A National Journal of Indian Association of Preventive and Social Medicine

# HEALTHLINE



#### pISSN 2229-337X / eISSN 2320-1525

VOLUME : 14 ISSUE : 4 OCTOBER - DECEMBER 2023

For more details visit : www.healthlinejournal.org

#### **HEALTHLINE JOURNAL**

#### A National Journal of

#### Indian Association of Preventive and Social Medicine managed by IAPSM-GC

Volume : 14 Issue : 4 (October - December 2023)

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#### Healthline journal is indexed with Index Copernicus, DOAJ, OPENJGATE, CABI, Index Medicus-SEAR

#### **HEALTHLINE JOURNAL**

A National Journal of Indian Association of Preventive and Social Medicine managed by IAPSM-GC Volume : 14 Issue : 4 (October - December 2023)

## INDEX Content Page No. Editorial Harnessing the Power of Artificial Intelligence (AI) for Predicting Nutritional At-Risk Children **Original Articles** Treatment Seeking Behavior and Psycho Socioeconomic Impact of Infertility Affected Couples Residing in the Catchment Area of an Urban Health Training Centre, Ahmadabad City: Mixed Method Study Parita Patel, Rashmi Sharma, Harsh Bakshi, Brijesh Patel, Sanju Gajjar, Roshni Dave, Nirav Bapat ......257-264 Confirmatory Factor Analysis of Depression, Anxiety and Stress 21 (DASS 21) scale in a study on Occupational Health Psychology in Health Care Professionals from Anand, Guiarat Technology Empowerment of ASHA Workers Using E-Health Initiatives in Rural Rajasthan Perception towards Biomedical Research among Undergraduate Medical Students in a Tertiary Care Institute of Kolkata: A Cross-Sectional Study Sreetama Chakrabarti, Prince Kerketta, Mausumi Basu, Shalini Pattanayak, Somnath Naskar, A Cross-sectional Study on Determinants of Overweight and Obesity among College Students Perusing Selected Allied Health Courses at Jamnagar City, Gujarat. Jimmy Kagathara, Samprada Tank, Monika Patel, Dipesh V Parmar, Niket Satapara, Mittal Rathod ......290-300 Assessment of Satisfaction Level of Admitted Patients in a Trauma Care Centre of Tripura - A **Questionnaire Based Study**

#### **HEALTHLINE JOURNAL**

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Volume : 14 Issue : 4 (October - December 2023)

### **INDEX**

Content	Page No.
A Case Control Study of Type 2 Diabetes Mellitus among Patients Attending Medicine Tertiary Care Hospital, Gurugram, Haryana	Department of
Manish Kundu, Manisha Singh, Vaibhav	
Impact of Domestic Environment & Personal Hygiene on Morbidity Pattern and He Children: A Community Based Cross Sectional Study in Surendranagar City.	alth Status of
Dhara V. Thakrar, Mohnish N. Tundia, Kishor Sochaliya, Priya Dabhi	
Epidemiological Profile of Children with Malnutrition at Child Malnutrition Treatment Ce Saurashtra Region	nter (CMTC) in
Dhara N. Jahangirporia, Chikitsa D. Amin, Amiruddin M. Kadri	
Cardiovascular Risk Assessment Using Updated WHO/ International Society of Hype Prediction Charts and Atherosclerotic Cardiovascular Disease Risk Score in Residents of A	ertension Risk Amreli District
Trusha Kansagara, Nitin A. Lodha , Yamini J. Gurjar	
ReviewArticle	
"Ni-kshay SETU", A Digital Health Intervention for Capacity Building in Tuberculosis und	er the National

TB Elimination Program in India: A comprehensive mHealth app review

Bhavesh Modi, Bhavna Puwar	

# Harnessing the Power of Artificial Intelligence (AI) for Predicting Nutritional At-Risk Children

#### Somen Saha<sup>1</sup>, Deepak B Saxena<sup>2</sup>

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Artificial intelligence (AI) is a new buzz word for various public health solutions, AI is expected to transform Indias dream of affordable universal healthcare into reality. India has been rapidly transformed the power of AI in diagnostic services, addressing shortage of human resource, and hospital management services. However, there is a huge potential to transform the power of machine learning for examining the huge data and records collected under mother and child tracking systems for health and nutrition at risk assessment. We reflect on use of AI for addressing Malnutrition in India.

Malnutrition is among the most critical reasons for child mortality in India, especially children below five years of age.<sup>14</sup> The first 1000 days, spanning from conception to a child's second birthday, represent a critical period characterized by rapid growth and development. States such as Gujarat, despite experiencing overall economic growth, faces significant challenges in several key areas of child well-being and survival, with malnutrition being the most common underlying problem, which has further deteriorated over the period.<sup>12,11</sup> This calls for the need of adapting or reforming the existing strategies, otherwise, it may risk disempowering local managers and lead to a "business-as-usual" acceptance of unreachable goals.

Available evidence suggests malnutrition in children a result of several well-established risk

factors including short maternal stature, mothers education, poverty, poor dietary diversity, maternal underweight, have been identified as some of the top risk factors.<sup>14</sup> These factors also reflect poor socioeconomic conditions and/or inadequate nutritional environments in children's households. Majority of this established risk factors are routinely captured by the programmatic trackers of health department and integrated child development scheme (ICDS). In Gujarat, the mother and child data are tracked through a name-based tracking system of Health & Family Welfare Department, called TeCHO+, while Poshan Tracker platform of the ICDS programme of Government of India remains an important platform for management of data gathering by the Women and Child Development Department, Gujarat. Despite a concern on reliability of both data sets, optimal analysis of the data thus gathered can lead to better decision making and targeted action.

The data captured through these trackers can be utilized to identify the pattern of risk factors of malnutrition and their regional variations. The power of machine learning can be harnessed to create a risk-based scoring approach for predicting families at risk of malnutrition as well as to develop regional forecast and identify high-risk pockets. With several evidence-based interventions already in place, based on the risk factor prediction, forecast

Quick Response Code	Access this article online	How to cite this article :			
	<b>Website :</b> www.healthlinejournal.org	Saha and Saxena Harnessing the Power of Artificia Intelligence (AI) for Predicting Nutritional At-Risk			
	<b>DOI :</b> 10.51957/Healthline_585_2023	Children. Healthline. 2023; 14 (4): 255-256			

and high malnutrition risk pocket identification, implementation of targeted intervention with a mix of already existing strategies or newly devised areaspecific strategies has a potential to better combat or prevent malnutrition.

We propose a two-phased approach. In the first phase, data analysis should be undertaken on the data captured in existing government nutrition tracker-based systems. Using the large pool of beneficiary data, machine learning algorithm can track the data to create an at-risk scoring. The collected data need to be preprocessed, which will be utilized for development and validation of an advanced predictive model of childhood malnutrition. Furthermore, it is possible to investigate the underlying mechanisms and pathways of identified risk factors, identified geographical and individual characteristics associated with a high risk of malnutrition, and generate forecasts of regional pockets with potential higher rates of malnutrition. In the second phase, a differentiated care model can be designed based on the forecasted findings, integrating insights from the predictive model. It is important that the model thus generated needs to be continuously refined, incorporating evidence-based findings and identifying the need for innovative strategies through literature review, consultative and validation workshops, and key informant interviews. Pilot testing and iterative improvement of the differentiated care model should be conducted to assess its feasibility, acceptability, and effectiveness. In the final phase, the scalability, sustainability, and potential challenges and opportunities of integrating the model into existing data tracking system should be assessed, considering resource requirements and long-term implementation strategies.

The model will support in predicting the children at risk of malnutrition. Based on this, a differentiated care package can be developed, which can support the State in selecting high impact interventions and allocation of resources. The predictive model and the differentiated care package can also help uncover the areas not addressed under the existing set of interventions and propel innovations, newer initiatives and undertake policy changes. With timely interventions, we anticipate a reduction in the prevalence of childhood malnutrition and its associated long-term health effects. The model's insights can also help develop evidence-based policies for child nutrition and development during the first 1000 days. The model can be adapted and applied in different regions and populations, contributing to efforts to combat childhood malnutrition.

As India is leading the Global partnership on Artificial Intelligence, it is important to undertake efforts to address the power of AI in prioritizing children at risk of malnutrition. We believe there is a huge potential to effectively harness the power of machine learning for faster progression towards identifying at risk children and pre-emptively plan activities for an intensified Poshan Abhiyaan, to begin with in nutrition high priority States. This also warrants on convergence of stake holders that includes members of academic (from Medical Colleges, Engineering college), Professional bodies like (IAP, IAPSM) and above all a strong political will and administrative will.

#### **Declaration:**

Funding: Nil

Conflict of Interest: Nil

#### **References:**

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:: 256 ::

#### Treatment Seeking Behavior and Psycho Socioeconomic Impact of Infertility Affected Couples Residing in the Catchment Area of an Urban Health Training Centre, Ahmedabad City: Mixed Method Study

Parita Patel<sup>1</sup>, Rashmi Sharma<sup>2</sup>, Harsh Bakshi<sup>3</sup>, Brijesh Patel<sup>1</sup>, Sanju Gajjar<sup>1</sup>, Roshni Dave<sup>4</sup>, Nirav Bapat<sup>5</sup>

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#### Abstract:

**Introduction:** Infertility is a serious public health issue and addressing this, is in centre to not only to attain SDG 3 and SDG 5, but also to ensure human rights to everyone. **Objective:** To document the treatment seeking behavior and psycho social impact on infertility affected couple residing in the catchment area of urban health training centre, Ahmedabad city. **Method:** A community based, cross sectional, mixed method study was conducted in the areas under the Urban Health Training Canter (UHTC) of GMERS Medical College, Sola, Ahmedabad. Survey covered 689 married women of reproductive age group for infertility (based on WHO field based definition). A total 51 women from infertile couples were interviewed in-depth and were also assessed for anxiety and depression using GAD 7 and PHQ 9 respectively. **Results:** Out of 51 affected women, 36 (70.6%) took treatment; mostly (88.9%) from Gynaecologists who were invariably from private sector. Out of pocket expenditure (OOPE) for treatment varied highly, from INR 200 to INR 1200000. Out of 51 women, 8 (16%) had anxiety and 10 (19.6%) had depression. A total 7 (13.7%) of them were blamed by husband or in-laws while 6 of them (11.8%) stated that issue of infertility has affected their sexual life as well. **Conclusion:** Couples affected with infertility had varied out of pocket expenses and were also prone to anxiety and depression. Due to the social and psychological implications and huge OOPE, management of infertility should be covered under various governmental health insurance schemes.

**Keywords:** Infertility, Mixed Method study, Out of pocket expenditure, Psycho social consequences, Treatment seeking behavior

#### Introduction:

Infertility has been recognized as a public health issue worldwide by the World Health Organization (WHO).<sup>[1]</sup> Infertility is not only a medical challenge but also takes a major psychological and financial toll on the couples.<sup>[2]</sup> Today the main causes of infertility are stress, male factor, medical disorders such as diabetes, hypertension, hypothyroidism and lifestyle diseases such as obesity and addictions in the young etc., and sometimes unexplained. Tobacco and alcohol are the most prevalent addictions significantly affecting semen quality.<sup>[3]</sup>

Women are either divorced or abandoned by husbands for second marriage if a woman is unable to give birth to a child. Estimates suggest that in the developing world, the overall burden of infertility is

Quick Response Code	Access this article online	How to cite this article :
	<b>Website :</b> www.healthlinejournal.org	How to cite this article: Patel P, Sharma R, Bakshi H, Patel B, Gajjar S, Dave R, Bapat N. Treatment Seeking Behavior and Psycho Socioeconomic Impact of Infertility Affected
	<b>DOI :</b> 10.51957/Healthline_571_2023	Couples Residing in the Catchment Area of an Urban Health Training Centre, Ahmedabad City: Mixed Method Study. Healthline. 2023; 14 (4): 257-264

over three times higher than developed countries.<sup>[4]</sup> When allopathic treatment does not work, women seek other methods, or visit holy places and spiritual healers. Most couples seek treatment after they fail to conceive within 1 - 4 years.<sup>[5]</sup> Some factors influence the treatment-seeking behaviour of women are the willingness of couples, accessibility of infertility care, social and emotional repercussions during ongoing treatment,<sup>[6]</sup> and affordability of the expenses of treatment.<sup>[7.10]</sup>

No governmental program focuses on the management of infertility and it has become a neglected reproductive health issue. Infertility treatment is not covered under Ayushman Bharat and Pradhan Mantri Matrutva Vandana Yojana. Current programs at no stage records or addresses the problem of infertility. Such couples on their own go from one clinic to other for the treatment including faith healers, quacks and practitioners of alternative health systems.

#### **Objectives:**

1. To document the profile, out of pocket expenditure (OOPE) and treatment seeking behavior of infertility affected couple residing in the catchment area of Urban Health Training Centre, Ahmedabad City.

2. To assess psycho social impact of infertility on the affected women.

#### Method:

An operational research (OR) project was granted to us by State Health System & Resource Centre (SHSRC), Gujarat to document a complete picture of infertility in urban settings. In order to document the prevalence of infertility in urban areas, a community-based cross-sectional survey was done among 689 married women of child bearing age (18 – 49 years) in the catchment areas of an Urban Health Training Centre, Ahmadabad City. Study sample was determined by global estimated lifetime prevalence of 17.5% (15.0 – 20.3) (WHO).<sup>[11]</sup> This survey yielded 51 women from infertile couples who constitute the study sample for present research work. Therefore, present communication captures findings relevant to the objectives narrated above.

A flow diagram is presented as Figure 1 to describe the process of sample selection for the community survey.





#### Data collection tools:

Pre tested, semi structured questionnaires (along with checklist) were prepared after several meetings and validation by practicing gynecologists from both private and government sectors. For, assessing depression and anxiety, in consultation with consultant Psychiatry, PHQ 9<sup>[12]</sup> and GAD 7<sup>[13]</sup> scales, respectively were used. Women with infertility had in-depth interviews with open ended questions using thematic guidelines.

#### Data quality:

Operational Definitions for data collection were adopted as per WHO.<sup>[14]</sup> All study tools were field tested and modified based on the pilot testing. All investigators were trained for using study tool and in case of any missing information during first visit, a second visit/contact was made within 48 hours to complete the information.

#### Data analysis:

Data was entered in MS excel and appropriate statistical tests were applied and their qualitative data including perceptions and experiences were analyzed manually and were quoted as verbatim.

#### **Ethical Issues:**

Ethical clearance was obtained from local Institutional Ethics Committee (IEC) vide GMERSMCS/IEC/01/2022 dated 29/01/22. For the teams, while collecting information in the field, there was a provision of (1) one female social worker during household survey for RAG women and (2) 1 lady doctor in each team for interviewing couple with infertility. All interviews were conducted in full privacy and participants were informed about the freedom to withdraw from study at any point of time. Data Confidentiality and nondisclosure of identity were maintained; data identifiers were removed during analysis. Those who were found in need of counselling or treatment for infertility or mental health issues were referred to our hospital (tertiary level multi-specialty type) with a referral slip.

#### **Results:**

Based on operational definition of infertility, 51 women detected during the community survey were interviewed in-depth. Though this study primarily

focuses on female partner but efforts were made to get the information about the male partners either from them directly or from their wives. As per the demographic profile, 25 (49.0%) female partner were between 25 and 35 years, only 2 (3.9%) male partner and 9 (17.6%) were very young (18-25 years) and 4 to 5 (9.8%) of the couple were in middle age. Mean age of male and female partner was 34.3 ± 7.4 and 31.6  $\pm$  7.2 years, respectively. Median age for female and male partners were 26.6 and 28.2 years, respectively. In case of females, only 1 woman and in case of male 2 were married for the second time; for the rest it was first marriage. Only 3 females (6%) and 32 (62.7%) males were addicted to tobacco consumption. Out of 51, 8 women reported some genitourinary disease/ disorder and 2 of the male partners had undergone surgery for genital disorders at the time of study. Eight female and 3 of the male partners had episode(s) of RTI/ STI in last one year; all of them took treatment. (Table 1)

Table 1: Profile of couple with Infertility (N=51)

Profile	Female	Male		
	partner	partner		
	n(%)	n(%)		
Age (years)	-			
18 - 25	9 (17.6)	2 (3.9)		
25 - 35	25 (49)	26 (51.0)		
35 - 45	13 (25.5)	18 (35.3)		
45 -50	4 (7.8)	5 (9.8)		
Mean ± SD	31.6 ± 7.4	34.3 ± 7.4 years		
Median (years)	26.6	28.2		
Marriage order				
1 <sup>st</sup>	50 (98)	49 (96.1)		
2 <sup>nd</sup>	1 (2)	2 (3.9)		
H/O Addiction	3 (5.9)	32 (62.7)		
Diseases/surgery	8 (15.7)	2 (3.9)		
of genitourinary				
tract				
H/O of RTI/ STI in	8 (15.7)	3 (5.9)		
the past 1Year				
Semen analysis	NA	12 (38.7)		
report				
(abnormality				
detected) (N=31)				

# Table 2: Out of pocket expenditure (OOPE) of affected couple with Infertility\* (N=36)

Cost of treatment (INR)	n (%)
<10000	6(16.7)
10000-25000	8(22.2)
25000-50000	6(16.7)
50000-100000	3 (8.3)
100000-500000	11 (33.3)
>500000	2 (6.0)
Mean ± SD (Range)	1,37,894±2,68,943
	(200-1200000)
Median (IQR)	32500
	(12550 – 150000)

# Table 3: Treatment seeking behaviour of women having Infertility (N=51)

Treatment seeking behavior	n (%)					
Treatment sought	36(70.6)					
Treatment Provider * (N=36)						
MBBS / Registered Medical Practitioner 2 (						
AYUSH (1 Ayurveda & 1 Homeopathy)	2 (5.5)					
Gynecologist	32 (89)					
Type of treatment modality (N = 36)						
Medical alone	19 (52.8)					
Medical with surgical	17 (47.2)					
Mean duration after marriage couples						
starts seeking treatment = 3.05 ± 1.84 years						
Mean duration of treatment 3.4 ± 3.1 years						
Reasons for not seeking treatment by						
infertile women (N = 15)						
Myths 7 (4						
Financial Issues	2 (13.3)					
Social stigma	1(6.7)					
No reason	5 (33.3)					

It was decided to know the economic burden in terms of OOPE. As per the 36 responses received variations was observed in OOPE from mere INR 200 to INR 1200000. Median (IQR) expenditure was INR 32500 (12550 - 150000) with mean expenditure as  $1,37,895 \pm 2,68,944$ . (Table 2) Thereafter only 30 of them could elaborate details of expenses and it was mainly on surgical treatment followed by medications and investigations by 21.5% and 13.7% respectively. (Figure 2)

Figure 2: Details of out-of-pocket expenditure by affected couples (N=30)\*



<sup>\*6</sup> were non-respondents

Table 4: Psychosocial consequences of infertility in studied women (N=51)

Psychological consequences	n(%)						
Anxiety (N=50)*							
None	42 (84.0)						
Mild	5(10.0)						
Moderate to Severe (include 1 severe)	3 (6.0)						
Depression (N=50)*							
None	40 (80.0)						
Mild	5(10.0)						
Moderate	5(10.0)						
Distressing activities (N=51)							
Yes	12 (23.5)						
No	39(76.5)						
Type of activity (N = 12) **							
Yoga/Meditation/Pranayama	12(100)						
Exercise	7 (58.3)						
Emotional support from	51 (100)						
husband (N=51)							
Social Consequences (N=51)							
Episodes of blaming by husband	7 (13.7)						
or in-laws							
Sexual life affected	6(11.8)						
Pressure for remarriage of spouse	1(1.9)						
Problem physical relation with spouse	3(5.9)						
Socialisolation	3 (5.9)						
No social Consequences	31 (60.8)						
1 case was non-responsive; ** Multiple responses							

Out of 51 affected women, 36 (70.6%) took some treatment and mostly 32 (88.9%) from Gynecologists who all were from private sectors usually by referral from MBBS doctors. Amongst those 15 (29.4%), who did not seek any treatment, most common reason was prevailing myths 7(46.7%), followed by financial issues 2(13.3%) and social stigma in 1 case. Five of them (33.3%) did not provide any reason for not seeking treatment. (Table 3) Prevailing myths preventing the couples to access the treatment were "there is no treatment of infertility" or "Bhuva (exorcist) forbade them for the treatment" or "She will conceive only when there are blessings from the goddess"

As per the depression screening tool (PHQ 9), 10 of the affected women (20%) had depression (5 each with mild & moderate type). Similarly, as per screening tool GAD 7 for anxiety, 8 (16%) had anxiety (including 5 as mild, 2 as moderate & only 1 as severe). When asked by all (51) how do they destress themselves, only 12 were doing activities like Physical exercise/ Yoga/ Meditation/ Pranayama. All these women were asked that whether they get adequate support from their husbands and family members to cope with related stress. All of them agreed to have full support from their husbands. But at different occasions, 7 of them (13.7%) told that they were blamed by husband or in-laws. Also, 6 (11.8%) stated that issue of infertility has affected their sexual life too (including 3 who specifically mentioned about facing problem in physical relation with spouse). Only 1 woman was facing pressure for re marriage of husband by relatives. However, none of them has any experience of domestic violence. Three women experience social isolation whenever they attended any social function. Psychological consequences of infertility among study participants is shown in table 4.

#### Perception about Infertility, treatment seeking behaviour and experiences and challanges by the affected couple:

*"We do not want any treatment. When Goddess will bless, we will go for treatment at local corporate* 

*hospital.*" (39 years old female, residing in slum area, having active married life of 15 years had primary infertility)

There was a female aged 33 years with symptoms of Poly cystic Ovarian Syndrome (PCOS) (hirsutism, irregular menses, & lower abdominal pain) with depression and she was taking naturopathy treatment.

#### Discussion:

To identify couple suffering from infertility (primary & secondary) at community level, survey was done in 3 phases and Standard operation definition given by WHO<sup>[14]</sup> was adopted. Study population was representative of potential population of prime reproductive age group as half of them were between 25 to 35 years. In a study conducted by Deshpande et.al the mean age of the females and males were 28.35 and 32.9 years respectively.<sup>[3]</sup> Community-based study to assess infertility has its own limitation which was tried to overcome through reviewing their case papers by investigators. In present study couples sought treatment after a mean duration of  $3.05 \pm 1.84$  years and the mean duration of treatment was  $3.4 \pm 3.1$ years. These findings compare well with other studies.<sup>[3]</sup> OOPE varied from mere INR 200 to INR 1200000.

Objectives of family planning include; prevent unwanted pregnancies and bring about the wanted pregnancies. However, the objective of bringing about wanted pregnancy is never addressed. Barring a few and isolated attempts in certain states to provide financial assistance enabling women to take treatment of infertility in private sector, no program focusses on the management of infertility and it has become a neglected reproductive health issue. Infertility treatment is not covered under Ayushman Bharat and Pradhan Mantri Matrutva Vandana Yojana. Goa is one state which provides free IVF treatment to everyone, IVF treatment is too costly and result may not be expected in first cycle. Even one cycle treatment of IVF costs about 1.5 lac and for the

couple from middle /lower social class, it is very difficult to manage. Many of the couples leave the treatment after 1 or 2 cycles of IUI/IVF because of expensive treatment.<sup>[15]</sup> OOPE was mainly on surgical treatment and mostly (88.9%) from Gynaecologist. It was envisaged initially to study the male partners as well; however, their cooperation or participation was not there. While reviewing the case papers of these 51 women, 38.7% of male partners had abnormality detected in semen which is higher than observed by Deshpande et. Al  $(20\%)^{[3]}$  As per the systematic review 17 studies (N = 6410 women), proportion of couples seeking medical care was, on average, 56.1% (42-76.3%) in more developed countries and 51.2% (range 27-74.1%) in less developed countries.<sup>[1]</sup> which is more or less similar to current study. In a study by Patra et al,<sup>[16]</sup> among 159 interviewed women, only 3 did not seek any kind of treatment. About 70% of women mentioned they did not know where to go, about 49% said they wanted to wait for natural pregnancy and about 54% responded that they didn't feel that treatment was necessary. Further, among those who felt the treatment was necessary, about 30, 44, 10, and 19% mentioned that due to unaffordability, inaccessibility, or inconveniences like no time or no one at home etc. they didn't consult allopathic treatment. This study further concludes that educated and media savvy women tend to consult allopathic treatment. Time/ money spent on care vary by type of treatment and socioeconomic factors. They finally emphasised a need for mandatory insurance for infertility treatment from state government.

There are multiple reasons for poor mental health and so also multiple manifestations. Mental health and infertility are bidirectional. Several studies have demonstrated that the anxiety had a negative effect on fertility and vice versa. The women with long-standing infertility suffer more from nervousness, panic attacks, agitation, and intolerance. Infertility affects psychological wellbeing of women<sup>[17-19]</sup> but in current study it was not that much higher, this may be due to low sensitivity of

diagnostic tool, inadequate time given to evaluate, presence of other members and less privacy. Infertility is a medical as well as social problem, the couple and the families suffer at the same time silently but hesitate to discuss this topic. In most cultures "being childless" is undesired socially.<sup>[2]</sup> Infertility places women at risk of social and familial displacement, and women clearly bear the greatest burden of infertility.<sup>[20]</sup> Infertility has damaging psycho-socio-economic consequences on the affected couples and more so on the female partners in Indian settings. It is common knowledge that a woman is divorced or abandoned by husband for second marriage if she is unable to give birth to a child. Infertile women experience negative social consequences, including marital instability, stigmatization, and abuse. It could have a serious effect on both psychological well-being and social status of woman.<sup>[18 - 21]</sup> In present study, initially all women said they had emotional support from their husband but later 7 women (13.7%) told that they were blamed by husband or in-laws, 6 (11.8%) stated that this issue has affected their sexual life too (including 3 who specifically mentioned about facing problem in physical relation with spouse) and 1 woman was facing pressure for re marriage of husband by relatives. A study by Singh and Prasad<sup>[22]</sup> observed that in 65% cases husbands were supportive with protective attitude towards their wife, 35% were involved in psychological or physical violence, approx. 66% infertile women are subjected to domestic violence (55.7% psychological & 10.7% physical violence) by their family, 37.14% infertile women are threatened for divorce & second marriage by their in-laws. Same study <sup>[22]</sup> observed that 58.57% in-laws were involved in violence and threatening to infertile women. It further observed that in 13.5% cases even parents of infertile women were nonsupportive to their daughters.

#### Limitation of the study:

In few cases of infertility, women were not present at home because of her job schedule/ out of

station, so physical interview couldn't be possible. In such cases telephonic interviews were taken but those were less reliable and physical parameters could not be obtained for them. It was envisaged in the beginning to include male partners as well but their participation could not be obtained. Estimation of fertility and its type primary or secondary was based on questionnaire based interview method.

#### **Conclusions and Recommendations:**

Infertile couples in the study were aware about need of treatment as 70% of them approached to health facility mostly (88.9%) those with gynaecologist. Infertility and mental health have a bidirectional association but, in this study, only 16% and 20% had anxiety and depression, respectively. Anxiety and depression manifestations of mental illhealth, as assessed by the tools were prevalent among these women but the prevalence was not very high. However other indicators of psycho-social health such as social isolation, ill treatment from in laws, deterioration of family/ sexual life was present in few of them and a further under reporting cannot be ruled out due to the stigma associated with the victims of infertility. Couples who opted for treatment had huge OOPE up to INR 1200000. Hence infertility treatment needs to be provided at government facilities for the couples seeking the treatment and must be covered under some governmental schemes like PMJAY. Counselling of such couples (including male partners) should be made available at higher health facilities.

#### Acknowledgement:

Authors are thankful to State Health System Resource Centre (SHSRC), Gujarat for providing Technical and Financial support.

#### **Declaration:**

Funding: State Health System Resource Centre (SHSRC), Gujarat

#### Conflict of Interest: Nil

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#### Confirmatory Factor Analysis of Depression, Anxiety and Stress 21 (DASS 21) scale in a study on Occupational Health Psychology in Health Care Professionals from Anand, Gujarat

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#### Abstract:

Introduction: Confirmatory factor analysis (CFA) is a statistical technique to verify the factor structure of a set of observed variables. Objective: The study was conducted with an objective to study the psychometric properties of DASS 21 scale by Confirmatory factor analysis. Method: This study used a Multi Method Design (Multiple approach Design), one was a cross sectional study of 228 participants and the other was a Solomon 4 group Design with total 64 participants. Four groups of health care professionals viz Allopathic doctors, Physiotherapists, Nursing professionals and Community Health Officers (CHOs) were chosen for the study. Convenience sampling was done at two stages. Results: Confirmatory factor analysis was used to evaluate the construct validity of DASS 21 scale. The model was overidentified as the estimated parameters were less than the number of observed variances and covariances. CMIN/DF (Chi square (minimum discrepancy function) /Degree of freedom) value was 2.021 which was < 5. Goodness of Fit Index (GFI) value (0.892) was near to .9. Root Mean square Residuals (RMR) and Root Mean Square Error of Approximation (RMSEA) value were 0.031 and 0.063, respectively which were less than 0.08. Average variance extracted (AVE) for the three constructs were less than the squared interconstruct correlation. Conclusion: DASS-21 scale demonstrated a good convergent validity, but in this study, discriminant validity was found to be poor as determined by average variance extracted in comparison to squared Interconstruct correlation.

**Keywords:** Confirmatory factor analysis, DASS 21, Health care professionals, Occupational Health Psychology

#### Introduction:

Factor analysis is to identify and/or understand the nature of the latent constructs underlying the variables of interest.<sup>[1]</sup> Confirmatory factor analysis (CFA) is a statistical technique to verify the factor structure of a set of observed variables. CFA tests a hypothesized relationship between observed variables and their underlying latent constructs.<sup>[2]</sup> Confirmatory factor analysis (CFA) is the fundamental first step before Structural equation modelling (SEM models). These methods explore the relationship between an outcome variable and predictor variables. Factor loadings of the indicators (observed variables) are calculated. Convergent validity is indicated by high factor loadings. Goodness of fit statistics test for absolute, parsimonious, and

Quick Response Code	Access this article online	How to cite this article :			
	<b>Website :</b> www.healthlinejournal.org	Sharma D. and Sharma H. Confirmatory Factor Analysis of Depression, Anxiety and Stress 21 (DAS			
	<b>DOI :</b> 10.51957/Healthline_570_2023	in Health Care Professionals from Anand, Gujarat. Healthline. 2023; 14 (4): 265-275			

incremental goodness of fit. Confirmatory factor analysis for all constructs is an important first step before developing a structural equation model.<sup>[3]</sup> Confirmatory factor analysis (CFA) is a powerful statistical tool for examining the nature of and relations among latent constructs.<sup>[4]</sup> DASS 21 is a Likert scale and is frequently used in research. The scale consists of 7 questions on stress, anxiety and depression and in total 21 questions are there.<sup>[5]</sup>

#### **Objective:**

The study was conducted with an objective to study the psychometric properties of DASS 21 scale by doing Confirmatory factor analysis.

