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# Indian Journal of Public Health Research & Development

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## Contents

	Page No.
1. <b>Invisible Hands, Unprotected Lives: Occupational Health Risks among Urban Indian Rag Pickers</b> <i>Adithya C Nambiar, Mihir Kumar Mallick</i>	1
2. <b>Sleep Disturbances and Sleep Quality among Individuals Diagnosed with Osteoarthritis: A Systematic Review Protocol</b> <i>Priyanka Sahu, Ansuman Panigrahi, Swati Sambita Mohanty, Purnashashi Behera, Jewel Ipsita Sahani, Rutuparna Sibani Dandsena, Narayana Swamy D M</i>	9
3. <b>A Study on Prevalence of Hypertension and Its Associated Risk Factors Among School Going Adolescents of Banda District</b> <i>Ajay Yadav, Suneel Kumar Kaushal, Mohd. Maroof, Lal Divakar Singh, Shailendra Singh Chaudhary, Saurabh Tripathi</i>	13
4. <b>Habitual Level of Physical Activity in Free-living Older Adults: An Exploration of Gender Differences</b> <i>Aavani Saij Shyam, Sandeep PH, Saritha K Francis</i>	18
5. <b>Exploring Mental Health and Quality of Life of Transgenders of North India: An Anthropological Perspective</b> <i>Abhinandana Singh, Raminder Kaur, Shriya Kalia, Maninder Kaur, Jagriti Mehta</i>	25
6. <b>Histopathological Features and Clinical Variants of Psoriasis in a Tertiary Care Centre in Western Uttar Pradesh</b> <i>Abhishek Chauhan, Shweta Grover, Meenakshi Tyagi, Anupam Varshney, Rajnish Kumar</i>	34
7. <b>Building Resilient Health Systems Through Community Voices: Insights from Delhi During COVID-19</b> <i>Anisur Rahman, Sakhi John, Shibu John</i>	40
8. <b>Family and Childhood Adversity: A Quantitative Study of Household Dysfunction using ACE-IQ Data from Madhya Pradesh</b> <i>Anusree Jayamohan, Shashi Prabha Tomar, Prashant Verma</i>	47
9. <b>Mapping Child Survival: A District-Level Assessment of SDG-3 Target for Under-five Mortality Rate in Assam</b> <i>Arjina Begum, Sanjay Sinha</i>	55
10. <b>Factors Influencing Drug-Resistant Tuberculosis Treatment Outcomes in Banda District of Bundelkhand Region</b> <i>Ashish Kumar, Shailendra Singh Chaudhary, Saurabh Tripathi, Suneel Kumar Kaushal, Lal Divakar Singh, Mohd. Maroof</i>	64
11. <b>Factors Influencing Home Deliveries in Kerala: A Focused Ethnographic Study in Malappuram District</b> <i>Athira K, K Rajasekharan Nayar</i>	70

12.	<b>Daily Assessment of Infection Control Practices: Effective Strategies in CLABSI Management at a Tertiary Health Care and Research Centre</b>	77
	<i>Bindu Jadeja, Juliah Chelliah, Aparna Naik, Shaoli Basu, Anjali Shetty Camilla Rodrigues</i>	
13.	<b>Prevalence and Antibiotic Resistance Profiles of Uropathogens in Haldia, an Industrial City in Eastern India</b>	86
	<i>Biswajit Chakraborti, Ramsundar Kamilya, Sanchari Basu, Sourav Pradhan, Sourav Biswas, Pikash Pratim Maity, Debabrata Adak, Nirmalya K. Sinha, Smarajit Maiti</i>	
14.	<b>Association between Knowledge of the Recommended Physical Activity Guidelines and Physical Activity Levels among Adults</b>	96
	<i>Brinda P, Sandeep P H, Saritha K Francis</i>	
15.	<b>Prevalence of Self-Medication Among Medical Students at Science and Technology University, Sana'a Yemen 2024: A Cross-Sectional Study</b>	104
	<i>Butheina Abdul-Wally Alamrani, Amal Ahmed Alawi Alahmadi</i>	
16.	<b>Applicability of PALM-COEIN Classification for Categorization of Abnormal Uterine Bleeding: A Clinico-Confirmatory Comparison in Women from South India</b>	112
	<i>Arthi Ekambaram, K. S. Rajarajeswari</i>	
17.	<b>Epidemiology of Patients Presenting with Posterior Segment Trauma to a Tertiary Care Eye Hospital in Eastern Uttar Pradesh, Following Closed Globe Injury</b>	120
	<i>Indranil Saha, Ashima Varshney</i>	
18.	<b>Prevalence of Depression, Anxiety and Stress among Tuberculosis Patients of Belagavi</b>	131
	<i>Melkey Stephen Bunyan, Mubashir Angolkar, Ashwini Narasannavar Anagha Prakashan Kappadan</i>	
19.	<b>Beyond Hospitals: NCD Knowledge, Attitudes and Practices for Healthier Futures Among Rural Population of Central Gujarat: A Block Level Observational Study</b>	139
	<i>Mistri P, Roy S<sup>2</sup>, Roy K</i>	
20.	<b>Physical Activity and Its Impact on Sleep Quality and Sleep Hygiene Among Physiotherapy Students: A Cross-Sectional Study</b>	147
	<i>Mohit Kumar, Sandeep Kumar, Smati Sambyal, Armanjot Singh Walia, Shivam Monga, Mitali Raj</i>	
21.	<b>Bacteriological Spectrum and Antibiotic Susceptibility of Non-Fermenting Gram-Negative Bacilli in Bloodstream Infections</b>	154
	<i>Mrudul Randive, Desma D'souza, Chaitanya Kanade, Prachi Srivastava, Rohini Gaikwad, Priyanka Kale, Dilip Turbadkar</i>	
22.	<b>Comparative Analysis of Perception of MBBS Students on Foundation Course: A Questionnaire Based Study</b>	163
	<i>Nabanita Barua, Pramit Ghosh, Ranjita Santra, Shuchi Agarwal, Sanjeev Das, Supratim Datta</i>	
23.	<b>Association of Physical Factors (BMI and WHR) with Physical Activity Level (PAL) and Gender-wise Comparison among College Students</b>	172
	<i>Nadim Haider, Somnath Gangopadhyay, Alok Chattopadhyay</i>	
24.	<b>A Comparative Study of Diseases Prevalence among Tribal Women in Different Villages of Khowai District, Tripura: A Hospital Data - Using GIS</b>	180
	<i>Palaniyandi Masimalai, Jebina Kaipeng, Probhu Boro</i>	

25.	<b>Geographical analysis of Hepatitis-B and Hepatitis-C patients in the selected two districts of Tripura, India-using GIS</b>	192
	<i>Palaniyandi Masimalai, Tania Akhter, Probhu Boro</i>	
26.	<b>Socio Demographic and Occupational Risk Factors as Determinants of Musculoskeletal Disorders among Women in Unorganized Sectors</b>	204
	<i>Paramasivam Parimalam, Thirumoorthy Amaravathi, Ganesan Sashidevi, Anind Kumar Ganguli, Baskaran Sivasankari</i>	
27.	<b>Impact Assessment of Monthly Informal Health Awareness Sessions, as a Part of the Village Adoption Scheme on the Knowledge, Attitude and Practices of Menstrual Health and Hygiene, in Young Women, Over Three Years in a Rural Setting in Central Maharashtra</b>	215
	<i>Rhea Aggarwal, Adarsh Keshari, Sheetal Gaur, Arjunkumar Jakasania</i>	
28.	<b>Preventive Health Check-Up: A Welfare Initiative for the Truck Drivers</b>	223
	<i>Sahil Jagnani, Ankit Chowdhury, Snigdha Saikia</i>	
29.	<b>Assessment of Beneficiaries Satisfaction under Ayushman Bharat Pradhan Mantri Jan Arogya Yojana (AB-PMJAY) in Banda District of Uttar Pradesh</b>	232
	<i>Sarang, Pooja Chaudhary, Suneel Kumar Kaushal, Lal Divakar Singh, Mohd. Maroof, Shailendra Singh Chaudhary</i>	
30.	<b>Barriers to Genetic Counselling and Testing among Breast and Ovarian Cancer Patients in low Middle-income Country Referral Hospital: A Prospective Study</b>	238
	<i>Siripurapu Indraja, Gowda Nishil, Maka Vinayak V, Palassery Rasmi, M MounaB, Devadas Santhosh Kumar</i>	
31.	<b>Morbidity Profile of Children at a Construction Site: Reaching the last Mile</b>	246
	<i>Sonal Raut, Satish Shahane, Monica Jambhulkar, Rishikesh Wadke</i>	
32.	<b>Procalcitonin as a Biomarker for Predicting Clinical Utility in Cases of Neonatal Sepsis: Outcomes from a Single-Centric Procalcitonin Monitoring Study</b>	253
	<i>Subhranil Mal, Neha Karar, Biyanka Sau, Arpita Bain, Suhena Sarkar</i>	
33.	<b>Environmental Tobacco Smoke and its Impact on Wheezing Disorders and Early Childhood Caries among Children Aged 30-60 Months in Mangaluru, South India</b>	260
	<i>Supriya Amanna, Rekha Shenoy, Praveen Jodalli, Imran Pasha,</i>	
34.	<b>Knowledge, Attitude, and Practices Regarding Iron Folic Acid Tablets and Coverage of the Weekly Iron Folic Acid Supplementation Programme Among Rural Adolescent Girls in Nagpur District: A Cross-Sectional Study</b>	268
	<i>Varsha S. Dhurde, Archana B. Patel, Lindsey M. Locks, Patricia L. Hibberd</i>	
35.	<b>Study of Histopathological Spectrum of Leprosy with Special Reference to Bacteriological Index in a Tertiary Care Centre</b>	277
	<i>Zartab Zaki, Meenakshi Tyagi, Shweta Grover, Anupam Varshney, Shezan Rasool</i>	

# Invisible Hands, Unprotected Lives: Occupational Health Risks among Urban Indian Rag Pickers

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## Abstract

**Background:** Ragpickers perform essential yet hazardous work, handling waste without protective equipment. Their occupation exposes them to physical injuries, respiratory illnesses, infections, and chronic conditions, compounded by poor socioeconomic status and exclusion from healthcare services.

**Methods and Materials:** A literature search was conducted using Google Scholar and PubMed. The findings were thematically grouped into six themes: physical/chemical risks, biological conditions, social stigma, COVID-19, government/NGO support, and child vulnerability.

**Results:** Findings indicate that they suffer from respiratory illness, musculoskeletal disorders, dermatological, and gastrointestinal infections. It has been noted that women faced increased reproductive health issues and a rise in anemia. Access to personal protective equipment such as gloves, masks, and footwear was restricted. Structural barriers like social exclusion and denial of welfare access were widespread.

**Conclusions:** This review highlights the urgent need for their inclusion in policy through enhanced registration, distribution of PPE, health monitoring, and specific acknowledgment, leveraging existing frameworks such as the Occupational Safety, Health, and Working Conditions Code (2020), Solid Waste Management Rules (2016), Ayushman Bharat, and the National Urban Health Mission (NUHM).

**Keywords:** Rag pickers, Occupational Health, Waste Management, Health Hazards.

## Introduction

Occupational health is a crucial aspect of public health, focusing on the enhancement and maintenance of optimal levels of physical, mental, and social

well-being among workers across various sectors. Occupational health encompasses the prevention of occupational diseases and injuries, workplace safety, health promotion, and the protection of vulnerable groups through systematic policy implementation

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and monitoring (WHO, 1995). Although occupational health systems are better developed for formal sector workers in India, the large informal sector workforce, which employs nearly 90% of the workforce, remains out of reach of organized occupational safety measures [1].

Rag pickers and street waste collectors are an extremely marginalized group in the informal economy. They have a vital role to play in the Indian urban waste management system, which allows for the recovery and recycling of large volumes of solid waste that would otherwise be a burden on municipal systems. Despite their important ecological and economic contributions, rag pickers are subjected to extreme occupational hazards: they labor in open dumps, landfills, and street corners with no protective equipment, health cover, or legal protection. Constant exposure to rotting organic waste, broken glass, biomedical waste, and toxic industrial effluents is common<sup>[2,3]</sup>. Their workplaces are typically unhygienic and unregulated, leading to high rates of injury, infections, respiratory diseases, and chronic diseases.

Women and children make up a significant proportion of the workforce of rag pickers, and the majority of the children start waste collection activity from the age of five<sup>[4]</sup>. Female rag pickers are subjected to greater reproductive health-related hazards, including anemia<sup>[5]</sup> and are victims of sexual violence<sup>[4]</sup>. As a vital component of the urban waste management systems, rag pickers are often neglected in government policy, occupational health schemes, or municipal planning systems. Initiatives such as the Swachh Bharat Mission and Solid Waste Management Rules (2016) have not effectively integrated these individuals' concerns regarding security, recognition, or access to services<sup>[2],[6]</sup>, thus exacerbating their existing exclusion.

This review aims to synthesize the occupational health risks, institutional exclusion, and safety management deficiencies that Indian city waste workers and rag pickers face. Drawing from different studies, the review synthesizes the evidence into six main themes: physical and chemical hazards, biological health concerns, social exclusion and stigmatization, effects of COVID-19, government and non-government organization support, and risk to

children. In addition, it includes comparative insights from global literature to contextualize the problems that India faces within the broader global south context.

### Objectives of the study

This qualitative narrative synthesis tries to:

1. Summarize and encapsulate the main occupational health risks, including physical, chemical, and biological hazards, that are typically encountered by rag pickers and informal waste pickers in urban areas across India.
2. Analyze the socio-structural determinants of the vulnerability of this group, specifically to the roles of social stigma, discrimination, and the lack of support from the government and NGOs.
3. Study the specific challenges and sites of frustration for informal waste pickers, particularly children and youth, in specific crises such as the COVID-19 pandemic.
4. State key gaps in the existing policies and interventions relating to informal waste management, and present evidence-based policy recommendations to enhance the health, safety, and social inclusion of Indian city rag pickers.

### Method of the study

This review applies narrative synthesis to discuss occupational health hazards and safety management issues of rag pickers and waste pickers in Indian cities. This is a qualitative summation and descriptive synthesis of evidence from previous research with the aim of determining key themes, trends, and gaps in the literature. The main aim was to generate thematic findings in six outlined areas: (1) chemical and physical risks, (2) biological health hazards, (3) discrimination and social stigma, (4) impacts of COVID-19, (5) government and non-government organization support, and (6) child labor or exposure in informal waste collection.

A comprehensive literature search was conducted on all major academic databases, i.e., Google Scholar, PubMed, and additional data were also gathered from grey literature on institutional websites and public health organizations.

Inclusion criteria were: (a) articles between 2004-2025, (b) English language articles, and (c) articles that were specifically on one or more of the six theme areas. The literature selected included research from various urban settings in India, as well as relevant research from the Global South. The review of foreign literature sought to draw comparative lessons on common issues, diverse policy responses, and best practices, if any, in comparable socio-economic settings, thus enhancing the understanding of India's distinctive occupational health situation.

## Results

The result of the analysis has been arranged as follows:

### Physical and Chemical Hazards

The literature recognizes that the informal waste collectors and rag pickers are exposed to numerous physical and chemical hazards while working and therefore present a serious health and safety risk to their lives. The danger is also increased due to a critical lack of personal protective equipment (PPE) since studies have found that over 90% of the workers never practice any form of protection<sup>[7]</sup>. This deficiency leads to frequent direct contact with hazardous waste, such as sharp objects, commonly causing cuts and puncture wounds, with incidence reported to be over 91% in some studies<sup>[3,8]</sup>. A critical concern is the presence of biohazardous materials like used condoms, sanitary napkins, open syringes, and saline bottles, directly exposing workers to serious infectious diseases like HIV and hepatitis<sup>[9]</sup>.

Workers are also exposed to airborne pollutants and various chemicals in the air<sup>[2,10]</sup>. Specific chemical risks include instances of metal poisoning and asbestos poisoning, and eye irritation<sup>[11,8]</sup>. The decomposition of organic matter not only contributes to chemical exposure but also creates unpleasant and potentially harmful environments, leading to an increased risk of skin infections, gastrointestinal illnesses, and exposure to airborne pathogens<sup>[12]</sup>. Furthermore, workers are vulnerable to burn injuries<sup>[13]</sup>. A study<sup>[5]</sup> reported that 16.5% of workers sustained animal bites from dogs and rats, which are common in areas where waste collection occurs. The physical demands of the work, including heavy lifting and repetitive

motions, result in the prevalence of musculoskeletal issues such as back pain (40%) and joint pain<sup>(8)</sup>.

### Biological Ailments

A high incidence of biological disease among rag pickers and informal waste collectors, primarily as a result of their hazardous working and living conditions. Respiratory impairment is very prevalent, with the majority of studies reporting high rates of both Upper Respiratory Symptoms (URS) and Lower Respiratory Symptoms (LRS), 75.5% and 81.6% respectively, among rag pickers<sup>[2]</sup>, often accompanied by breathlessness in about 47%<sup>[3]</sup>. Gastrointestinal symptoms, including vomiting, ulcers, diarrhea, and jaundice, are also very prevalent.<sup>[2,3,5,9,14]</sup> These enteric diseases are frequently explained by poor diet, since numerous workers survive on consuming food waste from dumps<sup>[9,10]</sup> and are highly food insecure<sup>[15]</sup>, as attested to by their reported low body mass index (BMI)<sup>[16]</sup> and high malnutrition rates<sup>[7-9,12,15]</sup>.

They also have a high rate of dermatitis<sup>[2]</sup>, skin infections<sup>[12,16]</sup>, fungal infections, parasitic infestations<sup>[7,12]</sup>, and high white blood cell (WBC) counts<sup>[2]</sup>. Tuberculosis is also very common among them, and its worsening and progression are driven by low standards of hygiene.<sup>[5,7,8,10,16]</sup>

In addition, many studies have established the high rates of alcohol<sup>[10,14,15]</sup>, tobacco<sup>[8, 11, 12, 15]</sup>, and glue sniffing<sup>[10]</sup>. Such addictions also contribute significantly to dental issues such as gingivitis, gum swelling, teeth staining, and oral cancer. Many people reported no access to health care support from the government or NGOs<sup>[23]</sup>. This low utilization of formal health care services is largely a result of their low socioeconomic status, as well as the huge social stigma attached to their occupation<sup>[11,12]</sup>. Health-seeking behavior among women ragpickers was strongly influenced by economic pressures and work schedules, with many delaying care to avoid loss of daily income.<sup>[16]</sup>

### Social Stigma and Discrimination

The large majority of migrant workers who are from Eastern India and Bangladesh<sup>[2]</sup>, are often subjected to the worst social stigma and discrimination in urban centers where they are usually housed in

slums. They are routinely treated as 'untouchables'<sup>[7]</sup>. A study said that 52% of the rag pickers said that the members of society go out of their way to avoid them<sup>[3]</sup>. Such exposure is especially heightened for adolescent girls working as waste pickers, with greater danger of all kinds of harassment, ranging from eve-teasing, theft, robberies, to, most seriously, rape<sup>[10]</sup>.

Despite these robust barriers, many workers do gain a sense of dignity and autonomy through their independent existence, viewing it as an honorable way of making their living<sup>[12]</sup>. During the COVID-19 pandemic period, this already pre-existing stigma was unfortunately amplified, as waste pickers were often mistakenly stigmatized and excluded as 'virus carriers'<sup>[4]</sup>, thus further intensifying their psychosocial suffering. Second, the ubiquitous absence of official status is the basis of much of this discrimination; there are many paperless families, lacking even basic identification such as Aadhaar cards<sup>[15]</sup>. This absence of official status is directly responsible for their exclusion from important government welfare programs, such as the Integrated Child Development Services (ICDS)<sup>[18]</sup>, thus further intensifying their marginalization and consolidating their weak status<sup>[4]</sup>. A study also found that stigma and social exclusion intersect with economic deprivation, reinforcing healthcare neglect, with most respondents seeking care only in emergencies and largely relying on unqualified providers<sup>[22]</sup>

### COVID-19 Impact

The COVID-19 pandemic severely disrupted the lives and economic security of informal waste collectors and rag pickers, intensifying their existing vulnerabilities. Work ceased significantly, causing a drastic decline in earnings<sup>[15]</sup>. Their poor living conditions, lacking sanitation and privacy, made self-isolation impossible, directly exposing them to COVID-19<sup>[4]</sup>.

Despite handling a 10-15 fold increase in biomedical waste (e.g., masks, gloves, hospital materials), waste workers were not prioritized for personal protective equipment, training, or medical care<sup>[13, 17]</sup>. They continued working during lockdowns without sanitary protocols, facing increased workloads without protection or proper

remuneration<sup>[17]</sup>. Inefficient door-to-door waste collection also led to higher concentrations at collection points, further increasing their exposure<sup>[17]</sup>. The pandemic deepened socio-digital exclusion, as many were unable to access digital healthcare and education services, often excluding them from vital government support programs and healthcare<sup>[6]</sup>. Additionally, parental work demands worsened child-rearing behaviors, leading to poor academic performance and loss of access to Integrated Child Development Services (ICDS)<sup>[18, 6]</sup>.

### Government and NGO support

Studies repeatedly point towards a dearth of serious formal support from governmental departments or an entire safety net; a staggering 100% of the participants in some studies received absolutely no support from the government or NGOs, and they had minimal access to basic medical facilities, education, PPE, or legal safeguards<sup>[3]</sup>.

Municipal health systems are mostly inaccessible, with most using private clinics or traditional healers due to cost and fear of discrimination, instead of municipal hospitals<sup>[8,15,16]</sup>. Remarkably, 75% had never attended a health camp, indicating huge gaps in outreach<sup>[8]</sup>. In workplaces, basic human needs are appallingly lacking; most landfills have no basic water, toilet, washing, or shaded resting areas, and local government attempts at upgrading facilities or inspecting for safety are negligible<sup>[10]</sup>. In addition, workers typically earn subminimum wages under outsourced municipal contracts, get no formal health training, have no job security, and are not eligible for retirement or injury benefits<sup>[7,13,19]</sup>. The Solid Waste Management Rules (2016), intended to cover rag pickers, have basically failed at the grassroots level, with private contractors increasingly taking over waste. While some intermittent humanitarian relief, such as occasional dry rations, was given during lockdowns, it was generally not available due to paperwork<sup>[4]</sup>. While NGOs and civil society occasionally offer routine health interventions, these are episodic and without a systematic long-term effect.<sup>[5,11]</sup>

### Child Labor or Vulnerability in Informal Waste Collection

Repeated research findings show that children as young as five years old, and in some cases even infants

as young as three months, are working day and night in dump yards or are being taken to hazardous sites by parents<sup>[4,7,15]</sup>. Scary facts show that over 60% of the labor force involved in rag picking are children and youth, of which 22% are below 10 years of age and 39% are between 10 and 20 years of age<sup>[2,3]</sup>.

These children, often without footwear or basic protective equipment, are thus exposed to an unprecedented range of dangers. These children are exposed directly to highly poisonous chemicals, cut materials, smoke, and other chemicals, and are most vulnerable due to their underdeveloped detoxification systems, leading to disproportionate levels of toxins with body weight<sup>[7,11]</sup>. Apart from material hazards, these children also experience psychological damage from surroundings where aborted fetuses or dead animals are tossed around carelessly, with adolescent girls being more vulnerable to sexual harassment, molestation, robbery, and theft, and thus dropping out of the fieldwork to look for other similar jobs<sup>[8,12]</sup>. Their development is weak because malnutrition, low birth weights, and high mortality rates among children are the norm<sup>(8,12)</sup>. Many children are deprived of schooling altogether, or are educated but do not attend due to backbreaking labor demands, along with the digital divide in the time of COVID-19<sup>[3,6,8]</sup>. This widespread educational disadvantage, combined with the observation of drug abuse in the household (56.7%) and widespread emotional neglect, creates maladaptive behavior and strongly discourages physical and mental development<sup>[4,12]</sup>. The intergenerational nature of this labor, as children are forced to accompany their parents, and caste and occupational bias within schools, continues a miserable cycle of risk and abused childhood<sup>[6,14]</sup>.

## Discussion

This study unlocks the long-standing occupational risks that define rag pickers' work and lives in Indian cities. Their health risks are not just environmental but also the product of systemic negligence, social exclusion, and policy implementation failure.

The cumulative effect of injuries, chronic illnesses, and poor healthcare access likely shortens life expectancy among ragpickers. While India-specific lifespan data are scarce, international evidence is stark: in Mexico City, dumpsite waste collectors

live on average just 39 years compared to the national average of 69<sup>[20]</sup>, and in Egypt's Zabbaleen community, infant mortality was 240 per 1,000 births in 1981 compared to ~45 per 1,000 in Cairo<sup>[21]</sup>. These trends align with Indian data indicating untreated chronic diseases, malnutrition, and a lack of insurance among ragpicker populations<sup>[22,5,8]</sup>.

Furthermore, their current statistical invisibility due to exclusion from official records must be immediately rectified through inclusive data collection, as evidence-based policy cannot be formulated for an unseen population. The protection and holistic development of these children is an unequivocal priority.

In conclusion, this review underscores that the dependence of Indian cities on ragpickers, juxtaposed with their systematic exclusion from rights and dignity, presents a critical ethical dilemma. The future well-being of these essential workers, and indeed the sustainability of urban waste management, hinges on a fundamental paradigm shift: explicitly recognizing ragpickers as integral and rights-bearing urban citizens.

## Policy Recommendations

With the high incidence of weaknesses and absence of institutional control, urgent and effective policy measures are necessary in an effort to protect the occupational health and social well-being of Indian informal waste workers.

1. **Formal Recognition and Social Inclusion:** Establish inclusive policies for the formal recognition and registration of all informal waste pickers, giving them unrestricted access to government-issued identity cards.
2. **Compulsory PPE Provision and Training:** Enact policies requiring free and uniform provision of suitable Personal Protective Equipment by local authorities. This should go hand in hand with mandatory, culturally sensitive training in the use of PPE and the safe handling of waste.
3. **Workplace Infrastructure and Environmental Remediation:** Call for the provision of amenities at dumping sites and collection points, such as safe drinking water, functioning toilets, washstands, shaded resting places, and storage space. At the same

time, launch large-scale scientific closure and ecological restoration schemes for landfills, viewing them to be serious health and environmental risks to rag pickers and local populations alike.

4. Education, Reintegration, and Child Protection: Enact and enforce child labor laws against waste picking. Offer specialized education, reintegration, and rehabilitation for child waste pickers, such as scholarships, safe study facilities, and overcoming challenges like family drug abuse and home financial instability.
5. Better Policy Implementation and Monitoring: Interconnect existing policies (e.g., SWM Rules 2016, Occupational Safety Code 2020) and reality on the ground by enforcing, monitoring, and holding local governments and private contractors accountable. Make these policies clearly facilitate informal workers' inclusion in formal waste management.

These proposals collectively aim to shift the paradigm from reactive neglect to proactive recognition, protection, and inclusion of this valuable but underutilized workforce and also address broader environmental consequences of waste management.

