers for developing Rotor yarn

The natural cohesive of the fibers and ability of the felt to stick was used to extract raw fibers which were further subjected for developing rotor yarns shown in Figure: 3.

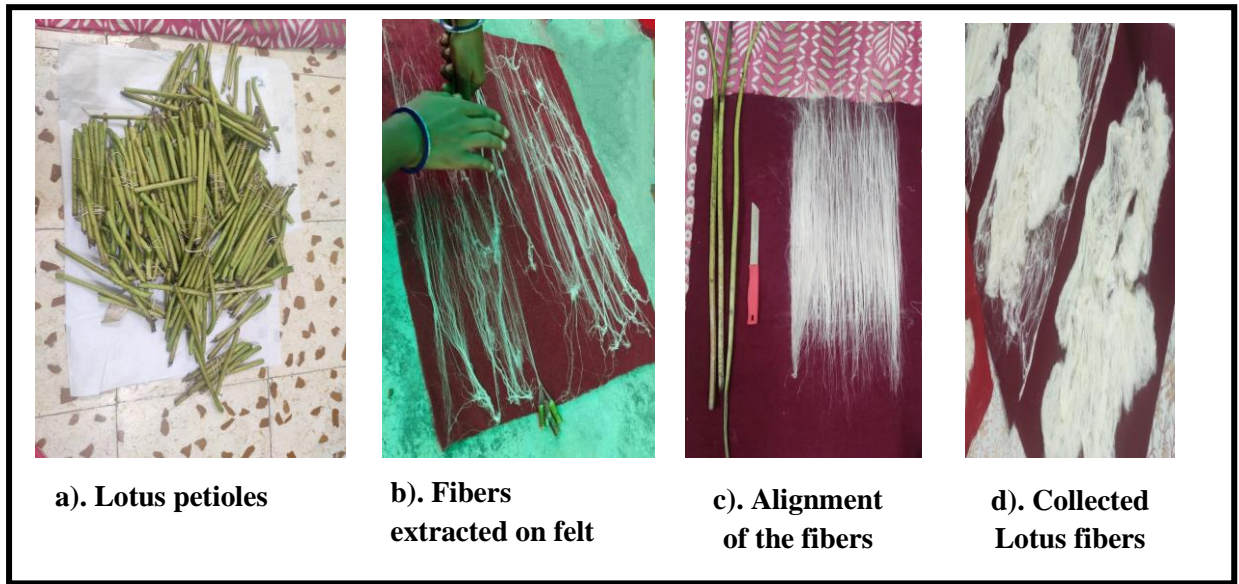


Figure: 3 Extraction process of fibers for developing Rotor yarn

### Development of yarns

#### Hand spinning

The *Ambar charkha* consists of 2 spindles was used for twisting of Lotus yarn. It is driven by hand as shown in Figure: 4.



Figure: 4 Spinning Lotus yarn on *Ambar Charkha*

#### Spinning of Lotus yarn from fabricated machine

Fabricated machine has a dual mechanism of extracting and spinning the fibers simultaneously shown in Figure: 5. Yarns of different counts were produced from fabricated machine

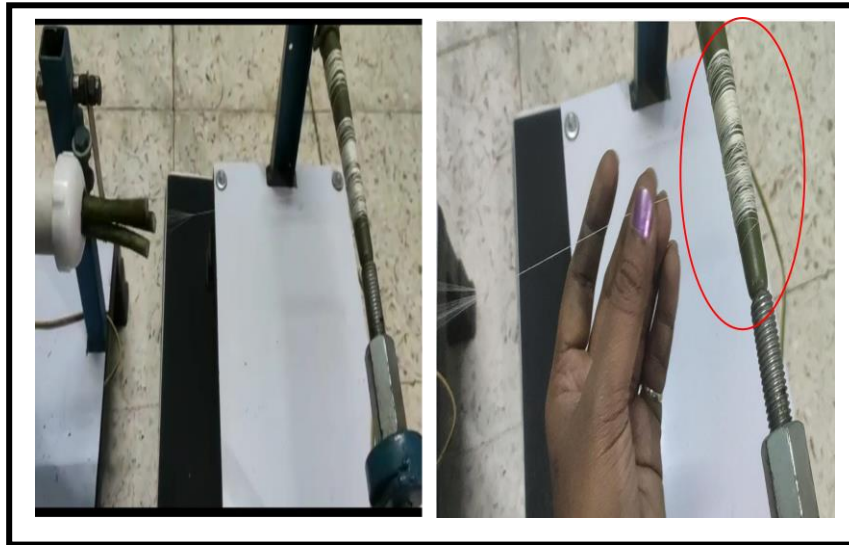


Figure :5 Spinning of Lotus yarn from fabricated machine

#### Development of Rotor spun yarn

Two blend proportion was obtained that is: 50:50 (Lotus: Cotton) and 70:30 (Lotus: Cotton). For blending process as shown in Figure:6. Initially 100 % Cotton was subjected for carding and laps were prepared. Then between two cotton laps, Lotus fibers were sandwiched, arranged and proceeded further for carding. From the lap, slivers were drawn and collected in the plastic drum. Slivers were further proceeded for Rotor spinning.





Figure : 6 Development of Lotus :Cotton Rotor spun yarn

#### Analysis of the properties of developed yarn

According to test results, it was observed that the finer yarn was L1A having a count of 96's followed by L2A that is 86's and L3A that is 81's. All the yarns consist of S-direction twist. L1A has a highest twist of 130 TPI followed by L2A that is 121 TPI and L3A that is 63 TPI. Strength of L1A yarn was higher with the maximum load of 219.188 gf followed by L3A has a maximum load of 129.763 gf. L2A yarn has a less strength with the maximum load of 115.618 gf. Amongst all the three yarns extension of L2A yarn was higher that is 4 mm.

In case of yarns developed from fabricated machine it was observed that MYHS1 was more finer with the count of (71's) followed by MYHS2 (60's). Twist direction of both the yarns were S. MYHS1 and MYHS2 has a higher twist of 100 TPI. Tensile strength of MYHS2 was higher as compare to MYHS1.

Rotor spun yarns were coarser in count. LCRY (50:50) yarn has 5's count finer than LCRY (70:30) yarn that has 3's count which may be due to the more amount of Lotus fiber in LCRY (70:30) yarn composition. Both the yarns has Z direction twist. LCRY (50:50) yarn has higher twist of 94 TPI as compare to LCRY (70:30) yarn which has 82 TPI. The strength of LCRY (70:30) yarn was more with the maximum load of 656 gf as compare to LCRY (50:50) yarn which has a maximum load of 528 gf. Extension of LCRY (70:30) yarn was higher that is 32 mm as compare to LCRY (50:50) yarn that is 30.5 mm this may be due to inherent elongation property of Lotus fibers.

**Table:1 Codes of yarns**

Sr.No	Yarn Codes	Description
1	L1A	Lotus yarn, 1 petiole extracted, Ambar charkha spun yarn
2	L2A	Lotus yarn, 2 petiole extracted, Ambar charkha spun yarn
3	L3A	Lotus yarn, 3 petiole extracted, Ambar charkha spun yarn
4	MYHS1	Machine yarn high speed 1
5	MYHS2	Machine yarn high speed 2
6	LCRY (50:50)	Lotus:Cotton Rotor yarn 50:50
7	LCRY (70:30)	Lotus:Cotton Rotor yarn 70:30

### Construction and analysis of fabric properties

**Table : 2 Details of fabrics**

Sr. No.	Fabric sample	Warp yarn		Weft yarn	
		Fiber content	Yarn count	Fiber content	Yarn count
1	HS Fabric – 1	Hand spun Cotton	120's	100 % Lotus handspun yarn	2/ 86's
2	HS Fabric – 2				3/81's
3	HL Fabric – 3				Mulberry Silk
4	PL Fabric – 8	Cotton	80's	100 % Lotus machine extracted and spun from fabricated machine	3/71's
5	PL Fabric – 9	Cotton	80's	100 % Lotus machine extracted and spun from fabricated machine	3/60's

6	PL Fabric – 13	50:30 Lotus cotton blended yarn	5's	50:30 Lotus cotton blended yarn	5's
7	PL Fabric - 14	70:30 Lotus cotton blended yarn	3's	70:30 Lotus cotton blended yarn	3's

**Preliminary data of fabrics:** comprising of thickness, fabric count and GSM is given in Table: 3.

**Table : 3 Preliminary data of fabrics**

Sr. No.	Fabric code	Thickness (mm)	Fabric Count	Cover Factor	GSM
1	HS.Fabric – 1	0.34	52×34	7.7	80
2	HS Fabric – 2	0.36	50 × 32	7.4	84
3	HL Fabric – 3	0.24	53 × 28	2.8	71
8	PL Fabric – 8	0.26	53×35	9.4	64
9	PL Fabric – 9	0.27	48×55	11	74
13	PL Fabric – 13	0.48	22×31	19	323
14	PL Fabric – 14	0.52	19×31	21.9	336

### Tensile strength of fabrics

Power loom Fabrics developed from rotor yarns has a higher tensile strength and elongation in both warp and weft direction (Table: 4). Khadi fabrics showed lesser tensile strength in weft direction. This may be due to the lesser strength of Lotus handspun yarns used in weft direction. HL Fabric – 3 (Handloom fabric: Warp - Machine spun Mulberry Silk yarn; Weft – handspun Lotus yarn – 1 petiole) has showed less elongation and tensile strength in weft direction. Union fabrics developed on powerloom has obtained higher tensile strength in weft direction. This may be due to higher strength of Lotus yarns developed from the fabricated machine.

**Table: 4 Tensile strength of fabrics**

Sr.No.	Fabric code	Maximum Load (kgf)		Extension (mm)	
		Warp	Weft	Warp	Weft
1	HS Fabric - 1	19.39	6.50	15.14	10.5
2	HS Fabric - 2	15.35	5.50	12.15	10.8
3	HL Fabric – 3	14.17	2.41	13.89	8.30
4	PL Fabric – 8	12.84	19.97	14.70	10.48
5	PL Fabric – 9	15.07	32.55	18.87	12.36
6	PL Fabric – 13	26.64	23.34	40.63	35.65
7	PL Fabric – 14	19.75	19.89	38.86	27.82

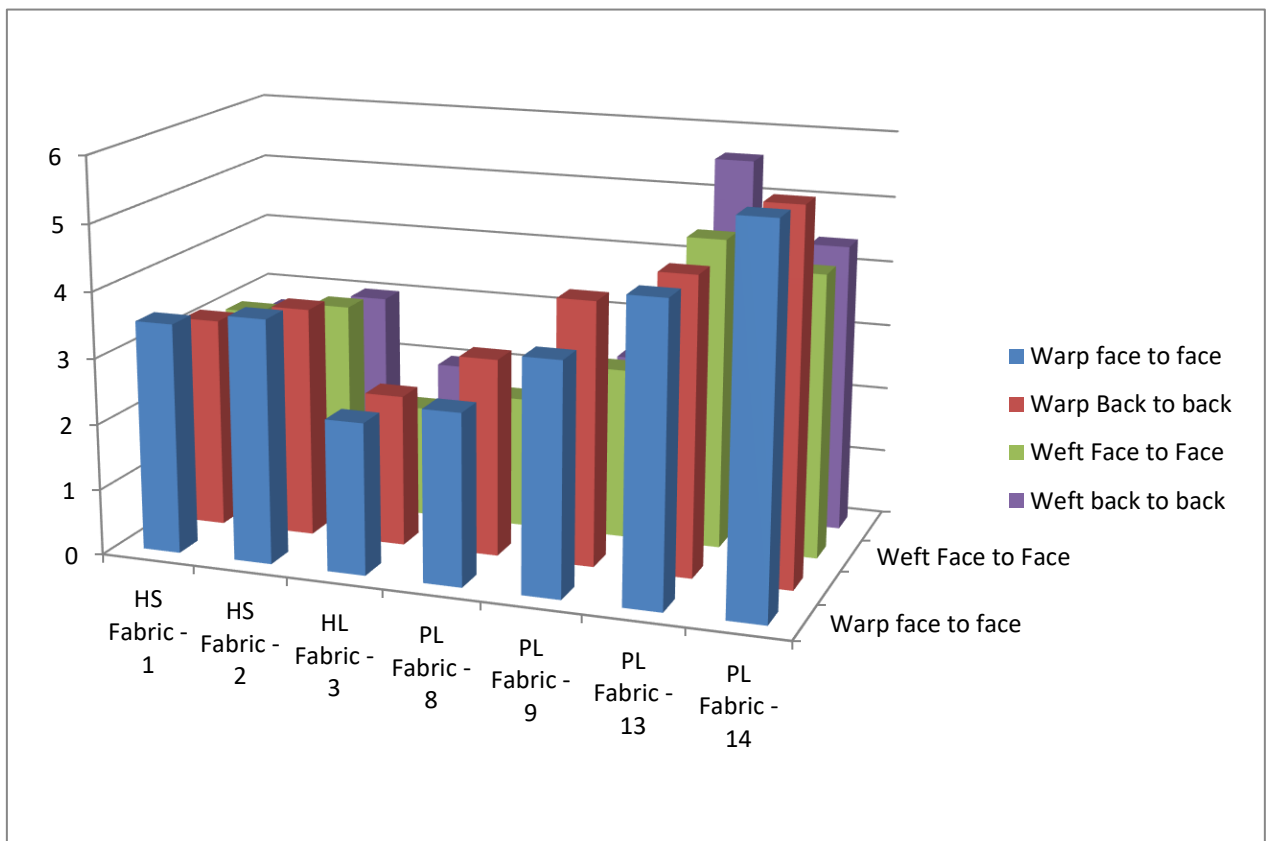
**Stiffness of fabrics**

It was observed HL Fabric – 3 has showed lower bending length in both warp and weft direction. Higher bending length was observed in the fabrics developed in powerloom using 100 % coarser Lotus yarns and blended rotor spun yarns shown in (Graph :4 and Table: 5).

**Table:5 Bending length/Stiffness of fabrics**

Sr.No.	Fabric code	Warp		Weft	
		Face to face	Back to back	Face to face	Back to back
1	HS.Fabric – 1	3.5	3.2	3	2.7

2	HS Fabric – 2	3.7	3.5	3.2	3
3	HL Fabric – 3	2.3	2.3	1.7	2
4	PL Fabric – 8	2.6	3	2	1.8
5	PL Fabric – 9	3.5	4	2.6	2.4
6	PL Fabric – 13	4.5	4.5	4.7	5.6
7	PL Fabric – 14	5.7	5.6	4.3	4.4



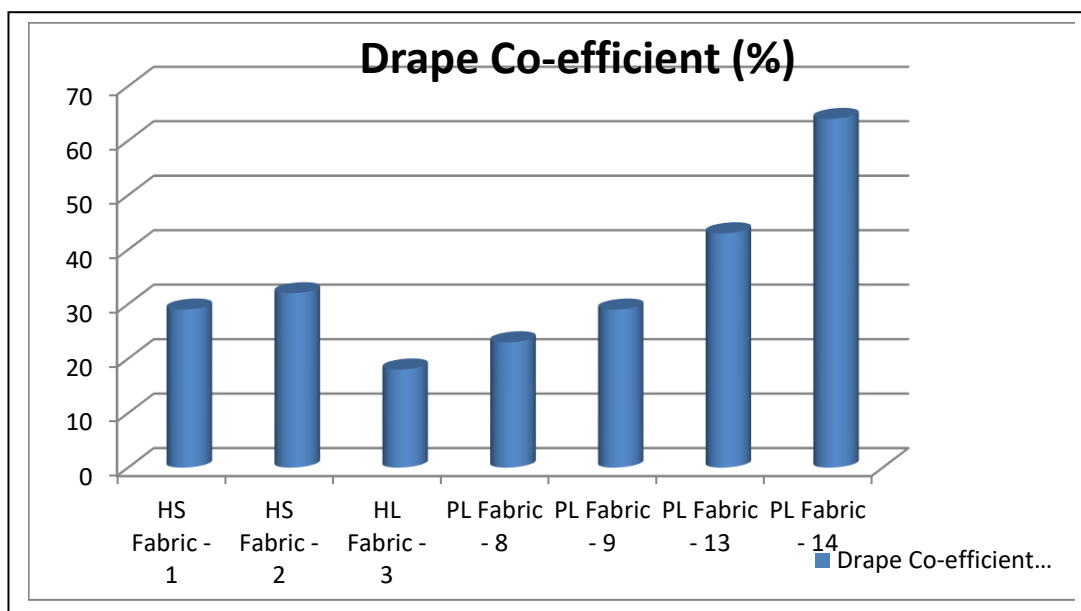
Graph: 4 Bending length/ stiffness of fabrics

**Drape coefficient of fabrics**

Amongst all the fabrics, the drape co-efficient of HL Fabric – 3 was 18. This may be due to the finer and light weight Silk yarns in warp and finer Lotus yarn extracted from one petiole. The drape co-efficient of PL Fabric – 14 was 64. This may due to the coarser appearance of rotor yarns. Hence this fabric can be used in developing jackets, coats and household applications. (Table: 6 & Graph: 5).