#### Method:

The current study was done using Multimethod study design in Anand District amongst the healthcare professionals over the study period starting from December 2020 to September 2023. The data collection period was of 2 years (February 2021- Jan 2023).Two study designs were used in this Multi Method study Design (Multiple approach Design). These were 1.Cross sectional study Design: Base pool of participants and 2. Quasi experimental -Solomon four Nonequivalent control group study design for intervention.

#### Sample size:

For Cross sectional study sample size was calculated using OpenEpi Version 2.3.1 and by the formula=  $[DEFF*Np (1-p)]/[(d2/Z_{1-\alpha/2}^2*(N-1)+p*(1-p)]^{[6]}$ 

In the formula, N- Population size.

Hypothesized % frequency of outcome factor in the population (p)- 50% to keep the maximum sample size for the given set of particulars in sample size calculation.

Absolute Precision %-7%

Confidence limits as % of 100-/+ 7%

 $Z^{2}_{1-\alpha/2}$  = Standard normal variate (at 5% type I error p= 0.05, it is 1.96)

#### DEFF-Design effect-1

#### Confidence level - 95%

Based on the "p" and at 95% confidence limit, the calculated sample size was 196. Considering 10% non-response rate, the final sample size came to 216. The data collection was done for 231 participants and during data entry, 3 proformas with incomplete information for the 9 scales were rejected. So, the final base pool of participants was 228.

Sample size for Solomon 4 group Design was calculated by using GPower 3.1<sup>[7]</sup> for F tests: ANOVA: Repeated measures, within-between interaction

Effect size f = 0.25  $\alpha \text{ error (prob)} = 0.05$ Power = 0.90 Number of groups = 4

Keeping the intervention group participants in the overall sample size, the sample increased by 32 participants over the base sample from Group III and Group IV of Solomon 4 Group Design.

Cross sectional study of 228 participants in phase I was done followed by Solomon 4 group Design with a total 64 participants. Total 32 participants were from original frame as Group I and Group II participants. So, 32 participants additional to 228, 260 was the overall sample size.

This study was approved by the Institutional Ethics committee and the clearance number was IEC/ HMPCMCE/ 122/ Faculty/ 4/. All the participants have filled the informed consent form. The data was analyzed by SPSS version 15.0 (SPSS Inc., Chicago, IL, USA) and trial version AMOS 26.0 graphical interface (SPSS Inc.).

**Inclusion criteria**: Those who agreed to participate in the study and with minimum of 1 year of exposure to work in the same profession and at the same place, working only in an institution either Government or private.

**Exclusion criteria**: There was as such no exclusion criteria.

Different health care professionals viz Allopathic doctors, Physiotherapists, Nursing Professionals and Community Health Officers (CHOs) were included as study participants.

Sampling was convenient sampling and done in 2 stages

**Stage 1:** Primary units (Institutions and Government Public health facilities)

#### Participants were selected from:

- 1. One Medical college and hospital
- 2. One Nursing school
- 3. Two District blocks
- 4. Civil hospital
- 5. Three Physiotherapy colleges

**Stage 2:** Participants from the institutions: Those who agreed to participate and were in the inclusion criteria.

- 1. Medical college hospital: Doctors were selected
- 2. Nursing school: Nursing professionals were selected
- 3. District blocks: Nursing professionals and CHOs were selected
- 4. Civil hospital: Doctors were selected
- 5. Physiotherapy colleges: Physiotherapists were selected

Different organizations were taken as the entire pool was not available at a single institute and varied responses related to govt and private organizations was to be seen in relation to employer care and other such occupational attributes. In this study, 49 Allopathic Doctors, 112 Physiotherapists, 51 Nursing professionals and 48 Community health officers (CHO) participated.

**Selection of questionnaires:** To meet the desired objectives of the overall project, 9 scales/ questionnaires along with a socio-demographic proforma including occupational attributes and a proforma for qualitative study in form of "Open

ended questions" was finalized. Out of these 9 scales, one was DASS 21. The current manuscript is about the Confirmatory factor analysis to study the psychometric properties of DASS 21 scale. All the 21 variables were coded as DASS1 to DASS21.

Respondents rate items on a 4-point Likert scale, ranging from 0 - "Didn't apply to me at all- Never" to 3 - "Applied to me very much, or most of the time."

Final outcomes were coded as S , D and A. The final score for a particular construct is by multiplying with 2. The specific questions for a particular construct were

S (Stress)= (DASS1+ DASS6+ DASS8+ DASS11+ DASS12+DASS14+DASS18)\*2

A (Anxiety)= (DASS2+ DASS4+ DASS7+ DASS9+ DASS15+DASS19+DASS20)\*2

D (Depression)= (DASS3+ DASS5+ DASS10+ DASS13+ DASS16+ DASS17+ DASS21)\*2

#### **Results:**

This study was an attempt to assess the relative performance of continuous and categorical estimation methods in the same sample, with the underlying assessment of univariate and multivariate normality assumptions. All the 4 identified Data sets were of the same data and these were identified based on the theoretical consideration for continuous data and the Likert scale. In theoretical consideration for continuous data, 1) First Data set was naïve data, 2) Second Data set was with the correction for normality based on Kurtosis >2, 3) Third Data set was with complete correction for outliers and 4) Fourth Data set was considering the naïve data as on Likert scale. ML (Maximum Likelihood) method of estimation was usedin the first 3 Data sets considering the data set as on continuous numerical scale and was applied Bollen Stine bootstrapping correction for the nonnormality. For the Likert scale, was used. ULS (Unweighted Least Square) estimation method. The metrics of model fit indices mentioned are of Data set 1.



#### Figure 1: Outline showing the 4 studied Data sets for CFA analysis

#### Normality Assessment:

Mardia's statistic for multivariate normality was used.<sup>[8]</sup> Multivariate outliers were identified by Mahalanobis distance (Squared).<sup>[9]</sup> Bollen-Stine bootstrap procedure was applied in the non-normal data as seen here and it helps in accommodating the negative distributional properties of the data.<sup>[10]</sup>

# Calculation of Construct reliability (a measure of convergent validity with AVE) and Divergent validity.

CFA measures construct validity. It comprises of convergent and divergent validity. Item reliability is square of the factor loadings which are standardized estimates. Delta is calculated as 1- Item reliability. AVE is total summation of squared factor loadings or summation of item reliability of a construct divided by the total variables in that construct. Construct reliability is square of the summation of factor loadings divided by the total sum of square of the summation of factor loadings and total delta sum of that construct.

Item reliability IR =  $(FL)^2$ 

Delta=1-IR

AVE= Sum of (FL)<sup>2</sup>/Total number of variables of the same construct

 $CR=(Sum FL)^2/[(Sum FL)^2 + Sum (Delta)]$ 

DASS-21 scale along with standardized regression weights (factor loadings). Significance of the particularitem/variableisalsoshown.

Table 1 shows the maximum likelihood estimates for the different items/variables of DASS-21 scale along with standardized regression weights (factor loadings). Significance of the particular item /variable is also shown.

In this scale, all the measured variables kurtosis was less than 2, except DASS 4 and 7. Mardia's coefficient 180.69 was lower than 440 i.e p (p+2) where p was 20 here. Mahalanobis Distance (Squared) was 83.90 and it was more than the chisquare value (for the degree of freedom equals to the number of variables) at p<.001 (45.31), so it is suggestive of outliers. Mahalanobis distance (squared) has also reduced to a great extent from Data set 1 to Data set 3. (Table 2)

Variables		Constructs	Estimate	S.E.	C.R.	Р	Standardized Regression
							Weights
DASS1	<	Stress	1.000				.531
DASS6	<	Stress	.945	.134	7.079	<.001	.564
DASS8	<	Stress	1.251	.169	7.418	<.001	.688
DASS11	<	Stress	1.342	.170	7.898	<.001	.757
DASS12	<	Stress	1.474	.154	9.542	<.001	.776
DASS14	<	Stress	1.411	.163	8.675	<.001	.803
DASS18	<	Stress	1.214	.173	7.014	<.001	.619
DASS20	<	Anxiety	1.000				.710
DASS19	<—-	Anxiety	.977	.101	9.658	<.001	.629
DASS15	<	Anxiety	1.220	.097	12.626	<.001	.828
DASS9	<	Anxiety	1.160	.113	10.279	<.001	.720
DASS7	<	Anxiety	.825	.087	9.484	<.001	.618
DASS4	<	Anxiety	.551	.071	7.788	<.001	.506
DASS3	<	Depression	1.000				.582
DASS5	<	Depression	.838	.109	7.668	<.001	.567
DASS10	<	Depression	1.114	.118	9.426	<.001	.756
DASS13	<	Depression	1.246	.131	9.488	<.001	.766
DASS16	<	Depression	1.288	.132	9.781	<.001	.804
DASS17	<	Depression	1.166	.125	9.357	<.001	.751
DASS21	<	Depression	1.118	.128	8.711	<.001	.673

#### Table1: Maximum Likelihood Estimates and Standardized Regression Weights for DASS 21

SE- Standard error, CR- Critical ratio, P- p value

All the metrics of model fit indices were judged against the specific values as suggested by authors given in the last column. (Table 3)

Data set 1 is taken as reference for the model figure and the calculations in Table 4.

All the construct's AVE estimates were lesser than the corresponding squared Interconstruct correlation

estimates suggesting poor divergent validity. (Table 4)

#### **Discussion:**

In this study, all the factor loadings (Standardized regression weights) for DASS 21items/ variables were above 0.5 except DASS 2 (.322) in anxiety domain. All the items/variables having significant p

Variables	Data Set 1			Data Set 2				Data Set 3				
		(Original)			(>2 Kurtosis Corrected)		(Out	(Outliers corrected)				
	Skewness	Critical	Kurtosis	CR	Skewness	CR	Kurtosis	CR	Skewness	CR	Kurtosis	CR
		ratio(CR)										
DASS21	1.40	9.22	0.99	3.26	1.40	9.22	0.99	3.26	0.98	6.42	-0.52	-1.70
DASS17	1.22	8.04	0.77	2.53	1.22	8.05	0.77	2.53	0.81	5.31	-0.69	-2.28
DASS16	1.08	7.15	0.42	1.39	1.09	7.15	0.42	1.39	0.65	4.30	-0.92	-3.02
DASS13	0.92	6.08	0.09	0.30	0.92	6.08	0.09	0.30	0.49	3.21	-1.09	-3.60
DASS10	1.22	8.06	0.88	2.89	1.23	8.07	0.88	2.89	0.85	5.57	-0.57	-1.88
DASS5	0.89	5.89	0.46	1.53	0.90	5.89	0.46	1.53	0.42	2.73	-0.91	-2.98
DASS3	0.89	5.89	-0.25	-0.83	0.90	5.90	-0.25	-0.83	0.54	3.55	-1.24	-4.06
DASS4	2.17	14.28	5.05	16.60	1.67	11.00	1.83	6.02	1.68	11.00	1.83	6.02
DASS7	1.66	10.93	2.48	8.18	1.13	7.44	0.11	0.36	1.13	7.44	0.11	0.36
DASS9	1.05	6.93	0.27	0.88	1.05	6.94	0.27	0.88	0.57	3.77	-1.03	-3.40
DASS15	1.05	6.96	0.50	1.63	1.06	6.96	0.50	1.63	0.62	4.10	-0.88	-2.90
DASS19	0.83	5.52	-0.11	-0.37	0.84	5.52	-0.11	-0.37	0.44	2.90	-1.17	-3.85
DASS20	1.12	7.40	0.54	1.78	1.13	7.40	0.54	1.78	0.80	5.26	-0.68	-2.24
DASS18	0.62	4.14	-0.61	-2.00	0.63	4.14	-0.61	-2.00	0.60	3.96	-0.65	-2.13
DASS14	0.86	5.67	0.14	0.45	0.86	5.67	0.14	0.45	0.46	3.01	-1.02	-3.36
DASS12	0.75	4.95	-0.25	-0.81	0.75	4.95	-0.25	-0.81	0.33	2.15	-1.24	-4.08
DASS11	0.98	6.49	0.53	1.74	0.99	6.50	0.53	1.74	0.46	3.04	-0.93	-3.06
DASS8	0.80	5.28	-0.05	-0.16	0.80	5.28	-0.05	-0.16	0.39	2.55	-1.13	-3.71
DASS6	0.47	3.12	-0.43	-1.43	0.48	3.13	-0.43	-1.43	0.20	1.32	-1.11	-3.66
DASS1	0.77	5.12	-0.10	-0.31	0.78	5.13	-0.10	-0.31	0.30	1.98	-1.17	-3.85
Mardias		I	180.69	49.10			173.64	47.19			108.72	29.55
coefficient												
Variables		20 x 22=	440		20	x 22=	440		20 x 22= 440			1
Mahalan-	83.9		84.18				57.46					
obis												
distance-												
(Squared)												
Chi Square		45.31				45.31				45.31		
p<.001												

	Inc	licesValues in	Suggested value				
	Data Set 1	Data Set 2	Data Set 3	Data Set 4			
	(Original)	(>2 Kurtosis	(Outliers	(Original)			
		Corrected)	corrected)				
		<b>ML</b> estimation		ULS			
CMIN/DF	2.021	2.045	1.885	CMIN 49.954	< 5.00 (Hair JF et al.) <sup>[11]</sup>		
GFI	0.892	0.888	0.902	0.992	> 0.90 (Hu LT and Bentler PM) <sup>[12]</sup>		
AGFI	0.852	0.849	0.865	0.989	> 0.90 (Hair JF et al.)		
CFI	0.944	0.942	0.948		> 0.90 (Hooper D et al.) <sup>[13]</sup>		
NFI	0.897	0.894	0.897	0.99	> 0.90 (Hu LT and Bentler PM)		
TLI	0.931	0.929	0.936		> 0.90 (Hooper D et al.)		
RMR	0.031	0.031	0.023	0.03	< 0.08 (Hair JF et al )		
RMSEA	0.063	0.064	0.058		< 0.08 (Hair JF et al.)		
Parsimony Adjusted Measures							
PNFI	0.722	0.729	0.723	0.797	>.5(Hooper D et al.)		
PCFI	0.76	0.768	0.764		>.5(Hooper D et al)		
Cronbachs Alpha	S=.85	S=.85	S=.84		>.7		
	A=.83	A=.83	A=.83				
	D=.87	D=.87	D=.86				
Bollen-Stine Bootstrap	0.05						

# Table 3 : Metrics of Model Fit Indices for 4 Data Sets based on the normality assessment and estimation method

CMIN/DF- Chi square /Degree of freedom, GFI- Goodness of Fit Index , AGFI- Adjusted Goodness of Fit index, NFI- Normed Fit Index, CFI- Comparative Fit Index , TLI- Tucker Lewis index, RMR- Root Mean square Residuals, RMSEA- Root Mean Square Error of Approximation, PNFI- Parsimony normed fit index, PGFI- Parsimony goodness of fit index

#### Figure 2: CFA model DASS 21



# Table 4 : Calculation and Comparison of Construct reliability (CR), AVE and Squared Interconstructcorrelation with inference for Convergent and Discriminant validity for DASS 21

Factors	Direction	Constructs	Estimate	IR	Delta	Sum	AVE	Sum	Sum	Square	CR	Squared
			(Standardized)			IR		Delta	FL	Sum FL		Interconstruct
			FL									correlation
DASS1	<	Stress	0.53	0.28	0.72							Stress X
DASS6	<	Stress	0.56	0.32	0.68							Anxiety
DASS8	<	Stress	0.69	0.47	0.53							0.9
DASS11	<	Stress	0.76	0.57	0.43							
DASS12	<	Stress	0.78	0.60	0.40							Stress X
DASS14	<	Stress	0.80	0.64	0.36							Depression
DASS18	<	Stress	0.62	0.38	0.62	3.28	0.47	3.72	4.74	22.45	0.86	0.92
DASS20	<	Anxiety	0.71	0.50	0.50							Anxiety X
DASS19	<	Anxiety	0.63	0.40	0.60							Depression
DASS15	<	Anxiety	0.83	0.69	0.31							0.87
DASS9	<	Anxiety	0.72	0.52	0.48							Anxiety X
DASS7	<	Anxiety	0.62	0.38	0.62							Stress
DASS4	<	Anxiety	0.51	0.26	0.74	2.74	0.46	3.26	4.01	16.09	0.83	0.90
DASS3	<	Depression	0.58	0.34	0.66							Depression X
DASS5	<	Depression	0.57	0.32	0.68							Anxiety
DASS10	<	Depression	0.76	0.57	0.43							0.87
DASS13	<	Depression	0.77	0.59	0.41							
DASS16	<	Depression	0.80	0.65	0.35							Depression X
DASS17	<	Depression	0.75	0.56	0.44							Stress
DASS21	<	Depression	0.67	0.45	0.55	3.48	0.50	3.52	4.90	24.00	0.87	0.92

Legends: IR: Item reliability, AVE-Average variance extracted, FL: Factor loading (Standardized estimates), CR- Construct reliability

values and standardized regression weights as more than .5 were kept for further analysis, so DASS 2 item was removed and not taken forward. (Table 1). Univariate and multivariate normality are basic assumptions in CFA using ML method of estimation. In this study, both the univariate and multivariate normality were assessed. (Table 2). In order to prove normal univariate distribution, as per George and Mallery, the values for asymmetry and kurtosis between -2 and +2 are considered as acceptable.<sup>[14]</sup> Different such cut off values were suggested by other authors. Kurtosis values greater than 3 in magnitude may indicate the non-normal distribution of the variable as mentioned by Westfall and Henning.<sup>[15]</sup> Cut-off values of 3 for univariate skewness and 7 for univariate kurtosis have been proposed by West et al<sup>[16]</sup> Gravetter and Wallnau suggested acceptable limits as  $\pm 2$ .<sup>[17]</sup> Curran et al. suggested these same moderate normality thresholds of 2 and 7 for skewness and kurtosis respectively when assessing multivariate normality.<sup>[18]</sup> Mardia's coefficient if lower than p(p+2), where p is the number of variables studied, then the combined distribution of the variables is multivariate normal.<sup>[8]</sup> There are many recommendations related to the limits of kurtosis and skewness for normality and themselves are not uniform. Skewness index and Kurtosis index are important measures of normality. (Table 2) Ding et al. recommended a minimum sample size of 100 and 3 indicators per factor in order to use ML estimation appropriately.<sup>[19]</sup> We had a sufficient sample of 260. We found a very narrow difference in all the 4 data sets and all suggesteda good model fit based on the metrics of model fit indices, with the increasing value of fit indices as we move from  $1^{st}$ Data set to 3<sup>rd</sup> Data set. (Figure 1) In a study at University of Pretoria, Mardia's statistic showed multivariate normality in presence of univariate nonnormality and that happened to be a limiting factor for ML estimation procedures.<sup>[20]</sup> When the data is a Likert scale, the other estimation methods are suggested. In this study, we have analyzed how the metrics of model fit indices changes on framing 4

Data sets with specific distribution and estimation method. Browne used ULS (Unweighted least squares) and RULS (Robust ULS)to account for ordinal data.<sup>[21]</sup> Two suggested methods are unweighted least square (ULS) and diagonally weighted least square (DWLS). We found slight difference between the indices by ML and ULS estimation. In ULS estimation, different indices value haveincreased as compared to ML estimation and RMR has slightly decreased. (Table 3) Psychometric properties of Depression, Anxiety and Stress 21 scale (DASS 21): Total number of variables in the model were 43, 23 exogenous and 20 endogenous. Number of possible variances and covariances among the items/variables = (20x21)/2=210.p(p+1)/2 where p is endogenous variables. p is 20, no of endogenous variables. Total number of parameters observed were 80, this in particular is AMOS output. (20x21)/2=210 is > 80, so this model is overidentified. A model should be overidentified.<sup>[22]</sup> The number of parameters that are being estimated needs to be less than the number of variances and covariances observed and this is called an overidentified model. So, this model was overidentified. All the measured variables kurtosis were less than 2, except DASS 4 and 7. DASS 2 was deleted as the standardized regression weight was less than .5. Mardia's coefficient (180.69) was less than 440 20(22) in all the 4 data sets, proving multivariate normality. Mahalanobis Distance (Squared) was 83.90 and it was more than the chisquare value (for the degree of freedom equals to the number of variables) at p<.001 (45.31), so it was suggestive of outliers. Multivariate normality measure and Mahalanobis distance-(Squared) has reduced from Data set 1 to 3. Owing to univariate nonnormality in DASS 4 and 7, Bollen Stine Bootstrapping procedure was applied and it was .05, suggesting good model fit. This should be nonsignificant for model to be fit. The Bollen-Stine bootstrap procedure was used to counter the negative distributional properties of the data because of multivariate nonnormality.<sup>[10]</sup> The metrics

of model fit indices were assessed. CMIN/DF value was 2.021 which was< 5. Goodness of Fit Index (GFI) value (0.892) was near to .9. The Normed Fit Index (NFI) value (0.897), Comparative Fit Index (CFI) value (0.944) and Tucker Lewis index (TLI) value was (0.931) were above 9 as suggested. Root Mean square Residuals (RMR) and Root Mean Square Error of Approximation (RMSEA) value were 0.031 and 0.063 respectively which were less than 0.08. Parsimony adjusted measures were more than 0.5. Morrison et al have given a vivid description of all these indices.<sup>[22]</sup> (Table 3). The model fit indices have increased as we move from Data set 1 to set 4. The results showed that ULS lead to smaller RMR and larger CFI and TLI values than does ML estimation. Construct reliability along with AVE is a measure of convergent validity. Ideally AVE should be more than .5, but when the construct reliability is more than .7, its lesser value is not a problem. Construct's AVE estimates (from .46 to .50) were lesser than the corresponding squared Interconstruct correlation estimates suggesting poor divergent validity between stress, depression and anxiety. Covariances and modifications were shown in Figure 2. In our study, we got Cronbach's alpha as stress .85, anxiety .83 and depression as .87.Cao et al. in their study mentioned that DASS-21 scale demonstrated a high degree of internal consistency (Cronbach's alpha >0.85), and good convergent validity. Discriminant validity was poor as determined by average variance extracted.<sup>[23]</sup> (Table 4). DASS-21 had difficulty in properly identifying and discriminating between symptoms associated with depression and anxiety in study in Hispanic population.<sup>[24]</sup> The study by Lee has provided evidence regarding the convergent, discriminant, and nomological validity of DASS-21 through CFA.<sup>[25]</sup>

#### **Conclusion**:

DASS-21 scale demonstrated a good convergent validity, but discriminant validity was poor as determined by average variance extracted in comparison to squared interconstruct correlation in this study.

#### **Declaration:**

This manuscript is one of the manuscripts from a PhD study on Occupational health Psychology done in health care professionals. The details in materials and methodology remain same in the papers/ manuscripts with specific emphasis for particular objective in the paper/manuscript. Each of the manuscripts caters to a particular domain and is related to specific objective. The detailed scoring of DASS 21 constructs and associations with other variables are published in a separate paper and the interested readers can read from the paper1 and the translation details and other detailing of participants involvement can be read from paper 2

Paper1: Sharma DB, Sharma HK. An epidemiological study on occupational health psychology in health care professionals (doctors, physiotherapists, nursing professionals and community health officers). Int J Health Sci Res. 2023; 13(3):174-186.

Paper 2: Sharma DB, Sharma HK. The Translation Process, Validity and Reliability Study in Occupational Health Psychology amongst Healthcare Professionals by Multitrait-Multimethod Matrix: A Multimethod Study. Clin of Diagn Res.2023; 17(6):VC08-VC13.)

Funding: Nil

Conflict of Interest: Nil

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#### Technology Empowerment of ASHA Workers Using E-Health Initiatives in Rural Rajasthan

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#### Abstract:

Introduction: Electronic health (e-health) initiatives grant the tools and knowledge to improve health care, benefiting not only patients but also healthcare professionals and institutions. Objectives: To empower ASHA (Accredited Social Health Activist) technically in terms of using e-health initiatives and to assess feasibility and usefulness of such initiatives; to enhance digital health literacy and to observe the effect of training and skill development of grass root level healthcare workers engaged in primary care. Method: A prospective observational cohort study, in which ASHA's were recruited in two selected villages of Rajasthan. They were trained to use a web-based application, developed for use on portable device (tablet) to screen, diagnose and provide health education on non-communicable diseases. In-depth interviews and group discussions were done with ASHAs to know their views about the tablet and application use. Results: There was 19.3%, 29.3% and 40% improvement in ASHAs' ability to measure haemoglobin, blood sugar and blood pressure, respectively and also an improvement of 86.5% in tablet and application operation was observed. This improvement in ability of ASHAs was highly significant for all above four parameters(p-value <0.001).ASHAs agreed that the app was useful and helped them connect to the people and explain things more properly. They reported the beneficiaries understood more clearly through pop- up videos which also proved beneficial in increasing compliance. Conclusion: Training ASHA worker in e-health technology is feasible and can assist in screening and management of non-communicable diseases.

Keywords: ASHA, E-health, Health app, Non-communicable diseases, Rural

#### Introduction:

As we are moving towards a digitally advanced society, we are constantly being equipped with information and communication technologies that grant us the tools and knowledge to improve healthcare, benefiting not only patients but also healthcare professionals and institutions.<sup>[1]</sup> E-health relates to the usage of communication and information technology within healthcare environments.<sup>[2]</sup> It can serve as a vehicle for transforming health conditions in the developing world, particularly for those living in rural and remote areas.<sup>[1]</sup>

India too is marching towards its excellence in the field of e-Health, we tried to contribute by developing an application (app) namely the Health

Quick Response Code	Access this article online	How to cite this article :
	<b>Website :</b> www.healthlinejournal.org	Mangal S, Sharma R, Fatima A, Mangal D, Panwar V, Panwar R. Technology Empowerment of ASHA
	<b>DOI :</b> 10.51957/Healthline_579_2023	Workers Using E-Health Initiatives in Rural Rajasthan. Healthline. 2023; 14 (4): 276-281

#### Mangal et al

Smart app, made with the concept of facilitation of data entry and its usage. This initiative is a way forward to empower and improve the performance of healthcare systems by linking various systems.

With the introduction of the cadre of accredited social health activists (ASHAs), who are village-based community healthcare workers and females, community healthcare lies mainly with women in rural areas in India.<sup>[3]</sup>

Primary health care, to a great extent, depends on the involvement of women, explicitly in health education. It entitles them to aid and thereby uplift their communities by improving the health of women and their families and by priming them both as caregivers and health educators.Decision-making and cumulative reflection make women feel more entitled.<sup>[3]</sup>Women health workers working in rural areas have shown they can improve the health status of their community if they receive encouragement to learn healthcare skills.<sup>[4,5]</sup>

The strategic objectives of this study wereto empower ASHA (Accredited Social Health Activist) technically in terms of using e-health initiatives and to assess feasibility and usefulness of such initiatives; to enhance digital health literacy and to observe the effect of training and skill development of grass root level healthcare workers engaged in primary care.

This initiative of adopting digital methods is also a step forward to save the paper and thereby preserve the environment.<sup>[6]</sup>

#### Method:

The study was a prospective cohort, approved by Institutional Ethics Committee conducted after obtaining written informed consent from participants.

Two villages were identified which were hard to reach and lacked satisfactory health facilities. A total of 825 families covering 3853 people were included in the study. From each of the identified village, two ASHAs were recognized, who consented and were willing to work in the project. Study was completed in one year. Work plan of ASHA: Authors developed a training module for ASHA, who were the key worker for this project. Training was given to them on different aspects for two weeks. In the subsequent process researchers made them friendly with Health Smart Android Application. The cardinal features were GPS, Skype and 3G enabled. This helped in live data accumulation and visibility of data at central location. Distinctive characteristic of the application was automatic transfer of data and formation of report at central location.

She was acquainted with different forms of the questionnaire and the entries to be made on the tablet itself. She was trained through training modules and real time demonstrations to take different anthropometric measurements like height, weight; blood pressure through digital blood pressure instrument, blood sugar through glucometer, hemoglobin estimation through color scale. She was trained to screen the diseases in their early stage and provide education and awareness about them.

Written consent was taken from the head of all the families followed by recruitment of all the villagers along with elaborative baseline evaluation by the app. Collection of baseline data by ASHAs was done in 3 months after which follow-up was done monthly for 8 months. Periodic and standardized collection of data was done by ASHAs which helped them to track modification in lifestyle, presence of any risk factor and screening of non communicable diseases. Health education was provided to participants through pop-up videos in the Model based application which would spring up the instant it detects any health risk e.g. smoking, alcoholism, high risk pregnancy, incomplete immunization, high BMI (obesity), high blood pressure, high blood sugar(diabetes), and for those diagnosed anaemic or known cases of hypertension, diabetes or anaemia, also related to family planning and sanitation. Dismissal of misbelieves was done by the ASHAs. Participants were enlightened about the necessity of

Empowerment of ASHA using E-Health Initiatives...

treatment compliance which was further tracked by the ASHAs.

ASHA made referral of patients to first referral unit. The participants were provided with visits by specialist monthly in the village itself. ASHAs were trained to track the newly diagnosed patients for treatment compliance as well as follow up. For all anaemic subjects above 6 month of age, 3 month of Iron Folic Acid was given and their haemoglob in estimation was done after 1 month of completion of the course to see the effect. ASHAs reported any new event in the family e.g. birth, morbidity or mortality on a daily basis. Coordinating team used to supervise and monitor ASHA weekly.

In order to uplift ASHA financially an honorarium was paid to them per family.

The ASHAs were regularly supervised and trained for the work they were assigned. Their performance was being checked randomly, regularly every month in terms of how they were operating the tablets and application, doing haemoglobin estimation and measuring blood pressure and blood sugar levels.

Five sessions of 30 minutes each were conducted consisting of one in-depth interview with each ASHA and one group discussion in volvingall four ASHAs to know their views about the tablet and application use, what were the difficulties they faced and advantages they felt while using it. Also, how it affected their working and outcome was inquired during these discussions.

*Statistical analysis*: MS Excel was used for analysis. Quantitative data was entered in the form of percentage. Test for statistical significance was applied. A p-value of 0.05 was regarded as significant and <0.001 was regarded as highly significant. Thematic analysis was done for qualitative data.