### Limitations

This evaluation, despite its thoroughness, has several limitations. The research relies solely on secondary sources, lacking primary data collection or field observations. Moreover, the ability to make quantitative comparisons across studies was restricted due to differences in sample sizes, study methodologies, and health indicators, which hindered the potential for a more standardized aggregation of prevalence rates.

### Conclusions

- Systemic Injustice and Invisible Labor: The India-based informal waste pickers are not only informal workers but also the invisible infrastructure of the urban world. They live and die among garbage because of an inherently skewed and morally reprehensible system that leaves them out of the law, denies them protection through policy, and renders them invisible to society.

- Call for Fundamental Recognition: The assessment calls for progress beyond basic reform, encouraging the recognition of their labor as a civic responsibility, the recognition of wastage as a collective responsibility, and the recognition of their inherent dignity as non-negotiable.
- Justice as Policy Imperative: Policy inclusion of rag pickers is a question of justice, not philanthropy, as urban development is hollow, law is incomplete, and the collective conscience is impure without them.
- Reconceptualizing Citizenship and Development: It is of utmost significance to regard rag pickers as basic members of society, realizing that any society that bases its development on the work of its most marginalized members cannot truthfully claim its development status.

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# Sleep Disturbances and Sleep Quality among Individuals Diagnosed with Osteoarthritis: A Systematic Review Protocol

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## Abstract

**Background:** Osteoarthritis (OA) is a leading cause of chronic pain and disability, particularly affecting weight-bearing joints such as knees and hips. While the impact of knee and hip OA on physical function is well-recognized, there is increasing concern about how these conditions influence sleep disturbances and overall sleep quality.

**Objectives:** This systematic review will assess the level of sleep disturbances, associated factors, and various aspects of sleep quality such as type, pattern, duration, onset time, and efficiency as well as to evaluate effective interventions for improving sleep among patients diagnosed with knee and hip osteoarthritis (KHOA).

**Methods:** Following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA- P) guidelines, this study aims to assess and consolidate data on sleep issues and quality in knee or hip osteoarthritis. It will be conducted across electronic databases, including Medline via PubMed, CINAHL via EBSCO, EMBASE, Scopus, ScienceDirect, and Web of Science. Additionally, grey literature will be explored using Google Scholar, ProQuest and Sodhganga.

**Expected outcomes:** This study will provide a comprehensive understanding of the extent of sleep issues and disorders, characteristics of sleep quality as an impact of KHOA. The findings will be valuable for policymakers and healthcare providers in developing effective strategies to enhance the quality of life for individuals with OA who experience sleep disturbances.

**Keywords:** Sleep disturbances; Sleep quality; Osteoarthritis; Systematic review

**Prospero registration number:** CRD42024547589

## Background

Osteoarthritis (OA) is a leading cause of chronic pain and disability, particularly affecting weight-

bearing joints such as knees and hips<sup>1-3</sup>. This degenerative joint disease is marked by the progressive breakdown of cartilage, leading to pain, stiffness, and

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reduced mobility<sup>4</sup>. Current factsheet evidences 113% increase in OA cases since 1990 to 2019 accounting for about 365 million knee OA (KOA) sufferers followed by hip with a future prediction of rise in OA till 2050 resulting increase global health burden<sup>4-6</sup>. While the impact of knee and hip OA on physical function is well-recognized, there is increasing concern about how these conditions influence sleep disturbances and overall sleep quality. Both knee and hip osteoarthritis are associated with significant discomfort that can interfere with the ability to achieve restful sleep. Patients often experience pain that disrupts their sleep patterns, leading to difficulties falling asleep, frequent awakenings, and diminished sleep quality. These sleep disturbances not only exacerbate the pain but also contribute to a broader spectrum of health issues, including mood disturbances, cognitive impairment, and decreased overall quality of life<sup>7-9</sup>.

Understanding the specific impact of knee and hip OA on sleep is essential for developing effective management strategies. While both types of OA can lead to sleep problems, the exact nature and extent of these disturbances may vary between knee and hip OA due to differences in joint function, pain patterns, and patient activity levels. Till now, there is no systematic review on the prevalence and assessment of sleep disorders/disturbances and sleep quality among patients diagnosed with knee and hip osteoarthritis (KHOA). This research aims to examine the impact of knee and hip osteoarthritis on sleep disturbances and sleep quality, exploring how the severity of symptoms in these two types of OA affects sleep patterns. By exploring these dynamics, the study seeks to highlight the importance of addressing sleep issues in the management of OA and to inform strategies for enhancing both sleep and overall health in affected individuals.

### Objectives

1. To determine the level of sleep disturbances among individuals diagnosed with knee and hip osteoarthritis
2. To uncover the factors associated with sleep disturbances in individuals with knee or hip osteoarthritis
3. To assess various aspects of sleep quality such as type, pattern, duration, onset time, and efficiency as well as to evaluate effective interventions for improving sleep

### Research question

What are the evidences about sleep disturbances/ disorders and sleep quality among patients diagnosed with knee or hip osteoarthritis?

### Methods

Following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA-P) guidelines<sup>10</sup>, this systematic review aims to assess and consolidate data on sleep issues and quality in knee or hip osteoarthritis (KHOA). The comprehensive protocol has been registered in the PROSPERO database with the registration number – CRD42024547589

#### Study selection criteria:

Inclusion criteria:

- Original research examining sleep disturbances, or aspects of sleep quality in patients with KHOA
- Accessible full-text articles
- Articles published in English language in the last 20 years (2004 - 2024)

Exclusion criteria:

- Case reports, case series, reviews (including literature, scoping, systematic, and umbrella reviews), editorials, conference proceedings, policy briefs, letters, reports, synopses, and documents related to policy or programs that lack evidence-based information on sleep issues and quality in KHOA patients
- Studies focusing on osteoarthritis in joints other than knee or hip
- Studies not assessing sleep disturbances or quality or interventions related to sleep improvement in KHOA

#### Eligibility criteria:

Population:

- Persons with all age group
- Clinically relevant KHOA as per the diagnosis of physician
- Self-reported KHOA patients with confirmed radiological findings or computed tomography (CT) scan

**Exposure:**

- Factors influencing sleep disturbances/ disorders such as pain, medication use, psychological factors, physical activity level etc.
- Interventions improving sleep quality in KHOA patient population

**Outcomes:**

- Prevalence of sleep disturbances/sleep disorders concerning KHOA as main outcomes.
- Factors contributing to sleep problems in KHOA
- Changes in sleep quality including sleep onset, duration, efficiency, latency, type, patterns etc.
- Effective sleep assessment measures
- Effective treatment modalities for sleep issues concerning KHOA.

**Search strategy:**

A systematic search will be conducted across electronic databases including Medline via PubMed, CINAHL via EBSCO, EMBASE, Scopus, Science Direct, and Web of Science. The structure of the search strategy will be prepared as per the requirements of the research question and the necessary formats that are unique to the databases. Additionally, grey literature will be explored using Google Scholar, ProQuest and Sodhganga.

**Study screening and selection:**

Once the data and references will be compiled, they will be extracted in various formats such as CSV, RIS and other formats. Then all the studies will be imported into Rayyan QCRI software to eliminate any duplicates. Screening will be done in two phases: title-abstract screening and full-text screening. Title-abstract screening will be carried out independently by three reviewers according to the inclusion and exclusion criteria. Conflicts will be resolved by discussion with third reviewer. Full-text articles meeting the inclusion criteria will be undergone a detailed evaluation by two impartial reviewers. Any disagreements regarding the inclusion of potentially eligible studies will be resolved through discussion with a third consulting reviewer. A record of excluded articles during full text screening will be created, detailing the reasons for exclusion based on

the eligible study criteria. Relevant studies will be organized by study design, osteoarthritis, and sleep components, and then those will be compiled into an excel sheet in a tabulated format.

**Data extraction:**

A pre-designed pilot coding form will be used for extracting key data from the included studies to synthesize evidence on the impact of KHOA on sleep, aligning with the overall objective. This form will capture essential details such as the study setting, period, sample size, publication date, and authors. The data extraction sheet will cover:

- Study characteristics
- Participant characteristics
- Methods for assessing sleep
- Outcomes related to sleep disturbances and quality
- Main findings and conclusions

**Data synthesis and subgroup analysis:**

Following the synthesis without meta-analysis (SWiM) guidelines<sup>11</sup>, a narrative synthesis will be conducted to review sleep assessments related to knee and hip osteoarthritis. If significant heterogeneity is present, indicated by I<sup>2</sup> calculations, subgroup analyses and meta-analyses will be performed where appropriate to derive key findings.

**Quality appraisal to prevent risk of bias:**

Quality appraisal will be conducted independently by three reviewers as needed. As per the need, the risk of bias will be assessed following the Joanna Briggs Institute (JBI) guidelines<sup>12</sup>.

**Discussion**

As previously outlined, this study aims to provide a comprehensive understanding of the extent of sleep issues and disorders, characteristics of sleep quality as an impact of KHOA. It will also explore factors contributing to sleep problems, sleep assessment tools, and effective treatment interventions. These findings will be valuable for policymakers and healthcare providers in developing effective strategies to enhance the quality of life for individuals with OA who experience sleep disturbances.

## Limitations

This study may be limited by its exclusive use of six databases and its restriction to English-language publications. As a result, relevant studies published in other languages or those indexed in other databases may be inadvertently excluded. The search is restricted to studies published in the last 20 years, which may omit relevant findings prior to 2004.

## Expected outcomes

We aim to determine the extent of sleep disturbances, including sleep type and pattern, duration, latency, efficiency, and onset time. Additionally, we will assess sleep measures to identify effective interventions for addressing sleep issues and quality.

## Author contributions

Concept and design: AP, PS

Acquisition of data: PS, AP, SSM, PB, JIS, RSD, NSDM

Analysis and/or interpretation of data: AP, PS

Drafting of the manuscript: PS, AP

Critical revision of the manuscript for important intellectual content: AP, PS, SSM, PB, JIS, RSD, NSDM

Approval of the version of the manuscript to be published: AP, PS, SSM, PB, JIS, RSD, NSDM

## Declarations:

**Competing interests:** The authors declare that they have no competing interests.

**Data availability:** No data is associated with this article.

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**Ethics and dissemination:** Not Applicable

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# A Study on Prevalence of Hypertension and Its Associated Risk Factors Among School Going Adolescents of Banda District

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## Abstract

**Context:** Hypertension is increasingly recognized as a major health concern affecting adolescents, with its prevalence in India ranging from 1% to 24%. This condition, commonly linked to obesity, serves as a key risk factor for cardiovascular diseases, which remain the leading cause of deaths globally.

**Aims:** This study aimed to assess the prevalence of hypertension and identify associated risk factors among school-going adolescents in Banda district, Uttar Pradesh.

**Settings and Design:** A cross-sectional study design was used, involving 384 adolescents aged 13–18 years from rural and urban schools.

**Methods and Material:** Data collection included a semi-structured questionnaire, and statistical analysis explored the relationships between dietary habits, physical activity, sleep duration, and blood pressure categories.

**Statistical analysis used:** The data collected were entered in a Micro-Soft Excel worksheet, and then data were transferred to Statistical Package for Social Science (SPSS) software used to analyse the data.

**Results:** The study revealed that 74.48% of participants had normal blood pressure, while 13.28% were prehypertensive and 12.24% hypertensive. Socioeconomic status showed a significant association with hypertension, while family type did not. Daily breakfast consumption and regular intake of green leafy vegetables were linked to lower hypertension rates, while frequent soft drink intake increased risk.

**Conclusions:** This study highlights the importance of modifiable lifestyle factors in managing adolescent hypertension, emphasizing dietary habits and physical activity as protective measures.

**Key-words:** Obesity, Hypertension, Adolescents.

**Key Messages:** Modifiable lifestyle factors, such as balanced nutrition and regular physical activity, play a crucial role in preventing adolescent hypertension.

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## Introduction

As the prevalence of hypertension is pursued to leap up, it has emerged as a significant health issue affecting not only adults but also children and adolescents.<sup>1,2</sup> Several studies in India have identified that the prevalence of hypertension among adolescents ranges from 1% to 24%, with this percentage increasing to 26% among obese adolescents.<sup>3,4</sup> Obesity often leads to high blood pressure, which is a major risk factor for heart diseases. These cardiovascular diseases are, in fact, the leading cause of deaths worldwide. Simply put, obesity doesn't just stop at weight issues – it triggers a chain reaction, starting with high BP and leading to more severe heart-related problems.<sup>5</sup> Identifying cardiovascular risk factors like hypertension and obesity early on is crucial for public health. By catching these conditions early, we can take steps to stop the serious impacts of heart conditions later in life or grave outcomes of cardiac disorders in adulthood. This proactive approach not only helps individuals maintain a healthier lifestyle but also alleviates the broader socio-economic burden associated with heart-related illnesses. Prioritizing early detection and intervention empowers us to create a healthier future for everyone.<sup>6</sup> High blood pressure (BP) and obesity among adolescents, along with their associated health issues such as dyslipidemia, abnormal plasma glucose levels, and metabolic disorders, have seen a significant increase over the past two decades globally due to rapid socioeconomic, nutritional and epidemiological transitions. Early detection of these cardiovascular risk factors is crucial for public health as it can potentially prevent adverse cardiovascular events in adulthood.<sup>7</sup>

**Need for the study:** There is limited data on the prevalence of hypertension among school-going adolescents, particularly in rural areas like Banda district. Most existing research focuses on adults, neglecting the early identification of risk factors in younger populations. Region-specific studies linking lifestyle, dietary habits, and socio-demographic factors to adolescent hypertension are lacking. Awareness about hypertension in adolescents remains low among students, parents, and school staff. School-based screening programs are insufficient, leading to underdiagnosis of pre-hypertensive and hypertensive

cases. Early detection is crucial to prevent long-term complications, yet research in underdeveloped regions is scarce. Cultural and environmental factors unique to Banda may influence adolescent health behaviours and require localized investigation. This study is essential to inform local health policies and design effective school-based interventions for cardiovascular risk reduction among adolescents.

**Aim:** A study on prevalence of hypertension and its associated risk factors among school going adolescents of Banda district

## Objective

To estimate the prevalence of hypertension in adolescents.

To determine the Risk factors associated with hypertension in adolescents.

## Material and methods

**Study Type and Study Design** This was a community-based, cross-sectional study conducted in Banda district, Uttar Pradesh.

**Study Duration** The study was carried out from January 2025 to March 2025.

**Study Population and Setting** The study focused on school-going adolescents aged 13–18 years from rural and urban schools to ensure diverse representation. Banda district consists of eight towns and eight community development blocks.

**Sample Size Calculation** The sample size was calculated based on the prevalence of hypertension (7.2%). Using the formula:  $n = \frac{Z^2pq}{d^2}$  where  $p = 7.2\%$ ,  $q = 92.8\%$ ,  $d = 3\%$  (absolute precision), and  $Z = 1.96$  (for 95% confidence interval), the sample size was estimated to be 285. To enhance the robustness of the analysis, 384 participants were included, with 192 from rural schools and 192 from urban schools.

**Sampling Technique:** From a list of 185 schools provided by the Basic Shiksha Adhikari, one public and one private school were randomly selected from both urban and rural areas, totaling four schools. Systematic random sampling with probability proportional to size was used to select students from classes 9 to 12. A total of 96 students were selected from each school,

maintaining a ratio of 2 boys to 1 girl (16 boys and 8 girls per class). If the required sample size was not met in a school, another school was randomly selected to meet the quota. Adolescents (aged 13-18 years) with SBP and DBP levels lower than 90th percentile were considered normotensive, and subjects with BP level of 120/80 mm Hg or above, or average systolic blood pressure (SBP) or diastolic blood pressure (DBP) levels greater than equal to 90th percentile, but less than the 95th percentile, were classified as pre hypertensive. Study participants were classified as hypertensive if their SBP or DBP or both were equal to or more than the 95th percentile for age, sex, and height. Those adolescent whose BP was on higher side were followed up after 2 weeks and if the BP remains high after following then they were Counseled and then referred to physician for proper management.

**Data Collection:** Participants were informed about the study's purpose, and informed consent was obtained from both students and guardians. Data was collected using a semi-structured questionnaire focusing on health indicators, including hypertension.

**Ethical Approval:** Ethical clearance was obtained from the Institutional Ethics Committee of RDMC, Banda (IEC/RDMC/Cert/16; Date: 24/08/2023).

## Results

Most individuals are categorized as normal (74.48%), while 13.28% are pre-hypertensive, and 12.24% are hypertensive. This highlights a predominance of normal blood pressure levels within the population.

### Figure 1: Prevalence of Blood Pressure Categories in the study Population

In our study Hypertension is significantly associated with socioeconomic status ( $p=0.0071$ ), with higher rates in lower classes. Nuclear families showed higher prevalence (14.24%) compared to joint (8.47%) and third-generation families (0%), though family type association isn't statistically significant ( $p=0.244$ ).

### Table 1: Dietary and Lifestyle Patterns in Relation to Hypertension Status

Table 1-The study found significant dietary and lifestyle patterns associated with hypertension among

adolescents. Adolescents who ate breakfast daily had the lowest prevalence of hypertension (6.41%) compared to those eating breakfast fewer than three days a week, where hypertension prevalence was higher at 17.30%. This association was statistically significant with a p-value of 0.013. Participants consuming 2-3 meals per day showed a hypertension prevalence of 12.75%, while those consuming fewer than two meals per day had a prevalence of 40%, though this association was not statistically significant ( $p$ -value = 0.08). Regular consumption of green leafy vegetables was inversely associated with hypertension. Adolescents consuming vegetables 1-2 days per week had a hypertension prevalence of 12.76%, whereas those who never consumed them had a higher prevalence of 26.19%. This association was statistically significant with a p-value of 0.028. Adolescents who never consumed soft drinks had the lowest prevalence of hypertension (6.38%), while those consuming soft drinks 1-3 days per week showed a prevalence of 16.43%. This association was also statistically significant, with a p-value of 0.019.

### Table 2: Physical Activity and Sleep Patterns in Relation to Hypertension Status

Table 2- explores the relationship between physical activity, sleep duration, and blood pressure categories (Non-Hypertensive, Hypertensive, Normal, and Prehypertensive). The analysis uses chi-squared tests to evaluate statistical significance. Physical activity is categorized by the frequency of engagement (60 minutes per day). Participants who engage in physical activity 4-6 days per week show the lowest rates of hypertension and prehypertension, with 86.54% being non-hypertensive. Those who never exercise or exercise only 1-3 days per week show higher rates of hypertension and prehypertension. This variable is statistically significant, with a p-value of 0.04,  $X^2 = 6.40$ , and  $df = 2$ , indicating that regular physical activity may help prevent hypertension. Sleep duration is assessed across three categories: less than 6 hours, 6-8 hours, and more than 8 hours per day. Participants sleeping 6-8 hours per day form the majority and exhibit a relatively balanced distribution across the blood pressure categories. Those sleeping fewer than 6 hours or more than 8 hours show slightly higher rates of hypertension. However, this variable does not reach statistical significance, with a p-value

of 0.08,  $X^2 = 4.83$ , and  $df = 2$ . The findings emphasize the role of regular physical activity in reducing hypertension risk and suggest a potential, though not statistically significant, link between optimal sleep duration (6-8 hours) and healthy blood pressure levels. These insights can be integrated into health promotion strategies for managing and preventing hypertension.

### Discussion

Our study found that 12.24% of adolescents have moderate hypertension, which is higher than the 7.2% reported by **Satapathy Manjita Minarva et al. (2025)**<sup>8</sup> but lower than the 18.9% found by **M V Sumna et al. (2023)**<sup>9</sup>. These differences show how blood pressure levels vary across regions and between urban and rural areas. Pre-hypertension levels in this study (13.28%) are also higher than **Satapathy et al.'s findings (5.3%)**, suggesting that factors specific to different populations affect blood pressure trends. Our study's findings regarding the significant association between green leafy vegetable consumption and hypertension prevalence are consistent with existing research, including the studies by **Fadnis P. Vidya et al. (2020)**<sup>10</sup> and **Bagudai Satyajit et al. (2014)**<sup>11</sup>. These studies collectively highlight the importance of incorporating green leafy vegetables into the diet as a potential strategy for hypertension prevention and management. Our study found notable association between physical activity and hypertension, with individuals active 1-3 days per week experiencing higher hypertension rates (15.49%) compared to those active 4-6 days per week (3.85%). This observation aligns with findings from a study by **Kumar et al. (2020)**<sup>12</sup> which analyze a notable "relationship" between "screen time" and physical activity among middle school children in Tamil Nadu, India. However, the association between physical activity and hypertension in our study contrasts with general health guidelines that typically associate regular physical activity with reduced hypertension risk. In examining these results in the context of existing literature, the study by **Satapathy Manjita Minarva et al. (2025)**<sup>8</sup> sheds light on the effects of consuming soft drinks on "health and behaviour." It reveals that "frequent consumption of carbonated soft drinks" is linked to "various health risk behaviours." These findings

underscore the importance of "reducing soft drink intake" to promote "better health outcomes" and encourage "healthier lifestyle choices." including increased energy intake, which can lead to weight gain and obesity. This aligns with our observation that frequent consumption of carbonated soft drinks is linked to higher hypertension rates.

### Conclusion

This study highlights the influence of dietary habits, physical activity, and sleep duration on adolescent blood pressure levels. Regular breakfast consumption and increased intake of green leafy vegetables were associated with lower rates of hypertension and prehypertension, while limited consumption of soft drinks further showed protective benefits. Consistent physical activity contributed significantly to better blood pressure regulation, with adolescents exercising 4-6 days per week having the lowest hypertension prevalence. Although sleep duration demonstrated a minor relationship, maintaining an optimal range could support cardiovascular health.

**Limitations:** This study was limited by its cross-sectional design, which prevents establishing causal relationships. The sample was restricted to school-going adolescents, excluding out-of-school youth who may have different risk profiles. Self-reported dietary and physical activity data may be subject to recall bias. Additionally, regional factors specific to Banda district may limit the generalizability of findings to other areas.

### Recommendation

The study emphasizes the importance of modifiable lifestyle factors in managing hypertension among adolescents. Daily breakfast consumption and regular intake of green leafy vegetables were associated with lower rates of hypertension and prehypertension, while limiting the consumption of carbonated soft drinks could provide additional benefits. Consistent physical activity, particularly 4-6 days a week, significantly reduced the prevalence of elevated blood pressure levels, underscoring its protective effect against hypertension. Addressing socioeconomic disparities and promoting healthy lifestyle choices could play a crucial role in reducing hypertension risk in this age group.

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# Habitual Level of Physical Activity in Free-living Older Adults: An Exploration of Gender Differences

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## Abstract

**Background:** Aging is associated with a decline in physical function, leading to reduced mobility and increased health risks. Physical activity is crucial for maintaining health and independence in older adults, yet its levels tend to decline with age, however, the gender differences in habitual physical activity among free-living older adults remain underexplored, particularly in the Indian context. The present study is undertaken to identify any significant gender-based differences in habitual level of physical activity in free-living older adults aged 65 to 85 years by using the Physical Activity Scale for Elderly (PASE)

**Methods:** A cross-sectional study was conducted among 62 participants (31 men and 31 women) residing in Mysuru, recruited using convenience sampling. Data collection involved face-to-face interviews utilizing the PASE questionnaire, which assesses physical activity levels across occupational, household, and leisure domains over the past seven days. Statistical analysis was performed using an independent samples t-test to determine gender-based differences in habitual physical activity levels.

**Results:** The study found a statistically significant gender difference in habitual physical activity levels. Men exhibited higher physical activity levels compared to women, as evidenced by a significant p-value ( $p < 0.001$ ) and a large effect size (Cohen's  $d = -1.25$ ).

**Conclusion:** This study highlights a clear gender difference in habitual physical activity levels among free-living older adults. Addressing these disparities through tailored interventions and policy initiatives can contribute to improved health outcomes and overall well-being in aging populations.

**Keyword:** community dwelling, health behaviour, routine physical activity

## Introduction

Aging is an ongoing progression of development and eventual decline. It starts from the point of

conception and concludes with the occurrence of death.<sup>1</sup> With age, the human body goes through several noticeable changes, and the aging process

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is commonly associated with a decrease in bodily functions. It is crucial to understand that a decline in function is not the same as the loss of function caused by disease.<sup>2</sup> Despite this decline, the majority of functions maintain adequacy throughout life, primarily because most organs possess a considerably greater functional capacity, referred to as functional reserve, than what is required by the body.<sup>3-4</sup>

Over the past five decades, India has witnessed a substantial demographic transition, characterized by nearly a threefold increase in its older adult population.<sup>5</sup> This upward trend in ageing is anticipated to continue in the coming years, and the projections suggest that the proportion of older adults in the total population will rise from 7.5% in 2010 to 11.1% by the year 2025. Though this shift may appear modest in percentage terms, the absolute increase is significant. In 2010, the elderly population was estimated at over 91.6 million, with an annual growth of approximately 2.5 million between 2005 and 2010,<sup>6</sup> by 2025, the number of older adults is projected to reach 158.7 million, and by 2050, this group is expected to outnumber the population of children below 14 years of age.<sup>6</sup>

Healthy aging refers to the capacity to uphold autonomy, purpose, energy, and life quality into advanced age, even in the face of unforeseen health issues, accidents, and adverse social health determinants.<sup>7</sup> Physical activity (PA), or exercise, plays a crucial role in healthy aging, helping to prevent or lessen the impact of falls.<sup>7,8</sup> PA is defined as any body movement that involves energy use.<sup>9</sup> It encompasses exercise, which is a planned, structured, and repetitive activity aimed at enhancing or maintaining one or more aspects of physical fitness, as well as leisure or lifestyle activities such as walking or gardening.<sup>9,10</sup> Habitual PA is a bodily movement produced regularly by the contraction skeletal muscles that result in a substantial increase over resting energy expenditure.<sup>11</sup>

Engaging in PA is a fundamental strategy for enhancing the health of older adults.<sup>10,12</sup> Regular PA can provide older adults with similar health benefits as adults, such as improvements in quality of life, well-being, sleep, mental health, management of risk factors, and control of various conditions. Furthermore, PA can have a greater impact on health as people age<sup>12</sup>

Physical exercise routines have been reported to be influenced by income<sup>8,13</sup>, gender<sup>14,15</sup>, age, ethnicity<sup>16</sup>, and disability.<sup>17</sup> In India, gender significantly influences PA patterns among older-adults. Older-women predominantly engage in household tasks such as cooking, cleaning, and caregiving, which are physically demanding, are often not recognized as formal exercise. At the same time, older-men are more likely to participate in outdoor activities like walking, attending community gatherings, or light recreational sports. These disparities are influenced by societal norms, safety concerns, and mobility restrictions that often limit women's movement outside the home.<sup>18</sup>

Despite increasing recognition of the benefits of PA, there is limited literature on habitual PA levels among free-living older adults in India, especially regarding gender differences. Most existing studies group older adults as a single cohort or focus on structured exercise, ignoring everyday activities. Recent findings indicate that older women are less likely to meet PA recommendations and are underrepresented in community fitness programs, but there is insufficient exploration of their habitual activities, such as walking and domestic work.<sup>19-21</sup> Gender is a key factor affecting PA levels, yet to the best of authors knowledge, its impact has not been thoroughly investigated in India. This study aims to examine habitual PA and gender differences, ultimately aiding in the creation of more inclusive health promotion programs.