**Table:6 Drape Co-efficient of fabrics.**

Sr.No.	Fabric code	Drape Co-efficient (%)
1	HS Fabric – 1	29
2	HS Fabric – 2	32
3	HL Fabric – 3	18
4	PL Fabric – 8	23
5	PL Fabric – 9	29
6	PL Fabric – 13	43
7	PL Fabric – 14	64



**Pilling test**

It was observed that Khadi fabrics (HS Fabric – 1, HS Fabric-2), Handloom fabrics (HL Fabric-1) and powerloom fabrics (PL Fabric -8, PL Fabric -9) has no pilling with the rating 5. The main reason behind this is continuous length of the fibers in been used in developing this kind of yarns. Fabrics developed from Rotor spun yarn (PL Fabric – 13, PL Fabric-14) has slight pilling with rating

4. The main reason behind this fibers are cut in the staple form for developing rotor spun yarns. Hence the slight pilling has been observed (Table: 7).

**Table : 7 Pilling test**

Sr.No.	Fabric code	Pilling Rating	Appearance
1	HS Fabric – 1	5	No Pilling
2	HS Fabric – 2	5	
3	HL Fabric – 3	5	
4	PL Fabric – 8	5	
5	PL Fabric – 9	5	
6	PL Fabric – 13	4	Slight pilling
7	PL Fabric – 14	4	

### Shrinkage test

There was no shrinkage observed in Khadi, handloom, powerloom union fabrics. Blended fabrics developed from rotor spun yarns has showed slight shrinkage of 0.3 % in both warp and weft direction.

### Abrasion

As shown in Table: 8, Powerloom fabrics developed from rotor yarns has obtained highest cycles of 800-1000. Khadi fabrics (HS Fabric – 1 & HS Fabric – 2) has obtained 200 cycles. Powerloom union fabrics (PL Fabric – 8 & PL Fabric – 9) has obtained 300-400 cycles.

**Table : 8 Abrasion test**

Sr.No.	Fabric code	Sample weight before abrasion (mg)	No of Cycles	Sample weight after abrasion (mg)	Weight Loss (%)
1	HS Fabric – 1	1800	200	1700	5.5
2	HS Fabric – 2	2500	200	2100	6.25
3	HL Fabric – 3	1400	500	900	2.8
4	PL Fabric – 8	1800	400	1400	4.5

5	PL Fabric – 9	2200	300	1900	7.3
6	PL Fabric – 13	6200	800	5700	11
7	PL Fabric – 14	6000	1000	5800	30

### Kawabata test

Amongst the 7 woven fabrics, 2 fabrics were selected and subjected for Kawabata test. One fabric was HS Fabric -2 and another was PL Fabric -8. From the Table: 9 it was observed that both the fabrics has lower Koshi (stiffness) value that is due to the inherent softness of the Lotus fiber. Numeri (Smoothness) value of PL Fabric -8 was higher than HS Fabric-2. The smoothness of the powerloom fabric was higher than Handspun khadi fabric the reason behind this is extraction and spinning process of the fiber. HS Fabric contains hand extracted and handspun Lotus yarns which shows some slubs and unevenness in the entire fabric surface whereas the PL- Fabric -8 contains Lotus yarns which is extracted and spinned in the fabricated machine developed by the researcher. The Lotus yarns developed from the fabricated machine was uniform which gives the even appearance in the entire fabric surface and it can withstand strength in the powerloom. From Table :11 it was found that LC of HS Fabric-2 was higher than PL Fabric-8. Tensile properties are shown in Table :12, it was observed that tensile strain (EMT) affects the slim slippage and tailorability. Greater value of EMT provides comfort properties to the wear but on another side, it can create issues during seam pressing and stitching. There was not much difference seen in the EMT values of both the fabrics. Shear properties are shown in Table:13. Greater values of shear causes problems in stitching and it is uncomfot for the wearer. Shear rigidity depends on the mobility of warp and weft yarns within the fabric. The compact fabric consists of higher pick density and consists of higher shear values and hysteresis of shear. The shear values of HS Fabric-2 was higher than PL Fabric-8. It was found that Coefficient of friction (MIU) and mean deviation (MMD) was greater in HS Fabric -2 and lower in PL Fabric-8. (Table : 14).

**Table : 9 Primary and Total Hand values**

Sr. No.	Fabric sample	PRIMARY HAND VALUES				THV
		Women's Suiting				
		Koshi	Numeri	Fukrami	Sofutosa	KN-301 W- MDY
1	PL Fabric-8	3.07	8.26	6.22	5.86	4.68
2	HS Fabric -2	3.53	3.26	3.20	2.30	1.96

**Table :10 Fabric Weight and thickness**

Sr. No.	Fabric sample	Fabric Thickness (mm)	Fabric thickness at compression	Fabric weight (mg/cm <sup>2</sup> )
1	PL Fabric-8	0.685	0.366	9.875
2	HS Fabric -2	0.609	0.358	10.15



**Table:11 Compression properties (KES-FB3A)**

Sr. No.	Fabric sample	LC	WC g.cm/cm <sup>2</sup>	RC (%)
1	PL Fabric-8	0.239	0.190	35.17
2	HS Fabric -2	0.273	0.171	38.97

**LC : Linearity of compression –thickness curve**

**WC : Compressional energy**

**RC :Compressional Resilience**

**Table:12 Tensile properties (KES-FB1A)**

Sr. No.	Fabric sample		LT	WT Gf/cm/cm <sup>2</sup>	RT (%)	EMT (%)
1	PL Fabric-8	Warp	0.617	8.25	49.39	5.35
		Weft	0.640	6.65	45.35	4.16
		<b>Average</b>	<b>0.628</b>	<b>7.45</b>	<b>47.37</b>	<b>4.75</b>
2	HS Fabric -2	Warp	0.656	8.58	48.35	5.23
		Weft	0.674	6.97	47.02	4.13
		<b>Average</b>	<b>0.665</b>	<b>7.78</b>	<b>47.68</b>	<b>4.68</b>

**LT : Linearity of load- extension curve**

**WT : Tensile energy**

**RT: Tensile resilience**

**EMT : Extensibility**

**Table:13 Shear Properties using shear tester (KES-FB1)**

Sr. No.	Fabric sample		G gf/cm.deg	2HG gf/cm	2HG5 gf/cm
1	PL Fabric-8	Warp	0.37	0.33	0.48
		Weft	0.24	0.30	0.32
		<b>Average</b>	<b>0.30</b>	<b>0.31</b>	<b>0.40</b>
2	HS Fabric -2	Warp	0.54	0.83	1.43
		Weft	0.46	0.77	1.20

		Average	0.50	0.80	1.32
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**G: Shear Hysteresis**

**2HG: Hysteresis of shear force at 0.5 degree shear angle**

**2HG5 : Hysteresis of shear force at 5 degree shear angle**

**Table : 14 Surface properties (KES-FB4)**

Sr. No.	Fabric sample		MIU	MMD	SMD (µm)
1	PL Fabric-8	Warp	0.105	0.0077	1.792
		Weft	0.115	0.0076	4.550
		<b>Average</b>	<b>0.110</b>	<b>0.0077</b>	<b>3.171</b>
2	HS Fabric -2	Warp	0.198	0.0554	14.318
		Weft	0.178	0.0228	14.338
		<b>Average</b>	<b>0.188</b>	<b>0.0391</b>	<b>14.328</b>

**MIU: Coefficient of friction**

**MMD: Mean deviation of MIU**

**SMD : Geometrical Roughness**

**Training the women force**

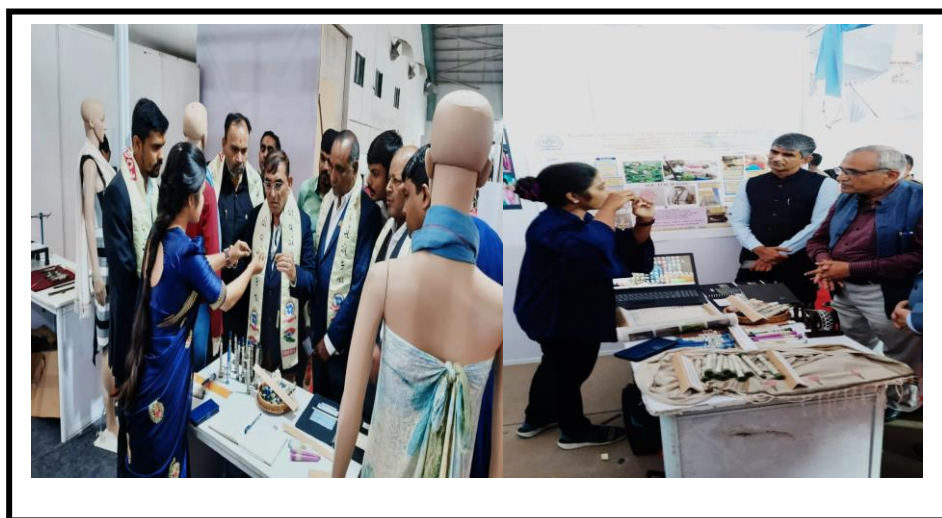
Group of rural women learned the manual extraction and hand spinning process as shown in Figure : 7.



**Figure : 7 Training women for extraction and spinning**

Lotus yarn of 20 s count was developed and hand woven stoles were prepared. stoles were exhibited in three exhibitions. First exhibition on International Women’s day – 8 March, 2022 at Eva Mall, Vadodara, second exhibition at “Agripreneurs conclave – 2022” at Gujarat Technological

University, Ahmedabad and third at Weave knit Exhibition -2022 at Surat. (Figure: 8). The exhibition has given the wide coverage of the entire work.



**Figure :8 Exhibition of the Lotus fabrics a). Weave knit exhibition 2022 b). Agri conclave 2022**

## **CONCLUSION**

Consequences of the study indicated that fabricated machine has a dual mechanism of fiber extraction and spinning one at a time. 600 grams of spun yarn can be developed from the fabricated machines (high speed) in 6 hours using 1 manpower whose role is to feed the stems in the machine and operating the speed regulators. Whereas in the manual extraction and spinning process only 30 grams of yarn (6 hours extraction + 1 hour spinning) can be developed in 6 hours using 1 manpower. Twist per inch of all the developed were high due to the inherent property of adhesion and more amount of fats and waxes in fiber composition. Using different spinning systems Lotus yarn with the count range of 3's to 96's has been achieved. Amongst all the fabric, Lotus: Silk (Fine lotus in weft and mulberry silk in warp) was lighter in weight, less in thickness, cover factor and fabric count. Dimensional stability property like shrinkage and serviceability properties like abrasion and pilling was also good. But the tensile strength and elongation was less as compared to all other fabrics. So, its use can be restricted in the garments where the less stress is required. Fabrics developed from open end yarns has showed an excellent tensile strength. Kawabata test revealed the developed fabrics are suitable for **women's suiting**.

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## IN VIVO STUDY OF THE EFFECT OF BUCKWHEAT INCORPORATED BREAD ON GLYCEMIC INDEX

Natasha R. Marak<sup>1</sup>, Pranati Das<sup>2</sup>, Manashi Das Purkayastha<sup>3</sup> and Luna Dutta  
Baruah<sup>4</sup>

<sup>1</sup>Department of Food Science & Nutrition,  
College of Community Science, Central Agricultural University,  
Tura, Meghalaya.

<sup>2,4</sup>Department of Food Science & Nutrition,.

<sup>3</sup>Department of Horticulture,  
College of Agriculture, Assam Agricultural University,  
Jorhat, Assam.

E-mail: <sup>1</sup>natasha.marak@gmail.com

<sup>2</sup>drpranatidas26@gmail.com,

<sup>3</sup>manshi.das@aau.ac.in

<sup>4</sup>luna.d.bruah@aau.ac.in ,

HSAI membership number: HSAI-2023-MG-1475-LF

**Winner of Mid Career Scientist Award at the 35 th Biennial conference of HSAI,  
17-19 Jan. 2024**

### ABSTRACT

Bread has been consumed for centuries and is considered to be the best vehicle for fortification. Food industry is always in the process of developing new and improved food products according to the demands of the consumer. This is also a demand of the hour, to produce food products with health benefits to counteract increased incidences of non-communicable diseases all over the world. Common buckwheat (*Fagopurum esculentum*) is a valuable source of protein, fibre, poly-phenolic acids, flavonoids and anthocyanins with numerous biological activities. The major flavonoid in buckwheat is quercetin, existing chiefly in the glycosylated forms as rutin. Some components such as proteins showed valuable cholesterol lowering properties and remarkable health-promoting properties. In this study, buckwheat incorporated bread was formulated using six variations. Out of these six formulations, one composite formulation was selected on the basis of sensory and nutritional attributes, to further investigate physical parameters i.e. loaf weight, loaf volume, specific volume, colour and texture; proximate compositions; minerals; functional properties (bioactive components) and glycemic index using standard methods. The glycaemic index (GI) study of the selected buckwheat bread was 53.00, which is a low GI category food. As diet is a cornerstone of type-2 diabetes mellitus prevention and therapy, therefore investigation on glycemic index of composite bread was considered.

**Keywords:** buckwheat, buckwheat bread, multigrain bread, *in vivo* study, glycaemic index

## **INTRODUCTION**

Pseudocereal grains such as quinoa, buckwheat, and amaranth are rich in a wide range of compounds such as flavonoids, phenolic acids, fatty acids, trace elements and vitamins with known effects on human health (Gorinstein et al. 2008). Common buckwheat (*Fagopurum esculentum*) is a valuable source of proteins, fibre, as well as minerals. It was found that some components such as proteins showed valuable cholesterol lowering properties and remarkable health-promoting properties (Christa and Smietana 2008). There are several studies dealing with the nutritional characteristics and the application of buckwheat as functional food in studies involving wheat bread enriched with buckwheat flour and gluten-free egg pasta analogues containing buckwheat flour (Alamprese et al. 2007).

Bread has been regarded for centuries as one of the most popular staple food products and is considered to be the best vehicle for fortification. The basic ingredients or formula used to make dough are flour, water, leavening agent (yeast or chemicals) and sodium chloride (Tipples et al. 1978). The technical procedures are carried out in such a way that the dough can produce the appropriate mechanical properties which will allow to keep the gas and thus produce a well-expanded loaf of bread with an even crumb structure (Kokelaar and Prins 1995). Among the food grains, wheat, which when processed into flour is unique as it is the only grain when mixed with water, gives elastic dough (due to gluten), which can be leavened by yeast fermentation and baked into tasty and attractive loaf of bread. The crucial ingredients for bread making are refined wheat flour (*maida*), water, yeast, sugar, shortening and salt. Quality and uniformity of raw material is a vital factor to produce high standard bakery products. At present, the trend is to produce specialty breads made from whole grain flour and other functional ingredients referred to as health breads or functional foods (Dewettinck et al. 2008). In this context, the utilization of flours derived from minor cereals, pseudo cereals, and other non-traditional crops could be included in bread formulation to obtain a healthier product with excellent sensorial properties (De Escalada Pla 2013). Formulation of functional foods with the inclusion of grains from the categories of cereals, millets, pseudo cereals, legumes and oilseeds enhance the nutritional qualities of bread. Consumption of whole grain products have been associated with reduced incidence of diseases such as cancer, cardiovascular disease, high blood pressure and diabetes. Therefore, increased consumption of whole grain products has been recommended to be part of the daily menu (Richardson 2003). This research was thus carried out with the objective to develop composite, nutritionally enriched buckwheat bread and to study its effects on glycemic index *in vivo*.

## **MATERIALS AND METHODS**

### **Procurement of raw materials**

Ingredients like whole wheat flour, refined wheat flour, wheat bran, buckwheat seeds, fenugreek seeds, sugar, salt, yeast, oil, margarine were procured from local market of Jorhat, Assam.

### **Formulation of buckwheat flour incorporated multigrain breads**

One of the goals of the research was to formulate bread without the use of additives and preservatives. Therefore, the control used for this study was also formulated to incorporate as much of whole wheat bread without affecting the sensory properties (study not shown here). The control

bread formulation of 60:40 ratio of refined wheat flour to whole wheat flour was thus used as the base. A total of six formulations were developed with 5%, 10% and 15% buckwheat flour with and without fenugreek flour and wheat bran (Table 1). After the formulation, buckwheat flour incorporated breads were evaluated for sensory parameters.

### **Sensory evaluation of multigrain breads**

Sensory evaluation was done in the Department of Food Science and Nutrition, College of Community Science, Assam Agricultural University, Jorhat, by using twenty trained and semi trained panel members from the Department.

### **Physical properties of multigrain breads**

Loaf weight, loaf volume, specific volume, texture profile and colour were studied for the developed buckwheat bread sample.

### **Texture profile analysis**

Texture profile analysis (TPA) was performed using a texture analyzer (TA-XT Plus, Stable Micro Systems, UK) as adopted by the standard method by AACC (2000).

### **Colour analysis**

Colour analysis of multigrain breads was done by using Hunter Lab colorimeter (model SM-3001476 micro sensors). Readings were displayed as L\*, a\* and b\* colour parameters according to CIELAB system of colour measurement.

**Proximate Analysis:** The analysis of moisture, crude fat, crude protein, crude fibre and ash were carried out as described in AOAC (2000). The carbohydrate content was calculated by the difference method. Energy value (kcal) of the bread sample was calculated by the method of Gopalan et al. (2015). Total dietary fibre was also estimated as described by (AOAC 2000).

### **Estimation of minerals**

The minerals like calcium and iron were determined by using atomic absorption spectrophotometer according to the method of (AACC 2000).

### **Bioactive components of buckwheat bread**

#### *Determination of total antioxidant capacity*

Total antioxidant activity was measured using the DPPH method.

#### *Determination of total phenolics content*

Total phenolics were determined spectrophotometrically using Folin-ciocalteu reagent and expressed as gallic acid equivalent/g (mg of GAE/g of sample).

#### *Determination of total flavonoids estimation*

Total flavonoid content (TPC) was determined by using method described by Zhishen et al. (1999). The absorbance of resulting pink colour was read at 510 nm against blank (distilled water) and Rutin (50µg to 200 µg) was taken as standard.