#### **Results:**

The results of the study were classified as quantitative and qualitative.

In order to create technology empowered ASHA workers, authors trained, retrained and monitored them. Performance of each ASHA was observed by the investigators at each point of time ,i.e., at the end of 1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup> and 11<sup>th</sup> month and every parameter was observed randomly 25 times for each ASHA, making it to 100 observations for each parameter at each point of time, in terms of haemoglobin (Hb) estimation by Hb color scale, blood sugar estimation by glucometer, blood pressure estimation by digital BP instrument and tablet usage for survey in form of filling the entries, increasing awareness among



Figure 1 : Technical Empowerment of ASHA Workers between First and Eleventh Month

surveyed population through videos on e-health application.

The technology empowerment of ASHAs could be visibly seen between first and eleventh month. The ASHA were checked for their ability to perform above mentioned tasks. In the first month only 83% (83/100) times ASHAs were able to measure and read haemoglobin level correctly, 75% (75/100) times could measure blood sugar levels, 70% (70/100) times could measure blood pressure and 52% (52/100) times could operate the tablet correctly using the installed application. By the end that is eleventh month, 99%,97%, 98% and 97% ASHAs were capable of measuring haemoglobin, blood sugar, blood pressure and operating the tablet and application correctly, respectively. Considering feasibility authors measured 100 observations in total(25 for each ASHA) for each parameter at each point of time. (Figure 1)

Cochran-Q test was applied to detect change in the level of technological empowerment of ASHAs over time duration that is first to eleventh month, regarding the four parameters that are haemoglobin , blood sugar and blood pressure measurement, as well as tablet and Application use. According to which there was highly significant change for all the abovementioned parameters (p value <0.001). This improvement in the ability of ASHAs is also reflective in terms of percentage improvement from first to end day. There was 19.3% improvement in their ability to measure haemoglobin,29.3% and 40 % improvement in measuring blood sugar and blood pressure respectively. An improvement of 86.5% in tablet and application operation was also observed. (Figure 2)

The interventions provided by ASHAs lead to increased coverage of health services in both the villages. All ASHAs were found to possess sufficient competency to use the application. None of the ASHA stopped using the application on tablet throughout the project.

ASHAs were given monthly honorarium as per the number of families surveyed and follow up of the beneficiaries conducted by them. This helped in boosting them up to conduct their work and be a part of this study throughout the study period. Along with this it also empowered them financially.

Qualitative results were reported on the basis of interviews conducted with the ASHAs .All the four ASHAs agreed, "The application was useful for them and helped them connect to the people and explain things more properly". The ASHAs reported, "The beneficiaries understood more clearly through pop-



Figure 2 : Improvement in Ability of ASHAO bserved From Day One to End Day

up videos". This also proved beneficial in increasing compliance towards the advice provided by the ASHA regarding management of their health condition. The beneficiaries were found to seek care and follow advice from ASHAs. This proves increase of confidence in ASHAs by the beneficiaries. Follow-ups were made more systematic and regular. The application had a feature of reminder about tasks to be performed on due dates which lead to streamlining of work and helped ASHAs. They consented "The application made us more punctual in regards of the tasks by giving us reminders through messages on application." ASHAs appreciated "The frequent training, retraining, supervision and monitoring provided by the team were very helpful." They reported "It not only enhanced our knowledge but also helped us gain confidence."

#### Discussion:

The current study has stressed the utility of ehealth by grassroot health care workers in rural India along with focus on women empowerment, technology upgradation and a step towards environment conservation through saving paper.

The question that how empowerment of grassroot women is to be affected, has always been a point of debate in our country. The quantity and quality of womens development and equality has been talked about since a very long time. There has always been a general agreement for the need of empowerment of grassroot women, especially in rural India such need is felt more acutely.<sup>[3]</sup>

Digital technology has been found to be better for the training and supervision of community health workers and helping health care delivery in low and middle income countries.<sup>[7-10]</sup> Recent researchers show digital technology can increase efficiency in training, communication and coverage of health services by health workers.<sup>[7-9]</sup>

Similar to of current study results, other studies have also reported increased acceptability of e-health interventions among the community health workers.<sup>[7,11-15]</sup>

In the current study, all the ASHAs appreciated the frequent training by the team. However, it was observed in some other studies that a few ASHAs did not appreciate the same and said that it consumed a lot of their time and caused hurdle in their routine tasks.<sup>[9]</sup> Muke SS et al in their respective studies reported participants to have low engagement with the training content but when additional learning activities (like case vignettes and quizzes) wereincluded ASHAs appeared more engaged.<sup>[7]</sup> Although the importance of training of ASHAs has been reflected upon in various studies also.<sup>[16]</sup>

There were a few studies in which in spite of agreeing to use digital technology, the community health workers actually did not use them. This may be due to absence of encouragement by the study team.<sup>[12]</sup> In agreement to of this study results, a systematic review along with a number of other studies observed digital platforms to help health care workers to follow treatment protocols leading to increase in outcome and satisfaction of the patients.<sup>[7,17-20]</sup>

The choice of correct device considering battery life, network and internet connectivity are also to be emphasized upon.<sup>[7,10,13]</sup> In this study internet connectivity was an issue in the villages initially so authors shifted to another internet source which had better connectivity in those villages.

#### Limitations:

In this study only two villages and their ASHAs were covered. Similar types of initiatives in other rural as well as urban areas are call of the time.

#### **Conclusion:**

This study concludes that capacity building and digital empowerment benefits ASHA, the grass root level healthcare workers engaged in primary care in rural India. It proves feasibility and usefulness of digital technology. It can provide a step towards empowering women with technology, expanding new horizons of their capabilities and contributing a bit towards their financial growth too. Apart from this, it also emphasises towards paper preservation thereby leading to environment conservation by moving towards digitally advanced society.

#### **Recommendation:**

Primary health workers should be technically empowered with special focus on digital technology which will uplift their capabilities as well as help serve the community better.

#### **Declaration:**

Funding: Rajasthan University of Health Sciences, Jaipur, Rajasthan

#### Conflict of Interest: Nil

#### Acknowledgement:

The authors would like to acknowledge Dr Vaseem N Baig, Professor, Community Medicine, RUHS - CMS Jaipur for his continuous administrative support.

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#### Perception towards Biomedical Research among Undergraduate Medical Students in a Tertiary Care Institute of Kolkata: A Cross-Sectional Study

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#### Abstract:

**Introduction:** Biomedical research at undergraduate level is a novel and important concept. It is believed to effectively foster research-oriented thinking among the students, thereby encouraging them to undertake further research activities in future. Objectives: The objectives of this study were tofind out the level of perception of undergraduate medical students towards biomedical research, to explore the facilitators and barriers to biomedical researchand to identify any associated background information of the students with their perception. Method: A cross-sectional study was conducted from December 2022-February 2023, among 298 students belonging to Phase III of MBBS (Part I and Part II) of a Tertiary Care Institute of Kolkata. Complete enumeration method was employed. Perception was assessed using a 5-point Likert Scale. Association of background information of participants with their perception was assessed using Multinomial Logistic Regression. Results: Among the students, around 53% had favourable perception (27% highly favourable and 26% moderately favourable) towards biomedical research. Self-interest and improved academics were identified as facilitators while lack of dedicated research time, lack of interest, and lack of assistance from faculties were found to be the barriers. Statistically significant higher odds of 'highly favourable' and 'moderately favourable' perception towards research were found among students from English-medium schools as compared to those who had other languages as medium of instruction in their schools; Part I students had statistically significant higher odds of 'moderately favourable' perception as compared to Part II students. Conclusion: Nearly one-third of the participants had highly favourable perception towards biomedical research. Personal interest and lack of dedicated research time were the major factors influencing research.

Keywords: Biomedical Research, Perception, Undergraduate Medical Students

#### Introduction:

Biomedical research at undergraduate level is an important emerging concept. It is being considered as an effective measure for encouraging and creating research-oriented thinking.<sup>[1]</sup> Assessing the perception towards research among undergraduate medical students is not only important to create awareness and interest, but also to enhance critical thinking. Now a days, Evidence-Based Medicine (EBM) has become an integral part of medical science. In order to establish the importance and practicality of EBM among undergraduate students, formal teaching of EBM has been included

Quick Response Code	Access this article online	How to cite this article :		
	<b>Website :</b> www.healthlinejournal.org	Chakrabarti S, Kerketta P, Basu M, Pattanayak S, Naskar S, Goswami D. Perception towards Biomedical		
	<b>DOI :</b> 10.51957/Healthline_547_2023	Tertiary Care Institute of Kolkata: A Cross-Section Study. Healthline. 2023; 14 (4): 282-289		

as part of the undergraduate medical curriculum.<sup>[1]</sup> Participation in research is important for developing an insight into evidence-based medicine. But unfortunately, very few research opportunities are available at undergraduate level in India. According to a study conducted by Garg R et al., the reason behind this lacuna is lack of encouragement, lack of basic infrastructure, facilities and structured mentorship programs along with no extra incentives to researchers.<sup>[2]</sup> Another reason is lack of writing skills for publication.<sup>[2]</sup> Research is a core essential component of evidence-based medicine.<sup>[3]</sup> Encouraging research among students early during their undergraduate days is believed to be an effective strategy in stimulating interest in further research. A study conducted by Ngeh EN in Cameroon revealed that poor research infrastructure, poor study facilities, lack of proper mentorship are some of the underlying factors that act as barriers towards biomedical research.<sup>[4]</sup>A significant advantage of including clinician-scientists in the biomedical research teams is to utilize their ability to identify patient-oriented problems, distinguish clinically helpful information and address it with their medical knowledge.<sup>[4]</sup> It is seen that students who participate in undergraduate research become equipped with better self-evaluation of designing research projects, use of statistical software, making figures and charts, evaluating experimental results and performing experiments than those who do not.<sup>[5]</sup> Most students considered research valuable but at the same time they perceived it as stressful and complex.<sup>[6]</sup> Although some studies have been done from the southern and northern parts of India, there is paucity of data from eastern India. Hence, the current study aimed at finding out the level of perception towards biomedical research among the undergraduate medical students in a Tertiary Care Institute of Kolkata, the factors influencing their perception towards research and also to identify any associated background information of the participants with their perception.

#### Method:

A cross-sectional study was conducted among the undergraduate medical students of Phase III of MBBS (Part I and Part II) of Institute of Post Graduate Medical Education and Research (IPGME & R) and Seth Sukhlal Karnani Memorial (SSKM) Hospital, Kolkata, West Bengal. The study was done for a period of 2 months (December 2022- February 2023). All 194 students of Part I and 142 students of Part II of Phase III of MBBS of IPGME & R and SSKM Hospital were included as study participants. Five students from each batch were selected for pre testing of the questionnaire. After excluding them the total participants were 326. Complete enumeration was employed for the study. However, after applying the selection criteria, at the end of the data collection period, the final sample was 298.

An anonymous, predesigned, pretested and structured questionnaire was employed to collect data from the participants. It comprised of the following variables: i) background information of the study participants, ii) knowledge of the study participants regarding biomedical research, iii) their perception towards biomedical research, iv) their practice towards research, v) factors influencing biomedical research. This self-administered questionnaire had a mix of open and close-ended, single and multiple-response questions. The questionnaire was validated for its content by three faculties from the Medical Education Unit (MEU) of the institution and necessary changes were incorporated before pretesting it. All of the study participants were well-versed in English language, so the questionnaire was developed in English and no translation was done.

The students who attended clinical postings/ lecture classes during data collection were administered the questionnaire at the end of their classes or postings and the absentees were called over telephone and told to come the next day. Three phone calls were made individually and those who did not reply or were absent throughout the data collection period were excluded from the study.

#### Statistical Analysis:

Data were tabulated in Microsoft Office Excel 2021 (Microsoft Corp, Redmond, WA, USA) and analysed using Statistical Package for the Social Sciences (SPSS) version 25.0. Categorical data were represented as proportions and with the help of suitable diagrams. Continuous data were represented as mean/median and other suitable measures. Perception towards biomedical research was assessed using a 5-point Likert Scale, consisting of 8 items ranging from "strongly agree" (score 5) to "strongly disagree" (score 1). Three questions were reversely scored. The total possible score ranged from 8-40. A score more than 75<sup>th</sup> percentile of the overall perception score was taken as 'highly favourable perception', between 50<sup>th</sup>-75<sup>th</sup> percentile as 'moderately favourable perception' and less than 50<sup>th</sup> percentile was considered as 'low perception'. Association of background information of the study participants with their perception was assessed using Multinomial Logistic Regression. (pvalue<0.05 was considered statistically significant).

#### Ethical considerations:

Anonymity and confidentiality of data were maintained throughout the study. Informed verbal consent was taken from each study participant. Proposal for the study was submitted and clearance was obtained from the Institutional Ethics Committee (IEC) of IPGME&R and SSKM Hospital, Kolkata (IPGME&R/IEC/2023/111).

#### **Operational definition:**

**Perception:** A belief or opinion, often held by many people and based on how things seem to them. 'Favourable perception' is a positive emotional disposition or thinking towards the subject.<sup>[7]</sup> For the purpose of analysis this was further categorised as 'highly favourable' perception and 'moderately favourable' perception as explained in the statistical analysis.

#### **Results:**

The response rates among the study participants (Part I and Part II) were 96.82% and 83.94% respectively. The mean age of the participants was 22.48 ± 0.14 years. Majority (98%) of them were between 20-24 years of age. Among them, 210 (70.5%) were male students, 183(61.4%) studied in Part I and 115 (38.6%) studied in Part II of Phase III of MBBS. (Table 1)Most of the participants belonged to West Bengal [280 (94%)]. Among them, 207 (69.5%) resided in hostel. The medium of instruction in the schools of 206 (69.1%) participants was English and nearly 172 (57.7%) students passed XII<sup>th</sup> standard from West Bengal Council of Higher Secondary Education (WBCHSE), followed by CBSE (41.3%). Only 17 (5.7%) of them were involved in research during school days. (Table 1)

The source of knowledge regarding biomedical research for the students was mainly Community Medicine project at undergraduate level (44.1%), Internet (31%), and medical textbooks (3.4%). Only 32.8% of participants had knowledge about Government-sponsored fellowship for undergraduate medical students in India, while only 48 knew about Indian Council of Medical Research (ICMR) as an organization which sponsors undergraduate biomedical research. Sixty respondents knew about The Lancet as a journal which publishes biomedical research and nearly 12% knew and could name the Institutional journal (Annals of Medical Science and Research). Among the participants, 20 (6.7%) carried out research activity apart from Community Medicine project, out of which, 8 did not publish their studies yet, while 6 students presented their papers in various National and State conferences.

In case of undertaking research in their undergraduate curriculum, nearly 76% of the study participants had a positive approach. Nearly 46% of them had a negative opinion with research being relevant in competency-based medical education. Almost 36% of the study participants were neutral regarding not being confident enough in writing research methodology and/or analysing results.

Nearly 51% disagreed with the concept that research would not be helpful to develop career as a clinician. (Table 2)

Table 1: Distribution of the study participants	s according to their background information	ı (N=298)
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Variables	n (%)					
Age (in completed years)						
20-24	292 (98.0)					
25-29	6 (2.0)					
Gender						
Male	210 (70.5)					
Female	88 (29.5)					
Batch of MBBS						
Part I	183 (61.4)					
Part II	115 (38.6)					
State of Origin						
West Bengal	280 (94.0)					
Others	18 (6.0)					
Place of current residence						
Hostel Dweller	207 (69.5)					
Day scholar	91 (30.5)					
Medium of instruction in school						
English	206 (69.1)					
Others	92 (30.9)					
Board in which passed schooling						
West Bengal Council of Higher Secondary Education (WBCHSE)	172 (57.7)					
Central Board of Secondary Education (CBSE)	123 (41.3)					
Others (ISC and other state boards)	3 (1.0)					
Education of father						
Primary	33 (11.1)					
Middle school	52 (17.4)					
Secondary and above (H.S./Graduation/Post-graduation)	213 (71.5)					
Education of mother						
Primary	26 (8.7)					
Middle school	46 (15.4)					
Secondary and above (H.S./Graduation/Post-graduation)	226 (75.8)					
Occupation of father						
Retired/Unemployed	23 (7.7)					
Others	275 (92.3)					
Occupation of mother						
Home-maker	226 (75.8)					
Others	72 (24.2)					
Any previous involvement in research during schooling						
Yes	17 (5.7)					
No	281 (94.3)					

Table 2: Perception of the study participants towards biomedical research assessed using5-point Likert Scale (N=298)

Questions	Strongly agree Number (%)	Agree Number (%)	Neutral Number (%)	Disagree Number (%)	Strongly disagree Number (%)
Every medical student should undertake	75 (25.1)	153 (51.3)	59 (19.8)	10(3.36)	1 (0.3)
research in their undergraduate curriculum					
Inclusion of short-term research project	92 (30.8)	181 (60.7)	23 (7.7)	2 (0.67)	-
will enrich their academic knowledge					
Research experience in undergraduate	92 (30.8)	160 (53.7)	42 (14.0)	4(1.35)	-
students improves curriculum vitae					
Research stimulates critical thinking	123 (41.2)	151 (50.6)	21(7.0)	3(1.01)	-
Research is not relevant in competency	20(6.7)	40 (13.4)	101 (33.9)	104 (34.90)	33 (11.0)
based medical education					
Involvement in biomedical research in	87 (29.1)	173 (58.0)	27 (9.0)	3 (1.01)	8 (2.6)
undergraduate level helps to gain interest					
in further research					
"I am not confident in writing research	28 (9.4)	65 (21.8)	106 (35.57)	75 (25.17)	24 (8.0)
methodology and/or analyzing					
result section"					
Medical research will not be helpful to	20 (6.7)	34 (11.4)	81 (27.1)	113 (37.9)	50 (16.7)
develop career as a clinician					

Among the participants, 81 (27%) had 'highly favorable' perception, 76 (26%) had 'moderately favorable' whereas 141 (47%) had 'low perception' towards biomedical research. (Figure 1)

The main factors favorable in carrying out research were found out to be personal interest (80.2%), improved academics (70.1%) and career progression (64.4%). (Figure 2)

Some of the factors unfavorable for research obtained were lack of dedicated time to undertake research (87.5%) and lack of assistance from the faculty members (54.7%). (Figure 3)





:: 286 ::
#### Figure 2: Distribution of responses among the study population regarding factors favourable for research. (N=298)



[\*multiple responses]

Figure 3: Distribution of responses among the study population regarding factors unfavourable for conducting biomedical research (N=298)





Table 3: Multinomial Logistic Regression showing association of perception with<br/>background information of study participants (N=298)

Moderately favourable perception			Highly fav	ourable pero	ception
	(n <sub>.</sub> = 76)			(n <sub>2</sub> = 81)	
Frequency	OR (95%	p value	Frequency	OR (95%	p value
(%)	Confidence		(%)	Confidence	
	Interval)			Interval)	
50 (65.8)	1.960	0.028	58 (71.6)	1.593	0.131
	(1.08- 3.56)			(0.87-2.91)	
26 (34.2)	Ref.		23 (28.4)	Ref.	
9 (11.9)	3.09	0.016	14 (17.3)	1.706	0.306
	(1.24- 7.77)			(0.61-4.74)	
18 (23.7)	1.57	0.256	15 (18.6)	2.088	0.057
				(0.98- 4.45)	
49 (64.4)	Ref.	-	52 (64.1)	Ref.	-
11 (14.4)	1.686	0.363	8 (9.8)	4.086	0.009
	(0.54-5.20)			(1.41-11.80)	
18 (23.7)	1.320	0.519	12 (14.9)	2.774	0.010
	(0.56- 3.08)			(1.28-6.05)	
47 (61.9)	Ref.	-	61 (75.3)	Ref.	-
58 (76.3)	2.157	0.021	62 (76.5)	2.340	0.012
	(1.12- 4.13)			(1.20-4.55)	
18 (23.7)	Ref.		19 (23.5)	Ref.	
	Frequency         (%)         50 (65.8)         26 (34.2)         9 (11.9)         18 (23.7)         49 (64.4)         11 (14.4)         18 (23.7)         47 (61.9)         58 (76.3)         18 (23.7)	(n = 76)         Frequency       OR (95%         (%)       Confidence         Interval)       1.960         50 (65.8)       1.960         26 (34.2)       Ref.         9 (11.9)       3.09         11 (14.4)       1.686         (0.54-5.20)       13 (23.7)         18 (23.7)       1.320         18 (23.7)       1.320         (0.56-3.08)       47 (61.9)         48 (23.7)       Ref.         18 (23.7)       Ref.	Instante per ception         frequency       OR (95%       p value         (%)       Confidence       p         1mterval)       0.028         50 (65.8)       1.960       0.028         26 (34.2)       Ref.       -         9 (11.9)       3.09       0.016         18 (23.7)       1.57       0.256         11 (14.4)       1.686       0.363         118 (23.7)       1.320       0.519         18 (23.7)       1.320       0.519         18 (23.7)       1.320       0.519         58 (76.3)       2.157       0.0221         18 (23.7)       Ref.       -         18 (23.7)       Ref.       -	Inderately laverable perception         Inight laverable perception           Interval         p value         Frequency           (%)         OR (95%         p value         Frequency           (%)         Interval)         p value         Frequency           50 (65.8)         1.960         0.028         58 (71.6)           26 (34.2)         Ref.         23 (28.4)           9 (11.9)         3.09         0.016         14 (17.3)           11 (14.4)         1.57         0.256         15 (18.6)           49 (64.4)         Ref.         -         52 (64.1)           11 (14.4)         1.686         0.363         8 (9.8)           (0.54-5.20)         -         -         -           18 (23.7)         1.320         0.519         12 (14.9)           (0.56- 3.08)         -         -         -           58 (76.3)         2.157         0.021         62 (76.5)           18 (23.7)         Ref.         -         19 (23.5)           18 (23.7)         Ref.         -         19 (23.5)	Noderately lavoration prevention         Iniging lavoration prevention           Index (n,= 76)         p value         Frequency         OR (95%         p value         Frequency         OR (95%           (%)         Confidence         n         Frequency         OR (95%         frequency         OR (95%           (%)         Confidence         n         Frequency         OR (95%         OR (95%           (%)         Confidence         (%)         Confidence         Interval         Interval           50 (65.8)         1.960         0.028         58 (71.6)         1.593           (1.08-3.56)         (1.08-3.56)         23 (28.4)         Ref.           9 (11.9)         3.09         0.016         14 (17.3)         1.706           (1.24-7.77)         I         I         0.61-4.74)           18 (23.7)         1.57         0.256         15 (18.6)         2.088           (0.54-5.20)         I         I         I         I           18 (23.7)         1.320         0.519         12 (14.9)         2.774           (1.12-4.38)         I         I         I         I         I           58 (76.3)         2.157         0.021         62 (76.5)         2.340<

Ref. Cat= 0 (low perception)

Multinomial Logistic Regression revealed statistically significant higher odds of 'highly favourable' (OR= 2.34, 95% CI, 1.20-4.55; p= 0.012) and 'moderately favourable' perception (OR= 2.15, 95% CI, 1.12-4.13; p= 0.021) towards biomedical research among students from English-medium instruction as compared to those who had Bengali or other languages as medium of instruction in their respective schools. There were statistically significant higher odds of 'moderately favourable' perception among Part I students as compared to those of Part II (OR= 1.96, 95% CI, 1.08-3.56; p= 0.028) while statistically significant higher odds of 'highly favourable' perception were found among those students whose mothers had received education till Middle school, than among those whose mothers had received higher education (Class Xth pass and above) (OR= 2.74, 95% CI, 1.28-6.05; p= 0.010). (Table 3)

#### Discussion:

In this study, 91.6% of the respondents believed that inclusion of short-term research project will enrich their medical education, in contrast to a study conducted by Chatterjee S. et al. in a medical college of Kolkata, where 79.5% believed the same.<sup>[8]</sup> In the same study, 63.7% believed that lack of concept and self-confidence was an important unfavourable factor in carrying out research, while in the current study, 87.5% were of the opinion that lack of dedicated research time was the main factor that may hinder research. This can be due to the huge curriculum of MBBS along with the rigorous clinical postings and internal assessments that take up majority of the time of the students. This too can be a reason why students develop lack of interest in carrying out research activities, as obtained from this study (66.7%).

A study conducted by Ibrahim et al. in Egypt, 69% of medical students believed that research helped for their long-term career objective, yet only 11% of them published a paper.<sup>[9]</sup>On the contrary, in the current study, 84.5% participants agreed that research activities helped to improve their

curriculum vitae for the long run, while only 6 out of the 20 students, who undertook research during college, presented their papers in National and State conferences. This might be due to less scope for an undergraduate medical student to present a scientific paper in any conferences.

According to a study conducted by Manju L. et al., positive attitude was a highly contributing factor favouring research, whereas the current study demonstrated personal interest was the main favouring factor<sup>[10]</sup>

According to a study conducted by Shahbaz et al. in Lahore, with undergraduate university students, it was found that 86% believed research was an essential aspect of their field of study; however only 33% of them had previous research experience.<sup>[11]</sup> Despite positive attitude toward research, the participation in research, presentation and publication were less in another study conducted in Kolar, India.<sup>[12]</sup> In present study, only 5.37% had a previous experience of research in school and only 20 out of 298 participants (6.7%) undertook research during MBBS. Lack of self-motivation and shortage of time, along with lack of adequate workshops, difficulty to read/write in English for those who did not have English as the medium of instruction in schools, lack of adequate financial rewards, etc. were identified as some barriers in undertaking research in the present study. Similar findings were noted by the other study where inadequate financial grants to carry out research followed by difficulty in follow-up of patients, lack of time and awareness regarding research.

In a study conducted by Black ML et al., which focussed on the impact of research, self-efficacy among students before and after a summer internship programme, there were no statistically significant associations of improvement in selfefficacy with gender, type of college attended, type of research, or program type, while in the current study, statistically significant higher odds of highly favourable perception among Part I students as compared to those of Part II, those who had studied in

#### Chakrabarti et al

English-medium schools, among those students whose mothers had received education till Middle school, than among those whose mothers had received higher education.<sup>[13]</sup>

A study conducted by Sobczuk P et al., lack of time and knowledge on starting a research project were identified as the main barriers to scientific/research work.<sup>[14]</sup> Similarly in this study, lack of dedicated time for undertaking research was found as the major hindering factor influencing research work.

#### Limitations of the study:

The present study was conducted in a single institution situated in a metropolitan city, hence the result might not be generalised to all the undergraduate medical students across the state. Also, the study relied upon self-reported data, which may be subjected to social desirability bias.

#### **Conclusion:**

The present study revealed that almost one-third of the study participants had highly favourable perception, while nearly half of them had low perception towards biomedical research. Career progression, improvement in academics and personal interest were some of the favorable factors for carrying out biomedical research, whereas lack of dedicated research time, workshops on research and guidance were identified as barriers for carrying out research.

The findings from this study highlight the need for interventions to enhance students' interest in research and increase dedicated research time to foster research-oriented thinking among them. Awareness could be spread among them about opportunities in biomedical research by organizing workshops and seminars on research methodology involving eminent researchers and providing them assistance to overcome the research related difficulties as mentioned by them.

#### **Declaration:**

Funding: Nil

Conflict of Interest: Nil

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:: 289 ::

A Cross-sectional Study on Determinants of Overweight and Obesity among College Students Perusing Selected Allied Health Courses at Jamnagar City, Gujarat.

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#### Abstract:

Introduction: College students perusing health allied courses like Medical, Dental, Ayurveda and Physiotherapy are at a greater risk for overweight/obesity compared to their counterparts studying in other streams due to specific risk factors. Objectives: 1) The present study was conducted to find prevalence of obesity and overweight and their determinants in college-going students. 2) Internal comparison of obesity and overweight between students perusing selected health allied courses at Jamnagar City, Gujarat. Method: A cross-sectional study was conducted in 985 Medical, Dental, Ayurvedic and Physiotherapy college students using proportion of annual intake in each college. Data was collected using a pre-tested, structured questionnaire. Students were classified using Asian BMI cut-off. Chi-square test, ANOVA and Univariate logistic analysis were used as statistical tools. Results: Out of the total sample size of 985, 18.37% students were obese and 13.80% students were overweight. Higher mean BMI was seen in medical college students as compared to students of other colleges (F ratio = 3.58, p-value <0.01). Highest proportion of obesity was present in medical students (22.92%) and highest proportion of overweight was present in Dental students (19.02%). Increasing age is associated with higher prevalence of overweight/obesity (r = 0.70, p < 0.001, t = 30.29) Conclusion: Students who are older, male, have a positive family history of obesity or overweight, eat a mixed diet, consume more junk food, and spend more time sitting down than moving around are more likely to be overweight or obese.

Keywords: Allied health courses, Body Mass Index, Obesity, Overweight

#### Introduction:

Overweight and obesity have increased and evolved into a public health problem in the last century, particularly in developing countries.<sup>[1]</sup> Obesity can be defined as an abnormal growth of adipose tissue due to an enlargement of fat cell size (hypertrophic obesity) or an increase in fat cell number (hyperplastic obesity) or a combination of both.  $\ensuremath{^{[2]}}$ 

It has been observed that the period between youth and adulthood is crucial for the emergence of obesity and unhealthy lifestyles. Most university students have identified the main obstacles to participating in healthy activities as being a lack of

Quick Response Code	Access this article online	How to cite this article :
	<b>Website :</b> www.healthlinejournal.org	Kagathara J, Tank S, Patel M, Shah D, Satapura N, Rathod M. A Cross-sectional Study on Determinants of Overweight and Obesity among College Students
	<b>DOI :</b> 10.51957/Healthline_573_2023	Perusing Selected Allied Health Courses at Jamnagar City, Gujarat. 2023; 14 (4): 290-300

time, self-discipline, social support, and parental control.<sup>[3]</sup> An energy imbalance between calories consumed and expended is the primary cause of obesity along with positive history of obesity in parents and second-degree relatives. Increased consumption of foods high in energy, a lack of exercise, and urbanisation that promotes a sedentary lifestyle are the causes.<sup>[4,5]</sup>

Currently, the prevalence of obese college students in various courses is 20% in UK and Australia, 15.8% in Saudi Arabia, 15.6% in Thailand, 10% in Japan, and 7.8% in Iran.<sup>[6]</sup> Studies done on students pursuing health allied courses in India have shown wide variation in the prevalence of overweight and obesity. Similar studies from other cities of Gujarat medical students have reported obesity in the range of 6-11%.<sup>[7,8]</sup> Studies conducted on medical students in Kolkata have shown the prevalence of overweight and obesity as 47% and 13%, respectively whereas in Tamil Nadu it is 9% and 24%, respectively.<sup>[9]</sup>

Between 2010 and 2040, the incidence of overweight will more than double among Indian adults aged 20 to 69, but the prevalence of obesity will triple. Male prevalence of overweight and obesity is expected to increase to 30.5% (27.4%–34.4%) by 2040, while female prevalence is expected to increase to 27.4% (24.5%–30.6%).<sup>[10]</sup>

"Allied health courses" are specifically chosen for obesity study because they have predominantly sedentary lifestyle and gaps are present in training and education regarding obesity in young physicians. Most of the students have busy schedules due to which they have less time for physical activities. Gaps still exist in causation and training programmes of obesity for medical students. Along with medical students' other college students were taken to include all medical and para-medical students as most of them have similar lifestyle and paucity in literature of all the allied health courses.<sup>[11]</sup> Considering the above facts, the present study was undertaken to detect the prevalence and determinants of overweight and obesity in students of selected health allied courses in study area.