## Objective

The objective of the study is to identify any significant gender-based differences with habitual level of physical activity in free-living elderly by using Physical Activity Scale for Elderly (PASE).

## Methodology

### Study design and sampling:

The study utilized a cross-sectional design, and the data were sourced from surveying free-living older-adults aged 65 to 85 years residing in Mysuru, Karnataka. The convenience sampling strategy was used to recruit participants who are proficient in English.

The sample size of the current study was determined based on the geriatric population in Mysuru, and the population proportion was estimated with specified absolute precision using the formula from Lwanga and Lemshow's sample size determination manual.<sup>22</sup> According to the 2011 Census, the geriatric population of Karnataka accounted for 10% of the total population. By 2024, this proportion was estimated to have increased to 20%.<sup>6</sup> Given that the total population of Mysuru is approximately 12,61,000, the estimated geriatric population in the city was calculated to be 2,52,200, considering the projected 20% proportion. Based on this estimation, the sample size was determined using an anticipated population proportion (P) of 20%, a confidence level of 95%, and an absolute precision (d) of 10%. Using the formula for sample size calculation, where  $P = 0.20$  and  $d = 0.01$ , the required sample size was obtained as 61. To ensure an equal distribution of participants between men and women, the sample size was adjusted to 62, allowing for a balanced comparison of habitual PA levels across genders.

### Study criteria

Participants included in the study were men and women above the age of 65 years from Mysuru and they should be proficient in English language. Participants were excluded if they had psychiatric disorders like schizophrenia, were on psychoactive drugs affecting cognition, or had conditions such as severe sarcopenia, frailty, COPD, cardiac diseases, CVA, TBI, or other neurological disorders that hinder communication and memory. Older adults institutionalized in rehabilitation or geriatric homes for over a year were also excluded. The PASE questionnaire was used to assess the habitual level of physical activity in the participants.

### Procedure

Approval of the study was obtained from the Institutional Research Committee (IRC), JSS College of Physiotherapy. The data was collected from the Physiotherapy OPD of JSS hospital, religious and public forums, and home visits. Participants were recruited based on inclusion and exclusion criteria. The procedure of the study was explained to the participants, and informed consent from the participants was obtained. The questionnaire was

given to the selected participant through a face-to-face interview. The response obtained from the participants was documented, analysis was done using Jamovi software version 2.6.44 and the habitual level of PA among free-living older-adults and gender differences were explored using an independent samples t-test.

### List of tables

Table no	Contents	Page no
1	Demographic characteristics of participants	9-10
2	descriptive statistics and independent sample t test	11

## Results

### Demographic characteristics

Table 1 shows the demographic characteristics of the participants involved in the study. The data is categorized into key demographic variables, including age, gender, co-morbidities, financial independence, socio-economic status, educational level, and living arrangements. The study participants were aged 65 years and above, and the major reported comorbidities were hypertension, diabetes mellitus (Type II). The socio-economic status of the participants was categorized based on whether they lived above or below the poverty line. The poverty line is a benchmark set by the government of India to identify financially vulnerable individuals and households who may need government assistance, and all of the participants were above the poverty line. In addition, the majority of participants have attained higher education.

**Table 1. Demographic characteristics of participants aged 65 years and above**

Demographic Characteristic	Number of Participants
<b>Gender</b>	
Men	31
Women	31
<b>Co-morbidities</b>	
Diabetes mellitus (Type II)	17
Hypertension	19
Hypothyroidism	2
Hyperlipidaemia	2

Demographic Characteristic	Number of Participants
<b>Financial independence</b>	
Independent	44
Dependent	18
<b>Socioeconomic status</b>	
Above poverty line	62
Below poverty line	0
<b>Educational level</b>	
Illiterate	0
Primary education	3
Secondary education	14
Degree	45
<b>Living arrangement</b>	
Alone	7
With spouse	46
With children	8
Others	1

### Inferential Statistics

An independent samples t-test was conducted to compare the mean age between men and women. Women had a mean age of **68.9 ± 4.24 years**, while men had a higher mean age of **72.2 ± 5.30 years**. The difference in age between the groups was statistically significant (**t = -2.73, p = 0.008**), indicating that the men in the study were significantly older than the women.

Habitual PA was assessed using PASE. The results showed that women had a lower mean PASE score (56.1) compared to men (161.9). The independent samples t-test revealed that this difference was statistically significant (**t = -4.91, p < 0.001**). This indicates that men demonstrated significantly higher levels of habitual PA than women.

Furthermore, Cohen's d effect size (-1.25) represents a large effect (a value above 0.8 is typically considered large), indicating that the difference in PA levels between men and women is not just statistically significant but also clinically meaningful.

Before interpreting the t-test results, we checked for the assumption of equal variances using Levene's test. The test indicated that variances were significantly different (**p < .05**), meaning that the assumption of equal variances was violated (shown

in Table 3). Since the assumption of homogeneity of variances was not met, the t-test results were adjusted accordingly to provide a more accurate estimate.

**Table 2: descriptive statistics and independent sample t test**

	N	Age in years (mean ±SD)	PASE score mean
Women	31	68.9 ± 4.24	56.1
Men	31	72.2 ± 5.30	161.9
Student's t		-2.73	-4.91
p		0.008	< 0.001
Note $H_a: \mu_0 \neq \mu_1$			

<sup>a</sup> Levene's test is significant (**p < .05**), suggesting a violation of the assumption of equal variances

<sup>b</sup> N= number of participants, SD= standard deviation, p= p value

### Discussion

The study included participants who were generally stable in their socio-economic status and well-educated. These factors facilitated and contributed to their understanding and engagement in healthy behaviors to a larger extent.

In the current study, older-men demonstrated significantly higher PASE scores, a finding that aligns with numerous previous studies indicating that gender differences in PA are common among older-adults in various environments and cultures. The key factor in this disparity was occupational engagement.<sup>23-25</sup> Many older-men remained employed or engaged in informal work, leading to increased PA. This aligns with Stahl et al.'s findings, which highlighted that occupational PA significantly impacts overall activity levels among independent older-men.<sup>26</sup>

Conversely, the older-women participating in this study mainly took part in household tasks like cooking, cleaning, and caregiving. Although these activities can be physically demanding, they are typically undervalued in PASE scoring systems because of their low intensity, which leads to an underweighted estimate true energy expenditure. Comparable findings have been noted in research from countries like Japan and Canada, indicating that conventional PA scales frequently overlook

the comprehensive range of domestic activities performed by older-women.<sup>27,28</sup>

Walking has emerged as the most commonly mentioned activity across all genders. Its ease of access and low impact make it especially suitable for older-adults. However, the intensity and purpose of walking- whether for recreation, errands, or work – may vary and can influence its health benefits. This aligns with research conducted by Tudor-Locke et al. and Dipietro L et al., which highlights walking as an important activity that is engaged in differently among senior populations.<sup>29,30</sup>

Another significant finding of this study is that participation in leisure-time or structured PA was low for both genders, reflecting global observations of inadequate adherence to suggested exercise guidelines among older-adults. This pattern presents a considerable obstacle to enhancing health outcomes and highlights the need for community-oriented initiatives designed to address gender-specific challenges and incentives.<sup>31</sup>

**Strength of the study:** This study has several strengths including use of a validated PASE questionnaire to assessing habitual PA in older-adults. Its structured approach ensures comprehensive data collection. Equal representation of men and women allows unbiased gender comparisons. In-person interviews reduced recall bias and improved response accuracy compared to self-reported surveys completed independently. The finding offers valuable insight into gender-based PA pattern in community setting.

**Limitation of the study:** The relatively small sample size limits the generalizability. The reliance on self-reported PA may introduces recall bias and social desirability bias, where participants may overestimate or underestimate their activity levels. The study did not incorporate accelerometers, pedometers, or other wearable devices, which could reduce objective measurement. Additionally, the questionnaire was in English, limiting participation to those proficient in the language.

#### **Future direction of the study**

Conducting studies with a larger and more diverse elderly population across multiple geographic

regions would enhance the generalizability of the results. Integrating wearable technology would help validate self-reported activity levels and provide a more accurate assessment of physical movement.

### **Conclusion**

This study highlights a clear gender difference in habitual PA levels among free-living elderly, with males exhibiting considerably higher PA levels. Addressing these disparities through tailored interventions and policy initiatives can contribute to improved health outcomes, quality of life and overall well-being in aging populations. However, reliance on self-reported data, and limited generalizability should be considered when interpreting the results. Future research should involve larger, more diverse populations across regions and use outcome measures that give greater weight to household activities, which is essential for accurately capturing PA to enhance accuracy and generalizability.

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# Exploring Mental Health and Quality of Life of Transgenders of North India: An Anthropological Perspective

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## Abstract

**Background:** Transgenders are one of the most neglected, outcasted, and excluded groups in society, thereby making their mental health fragile. Only legal transformations are not sufficient to integrate them in the society. **Aim:** The present study is an attempt to evaluate the mental health and quality of life of the transgender population of Chandigarh (North India).

**Methods:** A total of 51 transgender individuals (36% of the total transgender population), ranging in age from 18 to 50 years, were enrolled in the study from Chandigarh by using a snowball sampling method. Mental health and quality of life were evaluated by the standardized instruments, i.e., the WHOQOL-BREF and PHQ-12 respectively.

**Results & Discussion:** The results demonstrated poor mean scores for overall quality of life (47.09), with the highest score in the physical domain (69.53) and the least in the psychological domain (59.44). A comparison between trans males and trans females exhibited statistically non-significant differences across four domains of the WHOQOL-BREF scale. The prevalence of depression was 49% among the present population, out of which 33.3% were having moderate depression. Hence, a positive public perception along with stringent legislative reforms is required for the holistic inclusion of transgenders in the society.

**Keywords:** Mental health, quality of life, trans male, trans female, psychological domain

## Introduction

Globally, the term transgender refers to individuals whose gender identity is incongruent with the sex assigned to them at birth. This makes them one of the most vulnerable and disadvantaged population in terms of extensive marginalization<sup>(1)</sup>. Transgender encompass various identities, including

transgender men, transgender women, non-binary, genderfluid, and agender individuals<sup>(2)</sup>.

According to the 2011 Census, a total of 487,803 were identified as transgender in India, and this was for the first time the transgender population was being quantified in India<sup>(3)</sup>. This figure may represent an underreporting, as numerous transgender

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individuals may not have disclosed their identities or may have been classified according to their transitioned identity as male or female. Historically, India and other South Asian nations possess a distinctive history of transgender individuals cohabiting within ethno-cultural kinship groupings, stated by various regional names such as the *Hijra* and *Kinnar* communities.

In India, in addition to engaging themselves in menial jobs, transgender population are also involved in providing traditional blessings to newborns and newlyweds. The transgender population across the globe confronts overlapping difficulties of non-acceptance, discrimination, stigma, violence, and restricted access to healthcare. These issues significantly impact their quality of life and mental well-being.

India attained independence in 1947; nevertheless, the transgender community did not obtain legal acknowledgement until 2014, when the Supreme Court legally recognized them as a third gender<sup>(4)</sup>. The societal ostracism and internalized stigma experienced by the transgenders incite a strong sense of solitude, exacerbating severe mental health issues that lead to a surge in suicidal ideation. A study performed by Grossman<sup>(5)</sup> revealed that risk factor of suicide among transgender was high as 82% of transgender individuals have contemplated suicide, and 40% have attempted it.

The World Health Organization highlighted that issues related to mental health can significantly impact all aspects of life, including academic and occupational performance, interpersonal relationships, and community engagement<sup>(6)</sup>. A systematic review to comprehend transgender population health in India highlighted that studies were mostly focused on sexual health neglecting overall health<sup>(7)</sup>.

Likewise, a study performed on transgender population of Rajasthan explored that discrimination was negatively related to mental health and quality of life. The results revealed that 'Guru' (leaders) were more prone to discrimination in comparison to their 'Chellas' (Students) which eventually distressed their mental health. Guru' are the senior members of the Hijra community, who possess significant social and financial influence, often take on leadership roles at the request or encouragement of junior community members (Chellas). Hence, more inclination of

stress, anxiety, and depression among transgender population<sup>(8)</sup>. A previous study also reported that transgender communities are more vulnerable to alcohol and substance use in comparison to normal population<sup>(9)</sup>. A case report conducted by Kalra and Shah<sup>(10)</sup> stated that about 48% of Hijra participants of Mumbai suffered from psychiatric disorders, multiple substance uses and depressive disorder and even though none of the individuals had never consulted for any disorder. Another study<sup>(11)</sup> conducted to evaluate the mental health of transgender population of South India showed that about 24.5% prevalence of moderate to severe depressive anxiety and depressive symptoms. Correspondingly, transgender individuals also reported discrimination (65.15%), verbal abuse (59.55%), sexual assault (22%), and physical assault (18.45%). There was a negative correlation observed between discrimination and the environmental domain of quality of life.

Despite recent legislative reforms and programs launched by the government, particularly in India, the practical enforcement of rights remains insufficient. There is still a lack of knowledge regarding life experiences and help-seeking behavior of transgender population which eventually affecting their mental as well as overall health. Hence, the present study delves into exploring existing gaps in knowledge concerning the transgender population health focusing on assessing the quality of life (QoL) and mental health among the transgender community of Chandigarh using the WHOQOL-BREF and PHQ-12 scale respectively.

## Methodology

The present study is a cross-sectional study concentrated on transgender individuals aged from 18 to 50 years, residing in Chandigarh (North India), encompassing those identifying as *Hijra*, trans men, trans women, by self-reporting method. According to census 2011, a total population of transgender is around 142 in Chandigarh. Out of that total 51 transgender individuals were enrolled in the study using a snowball sampling technique which is around 36% of total Chandigarh transgender population, and data was collected from June 2021 to July 2021 in Hallo Majra village, Chandigarh (North India). The participants who were born male and female at birth (physical characteristics) but now identify as female and male, respectively, are considered trans females and trans male respectively. The informed

consent was taken from each participant prior to data collection.

The socio-demographic and lifestyle profile of the participants were evaluated using interview schedule and variables like age, educational qualification, occupation status, gender by birth, psychological gender, relationship status, monthly income, smoking and alcohol consumption were recorded. To explore the current quality of life and mental health status few case studies were also inculcated in the study to gain in depth life experiences of transgender.

To ascertain the quality of life as well as the mental health, the standardized instruments WHOQOL-BREF and the PHQ-12 were used, respectively. WHOQOL-BREF is a well-established tool for gauging quality of life across multiple domains, including physical, psychological, social, and environmental factors, including overall quality of life (Q1). The scale primarily emphasizes four categories of quality of life (QoL), i.e., physical domain, psychological domain, social domain, and environmental domain. The scale consists of 26-items in four domains: physical domain (7 items- mobility self-care, daily activities, pain and discomfort, sleep and rest, energy and fatigue, physical environment), psychological domain (6 items- positive feelings, self-esteem, thinking, learning, memory and concentration, bodily image and appearance, negative feelings, social relationships; spirituality/religion/personal beliefs), social domain (3 items- personal relationships, social support, social activities, intimacy, isolation, community engagement, communication), and environmental domain (8 items- physical safety, home environment, financial resources, health and social care, transportation, environment pollution,

and social environment). The 4 domains are then scored and transformed to a 0 to 100 scale.

The PHQ-12 item is used to evaluate the prevalence of depression. It is a 12-item scale with a maximum score of 12. Each question consists of a binary response, i.e., yes and no, where yes response consists of 1 score. Participants who had a score of 4 or more were considered as depressed.

**Statistical Analysis:** The collected data were subjected to analysis by software Statistical Package for Social Sciences 20 (SPSS 20 Inc.). The qualitative data presented as frequency and percentages, whereas quantitative data as mean and standard deviation. A chi-square test was used to evaluate differences in qualitative characteristics, whereas a student's t-test determined the differences among quality-of-life domains of trans males and trans females. The p-values <0.05 are considered significant at a 95% confidence interval.

## Results

The study was conducted on 51 participants and provides valuable insights into the quality of life and mental health of the transgender of Chandigarh, focusing on the multiple domains involving the psychological and physical health, social relationships, environmental conditions, and prevalence of depression. *Table 1* presents general characteristics of the transgender population of Chandigarh. The sample predominantly consisted of those recognized as male at birth (78.4%), followed by those labelled as female (21.6%) with a statistically significant chi-square value (16.49\*\*).

**Table 1: General characteristics of the transgender population of Chandigarh (North India)**

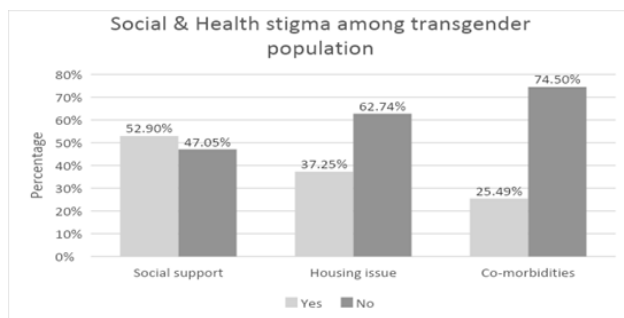
General Characteristics	Frequency (N)	Percentage (%)	Chi-square (p-value)
<b>Gender by birth</b>			
Male	40	78.4%	16.49**
Female	11	21.6%	(0.00)
<b>Educational status</b>			
Illiterate	15	29.4 %	6.64
Primary	10	19.6 %	(0.08)
Matriculation	19	37.2 %	
Graduation & higher	7	13.7 %	

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<b>Relationship Status</b>			
Single	34	66.6 %	53.70**
Married	3	5.8 %	(0.00)
Partnered	13	25.4 %	
Divorced	1	1.9 %	
<b>Employment Status</b>			
Unemployed	19	37.2 %	35.82**
Self-employed	27	52.9%	(0.00)
Employed	1	1.9%	
Traditional Jobs	4	7.8 %	
<b>Monthly Income</b>			
Upto Rs.1,000	22	43.1 %	33.47**
≤ Rs.10,000	24	47.1 %	(0.00)
Rs.10,000 - 20,000	4	7.8 %	
≥ Rs.20,000	1	1.9 %	
<b>Smoking Status</b>			
Yes	18	35.2%	4.41*
No	33	64.7%	(0.03)
<b>Alcohol consumption</b>			
Yes	27	52.9%	0.17
No	24	47.1%	(0.67)

Significance level \*=p&lt;0.05; \*\*=p&lt;0.01.

Frequency distribution of social and health stigmatization among the present research population is portrayed in figure 1.



**Figure 1: Frequency distribution of social and health stigmatization among the transgenders.**

Despite experiencing stigma, a significant number (52%) of the studied population exhibited

some level of community as well as familial backing. Nearly half of the population (47.05%) experienced an absence of societal and community support, which indicates a major area of concern. A large proportion (62.74%) of the transgender faced housing issues. Additional health conditions or co-morbidities have been reported by 25.49% of the population under study.

A descriptive and comparative account of the mean scores of quality of life (QoL) and its domains between trans male (TM) and trans female (TF) categories by utilizing the WHOQOL-BREF scale is presented in Table 2. The overall QoL score was considerably low (47.09) in the transgenders, indicating that on average, the community perceives their quality of life to be poor.

**Table 2: Descriptive statistics and comparison of mean score of Quality-of-life and its domains (WHO-BREF) among transgender population.**

Various domains	Total (n=51) Mean± S.D	TM (n=11) Mean± S.D	TF (n=40) Mean± S.D	t-test (p)
Quality of life	47.09± 5.9	47.03± 5.7	47.11± 6.1	-0.03 (0.96)
Physical domain	69.53± 11.7	69.80± 11.4	69.46± 11.9	0.08 (0.93)
Psychological domain	59.44± 16.2	59.09± 16.7	59.54±16.3	-0.08 (0.93)
Social domain	66.83± 16.6	67.42± 17.2	66.66± 16.6	0.13 (0.89)
Environmental domain	69.24± 15.1	65.62± 11.2	70.2± 15.9	-0.89 (0.37)

TM= Trans male; TF= Trans female; p<0.05\*

The **Physical domain** of the WHOQOL-BREF scale encompasses perceptions of bodily health, vitality, and exhaustion. The average score advocates that most transgender individuals indicate a level of physical health ranging from moderate to good, with the overall mean score of 69.53, whereas trans males demonstrate better physical health as compared to trans females (69.80 vs 69.46 p>0.05).

The **Psychological domain** assesses mental well-being, which includes emotional stability and self-esteem. An overall score of 59.44 indicates poor psychological well-being among the transgender population.

The overall mean score for **the social domain** is 66.83, which captures the quality of personal societal relationships, community participation, and social support. On comparison, trans males depict slightly better social domain scores as compared to trans females (67.43 vs. 66.66, p > 0.05), which showed that they might face challenges in building supportive social relationships and social integration.

The **environmental domain** refers to access

to healthcare services, financial resources, and the feeling of personal safety. Overall mean score for the environmental domain (69.24) exhibited that external factors such as living conditions and access to resources moderately influence the quality of life. Trans females had better environmental conditions as compared to transmale (70.20 vs 65.62, p > 0.05), though this difference is not statistically significant.

#### Mental Health Assessment:

The prevalence of depression amongst the trans males and trans females as assessed by PHQ-12 is presented in *Table 3*. Among the trans males, 15.6% of the total population and 35.3% of the trans females are classified as normal, whereas a significant number of individuals under study (49%) were considered as depressed. Overall, it was observed that the prevalence of moderate depression (trans males= 2%, trans females= 31.3%) was higher than that of mild depression (trans males=3.9%, trans females= 11.8%). However, no participant had shown the occurrence of severe depression. However, the chi-square test presented non-significant differences among trans male and trans female.

**Table 3: Frequency distribution of depression status of trans male and trans female using PHQ-12 scale.**

Depression status	Trans Male N (%)	Trans female N (%)	Total N (%)	Chi-square (p-values)
No Depression (0-3)	8 (15.7%)	18 (35.3%)	26 (51%)	3.82 (0.147)
Mild (4-6)	2 (3.9%)	6 (11.8%)	8 (15.7%)	
Moderate (7-9)	1(2.0%)	16 (31.3%)	17 (33.3%)	
Severe (10-12)	---	---	---	

N= Frequency, p<0.05\*

## Discussion

The quality of life and mental health of the transgender individuals has been receiving increased amounts of attention not just from the researchers but from the policymakers too in the recent years. This study offers an anthropological perspective to analyse the distinct obstacles encountered by the transgender in Chandigarh (North India), highlighting the psychological and emotional impact of stigma on these individuals. It was noticed that a substantial proportion (62.74%) of the transgenders confronted housing issues, 37.2% were unemployed, and unfortunately 43.1% mentioned their monthly income was up to Rs. 1000. Barriers to accessing stable, safe, and affordable housing are often the result of systematic discrimination.

Housing as well as employment challenges can significantly distress both physical health and emotional well-being, as secure housing is intricately linked to perceptions of safety, self-worth, and the capacity to participate in everyday activities. A study conducted by Glick et al. (12) also highlighted housing insecurity faced by transgender and gender non-conforming individuals (T/GNCI) in New Orleans. They further noticed that the housing problem was deeply associated with employment issues among them.

A respondent in our study named Aman (name changed, trans male, 33 years old) was from a financially sound family, but his parents could not accept him and he was forced to leave his family home at the age of 22. After finding a suitable apartment in Chandigarh, the landlord, oblivious to his identity, first consented to lease the flat to him. Upon learning that Aman was a transsexual woman, the landlord's demeanour shifted significantly. Aman said with tears in his eyes that he vividly remembers that the landlord said, "We cannot keep people like you in our building. Your presence will be problematic for our other tenants". Aman was very disheartened, as it was one of the first of such incidents for him. It is nearly impossible to find houses for transgender people, even when they can afford it. Aman has still not been able to find a home in a good locality, as his identity forced him into the margins of society.

Additional health conditions or co-morbidities have been reported among 25.49% participants. Co-morbidities may encompass ailments such as HIV, mental health disorders, or chronic illnesses, which might be aggravated by social stigma and scant healthcare. The diminished percentage may also indicate underreporting because of limited access to healthcare facilities or a lack of trust in medical systems, prevalent among marginalized populations. In concordance with the findings of our study, Scheim et al.(13) mentioned that trans populations were exposed to greater disease burden with significant heterogeneity within and among settings. They identified depression, suicidality and other mental health conditions, anxiety, psychological distress, and HIV as the most commonly occurring health burden, while the least frequent were respiratory conditions, cancer, and other infectious diseases

Describing her challenges, one of the respondents, Rekha (name changed, 29-year-old) narrated that she was raised in a traditional family that never really embraced her gender identity. Being raised in a conservative family, she witnessed psychological abuse and social exclusion. She left her family residence at the age of 19 years and became a member of a transgender community. Although she experienced a sense of belonging in this community, her life has been marked by persistent struggles with stigma, discrimination, and financial instability, which have significantly impacted her quality of life. Notwithstanding community support, Rekha's existence continued to be characterized by financial instability, with erratic income from dancing and begging, rendering her susceptible and at risk of abuse. Rekha even mentioned that her experience is neither unusual nor catastrophic; rather, it is a fundamental narrative shared by all of us and said, "*We have to pay a very high price if we want to live our lives the way we want to live.*"

Such cases need policy interventions to improve social inclusion, financial stability, and healthcare access. Addressing all these challenges will enhance their overall quality of life and well-being.

The present study reported overall low quality of life ( $47.09 \pm 5.9$ ), with minimal differences among the trans men and trans women. The comparative account exhibited that mean score for overall quality

of life of present study was lower than the normal population i.e., 86.6 mean score of Delhi adults <sup>(14)</sup>, 63.5 mean scores of Puducherry adults <sup>(15)</sup> and 67.6 mean scores of rural adults from Haryana <sup>(16)</sup>.

It was observed that in the physical domain (69.53± 11.7), social (66.83± 16.6), and environmental domain (69.24± 15.1) of well-being, the transgender of Chandigarh has scored moderately. They have managed to achieve some level of well-being, yet they continue to face significant challenges, which is evident in terms of poor psychological score (59.44± 16.2) or well-being. A similar study conducted by Poudel <sup>(17)</sup> on the transgender reported low quality of life, specifically poor psychological scores, due to substantial stigma and discrimination experiences. Similarly, a systematic review and meta-analysis of results on the quality of life of transgenders illustrated poorer mental health and QoL as compared to the general population <sup>(18)</sup>.

The present research assesses the mental health status of the transgender population. The prevalence of depression in the overall transgender sample was found to be 49%, indicating that nearly half of the participants examined exhibit depressive symptoms. This corroborates with previous studies <sup>(19, 20)</sup> in this realm indicating that transgender encounter mental health issues at markedly elevated rates compared to the general population, attributable to variables such as societal stigma, discrimination, and minority stress. When assessing the severity of depression, the most frequent level of depression observed was moderate depression (33.3%) followed by mild depression (15.7%) among the participants.