### **In vivo assessment to study the glycaemic index (GI) of multigrain bread**

## Glycaemic index (GI)

For the estimation of GI, the procedure given by Wolever et al. (1991) was followed.

## Legal ethical aspects

The study was approved by the Ethical Committee of the University.

## Statistical analysis

The obtained data was statistically analyzed by using SPSS statistics (Ver. 20) software using one way of analysis of variance (ANOVA), and significance of difference between means of tested parameters was carried out using Duncan's Post hoc test. Differences were considered statistically significant at the  $P \leq 0.05$  level at 5% level of significance.

## RESULTS AND DISCUSSION

### Formulation and sensory evaluation of buckwheat bread

Out of the six formulations with buckwheat incorporated bread, TBW1, TBW2 and TBW4 had similar scores in all sensory parameters and scores were significantly ( $p \leq 0.05$ ) higher as compared to all other formulations. Further, although TBW1, TBW2 and TBW4 had statistically similar scores ( $p \geq 0.05$ ), TBW4 was expected to have better nutritional profiles as the inclusion of buckwheat was at higher level as compared to TBW1. Although TBW2 and TBW4 were both formulated with 10% inclusion of buckwheat flour, TBW4 was further incorporated with an additional 3% of wheat bran (Table 1) and was expected to contain higher amount of fibre. It was therefore selected for further studies.



Fig 1. Formulations for buckwheat flour incorporated multigrain bread



**Table 1 Formulation of buckwheat flour incorporated multigrain breads**

Formulation	Refined wheat flour (%)	Whole wheat flour (%)	Buckwheat flour (%)	Fenugreek seed flour (%)	Wheat bran (%)
T <sub>0</sub>	60	40			
TBW1	60	35	5	-	-
TBW2	60	30	10	-	-
TBW3	60	25	15	-	-
TBW4	57	30	10	-	3
TBW5	60	25	10	5	-
TBW6	60	25	15	5	-

**Table 2 Sensory evaluation of buckwheat flour incorporated multigrain breads**

Sample name	Sensory score					
	Colour	Texture	Taste	Flavour	Appearance	Overall Acceptability
TBW1	8.0±0.61 <sup>c</sup>	8.0±0.66 <sup>d</sup>	7.5±0.5 <sup>e</sup>	7.1±0.59 <sup>d</sup>	7.2±0.65 <sup>c</sup>	7.5±0.44 <sup>e</sup>
TBW2	7.8±0.55 <sup>c</sup>	7.8±0.51 <sup>d</sup>	7.3±0.67 <sup>e</sup>	7.1±0.59 <sup>d</sup>	7.2±0.87 <sup>c</sup>	7.4±0.38 <sup>e</sup>
TBW3	6.0±0.23 <sup>a</sup>	5.0±0.22 <sup>a</sup>	4.5±0.27 <sup>b</sup>	4.5±0.35 <sup>b</sup>	5.0±0.36 <sup>a</sup>	5.0±0.28 <sup>a</sup>
TBW4	7.0±0.29 <sup>b</sup>	7.1±0.37 <sup>c</sup>	6.8±0.35 <sup>d</sup>	7.0±0.38 <sup>d</sup>	7.3±0.54 <sup>c</sup>	7.4±0.51 <sup>e</sup>
TBW5	6.7±0.36 <sup>b</sup>	6±0.39 <sup>b</sup>	5.5±0.42 <sup>c</sup>	5.5±0.34 <sup>c</sup>	6.0±0.22 <sup>b</sup>	6.0±0.43 <sup>c</sup>
TBW6	6.2±0.67 <sup>a</sup>	5.0±0.54 <sup>a</sup>	4.0±0.51 <sup>a</sup>	4.0±0.5 <sup>a</sup>	5.2±0.45 <sup>a</sup>	4.8±0.45 <sup>a</sup>
CD at 5%	0.329	0.623	0.463	0.558	0.505	0.564

Values are expressed in Mean ± SD (Standard Deviation)

Means within columns separated by Duncan's multiple range tests

Means followed by the same letter in superscript(s) are not significantly different

### Physical properties of buckwheat bread

Loaf weight of TBW4 (441.43±0.87g) was significantly higher than the control (434.28±0.56). Loaf volume (1170.27±0.56 cm<sup>3</sup>) and specific volume (2.65cm<sup>3</sup>/g) was significantly lower than the

control (Fig 1). It has been reported that the presence of  $\beta$ -glucans-a fraction of total dietary fibre, in high levels, reduces the specific volume of the breads (Skendi et al. 2009), which can be compared to the present study where fibre might have reduced the volume. High levels of fibre dilutes gluten, lowers gas retention causing a decrease in loaf volume.

The texture profile of bread was attributed to hardness, cohesiveness, springiness and chewiness. The hardness(kg) of buckwheat bread was reported to be  $1.60 \pm 0.58$  whereas for control it was only  $0.33 \pm 0.56$ , cohesiveness  $0.90 \pm 0.26$  sec, springiness  $1.00 \pm 0.26$  and chewiness  $1.50 \pm 1.42$  kg-sec. The study by Gabriella et al. (2016) on the texture properties of bread with different levels of brown flaxseed, reasoned that it might be due to the dilution of gluten proteins caused due to the addition of brown flaxseed. Goksen and Ibrahim (2016) in their study reported that higher cohesiveness in composite breads may be due to higher moisture retention compared to control bread. The result of the present investigation are also similar to the finding of Abdelghafor et al. (2011) who reported that chewiness increased progressively with increase in level of multigrain flour in the composite bread as compared to the control.

The L\* value in regards to the crust colour of the developed bread was  $52.12 \pm 0.10$  whereas for the control it was  $67.50 \pm 1.15$ . The a\* value was  $2.24 \pm 0.30$  and b\* value  $15.05 \pm 0.92$ . Similarly, the crumb colour had lower values for L\* ( $42.92 \pm 0.10$ ) compared to the control ( $61.21 \pm 1.25$ ) indicating the intensity of darkness value. Tuncel et al. (2014), reported that redness (+a\*), yellowness (+b\*) chroma values were increased gradually with the addition of fibre, which was similar to the findings of the present study.

**Table 3 Physical properties of buckwheat multigrain bread**

Physical	T0	TBW4	t-value
Loaf weight (g)	434.28±0.56	441.43±0.87	8.132*
Loaf volume(cm <sup>3</sup> )	1486.32±0.64	1170.27± 0.56	171.437*
Specific volume (cm <sup>3</sup> /g)	3.42±0.75	2.65±0.51	118*
<b>Texture profile</b>			
Hardness(kg)	0.33±0.56	1.60±0.58	86.536*
Cohesiveness(sec)	0.45±1.22	0.90±0.26	26.369*
Springiness	1.00±0.26	1.00±0.26	1.732*
Chewiness (kg-sec)	0.06±1.27	1.50±1.42	154.503*
<b>Crust colour</b>			
L*	67.50 ± 1.15	52.12 ± 0.10	1190*
a*	2.09 ± 0.05	2.24±0.30	10.447
b*	16.46 ± 0.58	15.05 ± 0.92	133.447*
<b>Crumb colour</b>			
L*	61.21 ± 1.25	42.92 ± 0.10	675.034*
a*	11.51 ± 0.13	14.28±0.30	178.875*
b*	13.90 ± 0.65	28.46 ± 0.92	413.498*

a\* value ranged from -100 (redness) to +100 (greenness),

b\* values ranged from -100 (blueness) to +100 (yellowness)

L\* value indicating the measure of lightness, ranged from 0 (black) to 100 (white)

Values are expressed in Mean ± SD (Standard Deviation)

\*Significant at  $p \leq 0.05$

**Table 4 Chemical properties of buckwheat multigrain bread**

Nutrients	T0	TBW4	t-value
1.Moisture (g/100g)	34.79±0.62	39.96±0.23	330.248*
2.Fat (g/100g)	3.21±0.84	4.04±0.34	53.940*
3.Protein (g/100g)	12.74±0.50	10.30±0.51	96.411*
4.Crude fibre (g/100g)	1.09±0.62	1.80±0.65	55.750*
5. Total ash (g/100g)	0.98±0.47	1.06±0.48	6.934*
6.Carbohydrates (g/100g)	25.98±0.88	28.51±1.04	96.499*
7.Energy (kcal)	252±0.44	269±0.37	9.391*
8.Calcium (mg/100g)	91.95±1.30	100.47±1.75	92.066*
9. Iron (mg/100g)	9.85±0.46	16.42±0.66	97.074*
10. Total Dietary Fibre (g/100g)	12.10±0.45	13.82±1.65	28.139*
11. Insoluble Dietary Fibre (g/100g)	9.96±0.57	11.26±0.96	61.104*
12. Soluble Dietary Fibre (g/100g)	2.14±0.38	2.56±1.34	12.336*

Values are expressed in Mean±SD (Standard Deviation)

\*Significant at  $p \leq 0.05$

**Table 5 Bioactive components and glycaemic index study of buckwheat bread**

	T0	TBW4	t-value
<b>Total Antioxidant (%)</b>	<b>25.88 ± 0.37</b>	<b>39.73 ± 0.87</b>	<b>19.141*</b>
<b>Total Phenolic (mg GAE/g)</b>	<b>1.05± 0.22</b>	<b>2.16 ±0.47</b>	<b>58.876*</b>
<b>Total Flavonoids mg (QE/g)</b>		<b>0.22 ± 0.72</b>	<b>7.184*</b>
<b>Glycaemic index</b>	<b>0.11 ± 1.45</b>	<b>53.00 ± 0.39</b>	<b>28.092*</b>
	<b>69.20±1.84</b>		

Values are expressed in Mean±SD (Standard Deviation)

\*Significant at  $p \leq 0.05$

### Chemical properties of buckwheat bread

The values of moisture, fat, crude fibre, total ash, carbohydrate, energy, calcium, iron, total dietary fibre, insoluble dietary fibre and soluble dietary fibre content, as evident from Table 4, were found to be higher in bread formulated with buckwheat flour. The differences of all the means of the bread sample were found to be statistically ( $p \leq 0.05$ ) significant. Results of present investigation are well in accordance with those reported by Otegbayo et al. (2018) who reported higher moisture in wheat bran incorporated breads and composite breads. The crude fibre content of TBW4 was higher compared to control, which could be the reason for higher moisture levels.

### **Bioactive components and glycaemic index of buckwheat bread**

The bioactive components as shown in Table 4 reported an antioxidant capacity of  $39.73 \pm 0.87$  %, total phenolics content (TPC) of  $2.16 \pm 0.47$  mg GAE/g and total flavonoids of  $0.22 \pm 0.72$  (QE/g). Similar result was cited by Verardo et al. (2018) in regard to buckwheat enriched breads. The high TPC of whole grain and bran are due to the presence of pericarp and aleurone layers which are rich in antioxidant compound (Sharma et al. 2018).

GI is a concept that allows ranking of carbohydrate-rich foods in terms of their potential to raise blood glucose level. A number of studies have documented the health benefits that can be obtained by selecting foods that have a low glycaemic index. The GI of buckwheat bread ( $53.00 \pm 0.39$ ) as presented in Table 11 was significantly lower than the control, falling under the category of low GI food, which can be recommended for lowering blood sugar. Diets with low glycaemic index value aid in the prevention of coronary heart disease in diabetic and healthy subjects. Selecting low GI foods has also demonstrated benefits for healthy persons in terms of postprandial glucose and lipid metabolism (Rizkalla et al. 2002). Adam et al. (2018) also reported that the dietary fibre intake in the diet may delay the glycaemic response.

## **CONCLUSION**

Buckwheat is known for many health benefits and is rich in iron, calcium, dietary fibre, etc. compared to wheat flour. Bread is considered a staple food worldwide and is a good source of energy for the human body. However, bread made with refined wheat flour is a nutrient-poor food and the incorporation of buckwheat in its preparation can produce healthier breads, rich in bioactive compounds, fibers and minerals. This study has made it evident that low GI bread without the use of additives is possible and can be an option for the diabetic or pre-diabetic patients. Though they are found to have slightly lower physical attributes, nutritionally it is packed with many nutrients that are required for the body for healthy functioning and protection against many diseases.

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## DESIGN APPROACH FOR AN IMPROVED LOOM TO REDUCE OCCUPATIONAL RISK FACTORS AMONG COMMERCIAL HANDLOOM WEAVER

**Dr. Geetashree Bori and Dr. Nandita Bhattacharyya**

Department of Family Resource Management and Consumer Science,  
College of Community Science, Assam Agricultural University,  
Jorhat, Assam, India.

E-mail: geetashree\_bori@yahoo.co.in; nbhatta2000@yahoo.com

**Short listed paper for the award of Mid career Scientist  
at the 35<sup>th</sup> Biennial conference Of HSAI, 17-19 Jan, 2024**

### ABSTRACT

Handloom weaving provides the largest livelihood generation among the women weavers in Northeast India, specifically Assam. It is a manual activity where women weavers constitute nearly 91.8% of the total workforce in Assam. The weavers in the handloom weaving units perform weaving activities such as picking, battening, and shedding, and they are found to assume awkward postures and repetitions at work. The present study was carried out in the Lakhimpur district of Assam to understand the scope of effective intervention for an improved loom to reduce the occupational risk among commercial handloom weavers. For designing the loom holder or (*mothi*) dimension was determined. The weavers are found to use various shapes, sizes, lengths, and diameters of hand tools in weaving activities where unnatural postures, frequent repetition of tasks, and force are exerted for long hours at work. Prevalence of occupational risk factors was observed among the women weavers in the existing working environment. A significant reduction in grip fatigue, pinch fatigue and decrease in the electrical activity of the EMG(RMS) value of the muscles was found in the improved loom. Therefore, the proposed improved loom was found comfortable by the women weavers which would ultimately help in increasing production and income with reduced health issues.

**Keywords** Handloom weaving, Occupational risk, Women weavers.

### INTRODUCTION

Handloom weaving is a highly labour-intensive industry and employs a huge number of labour force, who do the activities manually. As per the fourth Handloom Census of India (2019-20), weavers engaged in weaving and allied activities are more than 3.14 million handloom households, and out of this, seventy-two per cent are women weavers [1]. Weaving has been an integral part of the crafts activities performed by the women of Northeast India from time immemorial and thus many small industries are located in this region [2]. The Handloom Industry engages commercial weavers for more than 5-6 hours daily where they adopt a sitting posture on a

plank or a bench without considering their capabilities and limitations [3,4,5]. Despite evidence that handloom weaving is a strenuous activity and requires a lot of constraints while performing the task, the workers overlook the issues arising from the workplace and ignore the risk factors resulting in health problems or complications [3,6,7]. In most occupational settings, the task involving repetitive movements of the arms and the legs may not encompass heavy exertion but long hours of work, the prevalence of early fatigue, pain, repetitive strain injuries in the back, shoulder, neck, arm, etc., are observed. It is also noticeable that physical requirements such as awkward posture for long periods, static contractions, and repetitive movements can be very damaging to both productivity and workers' health [8]. Additionally, studies suggest that in the long run, these sorts of tasks increase the health risks associated with the workers [9-12]. This static muscle exertion inhibits blood flow and causes muscle fatigue which reduces the overall efficiency and effectiveness of the worker and finally productivity is reduced.

Epidemiological studies suggest that work-related stress considers three sets of risk factors Physical, Psychosocial and Individual factors that are strongly associated with occupational injury risks [12-15]. The risk factors of handloom weavers are found to be associated with the physical environment of the workplace such as the dimension of the looms, repetition of tasks, work posture and duration of work [4,16-18]. However, differences in the level of risk factors might arise within the same occupational group due to anthropometric variation, wage pattern, length of exposure, duration of work etc. The demands of the body are not the same for sitting quietly at rest and sitting for active work.

A Correct hand tool design is important for preventing risk factors in an occupational setting. The design of a hand tool that does not fit the hand or requirements to use the tool in the way it was intended, an injury may be developed. The development of these injuries does not happen in a single event, instead, they result from the repetitive movements being performed for a long period. This in combination with the application of force may result in damage to the muscles, tendons, nerves, ligaments, joints, cartilage, spinal discs, or blood vessels. It is important to have an effective interface and compatibility of hand tools and the user's hand to decrease the risk of injury and increase the efficiency of the user. This activity is repetitive where force is exerted with the right hand for picking with the help of a hand tool to draw the string to and fro i.e., a holder whereas the left hand is used for beating off or battening.

The commercial weavers reported discomfort in performing the weaving activities with the existing working conditions where Frame-loom using jacquard is a highly used handloom for commercial production. So far little effort has been made for alleviating the associated risk factors, as explained above, in weaving activities. Keeping in view the current working conditions, an effort has been made to study with the objective:

-to understand the scope for effective intervention for an improved loom to reduce the occupational risk among commercial handloom weavers.

## **METHODOLOGY**

The present study aimed to attempt a comfortable gripping of the holder (*Mothi*) for weavers that can assist in the comfortable performance of the weaving activity. Weavers having chronic ailments, physical deformity, pregnancy and lactating were excluded from the study.

### **Experimental details of sample size taken for the design of the holder-**

A participatory approach was adopted for the design development process. The design parameters taken for the study were hand length, handbreadth and grip diameter inside (Fig 2). Anthropometric measurements of 90 weavers were taken for hand length and a hand breadth. For the determination of shape, size and length of holder 10 weavers of average 16.8 cm hand length were taken. For predictive regression analysis, 300 weavers were taken for the determination of the holder diameter. Parameters used for evaluation of the existing and the improved holder design: grip strength, pinch strength and EMG(Electromyography) analysis. The surface EMG analysis was performed and recorded in two muscles: the hand (adductor pollicies) and forearm (flexor digitorum profundus).