#### Method:

A cross-sectional study was carried out in the study area between September 2021 and December 2022. The study was carried out in Medical (M.B.B.S, B.D.S & B.A.M.S) and Para-medical (B.P.T) students. The formula for sample size calculation is  $Z^2pq/l^2$ , where p is 11.53% prevalence of obesity taken from a previous study<sup>[8]</sup> and l is taken as 2% error with 95% Confidence Interval. The calculated sample size was 980. The total sample size was divided among four colleges by proportionate sampling method. The annual intake of different colleges is 250 for Medical college, 125 each for Dental and Ayurvedic college and 100 for Physiotherapy college. Hence, 41.66% samples were taken from Medical, 20.83% each from Dental and Ayurvedic colleges and 16.67% from Physiotherapy college. Thus, final sample size was 410 from Medical college, 205 each from Ayurvedic and Dental college and 165 from Physiotherapy college, hence total of 985 students were considered for the study. The total sample for each college was divided between 4 years equally.

Before conducting the study, an ethical approval letter (Project No:125/05/2021) was obtained from the Institutional Ethics Committee. Along with that approval letters from the Dean/Principal of concerned colleges were obtained beforehand.

Students who wished to give "Informed Consent" and were above 18 years of age were considered for the study. Exclusion criteria are students who were physically challenged, foreign nationality, having endocrine disorders and absent on the day of data collection.

By proper Review of Literature, a pre-designed and structured questionnaire was prepared. Pilot testing was done on nearly 10% of participants and some changes were made in the questionnaire. Data collection was done in lecture halls and demonstration rooms post/pre-lectures. Students were selected in classroom by Simple Random Sampling Method using roll numbers. Data were collected by "Google Questionnaire forms" under the direct supervision of investigators after necessary instructions and assurance about ethical aspects of research and individual identification. Various factors considered in questionnaire were Sociodemographic characteristics, Dietary history, Sedentary and physical activity (including sports, walking or exercises in a gymnasium) and family history of obesity. Regarding socio-economic status classification–Modified Kuppuswami Scale<sup>[13]</sup> is used.

Weight and Height were recorded by the investigators. Weight was measured through Electronic Weighing Scale and Height was measured through a stadiometer. Weight was rounded off to 100 grams and height was rounded off to the nearest centimeter.

The weight and height were used to calculate the BMI of each student using the formula BMI= Weight (in kg) / Height (in m<sup>2</sup>).<sup>[14]</sup>

BMI cut-off used was ASIAN BMI cut-off classification. <sup>[15]</sup> According to the classification underweight is classified as <  $18.50 \text{ kg/m}^2$ , normal as  $18.50 \text{ to } 22.99 \text{ kg/m}^2$ , overweight as 23 to 24.99 kg/m<sup>2</sup>, obese class 1 as 25 to 29.99 kg/m<sup>2</sup> and obese class 2 as >  $30 \text{ kg/m}^2$ .

Data was entered in Microsoft Excel and was analyzed using Microsoft Excel and SPSS (Statistical Package for Social Sciences) version 26.

Descriptive statistics in the form of percentages was applied to describe various variables under study for different study groups. The chi-square test was applied to detect the association between various variables among different study groups. ANOVA test was used to compare weight of students of selected colleges. Univariate logistic analysis was done for variables found positively associated by Chi-Square test.

#### **Results:**

A total of 985 students were included in the study out of which 410 were from Medical, 205 each from Dental and Ayurvedic and 165 from Physiotherapy. Males were 378 (38.37%) in number and females were 607 (61.62%). Most of the students were from 19, 20 and 21 years of age while only 27 (2.74%) were 24 or above. Majority of students were Hindus (89.34%). Hostel residing students were 716 (72.69%) while only 154 and 115 students were residing at home and paying guests respectively. Rural native was found in 307 (31.16%) students. Almost  $2/3^{rd}$  (64.87%) students belonged to nuclear family and 508 (51.57%) students belonged to upper middle socio-economic classification, followed by lower middle (31.57%) and none from lower class.

A positive history of parents for obesity/ overweight as perceived by study participants was present in 276 students (28.03%) and 366 students (37.15%) had a positive history of second-degree relatives as perceived by study participants being overweight/obese. Vegetarian diet was practiced by 81.01% students. Fruits were consumed by 436 students (44.26%) for 1-2 days in a week and 635 students consumed vegetables everyday (64.46%). Almost 85% of student had the habit of eating junk food / fast food every week. Groundnut oil as a cooking medium was used by 358 students (36.34%), while 204 students (20.71%) used cottonseed oil. About 205 students did not know about the type of oil consumed by them. Over 72% students had the habit of eating snacks in between meals.

As shown in Table 1, Mean weight (in BMI) is highest in medical students (Overall, boys and girls) and it is lowest among Physiotherapy students. On applying the ANOVA test for comparison of BMI of four colleges p-value is <0.05 which implies a statistical difference in BMI of the four colleges.

Figure 1 shows proportion of students having obesity/overweight along with underweight and normal BMI. The overall proportion was 32.18% and

Course	BMI in kg/m <sup>2</sup> (Mean ± SD)					
	Overall	Boys	Girls			
Medical	21.98 ± 4.23	21.95 ± 3.99	21.92 ± 4.23			
Dental	21.37 ± 3.59	$21.35 \pm 3.77$	21.68 ± 3.59			
Ayurvedic	21.54 ± 3.77	21.21 ± 3.90	21.55 ± 3.79			
Physiotherapy	$20.81 \pm 4.04$	$20.82 \pm 4.08$	$20.81 \pm 4.04$			
F ratio, d.f, p-value	3.58, 3, (0.013) *	1.26, 3, (0.28)	2.30, 3, (0.07)			

 Table 1: Gender wise distribution of mean BMI among study participants (N=985)

Figure 1: Distribution of BMI in students of various health allied courses in Jamnagar city(N=985)



highest in medical students (36.58%) closely followed by Dental students (36.09%) and least being in Physiotherapy students (21.81%).

Out of 985 students, 442 students (44.87%) were in the normal category while 181 were in the obese category (18.37%) and 136 (13.80%) students were in overweight category. Total 226 students (22.94%) were in underweight category.

Socio-demographic factors and its association with overweight and obesity is shown separately for different colleges in table 2. Overweight was associated with pocket money per month, native and current residence in all 4 colleges. Obesity was associated with age, gender, pocket per month and current residence in all 4 colleges. There was gradual increase in obesity/overweight with age and was statistically significant (p-value = 0.03). Males have higher proportion of being overweight/obese (37.56%) as compared to females (28.82%) (p-value = 0.0014). Students having positive parent's history of obesity (39.85%) and second degree relative/ grandparents of obesity (37.97%) have higher chance of being obese/overweight and is statistically significant as compared with negative history (pvalue = 0.001). Urban native (34.51%) students have higher chance of being obese/ overweight as compared to rural (27.03%) (p-value = 0.02).

Overweight and obesity for different colleges are compared with various dietary habits and physical activity of students (Table 3a and 3b). Overweight in college students was associated with daily intake of fruits, frequency of eating junk foods

## Table 2(a): Socio-demographic factors and its association with overweight in different college students (N=136)

Variable	Overweight present					x <sup>2</sup> , p value, d f
	Medical	Dental	Ayurveda	Physio-	n=136	
	n=56 (%)	n=39 (%)	n=25 (%)	therapy		
				n=16 (%)		
A) Age Group (	in completed	years)				
18-19	18 (38.29)	13 (27.65)	9 (19.14)	7 (14.89)	47	0.79, 0.85, 3
20-21	22 (36.06)	26 (42.62)	8 (13.11)	5 (8.19)	61	
22-23	10 (47.61)	0 (0.00)	7 (33.33)	4 (19.04)	21	
24 and above	6 (85.71)	0 (0.00)	1 (14.28)	0 (0.00)	7	
B) Gender						
Male	31 (48.43)	17 (26.56)	13 (20.31)	3 (4.68)	64	7.12, 0.06, 3
Female	25 (34.72)	22 (30.55)	12 (16.66)	13 (18.05)	72	
C) Parents hist	ory of curren	t/past obesity			•	
Present	15 (37.50)	8 (20.00)	9 (22.50)	8 (20.00)	40	5.42, 0.14, 3
Absent	41 (42.70)	31 (32.29)	16 (16.66)	8 (8.33)	96	
D) Second deg	ree relative o	r grandparents	' history of obe	sity	•	
Present	16 (33.33)	13 (27.08)	10 (20.83)	9 (18.75)	48	4.49, 0.21, 3
Absent	40 (45.45)	26 (29.54)	15 (17.04)	7 (7.95)	88	
E) Native						
Rural	23 (57.50)	5 (12.50)	8 (20.00)	4 (10.00)	40	9.06, 0.02*, 3
Urban	33 (34.37)	34 (35.41)	17 (17.70)	12 (12.50)	96	
F) Type of family						
Nuclear	40 (44.94)	22 (24.71)	19 (21.34)	8 (8.98)	89	5.21, 0.15, 3
Joint	7 (23.33)	11 (36.66)	6 (20.00)	6 (20.00)	30	
3 <sup>rd</sup> Generation	9 (52.94)	6 (35.29)	0 (0.00)	2 (11.76)	17	

#### \*p-value statistically significant

(in days) and consumption of snacks in between meals. Obesity in college students was associated with frequency of intake of junk foods, type of cooking oil used and consumption of snacks in between meals.

The chance of being obese/overweight was higher in students consuming mixed diet (40.10%) as compared to vegetarian (30.32%) and was statistically significant (p-value = 0.009). Students having junk food for 5-6 days (39.86%) have highest chance of being obese and not eating junk (24.66%) food has the least (p-value = 0.02). There is gradual

increase in overweight/obesity with increase in sedentary hours. Similarly, there was decrease in overweight/obesity with increase in physical activity like walking, cycling, or running but is not statistically significant by Chi-square test.

Variables that are associated on applying Chisquare test for overweight/obesity are applied Binary Logistic Regression. Variables that are associated with Chi-square for total sample size of 985 are also positively associated on applying Binary logistic regression. (p-value < 0.05) (Table 4) Along with the variables shown in Table 4 other variables

Table 2(b): Socio-demographic factors and its association with obesity in different
college students (N=181)

Variable	Overweight present					x <sup>2</sup> , p value, d f
	Medical	Dental	Ayurveda	Physio-	n=181	
	n=94 (%)	n=35 (%)	n=32 (%)	therapy		
				n=20 (%)		
A) Age group (	in completed	years)				
18-19	23 (39.65)	13 (22.41)	12 (20.68)	10 (17.24)	58	20.22, 0.002*, 6
20-21	32 (43.83)	17 (23.28)	16 (21.91)	8 (10.95)	73	
22-23	32 (76.19)	4 (9.52)	4 (9.52)	2 (4.76)	42	
24 & above	7 (87.50)	1 (12.50)	0 (0.00)	0 (0.00)	8	
B) Gender						
Male	46 (58.97)	10 (12.82)	17 (21.79)	5 (6.41)	78	8.30, 0.04*, 3
Female	48 (46.61)	25 (24.27)	15 (14.56)	15 (14.56)	103	
C) Parents hist	ory of curren	t/past obesity		1	•	
Present	34 (48.57)	13 (18.57)	15 (21.42)	8 (11.42)	70	1.20, 0.75, 3
Absent	60 (54.05)	22 (19.81)	17 (15.31)	12 (10.81)	111	
D) Second deg	ree relative o	r grandparents	' history of obe	sity	1	•
Present	43 (47.25)	16 (17.58)	22 (24.17)	10 (10.98)	91	5.47, 0.14, 3
Absent	51 (56.66)	19 (21.11)	10 (11.11)	10 (11.11)	90	
E) Native						
Rural	20 (45.45)	6 (13.63)	12 (27.27)	6 (13.63)	44	4.82, 0.18, 3
Urban	74 (54.01)	29 (21.16)	20 (14.59)	14 (10.21)	137	
F) Type of fam	ily					
Nuclear	63 (55.75)	22 (19.46)	18 (15.92)	10 (8.84)	113	9.58, 0.14, 6
Joint	15 (35.71)	9 (21.42)	9 (21.42)	9 (21.42)	42	1
3 <sup>rd</sup> Generation	16 (61.53)	4 (15.38)	5 (19.23)	1 (3.84)	26	]

#### \*p-value statistically significant

which are positively associated with overweight/ obesity are increasing hours spent in sitting/ reclining and increased frequency in eating junk food in a week or eating snacks in between meals.

Co-relation between age and obesity/ overweight has been analyzed. There has been an increasing prevalence of obesity/overweight with age. On applying Pearson's Co-relation co-efficient (r) is 0.70 which implies a moderately strong positive correlation, t value for the same is 30.29 and p-value < 0.001 which implies a positive association.

#### **Discussion:**

The present study was done to detect the overall prevalence of overweight and obesity in medical and para-medical students of the area along with its associated factors. The overall Mean BMI of 985 students comprising all faculties is  $21.63 \pm 3.99$ kg/m<sup>2</sup>. Similarly, in a study conducted in Tamil Nadu<sup>[16]</sup> Mean BMI of students was  $21.84 \pm 2.55$ kg/m<sup>2</sup>. A previous study done in Karachi, Pakistan<sup>[17]</sup> and Saudi Arabia<sup>[12]</sup> reported higher BMI as compared to the present study. Overall, in present study, 317 (32.18%) students were found to have obesity or Table 3 (a): Association of dietary habits & physical activity with overweight in students of different colleges (N=136)

Variable	<b>Overweight present</b>				Total	x <sup>2</sup> , p value, d f
	Medical	Dental	Ayurveda	Physio-	n=136	
	n=56 (%)	n=39(%)	n=25 (%)	therapy		
				n=16 (%)		
A) Type of diet						
Vegetarian	43 (43.43)	26 (26.26)	19 (19.19)	11 (11.11)	99	1.45, 0.69, 3
Mixed/Non-Vegetarian	13 (35.13)	13 (35.13)	6(16.21)	5 (13.51)	37	
B) Number of days eating	ngfruits				_	-
Not eating Fruits	11 (39.28)	8 (28.57)	5 (17.85)	4 (14.28)	28	33.22, <0.001*, 6
1-2	12 (19.35)	27 (43.54)	16 (25.80)	7 (11.29)	62	
3-4	14 (73.68)	2 (10.52)	3 (15.78)	0 (0.00)	19	
5-6	15 (88.23)	1 (5.88)	0 (0.00)	1 (5.88)	17	
Daily	4 (40.00)	1 (10.00)	1(10.00)	4 (40.00)	10	
C) Number of days eatin	ngjunkfood/1	fast food		•	•	
Not eating Junk Food	5 (35.71)	4 (28.57)	3 (21.42)	2 (14.28)	14	34.06, <0.001*, 12
1-2	1 (2.85)	18 (51.42)	9 (25.71)	7 (20.00)	35	
3-4	30 (61.22)	10 (20.40)	6(12.24)	3 (6.12)	49	
5-6	13 (59.09)	3 (13.63)	4 (18.18)	2 (9.09)	22	
Daily	7 (43.75)	4 (25.00)	3 (18.75)	2 (12.50)	16	
D) Number of days eating snacks in between meals or having late night snacks						
Not having snacks in	9 (28.12)	11 (34.37)	9 (28.12)	3 (9.37)	32	19.03, 0.02*, 9
between meals						
1-2	15 (36.58)	12 (29.26)	5 (12.19)	9 (21.95)	41	
3-4	13 (76.47)	2 (11.76)	2 (11.76)	0 (0.00)	17	
5-6	7 (58.33)	2(16.66)	2(16.66)	1 (8.33)	12	

#### \*p-value statistically significant

overweight. A study done in Ujjain<sup>[17]</sup> on medical students reported that 44.9% as either obese/ overweight. A lower prevalence of obesity/ overweight was found in a study by Panchal et al<sup>[7]</sup> which was 18.1% and by Sarkar et al.<sup>[18]</sup> A higher proportion of obesity was seen in a study conducted by Nisar in Karachi.<sup>[17]</sup>

Obesity/overweight proportion increases with increase in age which is also found positive in other studies.<sup>[7,11,19]</sup> Males had a higher chance of being obese/overweight which may be due to their higher outings and consumption of fast food whereas females may be cautious about their weight. A similar finding is seen in a study by Geeta Mani<sup>[16]</sup> in which prevalence of obesity/overweight was higher in males as compared to females whereas in contrast to a study conducted in Saudi Arabia<sup>[12]</sup> in which females had a higher chance of being obese. In two other studies, no significant association was found between gender and obesity.<sup>[7,19]</sup>

Strong association of parental history with obesity has also been obtained in past from other studies in which the significance of p-value ranges from <0.05 to  $<0.00001^{[7,11,19,20,21,22]}$  Such strong data on

Variable	OBESITY PRESENT (n=181)				Total	x <sup>2</sup> , p value, d f
	Medical	Dental	Ayurveda	Physio-	n=181	
	n=94 (%)	n=35 (%)	n=32 (%)	therapy		
				n=20 (%)		
A) Type of diet						
Vegetarian	73 (51.04)	28 (19.58)	23 (16.08)	19 (13.28)	143	4.18, 0.24, 3
Mixed/Non-Vegetarian	21 (55.26)	7 (18.42)	9 (23.68)	1 (2.63)	38	
B) Number of days eating	ngfruits					
Not eating Fruits	26 (46.42)	14 (25.00)	7 (12.50)	9(16.07)	56	10.33, 0.58, 12
1-2	28 (48.27)	11(18.96)	14 (24.13)	5 (8.62)	58	
3-4	13 (56.52)	2 (8.69)	6 (26.08)	2 (8.69)	23	
5-6	16 (59.25)	5 (18.51)	4 (14.81)	2 (7.40)	27	
Daily	11 (64.70)	3 (17.64)	1 (5.88)	2(11.76)	17	
C) Number of days eating	ng junk food/f	fast food				
Not eating Junk Food	12 (52.17)	5 (21.73)	3 (13.04)	3 (13.04)	23	29.81, 0.002*, 12
1-2	34 (69.38)	8 (16.32)	4 (8.16)	3 (6.12)	49	
3-4	31 (60.78)	7 (13.72)	9(17.64)	4 (7.84)	51	
5-6	8 (20.51)	15 (38.46)	11 (28.20)	5 (12.82)	39	
Daily	8 (42.10)	2 (10.52)	5 (26.31)	4 (21.05)	19	
D) Number of days eating snacks in between meals or having late night snacks						
Not having snacks in	15 (40.54)	10(27.02)	8 (21.62)	4 (10.81)	37	19.26, 0.02*, 9
between meals						
1-2	23 (38.98)	11(18.64)	14 (23.72)	11 (18.64)	59	
3-4	17 (70.83)	2 (8.33)	4 (16.66)	1 (4.16)	24	
5-6	14 (82.35)	2(11.76)	1 (5.88)	0 (0.00)	17	

#### Table 3 (b): Association of dietary habits with obesity in students of different health courses (N=181)

#### \*p-value statistically significant

positive family history with BMI signifies that positive parental history of obesity plays a vital role in deciding the BMI status of child. Similarly, positive association has been found between second degree relative /grandparent's history of obesity with student's current obesity status in other studies also.<sup>[12,21]</sup>

The maximum proportion of overweight or obesity is seen in students staying at home (35.06%) and the least in staying as paying guests or rentals (27.82%). However, data is not statistically significant. In a study conducted by Das et al <sup>[20]</sup> in Kolkata current residence has been significantly associated with non-communicable diseases like obesity and Hypertension. Similar findings were also obtained by a study in Saudi Arabia. <sup>[12]</sup> Least prevalence of obesity/overweight is seen in Upper lower class (26.82%) and maximum is seen in upper middle class (34.05%). There is no role of socioeconomic status in determining the BMI status of students. However, contradictory results have been obtained in other studies in which higher socioeconomic status students have higher chance of being obese and data is significantly associated.<sup>[8,22]</sup>

The role of diet as vegetarian or non-vegetarian has been controversial as findings from Deshpande et

Table 4: Association between overweight/obesity with multiple independent factors using univariate logistic regression (N=985)

Variables	Overweight/Obesity		OR (95%CI)	P-value
	Present n (%)	Absent n (%)		
A] Faculty/Course				•
Medical	150 (36.58)	260 (63.42)	2.03 (1.35-3.14)	(0.001)*
Dental	74 (36.09)	131 (63.91)	2.01 (1.26-3.22)	(0.001)*
Ayurveda	57 (27.80)	148(72.20)	1.38 (0.85-2.22)	(0.18)
Physiotherapy	36 (21.81)	129 (78.19)	-	-
B] Gender				
Male	142 (37.56)	236 (62.44)	1.49 (1.13-1.96)	(0.004)*
Female	175 (28.82)	432 (71.18)	-	
C] Religion				l
Hindu	268 (30.45)	612 (69.55)	-	-
Muslim	21 (44.68)	26 (55.32)	1.84 (1.02-3.33)	(0.04)*
Jain	24 (48.00)	26(52.00)	2.10 (1.18-3.73)	(0.01)*
D] Parental history of ov	erweight/obese			•
Present	110 (39.85)	166 (60.15)	1.60 (1.20-2.13)	(0.001)*
Absent	207 (29.19)	502 (70.81)	-	-
E] Second degree relativ	e/grandparents' hist	ory of obese/overwe	eight	
Present	139 (37.97)	227 (62.02)	1.51 (1.15-1.99)	(0.003)*
Absent	178 (28.75)	441 (71.25)	-	-
F] Native				
Rural	83 (27.03)	224 (72.97)	0.71 (0.53-0.96)	(0.02)*
Urban	234 (34.51)	444 (65.48)	-	-
G] Type of diet	· · · · ·			•
Vegetarian	242 (30.32)	556 (69.68)	0.65 (0.46-0.90)	(0.01)*
Mixed/Non-Veg	75 (40.10)	112 (59.90)	-	-

#### \*p-value statistically significant

al<sup>[18]</sup> and Das et al.<sup>[20]</sup> Both have reported type of diet as non-significant for BMI while Panchal et al<sup>[7]</sup> have found it significantly associated which is in line with the present study findings. As per the present study, there is gradual decrease in obesity with an increase in intake of fruits in a week. A multi-centric study conducted by Gulati et al<sup>[22]</sup> has shown significant difference between less fruit consumption and obesity. Similar findings have also been obtained in a cross-sectional study done in Tamil Nadu.<sup>[16]</sup> There is

no significant association between number of days of eating vegetables with proportion of overweight or obesity whereas a prospective cohort study that was done for over 24 years it mentioned that increasing intake of vegetables is inversely related to weight of a person. However, starchy vegetables like potatoes, peas and corn were associated with increased weight gain but green leafy vegetables and vegetables with higher fibre content are responsible for lower weight in longer term.<sup>[23]</sup> The present study has found positive association between obesity and increasing intake of junk food while a study conducted by Eway Makkay et al<sup>[12]</sup> by applying bivariate analysis reported no association between junk food and high BMI. However, from other studies conducted in India and Pakistan, significant positive association has been found between junk food eating frequency and BMI of students.<sup>[6,16,19,21]</sup>

There is a gradual increase in prevalence of obesity/overweight as the duration of sitting/ reclining increases among students. The maximum prevalence of obesity/overweight is seen in students having > 4 hours of sitting time (37.20%) while least is seen in the 2-3 hours group of students (21.95%). In a study done on undergraduate medical students in Tamil Nadu<sup>[20]</sup> almost 50% obesity has been found in students sitting > 4 hours in a day and a study done by Panchal et al<sup>[7]</sup> on same study population found highly significant association between obesity and sitting/watching TV/relaxing for > 2 hours in a day. No significant association has been found between walking and BMI in students which is similar to findings of other studies.<sup>[7, 18, 24]</sup> Aerobic activities like cycling, gyming, or running is also not found to be associated with BMI and similar findings have also been found in other studies in different geographies like Kolkata, Gujarat, and Saudi Arabia.<sup>[7,12,20]</sup>

#### **Conclusion:**

Medical students have higher mean BMI as compared to students of other colleges. Increasing age is associated with increasing overweight/ obesity. Male students have higher chance of being obese/overweight as compared to female students. Positive parental history, second-degree relative history of obesity, mixed diet and urban native are associated with higher obesity. Higher frequency of consumption of junk foods, consuming snacks in between meals and longer duration of sedentary hours have positive association with obesity in students.

#### **Recommendations:**

Students should be screened at the time of admission for high BMI and those screened positive should have regular follow-up and counselling for weight loss. Students with increasing age group have higher BMI hence health education should be imparted at younger age group to avoid increasing obesity in higher age group. Health education in the form of imparting knowledge regarding calorific value of junk foods and avoiding them should be given. Students should also be taught about increasing fruit intake along with decreasing latenight snack or snacks in between meals.

#### Limitations:

The present study is a cross-sectional study and all the limitations of cross-sectional study are applicable to it. Temporality of association cannot be established as no follow-up or backward history was taken. As data was collected by proforma/ questionnaire there is a high chance of recall bias from the study participants. BMI is used which considers only weight, which can be in the form of muscle mass or fat and it cannot be differentiated by BMI. The present study is being done in the urban area of a specific district and hence findings cannot be generalized. Any one institute would not represent the proportions of obesity in community. Present study was done on selected health allied courses hence they were considered. Authors are not claiming the findings of this study on general community.

#### **Declaration:**

Funding: Nil

#### Conflict of Interest: Nil

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# Assessment of Satisfaction level of Admitted patients in a Trauma Care Centre of Tripura – A Questionnaire Based Study

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#### Abstract:

Introduction: Tertiary care hospitals deal with complex medical care and are the face of development of the healthcare delivery system. Towards this advancement, good quality of patient care services addsvalue. One of the ways to find out about the quality of ongoing services is by carrying out patient satisfaction surveys. In this context, nearly five years after the inauguration of the state's first ever trauma care centre, it was planned to take a feedback on the services provided by the centre. Objective: To assess the level of satisfaction of the patients treated in the trauma care center of a tertiary care hospital in the state of Tripura. Method: A total of three hundred and sixty five (365) patients admitted in the trauma care centre were interviewed using a validated questionnaire adapted from National Health System survey format. Data was collected over period of six months. For the first three months, interviews were conducted on all odd days of the week and for the next three months the interviews were conducted on even days of the week. Results: In the present study, 84% of the responders were male and 16% female. It was observed that 78.08% of the patients had full confidence and trust on the doctors who attended the patients. The overall ranking provided by the patients on the services received in the hospital was satisfactory. In this study, 78.9% and 10.7% of the patients have rated the services to be 'good' and 'excellent', respectively. Conclusion: Although most of the patients were satisfied with the services provided in the trauma care centre of the study, 9.6% of them also reported that there is need to improve services. This study will not only help the hospital management to implement new policies but also prepare the hospital well to meet the needs of patients admitted in the trauma care center.

**Keywords :** Healthcare professionals, National Health System (NHS) survey, Patient satisfaction, Trauma care centre.

#### Introduction:

Patient satisfaction is defined as sum of all their experiences from time of admission to discharge from hospital.<sup>[1]</sup>Doctors, clinical staff and health care management of a hospital would be interested to know patient's view of care because patient satisfaction may be a direct or indirect measure of treatment outcome. Over the past few years, patient satisfaction surveys have been used as a meaningful and essential tool for identifying gaps and developing effective strategies for quality improvements in health care industry.<sup>[2]</sup> It has gained increasing attention as meaningful and essential sources of information for identifying gaps and developing an effective action plan for quality improvement in

Quick Response Code	Access this article online	How to cite this article :
	<b>Website :</b> www.healthlinejournal.org	Dutta S, Goswami B, Bhattacharjee B, Sengupta S.Assessment of Satisfaction level of Admitted patients
	<b>DOI :</b> 10.51957/Healthline_ 568_2023	in a Trauma Care Centre of Tripura – A Questionnaire Based Study. Healthline. 2023; 14 (4): 301-307

healthcare organizations. Despite of extensive research on client satisfaction in developing countries, there is a lack of data on patient satisfaction in India. Trauma care centres of a State are the first place where most trauma victims are brought in. A well- managed Trauma centre can reduce the burden of mortality caused due to trauma. The first ever trauma care centre in the state of Tripura started functioning at a tertiary care hospital around 5 years back with built in area of approximate 1660.23 sq. mt. with financial assistance from the North-eastern Council and the State Government<sup>[3]</sup>

The present study was conducted primarily to determine the level of satisfaction among the patients admitted in the trauma care centre in terms of different infrastructural and quality parameters. To find out gaps in service if any from patient's perspective would also enable the administrators to take wider view on rectification of those gaps.

#### Method:

This study was conducted at the trauma care centre of the apex tertiary care teaching hospital in Tripura from June,2021 to December,2021 i.e for six months after obtaining the Institutional ethical approval. Only willing patients or their relatives (Age>= 18 year) who consented to participate in the study were included. Patients reporting to the trauma care centre but not admitted or admitted for less than twenty-four hours were excluded from this study.

A validated questionnaire adapted from National Health System (NHS) survey performa<sup>[4]</sup> was used for interviewing the patient admitted in the trauma care centre after the patient attained stability and preferably just a day before their discharge from the hospital. When the condition of the victim would not warrant the interview, the relatives or the attendants were interviewed. A study in Central India reported the overall satisfaction of patients in terms of doctor patient communication to be around 60%.<sup>[5]</sup> For present study, sample size was estimated using the Open Epi software taking into account the overall level of satisfaction to be 60% and population adjusted with the average annual attendance at the trauma care centre which is approximately 3000. Considering an absolute error of 5%, the minimum required sample size estimated to be 334 subjects. Therefore, a total of 365 patients admitted in the trauma care centre were interviewed using the standard questionnaire. Data was collected over a period of six months. Consecutive sampling was followed to meet the required sample size in the given study duration. As the data collection could be done on three days of a week, for the first three months, interviews were conducted on all odd days of the week and for the next three months the interviews were conducted on even days of the week. In order to get the details from patients, interview was done with a standard questionnaire, designed to include questions eliciting knowledge, awareness and perception of patients about the impression on trauma care centre services like, waiting time, cleanliness, maintenance of privacy and problems faced during health check-up.