Findings of Srinivasan and Chandrasekaran,<sup>(11)</sup> recorded that the overall prevalence of psychiatric disorder among Indian transgender population was about 24.5%, out of which severity of depressive anxiety and depressive symptoms ranged from moderate to severe. The US Transgender Survey in 2015 by National Centre for Transgender Equality also reported 40% of their respondents with psychological distress, and severity range from moderate to severe. Likewise, a study conducted on the European transgender population demonstrated higher rates of depressive symptoms, i.e., 51.4% for transgender women; 48.3% for transgender men <sup>(21)</sup>.

The present study indicates that transgender females exhibit a much higher prevalence of depression in comparison to transgender males. This might be result from greater visibility, greater exposure to societal stigma, and potentially more frequent instances of discrimination and harassment encountered by trans females relative to trans males. Interestingly, similar research performed by Hajek et al. <sup>(19)</sup> reported an association between psychological gender abuse and depression, which was three folds higher among younger transgender women than older transgender women.

The chi-square test indicates no significant differences between gender (trans male or female) and depression level. Statistically, this indicates that the disparity in the depression rates between trans males and trans females is insignificant to imply a substantial correlation between gender identity and depression within the studied population. This might direct that other factor, such as socio-economic position, social support, or healthcare access, may be more significant predictors of depression in the transgender community than gender alone. There is a lack of statistically significant differences between the trans men and trans women across any of the QoL domains. There is a sense of uniformity and homogeneity being highlighted by the shared challenges, indicating the necessity for comprehensive policy interventions to cater to the specific needs and requirements of the entire transgender community.

In conclusion, the study offers an extensive examination of the quality of life (QoL) and mental health within the transgender population, specifically emphasizing trans males and trans females. The overall quality of life was poor (47.09), and the physical domain presented the highest score, while psychological domain was least scored showing poor mental health. Additionally, the prevalence of depression was 49% among transgender people. The findings indicate that transgender individuals, particularly trans females, suffer a substantial deterioration in overall quality of life due to widespread stigma, discrimination, and mental health issues. This study highlights the necessity for specialized healthcare interventions, mental health support frameworks, and inclusive social policies to enhance the well-being of transgender individuals. It

also highlights that both trans males and trans females have significant challenges in attaining a satisfactory quality of life and mental health, with trans females seemingly more susceptible to the intersections of gender-based and societal stigmatization.

#### Strength of the study:

This study is essential for providing a holistic understanding of the lives lived and experienced by the transgenders within the socio-cultural context of Chandigarh (North India). In fact, an anthropological lens facilitated a nuanced comprehension of the transgender community.

#### Limitation of the study:

The sample size of the study is relatively small and may not be fully able to provide representation to the broader transgender population of Chandigarh. Comparative analysis with the general population would have provided a clearer understanding about the quality of life and mental health. There can be a sense of bias in terms of using the WHO-QOL BREF and PHQ-12 scales, as they are self-reported questionnaires. This may lead to participants underreporting or over-reporting their quality of life or mental health status.

**Ethical Clearance:** As per authors, all necessary ethical standards, including informed consent, confidentiality, and the principles outlined in the Declaration of Helsinki were strictly followed during the study, although no formal ethical permission from the institute was taken. Confirmation of the same was received by the editorial office by the (Former) head of the department.

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# Histopathological Features and Clinical Variants of Psoriasis in a Tertiary Care Centre in Western Uttar Pradesh

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## Abstract

**Background:** Psoriasis is a chronic, immune-mediated, relapsing papulosquamous disorder with global prevalence and significant morbidity due to its chronic nature and systemic associations. Histopathological evaluation plays a vital role in confirming the diagnosis and identifying subtypes for optimal management.

**Objective:** To identify clinical and histopathological features and assess histological parameters useful in subtyping variants of psoriasis.

**Methods:** This prospective study was conducted over 18 months in the Department of Pathology at Muzaffarnagar Medical College, Uttar Pradesh. A total of 70 skin biopsy specimens with a clinical diagnosis or differential diagnosis of psoriasis were included. Histological features such as elongation of rete ridges, parakeratosis, suprapapillary thinning, Munro's microabscess, vascular dilatation, and inflammatory infiltrates were analyzed and correlated with clinical variants.

**Results:** Among 70 histopathologically confirmed psoriasis cases, the most common clinical variant was chronic plaque psoriasis (94.2%). Male predominance (72.86%) was noted with peak incidence in the 21–30 years age group. Common histological features included vascular dilatation (97.1%), parakeratosis (94.2%), elongation of rete ridges (90%), and suprapapillary thinning (90%). Munro's microabscesses and Kogoj pustules were noted in a minority. Two clinically suspected guttate psoriasis cases were reclassified histologically as plaque psoriasis.

**Conclusion:** Histopathological examination remains indispensable in confirming psoriasis, especially when clinical presentations overlap with other dermatoses. Accurate identification of histological features aids in proper subtyping and informs treatment decisions.

**Keywords:** Psoriasis, parakeratosis, histopathology, chronic plaque, Munro abscess, suprapapillary thinning.

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## Introduction

Psoriasis is a prevalent, chronic, immune-mediated inflammatory dermatosis affecting approximately 2-3% of the global population.<sup>(1)</sup> It manifests as a relapsing papulosquamous disorder characterized by well-demarcated, erythematous plaques with silvery-white scales. The disease has a significant impact on quality of life, often leading to emotional distress, social stigmatization, and substantial healthcare burden.<sup>(2,3)</sup>

The exact etiology of psoriasis remains elusive but is widely recognized as a multifactorial condition with complex interplay among genetic predisposition, immune dysregulation, and environmental triggers.<sup>(2,4)</sup> T lymphocyte-mediated autoimmunity, particularly involving Th1 and Th17 cells, is central to the pathogenesis of psoriasis.<sup>(5,6)</sup> Additionally, there is a strong association with certain human leukocyte antigens (HLA), especially HLA-Cw6, which is commonly linked to early-onset (Type 1) psoriasis while type Type 2 lacks HLA-Cw6.<sup>(7,8)</sup> Clinically, psoriasis presents with considerable heterogeneity. The most common variant is chronic plaque psoriasis, accounting for 80-90% of cases.<sup>(9)</sup> Less frequent forms include guttate, inverse (flexural), pustular, erythrodermic, and nail psoriasis, each distinguished by specific clinical and histological features.<sup>(9,10)</sup> In a study by Byung Yoon Kim chronic plaque psoriasis was observed in 43.9% of cases followed by Papular is 40.8% and Guttate is 15.3%.<sup>(17)</sup> In a study Psoriatic lesions commonly appear on extensor surfaces, scalp, trunk, and lower back. Symptoms such as pruritus and burning sensations are often reported and may be attributed to neurogenic inflammation involving mediators like substance P and nerve growth factor (NGF).<sup>(11-14)</sup>

Histopathological examination remains the gold standard for confirming psoriasis and differentiating it from other mimicking papulosquamous disorders such as lichen planus, tinea corporis, and pityriasis rosea.<sup>(3,15)</sup> Hallmark microscopic features include acanthosis, elongation of rete ridges, suprapapillary thinning, diminished granular layer, confluent parakeratosis, Munro's microabscesses, and spongiform pustules of Kogoj.<sup>(5,16)</sup> These findings, in conjunction with clinical data, allow for accurate diagnosis and classification of the psoriasis subtype.

Given the variability in clinical presentation, histo-pathological correlation is essential not only for definitive diagnosis but also for therapeutic planning. Differentiating psoriasis variants histologically can influence the selection of systemic or topical therapies, especially in cases resistant to conventional treatment. Furthermore, some histological parameters may correlate with disease severity and duration, providing insights into prognosis and disease progression.<sup>(17)</sup>

In this context, the present study was undertaken to analyze the histo-pathological features and correlate them with clinical variants of psoriasis in a tertiary care hospital in Western Uttar Pradesh. This approach aims to bridge diagnostic gaps, improve sub-classification accuracy, and contribute to the broader understanding of psoriasis pathology.

## Methods

The present study was hospital-based prospective study done after the ethical clearance from Institutional Ethical committee (Muzaffarnagar Medical College) (MMC/IEC/2023/246) dated: 20.03.2023 . The study included a minimum of 70 clinically diagnosed and histopathologically confirmed cases of psoriasis, based on the average case load over the preceding three years. Informed consent was taken from patients who participated in study. Clinically diagnosed cases with adequate biopsies were included, while inadequate samples and unwilling participants were excluded.

## Statistical analysis

The data were entered in Microsoft excel 2019 using SPSS (v17/20) and StatCal2 software, and a p-value of  $\leq 0.05$  was considered statistically significant for determining relevant associations.

## Results

The study analyzed a total of 70 clinically suspected cases of psoriasis over an 18-month period at Muzaffarnagar Medical College, all of which were confirmed histopathologically in this prospective study.

Patient ages ranged from 11 to 70 years, with the majority (30%) in the 21-30-year age group. Males predominance was noted (72.86%), with a male-to-

female ratio of 2.7:1. The upper extremities were the most commonly affected site (35.7%), followed by the lower extremities, abdomen, back, and scalp.

#### Clinical and Histopathological correlation:

Of the 70 cases, 66 were clinically diagnosed as chronic plaque psoriasis, 2 as guttate type and 2 as pustular variant. Histopathology confirmed all chronic plaque and pustular cases, while the two guttate cases were reclassified as chronic plaque based on features like confluent parakeratosis, acanthosis, and rete ridge elongation, highlighting the importance of biopsy in accurate subtyping.

**Table 1: Clinical and histopathological correlation (n=number of cases)**

CLINICAL DIAGNOSIS	HISTOLOGICAL DIAGNOSIS
CHRONIC PLAQUE PSORIASIS n=66	CHRONIC PLAQUE PSORIASIS n=66
GUTTATE PSORIASIS n=2	CHRONIC PLAQUE PSORIASIS n=2
PUSTULAR PSORIASIS n=2	PUSTULAR PSORIASIS n=2

#### Histopathological Finding:

The most common features were vascular dilatation (97.1%), parakeratosis (94.2%), and elongation of rete ridges (90%). Suprapapillary thinning, absent granular layer, and inflammatory infiltrate were each seen in 90%, 90%, and 20% of cases, respectively. Munro's microabscesses (15.7%), Kogoj's pustules (2.8%), and dermal edema (4.2%) were less frequent.

**Table 2: Histological parameters**

HISTOLOGICAL FEATURES	PRESENT (CASES)	PERCENTAGE (%)
Elongation of rete	63	90
Vascular dilatation	68	97.1
Inflammatory infiltrate	14	20
Micro Munro's abscess	11	15.7
Parakeratosis	66	94.2
Absent granular layer	63	90

Spongiform pustules	2	2.8
Suprapapillary thinning	63	90
Dermal edema	3	4.2
Elongation of dermal papillae	63	90

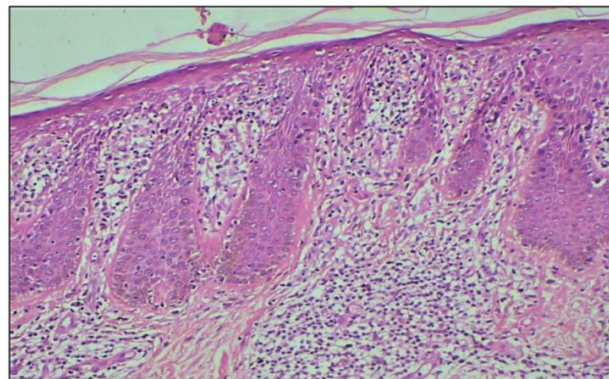


Image 1 Psoriasis: Low power view reveals parakeratosis, regular acanthosis, thinning of the suprapapillary plate, saw-tooth rete ridges, and dermal inflammation. (H&E stain, 100X magnification)

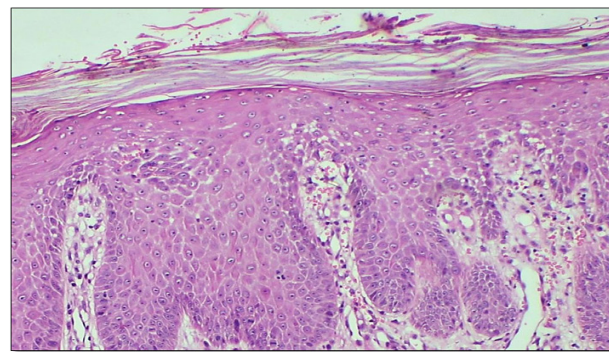


Image 2- Psoriasis: high power view showing parakeratosis, regular acanthosis, thinning of suprapapillary plate, mild spongiosis, and vascular changes. (H&E stain 400X)

#### Correlation among features:

Elongation of rete ridges significantly correlated with suprapapillary thinning and dermal papillae elongation. Parakeratosis showed strong association with inflammatory infiltrate and dermal changes. Vascular dilatation also correlated with inflammatory infiltrate, suggesting interplay between vascular changes, immune activation, and epidermal remodeling in psoriasis.

Table no. 3: Correlation between various histopathological parameters in psoriasis Method.

	Elongation of Rete	Vascular Dilatation	Inflammatory Infiltrate	Munro's Microabscess	Parakeratosis	Absent Granular Layer	Kogoj	Suprapapillary Thinning	Dermal Edema	Elongation of Dermal Papilla
Elongation of Rete	1 (0.000)	0.063 (0.606)	0.302 (0.011)	0.157 (0.195)	0.137 (0.259)	-0.008 (0.948)	-0.021 (0.862)	0.518 (<0.001)	0.442 (<0.001)	0.476 (<0.001)
Vascular Dilatation	0.063 (0.606)	1 (0.000)	0.365 (0.002)	-0.155 (0.202)	0.214 (0.075)	0.236 (0.053)	0.077 (0.526)	0.339 (0.004)	0.064 (0.597)	0.156 (0.198)
Inflammatory Infiltrate	0.302 (0.011)	0.365 (0.002)	1 (0.000)	-0.190 (0.116)	0.623 (<0.001)	0.081 (0.509)	0.253 (0.034)	0.302 (0.011)	0.328 (0.006)	0.432 (<0.001)
Munro's Microabscess	0.157 (0.195)	-0.155 (0.202)	-0.190 (0.116)	1 (0.000)	0.118 (0.329)	-0.103 (0.402)	-0.073 (0.547)	0.239 (0.046)	0.003 (0.979)	0.479 (<0.001)
Parakeratosis	0.137 (0.259)	0.214 (0.075)	0.623 (<0.001)	0.118 (0.329)	1 (0.000)	0.186 (0.129)	0.222 (0.065)	0.384 (0.001)	0.239 (0.047)	0.649 (<0.001)
Absent Granular Layer	-0.008 (0.948)	0.236 (0.053)	0.081 (0.509)	-0.103 (0.402)	0.186 (0.129)	1 (0.000)	-0.028 (0.820)	0.251 (0.039)	-0.191 (0.119)	-0.039 (0.750)
Kogoj	-0.021 (0.862)	0.077 (0.526)	0.253 (0.034)	-0.073 (0.547)	0.222 (0.065)	-0.028 (0.820)	1 (0.000)	-0.148 (0.223)	0.247 (0.040)	-0.037 (0.760)
Suprapapillary Thinning	0.518 (<0.001)	0.339 (0.004)	0.302 (0.011)	0.239 (0.046)	0.384 (0.001)	0.251 (0.039)	-0.148 (0.223)	1 (0.000)	0.169 (0.161)	0.553 (<0.001)

## Discussion

Psoriasis is a chronic, relapsing inflammatory dermatosis affecting approximately 0.1–1.5% of the global population. It arises from a complex interplay of genetic, environmental, and immunological factors. Key pathological processes include keratinocyte hyperproliferation, neoangiogenesis in the superficial dermis, and T-cell-mediated immune dysregulation, particularly involving CD1a-positive T cells. (18) Histopathology is widely considered the gold standard for diagnosis, especially in clinically ambiguous cases or to rule out malignancies. (15) The present study aimed to assess clinical and histopathological features of psoriasis and evaluate their correlations.

In our study, psoriasis predominantly affected males (M:F = 2.7:1) with a mean age of 39.11 years, consistent with findings by Appukuttan et al (19), Okhandiar et al (20), Kaur et al (21), and Bedi et al (22), M:F = 2.9:1; 2.5:1; 2.5:1 & 2:1 respectively. In our study, upper extremities (35.7%) were most commonly involved, followed by lower limbs, abdomen, back, and scalp.

## Histopathological Findings

The most consistent histological feature in our study was vascular dilatation (97.1%), followed

by confluent parakeratosis (94.2%), diminished or absent granular layer (90%), suprapapillary thinning (90%), and elongation of rete ridges (90%). These are well-established psoriatic changes, consistent with observations by Mehta S et al (25), Jayalakshmi et al (26), Shagun et al (15) and Appukuttan et al (19). Munro's microabscesses were present in 15.7% of cases and demonstrated a positive correlation with suprapapillary thinning. Studies by Ahmed et al (27) and Gyanchandani et al (10) also reported similar findings, highlighting these structures as indicators of acute or pustular variants. The absence of a granular layer, seen in 90% of our cases, reflects accelerated epidermal turnover and correlated moderately with suprapapillary thinning—echoing results from Jayalakshmi et al (26) and Shagun et al (15)

## Dermal Changes

Vascular alterations in the papillary dermis—particularly dilated and tortuous capillaries—are characteristic of psoriasis and often precede epidermal changes. These vessels contribute to the clinical Auspitz sign and are histologically evident early in disease progression. In our study, vascular dilatation correlated significantly with suprapapillary thinning and inflammatory infiltrates, consistent with findings by Mehta S et al (25), Jayalakshmi et al (26) and Appukuttan et al (19)

### Correlation with Clinical Variants

Out of 70 cases clinically diagnosed as psoriasis, 68 (97.1%) showed histopathological correlation. The two discordant cases were clinically labeled as guttate psoriasis but revealed histological features of chronic plaque psoriasis. This reinforces the diagnostic utility of biopsy in differentiating variants. Chronic plaque psoriasis was the predominant clinical subtype (97.1%), in concordance with studies by **Bedi et al** (22) and others.

### Histological Correlation Analysis

Strong correlations were observed between:

- Elongated rete ridges and suprapapillary thinning, inflammatory infiltrate, and elongated dermal papillae
- Confluent parakeratosis and inflammatory infiltrate, elongated dermal papillae
- Vascular dilatation and suprapapillary thinning, inflammatory infiltrate
- Munro's microabscesses and suprapapillary thinning

### Conclusion

This study confirms that vascular dilatation, confluent parakeratosis, suprapapillary thinning, absent granular layer, and elongation of rete ridges are the most consistent and diagnostically significant histological features of psoriasis. Their interrelationships further justify the use of structured histological scoring systems in clinical practice to aid diagnosis and monitor disease severity.

Variant	Key Histopathological Feature(s)
Plaque Psoriasis	Regular acanthosis, parakeratosis, Munro microabscesses, Kogoj pustules
Guttate Psoriasis	Focal parakeratosis, mild acanthosis, scattered neutrophils
Pustular Psoriasis	Spongiform pustules of Kogoj, subcorneal pustules
Erythrodermic Psoriasis	Diffuse inflammation, erosion, subtle psoriasiform features

Inverse Psoriasis	Minimal scaling, mild acanthosis, lacks typical pustules
Napkin Psoriasis	Mild psoriasiform changes in diaper area
Psoriatic Arthritis	Synovial lining hyperplasia, angiogenesis, inflammatory cells

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# Building Resilient Health Systems Through Community Voices: Insights from Delhi During COVID-19

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## Abstract

The COVID-19 pandemic exerted unique challenges to our health systems, particularly in urban settings with diverse and densely populated communities. This study explores how primary healthcare services in Delhi's South and West districts responded to these challenges.

**Objective:** This study aimed to examine the resilience of health systems in ensuring the availability with a focus on community-level experiences and perceptions.

**Methods:** A cross-sectional community-based survey was conducted among 402 adult household residents using a structured questionnaire.

**Results:** While initiatives such as Mohalla Clinics, neighbourhood-based primary healthcare facilities established by the Government of Delhi to provide free and accessible healthcare to residents, especially in underserved urban areas, played a crucial role in sustaining healthcare access, over 50% of respondents experienced challenges in accessing services, primarily due to the repurposing of healthcare facilities for COVID-19 response. Despite these barriers, 63.4% of respondents reported receiving necessary care, suggesting a degree of systemic resilience. However, communication emerged as a major concern, with 43.3% of participants not receiving timely information about service changes. Satisfaction with communication from healthcare authorities and providers was mixed. Significant disparities in information access were observed across socio-demographic groups, particularly among the differently abled, less educated, and marginalized populations. Although community support was perceived as important, actual collaboration between communities and healthcare providers remained limited.

**Conclusions:** The findings underscore the urgent need to develop community-centric and resilient health systems. Key policy recommendations include strengthening primary healthcare infrastructure, institutionalizing emergency preparedness, adopting inclusive and multi-channel communication strategies, promoting meaningful community engagement, and targeting support for vulnerable groups.

**Key-words:** Resilient Health Systems, Community Engagement, Primary Healthcare Access, COVID-19 Response, Urban Poor.

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## Introduction

The COVID-19 pandemic revealed significant vulnerabilities in health systems worldwide, particularly in low- and middle-income countries (LMICs) such as India<sup>1</sup>. Marginalized and underserved populations were disproportionately impacted due to limited access to healthcare services, essential resources, and a range of intersecting socio-economic challenges.

A community level survey was conducted to assess the service delivery and access to essential primary level healthcare services during the COVID-19 pandemic. The aim was to assess the resilience of health systems in ensuring the availability and continuity of primary healthcare services during COVID-19, with a focus on community-level experiences and perceptions.

## Methods

During the COVID-19 pandemic, the WHO conducted four rounds of Pulse surveys to evaluate the continuity of essential health services. These surveys offered timely insights from key informants into the scale of disruptions affecting selected tracer services, as well as the primary factors contributing to those disruptions within a rapidly evolving context<sup>2</sup>. The survey also identified the challenges health systems faced in maintaining access to essential services, highlighting how countries responded to address these issues, support recovery efforts, and strengthen the resilience of their health systems moving forward.

To lessen the severe impact of COVID-19 on health service delivery in India, the Ministry of Health and Family Welfare (MoHFW), Government of India, issued guidance in April 2020 aimed at ensuring the continued provision of essential health services during the pandemic. The term “essential services” encompasses a broad range of health services, including reproductive, maternal, newborn, and child health (RMNCH); the prevention and management of communicable diseases; and the treatment of chronic conditions to prevent complications and medical emergencies<sup>3</sup>. Gaining insights into essential health service delivery from the community’s perspective during the COVID-19

pandemic was crucial to ensure that health systems remained responsive, inclusive, and resilient. This is grounded in the understanding that communities are the first to feel the effects of service disruptions and are uniquely positioned to identify gaps, barriers, and priorities in care during health emergencies<sup>4</sup>. Engaging with communities enabled health systems to tailor services to local contexts - such as mobility restrictions, misinformation, or fear of infection, thereby supporting the continued delivery of care for chronic illnesses related to RMNCAH and mental well-being. This approach also helped build trust, promoted health-seeking behaviors, and empowered communities to take an active role in the pandemic response, ultimately enhancing the effectiveness and equity of health interventions.

In India’s national capital, Delhi’s primary healthcare system, especially 521 Mohalla clinics<sup>5</sup>, a primary care setup in the vicinity of the community, played a vital role during the pandemic in ensuring the delivery of important primary healthcare services. While larger institutions and hospitals had ceased providing outpatient consulting services, Mohalla clinics continued to do so. Despite facing resource constraints in delivering a broad range of primary healthcare services, these facilities served as vital access points for many individuals - particularly in slum areas - providing essential healthcare and COVID-19 testing services. However, the unequal distribution of services - exacerbated by the growing demand to repurpose facilities for the COVID-19 response, led to varying degrees of disruption in essential health services, which communities were often left to endure.

Delhi is home to a large population residing in slums and informal settlements, which often lack quality health services, adequate housing, living space, and basic amenities<sup>6</sup>. As these slums lack quality health services, quality housing, availability of living space and basic amenities, were at higher risk of getting affected by COVID-19. In order to understand the community level perception on access and availability of primary level essential health services during COVID-19, community level survey was conducted in two districts namely South and West in Delhi. A structured pretested questionnaire with closed-ended questions was used

to collect data covering domains related to healthcare access, service disruptions, information availability, and perceptions of health system preparedness. All responses were entered in MS Excel to follow cleaning before putting it into analysis framework. Before initiation, the study protocol was reviewed and approved, ensuring that all procedures aligned with national and international ethical norms, including the Declaration of Helsinki and ICMR regulations. All participants were provided with comprehensive information about the study and they gave their informed consent voluntarily to participate in the study. Confidentiality and privacy of participant data were rigorously maintained throughout the study. No procedures were undertaken that could cause harm or discomfort to participants.

Primary respondents for the assessment included community member, Head of the household, above 18 years of age. The respondents represented a diverse and dynamic segment of the population, often residing in informal settlements, slums, or unauthorized colonies in South and West Districts. These communities typically face precarious living conditions, with limited access to basic amenities such as health, clean water, sanitation etc.

In the absence of a proportion of respondents who faced difficulty accessing necessary primary health services during the pandemic, we assumed the most conservative value of  $p=0.5$  (50%). With desired absolute precision as 0.05 (5%) and confidence interval as 1,96 (95%), the sample size of respondents required for this study was 384. With a 5% non-response rate or incomplete data, the final sample size required for the current study was estimated as 403. The South and West districts of Delhi are characterized by a high concentration of informal settlements, where access to essential health services remains limited. To explore community-level health perceptions and behaviors in these underserved areas, a purposive sampling strategy was employed to randomly select households. Data collection was conducted using a structured, paper-based questionnaire, administered following informed consent from all participants. Upon completion, the hardcopy responses were digitized into Microsoft Excel for systematic data management followed by analysis through SPSS. This process included rigorous data cleaning and

the application of standardized coding protocols to ensure accuracy and consistency in subsequent analyses.

## Results

### *Socio-demographic profile*

The majority of participants fall within the 31–45 years age group (41.54%), followed by 18–30 years (32.34%). Older age groups, 46–60 years and 60+ years, constitute 17.91% and 8.21% respectively. Males represent a significant majority at 65.42%, while females account for 34.58%. Most respondents are married (76.12%), with unmarried individuals comprising 16.92%. A notable portion of the population is illiterate (27.86%). High school education (23.88%) and 10+2 (17.16%) are common, while only 12.69% have a bachelor's degree and 4.23% hold a masters degree. No respondents reported having a Ph.D. or higher. Only 1.74% of respondents identified as differently abled. The majority were Hindu (74.13%), followed by Muslims (24.13%) and Sikhs (1.74%). General category respondents form the largest group (45.77%), followed by OBC (33.08%) and SC/ST (18.16%). EBC and others make up a small fraction. 22.89% of respondents hold a Below Poverty Line (BPL) card, and 14.68% possessed a PM-JAY health card, indicating access to government welfare schemes.