### **Statistical analysis:**

Weightage score, ranking and pairwise comparison preference test was done to determine the the size and shape, length, and diameter of the holder. A simple regression analysis was done to determine a predictive model. Paired -t-test was done to evaluate the difference between the existing and the improved loom. The statistical analysis was done with the help of SPSS version 20.0.

## **RESULTS**

### **Determination of holder design**

For designing the holder (*mothi*) the parameters decided were the size and shape, length, and diameter of the holder. For determining the holder diameter, the study was conducted in three different stages:

#### **Stage I- Determination of the shapes and sizes of the holder (*mothi*)**

Holders (*mothi*) used in the handlooms come in different shapes and sizes. While drawing the string to and fro in picking and battening operation the shape of the holder should allow even distribution of forces over the area so that causing excessive pressure on the soft tissue of the palm is avoided. Accordingly, few models of holders with various sizes and shapes of holders were tried out among 10 women weavers of hand length 16.8 cm. The trials were done for Holder A, Holder B, Holder C, Holder D, Holder E and Holder F (presented in Figure 1) with a paired preference test.

Analysis of data, presented in Table 1 shows the feedbacks of the trials of different holders. From the obtained scores in the paired preference test holder D as presented in Table 1 is the most preferred holder and ranked I. While weaving the weaver draws the string to and fro with the help of the holder where the shuttle moves with the force applied by the handheld tool (i.e., holder) in repetition. So, more pressure was needed to put on the thumb in adduction and the fingers flexed to grip the holder. Therefore, a cylindrical shape holder is the preferred hand tool shape by the weavers. Research evidence suggested that the diameters of cylindrical or elliptical handles increase performance and comfort reducing the chances of cumulative trauma disorder, cramp muscles etc. Since the holders are found in different sizes it is necessary to standardize the length and the diameter of the holder for better handheld gripping and ease of use which is discussed in the subsequent two stages.



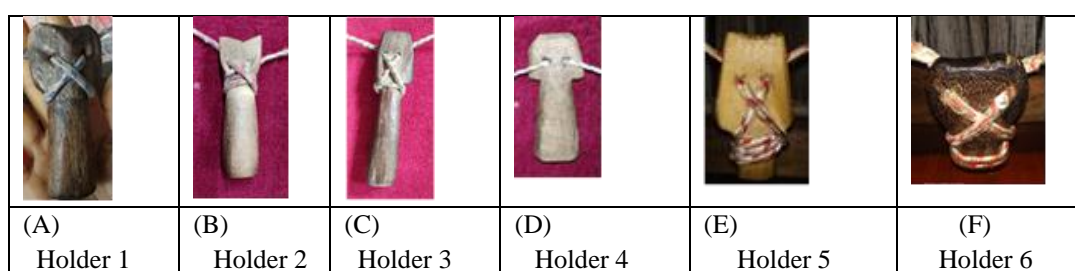


Figure 1. Different Shapes and Sizes of holders were tried out in the experiment

Table 1 Preference of shapes and size of the holder by the respondents

	A	B	C	D	E	F	Score	Rank
A	-	0	0	0	1	1	2	IV
B	1	-	1	0	1	1	4	II
C	0	0	-	0	1	0	1	V
D	1	1	1	-	1	1	5	I
E	1	0	1	0	-	0	2	IV
F	1	0	1	0	1	-	3	III

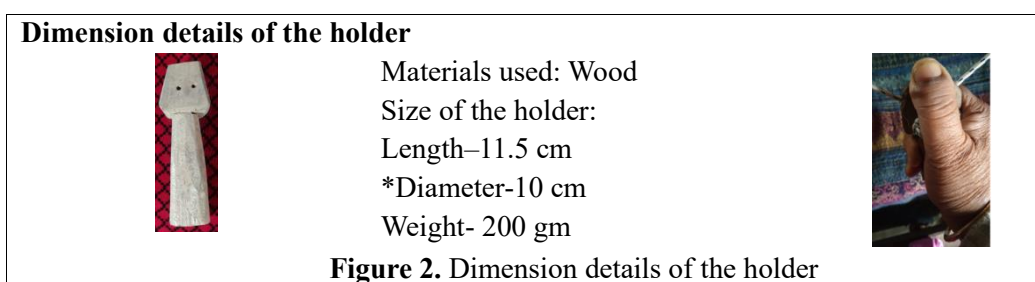
### Stage II-Standardization of the length of the holder

The length of the hand tool is one of the most important handle design considerations. According to the ergonomic principles, the length of hand tools or objects should permit the grasp to accommodate the palm width between the thumb and other fingers or thumb and palm of the hand to avoid excessive tissue compression along with proper gripping for ease of use i.e., the length of the handle should be sufficiently long enough to provide space for the whole palm. It should also accommodate the smallest and the largest dimensions of the hand sizes. Therefore, to determine the length of the holder the 5<sup>th</sup> and the 95<sup>th</sup> percentile of the weavers were taken for the study. From the anthropometric data of the weavers, the 5<sup>th</sup> and 95<sup>th</sup> percentile of the weaver's handbreadth was found to be 8.5 cm and 10.95 cm. Therefore, if the required length of the holder accommodates the palm width for the largest dimensions the smallest dimension can also be use it. Considering the handbreadth three dimensions for the length of the holder were taken for the study 11cm, 11.5cm, and 12cm and the opinion of the ease of comfort was rated after performing the weaving activity through a 3-point rating scale described as 1-very uncomfortable, 2-comfortable, and 3-very comfortable. The majority ninety per cent of the respondents found the 11.5 cm holder length to be the most comfortable while weaving. Therefore 11.5 cm was taken for further analysis in stage III.

### Stage III- Determination of the holder diameter based on the grip diameter inside

The holder diameter considered should accommodate the required grasp. The shapes of the handles cylindrical or elliptical provide guidelines for determining the optimal diameters to increase finger-force comfort, exertion, and contact area. After determining the shape and length of the holder, it

was required to determine the holder diameter for proper gripping. The gripping of the hand tool depends on the grip circumference or grip diameter inside of the worker. Many research studies have suggested the design of handle diameter. A handle diameter of around 40 mm with a cylindrical handle was found suitable for both men and women. Mital and Karwowski suggested that the handle diameter should be in a range of 25 to 50 mm [21]. Power grip should be between 30 mm to 50 mm where 38 mm is preferable. The holder diameters recommended in the studies were based on hand anthropometry. When the holder diameter is larger than recommended, it requires a higher gripping force than those with correct diameters. On the other hand, the higher the gripping force more frequently the worker will experience fatigue. To determine the diameter of the holder, the present study was conducted on 300 participants. The grip diameter inside of the participants was taken for the study. For a better power grip, the longest finger (middle finger) of the hand should not touch the palm according to the design principles of the hand tools.



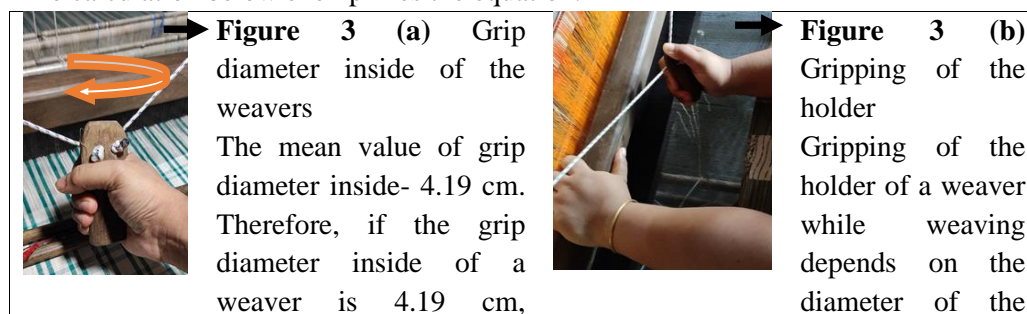
\*Holder diameter when the mean of 300 participants is 4.19cm

Table 2 and Fig 3(a, b) reveals the prediction equation of holder and can be interpreted as- with a 1cm increase in grip diameter inside, 0.441 unit increases in the diameter of the holder. From the above equation, the holder diameter for each weaver can be determined based on the grip diameter inside. One-size-fit-all hand tools are not appropriate in most cases as this type of product may be helpful for a few but not appropriate for all user populations. Therefore, the predictive equation would help in suggesting the best diameter of the holder where the weaver’s power grip of the holder gives maximum comfortability to exert adequate force while drawing the string to and fro in the process of weaving without causing any injury to the hand muscles. Dimension details of the holder is presented in Fig 2.

**Table 2 Prediction equation of holder through a simple regression model**

Parameter	Models
Diameter of Holder ( <i>Mothi</i> )	=1.501 + (0.441×Grip diameter inside)

The calculation below exemplifies the equation:



<p>according to the regression model the predicted diameter of the holder would be <b>3.35 cm</b> or 33.5mm.</p>	<p>holder. While gripping the holder the weaver's longest finger (middle finger) should not touch the palm.</p>
<p><b>Calculated value:</b> Diameter of the holder = <math>\{ [1.501 + (0.441 \times 4.19)] = 3.348\text{cm} \}</math></p>	

### Finalization of the design concept

The newly designed holder diameter of the loom was evaluated with the following parameters-

### Grip strength and Pinch strength

The evaluation was done based on the grip strength and pinch strength. A Significant reduction percentage between the existing and the improved loom in a decrease in grip strength and pinch strength was observed for both right and left hand as presented in Table 3. Eighty-three per cent of the participants found the improved holder of the loom very comfortable and only seventeen per cent comfortable. Therefore, the modified holder was found to be in line to meet the objectives of the target beneficiaries. Motivated, healthy and job content workers at the workplace would ultimately drive the performance, quality and competitiveness of an organisation.

### Comparison of muscles electrical activity during weaving in the existing and modified loom

The recorded EMG (RMS) values for all the muscles in the existing loom and modified loom are presented in Table 8. The EMG(RMS) value of the hand (adductor pollicies) and forearm (flexor digitorum profundus) muscles were recorded and compared between the existing loom and the improved loom as shown in Table 4. In the proposed improved holder, the significant decrease percentage in the EMG activity was found to be 42.45 per cent (adductor pollicies) and 11.88 per cent (flexor digitorum profundus). The paired t-test value was found significant at 0.01 per cent for adductor pollicies and significant at 0.05 per cent for flexor digitorum profundus.

**Table 3. Comparison of grip strength and pinch strength in the Existing and Improved loom**

Parameters		Existing loom	Improved loom	Significant reduction percentage	P-Value
Grip fatigue	Right hand	12.14±3.53	8.65±3.63	-28.74	-
	Left hand	10.57±5.42	9.73±3.45	-7.94	-
Pinch fatigue	Right hand	10.17±5.50	7.87±4.96	-22.61	-
	Left hand	10.24±6.29	8.84±3.89	-13.67	-

*Significant at .01 percent, Significant at .05 percent*

**Table 4. EMG analysis of the respondent in the existing and modified loom**

<b>Muscles</b>	<b>Existing loom (mean ±SD) (mV)</b>	<b>Improved Loom (mean ±SD) (mV)</b>	<b>Significant reduction in percentage</b>	<b>P-value</b>
Adductor pollicies	0.106±0.031	0.061±0.024	-42.45	0.000
Flexor digitorum profundus	0.303±0.097	0.267±0.088	-11.88	0.023

### DISCUSSIONS

The findings of the data reveal that to determine the comfort of the weaver with the proposed predictive model of holder dimension and, evaluation of the existing and the improved loom was done using the parameters grip strength, pinch strength and EMG analysis. The EMG (RMS) value with the high electrical activity of the muscles indicates high muscle strain and fatigue. A significant decrease in the electrical activity of the EMG data of the muscles and a significant reduction in the grip muscles and pinch muscles during weaving in the improved loom than the existing loom indicates that the muscle strain reduces in the improved loom. Thus, the improved loom would provide a beneficial impact on the health and productivity of the weaver

### CONCLUSION

In conclusion, the design intervention for an improved loom for the commercial weavers was found helpful in reducing work-related risk factors among the commercial weavers. The new improved loom with the holder dimension provided more comfort and enhanced the performance and productivity of the weavers with increased income. The holder dimension of the improved loom which is easily attachable and adjustable is of very low cost and affordable by the weavers. The results of the usability testing of the improved loom used during the field trial with limited weavers revealed that the loom is very comfortable and appreciated by the weavers.

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**CHILDREN AND HANDWASHING. INSIGHTS FROM A BEHAVIOR  
CHANGE COMMUNICATION INTERVENTION FROM RURAL  
INDIA**

**Vibha Gupta<sup>1</sup> and Sarita Anand<sup>2</sup>**

<sup>1</sup>Ph.D. Scholar and <sup>2</sup>Professor

Department of Development Communication and Extension

Lady Irwin College, University of Delhi, New Delhi (India)

vibha365@gmail.com , sarita.anand@lic.du.ac.in

HSAI Life Membership Number:HSAI-2019-DL-406-LF

**Short listed paper for the award of Mid-career Scientist at the 35<sup>th</sup> Bieniel  
conference  
Of HSAI, 17-19 Jan, 2024**

**ABSTRACT**

Despite being the single most recommended protective action against diarrhea, the adoption of hand washing with soap (HWWS) remains poor, especially among children. Schools are the first point where children learn healthy habits from teachers and other children. The present study was designed to assess the effectiveness of a low-cost, school-based participative intervention on hand hygiene knowledge, attitude and practice (KAP) of primary school children. The study also aimed to identify socio-demographic and WASH-related factors that influenced hand hygiene KAP. Observational assessment of school WASH infrastructure was done along with understanding hygiene perceptions of class teachers. This mixed-method, pre-post-test study was conducted in three rural blocks of Palwal district in Haryana. Systematic random sampling was used to draw a population-proportionate sample of 562 students and 28 class teachers from 28 school. While COM-B model of behavior change provided the theoretical framework, entertainment-education approach was used to design the intervention. The study reports significant improvements in mean scores for children's hand hygiene KAP after the intervention ( $p < 0.05$ ). Significant positive gains were also observed in children's understanding of germs, associated illness threat and HWWS as prevention mechanism. The study found universal coverage of WASH facilities in sampled schools though sufficiency and usability varied. Content analysis of school curriculum through the lens of hygiene and sanitation provided a pathway for catalyzing the intervention as potential addition to hygiene subject matter in textbooks and classrooms. The present study highlights that effective hygiene promotion at school level requires adequate infrastructure, motivated teachers and engaging participative tools that consistently remind and reinforce the importance of HWWS at critical moments thus contributing to SDG Goal 3 of health and well-being for all.

**Keywords:** Behavior change, Children, Handwashing, Hygiene, Rural, School

## **INTRODUCTION**

The Covid-19 pandemic has highlighted the critical importance of handwashing with soap (HWWS) as one of the simplest and effective ways to break the spread of communicable diseases. HWWS is also a prescribed action for protection against diarrhea, one of the leading causes of mortality and morbidity in children especially under the age of five (Freeman et al., 2014). School children are particularly vulnerable as they spend significant part of their day in proximity with other children and may not always be following proper hand hygiene (Olson, 2015). In India, a study by Morris et al. (2011) estimated infectious diseases to be responsible for more than 60% (nearly 1,96,000) deaths annually among children aged 5-14 years. Recognizing its critical importance, hygiene has been identified as a focus area for primary school children under *Ayushman Bharat*, School Health & Wellness program. The Mid-day Meal has been identified as an inflection point where HWWS before and after eating has been made mandatory, soap is an admissible expense and carving a specific time for handwashing in timetable has been recommended (Ministry of Health & Family Welfare, Ministry of Human Resource Development, 2018). Hygiene is a function of two enabling factors - *access* to adequate, equitable and functional facilities, and the *habit* of using those facilities when needed. Research suggests a positive relationship between knowledge and attitude of personal hygiene with its practice (Hazazi et al., 2018). The present experimental study assessed children's existing knowledge, attitude and practice (KAP) of hand hygiene with the hope of bring a positive shift in these parameters through a behaviour change communication intervention.

## **OBJECTIVES**

The objectives of the study were:

1. To assess the effectiveness of an entertainment-education based participative intervention on improving hand hygiene KAP of school children.
2. To identify the sociodemographic and WASH-related factors that influence children's hand hygiene KAP.
3. To evaluate the quality of WASH infrastructure available in the selected schools.
4. To understand class teacher's perceptions regarding their students' hand hygiene behavior

## **HYPOTHESIS**

Null hypothesis: There is no significant difference in the hand hygiene KAP before and after the intervention.

The alternate hypothesis: There is significant difference in hand hygiene KAP score after the intervention when compared to pre-intervention scores.

## **METHODOLOGY**

**Study design:** Mixed-methods, pre-post-test study.

**Study setting:** The study was carried out in Palwal district of Haryana state. Rural, government, coeducational, primary schools with functional PM POSHAN Program were identified from the three blocks of Palwal, Hathin and Hodal. A population proportionate sample was selected using systematic random sampling.

**Study Population:** class V students and class teachers formed the study population. Pretesting had revealed better readability, language comprehension, and response ability among class V students



when compared to junior classes, hence the present study was done among them. All class V students who were present on both days of baseline and end-line data collection were included in the study along with the class teachers. Thus, a total of 562 students and 28 class teachers from 28 schools participated in the study.