#### Statistical analysis:

All statistical analyses were performed using the IBM SPSS Statistics v25 (IBM Corp., Armonk, USA). Descriptive statistics were used to present the findings of the satisfaction survey (frequency and the percentage) and Chi square test was performed to study the categorical variables of the study participants.

Ethical Consideration: This study was approved by the Institutional Ethics Committee at Agartala Governmental Medical College

#### **Results:**

In the present study, the responses of 365 patients attending the trauma care centre of Tripura were collected in a structured, predesigned, precoded, pretested questionnaire format. Among the responders 84% (306) was male and only 16% (59) was female.

Characteristics		n (%)
Sex	Male	306 (84%)
	Female	59 (16%)
District	West	156 (42.7%)
	Khowai	38 (10.4%)
	North Tripura	21 (5.8%)
	South Tripura	62 (17%)
	Dhalai	36 (9.9%)
	Sepahijala	21 (5.8%)
	Unakoti	5 (1.4%)
	Gomati	26 (7.1%)
Community	General	236 (64.15%)
	Scheduled Caste	42 (11.5%)
	Scheduled Tribe	63 (17.3%)
	OBC	24 (6.6%)
Occupation	Farmers	58 (15.9%)
	Daily Workers	17 (4.7%)
	Students	62 (17%)
	Govt. employee	55 (15.1%)
	Private employee	52 (14.2%)
	Others namely drivers,	56 (15.3%)
	Sweepers, Businessman etc.	
	None	65 (17.8%)

Table 1: Demographic characteristics of study participants (N=365)

In the present study population (n=365), 114 participants (31.2%) were between 15-29 years old followed by 110 participants (30.1%) under 30-44 years age group. Table 1 represents the demographic details like communities, districts, occupation of all the study participants.

In this present study strong association (p=0.039) was found between trauma cause and different age groups. It was also observed in the present study that out of 365 trauma cases, 229 cases (62.7%) are only for Road Traffic accidents followed by fall from height (25.7%) and physical assault (7.94%) respectively. The cleanliness of the hospital rooms, toilets was one of the most important aspects assessed in the present study and 84.9% of the study population was satisfied with the very fine cleanliness of the trauma care centre (Table 2).

Present study also revealed that care provided by the hospital staff, which is another important issue

for the patients while visiting Trauma Care Center, was satisfactory in the hospital. Here in the study, nearly 57.80% of the study participants agreed of getting care from the hospital staff while in need whereas 13.15% declared that they did not get any care from the staff. It was also observed that 78.08% of the patients had full confidence and trust on the doctors who attended them during their hospital stay whereas 25.5% patients didn't have any trust on the Nursing staff of the hospital.(Table 3)

In this study, the overall ranking provided by the patients on the service received in the hospital was very satisfactory, 78.9% patients have given ranking as good for the service received and 10.7% indicated it to be excellent. Responses of study participants regarding trust and confidence on Doctors and Nurses by overall ranking where 78.08% patients have full confidence on doctors which is statistically significant (p = 0.001).

### Table 2: Responses regarding different parameters among the study population (N=365)

Variables	(n%)
Cleanliness of the room	
Very Clean	29 (7.9%)
Fairly clean	310 (84.9%)
Not Very Clean	26 (7.12%)
Food Quality	
Very good	71 (19.4%)
Good	55 (15.06%)
Fair	104 (28.5%)
Poor	27 (7.39%)
Nottaken	108 (29.58%)
Care provided by the hospital staff	
Yes always	211 (57.80%)
Sometimes	106 (29.04%)
No	48 (13.15%)
<b>Cleanliness of toilet</b>	
Very clean	44 (12.05%)
Fairly clean	259 (70.95%)
Not very clean	50 (13.69%)
Poorly managed	12 (3.28%)
Time to get bed	
Yes, definitely	151 (41.3%)
Yes to some extent	102 (27.9%)
No	112 (30.7%)
Availability of Medicine	
Yes always	77 (21.1%)
Sometimes	165 (45.2%)
No	123 (33.7%)
Privacy during treatment	
Yes Definitely	177 (48.5%)
Yes to some extent	166 (45.5%)
No	22(6%)
Privacy during Examination	
Yes always	214 (58.6%)
Yes sometimes	149 (40.8%)
No	2 (0.5%)
Total	365

Factors	Overall Ranking		Total	p-value		
	Need to	Poor	Good	Excellent		
	Improve					
Answer from doctor	•					•
Yes, always	1	0	215	89	305 (83.6%)	0.083
Yes, sometimes	17	8	31	4	60 (16.4%)	
No	0	0	0	0	0	
Confidence and trust or	doctor					
Yes, always	3	0	256	26	285 (78.08%)	0.001
Yes, sometimes	33	3	39	4	79 (21.6%)	
No	1	0	0	0	1 (0.3%)	
Answers from Nurses						
Yes, always	79	22	170	9	280 (76.7%)	0.000
Yes, sometimes	26	2	13	2	43 (11.8%)	
No	36	4	2	0	42 (11.5%)	
Confidence and trust or	Nurses					
Yes, always	106	16	114	6	242 (66.3%)	0.018
Yes, sometimes	12	8	8	2	30 (8.2%)	
No	72	18	3	0	93 (25.5%)	
Availability of enough n	umber of n	urses				
Always	34	7	159	7	207 (56.7%)	0.933
Sometimes	86	45	12	3	146 (40%)	1
Rarely or Never	7	5	0	0	12 (3.3%)	1

#### Table 3: Responses regarding Trust and confidence on Doctors and Nurses by overall ranking (N=365)

#### Discussion:

Patient satisfaction surveys are useful for an understanding of patients' needs and their perception of the service received. It is an important indicator in evaluating the quality of patient care. Present study evaluated the satisfaction level among trauma patients attending a trauma care centre of Tripura. Studies have shown that some of the factors associated with patient satisfaction include patient age and gender, care taken by the staff, cleanliness, availability of nurses and patient trust.<sup>[6-12]</sup>

In the present study, about 6% of the population expressed their concern on inadequate privacy during treatment. Whereas in a study on client satisfaction by Aldana et al, in rural Bangladesh showed 45.1% of the patients were dissatisfied with

the privacy.<sup>[13]</sup> Although in this study percentage is very less but privacy, which is an essential part of healthcare facility, especially for woman, should be ensured in order to improve hospital service. Cleanliness of rooms as well as toilets was reported to be good by more than 80% of the respondents in the present study, which is a satisfier, although there is scope of further improvement. Quality of food as well as availability of medicines was a point of action that requires attention of the administrators in this study setting. Another major point of concern is that nearly 70% of the study participants reported that they took some or more time to be shifted to a designated hospital bed in the colour coded trauma care zone. This may be because of more than 100% bed occupancy and also poor bed management. The usual

guideline is to shift a patient out of the trauma care from the yellow or green zone (for moderate or less serious patients respectively) to the concerned department like surgery, neurosurgery, orthopaedics, etc. by 48 hours of their admission for inpatient care, however, it is observed that this shifting usually takes longer time probably due to higher bed occupancy rates in the concerned departments also.

According to World Health Organization (WHO), level of satisfaction is an important measurement where patient care is concerned.<sup>[14]</sup> Present study reported that 78.9% of the patients were satisfied about the services they received from the hospitals. Similar results were seen in other studies by Sharma et al, and Pankaj Kumar et al. from India, where 73% and 78% of the respondents were satisfied with the hospital service.<sup>[15,16]</sup> In the present study, around 9.6% of the patients have reported that the services need to be improved, therefore it would be very useful to analyze their responses, and it would also serve as a better guide for the administration to improve their services.

The present study has few limitations and short span of observation was one of those. Other than this, the design of this study was observational which might not reflect the accurate situation of this trauma care center as OPD patients have not included in our study. Good communication is important factor responsible for patient satisfaction. In this study, 100% of patients received answers or response from the doctors always or sometimes while nearly 88% of them were responded always or sometimes by the nurses. A great deal of satisfaction comes from good soft skill of the health care workers. Studies have shown that good communication from physicians in terms of their attitude, explanation of conditions, level of care, emotional support and involving patients in their decision making were more influential factors compared to the clinical skills and hospital tangibles for patients.<sup>[17]</sup>

#### **Conclusion:**

In the present study, a majority of the patients were satisfied with the services provided in the newly established trauma care centre in the state. Responses from patients revealed several factors on which the hospital needs to focus in order to improve the quality of services, especially in the area of availability of medicines, confidence and trust on the nursing staff and food quality.

#### **Recommendation:**

Findings from this study would enable the hospital authority to identify the gaps in service and prepare new policies in overall management of trauma patients. Moreover, the public satisfaction of a health facility relates to the overall development in the public health centre.

#### Acknowledgement:

The authors are thankful to, then In-charge, Trauma Care Centre of the tertiary care hospital for his kind support for collection of data. The authors are indebted and thankful to the Department of Health Research (DHR), Govt. of India. Authors are also grateful to all the technical staffs of MRU of the hospital for their participation and successful completion of this study.

#### **Declaration:**

Funding: Received from Department of Health Research (DHR), Ministry of Health & Family Welfare, Govt. of India, New Delhi through Multi-disciplinary Research Unit (MRU) of the tertiary care hospital of the state.

#### Conflict of Interest: Nil

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## A Case Control Study of Type 2 Diabetes Mellitus among Patients Attending Medicine Department of Tertiary Care Hospital, Gurugram, Haryana.

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#### Abstract:

**Introduction:** Diabetes Mellitus (DM) is traditionally known as silent disease. Diabetes is no more restricted in urban areas only but is also established at rural areas as well. It is one of the leading cause of long term morbidity and a major health hazard in a developing country like India, therefore, it is pertinent to find its associated risk factors. **Objectives:** To study the clinical presentation and risk factors associated with type-2 diabetes mellitus patients attending SGT hospital. **Method**: It was a hospital based case control study done in medicine department of Tertiary Care Hospital, Gurugramusing the purposive sampling. There were 800 participants including 400 cases of type 2 diabetes mellitus and 400controls (age and gender matched). Information was collected on sociodemographic variables and risk factors using a pre-tested structured interview schedule. **Results:** The mean age among cases was 55.20<u>+</u>8.54 years and among control group was 53.96<u>+</u>9.29 years. The difference between education status and occupation of study subjects was found to be significant. Pain and numbness was the most common symptom which was 70.75%. On assessing risk factors, physical activity, the habit of smoking, family history and Body mass Index (BMI) had a positive association. **Conclusion:** The findings of the study revealed that a high proportion of risk factors such as family history of diabetes, literacy status, occupation, BMI, smoking and physical activity were prevalent in the type 2DM subjects.

Keywords: Body mass Index, Diabetes Mellitus, Sociodemographic, Tertiary care hospital.

#### Introduction:

The American Diabetes Association defines diabetes mellitus as "a group of metabolic diseases characterized by hyperglycemia resulting from defects in insulin secretion, insulin action, or both. The chronic hyperglycemia of diabetes is associated with long-term damage, dysfunction, and failure of various organs, especially the eyes, kidneys, nerves, heart, and blood vessels".<sup>[1]</sup> In 2019, diabetes was the direct cause of 1.5 million deaths and 48% of all deaths due to diabetes occurred before the age of 70 years. Another 460 000 kidney disease deaths were caused by diabetes, and raised blood glucose causes around 20% of cardiovascular deaths.<sup>[2]</sup>

Diabetes is slow in onset, most of the people are asymptomatic and as a result of this 66% remain undiagnosed and this causes a delay in the diagnosis by 8–12 years. The prevalence of diabetes is swiftly increasing over the globe at an alarming rate. According to the International Federation of Diabetes, 415 million adults around the world are suffering from diabetes, and it is estimated that the

Quick Response Code	Access this article online	How to cite this article :
	Website :	KunduM,Singh M, Vaibhav. A Case Control Study of
	www.healthlinejournal.org	Type 2 Diabetes Mellitus among Patients Attending
	DOI :	Medicine Department of Tertiary Care Hospital,
∎P÷359	10.51957/Healthline_550_2023	Gurugram. Haryana. Healthline. 2023; 14 (4): 308-316

numbers will reach around 642 million by 2040.<sup>[3]</sup> In India, an estimated 7.8% of the population above 18 vears of age has raised blood glucose levels or are on treatment for diabetes. Genetic predisposition combined with life style changes, associated with urbanization and globalization, contribute to this rapid rise of diabetes in India. Moreover, type 2 diabetes in the Indian population appears to occur at least a decade earlier compared to Europeans. This means that, in the next 10 - 20 years, productivity of the youth of our country could be seriously affected.<sup>[4]</sup> Type 2 diabetes affects how your body uses sugar (glucose) for energy. It stops the body from using insulin properly, which can lead to high levels of blood sugar if not treated. Over time, type 2 diabetes can cause serious damage to the body, especially nerves and blood vessels. Type 2 diabetes is often preventable. Factors that contribute to developing type 2 diabetes include being overweight, not getting enough exercise, and genetics. Early diagnosis is important to prevent the worst effects of type 2 diabetes. The best way to detect diabetes early is to get regular check-ups and blood tests with a

healthcare provider. Symptoms of type 2 diabetes can be mild. They may take several years to be noticed. Symptoms may be similar to those of type 1 diabetes but are often less marked. As a result, the disease may be diagnosed several years after onset, after complications have already arisen. More than 95% of people with diabetes have type 2 diabetes. Type 2 diabetes was formerly called non-insulin dependent, or adult onset. Until recently, this type of diabetes was seen only in adults but it is now also occurring increasingly frequently in children. Diabetes is an emerging global epidemic and public health problem. In spite of the drastic increase in both the prevalence and incidence of type 2 DM worldwide, they have been especially spectacular in societies with economic transition. Diabetes patients, if not strictly monitored, develop multiple chronic complications leading to irreversible disability and death. Coronary heart disease, lower limb amputation, stroke are more common in diabetics. Micro vascular

complications like diabetic nephropathy and retinopathy are severe health problems resulting in progressive worsening of the quality of life and premature death.<sup>[5]</sup> There are many studies describing natural history and risk factors of type 2DM in different populations, but still there is a paucity of studies conducted in population of Gurugram. Hospital based study would be more appropriate to include larger sample of type 2DM cases as compared to population based study. Hence it was decided to conduct a hospital based case control study to add knowledge in this regard among the population of Gurugram.

In view of the above, this study was conducted to study the clinical presentation of type 2 diabetes patients attending SGT hospital and to find the epidemiological correlates and risk factors associated with type-2 diabetes.

#### Method:

It was a hospital based case control study conducted among patients in SGT hospital. A total of 400 diabetic mellitus type 2(cases) and non-diabetic mellitus type 2(400) controls were recruited during the study period. People with fasting plasma glucose values of e >7.0 mmol/L (126 mg/dl), 2-h post-load plasma glucose e >11.1 mmol/L (200 mg/dl), HbA1c  $\geq$ 6.5% (48 mmol/mol); or a random blood glucose  $\geq$ 11.1 mmol/L (200 mg/ dl) in the presence of signs and symptoms were considered to have diabetes.<sup>[6]</sup>

Total 800 subjects were selected by using purposive sampling technique and divided into two groups i.e., case group (400 subjects) & Control group (400 subjects). Cases were defined as those who are known diagnosed diabetics and age above 18 years, as cases (Type2 Diabetes Mellitus). Controls were defined as those attended to medicine OPD and IPD of "Department of Medicine" SGT medical college Hospital, Gurugram during study period for other problems and with blood sugar levels within normal limits, which were age and gender matched with cases and who was willing to give his/her consent for the participation were included in the study. Person

who was unable to respond to questionnaire by any means (e.g. visual/hearing deficit, mentally unsound) and who did not agree to participate in the study were excluded and Pregnant women and critically ill persons were excluded. Patients who did not match for age and sex with selected cases, having history of cardio-vascular diseases, patients with fasting blood glucose  $\geq$ 126 mg/dl or Random blood glucose level/ Post-prandial glucose  $\geq$ 200mg/dl were excluded from controls.

The subjects were approached individually after ethical permission obtained from the institution of SGT, Gurugram. Hospital authority's permission were taken for data collection from the patients attended to medicine OPD for comparison age and gender matched healthy individuals as a control included in the study. Informed consent was taken from the sample to collect the data and confidentiality of the subjects was maintained. Guidelines of scale items were explained to participants. While queries were encouraged regarding unclear items. Weight in kg and height in cm of the study participants were recorded. Weight was recorded for each participant without shoes and heavy clothing, with standing erect using weighing machine to an accuracy of 0.5 kg using a standard procedure. Height was measured with a measuring tape to the nearest of 0.1 cm, using a standard procedure. Using the weight and height, body mass index (BMI) was calculated in  $Kg/m^2$ , for each subject. Socio demographic details include age, gender, educational status, occupational status, family type, living status, residence, monthly income, anthropometry (BMI) were collected. A predesigned, pre-tested, and semi-structured questionnaire was used for collecting data by personal interview method. The questionnaire included questions on socio-demographic characteristics of the study subjects, anthropometric measurements, physical examination and the socioeconomic status of the study subjects was assessed using Modified B G Prasad socio-economic scale.<sup>[7]</sup> Collected data was first entered in the MS Excel spreadsheet and coded appropriately. The

comparison between cases and controls were analyzed using Pearson's Chi-square test of significance and odds ratio wherever applicable. The level of significance was considered at p< 0.05. All statistical analyses were performed using SPSS software version 21.

#### **Results:**

Table 1 shows that the mean age among cases was  $55.20 \pm 8.54$  years and among control group was 53.96+9.29 years. The age range was 46 (minimum = 33 years, maximum = 79 years). There was no statistical difference between the distribution of age of cases and control. (P = 0.12). The observed similarity among case and controls is because of frequency matching conducted during selection of study subjects. Among all the study participants, 474(59.25%) were males and 326(40.75%) were females. Among (400) cases 68(17%) were illiterate, 231(57.75%) were educated till secondary and senior secondary while 74(18.50%) were graduate and above. Among cases graduate 74(58.74%) were more as compared to control group 52(41.26%). This difference was found to be statistically significant. (P< 0.001). The possible reason behind observed finding may be association between education and income. Higher educated people might be earning more and so living a more urbanized life style. Among all the study participants (800) most of them were unskilled or semiskilled 526(65.75%); while 60(7.5%) were unemployed, 135(16.89%) were retired. Out of 60 unemployed, cases constituted 31(51.66%) and rest 29(48.34%) belonged to control group. Similar distribution was found among those involved in unskilled occupation (314), 173(55.10%) were cases and 141(44.90%) were controls. Out of 212 semiskilled, cases constituted 93(43.86%) and rest 119(56.14%) belonged to control group. Out of 79 skilled occupation, cases were 31(39.24%) and rest 48(60.76%) were control group. Out of 135 retired, cases were 72(53.30%) and controls were 63 (46.67%). The difference in

distribution of cases and controls among different occupation was found to be statistically significant (p=0.02). It was observed that, 308(38.50%) of the study subjects belonged to socio economic class (II), followed by 245(30.62%) socioeconomic class (I), 133(16.62%) in class (III), 81(10.13%) in class (IV) and 33(4.13%) of the subjects belonged to class(V) respectively. Out of 245 class (I), cases constituted 130(53.06%) and rest 115(46.94%) belonged to control group. Out of 308 class (II), cases constituted 155(50.32%) and rest 153(49.68%) belonged to control group. Out of 133 class (III), cases constituted 59(44.36%) and rest 74(55.64%) belonged to control group. Out of 81 class (IV), cases constituted 39(48.15%) and rest 42(51.85%) belonged to control group. Out of 33 class (V), cases constituted 17(51.52%) and rest 16(48.48%) belonged to control group. This difference was found to be

 Table 1: Association between socio-demographic variables among cases and controls(N=800)

Variables	Cases(%)	Control(%)	Total(%)	chi square		
	(n=400)	(n=400)	(n=800)	p value		
Age group (in years)						
30-45	52 (41.94)	72 (58.06)	124 (100)	4.21*		
46-60	189 (50.40)	186 (49.60)	375 (100)	0.12#		
>60	159 (52.82)	142 (47.18)	301 (100)			
Gender						
Male	239 (50.42)	235 (49.57)	474 (100)	0.08*		
Female	161 (49.38)	165 (50.62)	326 (100)	0.77*		
Literacy						
Illiterate	68 (53.54)	59 (46.56)	127 (100)	57.09*		
Primary	27 (20.77)	103 (79.23)	130 (100)	< 0.001 **		
Secondary	126 (51.64)	118 (48.36)	244 (100)			
Higher secondary	105 (60.70)	68 (39.10)	173 (100)			
Graduate	74 (58.74)	52 (41.26)	126 (100)			
Occupation						
Unemployed	31 (51.66)	29 (48.34)	60 (100)	10.77*		
Unskilled	173 (55.10)	141 (44.90)	314 (100)	0.03#		
Semiskilled	93 (43.86)	119 (56.14)	212 (100)			
skilled	31 (39.24)	48(60.76)	79 (100)			
Retired	72 (53.33)	63 (46.67)	135 (100)			
Socio-economic status						
Class I	130 (53.06)	115 (46.94)	245 (100)	2.76*		
Class II	155 (50.32)	153 (49.68)	308 (100)	0.59*		
Class III	59 (44.36)	74 (55.64)	133 (100)			
Class IV	39 (48.15)	42 (51.85)	81 (100)			
Class V	17 (51.52)	16(48.48)	33 (100)			

 $*\chi^2$  value \*p-value, p-value < 0.05 considered as statistically significant

statistically non-significant (p = 0.59). Study population has the similar lifestyle in respect of socioeconomic class.

Figure 1 shows that most of the subjects had multiple symptoms. Pain and numbness was the most common presenting symptom 70.75%. Weakness was second most common symptom 62.50% which was more in <60yrs age group. Intense hunger was 61% and increased thirst was 55.25%. Frequent urination was symptom of approximately half of the subjects (54.50%). Dry mouth (37.25%), headaches (29%), lightheadedness (41.25%), night sweats (43.75%), blurred vision (48.75%) and itching/rash (25.25%) were common symptoms. Other symptoms were like decreased appetite (3.50%), vomiting (1%), abdominal pain (0.50%) and nightmare (5%).

Table 2 shows that habit of smoking was almost double among cases144(66.06%) then control group74(33.94%). This difference was found to be statistically highly significant (p=<0.00001) [OR 2.48,CI(1.79-3.43)]. Habit of drinking alcohol was more among cases 115(54.50%) as compared to control group96(45.49%). This difference was found to be statistically non-significant (p=0.13) [OR 1.28 CI (0.93-1.75)]. The cases may be occasional alcoholics. Among all the study participants (800) only 40(5%) subjects were having habit of tobacco chewing,760(95%) were non tobacco chewers. Among tobacco users 21(52.50%) were control and rest 19(47.50%) were cases. Among non-tobacco chewers 381(50.14%) were cases and rest 379(49.86%) were control. This difference was found to be statistically non-significant (p=0.74) [OR 0.90 CI (0.48-1.7)].



Figure 1: Distribution of cases according to their symptoms (N = 400)

			_	-	-
Risk factors	Response	Cases (n=400)	Controls n=400	chi square	Odds ratio
		(%)	(%)	p value	95% CI
Smoking	Yes	144 (66.06)	74 (33.94)	30.89*	2.48 (1.79-3.43)
	No	256 (43.99)	326 (56.01)	<0.001 <sup>#</sup>	
Alcoholuse	Yes	115 (54.50)	96 (45.49)	2.32*	1.28 (0.93-1.75)
	No	285 (48.38)	304 (51.62)	0.13 <sup>#</sup>	
Tobacco chewing	Yes	19(47.5)	21 (52.5)	0.11*	0.90 (0.48-1.7)
	No	381 (50.14)	379 (49.86)	0.75 <sup>#</sup>	

Table 2: Association between risk factors among cases and controls (N=800)

 ${}^{*}p\text{-value}$  , p-value <0.05 considered as statistically significant, \* $\chi^{2}$  value

Table 3 shows that among all the study participants (800) approximately half of the subjects 424(53%) were doing moderate physical activity, followed by 231(28.88%) who were doing heavy physical activity and 145(18.13%) were involved in light physical activity. Among those involved in light physical activity 85(58.62%) were cases and rest 60(41.38%) were control group. Among those involved in moderate physical activity 245(57.78%) were cases and rest 179(42.22%) were control group. Among those involved in heavy physical activity 70(30.30%) were cases and rest 161(69.70%) were control group. Thus, the proportion of cases is lesser among those with better physical activity and this was found to be statistically significant. (P<0.001). It was found that number of fathers is more than mothers who had history of Type 2 diabetes in this observation similarly males are more affected than females in our study table 3. This difference was found to be statistically significant(P <0.001). Among all the study participants (800), almost half of the subjects 425(51.87%) were overweight and above. Similarly, approximately half of the control group were having normal weight and below 194(48.50%). Out of 83 underweight, 32(38.55%) belonged to cases and rest 51(61.45%)

were control. Out of 302 normal weight, 108(35.76%) belonged to cases and rest 194(64.24%) were control. Out of 310 over weight, 189(60.97%) belonged to cases and rest 121(39.04%) were control. Out of 105 obese, 71(67.62%) belonged to cases and rest 34(32.38%) were control. This difference was found to statistically highly significant (p<0.001)

#### Discussion:

In the present study, the mean age of the cases (diabetic type 2, N=400) was 55.20 years (SD 8.54). Out of 400 cases (diabetic type 2), 189(47.25%) were in 45-60 age group, 159(39.75%) in >60yrs and 52(13%) in 30-45 age group. Similarly out of 400 controls, 186(46.50%) were in 45-60 age group, 142(35.50%) in >60yrs and 72(18%) in 30-45 age group. This finding is comparable with that reported in the study done by Jain S K et al<sup>[8]</sup> where reported mean age of cases was 54 years ± 12.30. Similarly in another hospital based study conducted in Rajasthan ,majority of the diabetic patients (96.0%) were aged more than equal to 30 years.<sup>[9]</sup> However, in a community based study conducted by Kundaswamy et al<sup>[10]</sup> in Puducherry, the mean age group among diabetics was 52.49±9.72 and majority belonged to 40-49 years.

Parameters	Classification	Cases n=400	Controls n=400	chi square
		(%)	(%)	p value
Physical Activity	Light	85 (58.62)	60 (41.38)	50.43*
	Moderate	245 (57.78)	179 (42.22)	<0.001#
	Неаvy	70 (30.30)	161 (69.70)	
Family History	Only father	90 (78.26)	25 (21.74)	212.84*
	Only mother	82 (82.82)	17 (17.18)	<0.001#
	Both Parents	43(93.48)	3 (6.52)	
	No history	155 (30.57)	352 (69.43)	
	Cousin	30 (90.90)	3 (9.10)	
BMI	Underweight	32 (38.55)	51 (61.45)	56.79*
	Normal	108 (35.76)	194 (64.24)	<0.001#
	Overweight	189 (60.97)	121 (39.04)	
	Obese	71 (67.62)	34 (32.38)	

Table 3: Association between different parameters among cases and controls (N=800)

# p-value <0.05 = statistically significant,  $*\chi^2$  value

In the present study out of (400, diabetic type 2) study subjects the proportion of 239(59.75%) male were more than 161 (40.25%) female. This finding is comparable with study conducted by Patel M et al<sup>[11]</sup> who reported that out of the 622 subjects, 384 (62%) were male and rest 238(38%) were female. Similarly in the study conducted by Balakrishnan Valliyot et al<sup>[12]</sup>, it was found that that diabetes is common among males than females. In the study Grover et al (2005)<sup>[13]</sup> showed a significant correlation between diabetes and educational status in India which is similar to the above study. In the present study, the difference in distribution of cases and controls among different occupation was found to be statistically significant (p=0.02). Reason for higher diabetics among unskilled study subjects may be higher possibility of drug abuse (e.g. alcohol, smoking) or high carbohydrate diet. In the National Urban Diabetic Survey (NUDS) an increased prevalence of diabetes was noticed among the retired and unemployed.<sup>[14]</sup>

In the present study, most of the subjects had multiple symptoms. Pain and numbness was the

most common symptom which was 70.75%. Weakness was second most common symptom 62.50%. Frequent urination was symptom of approximately half of the subjects followed by other common symptoms. This finding is comparable to the study done by Mayega RW et al<sup>[15]</sup> where two clinical symptoms were present in almost all new patients: Frequent urination (100%) and frequent thirst (79%). This finding is comparable with that reported in the study by Patel M et al<sup>[11]</sup> in which it was found that that out of the 622 subjects, 273 (44%) had nocturia, 192 (31%) had polyuria, and 145 (23%) had polydypsia. However, 57 (9%) subjects presented with vision impairment. The proportion of cases is lesser among those with better physical activity and this was found to be statistically significant (P<0.001). Similar findings of significance of association of DM with physical activity were reported by studies done by Ramachandran A et al<sup>[16]</sup> and Majgi SM et al<sup>[17]</sup> who reported prevalence of diabetes decreased significantly as the physical activity level increased. In the present study, habit of smoking was almost double among cases 144(66.06%) than control group 74(33.94%). This

difference was found to be statistically highly significant (p<0.001) and odds ratio 2.48, CI 95% (1.79-3.43). In a study done by MA Rahim et al<sup>[18]</sup>, almost 13% of newly detected diabetic patients were smokers in this study and this rate was over 25% for those having diabetic nephropathy.