### *Awareness and communication on the availability of essential health services during COVID-19*

A majority of respondents (56.72%) reported receiving information about changes in the availability or delivery of primary health services during COVID-19, while 43.28% did not receive such information. When asked about their satisfaction with communication from healthcare authorities: 9.70% were very satisfied, 35.82% were satisfied, 28.11% were neutral, 18.16% were dissatisfied and 8.21% were very dissatisfied. This indicates that while nearly half of the respondents were satisfied, a significant portion remained neutral or dissatisfied. Television was the most common source (37.06%) of information; social media platforms like Facebook, Instagram, and Twitter followed (23.38%); government circulars (11.44%) and newspapers (9.70%) were also notable sources. Regarding communication from healthcare

service providers on availability of services, 13.18% were very satisfied, 33.83% were satisfied, 32.34% were neutral, 14.18% were dissatisfied and 6.47% were very dissatisfied. These findings suggest that while a fair proportion of respondents were satisfied, a considerable number remained indifferent or dissatisfied, highlighting areas for improvement in communication strategies.

#### *Access to primary health services*

Over half of the respondents (52.74%) reported that their nearest health facility is within 1 km, while 30.10% travel 2 km. A smaller proportion travel 3–4 km (17.16%). Most respondents (79.10%) reach the facility within an hour, though 20.90% require more time, with a few taking up to 4 hours. Waiting times varied, with 35.82% receiving checkups within 30 minutes and 34.33% waiting 30–60 minutes. However, 22.64% waited over an hour, and 7.21% were unsure. A significant 55.22% faced difficulties accessing services during COVID-19. Nearly half (49.00%) observed that services were compromised due to the health system being repurposed for emergency response. While 44.53% acknowledged the availability of alternatives like outreach services or mobile units, 37.06% reported no such provisions, and 18.41% were unaware. During lockdowns, 48.26% experienced difficulties reaching healthcare facilities, while 41.04% did not. A notable 10.70% were uncertain. Despite challenges, 63.43% were able to receive the services they needed.

#### *Health systems preparedness for COVID-19*

When asked about the healthcare system's readiness to continue delivering primary health services during emergencies, 12.44% believed the system was fully prepared, 27.61% said it was prepared, 30.10% remained neutral, 19.40% felt it was partially prepared, and 10.45% considered it not prepared. This distribution suggests a moderate level of confidence in systemic preparedness, with a significant portion of respondents expressing uncertainty or concern. Regarding the readiness of individual healthcare providers: 10.45% rated them as fully prepared, 26.37% as prepared, 36.07% were neutral, 20.40% said partially prepared and 6.72% felt they were not prepared. These responses reflect a slightly lower confidence in individual provider preparedness compared to the system as a whole.

#### *Community engagement and community level support system*

A significant majority of respondents acknowledged the importance of community support networks- 24.38% strongly agreed and 37.31% agreed that community initiatives play a crucial role in ensuring the availability of primary health services during COVID-19. These findings suggest a generally positive perception of the community's role in supporting healthcare continuity during crises. This indicates that while the value of community support is recognized, actual collaboration with healthcare providers may be limited or inconsistent, highlighting an area for potential improvement.

#### *Information channels on changes and availability of primary healthcare services*

Regarding information about changes in primary health service availability or delivery during COVID-19, television emerged as the most common source of information (37.06%), followed by social media (23.38%), government circulars (11.44%), newspapers (9.70%), and radio (4.48%). Notably, 13.93% of respondents did not receive any information. Younger respondents (18–30 years) relied heavily on TV (34.62%) and social media (34.62%). The 31–45 age group also favored TV (35.33%), but had more diverse sources. Older groups (46+ years) leaned more on TV, with reduced use of social media and higher rates of not receiving information. Males were more likely to use TV (36.12%) and social media (25.48%). Females also favored TV (38.85%), but a higher proportion (18.71%) reported not receiving any information.

#### *Satisfaction level on communication from health authorities*

Nearly half of the respondents expressed satisfaction, a significant portion remained neutral or dissatisfied. The 60+ age group reported the highest satisfaction (72.72% satisfied or very satisfied). Younger groups (18–45 years) showed more mixed responses, with higher neutrality and dissatisfaction. Males reported slightly higher satisfaction (48.29%) compared to females (40.29%). Females had a higher proportion of neutral responses (33.09%). Respondents with master's degrees showed the highest satisfaction (70.59%). Among the differently abled, 42.86% were very dissatisfied, indicating a

significant communication gap. Sikhs reported the highest satisfaction (71.43%), though the sample size was small. SC/ST and other caste groups showed higher dissatisfaction levels. BPL cardholders and PM-JAY beneficiaries reported higher satisfaction (61.95% and 71.19% respectively), suggesting that targeted communication efforts may have been more effective for these groups.

*Access to information on any changes in primary health service availability or delivery*

Over 56.72% reported receiving information about changes in primary healthcare services, while 43.28% did not. The 60+ age group had the highest awareness (69.70%), followed by 18–30 years (60%). Awareness declined among the 46–60 years group (48.61%). Females (58.99%) were slightly more informed than males (55.51%). Awareness was highest among those with a master's degree (76.47%). Those with bachelor's degrees had lower awareness (49.02%), and illiterate respondents still showed relatively high awareness (58.04%). Only 28.57% of differently abled respondents received information, highlighting a significant disparity in communication outreach. BPL cardholders (73.91%) and PM-JAY beneficiaries (84.75%) had significantly higher awareness, suggesting effective government communication efforts. This underscores the importance of inclusive and accessible communication strategies, especially for marginalized groups such as the differently abled, divorced/separated individuals, and those with lower education levels.

*Communication from healthcare providers regarding the availability of primary health services*

About the communication from service providers on availability of services, 13.18% were very satisfied, 33.83% were satisfied, 32.34% were neutral. These results indicate that nearly half of the respondents expressed satisfaction, while a significant portion remained neutral or dissatisfied. The 60+ age group reported the highest satisfaction (84.85% satisfied or very satisfied). Respondents with a master's degree had the highest satisfaction (88.24%). Those with bachelor's degrees and 10+2 education leaned more toward neutrality. BPL cardholders and PM-JAY beneficiaries reported higher satisfaction (55.43% and 52.54%, respectively), suggesting effective outreach

among economically vulnerable groups. It highlights the need for targeted communication improvements, especially for women, lower-educated groups, and marginalized communities, to ensure equitable access to timely and clear health information.

## Discussion

The COVID-19 pandemic revealed significant weaknesses in health systems worldwide, with low- and middle-income countries (LMICs) like India bearing a disproportionate share of the challenges<sup>7</sup>. The community-level survey conducted in the South and West districts of Delhi provide important insights into how urban poor populations perceived and experienced disruptions in essential health services during the pandemic.

The findings highlight that while initiatives such as Mohalla Clinics played a crucial role in sustaining access to primary healthcare in Delhi, systemic challenges including limited resources, the repurposing of facilities for COVID-19 response, and communication breakdowns, significantly disrupted service delivery. More than half of the respondents reported difficulties in accessing healthcare, with nearly 49% attributing these challenges to the diversion of health system resources toward emergency pandemic efforts. Nevertheless, 63.43% of respondents were still able to access the services they needed, reflecting a notable degree of resilience within the system.

Communication emerged as a key area of concern. While 56.72% of respondents reported receiving information about changes in healthcare services, a significant 43.28% did not. Satisfaction levels with communication from healthcare authorities and service providers were mixed, with many respondents expressing neutrality or dissatisfaction. These findings underscore the urgent need for more inclusive, accessible, and targeted communication strategies - particularly for marginalized groups such as individuals with disabilities, those who are illiterate, and people without access to digital platforms.

COVID-19 has demonstrated need of a community - centric health system which ought to be resilient, and this may be instilled by revisiting

existing policies in line with the below-mentioned points:

- (i) **Strengthening primary healthcare infrastructure:** The role of Mohalla Clinics during the pandemic underscores the value of decentralized, community-based healthcare models. To ensure continuity of care during future emergencies, policymakers should prioritize investment in scaling up and strengthening similar grassroots health facilities.
- (ii) **Institutionalizing emergency preparedness:** The varied perceptions of system and provider preparedness highlight the need to institutionalize emergency response. This should include routine training, dedicated resource allocation, and regular simulation exercises for health workers.
- (iii) **Enhancing communication strategies:** The unequal access to information across socio-demographic groups highlights the need for a multi-channel, inclusive communication strategy. Utilizing local languages, FM radio, and trusted grassroots workers - such as ASHAs, ANMs, and others, can help close information gaps, particularly among vulnerable populations.
- (iv) **Promoting community participation:** Although community support was recognized, its practical implementation and integration into health systems remain limited. To strengthen collaboration between communities and healthcare providers, policies should institutionalize community engagement mechanisms, such as health committees or local health volunteers.
- (v) **Targeted support for vulnerable groups:** The findings underscore the need for targeted interventions aimed at groups with lower levels of awareness and satisfaction, such as individuals with disabilities, women, the elderly etc. Customized outreach efforts and service delivery models can help promote greater equity in healthcare access.
- (vi) **Monitoring and evaluation frameworks:** Developing strong monitoring systems to track service disruptions, gather community

feedback, and assess response effectiveness during health emergencies is essential. Such systems can support timely policy adjustments and contribute to long-term planning for health system resilience.

Similar to the role of Mohalla Clinics in Delhi, studies from Ahmedabad and Bangalore highlighted the importance of decentralized primary healthcare facilities and community health workers (CHWs) in sustaining essential services<sup>8,9</sup>. Communication challenges and disparities in information access, as observed in Delhi, were also prevalent in Mumbai's slums, where community engagement models ranged from passive recipient roles to active ownership, with the latter proving most effective for resilience<sup>10</sup>. Moreover, studies emphasized that community participation, though widely acknowledged, often lacked institutional support, mirroring Delhi's limited collaboration between communities and healthcare providers<sup>11</sup>. These analogies underscore the need for inclusive communication strategy and institutionalized community engagement to build resilient health systems.

## Conclusion

This study highlights the critical role of community perspectives in evaluating the resilience of health systems during public health emergencies. Despite significant disruptions caused by the repurposing of healthcare facilities during COVID-19, initiatives like Mohalla Clinics helped sustain access to essential services. However, gaps in communication and limited community engagement underscore the need for more inclusive, responsive, and community-centric health strategies. Strengthening infrastructure, institutionalizing emergency preparedness, and enhancing communication mechanisms are essential steps toward building resilient health systems. This study, while offering valuable insights into community-level experiences during the COVID-19 pandemic in Delhi, is subject to several limitations. The use of a structured questionnaire with closed-ended questions may have constrained the depth of responses. The reliance on self-reported data introduces the possibility of recall bias and social desirability bias. The future research should explore longitudinal community-level assessments to better understand how perceptions and access to primary healthcare evolve during and after public health emergencies.

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NIL

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# Family and Childhood Adversity: A Quantitative Study of Household Dysfunction using ACE-IQ Data from Madhya Pradesh

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## Abstract

**Background:** Adverse Childhood Experiences (ACEs) have been recognized as significant predictors of long-term physical and mental health outcomes. Household dysfunction, including parental substance use, mental illness, domestic violence, and disrupted family structures, contributes heavily to the burden of ACEs. This study investigates the association between these household-level adversities and ACE prevalence among youth in Madhya Pradesh, India. To examine the prevalence of key household ACE domains and assess the association of abuse and neglect in household with parental substance use and single parenting.

**Methods:** A cross-sectional quantitative study was conducted among 203 participants using the WHO ACE-International Questionnaire (ACE-IQ). Logistic regression analysis was employed to determine associations between parental alcohol/drug use, single parenting and specific ACE domains, including neglect, abuse, and domestic violence.

**Conclusion:** Emotional neglect (51.2%) and physical neglect (46.3%) were the most frequently reported ACEs. Parental substance use was significantly associated with increased odds of sexual abuse (OR = 3.019,  $p = 0.046$ ). Elevated, though non-significant, odds were also observed for emotional abuse (OR = 4.28) and exposure to violence (OR = 2.86). Household dysfunction plays a critical role in shaping childhood adversity. The strong association between parental substance use and sexual abuse, along with high rates of neglect, highlights the need for family-focused intervention strategies. Early identification, routine ACE screening, and integrated mental health support are essential to break intergenerational cycles of trauma.

**Keywords:** domestic, neglect, abuse, parental alcoholism, adverse childhood experience, India.

## Introduction

Adverse Childhood Experiences (ACEs) have garnered increasing attention for their profound and

long-lasting impact on health, development, and well-being. Among these, household dysfunction—characterized by parental substance use, domestic

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violence, separation, and the presence of incarcerated or mentally ill family members—has emerged as a significant contributor to intergenerational trauma.<sup>1,2</sup> Such environments can disrupt the formation of secure attachments, affect emotional regulation, and increase vulnerability to physical and mental health disorders in later life.

Multiple global studies underscore the prevalence and influence of household dysfunction. Merrick et al.<sup>3</sup> identified emotional abuse and parental separation as leading ACEs in a U.S. sample, while Mlouki et al.<sup>4</sup> including behavioral addiction such as Internet Addiction (IA) observed a high prevalence of intra-familial ACEs (94.5%) in Tunisian students, with emotional neglect topping the list. Similarly, Majid et al.<sup>5</sup> from Malaysia found household dysfunction to be more frequent among university students exposed to ACEs. Webster et al.<sup>6</sup> also noted that parental separation and financial hardship were common childhood adversities in young children. These patterns reflect how household-level adversities often form the core of early trauma, with the potential to perpetuate cycles of dysfunction and inequality.

In India, especially in states like Madhya Pradesh, where socio-economic vulnerabilities intersect with traditional family structures, the risk of adverse familial experiences can be particularly pronounced. However, limited research has been conducted to quantify and characterize such experiences in this context.

This study aims to examine the prevalence and interrelations between specific domains of household dysfunction—namely parental substance use, domestic violence, separated or single parent households, and incarcerated or mentally ill household members—among young adults in Madhya Pradesh using the WHO ACE-IQ tool. By understanding these relationships, the study contributes to the growing discourse on intergenerational trauma and the urgent need for targeted family-level interventions in public health.

## Methods

### Study Design and Setting

This is a community-based, cross-sectional, quantitative study conducted in Madhya Pradesh,

India. Considering the literature, (18) sample size was calculated with a 95% confidence interval (standard normal deviate,  $Z = 1.96$ ) as,

$$n = 4 \frac{pq}{l^2}$$

Where n is the desired sample,

n = required minimum sample size

p = prevalence of ACE = 88.2% = 0.882

q = 1 - p = 1 - 0.882 = 0.118

l = 5 % absolute error = 0.05

$$\text{So, } n = \frac{4 \times (0.882) \times (0.118)}{(0.05)^2}$$

n = 166.52 = 167 (approximately)

The minimum required sample size will be 167.

To account for non-response and incomplete data, the sample size will be increased by 10% to 184.

There are 78 wards in the Jabalpur urban area, 70 of which are under Nagar Nigam and 8 of which are under Cant area. Multistage random sampling was employed. In the first stage, 10 wards, were selected by lottery method. Ten wards were chosen by lottery in the first stage. In the second stage, houses were chosen from wards using systematic random sampling. Following line listing, the table of random numbers method was used to choose the first home, and the sampling interval (total household/20) was added to choose the remaining homes. From each ward, 20 houses are chosen, and research participants are enlisted. Young residents between the ages of 18 and 25 who have provided their informed consent to participate in the study are among the study's selection criteria. Individuals who declined to participate in the study were excluded.

Data was collected using the World Health Organization's Adverse Childhood Experiences International Questionnaire (ACE-IQ), which includes domains on abuse, neglect, and household dysfunction. For this analysis, the focus was on five variables:

1. Physical neglect
2. Emotional neglect
3. Alcohol and/or drug abuser in the household

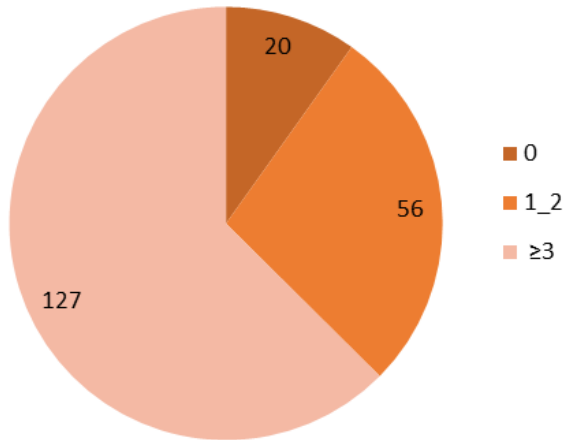
4. Someone chronically depressed, mentally ill, institutionalized or suicidal
5. Incarcerated household member
6. One or no parents, parental separation or divorce
7. Household member treated violently
8. Physical abuse
9. Emotional abuse
10. Contact sexual abuse

Data was entered and cleaned using Microsoft Excel and analyzed using SPSS version 23. Descriptive statistics were used to estimate the prevalence of each variable. Chi-square tests were used to examine associations between household dysfunction and ACE scores. A p-value < 0.05 was considered statistically significant. A multinomial logistic regression was conducted to examine the association between parental alcohol and/or drug abuse, Single parenting and various adverse childhood experience (ACE) domains, including exposure to violence, emotional and physical neglect, physical and emotional abuse, and sexual abuse.

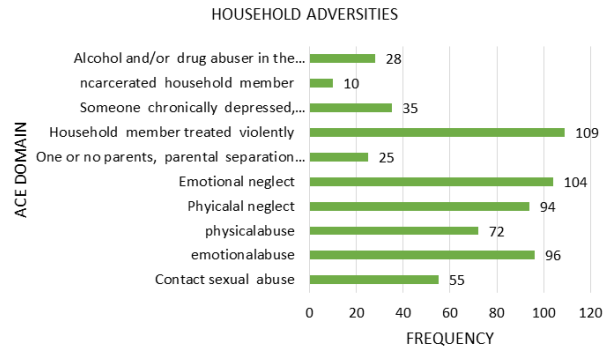
**Results**

The study included 203 participants, of whom 36% were male (n=73) and 64% were female (n=130). The mean age was 21.3 years (SD ±2.5). 87% were currently pursuing higher education. According to the analysis, the prevalence of Adverse Childhood Experience (ACE) was high (90.1%) with almost two-thirds (62%) of the sample had three or more ACEs. Figure 1

ACE Score of the study participants



**Figure 1: ACE Score**



**Figure 2: Frequency of household adversities**

Physical and emotional neglect were used as indicators of a parent-child relationship. Parental care and support was lacking in 51.2% of cases emotionally and in 46.3% of cases physically, and it was significantly associated with the frequency of ACE scores. The frequency of an ACE score has a significant association with all aspects of an adverse family environment, including 47.3% experiencing emotional abuse and 53.7% witnessing violent treatment of a household member. Figure 2

**Table 1: Association between ACE score and Household adversity domains**

Household adversities		Frequency of ACE score			P value
		0	1-2	≥3	
Physical neglect	Yes	0	12	82	<0.001
	No	20	44	45	
Emotional neglect	Yes	0	15	89	<0.001
	No	20	41	38	
Alcohol and/or drug abuser in the household	Yes	0	1	27	<0.001
	No	20	55	100	
Someone chronically depressed, mentally ill, institutionalized or suicidal	Yes	0	0	35	<0.001
	No	20	56	92	
Incarcerated household member	Yes	0	0	10	0.043
	No	20	56	117	
One or no parents, parental separation or divorce	Yes	0	3	22	0.016
	No	20	53	105	

Continue.....

Household member treated violently	Yes	0	6	103	<0.001
	No	20	50	24	
Physical abuse	Yes	0	3	69	<0.001
	No	20	53	58	
Emotional abuse	Yes	0	3	93	<0.001
	No	20	53	34	
Contact sexual abuse	Yes	0	3	52	<0.001
	No	20	53	75	

Among the ACE domains, **sexual abuse** showed a statistically significant association with parental

alcohol/drug use (OR = 3.019; 95% CI: 1.145–7.964;  $p = .046$ ), indicating that children exposed to parental substance use were over three times more likely to report experiences of sexual abuse compared to those not exposed. While not statistically significant, a positive trend was also observed for **emotional abuse** (OR = 4.276; 95% CI: 0.858–21.309;  $p = .076$ ), suggesting a potentially elevated risk that warrants further investigation. Other ACE domains, including exposure to violence (OR = 2.856), physical neglect (OR = 2.264), and emotional neglect (OR = 0.940), did not show statistically significant associations. Table 2

**Table 2: Multinomial logistic regression analysis of parental alcoholism with household ACE domains**

ACE Domain	OR	95% CI	p-value
Witnessing Domestic Violence	2.856	0.613 - 13.303	0.181
Emotional Neglect	0.940	0.360 - 2.454	0.899
Physical Neglect	2.264	0.774 - 6.623	0.136
Physical Abuse	0.560	0.208 - 1.508	0.251
Emotional Abuse	4.276	0.858 - 21.309	0.076
Sexual Abuse	3.019	1.145 - 7.964	0.046

The ACE domain that is most strongly and significantly linked to parental separation or divorce is sexual abuse. Additionally, physical neglect has a protective-looking odds ratio and is trending towards

significance ( $p = .058$ ). While emotional neglect trends upward (OR = 2.0), other domains such as emotional abuse, physical abuse, and emotional neglect do not exhibit any significant associations. Table 3

**Table 3: Multinomial logistic regression analysis of living with single parent with household ACE domains**

ACE Domain	OR	95% CI	p-value
Emotional neglect	2.007	0.709 - 5.680	.190
Physical neglect	0.355	0.122 - 1.038	.058
Physical abuse	1.331	0.444 - 3.990	.609
Emotional abuse	0.529	0.139 - 2.017	.351
Sexual abuse	11.204	3.495 - 35.919	.000

## Discussion

Unfavourable family environment was significantly associated with higher ACE scores. The study found that 46.3% of participants experienced physical neglect, while 51.2% experienced emotional neglect in household. The strong association between physical and emotional neglect and a higher ACE score suggests that individuals who experience neglect from parents are more likely to report multiple ACEs in future. In Indian context, a cross sectional study from Kerala suggest neglect was

the most common adverse childhood experience among the participants.<sup>7</sup> This was consistent with the literature from Tunisia done by Mlouki et al where students were exposed to more intra familial adverse events than social.<sup>4</sup> including behavioral addiction such as Internet Addiction (IA)

The association between ACE scores and family environment was strong, with higher ACE scores indicating more exposure to the negative family environment. In our study 13.8% of individuals had exposure to alcohol and/or drug abusers in their

household, 17.2% to someone chronically depressed, mentally ill, institutionalized, or suicidal, 4.9% to an incarcerated household member, 12.3% to one or no parents, parental separation or divorce, 53.7% to a violent household member, 35.5% to physical abuse, 47.3% to emotional abuse, and 27.1% to contact sexual abuse. All were strongly associated with higher ACE scores. One of the most alarming findings across studies is the strong correlation between ACEs and health-risk behaviors, including substance abuse, smoking, early sexual activity, and violent behaviors. For example, Chanda and Priya Maurya<sup>8</sup> show a strong association between family drug use and risky behaviors in adolescents, such as suicidal thoughts and early sexual debut. According to a 2021 study by Fernandez et al thirty three percent of the sample had witnessed domestic violence in India.<sup>9</sup> Studies by Majid et al. suggest that household dysfunction—such as living with an alcoholic or mentally ill parent, or witnessing domestic violence—is particularly pervasive and can be linked with a high prevalence of physical abuse (28.7%) and emotional abuse (27.25%) among health campus students in Malaysia, underscoring that ACEs are prevalent even among higher education populations.<sup>5</sup> Similarly, the Dominican Republic study (Luft et al.) finds that 49.6% of adolescents report exposure to domestic violence, which is likely to contribute to a range of psychological issues, including poor mental health and violent behavior later in life.<sup>10</sup> Ramiro et al. also report that exposure to alcohol abuse and domestic violence correlates with risky sexual behavior and smoking in adult populations.<sup>11</sup> health-risk behaviors, and chronic disease conditions in adult life. **STUDY POPULATION:** One thousand and sixty-eight (1,068) This suggests that ACEs do not only affect immediate emotional and physical well-being, but also increase the likelihood of engaging in behaviors that further perpetuate poor health outcomes.

In an American setting, Merrick et al. highlighted the prevalence of emotional abuse, followed by parental separation and substance abuse, among the U.S. population.<sup>3</sup> Emotional abuse can have long-term effects on mental health, and this is supported by studies showing strong associations between ACEs and mental health issues, such as depression, anxiety, and suicidal tendencies.<sup>12</sup> such as violence victimization, substance misuse in the household,

or witnessing intimate partner violence, have been linked to leading causes of adult morbidity and mortality. Therefore, reducing adverse childhood experiences is critical to avoiding multiple negative health and socioeconomic outcomes in adulthood. **METHODS:** Behavioral Risk Factor Surveillance System data were collected from 25 states that included state-added adverse childhood experience items during 2015-2017. Outcomes were self-reported status for coronary heart disease, stroke, asthma, chronic obstructive pulmonary disease, cancer (excluding skin cancer) In contrast, Webster et al. report a slightly more optimistic statistic from their study on children, where 70.9% had no ACEs. However, the common adversities in their study were intrafamilial, such as parental separation and financial hardship.<sup>6</sup> The relationship between ACEs and mental health disorders is also well-documented in these studies. Swedo et al. report that emotional and physical abuse lead to poor mental health, with a significant portion of adolescents in the U.S. reporting mental health struggles. These findings align with other research linking ACEs to long-term conditions like PTSD, depression, and anxiety. This further emphasizes the need for early intervention to prevent the escalation of mental health issues in individuals with high ACE scores.<sup>13</sup> potentially traumatic events with lifelong negative impacts. Population-level data on ACEs among adolescents have historically relied on parent reports and excluded abuse-related ACEs. We present the self-reported prevalence of ACEs among a large population-based sample of US high school students. **METHODS:** Using cross-sectional, state-representative data from 16 states that included core ACE questions on their 2021 Youth Risk Behavior Survey, we estimate the prevalence of 8 individual (lifetime emotional, physical, or sexual abuse, physical neglect, witnessed intimate partner violence, household substance use, household poor mental health, incarcerated parent or guardian

Cultural and regional contexts play a critical role in shaping the prevalence and types of ACEs experienced by different populations. For example, studies from India and Vietnam suggest that drug abuse, domestic violence, and parental neglect are prevalent in these regions, but the specific patterns and social norms may vary.<sup>8,14</sup> the majority of research

has been conducted in high-income-countries and little is known about ACE prevalence in low-and-middle-income-countries (LMIC). In India, the high rate of substance use within families and the association with risky behaviors point to a cultural context where substance abuse and its repercussions on children are significant concerns. Meanwhile, in Vietnam, factors such as emotional neglect and sexual abuse, although less frequently reported, remain critical areas that require attention. Additionally, the studies from developed nations, such as those in the U.S.,<sup>12,13</sup> such as violence victimization, substance misuse in the household, or witnessing intimate partner violence, have been linked to leading causes of adult morbidity and mortality. Therefore, reducing adverse childhood experiences is critical to avoiding multiple negative health and socioeconomic outcomes in adulthood. **METHODS:** Behavioral Risk Factor Surveillance System data were collected from 25 states that included state-added adverse childhood experience items during 2015-2017. Outcomes were self-reported status for coronary heart disease, stroke, asthma, chronic obstructive pulmonary disease, cancer (excluding skin cancer) reveal a different set of challenges, where emotional abuse and parental separation seem to be more prominent. These differences may be attributed to varying socioeconomic conditions, cultural attitudes toward mental health, and family structures across countries. These studies point to the need for interventions that address family dynamics as a crucial part of preventing the intergenerational transmission of trauma.