**Study Instruments:** COM-B model (Capability, Opportunity, Motivation - Behavior) for behavior change was used as the theoretical framework. The model suggests behavior to be an outcome of dynamic interplay between capability (physical and psychological), opportunity (environmental and social context) and motivation (automatic and reflective) (Michie et al., 2011). The study used combination of structured questionnaire, observation checklist, participative intervention, and interview schedule for data collection.

**Ethical Considerations:** The study was approved by the Institutional Ethics Committee, Lady Irwin College, Delhi University. Due permission was taken from DEEO Palwal, school principals, and class teachers. Written, informed consent was obtained from parents and verbal assent was taken from students.

**Study Process:** Each school was visited twice at baseline and end-line. On the day of baseline data collection, students first filled out the KAP survey questionnaire, then participated in the intervention. This was followed by class teacher interviews. The schools were visited after a 4-week gap to collect end-line data.

**Intervention design:** The intervention developed on the principles of Edgar Dale's Cone of Experience leveraged the engagement strategies from the bottom of the cone (Dwyer, 2010) to engage the students in a 'play and learn' activity. Glitter was used simulate germs in this entertainment-education based intervention that helped children visualize the route of germ transfer through hands, highlight the need for soap to remove germs against plain water while using a combination of demonstration and audio pathway for driving behavior change.

## **FINDINGS & DISCUSSION**

### **Sociodemographic Profile**

Of the total 562 students who participated in the pre-and post-phases of intervention, 52% (n=292) were girls. The average age of respondents was 10.3 years. Nearly 52% (n= 292) belonged to joint families with an average family size of 7.7 members per family. About 77% (n=432) of children had mothers who were literate of which 73.8% (n=319) actively participated in child's studies. A majority of (60.5%, n=340) mothers were housewives.

### **Baseline levels of hand hygiene KAP**

Five key themes emerged from analysis of baseline data as discussed below:

#### **1. Hand hygiene KAP at critical moments**

The first key insight from the present study is that children perceived some critical moments to be 'more critical' than others across KAP dimensions (refer Table1,2,3). There exists a hierarchy of critical moments in children's minds where HWWS after defecation is most important followed by HWWS after urination, before eating, before cooking and after playing in that order. This differential degree of importance to defecation could be due to heightened feeling of disgust associated with it (Scott et al., 2007). HWWS after coughing/ sneezing was not considered to be important.

**Table 1: Knowledge of hand hygiene at critical moments**

<b>Knowledge of hand hygiene at critical moments</b>			
	<b>No</b>	<b>Yes</b>	<b>Maybe</b>
It is okay to miss HWWS:	<b>n (%)</b>		
After defecation	480 (85.4)	54 (9.6)	28 (5)
After urination	400 (71.2)	127 (22.6)	35 (6.2)
Before eating	384 (68.3)	129 (23)	49 (8.7)
Before cooking	297 (52.8)	185 (32.9)	80 (14.2)
After playing	291 (51.8)	205 (36.5)	66 (11.7)

**Table 2: Attitude towards hand hygiene at critical moments**

<b>Attitude towards hand hygiene at critical moments</b>		
	<b>Agree</b>	<b>Disagree</b>
	<b>n (%)</b>	
It is okay to not wash hands with soap after going to toilet	150 (26.7)	412 (73.3)
It is necessary to wash hands with soap after defecation but not after urination	312 (55.5)	250 (44.5)
It is okay if you sometimes miss washing hands before eating	187 (33.3)	375 (66.7)
It is more important to wash hands after defecation than before eating	445 (79.2)	117 (20.8)

**Table 3: Practice of hand hygiene at critical moments**

<b>Practice of hand hygiene at critical moments</b>				
	<b>Do nothing</b>	<b>Wipe on clothes</b>	<b>Wash hands with water</b>	<b>Wash hands with soap</b>
	<b>n (%)</b>			
After going to toilet	35 (6.2)	10 (1.8)	261 (46.4)	256 (45.6)
After playing	155 (27.6)	39 (6.9)	285 (50.7)	83 (14.8)
After defecation	0	9 (1.6)	34 (6)	519 (92.3)

After coughing/ sneezing	181 (32.2)	198 (35.2)	154 (27.4)	29 (5.2)
Before eating	17 (3)	16 (2.8)	193 (34.3)	336 (59.8)

**2. Germs and handwashing** (Refer Table4,5)

An overwhelming 81.5% (n=458) children said that they had heard of germs while 77.6% (n=436) knew that germs can cause diarrhea. About 69% (n=388) of them knew that germs spread from one person to another by hands. Their attitude towards germs presented a concerning picture. Nearly 55.3% (n=311) of children agreed that if their hands looked clean, they were probably clean while 57.5% (n=323) agreed with the statement ‘if my hands look clean, I don’t have to wash them before eating’. Visual cues have been found to determine behaviors such as when the hands needed to be washed (Song et al., 2013) as parents often combine dirt with germs and use dirt as a visible prompt for handwashing. More than half (57.7%, n=324) of children in the study sample agreed that germs were harmless because they were invisible. Nearly half (50.7%, n=285) of the students believed that germs were not present in things that looked clean. Together these statements indicate possibility of a more casual attitude towards hand hygiene. This misplaced belief that ‘clean looking means germ-free’ poses a potential risk as a majority (67.3%, n=378) of children reported that they practiced HWWS only when they were visibly dirty (refer Figure1). Beshu et al. (2016) in their study among rural primary school children also found that 82.57% of children agreed with only the need for HWWS only when they looked dirty or smelt bad.

**Table 4: Children’s knowledge about germs**

<b>Knowledge about germs</b>			
	<b>Yes</b>	<b>No</b>	<b>Maybe</b>
	<b>n (%)</b>		
<b>Germ awareness</b>			
I have heard of germs	458 (81.5)	65 (11.6)	39 (6.9)
<b>Germ-illness connect</b>			
Germs can cause illness like loose motions	436 (77.6)	77 (13.7)	49 (8.7)
<b>Route of germ transfer</b>			
Germs are transferred from one person to another by hands	388 (69)	107 (19)	67 (11.9)

**Table 5: Children’s Attitude towards germs**

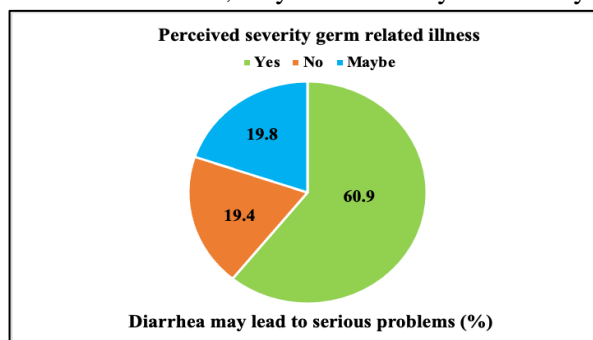
Attitude towards germs		
	Agree	Disagree
	n (%)	
If hands look clean, they are probably clean	311 (55.3)	251 (44.7)
If my hands look clean, I don’t have to wash them before eating	323 (57.5)	239 (42.5)
Because germs are invisible, they are harmless	324 (57.7)	238 (42.3)
Germs are not present in things that look clean	285 (50.7)	277 (49.3)
Washing hands with just water can remove germs from hands	199 (35.4)	363 (64.6)



**Figure 1: Practice of hand washing w.r.t. germs (%)**

### 3. Barriers to hand hygiene

At the knowledge level, the study finds low perceived severity to be a barrier as nearly 40% of children did not think that diarrhea could lead to serious problems (Refer figure2). If children do not perceive diarrhea as a serious threat, they are not likely to take any preventive action.



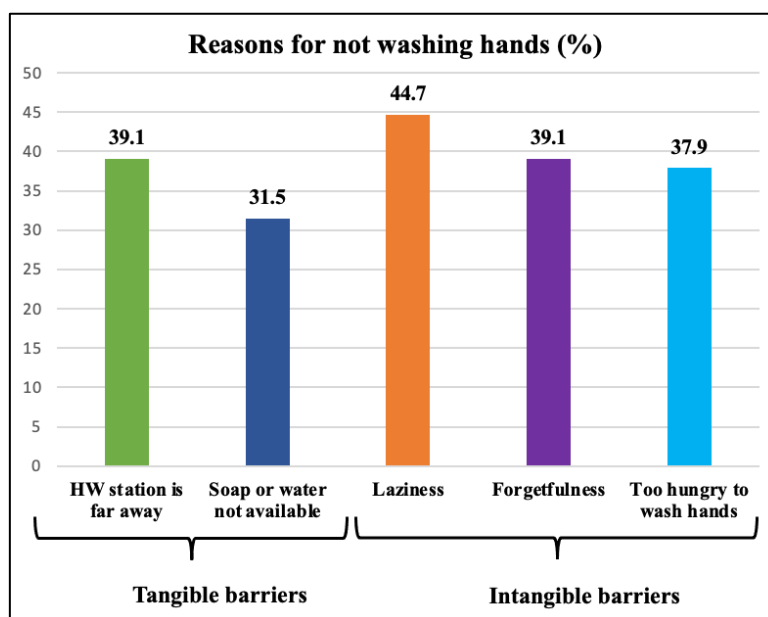
**Figure 2: Perceived severity of germ related illness**

Children’s outlook towards germs and need for visible cues to trigger hand washing emerged as a strong attitudinal barrier to adequate handwashing (Refer Table6). About 77.2%, n=434

children reportedly did not think it was important to do HWWS because they looked clean. The second attitudinal barrier to adequate HWWS was children’s low risk perception as 49.6% (n=279) did not believe that lack of handwashing before eating could lead to illness. As barriers to practice, the study identified a combination of tangible and intangible barriers as presented in Figure 3.

**Table 6: Attitudinal barriers to hand hygiene**

Attitudinal barriers to hand hygiene		
	Agree	Disagree
	n (%)	
It is not important to wash hands with soap if hands look clean	434 (77.2)	128 (22.8)
Nobody falls ill if they do not wash hands before eating	279 (49.6)	283 (50.4)
Wiping hands on clothes is an easy way to clean hands	277 (49.3)	285 (50.7)



**Figure 3: Barriers to practice of adequate hand hygiene**

The findings are similar to the study by Lopez-quintero et al. (2009) among school children in Colombia that also found forgetfulness, laziness and lack of time as the most common reasons for not washing hands.

**4. Enablers of hand hygiene**

The present study found self-efficacy and perceived benefit as two positive enablers for hand hygiene knowledge (Refer Table7). About 66.4% (n=373) children reported that they knew the correct way of washing hands. However, when probed further majority did not know all the 8

steps of handwashing (52%, n=292) or were unsure about what the steps were (13.3%, n=75). As for perceived benefit, 58.5% (n=329) responded that HWWS before eating can protect from diarrhea. Another 64.8% (n=364) affirmed that those who practice HWWS fall ill less often. When looking for factors enabling a positive attitude towards hand hygiene (refer Table8), the present study finds perceived proximity to be a key factor as 58.9% (n=331) children agreed that they tend to wash hands more regularly when the wash area was close by. About 61.7% (n=347) children agreed with the statement ‘I don’t want to miss school due to illness’, highlighting the importance of emotional drivers in influencing action. A majority (75.8%, n=426) children agreed that they will wash hands if their friends were also washing hands. Peer interactions have been found to play a significant role in child development particularly in relation to acceptance and rejection of certain behaviors including handwashing (Parker et al., 2015).

**Table7: Factors enabling knowledge**

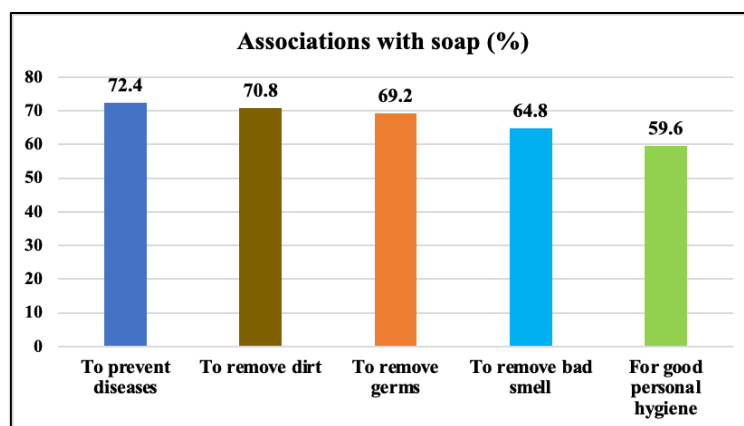
<b>Factors enabling knowledge</b>			
	<b>Yes</b>	<b>No</b>	<b>Maybe</b>
	<b>n (%)</b>		
<b>Self-efficacy</b>			
I am aware of the correct way of washing hands	373 (66.4)	84 (14.9)	105 (18.7)
I am aware of the 8 steps of washing hands	195 (34.7)	292 (52)	75 (13.3)
<b>Perceived benefit</b>			
Washing hands with soap before eating can protect me against diarrhea	329 (58.5)	151 (26.9)	82 (14.6)
People who regularly wash hands with soap before eating fall ill less often	364 (64.8)	117 (20.8)	81 (14.4)

**Table 8: Factors enabling a positive attitude towards hand hygiene**

<b>Factors enabling attitude</b>		
	<b>Agree</b>	<b>Disagree</b>
	<b>n (%)</b>	
I wash hands more regularly if the wash basin is close by	331 (58.9)	231 (41.1)
I don’t want to miss school due to illness	347 (61.7)	215 (38.3)
I will wash hands if my friends are washing hands	426 (75.8)	136 (24.2)

**5. Association with soap**

When asked about the reason to use soap, 72.4% (n=407) children knew that use of soap prevents diseases. Nearly 69.2% (n=389) even said that soap was important to remove germs. However, the term personal hygiene was not clearly understood. About 64.8% (n=364) students said that soap was important to remove bad smell from hands while 70.8% (n=398) said it was important to remove dirt thus showcasing the importance of sensory drivers influencing HWWS (Figure 4).



**Figure 4: Associations with soap**

**Impact of intervention**

A paired sample t-test was done to gauge the outcome of the behavior change communication intervention on children’s hand hygiene KAP. All the three aspects – knowledge, attitude and practice – witnessed a significant positive gain after the intervention (refer Table9).

**Table 9: Gain in hand hygiene KAP after the intervention**

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	SD	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Knowledge PostTest - Knowledge PreTest	7.3808	6.84831	0.28888	6.81337	7.9482	25.55	561	0
Pair 2	Attitude PostTest - Attitude PreTest	2.3594	13.0276	0.54953	3.43883	3.3652	2.29	561	0
Pair 3	Practice PostTest - Practice PreTest	4.5819	4.05592	0.17109	4.2458	4.9179	26.78	561	0

### Factors influencing hand hygiene KAP

The present study finds significant positive association between demographic factors such as mother's education and her involvement in child's education and hand hygiene KAP of school children. Mother's education has also been found to impact hand hygiene KAP of school children previously (Meleko & Elias, 2017; Vivas et al., 2010). However, the present study did not find any significant association between gender, mother's occupation, family type and past 3month illness pattern and hand hygiene KAP. A study by Mohammed & Malik (2017) in Bangalore also did not find any association between gender and hygiene knowledge. Additionally, the present study also attempted to decode the association between WASH facilities at home and children's hand hygiene KAP. Source of drinking water, method of water purification, access to toilet at home, especially personal toilet as well as presence of water at toilet were found to be significantly associated with hand hygiene KAP of school children. Previous studies have also linked access to water and sanitation facilities with improved hand hygiene KAP (Dobe et al., 2013; Vivas et al., 2010).

### School WASH facilities observation assessment

The sampled rural schools had 100% coverage of WASH facilities, though the quality, maintenance and functionality of infrastructure varied across the sample (Figure 8).

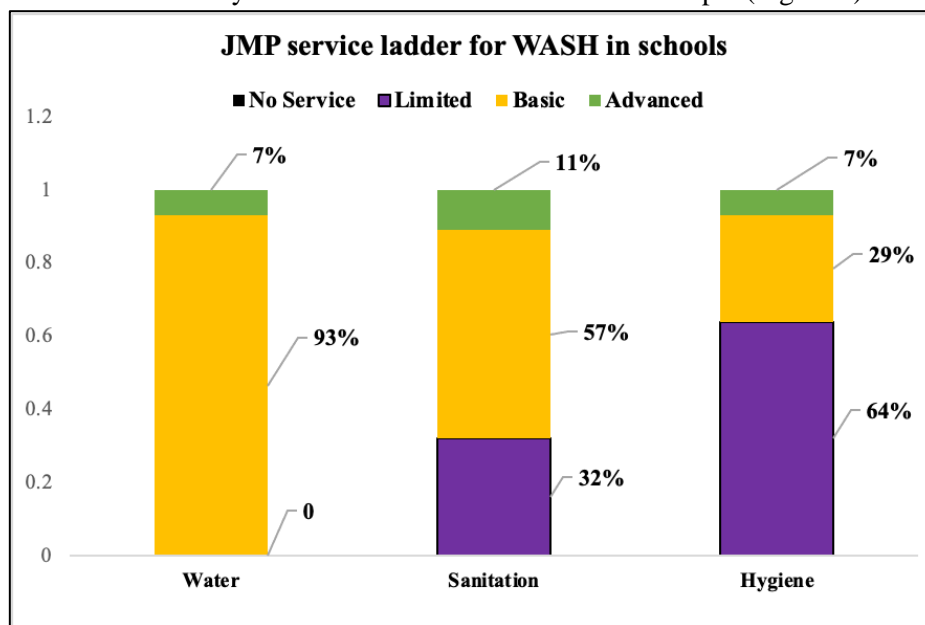


Figure 8: JMP service ladder for WASH in schools

The hygiene condition of the drinking water station varied from clean and hygienic piped exit for running water, some others had no piped exit leading to water stagnation and algae formation. Toilets were constructed as a separate unit at a distance from rest of the school building. The washbasin constructed as part of toilet structure were found to be non-functional and students went to a separate designated area for handwashing. Majority of schools had hand washing facilities with water, but no soap was available at the station at the time of visit. Class teacher confirmed that the soap was given to students for handwashing before the MDM only due to soap theft.