In the present study, out of 400 cases, 155(38.75%) had no family history of Type II DM, 90(22.50%) had history of Type II DM in father, 82(20.50%) had history of Type II DM in mother, 43(10.75%) had history of Type II DM in both parents and 30(7.50%) had history of Type II DM in cousins. Out of total 400 controls, 352(88%) had no history of Type II DM, 25(6.25%) had history of Type II DM in father, 17(4.25%) had history of Type II DM in mother, 3(0.75%) had history of Type II DM in both parents and 3(0.75%) had history of Type II DM in cousins. This difference was found to statistically significant.(P <0.001) In a study conducted by Patel M et al <sup>[12]</sup> found that out of the 622 subjects 67% had a positive family history of diabetes Sanjay D Bhalerao et al., 2014 reported that the odds of diabetes among those with family history of T2DM (in terms of parental history) were 35.97 times as compared to those without a family history of T2DM.<sup>[19]</sup>

It was found in the present study that diabetes was higher in the subjects who were overweight and obese. This difference was found to statistically highly significant(p < 0.001). This study is comparable with study done by Patel M et al<sup>[11]</sup> found that out of the 622 subjects, the majority (68%) of the T2DM subjects were obese. Similar findings were reported by many studies. In a case control study conducted by A. Awasthi et al<sup>[20]</sup> in South India, the proportion of cases with Body Mass Index (BMI) e" 25 kg/m<sup>2</sup> was 55% as compared to 22% of controls and this asso-ciation was statistically significant (p <0.05).Similarly, Ramchandran A et al<sup>[16]</sup> and Sumanth MM et al<sup>[17]</sup> studies reported independent predictor nature of BMI for development of diabetes. Hence early identification of high BMI, would give opportunity for primary prevention and early diagnosis of the diabetes. Also, it would suggest that Indians, especially, have to maintain lower BMI to prevent diabetes.

#### **Study Limitations:**

A key limitation of this study was the sample size estimation which was based on the convenience sampling that is selecting study participants who were easily accessible at the time of study.

#### **Conclusion:**

The difference between education status and occupation of study subjects was found to be significant. Pain and numbness was the most common symptom which was 70.75% followed by weakness (62.50%), intense hunger(61%), increased thirst (55.25%) and frequent urination (54.40%). On assessing risk factors, physical inactivity, the habit of smoking, family history of diabetes and Body mass Index (BMI) had a positive association.

#### **Recommendations:**

Simple steps such as awareness will increase the knowledge of Diabetes among care givers. Health education regarding diabetes should be provided to improve knowledge and to bring about positive attitude. Education programs for improvement in modification of life styles may be done by providing leaflets on prevention of complications of diabetes which include activities like aerobic exercise, gardening, mopping etc. Quality physical education supports children to develop behaviour patterns that will keep them physically active throughout their lives. Recreation facilities and sports provide opportunities for everyone to keep physically active. IEC (Information Education and Communication) /BCC (Behaviour change communication) should be developed particularly in rural areas/among less educated/unemployed or unskilled persons in terms of campaigns on diabetes.

#### **Declaration:**

Funding: None

Conflict of interest: None

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## Impact of Domestic Environment & Personal Hygiene on Morbidity Pattern and Health Status of Children: A Community Based Cross Sectional Study in Surendranagar City. Dhara V. Thakrar<sup>1</sup>, Mohnish N. Tundia<sup>1</sup>, Kishor Sochaliya<sup>2</sup>, Priya Dabhi<sup>3</sup>

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#### Abstract:

Introduction: Children are more vulnerable than adults to environmental risks, both physical and psychosocial, because of factors related to the development and growing up. Comprehensive risk assessments suggest a cluster of environmental hazards, many of which may concur in the places where children dwell, play and learn. With this background, current study can help to improve hygiene practices and thereby health of children. Objectives: To find the prevalence of various childhood morbidities and to assess the relationship of personal hygiene and domestic environmental factors with childhood its morbidity pattern and health status. Method: A cross sectional study was carried out in Surendranagar, including 210 children (5 to 14 years) selected by cluster sampling method. Results: Prevalence of morbidity among children was 82.38%. About 89% of students brushed their teeth once/day; for brushing, 70% used toothbrush and 97% used toothpaste. Majority (84%) of participants were taking bath daily while only 48% were using soap daily for bathing. Hygiene score was more in normal weight individuals as compared underweight and overweight participants and this difference was statistically significant. (p=0.00001) Various domestic environmental factors like type of house (p=0.03), presence of exhaust fan/window in kitchen (p=0.003) drinking water facility (p=0.02), size of house (p=0.02), cross ventilation (p=0.0003) and mosquito presence (p=0.007) were all significantly associated with presence of morbidity. Conclusion: The results of the present study confirm that there is great effect of personal hygiene practices and domestic environmental factors on morbidity pattern of children.

Keywords: Children, Domestic environment, Morbidity Rearrange, Personal Hygiene

#### Introduction:

Children are more vulnerable than adults to environmental risks, both physical and psychosocial, because of factors related to the development and growing up. Moreover, children have little control over their physical and social environment. Comprehensive risk assessments suggest a cluster of environmental hazards, many of which may concur in the places where children dwell, play and learn.  $^{\scriptscriptstyle [1]}$ 

A child's world centres around the home, school and the local community. These should be healthy places where children can thrive, protected from disease. But in reality, these places are often so unhealthy that they underlie the majority of deaths and a huge burden of disease among children in the developing world. In 2020, an estimated 8, 69,000

Quick Response Code	Access this article online	How to cite this article :
	<b>Website :</b> www.healthlinejournal.org	Thakrar D, Tundia M, Sochaliya K, Dabhi P. Impact of Domestic Environment & Personal Hygiene on morbidity pattern and health status of children: A
	<b>DOI :</b> 10.51957/Healthline_563_2023	community based cross sectional study in Surendranagar city. Healthline. 2023; 14 (4): 317-324

older children and young adolescents (5 to 14 years) died in linked to the environments in which they live, learn and play. Many children are born at home, and spend a major part of their young lives there. But from conception, their health may be adversely affected by hazards in the home such as lack of sufficient water, indoor air pollution, inadequate hygiene, contaminated food and water etc. <sup>[2]</sup>

Infection and malnutrition form a vicious circle and hamper children's physical development and cognitive performance, which compromise children's attendance and performance at school. Majority of the childhood diseases can be preventable by promotion of hygienic practices at school and home through proper health education.<sup>[3]</sup>

To the best of our knowledge there are very few studies taking into account the impact of domestic environment & personal hygiene on morbidity pattern and health status of children. Most of these studies used unrepresentative samples and measured only conventional socioeconomic variables, which led to mixed results. So, it is critical to generate information which can assist in developing programs in these regards. With this background, current study can help to improve hygiene practices and thereby health of children. It will also guide in policy making and interventions aimed at impact of domestic environment on health of children.

#### **Objectives:**

- Assessment of hygiene practices and domestic environment among children of 5-14 years of age-group in Surendranagar city.
- To find the prevalence of various childhood morbidity among children of 5-14 years of agegroup.
- 3) To assess the relationship of personal hygiene with its morbidity pattern and health status.
- To assess the relationship of domestic environment with its morbidity pattern and health status.

#### Method:

A cross sectional study was conducted in Surendranagar city. After obtaining permission from Ethical committee, C. U. Shah Medical College to conduct the study, data collection was started. Parents/ guardians of Children participating in this study were approached for verbal informed consent. Those who found with faulty hygienic practices were corrected after interview with proper education regarding correct hygienic practices.

Study period: November 2022 to January 2023.

**Study Subjects:** The study population included children aged 5 to 14 years who were permanent residents of the area and ready to be part of our study. Informed consents were taken from guardians. Parents/guardians were communicated for information. Those not willing to participate in the study, intellectually disable, not able to respond to interview due to illness were excluded from the study.

**Pilot study:** Carried out by personal interview of 25 subjects sharing same Socio-demographic and geographic conditions

Sampling technique: Cluster sampling method

Study tool: A pre formed, pre tested semi-structured questionnaire was used in this study. This questionnaire was filled up by investigator. Hygiene practice was assessed by a Likert scale, which contained 14 questions. Main variables of which were oral hygiene, hand washing, bathing practices, hand dipping while drawing drinking water, covering face while coughing and sneezing, trimming finger and toe nails, cleaning eyes and nostrils, washing hands and feet after returning home, wearing clean cloths, wearing slippers while going outside. Each question had three options, i.e. never, sometimes, and always. During the analysis, scores were given such as never – 0, sometimes – 1, and always – 2. Hence, the minimum score of the scale could be 0 and maximum could be 28.

Data collection: For data collection, 30 by 7 cluster sampling technique was used (developed by WHO) to reach final sample size of 210. The list was obtained from the Nagarpalika office. There were total 85 societies under Nagar palika. Here we consider one society as a one cluster. Total 210 children who are between age-group of 5-14 years were selected from 30 societies (7 children/society).<sup>[4]</sup> To get better representativeness, selection of children was done by dividing each cluster was into 4 quadrants. From 3 quadrants, 2 children were selected and from remaining 1 quadrant 1 child was selected. For multiple rows society random sampling was used for selection of children. In case of no child in house or unwillingness for participation in study, child was selected from next house.

**Case definition of morbidity:** In current study morbidity was considered as any common diseases or illness or symptoms of disease like fever, upper respiratory tract infection (URTI), diarrhea/ dysentery, dental caries, skin disease, eye infection, ear infection, louse infestation, pallor and worm infestation in last 3 months from the date of interview in children.

**Nutritional status**: It was assessed using BMI for age percentile based on CDC growth charts for children and teens.<sup>[5]</sup>

**Statistical analysis:** Data entry and analysis were done using MS excel and epi info version 7.2.5.0. Chi-square, Mann Whitney U test, Kruskal wallis test and Binary logistic regression were used to find out association.

#### **Results:**

The average age of the study participants was 8.7  $\pm$  2.93 years (mean  $\pm$  SD). More than half of the participants were female (53.81%). More than one third participants were from general caste (40.48%). Around 30% of mothers of participants were educated up to primary level while only around 10% of mothers were graduated. Almost half (48.10%) of the mothers of participants were working as a housewife. Two thirds of the participants were belonging to middle socio economic class (62.38%) (Table 1)

Table 1: Socio demographic profile of study
participants (N=210)

		•
Variables	Frequency	Percentage (%)
Age in years		
5	38	18.09
6	24	11.43
7	31	14.76
8	21	10.00
9	13	6.19
10	16	7.62
11	12	5.71
12	25	11.90
13	21	10.00
14	09	4.29
Meanage	8.7 <u>+</u> 2.93 y	ears
Gender		
Male	97	46.19
Female	113	53.81
Caste		
General	85	40.48
Other	125	59.52
Mother's educatio	n	-
Illiterate	38	18.10
Primary	63	30.00
Secondary	52	24.76
Higher Secondary	35	16.67
Graduate	17	08.09
Postgraduate	05	02.38
Mother's Occupati	on	
House wife	101	48.10
working	109	51.90
Socio economic cla	ass <sup>#</sup>	
Upper class	09	4.29
Upper middle	19	9.05
Middle	131	62.38
Lower middle	41	19.52
lower	10	4.76

<sup>#</sup> as per modified Prasad classification

About 89% of students brushed their teeth once/day; for brushing, 70% used toothbrush and 97% used toothpaste. Majority (84%) of participants were taking bath daily while only 48% were using soap daily for bathing. Around two third of the participants were never covered their face while coughing and sneezing. One third of the participants were not washing hands and feet after returning home. More than half (57.14%) of the participants were wearing slippers always while going outside. (Table 2)

Table 2: Distribution of study participant	s accor	ding
to practice of personal hygiene (	N=210)	)

Variables	Frequency	Percentage			
Brushing frequency per day					
Once	186	88.57			
twice	24	11.42			
Hand washing before e	ating with s	oap water			
Never	15	07.14			
Sometimes	58	27.62			
Always	137	65.24			
Hand washing after def	fecation witl	n soap water			
Never	07	03.33			
Sometimes	16	07.62			
Always	187	89.05			
Taking bath					
Daily	176	83.81			
Alternate day	25	11.90			
Bi weekly	09	04.29			
Trimming finger and to	oe nails				
Regularly	138	65.71			
Irregularly	72	34.29			
Cleaning eyes and nost	rils				
Regularly	148	70.48			
Irregularly	62	29.52			
Wearing clean cloths	Wearing clean cloths				
Yes	162	77.14			
No	48	22.86			

#### Figure 1: Prevalence of morbidity (N =210)



In present study prevalence of morbidity among children in last three months was 82.38%. (Figure 1) Figure2: Distribution of child according to type of morbidity within last three months





Almost half of the participants were suffered from Diarrhea/Dysentery followed by one third of participants were having fever and upper respiratory tract infection within last three months. Dental caries, skin disease, eye infection and ear infection (13.87%, 12.72%, 9.83% and 7.51%) were also reported from participants. Only few participants had complained of worm infestation. (2.89%) (Figure 2)

#### Table 3:Association of hygiene score with morbidity and Nutritional status (N=210)

Variables	Mean hygiene score <u>+</u> SD	Statistical test	p value
Morbidity			
Yes (n=173)	20.33 <u>+</u> 2.96	Mann Whitney U test	< 0.001
No (n=37)	22.79 <u>+</u> 2.21	U=2030	
Nutritional status according to BM	II		
Normal Weight (n=121)	22.08 <u>+</u> 3.14	Kruskal-Wallis test	< 0.001
Underweight (n=55)	17.66 <u>+</u> 3.57	H=47.1168	
Overweight(n=34)	21.09 <u>+</u> 3.82		

Domestic environmental factors	Morb	Morbidity		
	Present	Absent		
	n (%)	n (%)		
Type of house			·	
Pucca	115 (78.76)	31 (21.23)	0.03	
Semipucca/kaccha	58 (90.62)	06 (09.38)		
Floor type	- <b>I</b>	•	-	
Mud	27 (93.10)	02 (06.90)	0.1	
Concrete	146 (80.66)	35 (19.34)		
Separate kitchen	I	l	I	
Yes	118 (81.37)	27 (18.63)	0.56	
No	55 (84.61)	10 (15.39)		
Fuel			•	
LPG	129 (81.13)	30 (18.87)	0.56	
Domestic Chula/Kerosene stove	19 (90.47)	02 (9.53)		
Electrical chula	25 (83.33)	05 (16.67)		
Exhaust fan/window in kitchen (n=	145)	•	•	
Yes	39 (69.64)	17 (30.36)	< 0.001	
No	79 (88.76)	10 (11.24)		
Household drinking water	·	•	•	
Piped	32 (71.11)	13 (28.89)	0.02	
Other	141 (85.45)	24 (14.55)		
Overcrowding in house				
Yes	129 (86.00)	21 (14.00)	0.02	
No	44 (73.33)	16 (26.67)		
Cross Ventilation		•		
Present	42 (67.74)	20 (32.26)	< 0.001	
Absent	131 (88.51)	17 (11.49)		
Toilet facility				
Available	150 (81.08)	35 (18.92)	0.17	
Not available	23 (92.00)	02 (8.00)		
Presence of mosquito in house	·	•	·	
Yes	135 (86.53)	21 (13.47)	< 0.001	
No	38 (70.37)	16 (29.63)		
Smoking by other family member i	n house			
Yes	128 (87.67)	18 (12.33)	0.002	
No	45 (70.31)	19 (29.69)		

## Table 4: Association of various domestic environmental factors with morbidity status of children (N=210)

Variables	SE	Coefficient	Odds Ratio	95% CI	P value
Gender	0.4134	-0.2157	0.806	0.3585-1.8124	0.6019
Mother's Education	0.7674	-0.6966	0.4983	0.1107-2.2423	0.364
Mother's Occupation	0.4249	1.1815	3.2593	1.4172-7.4961	< 0.001
Socio Economic status	0.3347	-1.1973	0.302	0.1567, 0.5821	< 0.001
Hygiene score	0.083	-0.3312	0.7181	0.6102-0.8450	< 0.001

# Table 5: Binary logistic regression showing association between different factors and presence of morbidity among children (N=210)

Children who suffered from any type of morbidity had less hygiene score than who had no morbidity in the last 3 months and this difference was statistically significant (p<0.001) Hygiene score was more in normal weight individuals as compared under weight and overweight participants and this difference was statistically highly significant. (p<0.001) (Table 3)

Various domestic environmental factors like type of house(p=0.03), presence of exhaust fan/window in kitchen(p=0.003) drinking water facility(p=0.02), size of house(p=0.02), cross ventilation(p<0.001) and mosquito presence(p<0.001) were all significantly associated with presence of morbidity in children. (Table 4)

Finally, binary logistic regression showed that the mother's occupation, hygiene score, and socio economic class were significantly related to the presence of morbidity while considering the effect of confounders. (Table 5)

#### Discussion:

The present study was conducted in urban areas of Surendranagar city among 5-14 years of children. Morbidity pattern of the children was assessed by history only. Authors did not performed any clinical examination or any invasive laboratory investigations.

Mean age of participants were 8.7  $\pm$  2.93 years (mean  $\pm$  SD) in this study. The result of our study was nearer to study from West Bengal (7.4  $\pm$  1.73 years) and from Spain (9.9  $\pm$  0.27).<sup>[6,7]</sup> Regarding Educational status of mothers our study observed that one third

of mothers (30%) were educated up to primary level followed by secondary (25%) and higher secondary (17%) level, majority of mothers had completed high school education (23.64%); 17.73% had studied up to primary school in study from Meghalaya.Two third of participants were belonging to middle class in present study while study carried out from Meghalaya stated that three fourth participants were belonging to middle class.<sup>[8]</sup> Only 27% of mothers were employed in study from Maharashtra while it was almost 52% in present study.<sup>[9]</sup> The differences in socio-demographic profiles might be due to different study areas, sample size, availability of opportunities and various cultural practices.

Overall, 89% of children brushed their teeth once per day in present study. Similar result was observed from the study done in Warangal district of Telangana while lower performance was seen from study conducted in North Chennai and Mumbai.<sup>[9-11]</sup> Almost 70% of children were using toothbrush and around 90% used toothpaste as a brushing material in present study which was lower than study conducted by Ansari SY et al. and Hegde AM et al.<sup>[9,12]</sup> Only two third of participants used to wash their hands before eating while around 90% of participants were washing their hand after defecation which was much higher from study conducted in rural coal-field area in West Benga.<sup>[6]</sup> Nearly 100% of participants were washing their hand before eating and after defecation in study by Ansari SY et al.<sup>[9]</sup> A Study conducted from Warangal district showed that all (100%) participants were taking bath regularly while around 84% of participants were taking bath daily in present
study.<sup>[10]</sup> Similar result to ours study was found from study conducted in North Chennai.<sup>[11]</sup> The reason for this differences might bedue to study area of present study which was conducted in urban areas of Surendranagar city so practices were better as compared to study conducted in rural areas

Prevalence of morbidity was found 82.38% in present study while it was 29.2% in study by Maji B et al. from West Bengal and 74.04% by Sarkar M et al. from Kolkata.<sup>[6, 13]</sup> The reason for higher prevalence in this study was that authors had consider 3 month past history for morbidity while it was only last 15 days history in other studies. A study from Kolkata reported the most common morbidity was diarrhea, followed by fever with or without cough / cold which was similar to our study.<sup>[13]</sup> In contrast to current study, skin diseases and dental carries were most common morbidities among study conducted from West Bengal.<sup>[6]</sup> Though the prevalence of skin diseases and dental carries were almost similar in our study but they were not most common morbidities in our study. Personal hygiene was significantly associated with malnutrion and prevalence of morbidity in present study and the findings were comparable to study conducted by Maji Betal.<sup>[6]</sup>

In present study, socio economic class and mother's occupation were significantly associated with the morbidity status While study from west Bengal had showed the significant association of morbidity status with gender, class, caste, mother's education, and occupation.<sup>[6]</sup> Various domestic environmental factors like type of house, presence of exhaust fan/window in kitchen, drinking water facility, size of house, cross ventilation and mosquito presence were all significantly associated with presence of morbidity in this study while study from rural Nepal showed significant association with availability of toilet facility.<sup>[14]</sup>

## **Conclusion:**

Our study provides new evidence on the relationship among various morbidity, domestic

environmental factors and the personal hygiene practices of children. The practice of personal hygiene in present study was of moderate level. The domestic environment of household of children was up to the mark. The results of the present study confirm that there is great effect of personal hygiene practices and domestic environmental factors on morbidity pattern of children. Socio economic status and Mother's occupation also played an important role in determining the morbidity status of the children. Personal hygiene status had direct effect on nutritional status of children in current study.

#### **Recommendation:**

Majority of the childhood morbidities are preventable by promotion of hygienic practices. An improvement in domestic environmental factors through proper health education can also be helpful. Data of present study can be used for the development of new strategies like weekly session of personal hygiene at school, community based education of parents, peer education etc. which is of great importance to decrease the burden of communicable diseases in developing countries like India.

#### **Declaration:**

Funding: Nil

## Conflict of Interest: Nil

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## Epidemiological Profileof Children with Malnutrition at Child Malnutrition Treatment Center (CMTC)in Saurashtra Region

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## Abstract:

Introduction: Adequate Nutrition is important for optimum growth, immunity, neurological and cognitive development of the child. Malnutrition leads to illness and mortality among under 5 children. Nearly 40% under 5 children are malnourished in Gujarat despite many nutritional programmes. **Objectives:** To assess the epidemiological factors of malnourished children at Child Malnutrition Treatment Centre (CMTC) and to find outthe association between epidemiological factors and nutritional status of study participants. Method: A cross-sectional study was conducted on Children admitted at CMTC at Narayan Nagar Urban Health Center, the only one and newly established CMTC in Rajkot city in year 2015. Study duration was 14 months. Interview of mothers of 120 children was conducted to know epidemiological factors of malnourished children. Weight on admission was noted from register. Pre-formed, semi-structured proforma used. **Results:** Out of 120 children, 5.8%, 55.8%, 34.2% and 4.2% were from <1, 1-3, 3-5 and >5 year age groups respectively. Nearly 40% children belonged to Socioeconomic Class IV. The proportion of Low Birth Weight children was 40%. Current feeding practice was appropriate in 10.8% children according to IMNCI guideline. Upper Respiratory Tract Infection occurred in 76.7% children with average 4.5 episodes. High birth order of children is statistically significant with severity of malnutrition. Birth weight and feeding practices of children were not associated with grade of malnutrition. Conclusion: Need based education of mothers for preventing low birth weight, exclusive breastfeeding, complementary feeding, quantity and type of routine diet etc. should be given.

Keywords: Child Malnutrition Treatment Center, Low Birth Weight, Malnutrition

## Introduction:

Nutrition is an input to and a foundation for health and development.<sup>[1]</sup> Adequate nutrition is essential for ensuring healthy growth, proper organ formation and function, a strong immune system and neurological and cognitive development in early childhood. Malnutrition during childhood impacts cognitive function and contributes to poverty by impeding individuals ability to lead productive lives.<sup>[2]</sup>

Nutrition of the children between 1 to 6 years of age is of prime importance as they are most vulnerable to deficiencies or malnutrition.<sup>[1]</sup> An estimated 40% of worlds severely malnourished

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	<b>Website :</b> www.healthlinejournal.org	How to cite this article: Jahangirporia D, Amin C, Kadri A. Epidemiological Profile of Children with Malnutrition at
	<b>DOI :</b> 10.51957/Healthline_564_2023	Saurashtra Region. Healthline.2023;14 (4): 325-331

Epidemiology of malnourished children at CMTC...

under-5 children live in India and one in every 3 malnourished children in the world lives in India.<sup>[3]</sup> As per National Family Health Survey-V (year 2019-20), 35.5% of children under 5 years of age are stunted, 32.1% are underweight and 19.3% are wasted. Among them, 7.7% children are severely wasted in India.<sup>[4]</sup>And in Gujarat, 39.0% of children under 5 years of age are stunted, 39.7% are underweight and 25.1% are wasted. Among them, 10.6% children are severely wasted.<sup>[5]</sup>

Protein Energy Malnutrition (PEM) remains an important public health problem in all the states of India even after nearly sixty five years of independence.<sup>[1]</sup> Children with PEM are at an increased risk of mortality and often require intensive feeding in a hospital or clinic.<sup>[6]</sup> Maternal and child under nutrition contributes to more than one third of child deaths.<sup>[7]</sup>

Lack of food is not the sole cause of malnutrition. There are many socio-demographic factors which seem to be important contributory factors in determining the nutritional status of children.<sup>[1]</sup>

Two important interventions by the Government to improve nutritional status of children are Integrated Child Development Services (ICDS) and Gujarat State Nutrition Mission (GSNM). GSNM was launched on 18<sup>th</sup> September 2012 with an aim to combat malnutrition across the state. In this initiative, there is a three tier approach for the management of malnourished children.<sup>[8]</sup> Child Malnutrition Treatment Center (CMTC) is the second level Institutional care for inpatient management and treatment of severely malnourished children with complications at CHCs.<sup>[9]</sup>

Rajkot is the 35<sup>th</sup>- largest metropolitan area in India, with a population of more than 2 million as of 2021.<sup>[10]</sup> According to Census 2011, the total population of Rajkot city is 12, 86,678. Total children between 0-6 years are 1,38,052 in Rajkot city so the children forms 10.73% of total population of Rajkot City.<sup>[11]</sup> There was only 1 functional CMTC in Rajkot Municipal Corporation area in year 2015 which was situated at Narayan Nagar Urban Health Centre. All malnourished children of <6 years of Rajkot city who needed admission were admitted there for treatment. So the study was conducted with the objectives to assess the epidemiological factors of malnourished children admitted at CMTC and to correlate various epidemiological factors with nutritional status.

## Method:

The Cross-sectional study was conducted on malnourished Children of 0-6 years of age admitted at CMTC, Narayan Nagar Urban Health Center, Rajkot city. Data collection period was from May 2015 to May 2016. All malnourished children fulfilling the inclusion/exclusion criteria were included. Total number of malnourished children who attended CMTC was 120 during entire study period. The convenience sampling technique was used.

Inclusion criteria were the children between 0-6 years of age, newly admitted children in the study period and the children who had failed the appetite test and stayed for 14 days at the center. Written consent of the guardian was taken at the time of interview. Children whose guardian didnt give consent were excluded. Guardian were mostly mothers and in some case grandmothers also.

Pre-designed, pre-tested, semi-structured questionnaire was used for primary data collection by oral interview of guardian. Questionnaire included information regarding childrens sociodemographic profile, information regarding birth history; breast feeding history; diet history before admission; immunization status; history of past illness since last 6 months of admission and history of utilization of ICDS services by admitted children.

Guardians were asked about current feeding practices of children. The appropriateness of current feeding practices assessed based on IMNCI feeding recommendations from Chart booklet. For Socio-

Table 1: Socio-demographic profile of Study

economic classification, Modified Prasads classification for May 2015 of Rajkot city was used. Its calculation is based on Consumer Price Index (CPI). It was 248 for Rajkot city in May 2015 i.e. starting month of study.<sup>[12]</sup> Secondary data were collected from the registers maintained at the center which included weight of children on admission and grade of malnutrition.

The data entry was done in Microsoft Office Excel 2007 and analysis was done using both- the Microsoft Office Excel and Epi info software 7. The final study protocol was approved by the Institutional Ethics Committee of P.D.U. Government Medical College, Rajkot. Permission from Medical Officer of Health of Rajkot Municipal Corporation was obtained before starting the study.

Chi-square test was applied for association of Epidemiological factors with malnutrition status.

## **Results:**

## **Education and Occupation:**

Out of 120 studied children, fathers of 20 (16.7%) children were illiterate. Mothers of 15 (12.5%) children were illiterate.Primary school education was found in 59 (49.2%) childrens mothers. Out of total studied, 69 (57.5%) childrens fathers were labourers and 2 (1.7%) childrens fathers were unemployed. Mothers of 109 (90.8%) children were housewives and 9 (7.5%) childrens mothers were working as housemaids.

## **Birth history:**

There was hospital delivery in case of 108 (90.0%) children. Out of 120 children, 48 (40.0%) children were low birth weight (LBW) and 7 children had birth weight of more than 4 kg. Birth weight  $\geq$ 2.5 to 4 kg was considered as normal birth weight. According to Abubakari et al<sup>[13]</sup> weight was classified as Normal birth weight  $\geq$ 2.5 to <4, Low birth weight (<2.5 kg) and Too heavy ( $\geq$ 4kg). Out of 48 low birth weight studied children, 16 (33.3%) children born before 37 weeks of gestation. Out of total studied children, 53 (44.2%) children were having first birth

participants (N=120)	
Socio-demographic variable	n (%)
Age groups (Years)	
<1	07 (05.8)
1-3	67 (55.8)
3-5	41 (34.2)
> 5	5 (04.2)
Gender	
Male	52 (43.3)
Female	68 (56.7)
Area of Residence	
Slum	76 (63.3)
Non-slum	44 (36.7)
Religion	
Hindu	94 (78.3)
Muslim	26 (21.7)
Caste	
General	35 (29.2)
Socially and Economically	69 (57.5)
Backward Class (SEBC)	
Scheduled Caste (SC)	16 (13.3)
Type of family	
Nuclear family	55 (45.8)
Joint family	02 (01.7)
Three generation family	63 (52.5)
Total family members	
Up to 5 members	67 (55.8)
6-10 members	47 (39.2)
>10 members	06 (05.0)
Socio-economic class (n=119)*#	
Class I	02 (01.7)
Class II	10 (08.4)
Class III	35 (29.4)
Class IV	48 (40.3)
Class V	24 (20.2)

(\*1 guardian did not know the family income) # as per modified B G Prasad classification

Participants (N=120)	)
Variables	n (%)
Breastfeeding given (N=120)	
Yes	116 (96.7)
No	04(03.3)
Initiation of breastfeeding (n=48)*	¢
Initiation within an hour	13 (27.1)
Initiation after one hour	35 (72.9)
Exclusive breastfeeding (n=48)*	
Yes	27 (56.3)
No	21(43.7)
Age of initiation of Complementary	7
feeding (n=47)*#	
Initiated immediately after 6 months	33 (70.2)
Delayed initiation	14 (29.8)
Appropriateness of complementar	y
feeding (n=47)*#	
Appropriate	20 (42.6)
Inappropriate	27 (57.4)
Duration of breastfeeding	
(2-6 year group) (n=62)	
<6 months	02 (03.2)
6-12 months	08(12.9)
12-24 months	35 (56.5)
Continued after 24 months	17 (27.4)
Current feeding practices before	
admission (n=120)	
Appropriate and adequate to age	13 (10.8)
Inappropriate and inadequate to age	107 (89.2)

Table 2: Breastfeeding history of Study Participants (N=120)

(\*For babies <2 year of age, †Breastfeeding was stopped before 4 months in 1 child.)

order and 19 (15.8%) children were having third or more than third birth order. Out of 61 studied children who had  $\geq 2^{nd}$  birth order and whose data on preceding birth interval available, 4 (6.6%) children had birth interval of <1 year, 76 (63.3%) children had birth interval of 1-2 years and 45 (73.8%) children had preceding birth interval >2 years. Out of total, 51 (42.5%) children had 1 sibling and 7 (5.8%) children had more than 2 siblings.

Out of total studied, 102 (85.0%) children were completely immunized to age. Any kind of past illness within last 6 months before admission was present in 114 (95.0%) children.