These familial adversities are often deeply intertwined. For instance, substance use by a parent frequently co-occurs with domestic violence, while both are associated with higher risks of parental separation and mental health issues within the household.<sup>9,15</sup> Smoking and Substance Involvement Screening Test. A random-effects, two-stage individual patient data meta-analysis explained the associations between ACEs and substance misuse with adjustments for confounders such as sex and family structure. **RESULTS:** 1 in 2 participants reported child maltreatment ACEs and family level

ACEs. Except for sexual abuse, males report more of every individual childhood adversity and are more likely to report misusing substances compared with females (87.3% vs. 12.7%). Such cumulative exposure can compound psychological harm, a phenomenon consistent with the theory of toxic stress and its biological embedding over time. The study found that parental substance use is linked to increased emotional volatility, impaired caregiving, and household conflict, which can contribute to a hostile developmental environment. The non-significance of these associations may be due to limited statistical power or underreporting of certain ACEs due to stigma, fear, or normalization of violence in some familial contexts. Emotional and physical neglect showed elevated odds ratios, suggesting that substance-abusing caregivers may be less responsive to children's emotional and physical needs due to intoxication, withdrawal, or preoccupation with securing substances. The strong association with sexual abuse is particularly alarming, suggesting that in households affected by substance use, boundaries may be compromised and the family structure may be less capable of protecting children from external or intra-familial perpetrators. This highlights the need for early identification and intervention in substance-using households.

The study found a significant association between parental separation or absence and an increased risk of childhood sexual abuse (CSA). Children from separated or single-parent households had over eleven times higher odds of experiencing CSA compared to those from two-parent families. This aligns with recent Indian studies indicating high prevalence rates of CSA.<sup>16</sup> Emotional neglect did not reach statistical significance, but the observed odds ratio suggests a potential trend towards increased emotional vulnerability among children from disrupted families. Physical neglect showed a marginally significant inverse association, suggesting lower reported instances among children of separated parents.<sup>17</sup> This may reflect underreporting or differing perceptions of neglect, as well as the potential involvement of extended family or community support systems mitigating material deprivation.

## Conclusion

This study highlights the profound impact of adverse childhood experiences (ACEs), particularly those rooted in household dysfunction such as parental substance use, mental illness, domestic violence, and disrupted family structures.

The findings from this study resonate with international literature while also shedding light on the unique sociocultural dynamics of Indian families. Cultural stigma, normalization of violence, and underreporting likely contribute to the complexity of capturing the full extent of ACEs. Nonetheless, the evidence presented reinforces the critical need for early identification of at-risk families, especially those affected by substance use and mental illness.

To break the intergenerational cycle of trauma, policy and public health efforts must focus on strengthening family support systems, integrating ACE screening into routine healthcare, and expanding community-based interventions. Empowering caregivers through mental health support and substance use rehabilitation, alongside school and community programs for children, is vital to creating safer and more nurturing environments that foster resilience and healing.

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**Availability of data and material:** The datasets or any other necessary material can be made available by the corresponding author upon reasonable request.

The study was approved by the Ethics Committee of NSCB medical college No.IEC/2023/ 7335-87 Jabalpur dated 18-08-2023 and consent was taken from participants.

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# Mapping Child Survival: A District-Level Assessment of SDG-3 Target for Under-five Mortality Rate in Assam

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## Abstract

**Objective:** This study aims to present the district-level estimates of under-five mortality rate of Assam, with specific emphasis on assessing its progress towards attainment of Sustainable Development Goal 3.2.1 target by 2030. The paper additionally presents sex differentials in target achievement and identifying districts' likelihood of meeting or missing the goal by 2030. The under-five mortality rate indirectly offers insight into the overall health, quality of life, welfare, and development of an area.

**Materials and methods:** The study uses the unit-level data from National Family Health Survey 5 (2019-20) and 4 (2015-16). A synthetic cohort probability approach is used to obtain the district-wise estimates of the under-five mortality rate for the state of Assam.

**Results:** The analysis shows that 12 per cent out of all the districts across the state have already attained the target outlined in Sustainable Development Goal 3.2.1. However, nearly 30 per cent of the districts are unlikely to achieve it by 2030. Moreover, there exists a significant difference in attainment of the target across the two sexes. It is seen that female under-five mortality rates fluctuate relatively more across districts compared to male under-five mortality rate. Additionally, more districts are on track to meet the target in case of female under-five mortality rate by 2030.

**Conclusions:** Strategic adoption of policies, effective implementation, and efficient healthcare interventions is necessary in narrowing the gap and enabling all districts to meet the Sustainable Development Goal 3.2.1 by 2030. It is expected that 20 districts of Assam would attain the target by 2030.

**Keywords:** Child health, Under-five mortality, Sustainable development goals, Sex differential, Assam

## Introduction

A nation's true prosperity is fundamentally vested in its children, a sentiment powerfully

articulated by Kahlil Gibran,<sup>(1)</sup> who noted that a country's wealth and prosperity reside not in its material assets, but are deeply driven by its future generations. The children represent the bedrock of a

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nation's workforce, and safeguarding their health and well-being becomes an imperative. Consequently, the child mortality rate, a critical measure of child survival, is a key indicator of a nation's overall health, quality of life, welfare, and development.<sup>(2-4)</sup> A persistent decline in child mortality is both sought after and indicative of increased public health and well-being.

The UN's International Children's Emergency Fund (UNICEF) defines the Under-five mortality rate (U5MR) as the "probability a newborn would die before reaching exactly five years of age, expressed as per 1,000 live births."<sup>(2)</sup> The U5MR provides information regarding nutritional conditions<sup>(5-8)</sup> and indirectly provides insight into the health conditions of a region. Health is a necessary source of productivity because it can be considered a proxy for labour quality.<sup>(9)</sup>

The SDG-3.2.1 (Sustainable Development Goal 3.2.1) is regarding the under-five mortality rate, which is a key indicator within the framework of Sustainable Development Goal 3 (SDG 3) for "ensuring healthy lives and promoting well-being for all at all ages". The target of SDG-3.2.1 is to end preventable deaths of children under age five years, to reduce under-five mortality to at least 25 per 1,000 live births by 2030.<sup>(10-12)</sup>

India has significantly lowered its Under-five Mortality Rate in recent decades. From 2019 to 2020, this rate fell by 8.6 per cent annually, representing a three-point reduction in child mortality. As per reports, eleven States/Union Territories—namely Kerala, Tamil Nadu, Delhi, Maharashtra, Jammu & Kashmir, Karnataka, Punjab, West Bengal, Telangana, Gujarat, and Himachal Pradesh—have already attained the target U5MR.<sup>(13)</sup> However, disparities in accessibility to the health care system across regions and sex exists. Consequently, over the past few years, there has been an influx of information regarding socio-economic and geographical disparity in child mortality,<sup>(14,15)</sup> and only a limited number of research have explored the disparities in mortality at the district level.<sup>(7,8,16-19)</sup> This needs to be addressed to achieve the SDG-3.2.1 target better.

Assam, despite being identified as a high risk state,<sup>(16)</sup> has made considerable progress in reducing the U5MR to 39.1, outperforming the national average of 49.1 as per the National Family Health Survey-5 (NFHS-5). Regardless, many districts still

face challenges related to inadequate healthcare infrastructure and limited access to quality medical services. Moreover, the district-level figures of U5MR are not readily available, and minimal studies have explored disparity across the district level.

In this context, no prior study has comprehensively traced the pathway towards achieving the target SDG 3.2.1 at the district level for Assam, specifically utilizing the latest unit-level data from the National Family Health Survey (NFHS-5) 2019-20 dataset. Furthermore, numerous studies indicate a persistent gender gap in under-five mortality, characterized by an excess of female deaths, whether a similar pathway or disparity is observed within the state of Assam remains an unexplored area.

This study primarily presents the estimates of U5MR at the district level in Assam as per unit level NFHS-5 data. More specifically the paper assesses the state's progress towards reaching the Sustainable Development Goal 3.2.1 (SDG-3.2.1). Secondly, the paper analyses sex differentials across districts in achieving the target, identifying the districts likely to meet the SDG 3.2.1 by 2030, and highlight those which are at high risk of failure. This would enable policymakers to effectively identify high-risk districts and facilitate the necessary allocation of resources.

## Materials and Methods

The current study uses the data at the unit-level from the fourth and fifth rounds of the Demographic and Health Survey (DHS) of India, which is also known as the National Family Health Survey-5 (NFHS-5)<sup>(14,20)</sup> and National Family Health Survey-4 (NFHS-4)<sup>(15,21)</sup> conducted in 2019-21 and 2015-16, respectively.

There are two principal methods to obtain estimations of early childhood mortality rate: the direct method and the indirect method. The direct method has been used to minimise errors and get a robust estimated rate. This direct method of estimation is also known as the synthetic cohort probability method and is, in fact, consistent with the approach used in DHS reports. We employed STATA software version 17, alongside appropriate packages to conduct the analysis.<sup>(22)</sup>

The synthetic cohort probability method is used in DHS to determine death rates. Based on the entire birth history survey approach, the synthetic cohort probability approach enquires mothers about each

child's date of birth, current survival status, and, if deceased, the age at when the child died. By default, death rates are deduced for the five years preceding the interview period,<sup>(23)</sup> but for robustness of the study, we compute death rates for 10 years preceding the interview period.<sup>(16,23)</sup> We have separately estimated the district-level U5MR for the female, male, and total population. The result of this study is strictly based on the U5MR estimates, which are statistically significant at the 5 per cent level.

To undertake a comparative analysis of the status of all the districts across Assam, with specific reference to the attainment of SDG-3.2.1 target pertaining to the reduction of preventable deaths among newborns and children, we have categorised all districts into distinct three categories based on some conditions.

- a. **Already achieved:** Districts that had **already achieved or attained** the U5MR target outlined as per SDG-3.2.1 (i.e., less than or equal to 25 deaths per 1000 live births).
- b. **Likely to achieve:** Districts that are **likely to achieve** or are on track to attain the U5MR target outlined as per SDG-3.2.1 by 2030 (i.e., less than or equal to 25 deaths per 1000 live births by the end of 2030).
- c. **Not likely to achieve:** Districts that are **not likely to achieve** or are not on track or will not attain the U5MR target as per SDG-3.2.1 by 2030.

The following steps have been undertaken to include a district either in the category **likely to achieve** or **not likely to achieve**: We first obtain the U5MR estimates for all the districts across Assam for both NFHS-5 (five years preceding the survey) and NFHS-4 (five years preceding the survey). Secondly, we calculate the district-specific yearly reduction rate in U5MR from NFHS-4 to NFHS-5. Lastly, we adjust the district-specific yearly reduction rate to the mortality estimates obtained from NFHS-5 for a future period of 15 years. The reason for taking 15 years is that the period between 2015 (mid-point for the reference period of mortality estimates of NFHS-5, 10 years prior to the survey) and 2030 (SDG-3 achievement target year) is 15 years.

We assume that the district-specific annual reduction rate remains constant over the 15-year period from 2015 to 2030. Therefore, a district is included in the **likely to achieve** category only if it is expected to attain the target U5MR by 2030. Conversely, a district

falls into the **not likely to achieve** category if it does not meet both the criteria. In other words, if their projected progress doesn't show them reaching the target by 2030, they'll be placed in this category. For the newly formed districts, the district-specific yearly reduction rate of the parent districts has been taken. For instance, the districts like West Karbi Anglong, South Salmara-Mankachar, Majuli, Biswanath, Hojai, and Charaideo are bifurcated out of Karbi Anglong, Dhubri, Jorhat, Sonitpur, Nagaon, and Sivasagar, respectively. So, districts like West Karbi Anglong will carry the rate of Karbi Anglong and so on.

## Results

**Under-five mortality rate across district of Assam:** We estimated the mortality rates of under-fives for the 10 years preceding the survey by sex and total for each districts across Assam. The estimates, including the confidence intervals at 95 per cent, are presented in Table A (Appendix) for a detailed overview, and for better visualisation, a choropleth map of the estimates of U5MR of all districts of Assam is illustrated in Figure 1. It is seen that Bongaigaon district has the lowest U5MR estimate, with 17.58 deaths per 1000 live births, and Hailakandi has the highest U5MR estimate of 67.52 deaths per 1000 live births. Further, Table 1 provides descriptive statistics of these estimates.

### District wise U5MR for Assam as per NFHS-5

USMR (10 years preceding the survey estimates from NFHS-5)

18% 37% 68%

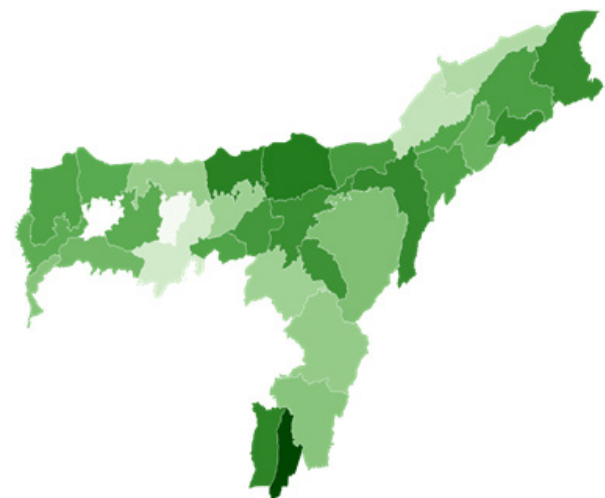


Figure-1: Choropleth map of Assam showing the U5MR estimates from unit level data of NFHS-5  
Source: Author's Calculation • Map data: © OSM • Created with Datawrapper

**Table 1: Descriptive statistics of the U5MR estimates (10 years preceding the survey) across the districts of Assam**

U5MR	Total No. of districts	No. districts with significant estimates of U5MR	Mean U5MR	Standard Deviation	Min	Max	Coefficient of variation
Male	33	33	42.08	13.20	20.17	71.73	0.31
Female	33	32	31.93	11.16	14.65	63.39	0.35
Total	33	33	36.75	10.26	17.58	67.52	0.28

The average U5MR across the districts vary significantly for males and females. With a mean rate of 31.93 deaths per 1,000 live births, females have a significantly lower under five deaths compared to males having a mean under five death rates of 42.08 deaths per 1,000 live births. This disparity is noticeable and statistically significant at 5 per cent level of significance (results of paired t-test is presented in

Table 2, where we reject the Null-hypothesis: there is no significant difference between the male U5MR and female U5MR). Female mortality rates fluctuate relatively more across districts compared to male U5MR, which can be seen through the coefficient of variation (CV) of female U5MR (0.35) being relatively higher than male U5MR (0.31).

**Table 2: Results of Paired Sample Test**

Pair 1	Mean	Standard Deviation	Standard Error Mean	95% Confidence Interval of the Difference		t	df	Sig. (2-tailed)
				Lower	Upper			
Male U5MR - Female U5MR	10.91	14.20	2.47204	5.88	15.95	4.41	32	0.00

**SDG-3.2.1 and the districts of Assam:** There exists mixed progress across districts towards the attainment of Sustainable Development Goal-3.2.1 (SDG-3.2.1) target on under-five deaths. As of 2021, a notable disparity in progress towards achieving the SDG-3.2.1 target for under-five deaths is observed

in Assam across male and female children. For the female U5MR, 25 per cent of the districts have already met the SDG-3.2.1 target, whereas only 9 per cent of the districts have achieved the same target for male U5MR.

**Table 3: Status as of 2021 for the progress of SDG-3.2.1 for children under five.**

U5MR	Number of districts with significant estimates (out of 33 districts)	Already achieved SDG 3.2.1	Likely to achieve by 2030	Not likely to achieve in 2030
Female	32	8 (25%)	21 (65.63%)	3 (9.37%)
Male	33	3 (9.09%)	17 (51.51%)	13 (39.39%)
Total	33	4 (12.12%)	20 (60.60%)	9 (27.27%)

Additionally, more than 65 per cent of the districts are likely to achieve the target for the female U5MR, whereas it is around 51 per cent for the male U5MR. Also, around 40 per cent of the districts are not likely to achieve the target for male U5MR, compared to 9.37 per cent of the districts for female U5MR by the end of 2030. We therefore observe a clear advantage

of female survivorship on under-five mortality (U5M) across the districts (Table 3).

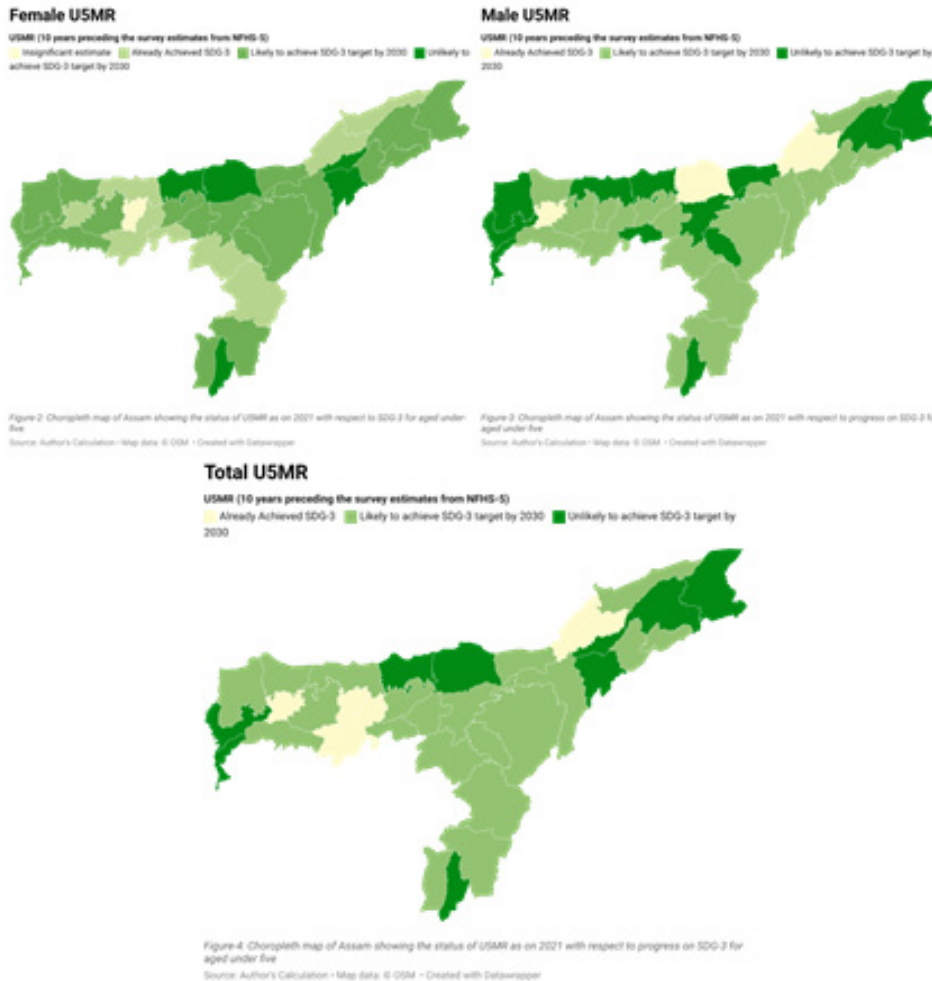
These findings highlight the necessity for focused interventions to mitigate the inequalities in under-five mortality rates among districts in Assam, especially concerning male children. It is also seen that 12 per cent of the districts have already met the

U5MR target outlined in SDG-3.2.1, irrespective of sex. However, nearly 30 per cent (27.27% to be exact) of the districts are not likely to achieve the 2030 target, despite reductions in mortality observed in the last two rounds of the National Family Health Survey.

Efforts to lower the U5MR over the years have set over 60 per cent of the districts on track to reach the U5MR target by 2030. While the coefficient of

variation is higher for female U5MR, more districts are on track to meet the SDG 3.2.1 target for Female U5MR by 2030 compared to Male U5MR. The choropleth map of Assam shows the status of female U5MR, male U5MR and the total U5MR towards the progress of SDG-3.2.1 for under-fives in Figures 2, 3, and 4 respectively.

### Discussion



A significant challenge in tracking child health progress, particularly in low and moderate-income nations, is the lack of routine checks of unit-level U5MR. Therefore, government and concerned authorities must conduct periodic surveys, and estimations to keep a check on these measurements. (24–26)

Our findings show a considerable disparity in the U5MR across the state. The estimates presented in the

Table A (Appendix) shows notable variability, with a coefficient of variation of 0.28 (Table 1). A child born in Bongaigaon has a far greater chance of reaching their fifth birthday (U5MR estimate is as low as 17.58 deaths per 1000 live births) than a child born in Hailakandi (U5MR estimate is the highest, at 67.52 deaths per 1000 live births), where the death rate is nearly four times higher. Additionally, disparities exist between female and male U5MR, with a higher

proportion of districts likely to achieve the target for female U5MR (65.63 per cent) compared to male U5MR (51.51 per cent). The probable reason for these wide disparities is the differences in the level of socio-economic development among the districts.<sup>(16,17,27)</sup> As of 2021, eight districts have already attained the SDG target for the under-fives for females, compared to only three districts for males. The analysis shows a clear advantage of female child survival over male child in our study area. The study's findings are also consistent with those from sub-Saharan African nations, where male under-five deaths were found to be 17-54 percent higher than female deaths.<sup>(28)</sup> But our findings deviate from the already established demographic trend typically observed in developing nations.<sup>(16-19,24,26,27,29)</sup> Additionally, this particular result is also inconsistent with national level analysis of under-five mortality using NFHS-4 data where districts with high risk of female under-five mortality were identified in northeast region.<sup>(16)</sup>

Thirdly, there has been a significant reduction in mortality which can be seen in the reports from the subsequent rounds of NFHS-3, NFHS-4 and NFHS-5 due to continuous efforts of the government both the central and state on improving the health infrastructure and accessibility through the National Rural Health Mission (NHM), and other initiatives.<sup>(20,21,30)</sup> But there has been a pronounced district-level variation in the mortality.<sup>(16,27,31)</sup> As an instance, the state estimate U5MR is 39 (10 years prior to the survey), whereas the district estimates vary from 17.58 to 67.52. This emphasises the need for district-level planning<sup>(25,32)</sup> Identifying high-priority areas, increase in community-level awareness and engagement, and, most importantly, reduce socio-economic inequalities in accessing health care facilities.<sup>(7,8,16)</sup>

### Conclusion

The novelty of this particular study lies in its estimation of district-level under-five mortality rates across Assam, taking into account the unit-level data of NFHS 4 and 5. Our findings underscore significant

and persistent disparities in under-five mortality rates across Assam's districts, notably revealing a survival advantage for females, where female under-five mortality rate is relatively lower than that of males, a pattern that challenges conventional demographic theories.

The foremost limitation of the study is that it assumes that the yearly reduction rate in mortality that the districts would experience is at a constant level. Specifically, the reduction of U5MR from NFHS-3 to NFHS-4 and subsequently to NFHS-5 is not constant; therefore, it is expected that the reduction in mortality rate would be higher for districts with high mortality levels and vice versa.

Furthermore, this study provides a roadmap for all the districts of Assam on the progress of the SDG-3.2.1 target for children under five. The reason of relatively higher under five deaths of male child over the female requires exploration. Additionally, the unreleased NFHS-6 dataset is expected to offer substantial insights into mortality trends for both genders. Also, replicating this detailed district-level analysis nationwide will shed light on the healthcare and socioeconomic conditions of the region. Such a deeper understanding will eventually facilitate exploration into the exact root cause of these disparities across regions.

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## Appendix

Table A: NFHS-5 U5MR estimates (10 years preceding the survey)

District	Under-five mortality rate (U5MR) estimates (p<0.05) with confidence interval (CI)								
	Male U5MR	CI (Lower)	CI (Upper)	Female U5MR	CI (Lower)	CI (Upper)	Total U5MR	CI (Lower)	CI (Upper)
Bongaigaon	20.17	5.20	35.14	14.65	2.12	27.19	17.58	6.11	29.05
Nalbari	30.02	10.83	49.22	-	-	-	18.71	7.74	29.67
<b>Kamrup</b>	27.83	9.87	45.78	16.26	2.02	30.49	22.61	8.89	36.34
Lakhimpur	24.88	6.41	43.35	23.65	6.61	40.69	24.28	10.8	37.76
Dhemaji	28.30	11.97	44.62	24.06	10.78	37.34	26.16	15.13	37.18
West Karbi Anglong	32.08	16.17	47.98	24.44	7.10	41.78	28.29	15.22	41.37
Darrang	29.70	14.58	44.82	27.04	10.07	44.02	28.53	15.29	41.76
Baksa	37.33	15.79	58.86	20.38	5.31	35.45	29.16	15.53	42.79
Dima Hasao	37.74	16.07	59.40	19.50	2.44	36.56	29.48	14.33	44.63
Cachar	36.03	18.07	53.99	25.65	10.64	40.66	30.95	18.68	43.22
South Salmara Mankachar	33.10	15.65	50.55	29.10	13.07	45.13	31.21	17.01	45.42
Karbi Anglong	35.45	18.83	52.08	28.22	10.11	46.33	32.00	14.99	49.01
Goalpara	37.88	18.95	56.80	29.60	10.85	57.58	33.72	19.92	47.52
Sivasagar	36.71	14.50	58.91	32.16	11.79	52.54	34.55	19.47	49.64
Dhubri	44.04	29.55	58.52	27.14	14.93	39.35	35.88	22.24	49.53
Barpeta	40.36	20.35	60.37	31.60	16.20	47.00	36.03	21.62	50.45
Chirang	39.54	22.33	56.74	32.99	16.29	49.70	36.39	18.85	53.93
Majuli	22.63	5.60	39.65	53.52	32.50	74.54	37.59	24.98	50.21
Kamrup Metropolitan	56.25	25.06	87.44	18.82	3.41	34.23	38.15	23.23	53.06
Jorhat	35.64	19.48	51.81	41.71	16.10	67.31	38.48	20.19	56.77
Kokrajhar	48.92	22.20	75.64	28.32	9.80	46.83	38.49	26.43	50.55
Dibrugarh	53.18	28.46	77.89	26.40	9.26	43.53	39.75	25.3	54.2
Biswanath	54.52	36.17	72.88	28.08	8.64	47.52	40.91	24.67	57.16
Morigaon	30.60	13.78	47.41	53.02	30.87	75.18	41.88	29.58	54.17
Hojai	48.67	31.83	65.51	37.68	15.92	59.44	43.67	24.17	63.17
Nagaon	54.75	32.69	76.81	35.15	17.94	52.35	44.80	27.42	62.18
Tinsukia	51.75	29.39	74.12	38.84	15.81	61.88	45.58	32.34	58.82
Charaideo	57.55	32.39	82.71	34.79	14.24	55.34	46.28	33.61	58.95
Golaghat	57.61	28.00	87.22	34.22	10.85	57.58	46.42	21.39	71.45
Karimganj	53.69	32.27	75.11	42.20	25.09	59.32	47.95	28.66	67.24
Udalguri	49.38	24.89	73.86	48.83	23.87	73.79	49.14	28.59	69.68
Sonitpur	70.72	38.62	102.82	30.34	14.14	46.55	50.57	30.00	71.13
Hailakandi	71.73	47.33	96.13	63.39	38.66	88.12	67.52	51.25	83.78

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# Factors Influencing Drug-Resistant Tuberculosis Treatment Outcomes in Banda District of Bundelkhand Region

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## Abstract

### Introduction

Tuberculosis (TB) remains a critical public health challenge in India, claiming nearly half a million lives annually. Additionally, around one million cases go undiagnosed or inadequately diagnosed each year, leaving them unreported. TB, caused by the airborne bacterium *Mycobacterium tuberculosis*. (1-3)

Drug-resistant tuberculosis (TB) is a growing threat worldwide. At the molecular level, *Mycobacterium tuberculosis* acquires resistance through chromosomal mutations in drug-target genes (*rpoB*, *katG*, *inhA*) and mechanisms like efflux-pump overexpression, altered cell-wall permeability, and metabolic adaptation, which reduce antibiotic effectiveness. (15)

DRTB remains prevalent globally, with population growth driving a modest 0.2% increase in incidence from 2022 to 2023. In 2023, TB occurrence was recorded at 134 new cases per 100,000 people. High-burden countries accounted for 87% of all cases,

with India alone contributing 26%. Males represented 55% of TB cases globally, while women constituted 33% and children, along with young adolescents, accounted for 12% .(1-3)

India and the WHO South-East Asia and African regions bore the majority of TB-related deaths in 2023. Among HIV-negative individuals, 80% of global TB deaths occurred in these regions, with India alone responsible for 30%. Combined deaths of HIV-positive and HIV-negative individuals also followed a similar trend, with these regions accounting for 81% of fatalities and India contributing to 26% of the total. India's overwhelming TB burden is exacerbated by drug-resistant TB (DR-TB), which accounts for 27% of global DR-TB cases. DR-TB treatment poses significant challenges due to its complexity and associated poor adherence, making it more difficult to manage than drug-sensitive TB.(2)

DR-TB in India has been proactive in combating TB through initiatives like the revised National

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Strategic Plan to eliminate TB by 2025. India has a significant burden of drug-resistant tuberculosis (DR-TB), with 2.5% of new TB cases and 13% of previously treated cases classified as DR-TB. The country accounts for nearly 27% of the global TB incidence, making it the highest TB burden country in the world. In 2022, India recorded 2.82 million new TB cases, with an estimated 331,000 deaths due to the disease.