### Class teacher perceptions

Thematic assessment of in-depth interviews with class teachers revealed a combination of external and internal factors that had a potential influence on student hand hygiene KAP as perceived by teachers, the details of which are published previously (Gupta & Anand, 2021).



### **SUMMARY, CONCLUSION AND IMPLICATIONS**

The present study assesses the effectiveness of a behaviour change communication intervention in improving school children's hand hygiene KAP. The analysis of both baseline and end-line data suggests a significant improvement in participants' hand hygiene KAP especially their understanding of germs and germ-related illness threat, severity perception as well as their belief in the ability of HWWS as a credible preventive action. The findings seem to suggest that children were more inclined to practice HWWS at critical moments despite hands appearing clean, once they understood that clean looking things does not necessarily mean they are germ-free too. Content analysis of the existing government primary school curriculum through the lens of hand hygiene revealed the areas which may require further development for getting across the message of HWWS at critical moments for children.

Overall, the present study recommends a multi-pronged reinforcement approach to scale up the intervention and build the habit of HWWS at critical moments among children. The study suggests a sharpening the curriculum-embedded hygiene messaging with a focus on all critical moments. The study also recommends involving parents, family and wider community to build a culture of hygiene that envelops the child and guides them to practice proper hand hygiene. The present study finds peers and teachers to be enablers of hand hygiene KAP of children. It makes a case for leveraging peers as another node for reinforcing the message of HWWS at critical moments through behaviour modelling as well as group learning. Teachers hold the key to unlocking the enthusiasm and learning in classroom. The present study suggests repeated reminders as a means to really drum the message of HWWS at critical moments so that it becomes a habit for children.

### **LIMITATIONS**

The study only attempts to understand in detail the singular aspect of HWWS out of the broad spectrum of WASH. The study relies on self-reporting of KAP of hand hygiene which may be impacted by the social desirability bias. Study is limited to rural government primary schools hence the findings may not corroborate with similar study in urban schools or public schools.

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## **THE COVERT KILLERS IN THE WORKPLACE: HEALTH HAZARDS AND MUSCULOSKELETAL DISORDERS**

**Dr. Rekha Vyas**

Emeritus Professor (FRM)

Department of Resource Management and Consumer Sciences

College of Community & Applied Sciences

Maharana Pratap University of Agriculture and Technology, Udaipur, India

rekhavyas1963@gmail.com

Life Membership No. - 13/RJ/V-1/LF

**Winner of Senior Scientist award of at the 35<sup>th</sup> Biennial conference  
Of HSAI, 17-19 Jan, 2024**

### **ABSTRACT**

The health hazards and musculoskeletal disorders (MSDs) stand out as the major covert killers of the workplace. Addressing these silent and hidden hazards is a crucial towards creating a safe and productive work environment. With the objective to delve into this multifaceted realm faced by the workers in in different occupations the present paper highlights the hazards and their causes. Established methodologies were used to elicit data. The data show that lifting heavy loads, overexertion, long hours of work, continuous and forceful motions, bending and awkward postures, unsafe use of chemicals and precarious environment were some of the main causes which attributed to many occupational health hazards and MSD's as reported by majority of the workers irrespective of their jobs. Ergonomic strategies and approaches were designed and suggested to safeguard the well-being of the workers. Educational interventions and aids were developed for empowerment of workers with recommendations for changes for health and safety during work.

**Keywords:** Ergonomic Assessment, Hazard Mitigation, Health Hazards, Musculoskeletal Disorders.

### **INTRODUCTION**

The workplace is a dynamic and complex environment where millions of individuals dedicate a significant portion of their lives to earn a living. It is also a domain where a multitude of health hazards lurk, threatening the well-being of the workers. In today's, fast-paced and demanding work environment, it's easy to overlook the insidious health hazards that silently prey on the workers and among these, musculoskeletal disorders (MSDs) stand out as the major covert killers of the workplace.

Assessing the global data of workers affected by health hazards in various occupations is a critical endeavor, as it sheds light on the scale of this multifaceted issue and provides valuable insights for policymakers, researchers, and stakeholders. Hazards not only pose a significant challenge for the affected individuals but also have far-reaching implications, including increased

healthcare costs, reduced productivity, and economic burdens. Therefore, addressing occupational health hazards and musculoskeletal problems is not just a moral obligation but an economic imperative. The well-being of workers is paramount, and addressing these silent and hidden health hazards is a crucial step towards creating a safe and productive work environment. Ergonomic assessments are an important component of workplace safety and workers health programs. The assessment considers ergonomic principles and guidelines to make recommendations for adjustments or changes. The guidelines are usually based on research and best practices in ergonomics.

### **OBJECTIVES**

The main objective of this research paper is to delve into the multifaceted realm of occupational health hazards and MSDs confronted by the workers in different occupations and the profound impact they have on the workers. The specific objectives are -

1. Ergonomic assessment of the workers' health status and workplace through Physiological parameters, Environmental parameters and Biomechanical parameters.
2. To find out the occupational health hazards and their causes among workers engaged in agriculture, vegetable cultivation, dairy activities, house construction, carpet making, tailoring and office work.
3. Prevention and mitigation of health hazards among workers by advocating ergonomic strategies and approaches to safeguard their well-being.
4. Development of ergonomic interventions and educational aids for empowerment of workers in various occupations.

### **METHODS AND METHODOLOGY**

**Locale of the study:** The present studies were conducted in the state of Rajasthan.

**Sample selection:** Table 1 highlights the number of samples taken in each occupation.

**Table 1: Number of samples in various occupations**

S. No.	Occupations	Number of Respondents		Total
		Male	Female	
1.	Agriculture	60	80	140
2.	Vegetable cultivation	30	30	60
3.	Dairy	30	30	60
4.	House Construction	60	-	60
5.	Carpet making	-	20	20
6.	Tailoring	-	20	20
7.	Office workers	60		60
<b>Total</b>				420

### **COLLECTION OF DATA**

**Physiological parameters used to assess the health status of the workers**

- **Body Mass Index (BMI):** Determined using the formula  $BMI (kg/m^2) = Weight (kg) / Height (m^2)$  and data was analyzed according to classification given by Garrow (1984).

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- **Aerobic Fitness:** Physical Fitness level of the respondents was measured in terms of  $VO_2$  max (l/min) and categorized as per the classification of Varghese et.al. (1994).
- **Rating of Perceived Exertion (RPE) and Physiological Workload:** RPE scale given by Varghese et.al (1994) was used to measure exertion on a 5-point continuum from very light to very heavy. The physiological workload of the person was identified according to the scores of RPE.

### Biomechanical parameters to assess the MSDs and risk of the respondents

- **Analysis of musculoskeletal problems - "Body Map"** developed by Corlett and Bishop (1976) was used to record intensity of pain perceived in body parts on a 5-point continuum and Overall discomfort score through Visual Analogue Discomfort (VAD) Scale on a 11-point scale, no discomfort to extreme discomfort.
- **Postural Risk Assessment-** Flexicurve and Rapid Entire Body Assessment given by Hignett and McAtamney (2000) was used.

### Environmental parameters assessed for working environment of offices and schools

Temperature, relative humidity, light intensity, noise and appropriateness of furniture.

### Assessment of occupational health hazards among workers and their causes

Data was collected from workers through survey.

### Prevention and mitigation of health hazards

Various strategies and approaches were identified which will safeguard the health of workers.

### Developing ergonomic guidelines for workers and workplace in various occupations

For enhancing productivity, reducing risks of injuries and improving overall health of the workers ergonomic guidelines were developed for various occupations.

## RESULTS AND DISCUSSIONS

### Background information of the respondents

The data showed that majority i.e. approximately 62-65% of the respondents were in the age group of 35-40 years. The mean age, height and weight of the male respondents was  $25.23 \pm 0.86$ ,  $162.36 \pm 1.23$ ,  $51.93 \pm 1.90$  respectively and that of female respondents was  $27.7 \pm 0.98$ ,  $156.9 \pm 4.61$  and  $48.76 \pm 1.53$  respectively. Monthly income ranged between Rs. 5000 -15000.

### Ergonomic assessment of health and working environment of workers

#### Physiological Parameters

- Body Mass Index of the Respondents:** Data in Table 2 reveal that approximately 32% of the total respondents irrespective of the gender were in the category of normal and 32 percent in the low weight normal category.

**Table 2: Body Mass Index of the Respondents**

Presumptive Diagnosis / BMI Class	Percentage of Respondents									Total N=360
	Agriculture workers		Vegetable cultivators		Dairy workers		Construction workers	Carpet weavers	Tailoring	
	M N=60	F N=80	M N=30	F N=30	M N=30	F N=30	M N=60	F N=20	F N=20	
CED* Grade II (Moderate) 16.0 - 17.0	-	13.3	-	3.3	8.3	8.0	23.34	30	15	<b>11.25</b>
CED* Grade I (Mild) 17.0 - 18.5	26.7	23.3	16.7	20.0	21.7	20.7	6.67	30	20	<b>20.64</b>
Low weight normal 18.5 - 20.0	30.0	28.0	43.3	46.0	40.0	38.3	25.00	18	20	<b>32.07</b>
Normal 20.0 - 25.0	40.3	33.3	37.0	26.7	30.0	33.0	36.66	20	30	<b>31.88</b>
Obese grade I 25.0-30.0	3	-	3	2	-	-	5.00	2	10	<b>2.78</b>
Obese grade II >30.0	-	2	-	2	-	-	3.33	-	5	<b>1.37</b>

(\*CED – Chronic Energy Deficient is the ‘steady state’ where an individual is in energy balance i.e. intake equals expenditure)

The correlation coefficient values were calculated which showed negative correlation which proved that BMI has association with hazard proneness i.e. as Body Mass Index decreases there is an increased incidence of hazards. It can therefore be understood that a low BMI is an indicator of impaired immuno-competence and an enhanced susceptibility to infection.

*ii. Aerobic Fitness:* VO<sub>2</sub> max data of the respondents is depicted in Table 3 which reveal that the mean values was 28.26±1.25. The aerobic capacity of majority of the respondents was high average to excellent indicating their good cardio respiratory fitness.

**Table 3: Percentage Distribution of Respondents according to VO<sub>2</sub> Max**

S. No.	VO <sub>2</sub> Max (ml/min.)	Physical Fitness Level	Total (N=360)	
			F	%
1.	up to 15	Poor	48	13.3
2.	16-25	Low average	60	16.7
3.	26-30	High average	110	30.6
4.	31-40	Good	52	14.4
5.	41-45	Very good	48	13.3
6.	beyond 45	Excellent	42	11.7
<b>Mean ± S.D.</b>			<b>28.26±1.25</b>	

*ii. Rating of Perceived Exertion and Physiological Workload:* Rating of Perceived Exertion score is given in Table 4. Researches have indicated that RPE is a reliable indicator of an individual’s activity tolerance. It is highly correlated with heart rate and thereby physiological work load.

**Table 4: Physiological Workload of the Respondents in Various Occupations according to RPE**

RPE Score	Heart Rate (beats/min.)	Physiological work load	Energy Expenditure (Kcal/min.)	Percentage of Respondents (N=360)						
				Agriculture Workers (N=80)	Vegetable cultivators (N=60)	Dairy workers (N=60)	Construction workers (N=60)	Carpet weavers (N=20)	Tailoring (N=20)	Office Workers (N=60)
1	up to 90	Very light	up to 5.0	-	-	-	-	-	-	25
2	91 – 105	Light	5.1 – 7.5	15	12	9	15	10	25	70
3	106 – 120	Moderately heavy	7.6 – 10.0	20	20	26	22	56	70	5
4	121 – 135	Heavy	10.1 – 12.5	55	52	50	50	24	5	-
5	136 – 150	Very heavy	12.6 – 15.0	10	16	15	13	10	-	-

The data in Table 4 reveal that 50-55% of the respondents in agriculture, vegetable cultivation, dairy and construction perceived the work as heavy with energy expenditure of 10.1 – 12.5 Kcal/min. and heart rate of 121-135 beats/min. whereas most carpet weavers and tailoring workers perceived the work as moderately heavy corresponding to energy expenditure of 7.6 -10 Kcal/min.

**Biomechanical Parameters**

*i. Analysis of musculoskeletal problems and discomfort of the workers engaged in various occupations*

**A. Agriculture workers:** The data revealed that in all the agricultural activities the intensity of pain reported ranged from very severe to moderate in all the body parts. Weeding was the most exhausting task reported by 85-100% of the female respondents and lower back was the most impacted body part. In harvesting and threshing of crops, pain was reported by 90-100% of the male respondents. Total Body Part Discomfort Score (BPDS) data of the respondents was highest for weeding activity. Data of Overall Discomfort Rating illustrated that for males and females all the activities fall under the category of ‘high discomfort’.

**Causes:** Exposure to heavy, repetitive/forceful work, adoption of awkward/uncomfortable postures and carrying of excessive loads were the main causes placing stress on muscles and joints. Also, traditional tools and methods of work were responsible for increased risk of musculoskeletal injury.

**B. Vegetable cultivators:** The data revealed that 80 -100% of the respondents confronted pain in various body parts during land preparation, sowing, weeding and picking of vegetables. Repetitive Strain Injuries were common among respondents performing weeding and harvesting.

**Causes:** Repetitive movements, awkward postures, heavy lifting, frequent kneeling or squatting, and carrying of loads were the main causes of MSDs leading to permanent disability.

**C. Dairy workers:** Pain in palm and fingers was confronted during milking. Lower back pain was reported by 90% of females and 65% of males while 70-75% of workers reported pain in shoulder, neck and knee during cleaning shed, carrying feed, cutting of fodder and handling animals.

**Causes:** Maneuvering large animals, repetitive bending and lifting, prolonged periods of standing/squatting, gripping and twisting motions of hands were the reported main causes for MSDs.

**D. Construction workers**

*i. Postural risk assessment and impact on health :* Construction workers perform for an average of 8-9 hours/day. The data depicts that poor postures have negative effects on health. The respondents reported pain in neck & shoulders (76%), back injuries (55%), muscle strains (44%), heat stress (65%), and cold-related illnesses (44%) during work. Flexion of pelvic and knee joints, extension of hands caused muscle spasm, cervical and lumbar spondylosis.

*ii. Musculoskeletal risk assessment of construction workers using REBA :* The REBA scores (Table 5) reveals that 75% of respondents worked with the trunk twisted or tilted to side and 78.34% with neck twisted or tilted. Upper arm flexion was 45-90° with shoulders raised and lower arm flexion of < 60° or extension of >100° whereas 85% of the respondents worked with wrist deviated or in twisted position. REBA elicited that 75% of workers had very high risk and change should be implemented immediately.

**Table 5: Distribution of respondents by their REBA scores**

Score	Risk assessment	Unskilled (n=30)		Skilled (n=30)		Total (N=60)	
		F	%	F	%	F	%
1	Negligible risk, no action required	–	–	–	–	–	–
2-3	Low risk, change may be needed	3	10.00	4	13.34	7	11.66
4-7	Medium risk, further investigation, change soon	1	33.34	2	6.66	3	5.00
8-10	High risk, investigate and implement change	2	6.66	3	10.00	5	8.34
11	Very high risk, implement change	24	80.00	21	7.00	5	75.00

**E. Carpet weavers:** Approximately 75% of the respondents reported low back and shoulder pain due to continuous bending for weaving and knotting movements. The pressure on the knees, combined with limited movement, resulted in strain and pain in thighs and lower legs confronted by 70-75% of the respondents. Squatting posture was adopted for about 3.5 hours on an average. Frequency of postural change was 4-6 times during complete cycle of work of approximately 7-8 hours. The average bend of the spine was 190.8° during work. The angle of deviation of lumbar region was 3.5° more than the normal.

**Causes:** Sitting in fixed positions for extended periods, repetitive hand and arm movements and lifting heavy materials, absence of proper back support and inappropriate loom height were found to be the main causes of MSDs.

**F. Tailoring:** The data revealed that 75% of the women reported back and neck pain and 60% shoulder pain and eye strain as a result of neck bending and poor lighting. The stationary posture was adopted for about 2.6 hours at a stretch. Frequency of postural change was 4-6 times during



complete cycle of work of 8-10 hours. The average bend of the spine was 188<sup>0</sup> during stitching and cutting of garment. The angle of deviation of lumbar region was 3.2<sup>0</sup> more than the normal standing position.

**Causes:** Prolonged hours of sitting without support, repetitive hand/arm movements, use of fine motor skills, pinching, gripping, sewing motions, neck and lumbar bending were the main causes of MSDs.

**G. Office workers:** The data showed that approximately 67% of employees had pain in lower back and 53% were suffering from pain in neck. Eye strain was reported by approximately 72% whereas pain in fingers and mid back was reported by 45.5% of the employees.

**Causes:** Desk-based work, extensive computer use, prolonged sitting in awkward posture, continuous bending of cervical spine due to work on computer were the common MSDs elicited from the data.