Out of total studied children, 108 (90.0%) children were registered at Anganwadi Centers and out of those registered, 95 (88.0%) children had utilized the services regularly. Annaprashan was given to 10 (22.7%) children out of 44 registered children of less than 2 years of age.

Out of total 120 participants, 75 children belonged to 0-3 year age group. Out of them more than half i.e., 40 (53.3%) children were moderately malnourished and 35 (46.7%) children were severely malnourished. and 45 children were from 3-6 years age group. Out of total 120 participants, 45 children belonged to 3-6 year age group. Out of them, 27 (60.0%) children were moderately malnourished and 18 (40.0%) children were severely malnourished.

#### **Discussion:**

In this study, majority 55.8% children belonged to toddler age group. Similar findings are observed in Ahmad et al<sup>[14]</sup> in which majority 49.6% children belonged to toddlers which was conducted at tertiary care center. Less number of toddlers in that area as compared to present area may be the reason for difference in proportion. In this study, 56.7% children were females and in study by Ahmad et al<sup>[14]</sup> 37.8%. which was conducted in a city of Uttar Pradesh. Reason for that may be that a high number of male proportion in that area. In present study, 40.3% children belonged to Socio-economic Class IV and only 2 children belonged to Socio-economic class I. In study by Ahmad et al<sup>[14]</sup> majority i.e. 48.7% belonged to Upper lower and 35.7% children belonged to Lower Middle Socio-Economic class. In present study, modified Prasad's classification was used and in Ahmad et al<sup>[14]</sup>Modified Kuppuswami classification was used.

Type of Past illness (n=120)	No. of malnourished children n (%)	Average no. of episodes within 6 months before admission	Hospitalization required n (%)	Average duration of hospitalization (days)
Fever	62 (51.7)	2	04 (06.5)	1
Diarrhoea	38(31.7)	2.5	03 (07.9)	3
Vomiting	01 (00.8)	1	00 (00.0)	—
Upper Respiratory	92 (76.7)	4.5	03 (03.3)	1
Tract Infection (URTI)				
Worm infection	04(03.3)	1	00 (00.0)	
Febrile convulsions	05 (04.2)	1	05 (100.0)	3
Malaria	01 (00.8)	1	01(100.0)	3
Dengue	01 (00.8)	1	00 (00.0)	_

## Table 3: Distribution of Study Participantsaccording to Past Illnesses and Hospitalization (N=120)

Table 4: Association of Epidemiological Determinants with Grade of Malnutrition

Determinants	Grade of r	nalnutrition		
	Severe	Moderate	Chi-square	p value
	n (%)	n (%)	Value	
Birth order (n=120)*	53 (100.0)	67 (100.0)	5.385	0.0203
More than 2	13 (24.5)	06 (09.0)		
Less than or equal to 2	40 (75.5)	61 (91.0)		
Birth weight (n=113)	51 (100.0)	62 (100.0)	0.798	0.3717
Low birth weight	24 (47.1)	24 (38.7)		
Normal birth weight	27 (52.9)	38 (61.3)		
Complementary feeding (n=111)	50 (100.0)	61 (100.0)	0.363	0.5468
Inappropriate and inadequate	25 (50.0)	34 (55.7)		
Appropriate and adequate	25 (50.0)	27 (44.3)		
Current feeding practices before	53 (100.0)	67 (100.0)	0.554	0.4567
admission (n=120)				
Inadequate	46 (86.8)	61 (91.0)		
Adequate	07 (13.2)	06 (9.0)		
Immunization status (n=120)	53 (100.0)	67 (100.0)	0.292	0.5889
Incomplete to age	09 (17.0)	09 (13.4)		
Complete to age	44 (83.0)	58 (86.6)		
Past illness since last	53 (100.0)	67 (100.0)	0.016	0.8993
6 months (n=120)				
Present	51 (96.2)	63 (94.0)		
Absent	02 (03.8)	04 (06.0)		

(\*Significant association between higher birth order and severe malnutrition)

In this study, 4 (6.6%) children had birth interval of <1 year, 76 (63.3%) children had birth interval of 1-2 years and 45 (73.8%) children had preceding birth interval >2 years. In study by Ahmad et al<sup>[14]</sup> 43% children had preceding birth interval  $\geq$ 2 years and 27% children had preceding interval of < 2 years. In present study, the data of under 6 children are observed but in Ahmad et al<sup>[14]</sup> children <3 years were observed.

In this study, 61.7% mothers were illiterate or having more than primary education. Similar finding was observed in study of Sudha kumari etal<sup>[15]</sup> in which 68.3% mothers were illiterate or having more than primary education. Here, the participants of same age group of children were included.

In this study, 40.0% children were low birth weight (LBW) babies and 7 children had birth weight of more than 4 kg. Similar results were found in study by Sudha Kumari et al<sup>[15]</sup> in which 41.5% children were LBW. Which was also the institution based study and Shukla et al<sup>[16]</sup> in which 39.1% children were LBW. Age group of children was similar to present study. Out of total children, 53 (44.2%) children were having first birth order and 19 (15.8%) children were having third or more than third birth order. Similar finding was observed in study of Aprameya etal<sup>[17]</sup> in which 15 (16.5%) children were having birth order third or more.

Out of the studied children, 48 (40.0%) children were of less than 2 years of age. Breast feeding was initiated within one hour of birth in only 13 (27.1%) children out of these 48 children. Similar finding was observed in study by Aprameya etal<sup>[17]</sup> and Kalathia et al<sup>[18]</sup> which showed that breas tfeeding was initiated within one hour in 31.9% and 32.7% children respectively. Exclusive breastfeeding was given in 27 (56.3%) children. Similar finding was observed in study of Amsalu etal<sup>[19]</sup> in which exclusive breast feeding was given in 52% children. In this study, complementary feeding was started immediately after 6 months in 33 (70.2%) children. Similar finding was found in Amsalu etal<sup>[19]</sup> in which complementary feeding was started immediately after 6 months in 77% children. In this study, complementary feeding was appropriate in only 20 (41.7%) children out of 48 malnourished children.

In this study, 102 (85.0%) children were completely immunized to age. In Shukla et al<sup>[16]</sup> 68.3% children were completely immunized. The difference might be because the children from rural area also get admitted in NRC and Aprameya etal<sup>[17]</sup> in which 77% children were completely immunized to age respectively.

There were some study limitations. Only one CMTC was studied. The findings cannot be generalized to all. Recall bias may had occurred as some questions in the proforma depended on the memory of guardian. The study also included secondary data from the center. Information biaseslike bias in abstracting records, misclassification bias and reporting bias may have occurred.

## **Conclusion:**

Out of total malnourished children, majority were in toddler age group. Exclusive breast feeding was not given in almost half of children. Current feeding practices before admission were appropriate and adequate in very less number of children. Majority of children had suffered from any kind of past illnesses before admission. URTI, fever and diarrhoea were common infections among children and having higher episodes and requiring more hospitalization which may contribute to malnutrition. Children who had birth order more than 2 have more chances of becoming severely malnourished.

## **Recommendations:**

Need based education sessions of mothers for preventing low birth weight, minimum birth interval between 2 children, suitable family planning methods for target couples, exclusive breast feeding, appropriate age of starting complementary feeding, type of complementary feeding, quantity and type of routine diet especially for toddler age group as per IMNCI guideline should be given. Education regarding ways to maintain hygiene to prevent infections in children especially for those living in slum area, prevention of URTI, health seeking to avoid hospitalization and maintain good nutritional status, regular weight monitoring, and completeness of immunization should be given.

## Acknowledgement:

Authors would like to thank the Medical Officer of Health of Rajkot Municipal Corporation, the Medical Officer of Narayan Nagar Urban Health Center, the Nutritionist, other staff at Child Malnutrition Treatment Center and participants included in this study.

#### **Declaration:**

#### Funding: Nil

#### Conflict of Interest: Nil

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## Cardiovascular Risk Assessment Using Updated WHO/International Society of Hypertension Risk Prediction Charts and Atherosclerotic Cardiovascular Disease Risk Score in Residents of Amreli District

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## Abstract:

Introduction: India is one of the countries the World Health Organization (WHO) has recognized as having the majority of lifestyle-related illnesses in the near future. The highest incidence of CVD are found on the Indian subcontinent. **Objectives:** To assess the cardiovascular risk among adults aged >40 years using the updated WHO/ISH risk prediction charts and ASCVD risk score and to compare baseline cardiovascular risk estimation by both risk scores. Method: This cross-sectional study was done among 228 individuals aged 40-74 years of urban and rural areas. A semi-structured interviewer administered questionnaire was developed. The data was collected in Epicollect 5 mobile application and analyzed using Jamovi software. Results: The mean age of the study participants was 56.54 ±0.73 years. CVD high risk was significantly higher in males as compared to females (P<0.05). The ASCVD risk score classified (38.2%), of the participants as high-risk, whereas the lab-based and non lab-based versions of WHO/ISH risk prediction classified less than 10% as high risk. There was moderate agreement between the lab-based and non lab-based versions of the WHO/ISH risk prediction (Kappa-0.724, p-0.000), fair between ASCVD risk score and non lab-based versions of the WHO/ISH (Kappa-0.310, p-0.000). The agreement between, ASCVD risk score and lab-based version of WHO/ISH risk predictor was fair (Kappa-0.309, p-0.000). Conclusion: In current study, it was observed that one-third of the participants had a high risk of CVD events based on the ASCVD risk score, and a smaller number of participants were found to be at high risk according to the WHO/ISH risk chart. So we need to implement this risk scores predictors of CVD events for identify the high risk individual and their further management.

**Keywords:** Atherosclerotic Cardiovascular Disease Risk Score, Cardiovascular Disease, WHO/International Society of Hypertension

## Introduction:

Cardiovascular diseases (CVDs) are a major public health concern globally, and India is no exception. India is a diversified country, and several of its states are undergoing an epidemiological health shift due to high rates of urbanization. This has resulted in economic growth, which has resulted in increased food intake, tobacco usage, and decreased physical activity. One of the consequences of the economic transition is a shift in disease prevalence from communicable to non-communicable diseases (NCD), particularly cardiovascular disease (CVD) and diabetes. NCD has a multi-factorial etiology, with lifestyle influencing many of the risk factors<sup>.[1]</sup>

India is one of the countries the World Health Organization (WHO) has recognized as having the majority of lifestyle-related illnesses in the near future.<sup>[2]</sup> The highest incidence of CVD are found on the Indian subcontinent.<sup>[3]</sup> The enormous population and high frequency of CVD risk factors across the

Quick Response Code	Access this article online	How to cite this article :
1882 1882	<b>Website :</b> www.healthlinejournal.org	Kansagara T, Lodha N, Gurjar Y. Cardiovascular risk assessment using updated WHO/International Society of Hypertension risk prediction charts and
	<b>DOI :</b> 10.51957/Healthline_562_2023	Atherosclerotic Cardiovascular Disease risk score in residents of Amreli district. Healthline. 2023; 14 (4): 332-341

Indian subcontinent result in a significant burden of cardiovascular disease.<sup>[4]</sup> Death from NCDs is on the rise, with developing world being hit hardest. CVD prevention must be effective in order to reduce this enormous burden and associated financial costs. The majority of these ailments are preventable. Therefore, interventions targeting the main risk factors (such as alcohol consumption, smoking, and physical inactivity) may significantly lessen the burden of non-communicable diseases.<sup>[5]</sup>

Estimating the population's lifetime and baseline CVD risk is a crucial component of a preventative program. Given the interplay of multiple factors related to the etiology of CVDs, using a single risk factor to predict cardiovascular risk is erroneous. The best approach will be to adopt a particular risk chart which considers a maximum number of all probable determinants so that the contribution of each risk factor can be ascertained in different regions. The World Health Organization (WHO) and the International Society of Hypertension (ISH) have developed CVDs risk prediction charts for use in different part of the globe. The proposed chart provides a ten-year risk of a major cardiovascular outcome and is a cost-effective tool for risk scorebased population stratification. Hence, it is useful tool to counsel patients to modify their lifestyles or comply with their medicines and in implementing timely preventive measures to improve the life expectancy, quality of life of the risk groups and reduction in the burdening of the health system.<sup>[6]</sup> Another scale put forth by the American Heart Association (AHA) and American College of Cardiology (ACC) is the atherosclerotic cardiovascular disease (ASCVD) risk score which also considers a maximum number of all probable determinants.<sup>[7]</sup>

Implementing risk assessment strategies can play a vital role in reducing the incidence and impact of CVDs in India. Regular risk assessments can track changes in an individual's cardiovascular risk over time. CVD risk assessment helps identify individuals

who may be more susceptible to these lifestylerelated CVD events. Conducting risk assessment can be a cost effective in limited resource country like India. In this context, the present study was conducted with objective to assess the cardiovascular risk among adults aged >40 years using the updated WHO/ISH risk prediction charts and ASCVD risk score and to compare baseline cardiovascular risk prediction by both risk scores. The findings from this study will be instrumental in devising evidence-based interventions and preventive measures, aiming to improve life expectancy, enhance quality of life, and reduce the overall burden of cardiovascular diseases in India. Addressing the challenges posed by NCDs through comprehensive risk assessment and management will contribute to building a healthier and more resilient nation.

## Method:

## Study setting and selection of study participants:

This cross-sectional study was carried out during January 2022 to July 2022. (Total four Preventive health checkup camps were organized by the Community Medicine Department in urban and rural areas. Total 423 individuals were attended camps. Among them 228 individuals, aged 40 to 74 years, who had no prior history of cardiovascular events and provided informed written consent, were included in the study using a convenient sampling technique

## Study tool and data collection procedure:

A semi structured interviewer administered questionnaire was developed for study based on extensive review of literature, updated WHO/ISH risk prediction charts 2019<sup>[8]</sup> and ASCVD risk score developed by the American College of Cardiology/ American Heart Association (ACC/AHA).<sup>[9]</sup> The questionnaire used in this study had three parts: (i) Socio demographic details including Modified BG Prasad socioeconomic classification<sup>[10]</sup> (ii) CVD risk factor which include age, gender, smoking status, body mass index(BMI),blood pressure, coexistence of diabetes, and serum cholesterol level. (iii) Assessment and classification into low risk(<10%), moderate risk (10% to 20%), or high risk (>20%) of a cardiovascular event over the next 10 years based on the updated WHO/ISH risk prediction charts  $2019^{[8]}$  and ASCVD risk score.<sup>[9]</sup>

Height was measured using a SECA 213 stadiometer (Hamburg, Germany), weight using digital weighing machines (Essae, Bangalore, India, accuracy 0.01 kg, standardized periodically with standard weights), waist circumference by a flexible measuring tape and blood pressure using an automated monitor (Omron HEM 7080, Kyoto, Japan) in the sitting posture for two readings 15 minutes apart. The average systolic and diastolic blood pressures were recorded. Blood samples (10 ml) were collected for total serum cholesterol. A digital glucometer (Accu-chek) was used to estimate random blood sugar levels. The data were collected in Epicollect 5 application on mobile phone.

#### **Operational definitions:**

Behavioral risk factors were determined based on the cut-offs recommended by STEPS guidelines.<sup>[11]</sup> Smoking and alcohol use in last thirty days and one year respectively, was considered as current use. Behavioral assessment was based on self-report.

WC ≥90cm for men and ≥80cm for women were regarded as abdominal obesity.<sup>[12]</sup> Systolic BP (SBP) of ≥140mm Hg or Diastolic BP (DBP) of ≥90mm Hg or currently on hypertension lowering drugs was considered as raised BP (hypertension).<sup>[13]</sup> Diabetes mellitus (DM) was determined at random blood glucose of ≥200 mg/dl or currently on anti-diabetic medications.<sup>[14]</sup> Hypercholesterolemia was defined as those having total cholesterol level of ≥200mg/dl<sup>[13]</sup> or currently on lipid-lowering drugs.

## Data analysis:

Data was retrieved from Epicollect 5 into Microsoft excel 2019 and was analyzed by using JAMOVI<sup>[15]</sup> software. Proportions were used to summarize categorical data while continuous variables ware summarized as means (standard deviations) as appropriate. Statistical significance between various categorical variables was assessed using the chi-square and Fisher exact tests and continuous variables were assessed using the Mann-Whitney U-test and Krushkal Wallis test. Cohen's kappa statistics was used to determine agreement between the two charts. The kappa statistic can range from -1 to +1. Cohen proposed the following interpretation of the Kappa result: ≤0 represents no agreement, 0.01-0.20 represents none to slight agreement, 0.21-0.40 represents fair agreement, 0.41- 0.60 represents moderate agreement, 0.61-0.80 represents substantial agreement, and 0.81-1.00 represents practically perfect agreement.<sup>[16]</sup> A p value < 0.05 was considered statistically significant in all analyses.

## **Ethics Statement:**

This study protocol was reviewed and approved by Institutional Review Board (IRB).

## **Results:**

In current study 6.1%,5.7% and 38.2% individuals had high risk of CVD events as per WHO/ISH lab based, WHO/ISH non lab based and ASCVD risk score respectively.(Figure :1) A total of 228 study participants, 126(55.26%) were women and 102(44.73%) were men. The mean age of the study participants was 56.54 ±0.73 years with. Table 1 reveals the association between different variables and the gender of the study participants. Higher proportion of women were illiterate in compare to men (p=0.001). Smoking was significantly more prevalent among males (p<0.001) and BMI >25  $kg/m^2$  was significantly more prevalent among females (p<0.001). Marital status, socio-economic class, diabetes, hypertension, SBP > 140 mm Hg, high waist circumference, high RBS, high TC, did not vary significantly with gender.

Variables	Female	Male	p-value
	n(%) or	n(%) or	•
	Mean±SD	Mean±SD	
Age (in year)	54.48±11.23	59.11±10.41	0.002*
Place			
Urban	80 (63.5)	42 (58.8)	0.001*
Rural	46 (36.5)	60 (41.2)	
Education			
Illiterate	60 (47.6)	24 (23.5)	0.001*
<high school<="" td=""><td>44 (34.9</td><td>48 (47.1)</td><td></td></high>	44 (34.9	48 (47.1)	
>High school	22 (17.5)	30 (29.4)	
Occupation			
Retired	12 (9.5)	35 (27.8)	< 0.001
Service/business	35 (27.8)	28 (27.5)	
Housewife	58 (46)	0(0)	
Agriculture/labourer	21 (16.7)	39 (38.2)	
Marital status			
married	104 (82.5)	88 (86.3)	0.44
Unmarried / Widow / Separated	22 (17.5)	14(13.7)	
Socioeconomic class			
Upper	21 (16.7)	23 (22.5)	0.12
Middle	33 (26.2)	16(15.7)	
lower	72 (57.1)	63 (61.8)	
Known hypertensive	31 (24.6)	31 (30.4)	0.48
SBP >140 mmhg	142.42±22.88	136.98±23.06	0.077
DBP >90 mmhg	85.09±14.47	81.15±15.09	0.046*
Known Diabetic	24 (19)	23 (22.5)	0.67
Random blood sugar	161.95±104.13	150.10±75.42	0.337
>140 mg/dl (n=218)			
Total cholesterol	147.91±67.94	153.22±46.69	0.503
>200 mg/dl (n=209)			
Current smokers	1 (0.8)	18(17.6)	<0.001
Alcoholhistory	0(0)	7 (6.9)	
Waist circumference (cm)	89.65±17.55	88.77±17.46	0.707
Body mass Index (kg/m <sup>2</sup> )	26.78±4.77	24.14±4.68	< 0.001

Table 1. Raseline characteristics	s of study participants	(N-228)
Table 1: Dasenne characteristics	s of study participants	(N-220)

\*p value are statistically significant at <0.05. SBP-Systolic Blood Pressure;

DBP-Diastolic Blood Pressure; WHO/ISH-world health organization /international society of hypertension; ASCVD-atherosclerotic cardiovascular disease; SD-Standard deviation.

# Table 2: Association between baseline characteristics and cardiovascular disease risk among<br/>the study participants (as per WHO/ISH risk predictor)

Variables	W	HO lab bas n (%) or l	sed ( n=214 Mean±SD	ł)	WHO	D non-lab b n (%) or N	ased (n=22 ⁄Iean±SD	8)
	High	Moderate	Low	p-value	High risk	Moderate	Low	p-value
	risk	risk	risk			risk	risk	
Sex	I		I				1	1
Female	4 (3.5)	32 (27.8)	79 (68.7)	0.012*	3 (2.4)	37 (29.4)	86 (68.3)	0.001*
Male	9 (9.1)	41 (41.4)	49 (49.5)		10 (9.8)	45 (44.1)	47 (46.1)	
Place			•	•			•	•
Urban	5 (4.5)	34 (30.9)	71 (64.5)	0.301	8 (6.6)	39 (32)	75 (61.5)	0.378
Rural	8 (7.7)	39 (37.5)	57 (54.8)		5 (4.7)	43 (40.6)	58 (54.7)	
Education							1	
Illiterate	6 (8.1)	34 (45.9)	34 (45.9)	0.032*	5 (6)	41 (48.8)	38 (45.2)	0.026*
<high school<="" td=""><td>6 (6.8)</td><td>23 (26.1)</td><td>59 (67)</td><td></td><td>4 (4.3)</td><td>25 (27.2)</td><td>63 (68.5)</td><td></td></high>	6 (6.8)	23 (26.1)	59 (67)		4 (4.3)	25 (27.2)	63 (68.5)	
≥high school	1 (1.9)	16 (30.8)	35 (67.3)		4 (7.7)	16 (30.8)	32 (61.5)	
Occupation								
Retired	3 (6.4)	28 (59.6)	16 (34)	< 0.001*	5 (10.6)	33 (70.2)	9 (19.1)	< 0.001*
Service/business	4 (6.3)	10 (15.9)	49 (77.8)		4 (6.3)	11 (17.5)	48 (76.2)	
Housewife	2 (4)	19 (38)	29 (58)		1 (1.7)	22 (37.9)	35 (60.3)	
Agriculture/labourer	4 (7.4)	16 (29.6)	34 (63)		3 (5)	16 (26.7)	41 (68.3)	
Marital status								
Married	9 (5)	59 (32.6)	113 (62.4)	0.106	8 (4.2)	66 (34.4)	118 (60.5)	0.019*
Unmarried/widow/	4 (12.1)	14 (42.4)	15 (45.5)		5 (13.9)	16 (44.4)	15 (41.7)	
separated								
Socioeconomic class							•	•
Upper	3 (7)	12 (27.9)	28 (65.1)	0.79	2 (4.5)	14 (31.8)	28 (63.6)	0.957
Middle	3 (6.5)	14 (30.4)	29 (63)		3 (6.1)	18 (36.7)	28 (57.1)	]
lower	7 (5.6)	47 (37.6)	71 (56.8)		8 (5.9)	50 (37)	77 (57)	
Known hypertensive	•							
Yes	4 (6.9)	30 (51.7)	24 (41.4)	0.003*	5 (8.1)	34 (54.8)	23 (37.1)	<0.001*
No	9 (5.8)	43 (27.6)	104 (66.7)		8 (4.8)	48 (28.9)	110 (66.3)	
Known Diabetic	-					-		
Yes	10 (21.3)	22 (46.8)	15 (31.9)	< 0.001*	2 (4.3)	25 (53.2)	20 (42.6)	0.022*
No	3 (1.8)	51 (30.5)	113 (67.7)		11 (6.1)	57 (31.5)	113 (58.3)	
Current smokers								
Yes	2 (11.8)	11 (64.7)	4 (23.5)	0.006*	3 (15.8)	12 (63.2)	4 (21.1)	0.002
No	11 (5.6)	62 (31.5)	124 (62.9)		10 (4.8)	70 (33.5)	129 (61.7)	
Alcohol history								
Yes	0 (0)	2 (33.3)	4 (66.7)	—	1 (14.3)	2 (28.6)	4 (57.1)	0.593
No	13 (6.3)	71 (34.1)	124 (59.6)		12 (5.4)	80 (36.2)	129 (58.4)	

		,						
Age	70.23	66.01±	50.05±	0.000*	67.92±	66.33±	49.41±	< 0.001*
	±4.26	6.43	8.22		6.48	6.17	7.79	
SBP >140 mmhg	167.69	145.7±	132.99	0.000*	175.08	145±	132.89	< 0.001*
	±20.84	24.8	±18.27		±18.66	23.22	±18.94	
DBP >90 mmhg	94.38±	83.49±	81.21±	0.006*	98.46	83.34±	83.32±	< 0.001*
	17.75	14.81	13.57		±20.58	14.14	14.85	
Waist circumference	(cm)							
Female	89.75	93.75±	87.72±	0.288	91.67±	92.30±	88.44±	0.528
	±7.85	11.6	20.41		12.58	10.91	19.85	
Male	84.22±	88.17±	90.24±	0.614	88.30±	88.96±	88.7±	0.994
	27.61	20.59	12.06		28.45	17.47	14.81	-
Body mass Index	25.77	25.2	25.54	0.867	26.58	25.47	25.27	0.75
$(kg/m^2)$	±2.94	±5.35	±4.84		± 3.98	±5.04	±4.91	
Random blood sugar	184.46	161.95	164.27	0.7	123±	167.01	165.68	0.259
(n=218)	±89.96	±90.78	±87.91		48.97	±90.42	±88.89	
Total cholesterol	163.17	163.26	161.4	0.979	159.78	159.78	166.99	0.427
(n=209)	±37.44	±37.09	±41.80		<u>+</u> 35.14	±35.14	±43.02	

## For continuous data (Mean±SD)

\*p value are statistically significant at <0.05. SBP-Systolic Blood Pressure; DBP-Diastolic Blood Pressure; WHO/ISH-world health organization /international society of hypertension; ASCVD-atherosclerotic cardiovascular disease; SD-Standard deviation.

Table 2 showed the association between the study variables and WHO/ISH risk. Lab-based and non lab-based WHO/ISH chart predicted CVD high risk was significantly lower in females as compared to males (P < 0.05). Aged people, male participants, lower educational qualifications, retired person, having diabetes/hypertension, currently smoking, high systolic and diastolic blood pressure were significantly associated with high risk for CVD (p<0.05). (Table 2)

With respect to ASCVD risk predictor, statistically significant difference was observed in age (p<0.001), sex (p<0.001), place (p=0.052), occupation (p<0.001), known hypertensive (p=0.000), known diabetic (p=0.000), current smoker (p=0.006), systolic blood pressure (p<0.001) and diastolic blood pressure (p=0.044). Male (56.9%) have a high risk for CVD compared to Female (23%). (Table 3) The ASCVD risk score classified (38.2%), of the participants as high-risk, whereas the lab-based and non lab-based versions of WHO/ISH risk predictors classified less than 10% as high risk. There was substantial agreement between the lab-based and non lab-based versions of the WHO/ISH risk predictors (Kappa 0.724, p-0 .000), fair between ASCVD risk score and non lab-based versions of the WHO/ISH (Kappa 0.310, p-0.000). However, the agreement between, ASCVD risk score and lab-based version of WHO/ISH risk predictor was fair (Kappa 0.309, p-0.000). (Table 4)

## Discussion:

The current study showed that a considerable number of the study participants (38.2%) had a high 10-year ASCVD risk. But less than 10% of study participants were classified in the high-risk group according to the WHO (ISH) CVD risk chart. ASCVD risk score classified more people in the high-risk group rather than the WHO risk score. Similarly Hasandokht et al also reported that ASCVD risk score classified more people in the high-risk group (35%) rather than the WHO risk score (4.5%).<sup>[17]</sup> Study done by Garg et al in North India reported that ASCVD risk score underestimate 28.3% CVD risk while WHO (ISH) risk score tool were estimated 16.3% CVD risk.<sup>[18]</sup> This higher CVD risk score in WHO (ISH) risk score is because of different study population. Study done at Nigeria by Ofori et al<sup>[19]</sup> also observed that WHO (ISH) risk score prediction were identified less high risk groups than ASCVD risk score, this study has also found similar type of finding.

In the present study, different variables have been assessed to identify their association with the study population with use of two different CVD risk score. Study done in South India by Ghorpade et al<sup>[6]</sup> found that level of education and employment status of the study participants was statistically associated with the gender of the study subjects which was also found similar in present study that level of education and occupations of the study participants was statistically associated with the gender of the study subjects. Current study revealed that there was a significant difference between male-female population with regards to variables like BMI, high blood glucose level, alcohol and smoking habits which was similar to National family health survey-5 (NFHS-5) data.<sup>[20]</sup> Epidemiological studies conducted in northern India showed no gender differences in parameters such as central obesity, overweight and hypertension.<sup>[21]</sup> The reasons for their differing results in their study could be due to the use of different study settings, and study participants.

The present study predicted a larger part of the male population was at high risk of CVD in comparison with the female population with use of WHO(ISH) risk prediction chart and ASCVD risk score. Other study done in North Iran by Motamed et al also reported that significant male population were at risk for 10-year CVD events.<sup>[22]</sup> The variables such as age, gender, education, occupation, having diabetes/hypertension, currently smoking, high systolic and diastolic blood pressure were

significantly associated with the high risk of CVD events using of WHO/ISH risk prediction chart in present study. As compared to other study done in karnataka among tribal population of Chamarajanagar district<sup>[23]</sup> results showed significant association was seen between age, occupation, education, BMI, hypertension and smoking with CVD risk (P< 0.05). While using ASCVD risk score, variables like such as age, gender, occupation, known hypertension/diabetic, current smoker, and high BP were found significantly associated with high risk of CVD events in this study. The study done in urban Rajkot, India<sup>[24]</sup> observed that life time ASCVD events was associated with increasing age, male, stress, elevated BP, high level of BMI, and central obesity but no association was found between smoking with ASCVD risk events. This difference may be due to use of life time ASCVD risk score, use of different variables and different study participants.

The present study showed that a considerable number of the study participants (38.2%) had a high 10-year ASCVD risk. But less than 10% of study participants were classified in the high-risk group according to the WHO (ISH) CVD risk chart. ASCVD risk score classified more people in the high-risk group rather than the WHO risk score. A populationbased national survey in Asia using the Framingham risk scale, SCORE (systemic coronary risk assessment) and WHO model<sup>[25]</sup> found that the WHO risk score did not identify individuals high-risk compared with the other two models. Similarly Hasandokht et al also reported that ASCVD risk score classified more people in the high-risk group rather than the WHO risk score.<sup>[17]</sup> Study done by Garg et al<sup>[18]</sup> in North India reported that ASCVD risk score and WHO (ISH) risk score tool were underestimated CVD risk than other tools Framingham Risk score-Coronary heart disease and Cardiovascular Disease ((FRS-CHD & FRS-CVD), QRISK2, Joint British Society risk 3 (JBS3). Study done at Nigeria by Ofori et al<sup>[19]</sup> also observed that WHO (ISH) risk score prediction were identified less high risk groups than ASCVD risk score.