### Aim & Objectives:

1. To estimate the prevalence of DR- TB in Banda district of Bundelkhand region
2. To determine factors Influencing Drug-Resistant tuberculosis Treatment Outcomes

### Material and Methods

**Type of Study:** Cross-sectional study.

**Sampling Unit:** public and private health facilities.

**Study area** - Banda district of Bundelkhand region of Uttar Pradesh

**Study population** - All public health facilities (District Hospital, AB-HWC, PHC, CHC, and DH). All DR-TB registered patients in Nikshay portal under NTEP.

**Period of Study:** May 2024 to December 2024

**Inclusion criteria:** All Drug resistant TB patients registered in Nikshay portal under NTEP of Banda District health care facilities.

**Exclusion criteria:** All Drug resistant TB patients who does not give consent for participating in my study.

- DR- TB patients with severe complications and Non-registered DR- TB patients

### Sample size:

All 130 Drug resistant TB patients registered in NTEP of Banda District till data saturation is achieved.

### Plan of study

- DR-TB patients list was taken from district tuberculosis office and prepare structural guided questionnaire and then visit to DR-TB patients for in-depth interview.

- Written informed consent was obtained from the CMO, and DTO Banda for the study.
- All health care facilities was assessed using checklist questions as per the Differentiated Tuberculosis Care Guidelines (2021) given by Central Tuberculosis Division.
- In depth interview of In-charge of 1 district tuberculosis hospital, 2 CHC, 10 PHC and 18 AB-HWCs was conducted.
- The structured In-Depth Interview (IDI) schedule had interview questions (depending on the stakeholders for whom it was customized). Questions were close-ended and were based on factors affecting the treatment outcome of DR-TB patients which includes delay in treatment initiation, on time drug received, adherence to treatment and interruption/missed dose of drugs.

### Study Tools

- (A) Assessment of patients:** A total of 130 drug resistant TB patients list was collected from District tuberculosis office, Banda. We visited the house of patients for their personal and family interview.
  - (B) All drug resistant TB patients registered under NTEP (N=130) were assessed at their residence using semi-structured questionnaire by in depth interview.**
  - (C) In depth interviews:** Structured in depth interviews were taken at each level which consist of date of diagnosis, Previous H/O contact/TB , Family H/O TB, symptoms present, adherence to treatment ,drug availability on time, missed dose and social stigma faced.
- **Ethical approval:** Ethical approval was taken from the institutional ethical review board at RDMC, Banda. (IEC/RDMC/Cert/18; Date:24/08/2023) (Appendix) Participants were informed of the research objectives and assured that their identities would remain confidential. All participants provided written consent before taking part in the study.
  - **Statistical analysis:** the data was entered in MS excel and descriptive analysis was done using short appropriate using frequency and percentages were done using statistical tool SPSS version 2.6.

## Results

### 1. Prevalence and Distribution of Drug-Resistant TB Cases

**Table 1:** R.R. TB accounted for the majority at 68.46%, followed by MDR-TB at 27.69%. H. Mono was less common, representing 1.54% of cases. Pre-XDR had a minimal share at 2.31%, while no cases of XDR were reported (0.0%). The distribution highlights R.R. TB as the most prevalent form within this cohort, with a clear overall total of 100%.

### 2. Factors influencing drugs and treatment outcomes

**Table 2** represents among patients with different types of drug resistance, those with H.mono all (100%) completed treatment with no cases of incomplete treatment, cure, or death. In patients with rifampicin resistance (RR), 37.08% completed treatment, 21.35% had incomplete treatment, 25.84% were cured, and 15.73% died. Among those with multi-drug resistant (MDR) TB, 44.44% completed treatment, 13.89% had incomplete treatment, 22.22% were cured, and 19.44% died. For patients with pre-extensively drug-resistant TB (Pre-XDR), 33.33% completed treatment, and 66.67% died, with no cases of incomplete treatment or cure.

Regarding adverse effects during medication, among patients who experienced adverse effects, 29.31% completed treatment, 17.24% had incomplete treatment, 18.97% were cured, and 34.48% died. In contrast, among those without adverse effects, 48.61% completed treatment, 19.44% had incomplete treatment, 27.78% were cured, and 4.17% died. When considering missed or interrupted doses, among patients who missed doses, 26.98% completed treatment, 19.05% had incomplete treatment, 26.98% were cured, and 26.98% died. Among those who did not miss doses, 52.24% completed treatment, 17.91% had incomplete treatment, 20.90% were cured, and 8.96% died.

Patients experiencing adverse effects, missed doses, non-adherence, delayed treatment, or lack of timely TB medication showed a higher risk of

incomplete treatment and mortality compared to those without these complications. Among those with adverse effects, 34.48% died, whereas only 4.17% of patients without adverse effects died. Similarly, patients who missed doses had a mortality rate of 26.98% compared to 8.96% for those who adhered to their schedule. Non-adherent patients faced an even higher risk, with 47.37% mortality, while adherent patients had a significantly lower rate of 12.61%. Delays in starting treatment also negatively impacted outcomes, as 31.71% of delayed patients died versus only 11.24% of non-delayed patients. These findings highlight the crucial role of adherence and timely intervention in improving treatment success.

Further, timely sputum rechecking and hospital admission played a significant role in patient outcomes. Among patients who underwent sputum rechecking after two months, 13.39% died, compared to a much higher 44.44% mortality rate among those who were not rechecked. Hospital admission, however, had a mixed impact—those admitted had a mortality rate of 22.22%, whereas non-admitted patients showed a lower rate of 3.23%, though they had a higher rate of incomplete treatment (32.26%). Sputum test results also influenced treatment success, with patients testing positive for sputum showing a higher cure rate (27.27%) compared to 21.33% among those with negative results. Overall, treatment adherence, timely medical interventions, and monitoring through sputum rechecking significantly contributed to better patient outcomes and reduced mortality.

**Table 1: Distribution of study subjects based on Prevalence of Drug-Resistant TB Cases**

PREVALENCE OF TB	N	%
H.MONO	2	1.54
R.R. TB	89	68.46%
MDR TB	36	27.69%
PRE XDR	3	2.31%
XDR	0	0.0
Grand total	130	100

**Table 2. Factors influencing drugs and treatment outcome.**

Variables	Complete		Incomplete		Cured		Death		Total	
	N (%)		N (%)		N (%)		N (%)		N (%)	
<b>Drug resistance TB different Categories</b>										
H.mono	2	100.00%		0.00%		0.00%		0.00%	2	100.00%
RR	33	37.08%	19	21.35%	23	25.84%	14	15.73%	89	100.00%
MDR	16	44.44%	5	13.89%	8	22.22%	7	19.44%	36	100.00%
Pre-XDR	1	33.33%		0.00%		0.00%	2	66.67%	3	100.00%
<b>Adverse effect during Medication</b>										
Yes	17	29.31%	10	17.24%	11	18.97%	20	34.48%	58	100.00%
No	35	48.61%	14	19.44%	20	27.78%	3	4.17%	72	100.00%
<b>Missed/Interrupted dose</b>										
yes	17	26.98%	12	19.05%	17	26.98%	17	26.98%	63	100.00%
no	35	52.24%	12	17.91%	14	20.90%	6	8.96%	67	100.00%
<b>Adherence to treatment</b>										
Yes	46	41.44%	22	19.82%	29	26.13%	14	12.61%	111	100.00%
No	6	31.58%	2	10.53%	2	10.53%	9	47.37%	19	100.00%
<b>Delay of more than 1 week in starting the treatment</b>										
Yes	13	31.71%	6	14.63%	9	21.95%	13	31.71%	41	100.00%
No	39	43.82%	18	20.22%	22	24.72%	10	11.24%	89	100.00%
<b>TB medication received on time</b>										
Yes	39	37.50%	20	19.23%	28	26.92%	17	16.35%	104	100.00%
No	13	50.00%	4	15.38%	3	11.54%	6	23.08%	26	100.00%
<b>Sputum rechecked after 2 months of treatment</b>										
Yes	47	41.96%	21	18.75%	29	25.89%	15	13.39%	112	100.00%
No	5	27.78%	3	16.67%	2	11.11%	8	44.44%	18	100.00%
<b>Result of sputum check</b>										
Positive	27	49.09%	4	7.27%	15	27.27%	9	16.36%	55	100.00%
negative	25	33.33%	20	26.67%	16	21.33%	14	18.67%	75	100.00%
<b>Hospital Admission during treatment</b>										
Yes	37	37.37%	14	14.14%	26	26.26%	22	22.22%	99	100.00%
No	15	48.39%	10	32.26%	5	16.13%	1	3.23%	31	100.00%

## Discussion

Rifampicin-resistant tuberculosis (R.R. TB) is the most common form of drug-resistant TB, accounting for 68.46% of cases, followed by multidrug-resistant TB (MDR-TB) at 27.69%. Studies from Ethiopia and India confirm the dominance of R.R. TB, likely due to the widespread use of Gene Xpert testing, which detects rifampicin resistance early. Treatment outcomes vary significantly, with H.mono cases achieving 100% success, while pre-XDR TB cases show a poor prognosis with a 66.67% death rate and no cures,

aligning with global findings that highlight the challenges of treating highly resistant TB strains.

Adverse drug effects, poor adherence, and delayed treatment initiation significantly impact survival. Patients with adverse drug reactions face higher mortality rates, and missed doses reduce treatment success while increasing deaths. Studies in South Africa, India, and China indicate that adherence is a crucial factor, with non-adherent patients experiencing nearly four times the mortality of adherent ones. Delays in starting treatment also worsen outcomes, as seen in research from

Bangladesh, where delayed initiation is linked to advanced disease progression and increased mortality.

Monitoring and hospital admission further influence treatment success. Patients who underwent sputum rechecking had better completion rates, reinforcing the importance of regular monitoring. However, sputum positivity at two months, despite higher completion rates, correlated with lower cure rates and increased mortality risks. Hospitalized patients faced a significantly higher death rate (22.22%), which likely reflects the severity of their illness rather than hospitalization itself. Regular follow-ups and patient support are critical in improving treatment outcomes and survival rates in drug-resistant TB cases.

### Conclusion

The study highlights rifampicin-resistant tuberculosis (R.R. TB) as the predominant form of drug-resistant TB, consistent with recent global trends. Treatment outcomes varied considerably based on the type of drug resistance, patient adherence, adverse effects, and timely initiation of therapy. Patients with H.mono had the best outcomes, while those with pre-XDR TB faced the highest mortality. Adverse drug reactions, missed doses, and poor adherence were strongly associated with unfavourable outcomes and higher death rates, emphasizing the need for better patient support and side-effect management. Delay in treatment initiation and lack of regular sputum monitoring were also critical factors leading to increased mortality. These findings reinforce global evidence that early diagnosis, consistent treatment adherence, prompt management of adverse effects, and regular patient monitoring are vital to improving outcomes in drug-resistant TB. Strengthening patient-centred approaches remains essential for tackling the complex challenges posed by drug-resistant tuberculosis.

### Recommendation

The study recommends to improve outcomes in drug-resistant TB, it is essential to ensure early diagnosis, strengthen patient adherence through education and support, manage adverse effects promptly, and conduct regular treatment monitoring.

Health systems should prioritize timely treatment initiation and adopt patient-centred care strategies to reduce mortality and enhance treatment success.

### Limitation of the Study

This study has following limitations. The small sample size and its observational, cross-sectional design limit the capacity to infer causal relationships. Data were obtained through self-reported responses collected via semi-structured, in-depth interviews conducted at patients' residences, which may have introduced recall, reporting, response, and interviewer biases, potentially compromising data accuracy and completeness. Furthermore, key variables such as comorbidities, socioeconomic status, psychosocial factors, and precise treatment regimens were not evaluated. The exclusion of patients with severe complications and those not registered in the Nikshay portal may have resulted in the underrepresentation of more severe DR-TB cases.

### Relevance of the Study

This study provides critical insights into factors influencing treatment outcomes in drug-resistant TB, highlighting the importance of early diagnosis, adherence, and managing adverse effects. By identifying key predictors of mortality and treatment failure, the findings can guide targeted interventions, improve patient management strategies, and support global TB control efforts.

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# Factors Influencing Home Deliveries in Kerala: A Focused Ethnographic Study in Malappuram District

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## Abstract

**Introduction:** The main objective of this study is to understand the factors that influence home deliveries in Kerala, particularly in regions where institutional care is widely accessible but underutilised.

**Materials and methods:** A focused ethnographic approach was used in this study. Participants were selected using the information obtained from the health department. In-depth interviews were held with the women who had home deliveries in the past three years. Key informant interviews were conducted with stakeholders and focus group discussions were used for ASHAs and Anganwadi workers.

**Results:** Traditional beliefs, peer influences, patriarchal decision-making, shyness and embarrassment, fear of hospitals, media exploitation, along with the availability of traditional birth attendants and encouragement from certain unqualified professionals all contribute to home deliveries.

**Conclusions:** There is a need to encourage community participation and create and implement policies to protect the rights of mothers and their unborn children. This will help in ensuring safe delivery and delivery practices.

**Key words:** Home deliveries, Traditional birth attendants, Women's autonomy, Kerala

## Introduction

The measures adopted for achieving SDG 3 and the Global Strategy for Women, Children, and Adolescent Health (2016-2030) and also the framework for Ending Preventable Maternal Mortality (2015-2030) are helping to increase "the proportion of births attended by skilled health personnel (SDG indicator 3.1.2)<sup>1-3</sup>. Despite such initiatives, studies show that

in middle- and low-income countries, many home deliveries happen without a skilled health worker<sup>4</sup>. India's Reproductive, Maternal, Newborn, Child, and Adolescent (RMNCH+A) strategy by the Ministry of Health and Family Welfare provides a comprehensive approach to child survival and safe motherhood, and it also ensures 'continuum care'<sup>5</sup>. For one third of India's population, consisting of women and preschool children, "any neglect or delay

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in care can adversely affect the wanted outcome<sup>6</sup>. Despite the initiation of Janani Suraksha Yojana (JSY) in 2005, a conditional cash transfer program (CCT) under the National Health Mission by the Government of India aimed at reducing maternal mortality rates through the promotion of institutional deliveries, a substantial number of deliveries continue to take place at home in India<sup>7</sup>. According to the Health Management Information System (HMIS), 1,067,470 home deliveries were reported in 2020-21 and 922,637 in 2021-22<sup>8</sup>. In many places women still preferred home for delivery due to a lack of skilled birth attendants, especially at the grassroots level<sup>9</sup>. Seeking and access to health care by women influenced by several other factors in India, such as household socioeconomic status, geographic regions, education level, inadequate health facilities, cultural and traditional factors, household dynamics etc<sup>10-13</sup>. Even though the government launched certain programs to tackle the out-of-pocket expenditure (OOPE) such as Janani Shishu Suraksha Karyakram (JSSK), we are still trailing behind.

According to 'Gender Statistics in Kerala,' a report prepared by the Department of Economics and Statistics, Kerala witnessed 740 home deliveries during the year 2017-2018, and this report shows that the prevalence of home deliveries was higher in Malappuram district compared to other districts, and Malappuram topped the chart (with 254), followed by Wayanad (151 cases)<sup>14</sup>. Unravelling the factors and understanding the dynamics behind the phenomenon would have profound significance for the improvement of the RMNCH+A Strategy and for the policy as well.

The broad objective of the study is to identify the factors influencing home deliveries in Kerala and also assess the accessibility and utilisation of comprehensive antenatal, postnatal, and neonatal care for mother and child with the purpose of specifically exploring their role in this phenomenon.

## Methodology

### Study design and setting

A qualitative study using a focused ethnographic approach was conducted in the Thanalur Panchayath, Malappuram district, Kerala covering women and stakeholders in relation to home deliveries.

### Study population and sample size

Women who had delivered at home and willing to participate were included in the study. Participants were selected purposively based on the information regarding home deliveries obtained from the ASHAs. Apart from the women, key informants as stakeholders were also interviewed. They include doctors and health workers, ASHA workers from the Family Health Centre, elected representatives, Anganwadi workers, ICDS supervisors, and CDPO (Child Development Project Officer). In total, 42 in-depth interviews were conducted with the participants in addition to informal conversations with a number of women, and 10 key informant interviews. Apart from this, focus group discussions were held with 20 ASHAs and 14 Anganwadi workers.

### Data collection

The fieldwork was undertaken from August to November 2024 after obtaining permission from the District Medical Officer (DMO) Malappuram. In-depth interviews and conversations with the women and key informant interviews were conducted on a one-to-one basis using an interview guide. Such a focused approach helped in finding out the factors which influence home deliveries. Apart from this, we also conducted focus group discussions with female health workers and anganwadi workers. Verbal informed consent was obtained before the interviews. House-to-house interviews were carried out in Malayalam (the local language) by the principal investigator.

### Data analysis

Thematic analysis was used after transcription and translation. Data was analysed manually, and the JBI critical appraisal checklist for qualitative research was used to find the congruence between research objectives and the findings<sup>15</sup>.

### Ethical clearance and consent to participate

The protocol was submitted to the Institutional Ethics Committee of Ananthapuri Hospitals and Research Institute for approval and ethical clearance obtained from the IEC (IEC NUMBER: AHRI/EC/206/Jan2024).

Consent was obtained before the interviews. Study objectives were clearly explained to the participants, and the interview schedules were filled without any identifier of the participants. No compulsion was there for the respondents to participate in this study. The prevailing pattern in Malappuram indicated that home deliveries were occurring in specific areas, known to everyone. Health workers routinely visit the area and interact with them, and we visited the houses in that area with their help, ensuring minimal risk for the respondent.

## Results

Four major themes developed from the analysis include: (1) socio-demographic factors, (2) psychosocial factors, (3) socio-cultural factors, and (4) health system factors.

### 1 Socio-demographic factors

#### 1.1 Area of living

Majority of the women who gave birth at home live in the same neighbourhood which may also influence future mothers to continue this tendency. Some women are hesitant to contact the outside world beyond their immediate family or neighbours and living in such a location would lead to continuing such a trend.

#### 1.2 Age and parity

Women gained confidence for home delivery after multiple deliveries and an increase in age. In some areas, multiparous women prefer home delivery. But surprisingly, many primiparous women also choose home to give birth to their child.

Many factors, such as socioeconomic status, education, and caste, which are often reported to influence home deliveries in other studies, do not appear to have any significant relevance in our context.

### 2. Socio-cultural factors

#### 2.1 Traditional beliefs

Some people believe in traditional constraints, conservative views, and strict norms to uphold their beliefs.

*"A native mother travelled from a developed foreign country to give birth to her baby at home, then returned. Two years later, she arrived for another home delivery. She had strong convictions, but she received all immunizations and visited the hospital as needed."* (ASHA worker, FGD)

#### 2.2 Gender hierarchy and autonomy in decision-making

Autonomy is regarded as critical for decision-making especially for selecting, seeking, and using health care services.

*"When I was taking a gender class at Devdhar School, one girl presented her thoughts on how a girl should behave. That incident made me realise that patriarchal society has an impact on the younger generation as well. We had an argument there, and I tried to convey the myths and misconceptions instilled by her family members, but she refused to accept them. Look, even in the modern era, these types of people influence and oppress the growing younger generation. This would always have an impact on home delivery, vaccine resistance, and seeking medical treatment."* (Elected representative, retired teacher)

##### 2.2.1 Decision-making power in accessing health care

Females are suppressed in many houses. In some households, women suffered as a result but the majority of them did not consider it as a major issue.

*"In some houses women are not permitted to leave their house alone. If they wish to travel somewhere, they will accompany their spouse. Father is the leader of the house, and he makes the decision, which everyone follows."* (Anganwadi worker, FGD)

##### 2.2.2 Decision-making power regarding choice of place of delivery

Some women can select where they give birth, but majority do not. Main decision-makers are fathers.

*"My father makes decisions regarding me. I will not say a single word against him. My second child died five hours after I gave birth. He has bluish discolouration all over the body; we attempted to save him. But it was his fate."* (36-year-old woman, IDI).

### 3. Psychosocial factors

#### 3.1 Shyness and embarrassment

Many women reported feeling shy and embarrassed during their institutional deliveries which further led them to choose home deliveries. Women faced lack of privacy and discomfort in many health care settings. This conflicted with their cultural beliefs, encouraging women to deliver at home where they feel more comfortable.

*"Why should I expose my body to someone who is completely unfamiliar to me? Even during pregnancy, the ossathi (Traditional Birth Attendant) would almost cover my body and arrange curtains to cover any exposed areas."* (23 years old, IDI)

#### 3.2 Peer influence

Another key factor for this trend is peer group impacts. The information concerning home delivery was passed down from one individual to another. Influence from friends and families contributed to home deliveries.

*"My school friends shared their home delivery experiences in our WhatsApp group. They recommended and encouraged me to perform delivery at home."* (21 years old, primiparous, IDI)

#### 3.3 Fear of hospitals

The fear of hospitals and fear created as a result of wrong knowledge led them to give birth at home. The women feared being alone as well as undergoing surgery. Many women want to give birth without medical interventions such as pain medication, labour induction, forceps, or other types of equipment.

### 4. Health system factors

#### 4.1 Disrespect

Some women at both public and private facilities stated unhappiness with the level of interpersonal care provided, particularly with the contempt shown by nurses and other health providers. Many women reported being scolded and shouted at. Some of them discussed the non-consented care they had received from the previous deliveries. The repeated per vaginal examinations without consent made them uneasy about institutional delivery. A few of them also reported neglect by health staffs during institutional

deliveries. Women who delivered at home explained that the presence of family members such as the women's mother and husband is vital because their closeness provides psychological support.

#### 4.2 Lack of trust in health system and no antenatal care visits

None of the mothers visited the antenatal care clinic at least once. Some of them took supplements like iron and folic acid from ASHAs. However, they were not ready to visit the subcentre. A few of them took vaccination after many rounds of counselling. One health staff revealed:

*"Many of them refused to inform us about their pregnancy. In many situations, we learnt only after five or six months. As a result, it is quite difficult for us to offer them counselling, routine check-ups, supplements, and vaccination."* (Health care provider)

Majority of the providers suggested that unqualified personnel from different backgrounds, including alternative practitioners and quacks, facilitate home delivery and they mislead the people and nurture an anti-institutional attitude in the society along with the availability of traditional birth attendants who promote home deliveries. They propagated that delivery should be conducted in a natural way.

*"Our ancestors gave birth to their children at home. Then why should we go to the hospital? Either it is a hospital or it is home; we must go through the same pain and must take the same effort; then why should we choose a hospital instead of a home?"* (25 years old, IDI)

#### 4.3 Mass media exposure

The younger generation in Thanalur who use social media blindly lacks trust in institutional delivery due to misleading information. According to information gathered from health workers, there are WhatsApp groups to propagate anti-institutional sentiments.

*"I have seen a lot of home birth videos on YouTube. When I read the comments below the videos, I understood that delivering a baby in a tranquil environment like home provides more comfort than a hospital."* (19 years old, IDI)

## Discussion

Despite significant advancements in maternal healthcare, many women in our study area still opt—or are compelled—to give birth at home. Our study undertaken in Thanalur Panchayath in Malappuram District shows that there are several factors that sustain such a practice despite the availability, accessibility, and affordability of care.

Our study findings indicate that the traditional beliefs do contribute to home deliveries. In India, a qualitative study conducted in rural Meghalaya stated that the prevailing traditional beliefs, along with superstitious concepts, contribute to home deliveries<sup>10</sup>.

We found that shyness and embarrassment are other important factors that lead to home deliveries among pregnant women. A study conducted in Delhi revealed that women felt embarrassed and uneasy being around unfamiliar people during such a vulnerable moment. The lack of privacy, along with the absence of a family member for support in the institutional setting, contrasted with the safe and secure environment they had at home during childbirth<sup>16</sup>. Fear also influences the choice of delivery. A study conducted in Vadodara, Gujarat, finds that the fear of being alone in unfamiliar surroundings and the fear of surgical interventions influence women to deliver their babies at home<sup>11</sup>.