**Environmental Parameters**

*i. Analysis of the working environment of offices:* The data in Table 6 depicts that all the environmental parameters were within permissible level except temperature and sound level which were higher than permissible limit in the four selected offices. Poor indoor air quality in office buildings can lead to respiratory problems, allergies etc. Improper workstation setup and poor ergonomics can exacerbate the risk of developing MSDs.

**Table 6: Evaluation of various parameters in Offices**

S.No.	Parameters	Mean Values	Recommended Standards
1.	<b>Environmental Parameters</b>		
	Concentration of CO	1.0 ppm	9 ppm for 8 hour exposure (WHO)
	Temperature ( °C )	29.7	20-24 <sup>0</sup> C (Grandjean, 1978)
	Relative humidity (%)	54	40 – 60% (OSHA/WHO)
	Light intensity (Lux)	239	300 – 400 Lux (WHO)
	Sound level (db)	73	55 db (WHO)
2.	<b>Furniture : Chair</b>		
	Height of seat pan	19”	15 -20 inches (Grandjean, 1978)
	Width of seat pan	17”	16-20 inches (Grandjean, 1978)
	Depth of seat pan	17”	15-18 inches (Grandjean, 1978)
	<b>Furniture : Table/desk</b>		
	Height of table	29.5”	25-28.5 inches (Barnes, 1994)

*ii. Analysis of the physical environment and safety in schools:* The infrastructural features were rated good to excellent in private schools and average to good in government schools. The cleanliness, sanitation, toilet facilities were average to poor and drinking water facilities were average to very poor respectively in private and government schools. The classroom features viz. ventilation and light was average to good in all the schools. The furniture was suitable for the children in private schools but in government school no furniture was provided to children. The classroom

temperature was above the comfortable range i.e. between 28.5 – 29.7°C and relative humidity was within comfort in all the schools. Data revealed that light intensity was lower and noise level was between 72.3 db to 71.2 db.

**Spectrum of Occupational Health Hazards (OHH) among workers and the causes of hazards**

Understanding of occupational health hazards is essential for implementing effective preventive measures in various jobs as they bring harm to the health of mankind either physically or mentally due to work.

***OHH among agriculture and vegetable cultivators:*** The data revealed that the major physiological hazards reported by 60-70% of the respondents were fatigue and body pain reported while sowing, weeding, harvesting and threshing. The mean percent scores (MPS) of male respondents depicted that they were directly affected by chemical hazards during plant protection. The MPS showed that 58-60% of males and females were prone to environmental hazards indirectly while weeding and threshing crops.

***OHH among workers of construction industry:*** The construction work often involves heavy lifting, working at heights and proximity to heavy equipment and materials which increases the risk of falls and 87% of the respondents opined this. One-third of the workers operated machinery during cutting stone, roof laying and floor polishing leading to pain in arms and faced the problem of numbness in fingers (50%) and feet (38%). Hand-arm vibration syndrome was reported by 40% and partial deafness due to noisy machines by 60% of the workers. Almost 90% of the workers were not using protective engineering controls and were exposed to electric shock/burns. Approximately 50% of the workers involved in painting and finishing work faced allergies of skin and eye. Respiratory issues were reported by approximately 70% of the respondents whereas 60% reported problems related to season.

***OHH among Dairy Workers:*** Zoonotic diseases through direct contact with cattle and their bodily fluids caused flu-like symptoms in 53% of the respondents. Milking cows, lifting feed and equipment, and cleaning sheds led to pain, joint problems and repetitive strain injuries confronted by 73-78%. Respiratory problems were reported by 56%, skin issues by 28%, fractures and injuries due to falls or animal kicks were confronted by 65% of the respondents. Handling large animals posed physical injuries to most. Weather extremes led to heat-related or cold-related illnesses. The nature of work lead to stress, anxiety, and depression among workers.

***OHH among Workers Engaged in Carpet Making Industry:*** Carpet making resulted in fatigue and stress-related health issues confronted by 73% of the women. Long hours in static postures brought back pain (100%) and repetitive strain injuries (65%). Dust and fine fibers released during the carpet weaving process posed respiratory problems among 71% of the workers. Low-light conditions caused eye strain and discomfort among 65% of women. Skin irritation was reported by approximately 40% of the respondents.

***OHH among Indian Workers Engaged in Tailoring:*** Tailors spend long hours sitting at sewing machines, cutting fabric which led back pain in 65%, neck pain in 40% and carpal tunnel syndrome in 38% of the respondents. Due to the repetitive sewing and cutting, 52% confronted tendonitis and strains in the hands and arms. Handling hot irons resulted in burns. Injuries were reported due to sharp needles (79%), moving parts of machine (76%), and fast-moving fabric (42%). Machine related accidents were reported by 45% of the respondents. Electric shock was reported by 58% of the respondents.

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**OHH among Office Workers:** Prolonged sitting led to back and neck pain among 79% whereas obesity was reported by approximately 50% of the office workers. Workers also reported carpal tunnel syndrome (42%) and tendonitis (33%). Long hours of exposure to computer screens caused eye strain and visual problems, including headaches, dry eyes, and blurry vision to 67%. Workplace stress led to anxiety and depression reported by 75% of the respondents. Noise pollution was confronted by approximately 62% of the respondents.

### Prevention and Mitigation of health hazards among workers by various strategies and approaches

The following ergonomic strategies and approaches were disseminated through educational trainings to workers and managers.

- **Elimination:** The first step involves elimination of the hazard itself so that there is no risk of injury.
- **Substitution:** If the hazard cannot be eliminated, it should be substituted with less hazardous or with safer process, material, operation or equipment.
- **Engineering controls:** These are work environment and work design changes that directly eliminate a hazard or limit the severity, eliminate or reduce exposure; minimize awkward postures and undue force of the muscles.
- **Administrative controls:** These include training, job planning, rotation and scheduling, changes to work procedure, work area protection, reduction in exposure time to hazard and similar measures.
- **Personal protective equipment:** This should be used as last alternative or in addition with other controls.
- **Warnings:** Warning lights and signals to attract attention.
- **Ergonomic Workstations:** Ensuring adjustable chairs, proper lighting, and equipment to minimize strain.
- **Mental Health Support:** Providing access to counseling services and wellness programs for employees to address potential health issues.
- **Managing Stress:** Five "STEPS" should be used i.e. Stop and relax 20 minutes each day, Talk about stress, Eat three meals a day, Prepare for stressful events and Strengthening relationships with others.
- **Training and education:** Training community leaders, health educators, or promoters can be an effective way of empowering the community.
- **Improved Healthcare Access:** Strengthening rural healthcare infrastructure, promoting good hygiene practices and encouraging sick employees to stay home to prevent infections.
- **Regulatory Compliance:** Enforcing safety regulations and building codes on work sites and considering reduced working hours to prevent stress and fatigue.

### Developing ergonomic interventions and educational aids for empowerment of workers in various occupations

Audio-visual aids and printed literature were developed for educating the associated persons -

- i. Development of a package on "Safety and occupational health hazards in agriculture". The package included a booklet, four folders, a documentary film and a VCD on improved agriculture implements.

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- ii. A booklet on 'Ergonomic Guidelines to Minimize Awkward Postures and Hazards during Construction Work' for construction workers, supervisors, managers etc.
- iii. Instructional manual on 'Ergonomic Checkpoints for Amicable Physical Environment and Safety in Schools' for school authorities.
- iv. A booklet on 'Guidelines for Ergonomic Workplace Designing' for all involved in design of home and workplaces.

### **SUMMARY AND CONCLUSION**

Hazards and MSDs pose many health problems to the workers in various occupations. Lifting heavy loads, overexertion, long hours of work, continuous and forceful motions, bending and awkward postures, unsafe use of chemicals and environment were some of the main causes which attribute to many occupational health hazards and MSD's in various occupations. Educational interventions based on ergonomic principals were developed for mitigating hazards and to improve the quality of life of the workforce. Effective strategies and approaches for controlling hazards such as engineering modifications, use of personal protective products and educational efforts for encouraging safe environment and practices during work can help minimize the risk of hazards and the covert MSDs.

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## PROXIMATE AND IN-VITRO BIOACTIVITY ANALYSIS OF ROSELLE BLENDED NOVEL HERBAL FRUIT TEA

Y. Prabhavati Devi<sup>1</sup> and Ingudam Bhupenchandra<sup>2</sup>

<sup>1</sup>KVK, Chandel, <sup>2</sup>KVK, Tamenglong,

ICAR, Manipur Centre

E-mail: prabhayumnam@rediffmail.com

HSAI life membership Number:11/y-1/LF

Short listed paper for Senior Scientist's award  
at 35<sup>th</sup> Biennial conference of HSAI ,17-19 Jan.2024

### ABSTRACT

Roselle is one of the nutritious underutilized plants remained wasted in North eastern hilly region. Roselle based herbal fruit tea was formulated by using underutilized locally available fruits and analyzed for proximate, phenolic, flavonoid content and antioxidant activities. The sensory quality for consumer acceptance of the fruit tea was analysed by hedonic scale. Roselle- pineapple blended fruit tea infusions contained high amount of total phenolic content of  $664.9 \pm 0.31$  mg GAE/100 g while flavonoid content of roselle-pineapple tea was recorded as  $232.2 \pm 0.12$  mg QE/100gm. The antioxidant activity of roselle-pineapple ( $460.0 \pm 0.2$  mg Ascorbic acid Equivalent/100 g sample) was very high as compared to other fruit tea ( $129.7 \pm 0.07$  mg Ascorbic acid Equivalent/100 g sample). The fruit tea infusions also contained high vitamin C content. However, the present fruit tea infusions have shown high sensory quality and infusion time is also directly correlated with sensory quality of roselle pineapple tea

**Keywords:** Antioxidant activity, Flavonoid content, Phenolic content, Roselle, Pineapple

### INTRODUCTION

Herbal fruit tea is fruit based healthy drink prepared from locally available fruits of North East region of India. It is very rich in natural bioactive compounds such as polyphenols, flavonoids, anthocyanins, carotenoids, coumarins, alkaloids, polyacetylenes, saponins, terpenoids etc. It exhibits high natural antioxidants which can scavenge the free radicals which are very reactive and harmful to human health. It is prepared by incorporating dried fruit pulp, calyx and ginger by mixing in proper proportion. Health and nutrition have always been a priority for a healthy and contented human life to ensure protection from disease. However, the raging pandemic, which has endangered and periled human life for the past two years, has focused the spotlight on these issues more than ever in recent times. As a result, the population of "health-conscious" consumers is growing, and so is their "paying power". The traditional drink "tea" originates from the "*Camelliasinensis*" plant. All true teas are derived from this plant in various forms, such as oolong, black tea, and green tea, while herbal teas are technically not tea and have nothing to do with the tea plant. According to Goodwin, 2022, herbal teas are decoctions and infusions, may be mixtures

of several ingredients, and are more accurately described as “tisanes”. Tisanes are made from or combined dried leaves, seeds, grasses, nuts, barks, fruits, flowers, or other botanical elements that give them their taste and provide the benefits of herbal teas. Herbal teas are caffeine-free and categorized from the plant part from which they are manufactured or derived, e.g. bark tisane (cinnamon), root tisane (ginger), fruit tisane (peach).

These herbal beverages, known as herbal teas, have gained wide popularity in the past few years and have captured the imagination of health-conscious consumers and an emerging niche market (Chandrasekara and Shahidi, 2018). According to Grand View Research, a market research and consulting company, “the value of the global fruit tea market size was USD 2.4 billion in 2019 and is expected to expand at a CAGR of 9.6% over a short time. The growing popularity of fruit-flavoured tea products with low caffeine content among health-conscious consumers is expected to remain a key driving factor for the industry. Furthermore, shifting consumer preference toward customized tea gift sets and the growing importance of a healthy lifestyle is expected to boost the demand for fruit teas worldwide.”

According to many experts, the important natural sources of phenolic compounds such as, flavonoids, phenolic acids and anthocyanins are fruits, herbs and aromatic plants form [Rommel, 1993, Hakkinen et al. 1998, Sahin et al, 2011], with multiple antioxidant properties both *in vivo* and *in vitro* [Heinonen et al. 1998, Isik et al. 2011]. It is well-known that free radicals can damage cells and play a role in heart disease, cancer and other diseases [Sahin et al. 2011]. On the other hand, natural antioxidants protect human cells against the effects of free radicals and play an essential role in preventing certain health conditions [Buettner and Jurkiewicz, 1996]. No wonder that Sahin, 2013 has rightly pointed out the increasing popularity of fruit tea worldwide because of its antioxidant properties and attractive taste. Herbal fruit tea infusions are successfully replacing sweetened drinks and juices because of its taste, aroma, flavour and attractive appearance. Hence, there is increasing market demand of new products having nutritive and appealing appearance.

### **OBJECTIVES OF THE STUDY**

1. To formulate nutri-rich herbal fruit tea with locally available fruits.
2. To analyse the nutritional value and antioxidant activities.
3. To assess the sensory acceptability.

### **MATERIALS AND METHODS**

#### **Collection of raw materials**

The matured and healthy roselle calyx, pineapple and ginger were procured from Imphal market, Manipur. The fruits and calyces were washed thoroughly with water to remove dust and dirt. The peels of the fruits were removed and the fruit pulp was sliced with stainless steel knife then kept separately. Dehydration of the fruit and calyx was done by using electric dehydrator at 58°C with different time. Roselle calyces were dehydrated for 12-13 h, pineapples slices were dehydrated for 17-18 h, and ginger slices were dehydrated for 10 h respectively till it retained moisture level of 3-5%. The dehydrated fruits calyces, pulps and ginger were separately transferred to food grade polythene pouch after sealing with electric sealer then stored at room temperature till it is used.

**Chemicals and reagents**

The chemical used for analysis of nutritional content were procured from Sigma Aldrich (Merck, India), Hi-media (India) and SRL(India). The food grade quality tea bags used for the study were procured from Delhi.

**Preparation of fruit tea**

For preparation of nutri blended herbal fruit tea, the different ingredients were ground separately for 20-30 seconds using a mixture grinder. Fine powders were removed by using a sieve (2 mm pore size) and the coarse sizes were selected for the purpose. Roselle-pineapple tea was formulated by mixing different ingredients (Table 1). For packaging, 3 gm of mixture was transferred to each food grade tea bag or sachet and sealed it with electric sealer. The individual tea bag was transferred in a plastic pouch and sealed it again with the electric sealer.

**Table 1: Recipe of herbal fruit tea per sachet**

Type of herbal tea	Ingredients	Quantity/100gm	Quantity/tea sachet (gm)
Roselle-pineapple tea	Roselle	55.55	1.3
	Pineapple	37.03	1.2
	Ginger	29.63	0.5

**Proximate composition**

Ash (Method No. 930.05), crude protein (Method no. 955.04) and fat (Method No. 2003.05) contents were determined according to AOAC methods (2005). Reducing and non-reducing sugar was estimated according Nelson-Somogyi method (Sadasivam and Manickam, 1992). Total carbohydrate was determined by anthrone method (Sadasivam and Manickam, 1992). Vitamin C present in the sample was determined by spectrophotometric method (Sadasivam and Manickam, 1992).

**Preparation of sample for invitro bioactivity**

3 gram of fruit tea samples was soaked into 100 mL (80°C) and kept for 10 min. The mixture was sieved and the tea infusion was used for further analysis of total phenol, flavonoid and antioxidant activity.



**Figure 1: Formulation of herbal fruit tea**

#### **Total phenolic and flavonoid content**

The content of polyphenols in every sample was assayed according to the Folin–Ciocalteu method (Singleton and Rossi 1965). The value was expressed as GAE/100 gDW (Gallic acid equivalent per 100-gram dry weight). Flavonoid content was determined according to Barros et al. (2007) and value was expressed as QE/100 g DW (Quercetin equivalent per 100-gram dry weight).

#### **Antioxidant assay**

Antioxidant activity was determined by DPPH method (Thaipong et al. 2006). The antioxidant activity was expressed as mg ascorbic acid equivalent/gofdry weight sample (AAE/g DW).

#### **Sensory evaluation of fruit tea**

For assessing the consumer preference and acceptability, sensory evaluation of fruit tea was conducted. Sensory qualities were estimated by the 30 semi-trained panelists. Panelists were familiar with fruit product sensory evaluation; most of them having knowledge on fruit tea preparation. Analysis was done using Nine Point Hedonic Scale viz; 9 = like extremely, 8 = like very much, 7 = like moderately, 6 = like slightly, 5 = neither like or dislike, 4 = Dislike slightly, 3 = Dislike moderately, 2 = Dislike very much, 1=Dislike extremely (Peryam and Pilgrim 1957; Larmond,1977).

### **STATISTICAL ANALYSIS**

The statistical analysis was performed in triplicate and data are presented as means  $\pm$  standard deviations (SD). Descriptive analyses, one-way ANOVA ( $p = 0.05$ ), and Duncan's multiple range test (DMRT) at 5% level of significance was used for separation of mean. (Rovira et al., 2011). Pearson's coefficient correlation analysis between different mean sensory score of tea



types was performed using SPSS version 22. The heat map was created using the R package "gplot" as an upgraded version of the basic stats function (Warnes et.al. 2005). Simple regression was worked out using Microsoft XLSTAT.