Table 3: Association between baseline characteristics and cardiovascular disease risk among th	e
study participants as per ASCVD risk predictor (N=228)	

n(%) or Jerminal Section           High risk         Moderate risk         Low risk         p-value           Sex         Image         29 (23)         28 (22.2)         69 (54.8)         <0.001*
High riskModerate riskLow riskp-valueSexFemale29 (23)28 (22.2)69 (54.8) $<0.001^*$ Male58 (56.9)23 (22.5)21 (20.6)-Place0.052*Urban42 (34.4)23 (18.9)57 (46.7)0.052*Rural45 (42.5)28 (26.4)33 (31.1)-EducationIlliterate32 (38.1)26 (31)26 (31)0.077 <high school<="" td="">34 (37)19 (20.7)39 (42.4)-&gt;high school21 (40.4)6 (11.5)25 (48.1)-OccupationRetired33 (70.2)1 3(27.7)1 (2.1)&lt;Service/business15 (23.8)11 (17.5)37 (58.7)-Housewife18 (31)18 (31)22 (37.9)-Agriculture/labourer21 (35)9 (15)30 (50)-Married69 (35.9)41 (21.4)82 (42.7)0.069Ummarried/widow/separated18 (50)10 (27.8)8 (22.2)-Socioeconomic classUpper18 (40.9)7 (15.9)19 (43.2)0.572Middle18 (36.7)9 (18.4)22 (44.9)-Iower51 (37.8)35 (25.9)49 (36.3)-Known hypertensiveYes42 (67.7)15 (24.2)5 (8.1)&lt;&lt;0.001*</high>
Sex         Image         Image         Sec (2.2)         Ge (954.8)         <<0.001*
Female $29 (23)$ $28 (22.2)$ $69 (54.8)$ $<0.001^*$ Male $58 (56.9)$ $23 (22.5)$ $21 (20.6)$ $Place<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>><<<<<<<<<<<><$
Male $58 (56.9)$ $23 (22.5)$ $21 (20.6)$ PlaceUrban $42 (34.4)$ $23 (18.9)$ $57 (46.7)$ $0.052^*$ Rural $45 (42.5)$ $28 (26.4)$ $33 (31.1)$ $0.077$ Education $31 (37)$ $26 (31)$ $26 (31)$ $0.077$ High school $34 (37)$ $19 (20.7)$ $39 (42.4)$ $2high school$ $21 (40.4)$ $6 (11.5)$ $25 (48.1)$ Occupation $8tired$ $33 (70.2)$ $13 (27.7)$ $1 (2.1)$ $<0.001^*$ Retired $33 (70.2)$ $13 (27.7)$ $1 (2.1)$ $<0.001^*$ Service/business $15 (23.8)$ $11 (17.5)$ $37 (58.7)$ $<0.001^*$ Housewife $18 (31)$ $18 (31)$ $22 (37.9)$ $<0.009$ Marital status $9 (15)$ $30 (50)$ $0.069$ Married $69 (35.9)$ $41 (21.4)$ $82 (42.7)$ $0.069$ Ummarried/widow/separated $18 (50)$ $10 (27.8)$ $8 (22.2)$ Socioeconomic class $18 (36.7)$ $9 (18.4)$ $22 (44.9)$ lower $51 (37.8)$ $35 (25.9)$ $49 (36.3)$ Known hypertensive $Yes$ $42 (67.7)$ $15 (24.2)$ $5 (8.1)$ Yes $33 (70.2)$ $8 (17)$ $6 (12.8)$ $<0.001^*$ No $45 (27.1)$ $36 (21.7)$ $85 (51.2)$ $<0.001^*$
Place           Urban         42 (34.4)         23 (18.9)         57 (46.7)         0.052*           Rural         45 (42.5)         28 (26.4)         33 (31.1)         0.052*           Education         1         26 (31)         26 (31)         0.077 <high school<="" td="">         34 (37)         19 (20.7)         39 (42.4)           &gt;high school         21 (40.4)         6 (11.5)         25 (48.1)           Occupation         33 (70.2)         1 3 (27.7)         1 (2.1)           Retired         33 (70.2)         1 3 (27.7)         1 (2.1)           Service/business         15 (23.8)         11 (17.5)         37 (58.7)           Housewife         18 (31)         18 (31)         22 (37.9)           Agriculture/labourer         21 (35)         9 (15)         30 (50)           Married         69 (35.9)         41 (21.4)         82 (42.7)         0.069           Unmarried/widow/separated         18 (50)         10 (27.8)         8 (22.2)         0.572           Socioeconomic class         1         22 (44.9)         0.572         0.572           Middle         18 (30.7)         9 (18.4)         22 (44.9)         0.572           Middle         18 (36.7)         &lt;</high>
Urban $42 (34.4)$ $23 (18.9)$ $57 (46.7)$ $0.052^*$ Rural $45 (42.5)$ $28 (26.4)$ $33 (31.1)$ $0.077$ EducationIlliterate $32 (38.1)$ $26 (31)$ $26 (31)$ $0.077$ $41 (37)$ $19 (20.7)$ $39 (42.4)$ $26 (31)$ $0.077$ $\geq$ high school $21 (40.4)$ $6 (11.5)$ $25 (48.1)$ $0.077$ OccupationRetired $33 (70.2)$ $1 3 (27.7)$ $1 (2.1)$ $<0.001^*$ Service/business $15 (23.8)$ $11 (17.5)$ $37 (58.7)$ $0.001^*$ Housewife $18 (31)$ $18 (31)$ $22 (37.9)$ $Agriculture/labourer21 (35)9 (15)30 (50)Married69 (35.9)41 (21.4)82 (42.7)0.069Unmarried/widow/separated18 (50)10 (27.8)8 (22.2)Socioeconomic classUpper18 (40.9)7 (15.9)19 (43.2)0.572Middle18 (36.7)9 (18.4)22 (44.9)0.572Iower51 (37.8)35 (25.9)49 (36.3)40 (01^*)Known hypertensiveYes42 (67.7)15 (24.2)5 (8.1)<0.001^*No45 (27.1)36 (21.7)85 (51.2)<0.001^*No54 (29.8)43 (23.8)84 (46.4)<0.001^*$
Rural $45 (42.5)$ $28 (26.4)$ $33 (31.1)$ EducationIlliterate $32 (38.1)$ $26 (31)$ $26 (31)$ lliterate $32 (38.1)$ $26 (31)$ $0.077$ <kligh school<="" td=""><math>34 (37)</math><math>19 (20.7)</math><math>39 (42.4)</math><math>\geq</math>high school<math>21 (40.4)</math><math>6 (11.5)</math><math>25 (48.1)</math>Occupation<math>0.077</math><math>1 (2.1)</math><math>&lt; 0.001^*</math>Retired<math>33 (70.2)</math><math>1 3 (27.7)</math><math>1 (2.1)</math>Service/business<math>15 (23.8)</math><math>11 (17.5)</math><math>37 (58.7)</math>Housewife<math>18 (31)</math><math>18 (31)</math><math>22 (37.9)</math>Agriculture/labourer<math>21 (35)</math><math>9 (15)</math><math>30 (50)</math>Martiad status<math>69 (35.9)</math><math>41 (21.4)</math><math>82 (42.7)</math><math>0.069</math>Unmarried/widow/separated<math>18 (50)</math><math>10 (27.8)</math><math>8 (22.2)</math><math>0.572</math>Socioeconomic class<math>Upper</math><math>18 (40.9)</math><math>7 (15.9)</math><math>19 (43.2)</math><math>0.572</math>Middle<math>18 (36.7)</math><math>9 (18.4)</math><math>22 (44.9)</math><math>0.572</math>Iower<math>51 (37.8)</math><math>35 (25.9)</math><math>49 (36.3)</math><math>45 (27.1)</math><math>36 (21.7)</math><math>85 (51.2)</math>No<math>45 (27.1)</math><math>36 (21.7)</math><math>85 (51.2)</math><math>&lt; 0.001^*</math><math>No</math>No<math>54 (29.8)</math><math>43 (23.8)</math><math>84 (46.4)</math><math>&lt; 0.001^*</math></kligh>
EducationIlliterate $32 (38.1)$ $26 (31)$ $26 (31)$ $0.077$ $<$ High school $34 (37)$ $19 (20.7)$ $39 (42.4)$ $0$ $\geq$ high school $21 (40.4)$ $6 (11.5)$ $25 (48.1)$ $0.077$ OccupationRetired $33 (70.2)$ $1 3 (27.7)$ $1 (2.1)$ $<0.001^*$ Service/business $15 (23.8)$ $11 (17.5)$ $37 (58.7)$ $<0.001^*$ Housewife $18 (31)$ $18 (31)$ $22 (37.9)$ $<0.001^*$ Agriculture/labourer $21 (35)$ $9 (15)$ $30 (50)$ $<0.009$ Martial status $<$ $<0.009$ $<0.009$ Married $69 (35.9)$ $41 (21.4)$ $82 (42.7)$ $0.069$ Upper $18 (40.9)$ $7 (15.9)$ $19 (43.2)$ $0.572$ Middle $18 (36.7)$ $9 (18.4)$ $22 (44.9)$ $0.572$ Ibiddle $18 (36.7)$ $9 (18.4)$ $22 (45.9)$ $0.001^*$ No $45 (27.1)$ $36 (21.7)$ $85 (51.2)$ $<0.001^*$ No $45 (27.1)$ $36 (21.7)$ $6 (12.8)$ $<0.001^*$ No $54 ($
Illiterate $32 (38.1)$ $26 (31)$ $26 (31)$ $0.077$ <high school<="" td=""><math>34 (37)</math><math>19 (20.7)</math><math>39 (42.4)</math><math>\geq</math>high school<math>21 (40.4)</math><math>6 (11.5)</math><math>25 (48.1)</math>OccupationRetired<math>33 (70.2)</math><math>13 (27.7)</math><math>1 (2.1)</math>&lt;0.001*</high>
<high school<="" th=""><math>34 (37)</math><math>19 (20.7)</math><math>39 (42.4)</math><math>\geq</math>high school<math>21 (40.4)</math><math>6 (11.5)</math><math>25 (48.1)</math>OccupationRetired<math>33 (70.2)</math><math>1 3 (27.7)</math><math>1 (2.1)</math>Service/business<math>15 (23.8)</math><math>11 (17.5)</math><math>37 (58.7)</math>Housewife<math>18 (31)</math><math>18 (31)</math><math>22 (37.9)</math>Agriculture/labourer<math>21 (35)</math><math>9 (15)</math><math>30 (50)</math>Married<math>69 (35.9)</math><math>41 (21.4)</math><math>82 (42.7)</math><math>0.069</math>Unmarried/widow/separated<math>18 (50)</math><math>10 (27.8)</math><math>8 (22.2)</math><math>0.572</math>Socioeconomic class<math>Upper</math><math>18 (40.9)</math><math>7 (15.9)</math><math>19 (43.2)</math><math>0.572</math>Middle<math>18 (36.7)</math><math>9 (18.4)</math><math>22 (44.9)</math><math>0.572</math>Iower<math>51 (37.8)</math><math>35 (25.9)</math><math>49 (36.3)</math><math>45 (27.1)</math><math>36 (21.7)</math><math>85 (51.2)</math>No<math>45 (27.1)</math><math>36 (21.7)</math><math>85 (51.2)</math><math>&lt;0.001^*</math>No<math>54 (29.8)</math><math>43 (23.8)</math><math>84 (46.4)</math><math>&lt;0.001^*</math></high>
$\begin{tabular}{ c c c c c c } \hline $$ $$ $$ $$ $$ $$ $$ $$ $$ $$ $$ $$ $$
OccupationRetired $33\ (70.2)$ $1\ 3(27.7)$ $1\ (2.1)$ <0.001*
Retired         33 (70.2)         1 3(27.7)         1 (2.1)         <0.001*           Service/business         15 (23.8)         11 (17.5)         37 (58.7)            Housewife         18 (31)         18 (31)         22 (37.9)            Agriculture/labourer         21 (35)         9 (15)         30 (50)            Married         69 (35.9)         41 (21.4)         82 (42.7)         0.069           Unmarried/widow/separated         18 (50)         10 (27.8)         8 (22.2)             Socioeconomic class         Upper         18 (40.9)         7 (15.9)         19 (43.2)         0.572           Middle         18 (36.7)         9 (18.4)         22 (44.9)              lower         51 (37.8)         35 (25.9)         49 (36.3)             Known hypertensive                 Yes         42 (67.7)         15 (24.2)         5 (8.1)         <0.001*           No         45 (27.1)         36 (21.7)         85 (51.2)            Known Diabetic            <0.001*           Yes
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No         45 (27.1)         36 (21.7)         85 (51.2)           Known Diabetic         33 (70.2)         8 (17)         6 (12.8)         <0.001*           No         54 (29.8)         43 (23.8)         84 (46.4)            Current smokers
Known Diabetic         Solution
Yes         33 (70.2)         8 (17)         6 (12.8)         <0.001*           No         54 (29.8)         43 (23.8)         84 (46.4)            Current smokers             <0.001*
No         54 (29.8)         43 (23.8)         84 (46.4)           Current smokers
Current smokers
Yes 12 (63.2) 6 (31.6) 1 (5.3) 0.006*
No 75 (35.9) 45 (21.5) 89 (42.6)
Alcohol history
Yes 2 (28.6) 2 (28.6) 3 (42.9) 0.853
No 85 (38.5) 49 (22.2) 87 (39.4)
For continuous data (Mean±SD)
Age 65.20±6.82 59.47±9.27 46.53±6.4 <0.001*
<b>SBP &gt;140 mmhg</b> 151.72±25.42 136.47±21.39 130.63±15.69 <0.001*
<b>DBP &gt;90 mmhg</b> 86.20±16.02 83.20±13.94 80.62±13.79 0.044*
Waist circumference (cm)
Female         94.55±11.62         90.43±13.48         87.28±20.54         0.167
Male 90.21±20.94 85.57±12.91 88.33±9.46 0.585
<b>Body mass Index (kg/m<sup>2</sup>)</b> 26.02±4.78 24.45±5.63 25.84±4.52 0.161
<b>Random blood sugar (n=218)</b> 165.56±88.08 144.08±62.43 173.61±99.07 0.171
<b>Total cholesterol (n=209)</b> 156.16±34.41 171.07±42.84 167.69±42.31 0.072

\*p value are statistically significant at <0.05. SBP-Systolic Blood Pressure; DBP-Diastolic Blood Pressure; WHO/ISH-world health organization /international society of hypertension; ASCVD-atherosclerotic cardiovascular disease; SD-Standard deviation.

Risk predictors		WHO/ISH non lab risk category			Total n(%)	Карра	P value
		High risk	Moderate risk	Low risk			
WHO/ISH lab	High risk	5	8	0	13 (6.1)	0.724	< 0.001
risk category	Moderate risk	6	61	6	73 (34.1)		
	Low risk	0	11	117	128 (59.8)		
	Total n (%)	11 (5.1)	80 (37.4)	123 (57.5)	214(100)		
ASCVD risk	High risk	12	61	14	87 (38.2)	0.31	< 0.001
category	Moderate risk	1	21	29	51 (22.4)		
	Low risk	0	0	90	90 (39.5)		
	Total n (%)	13 (5.7)	82 (36)	133 (58.3)	228		
<b>Risk predictors</b>		ASCVD risk category		Total n (%)	Карра	p value	
WHO/ISH lab		High risk	Moderate risk	Low risk			
risk category	High risk	13	0	0	13(6.1)	0.309	< 0.001
	Moderate risk	54	19	0	73(34.1)		
	Low risk	17	28	83	128(59.8)		
	Total n (%)	84 (39.3)	47 (22)	83 (38.8)	214 (100)		

 Table 4: Agreement between risk predictors

WHO/ISH-world health organization /international society of hypertension; ASCVD-atherosclerotic cardiovascular disease.

Figure: 1 Distribution of study participants using risk score



Current study found a good agreement (Kappa 0.724, p-0 .000) between WHO (ISH) risk predictor tool with cholesterol and without cholesterol. Study done by Das et al also found good agreement between this tools (Kappa 0.64).<sup>[26]</sup> We observed a fair agreement (Kappa 0.310, p-0.000) between ASCVD and WHO (ISH) risk predictor tools while study done by Hasandokht et al found moderate agreement between this two tools (Kappa 0.45). We found that a sizable proportion of participants were categorized as low risk using both risk scores. We noticed that a small subset of participants who were assigned the

WHO (ISH) categories of moderate risk and low risk were assigned the ASCVD score of high-risk groups. So ASCVD risk scores might be overestimating the high risk group which has been shown in several studies.<sup>[17,27,28]</sup>

## **Conclusion:**

In present study, it was observed that one-third of the participants had a high risk of CVD events based on the ASCVD risk score, and a smaller number of participants were found to be at high risk according to the WHO/ISH risk chart. Our study indicated WHO/ISH lab based and non lab based risk scores had fair agreement with ASCVD risk scores. Moderate agreement was found between WHO/ISH lab based and non lab based risk scores. So we need to implement these risk scores of CVD events to identify the high risk individual and their further management.

## Limitation:

The participants in this cross-sectional study were those who attended camps for the screening of diabetes and hypertension. It could lead to selection bias and affect the generalizability of the results. However, it has no influence on the ability of the study to assess the two cardiovascular risk assessment tools.

#### **Declaration:**

Funding: Nil

#### Conflict of Interest: Nil

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## "Ni-kshay SETU", A Digital Health Intervention for Capacity Building in Tuberculosis under the National TB Elimination Program in India: A Comprehensive mHealthapp review

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## Abstract:

This mHealthapplication review explores the evolution, design, and impact of Ni-kshay SETU, a digital health intervention tailored for India's National Tuberculosis Elimination Program (NTEP). Faced with escalating TB incidences, the NTEP prioritized capacity-building, leading to the conception of Ni-kshay SETU. This review describes the narrative of Ni-kshay SETU's concept from the beginning to the present day. It starts with the National Strategic Plan 2017–25, which says that capacity building of health care workers is important for reduction of tuberculosis morbidity and mortality by 2025. The digital platform materialized as a web app with Android and iOS versions, constituting a user-friendly interface. The app, embodying a ready reckoner and decision-making tool, offers cadre-specific modules in local languages, promoting ease of comprehension and applicability. The app's development, rooted in a consultative process, aligns with the nuanced needs of healthcare personnel across various geographies and cadres. With more than 40,400 subscribers and 1,450,000 visits, Ni-kshay SETU serves as a notable example of digital health intervention, providing a comprehensive and context-aware approach to TB care. However, it's important to acknowledge the limitations of Ni-kshay SETU. While the app aims to address various challenges in TB care, its effectiveness is contingent on factors such as digital literacy and access to smartphones. Additionally, the app's success relies on consistent updates and continuous user engagement for its usage, posing potential challenges in sustaining the momentum. In summary, Ni-kshay SETU is not just a tool for building capacity but also acts as a driver for affordable digital solutions in areas with limited resources, aiming to strengthen healthcare systems on the path to eliminating TB.

Keywords: Capacity Building, Digital Health Intervention, Ni-kshay SETU, Tuberculosis

## Introduction:

Tuberculosis (TB) is recognized as one of the health challenges that tends to be under reported globally, and there has been comparatively less emphasis on addressing the TB epidemic, considering its significant public health implications.<sup>[1]</sup> The END TB strategy aims to reduce TB incidence and mortality in 2035 (compared to 2015 figures) by 90% and 95%, respectively.<sup>[2]</sup> In the past, developed countries with efficient antituberculosis drugs and guaranteed adherence to therapy achieved cure rates in patients with TB of more than 95%, while the case fatality ratio (estimated mortality/estimated incidence) is 5% in high-income nations, it is still 20% in high-burden nations.<sup>[3]</sup> To meet these ambitious goals, it is imperative to work to lessen the disease burden and TB-related deaths in these nations, especially India.

Quick Response Code	Access this article online	How to cite this article :
	<b>Website :</b> www.healthlinejournal.org	Modi B, Puwar B. "Ni-kshay SETU", a Digital Health Intervention for Capacity Building in Tuberculosis under the National TB Elimination Program in India: A
	<b>DOI :</b> 10.51957/Healthline_584_2023	Comprehensive mHealth app review. Health 2023; 14 (4): 342-347

Government of India has set forth an ambitious National Strategic Plan (NSP) 2017-2025 under National Tuberculosis Elimination Program (NTEP) in line with the National Health Policy 2015 and global efforts such as the World Health Organization's (WHO) END TB Strategy, and the Sustainable Development Goals (SDGs) of the United Nations.<sup>[4, 5]</sup> The NSP for TB elimination in India has essentially four pillars to address the major challenges for TB control, namely, "Detect, Treat, Build and Prevent." The capacity building of the

health care staff and digital information ecosystem

for TB care are one of the components of the pillar

"Build".<sup>[4,5]</sup>
 Conceptual framework behind evolution of the Ni-kshay SETU

The effective management of TB within healthcare services, particularly those incorporating work-based learning experiences, demands a substantial commitment from health care workers. To optimize patient outcomes, health care workers need not only the requisite skills but also adequate support for latest updates of patient management. However, the healthcare system encounters challenges, such as limited resources and insufficient knowledge, skills, and attitudes of health care workers in the management of TB patients. Additionally, delays in the screening to treatment completion and referral process, from the field to primary care levels and beyond, further hinder the timely delivery of services.<sup>[6, 7]</sup> These contribute to poor outcomes and delays in getting the services, ultimately leading to morbidity and mortality in TB patients.<sup>[8]</sup> These challenges, highlighted in the context of the NTEP program in India, underscore the critical need for solutions designed to enhance the capacity and efficiency of healthcare workers in managing TB through digital platforms and innovative approaches.<sup>[911]</sup>

## Need for Capacity Building and National TB Elimination Programme (NTEP)

The rapid expansion of the NTEP and the continuous introduction of updated guidelines and protocols have necessitated the development of effective training strategies to ensure healthcare workers remain abreast of the latest advancements in TB care.<sup>[12]</sup>Furthermore, the challenges associated with engaging general health staff and the inadequate capacity-building infrastructure to address the vast need of healthcare providers highlight the critical role of digital technologyenabled solutions that support healthcare staff in accessing updates and undertaking training.<sup>[9, 13]</sup> A study was undertaken in the regions of Gujarat and Jharkhand in order to evaluate the necessity and potential strategies for improving the proficiency of healthcare personnel. The study emphasized the necessity of digital solutions that offer convenient access and user-friendly navigation to assist various levels of healthcare professionals in managing tuberculosis patients, based on their respective job roles. The consultative phase gathered suggestions from key stakeholders and NTEP officials from across the country and series of versions were piloted in Gujarat, Iharkhand, Himachal, Maharashtra, Goa and Andaman & Nicobar State, the Indian Institute of Public Health, Gandhinagar (IIPHG) to develop a learning mobile and web application known as "Nikshay (absence of TB) SETU (Support to End Tuberculosis) "under the USAID-funded "Closing the Gaps in TB Care Cascade" project.<sup>[14]</sup>

The Ni-kshay SETU (<u>https://nikshay-setu.in/</u>) application has been a promising solution with easy access to up-to-date information, comprehensive learning modules, and decision-support tools. This comprehensive digital platform empowers healthcare workers to deliver high-quality TB care services to manage the TB patients at community level. Moreover, the integration of TB services into Ayushman Bharat's network of HWCs further underscores the need for a robust digital solution to strengthen the reach and accessibility of TB care services.<sup>[15,16]</sup>

## **Comments onNi-kshay SETU mobile and web application** Key features

The landscaping of the application was created based on health workers cadre and level-specific individual login credentials and mapped with almost 75000+ health facilities and 6200+ tuberculosis units across all States and Union Territories of India. The app is comparatively easy to use, readily navigable, and intuitive with a clean interface. The content is distributed into six sections, i.e., Learn, Manage, Referral, Assess, Chatbot and Resource Materials. The app features an artificial intelligent (AI) driven chatbot that delivers over 70,000+ practical responses to the daily queries of healthcare personnel, spanning from front line workers to program managers to clinicians.

The application interface is designed to have brief directional learning in the form of algorithmbased decision-making interface, which takes user from the identification of presumptive TB patients to confirmation of the diagnosis to treatment completion. The modules are developed based on the national guidelines with the latest updates and contents landscaped in a precise manner in a way that supports the decision-making in TB patient management. The application is also equipped with repositories of all guidelines, global and India TB reports with learning videos on diagnostics and patient-centric care. It has quick assessment components to support the government health managers in accessing the training needs and designing the methods and modules.

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The back-end analytical dashboard with its assortment of reports greatly contributes to enhancing the capacity-building component of the NTEP interventions. The application also includes the user leader board for the completion of the modules, newer updates, app notifications and an interactive platform where a user can see the progress among their cadres.

# Navigating Ni-kshay SETU: Strengths and Weaknesses

The tester noted that app has similar interface in all three platforms: web, android and iOS that creates a wide acceptability among users across different devices and operating systems. Ni-kshay SETU exhibits numerous positive strengths contributing to its holistic nature, while it also presents weaknesses or limitations that necessitate further efforts for sustainability and scalability at a larger level.

Ni-kshay SETU's complete approach to TB care includes both excellent characteristics and needs for improvement from a program standpoint. The following observations were made:

# 1. Digital Learning Platform and Mobile Accessibility:

Strength: Ni-kshay SETU functions seamlessly on web, Android, and iOS platforms with OTP based individual login system, ensuring widespread accessibility with 40500+ users covering all States and presence in 65% districts of India.

Limitation: Despite this versatility, the application's efficiency may be influenced by the digital literacy levels of users, particularly in resource-constrained settings where internet is not available.

# 2. Patient-Centric Diagnostic and Treatment Algorithm:

Strength: The app provides a patient-centric

approach with diagnostic and treatment algorithms, promoting efficient management of TB cases.

Limitation: The effectiveness of the algorithm may be contingent on timely updates and adherence to evolving national guidelines.

## 3. Cadre-Specific Modules and Easy Navigation:

Strength: Ni-kshay SETU offers cadre-specific modules, enhancing the relevance and applicability of the content for various healthcare professionals.

Limitation: The interface's ease of navigation might still pose challenges for users with limited digital literacy.

# 4. Access to Digital Repository and Resource Materials:

Strength: The app includes a digital repository with resource materials, government orders, and guidelines, consolidating relevant information in one accessible location.

Limitation: The volume of available content could potentially overwhelm users, necessitating a user-friendly content filtering system.

# 5. Artificial Intelligence and Voice-Assisted Chatbot:

Strength: The inclusion of artificial intelligence and a voice-assisted chatbot enables the app to provide specific, timely solutions to user queries.

Limitation: The accuracy and effectiveness of the chatbot may be influenced by the complexity of queries and variations in language use.

# 6. Assessment Sections and Backend Analytical Dashboard:

Strength: Ni-kshay SETU incorporates assessment sections for health cadres, promoting continuous learning and skill development. Limitation: The backend analytical dashboard, while valuable, requires careful interpretation to translate usage patterns into actionable insights for refinement.

## 7. Multiple Indian Language Support:

Strength: The app caters to diverse linguistic needs by providing content in multiple Indian languages.

Limitation: Ensuring accuracy and cultural relevance in translations may pose challenges, impacting the effectiveness of communication.

Within the healthcare domain, numerous digital platforms have emerged, each catering to specific programs. The current necessity is to adopt an integrated approach by introducing dedicated applications for both health workers and patients or beneficiaries. These applications can encompass various domains such as knowledge management, record and reporting, program management, and communications. Ni-kshay SETU, specifically designed for knowledge management, does not necessitate patient information. However, it is essential to adhere to key considerations aligned with data privacy and ethical standards. These considerations include:

## 1. User Information Confidentiality:

Strength: Ni-kshay SETU prioritizes user data confidentiality, adhering to established norms and regulations.

Limitation: Vigilance is crucial to prevent inadvertent breaches, especially in shared or public settings.

## 2. User Authentication and Access Controls:

Strength: Secure user authentication enhances access controls for safeguarding sensitive information.

Limitation: User education on secure passwords and risks of unauthorized access is essential.

3. Secure Data Transmission and Data storage Practices: Strength: Ni-kshay SETU employs encryption for secure data transmission and data storage between the app and servers.

Limitation: Awareness of risks on public networks is vital for data security during data transmission and storage.

## 4. Informed Consent and User Awareness:

Strength: Ni-kshay SETU emphasizes informed consent, ensuring users are aware of data use and protection.

Limitation: Ongoing efforts are required to enhance user awareness of data privacy implications.

## 5. Data Sharing Policies and User Control:

Strength: Ni-kshay SETU establishes clear data sharing policies, limiting access to authorized personnel.

Limitation: User-friendly features for data control require continuous improvement to prevent unintended data disclosures.

In essence, Ni-kshay SETU represents a promising digital health intervention, excelling in accessibility, content relevance, and user engagement. Yet, sustained impact requires ongoing efforts in digital literacy, content management, and user feedback. Additionally, the app's robust data privacy measures necessitate continual vigilance and education to uphold its integrity in safeguarding sensitive healthcare information.

## **Conclusion:**

The development of the Ni-kshay SETU mobile and web application represents a significant progress in addressing the training needs of healthcare professionals involved in tuberculosis (TB) care. The commendable aspect of the developers is in their forward-thinking methodology and unwavering commitment towards creating a comprehensive digital reference tool. The integration of Ni-kshay SETU with the pre-existing TB patient program reporting platform, known as "Ni-kshay," holds the promise of enhancing the overall implementation quality of the program.On the context of numerous digital platforms providing information on tuberculosis (TB), Ni-kshay SETU distinguishes itself by giving brief and simply available learning materials that are grounded on evidence-based practices and adhere to established guidelines.

## Acknowledgement:

Authors wish to thank the team of Ni-kshay SETU and experts from the Indian Institute of Public Health, Gandhinagar for providing valuable inputs and feedback to the final draft of the manuscript.

## **Declaration**:

Funding: Nil

## Conflict of Interest: Nil

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The objective of the digital application is to deliver ease of access to the service providers with the scientific contents directed towards the patient-centric TB care.

## **Key Features of Ni-Kshay SETU**



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Knowledge Support Care Cascade Algorithm - NTEP guideline-based modules for the TB patient management



Multi-Lingual Support Multiple Language Support with manually edited content.



Voice-assisted AI chatbot provides practical solution for more than 70,000 NTEP operational functions.



Assess yourself to the content and cadre specific questions based on NTEP guidelines.