## **RESULTS AND DISCUSSION**

Proximate analysis of the fruit tea was presented in Table 2. Roselle pineapple tea had high protein content. From the analysis, it was found that roselle-pineapple fruit tea content low total sugar and total carbohydrate as compared with other fruit tea available in the market. Zieniewska et al. (2020) have analyzed seventeen fruit teas available in market where they observed that the protein content ranges from 0.7- 1.2 g/100 g, fat content ranges from 0.1-0.7 g/100 g and carbohydrate content from 10.3-18.9 g/100 g. The protein and carbohydrate content of the present study was higher than these seventeen reported commercially available fruit teas. The main components of the present fruit tea viz- roselle and pineapple fruit were not present in the composition of fruit teas used in their studies. The fruit tea infusion was found to contain a good amount of vitamin C. The vitamin C content in roselle-pineapple tea was recorded as  $83.86 \pm 3$  mg/100 g. This value is comparable with fruits which contains high amount of vitamin c such as orange and lemons.

Polyphenols and flavonoids are the two important phytochemicals present in plants. These phytochemicals are responsible for many bioactivities exerted by the plant extracts. Roselle-pineapple tea had higher TPC and flavonoid content than other fruit tea. The TPC value of roselle-pineapple was found to be  $664.9 \pm 0.3$  mg GAE/100g DW. Zieniewska et al. (2020) have studied the nutritional and antioxidant property of seven different fruit teas available in market, where they found TPC values ranged from  $0.699 \pm 0.19$ mg to  $51.31 \pm 0.9$ µg GAE/100g DW. While the flavonoid content of roselle-pineapple fruit tea was found to be  $111.0 \pm 0.14$ mg QE/100g DW. This showed that roselle-pineapple tea had much higher flavonoid content than the other fruit tea infusions.

The antioxidant activity analysis revealed that that roselle-pineapple tea ( $460 \pm 0.2$  mg AAE/100g) exhibited higher antioxidant activity than the other fruit tea ( $129 \pm 0.07$  mg AAE/100g) in DPPH assay. The higher antioxidant activity of roselle-pineapple tea may be contributed to higher phenolic and flavonoid content. It is well established that phenolic/flavonoid content is positively correlated to antioxidant activity.

The fruits used in this study are well-known for exhibiting health beneficial properties. For instance, roselle and pineapple fruits not only having the nutrition properties but also reported for medicinal properties including antioxidant, antimicrobial, antidiabetic and anticancer (Joshi and Pravakar 2020). Pineapple has been reported for anti-inflammatory, antioxidant activity, healing of bowel movement and monitoring nervous system function (Alis et al. 2020). While the roselle calyces have been used in traditional medicine to mitigate many diseases such as hypertension, diabetes and liver disorders (Nguyen and Chuyen 2020). Hence, consumption of these fruit tea infusions may give various health beneficial effects.

**Table 2: Proximate composition and in-vitro bioactivity of Fruit tea infusion**

Sample	Parameters (g/100g sample)									
	Ash (%)	Protein	Fat	Carbohydrates	Reducing Sugar	Total Sugar	Vitamin C mg/100g	Antioxidant activity (mg AAE/100g)	Phenolic content (mg GAE/100g)	Flavonoid content (mg QE/100g)
Roselle-Pineapple tea	5.9	5.08	0.16	23.70	0.27	4.68	83.86	460.0±0.2	664.9±0.31	232.20±0.12

**Sensory evaluation of fruit tea**

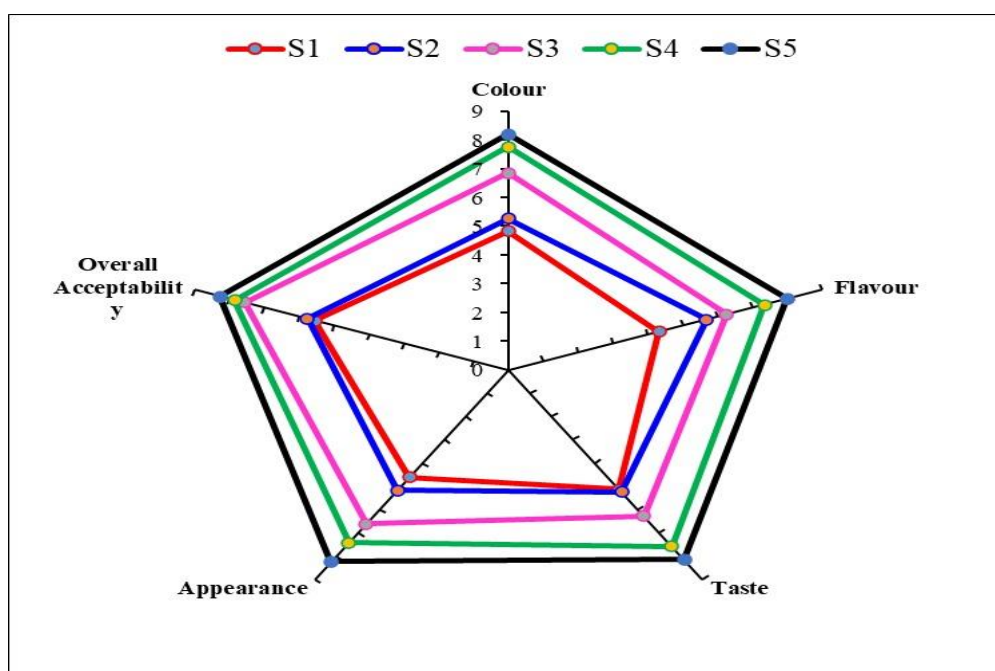
Sensory evaluation is one of the important factors to analyse the acceptability of the food products because it helps in designing and marketing of products to meet consumers’ sensory needs, which in turn reduce the risk of product failure (Sidel and Stone 1993). In order to assess the effect of infusion time on sensory parameters, the fruit tea samples (3 gm) were infused with 100ml freshly boiled water in a glass cup for 2-minute interval (2,4,6,8 and 10 minutes). One sample was provided at a time and panelists were asked to give scores for the sensory characteristic such as colour, flavour, taste, appearance and overall acceptability of the blended fruit tea. Before starting another sample, water was given to neutralize the taste and other samples were provided to give their preference and overall acceptability. Sensory tests were replicated thrice and water was present for taste cleansing amongst the sample.

The mean sensory scores of roselle-pineapple fruit tea were presented in table3.and graphically presented in figure2.It was observed that roselle pineapple tea infusions S<sub>5</sub> scored the highest while S<sub>1</sub> scored the lowest for all the sensory attributes. This showed that the sensory qualities of tea were improved with the increase in time of infusion. The interactions between the sensory parameters were evaluated by correlation, cluster and regression analysis. In order to assess the effect of infusion time on sensory parameters, the fruit tea samples (3 gm) were infused with 100ml freshly boiled water in a glass cup for 2-minute interval (2,4,6,8 and 10 minutes). One sample was provided at a time and panelists were asked to give scores for the sensory characteristic such as colour, flavour, taste, appearance and overall acceptability of the blended fruit tea. Before starting another sample, water was given to neutralize the taste and other samples were provided to give their preference and overall acceptability. Sensory tests were replicated thrice and water was present for taste cleansing amongst the sample.

**Table 3: Mean score for performance of colour, flavour, texture, taste and overall acceptability of roselle-pineapple fruit tea with different times of infusion**

Sample Code	Colour	Flavour	Taste	Appearance	Overall Acceptability
S <sub>1</sub>	4.82 <sup>c</sup>	4.32 <sup>c</sup>	5.13 <sup>d</sup>	4.61 <sup>d</sup>	5.57 <sup>c</sup>
S <sub>2</sub>	5.26 <sup>c</sup>	5.67 <sup>bc</sup>	5.25 <sup>c</sup>	5.17 <sup>c</sup>	5.78 <sup>c</sup>
S <sub>3</sub>	6.84 <sup>bc</sup>	6.25 <sup>bc</sup>	6.27 <sup>bc</sup>	6.62 <sup>b</sup>	7.58 <sup>ab</sup>
S <sub>4</sub>	7.75 <sup>b</sup>	7.34 <sup>b</sup>	7.58 <sup>b</sup>	7.43 <sup>ab</sup>	7.85 <sup>ab</sup>
S <sub>5</sub>	8.20 <sup>a</sup>	8.00 <sup>a</sup>	8.15 <sup>a</sup>	8.24 <sup>a</sup>	8.28 <sup>a</sup>

Means followed by a different letter are significantly different at  $p \leq 0.05$  by Duncan's multiple range test (Values are means of three replicates)



**Fig.2. Average sensory parameters of roselle-pineapple fruit tea with different times of infusion**

#### Correlation analysis between the sensory parameters

Results of the Pearson's correlation coefficient analysis (Table 4) in respect of roselle pineapple fruit tea revealed the existence of highly significant positive correlation between colour with flavour ( $p < 0.01$  and  $r = 0.959$ ), taste ( $r = 0.962$ ), appearance ( $r = 0.999$ ), and overall acceptability, ( $r = 0.995$ ). Similarly, flavour showed a highly significant positive correlation ( $p < 0.01$ ) with taste ( $r = 0.998$ ), appearance ( $r = 0.962$ ), and overall acceptability, ( $r = 0.966$ ). Taste was found to correlate significantly ( $p < 0.01$ ), appearance ( $r = 0.965$ ) and overall acceptability, ( $r = 0.967$ ). Appearance and overall acceptability observed a significant positive correlation ( $p < 0.01$  and  $r = 0.991$ ).

In respect of roselle-pineapple fruit tea also similar correlation was observed, wherein, colour was significantly and positively correlated ( $p < 0.01$ ) with flavour  $r = 0.963$ , taste ( $r = 0.979$ ), appearance ( $r = 0.996$ ), and overall acceptability, ( $r = 0.987$ ). Similarly, flavour ( $r = 0.952$ ), appearance ( $r = 0.973$ ), and overall acceptance ( $r = 0.923$ ) all revealed a highly significant positive connection ( $p < 0.01$ ). Taste, appearance ( $r = 0.981$ ), and overall acceptance ( $r = 0.941$ ) were shown to be strongly correlated ( $p < 0.01$ ). There was a substantial positive association between appearance and overall acceptability ( $p < 0.01$  and  $r = 0.979$ ). The overall results of correlation analysis (Table 4) indicates that all the sensory parameters are correlated to each other and this implies that the increment in one of the sensory parameters improved the other parameters and vice-versa; and they are dependent on each other. Similar finding was reported by Shanta et al. (2014) who also found correlation between colour, flavour, texture and overall acceptability as if any one of the parameters increases the other parameters also increases and overall acceptability of the product also increases.

**Table 4: Pearson correlation coefficient (r) matrix between colour, flavour, texture, taste and overall acceptability of roselle-pineapple fruit tea with different times of infusion**

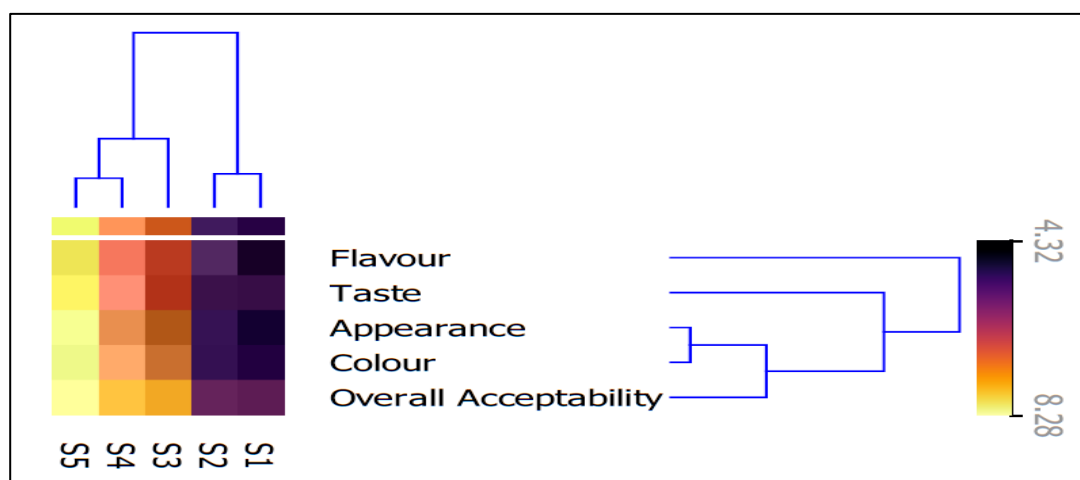
	Colour	Flavour	Taste	Appearance	Overall Acceptability
Colour	<i>1.000</i>	<i>0.963</i>	<i>0.979</i>	<i>0.996</i>	<i>0.987</i>
Flavour	<i>0.963</i>	<i>1.000</i>	<i>0.952</i>	<i>0.973</i>	<i>0.923</i>
Taste	<i>0.979</i>	<i>0.952</i>	<i>1.000</i>	<i>0.981</i>	<i>0.941</i>
Appearance	<i>0.996</i>	<i>0.973</i>	<i>0.981</i>	<i>1.000</i>	<i>0.979</i>
Overall Acceptability	<i>0.987</i>	<i>0.923</i>	<i>0.941</i>	<i>0.979</i>	<i>1.000</i>

Boldfaced italics numerical values indicated that correlation coefficient (r) values are significantly positive at  $p < 0.01$  (2-tailed)

The correlation coefficient (r) values correspond directly to the colour codes from green to yellow and red, respectively

**Cluster analysis of sensory parameters**

Cluster analysis was used to see the affinity and extent of association between the visual parameters in order to validate the correlation study results. The dendrogram was used to show and depict the cluster analysis results and group the parameters based on Ward's hierarchical clustering (Strauss and Maltitz 2017). In respect of roselle fruit tea cluster analysis there were formation of two dominant clusters viz., cluster I comprising of flavour and taste and cluster II consisting of overall acceptability, colour and appearance. The most likely reason for the formation of similar clusters in respect of visual parameters is due the existence of highly positive and significant correlation between them as evident in correlation (Fig.2)

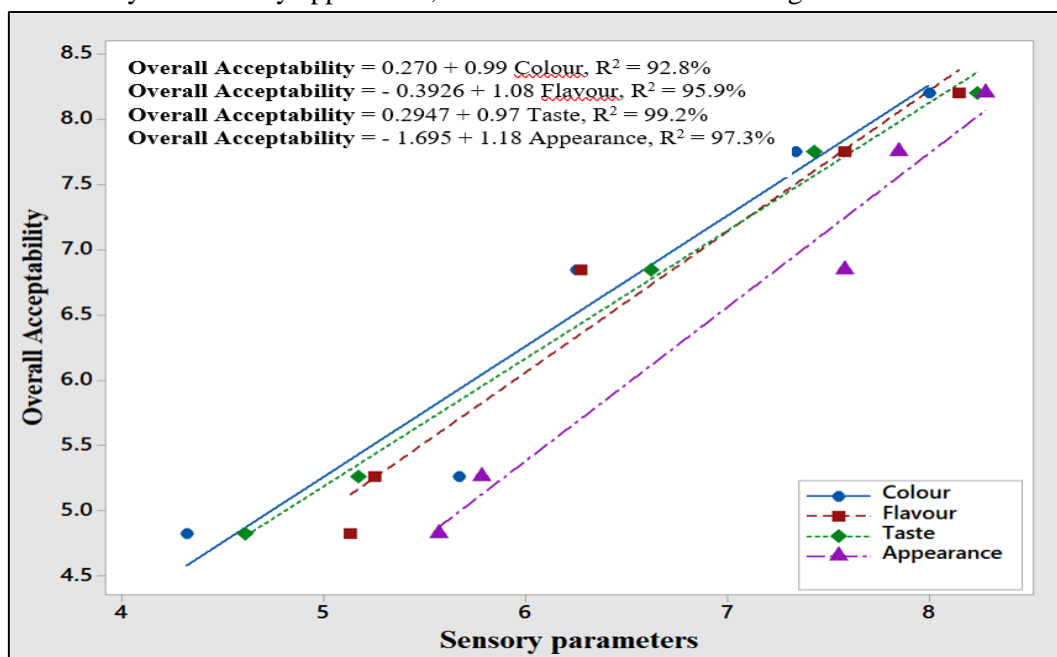


**Fig. 3: Heat map depicting the clustering sensory parameters of roselle-pineapple fruit tea with different times of infusion**

**Regression analysis for screening of the significant sensory parameters**

To screen the magnitude of attribution of differential sensory parameters to overall acceptability simple linear regression with each sensory parameters and multiple stepwise regression was computed. To work out the regression the sensory parameters were assigned as independent attributes while overall acceptability as dependent attribute. Upon iteration, the linear regression response curve for all the sensory parameters were laid in a single graph. Regression

response curve in respect of roselle fruit tea (Figure 3) exhibited a highly significant R<sup>2</sup> value of colour (99.0%), thereby indicating the strong dependence of colour on overall acceptability, which was closely followed by appearance, taste and flavour in decreasing order.



**Fig. 3: Response curve depicting the relationship between differential sensory parameters with overall acceptability in roselle-pineapple fruit tea with different times of infusion**

### CONCLUSION

From the present study it was found that the locally prepared roselle- pineapple fruit tea infusions have shown promising antioxidant activities and vitamin C content. The antioxidant activity of the fruit tea is because of the presence of high phenolic and flavonoid content. From the sensory evaluation study, it was observed that increased in infusion time giving more attractive colour, pleasant flavor and overall acceptability. These fruit tea infusions will be a good alternative for other sweetened drinks. The cost of fruit tea per sachet is Rs.6/-and can be accepted by different sections of population because of its high nutritional value. Hence, these fruit tea infusions will not only serve as the beverages but also act as dietary supplements of natural antioxidant and vitamin C of people of different age groups.

### SUGGESTION FOR FUTURE RESEARCH

- For further nutrient enhancement, other antioxidant rich fruits can be blended in order to make more nutrient dense health beverage.
- Comparative study of herbal fruit tea and green tea can be done.

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