A distinct factor that leads to home deliveries observed in Thanalur is peer influence. While other studies have shown that familial influence leads to home deliveries, in Thanalur, the influence of peer groups, particularly school friends, also plays a significant role. This peer influence is a new factor contributing to the decision to opt for such a method. Many studies have found that familial influence and sometimes familial pressure play a role in pregnant women choosing home deliveries. A situational analysis from urban slums in Delhi revealed that mothers and family members who played a significant role in decision-making commonly preferred home births. They observed that their relatives had experienced positive outcomes with home deliveries<sup>16</sup>.

Mothers with higher parity are more likely to choose home deliveries because they develop

confidence to give birth at home from the previous delivery, and therefore they perceive delivery as a normal process<sup>12</sup>. However, in our study, many younger primiparous women preferred home deliveries. Mothers in Thanalur living in the same geographical area and locations showed a higher tendency to give birth at home. This could be due to the exchange of information and other societal factors. Area of residence could also be an influencing factor in the choice of the delivery place, particularly between rural and urban settings. A national survey in India found that women living in rural areas were more likely to deliver at home<sup>12</sup>.

None of the women who give birth at home visited subcentres for antenatal care clinics. One of the studies conducted in India found that women who attend more than three antenatal care clinics were likely to deliver at an institution compared to women who did not attend antenatal care clinics or women who attended less than three antenatal care visits<sup>11</sup>.

Our study found that disrespect, including non-consented care, verbal abuse, prior experiences, and breaches of physical privacy, intimidated women from opting for institutional delivery. A study conducted in rural Uttar Pradesh reported experiences of women being shouted at, verbally abused, and discriminated against based on their societal status<sup>13</sup>. These findings align with existing literature on mistreatment and disrespectful care, providing additional evidence that such experiences, both those prior personal experiences and experiences of others, significantly influence women's decision-making and deter them from seeking care at facilities with skilled birth attendants<sup>13</sup>. Many studies in different settings mentioned about the disrespect and abuse during health facility-based delivery<sup>17-19</sup>.

Another significant trend observed in Thanalur is the growing lack of trust in the healthcare system which has fuelled an anti-hospital attitude among many villagers. This mistrust leads them to rely on individuals without formal qualifications in alternative medicine who often spread false information. Increasing negative news about institutional care deepens the mistrust in the healthcare system, particularly among younger generations. This growing scepticism discourages

them from considering institutional delivery and healthcare services.

Our study found that decision-making authority varied across households but the majority were male-dominated. One of the studies from Uttar Pradesh highlights that male involvement is also a crucial factor for enhancing the overall use of RCH and Integrated Child Development Services (ICDS)<sup>20</sup>. Studies have consistently shown that women with access to mass media are significantly more likely to opt for institutional deliveries<sup>12</sup>. However, the positive influence of social media or mass media is not seen in our study. Women, especially the younger generation, blindly rely on the misinformation that circulates through social media, which further exacerbates the situation and results in more people adopting an anti-institutional behaviour. Additionally, patriarchal societal norms often restrict women's access to social and mass media, limiting their exposure to healthcare and their rights. This restriction perpetuates ignorance and prevents women from seeking timely and appropriate healthcare services.

### Strengths and limitations

One of the major strengths of the study is that it is one of the unique studies that document the factors that contribute to the prevalence of home deliveries in Kerala. The findings help in getting a deeper insight into this growing trend by examining participants' views, experiences, and practices. It was indeed difficult to complete such a study in the present socio-cultural context in the district and it might require more innovative approaches to undertake a study based on implementation research methodology which could be useful.

### Conclusions

It is important to identify the unqualified individuals behind these malpractices and it is necessary to educate women about the complications of such malpractices and to empower them with knowledge about their rights to bodily autonomy and help them to make informed decisions regarding their health and childbirth. Health care must ensure a safe and comfortable environment that respects women's dignity. Promoting accurate health

information through trusted digital platforms and through other media with the help of community influencers or leaders is essential for community mobilisation. Policymakers must recognise the rights of mothers and their unborn children in Kerala which include strict regulations that must be enforced to prevent unqualified individuals from conducting unsafe practices.

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**Ethical Clearances:** The protocol was submitted to the Institutional Ethics Committee of Ananthapuri Hospitals and Research Institute for approval and ethical clearance obtained from the IEC (IEC NUMBER: AHRI/EC/206/Jan2024) dated 26th January 2024.

### Conflicts of interest: Nil

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# Daily Assessment of Infection Control Practices: Effective Strategies in CLABSI Management at a Tertiary Health Care and Research Centre

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## Abstract

**Background:** According to the CDC's National Healthcare Safety Network (NHSN), a Central Line-Associated Bloodstream Infection (CLABSI) is defined as a laboratory-confirmed bloodstream infection (LCBI) that is not secondary to an infection at another body site. CLABSIs are a major healthcare concern, increasing morbidity, mortality, and costs. Surveillance plays a crucial role in tracking trends and improving prevention strategies. Our institute, with over four decades of strong IPC practices, collaborates with global organizations to enhance patient safety. By implementing evidence-based protocols and continuous monitoring, we strive to reduce CLABSI rates and improve healthcare outcomes. We hypothesize that the ongoing application of these IPC interventions contributes to a sustained reduction in CLABSI incidence.

**Study Objective:** To evaluate and analyze the existing protocols and adherence to best practices for central line insertion and maintenance in the ICU setting. By focusing on these critical aspects, we aim to identify factors contributing to the occurrence of Central Line-Associated Bloodstream Infections (CLABSI), assess compliance with standardized protocols, and highlight effective measures for infection prevention and control.

**Methods:** This retrospective study was conducted in the ICU at P.D. Hinduja Hospital, Mumbai, on patients with a central venous catheter (CVC) for two or more days from January 2024 to September 2024. CLABSI was defined

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per CDC criteria. The IPC team monitored adherence to insertion and maintenance protocols through daily rounds and data collection. Monthly CLABSI rates were analyzed and discussed in infection control meetings to improve patient care and reduce infection rates.

**Results and Conclusion:** Central line insertion compliance was 100% for hand hygiene, skin preparation, and ultrasound guidance, while sterile barrier use was 95%, indicating a small gap. Maintenance compliance was also 95%, showing strong infection control and contributing to a low CLABSI rate. No repeat organisms were found, suggesting no cross-contamination. Adhering to protocols is key to reducing CLABSI and improving patient safety

**Keywords:** CLABSI-Central Line-Associated Bloodstream Infections, CVC- Central Venous Catheter, Infection Prevention and Control , ICU-Intensive Care Unit.

## Background

Intravascular devices are an essential component of modern medicine for the administration of intravenous fluids, medication, blood products, and parenteral nutrition and for monitoring hemodynamic status, hemodialysis, etc<sup>[1]</sup>. A significant public health concern, Central Line-Associated Bloodstream Infections (CLABSI) substantially increase patient morbidity, mortality, healthcare costs, and the duration of hospital admissions. The mortality rate of 12%-25% associated with CLABSIs, and the risk of in-hospital death can be significantly higher for patients with CLABSIs compared to those without CLABSI<sup>[2]</sup>. Evidenced by multiple studies for its effectiveness in CLABSI reduction, the bundle of care approach emphasizes hand hygiene as the most critical and cost-effective component for preventing all device-associated infections<sup>[3]</sup>.

According to data from 2015, in the United States, 80,000 episodes of CLABSI are diagnosed annually and are associated with increased mortality and elevated economic costs (Range of Estimates \$17,000-\$94,000 Per case depending on severity).<sup>[4]</sup> In contrast, the scenario in India presents a different yet equally concerning picture. The costs associated with each CLABSI case range from approximately Rs.60,000 to Rs. 300,000, depending on the severity of the infection and the required length of hospital stay for recovery. As in the U.S., most CLABSIs in India are preventable through the adoption of effective infection control measures, including rigorous aseptic practices and regular monitoring of compliance with care bundles<sup>[5]</sup>.

Therefore, surveillance of CLABSI is essential to evaluate the success of preventive interventions and to measure trends over time<sup>[6]</sup>. Standardized CLABSI monitoring enables intra- and inter-facility incidence

rate comparisons, which contribute to practice improvement<sup>[7-8]</sup>

The Centers for Disease Control and Prevention (CDC) emphasizes the critical importance of preventing Central Line-Associated Bloodstream Infections (CLABSIs) through a multifaceted approach. Key recommendations include the use of strict aseptic techniques during central line insertion and maintenance, employing chlorhexidine for skin antisepsis, and selecting the optimal insertion site to minimize infection risk. The CDC also advocates for the implementation of care bundles that incorporate best practices, regular training for healthcare personnel, and daily assessments of the necessity of central lines. Through these strategies, the CDC aims to significantly reduce CLABSI rates and enhance patient safety in healthcare settings<sup>[9]</sup>.

## Study Objective

The purpose of this study is to assess and provide a critical analysis of practices related to central line insertion and maintenance in the ICU setting. By focusing on these critical aspects, we aim to identify factors contributing to the occurrence of Central Line-Associated Bloodstream Infections (CLABSI), assess compliance with standardized protocols, and highlight effective measures for infection prevention and control.

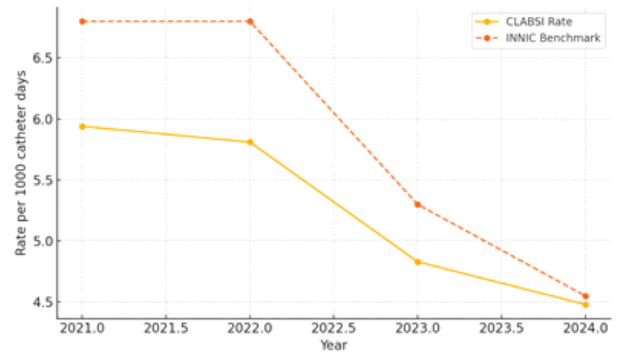
## Methods

This was a retrospective observational study of patients in the Intensive Care Unit at P.D. Hinduja Hospital and Medical Research Center, Mumbai, who had an indwelling central venous catheter (CVC) for two or more days between January to November 2024 (total eleven months). CLABSI was defined as a laboratory-confirmed new bloodstream infection that

is not secondary to an infection at another body site – in accordance with the CDC’s NHSN definition<sup>[10]</sup>. Our tertiary facility has 70 ICU beds.

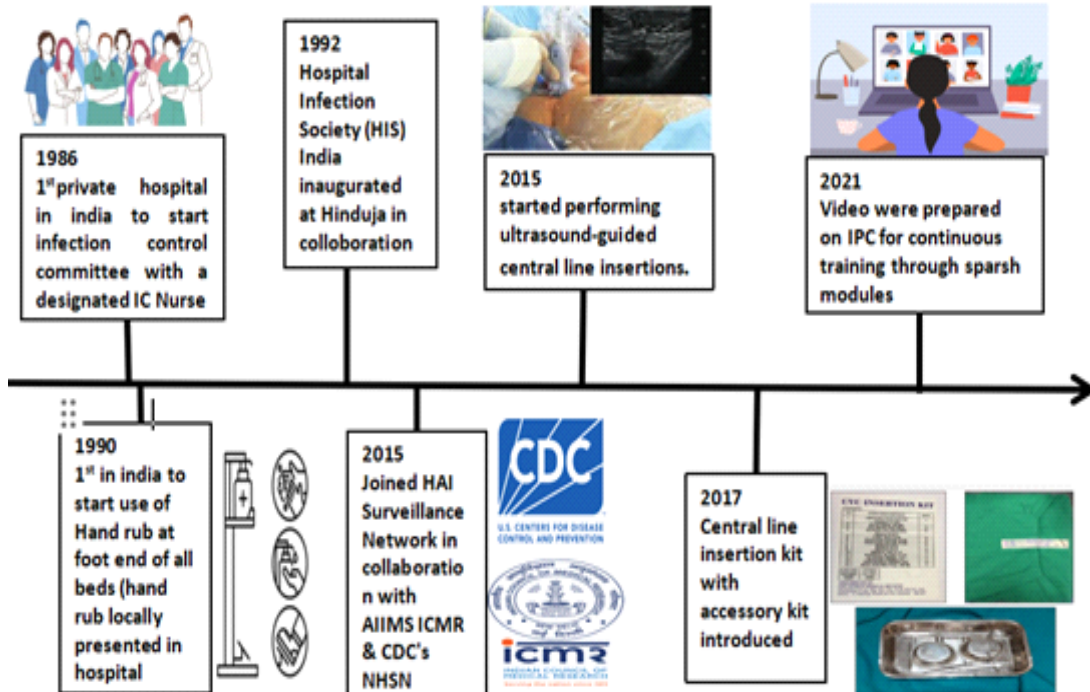
Our institute continuously strives to establish and enhance IPC practices. As shown in Figure 1, our IPC journey spans four decades, achieving key milestones in surveillance, antimicrobial stewardship, and diagnostics. We have implemented evidence-based strategies to reduce healthcare-associated infections and improve patient outcomes. Collaborations with CDC’s NHSN, J.P.N. Apex Trauma Center AIIMS, ICMR, Johns Hopkins, BMGF, and others have strengthened our commitment to patient safety and infection control.

At the end of each month, we calculate the CLABSI rate and present the data in a monthly hospital infection control meeting. During these meetings, we discuss strategies to enhance patient care and further reduce infection rates.



**Figure 1. CLABSI rate in our hospital compared with the INNIC benchmark from 2021 to 2024.**

According to the International Nosocomial Infection Control Consortium (INICC), the CLABSI benchmark was 7.4 per 1,000 central line-days in 2015 and has decreased to 4.55 per 1,000 central line-days in recent years. Our institute’s CLABSI rate has consistently remained below these benchmarks, reflecting the effectiveness of our infection prevention strategies and continuous quality improvement efforts.



**Figure 1: Milestones in our four-decade journey of infection prevention and control, highlighting advancements in surveillance, antimicrobial stewardship, diagnostics, and key national and international collaborations.**

**Table 1: Central Line Insertion and Maintenance Bundle Care Protocol**

<b>Central line insertion protocol</b>
<b>Complete Maximal Barrier Precautions</b> <ul style="list-style-type: none"> <li>The healthcare provider inserting the central venous catheter should: <ul style="list-style-type: none"> <li>Adhere to strict aseptic techniques.</li> <li>Wear <b>sterile gloves</b>, a <b>sterile gown</b>, a <b>surgical cap</b>, and a <b>surgical mask</b>.</li> <li><b>Cover the patient</b> with a <b>large sterile drape</b> to maintain a sterile field.</li> </ul> </li> </ul>
<b>Hand Hygiene</b> <ul style="list-style-type: none"> <li>Effective hand hygiene involves mandatory hand washing, along with the subsequent use of an alcohol-based hand sanitizer: <ul style="list-style-type: none"> <li><b>Before and after</b> palpating the catheter insertion site.</li> <li><b>Before and after</b> inserting, replacing, adjusting, or dressing the site.</li> <li>During palpation of the insertion site, after antiseptic application, only if full asepsis is maintained.</li> </ul> </li> </ul>
<b>Chlorhexidine 2% Skin Antisepsis</b> <ul style="list-style-type: none"> <li><b>Preparation:</b> <ul style="list-style-type: none"> <li>Use <b>2% chlorhexidine in 70% alcohol</b> with swabs and apply a friction scrub for <b>at least 30 seconds</b>.</li> <li>Allow the antiseptic to <b>air dry completely</b> before puncturing the skin. Avoid wiping or blowing dry.</li> </ul> </li> <li><b>Dry Site:</b> <b>Scrub for 30 seconds</b>.</li> <li><b>Moist Site (e.g., femoral):</b> <b>Scrub for 2 minutes</b>.</li> </ul>
<b>Optimal Catheter Site Selection</b> <ul style="list-style-type: none"> <li>In <b>adult patients:</b> <ul style="list-style-type: none"> <li>The <b>subclavian site</b> is associated with a lower risk of catheter-related bloodstream infections but may require greater expertise.</li> <li><b>Internal jugular</b> and <b>subclavian</b> sites are preferred for infection-control purposes.</li> </ul> </li> <li>Always use <b>sterile, single-use jelly</b> for ultrasound-guided insertions.</li> </ul>
<b>Central line maintenance protocol</b>
<b>Hand Hygiene</b> <ul style="list-style-type: none"> <li>According to the <b>Five Moments for Hand Hygiene:</b> <ol style="list-style-type: none"> <li>Before and after touching a patient.</li> <li>Before clean/aseptic procedures.</li> <li>After exposure to or risk of body fluids.</li> <li>After touching patient surroundings.</li> </ol> </li> </ul>
<b>Daily Review of Catheter Necessity</b> <ul style="list-style-type: none"> <li>Conduct a <b>daily review of central line necessity</b> during rounds to: <ul style="list-style-type: none"> <li>Assess whether the line is still required.</li> <li>Promptly remove any <b>unnecessary lines</b> to reduce infection risk.</li> </ul> </li> </ul>
<b>Aseptic Technique for Accessing and Changing Needleless Connectors</b> <ul style="list-style-type: none"> <li>Use an <b>alcohol-coated cap</b> on the access port or hub to maintain sterility.</li> <li>If an alcohol-coated cap is not available, <b>scrub the access port</b> with an appropriate antiseptic immediately before each use.</li> </ul>

The insertion and maintenance checklists are provided in Appendix A and Appendix B, respectively. Insertion data compliance was collected by the IPC monitoring team. When a central line insertion was planned, the ICU nursing staff coordinated with the IPC team, and an IPC team member recorded central line insertion practices on an adherence monitoring form.

For maintenance, an IPC team member performs daily rounds in the ICU, recording patient data on an Infection Prevention and Surveillance form. This form includes patient information, date, vital signs, and details of any invasive lines. We are also collecting daily data on the number of blood samples submitted for culture and sensitivity testing, monitoring the number of

positive cultures, and assessing for any signs of cross-infection or potential outbreaks.

### Statistical analysis

In this study, central line insertion data from 45 cases were analyzed. The insertion bundle includes hand hygiene compliance, the use of sterile barriers, proper skin preparation, the number of first attempts, and ultrasound-guided insertion

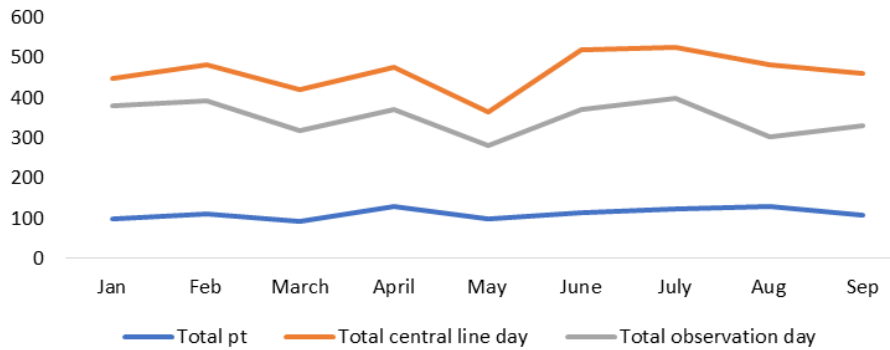
### Result

In this study, central line insertion data from 45 cases were analyzed. The insertion bundle includes hand hygiene compliance, the use of sterile barriers, proper skin preparation, the number of first attempts, and ultrasound-guided insertion.

**Table 2 Central Line Insertion compliance January to September 2024**

Month	Total Observation	Hand Hygiene Compliance	Sterile Barrier Usage:	Skin Preparation:	No. of 1st Attempts	USG Guidance:
Jan	7	7	7	7	7	7
Feb	4	4	4	4	4	4
March	7	7	7	7	7	7
April	6	6	6	6	6	6
May	6	6	5	6	6	6
June	2	2	2	2	2	2
July	8	8	8	8	7	8
Aug	3	3	2	3	0	3
Sep	2	2	2	2	1	2
Total	45	45(100%)	43(95%)	45(100%)	40(88%)	45(100%)

Figure 3 presents the total patients admitted to the ICU versus total central line days and total observation days.

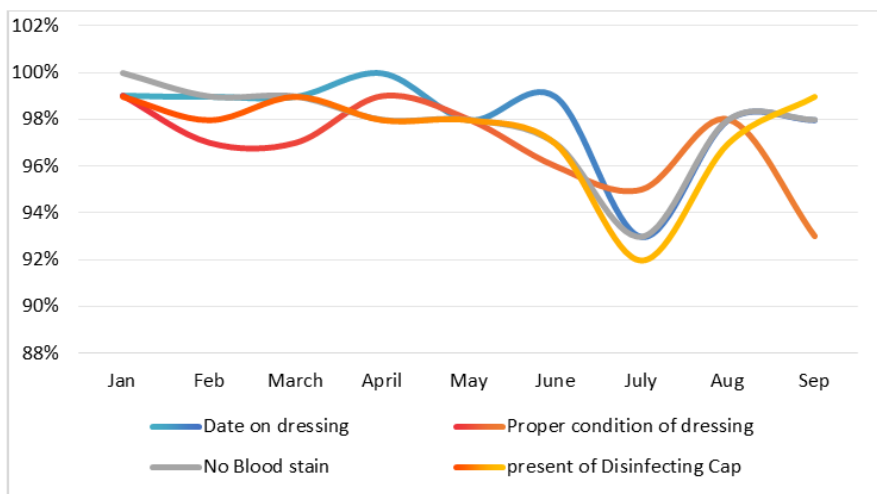


**Figure 3 illustrates the total number of patients admitted to the ICU, the total central line days, and the total observation days**

Table 3 outlines the monthly compliance percentages for central line maintenance. Maintenance compliance includes criteria such as the presence of a date on the dressing, proper condition of the dressing, absence of blood stains in the lumen, and the presence of a disinfection cap.

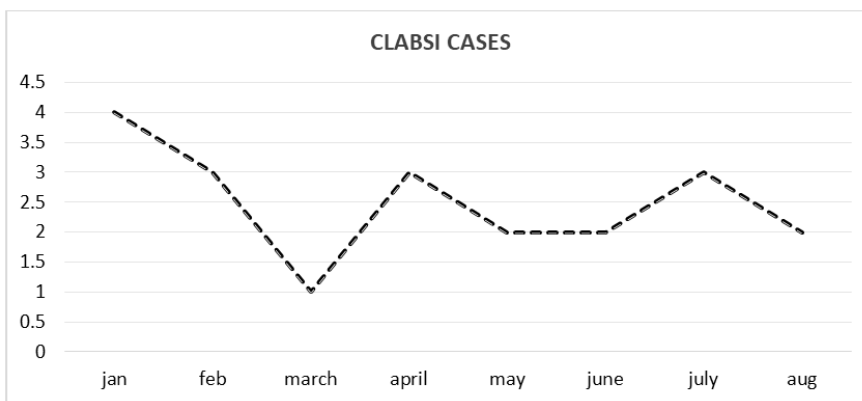
**Table 3: Monthly Compliance Rates for central line Maintenance in ICU**

Month	Date on dressing	Proper condition of dressing	No Blood stain	present of Disinfecting Cap
Jan	99%	99%	100%	99%
Feb	99%	97%	99%	98%
March	99%	97%	99%	99%
April	100%	99%	98%	98%
May	98%	98%	98%	98%
June	99%	96%	97%	97%
July	93%	95%	93%	92%
Aug	98%	98%	98%	97%
Sep	98%	93%	98%	99%



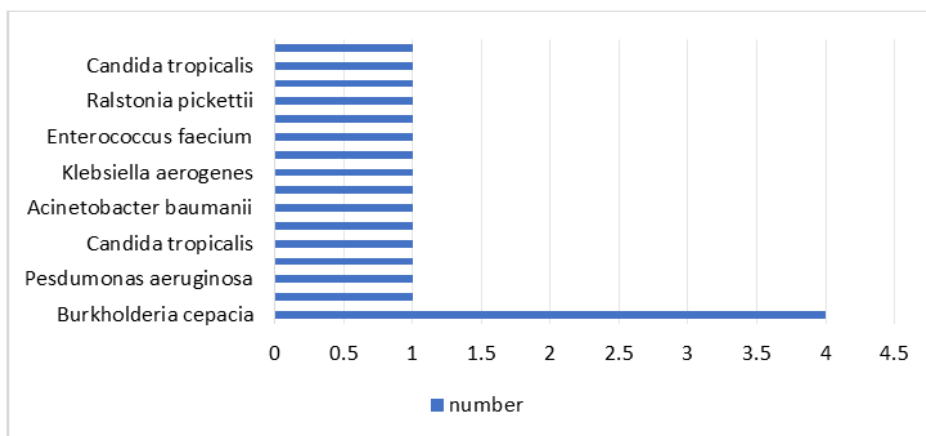
**Figure 4: Monthly Compliance Rates for central line Maintenance in ICU**

Our hospital maintains CLABSI cases below 4 rates. This reflects strong infection control and central line maintenance practices.



**Figure 5 illustrated CLABSI number of CLABSI cases Jan to September 2024.**

Figure 6 illustrates the organisms isolated in CLABSI cases, with no repeats except for Burkholderia, which was isolated three times at different periods and locations. This indicates the absence of cross-contamination event.



**Figure 6: Remarkable causative bacterial agent in CLABSI Cases**

## Discussion

The study highlights commendable compliance with central line insertion practices, including 100% adherence to hand hygiene, skin preparation, and USG guidance, demonstrating alignment with evidence-based guidelines. However, 22% of cases required multiple attempts due to factors such as vein collapse and skill level, underscoring the need for enhanced training. While 95% compliance with sterile barrier precautions is higher than rates reported in this studies, the 5% lapse due to improper mask usage remains a critical area for improvement. These findings emphasize the need to increase observations of bundle care practices, alongside continuous monitoring, education, and adherence reinforcement, to further reduce procedural complications and the risk of CLABSI. The impact of different care bundles varies and that maximal sterile barrier precautions are an essential component of the central line insertion bundle.<sup>[10]</sup>

This study found that the majority of nurses were compliant; however, the rate of CLABSI varied across the participating ICUs. Nurses working with a higher nurse-patient ratio had higher compliance scores. In our hospital, the nurse-patient ratio is 1:1, ensuring dedicated care and adherence to central line maintenance protocols. This finding was consistent with those of who reported that higher the nurse-patient ratio would result in improvement in nurses' compliance and might improve patients' outcomes.<sup>[11]</sup>

The average number of ICU admissions per month is 112, with 464 central line days and 349 observation days. The lower observation count can be attributed to factors such as holidays, patient availability for rounds (sometimes patients are under nursing care or away for procedures), and the fixed timing of rounds at 11:00 AM to capture the maximum number of patients.

Table 3 demonstrates the monthly compliance rates for central line maintenance, graphically represented in Figure 4, which shows a slight dip in June to just above 92%, while most months maintained rates close to or above 95%. Notably, this fluctuation did not directly correlate with an increase in CLABSI cases, as infection risk also depends

on patient-specific factors like immune status and antibiotic use, alongside other measures such as hand hygiene and environmental surveillance. High compliance with central line maintenance reflects consistent adherence to dressing protocols in the ICU. One study investigated whether a multidisciplinary, best-practice care bundle could reduce CLABSI rates in hospitalized patients and to further delineate the epidemiology of CLABSIs in this population.<sup>[12]</sup>

In line with this, we consistently monitor bundle care compliance and conduct regular educational programs to enhance the knowledge and skills of healthcare staff. These initiatives aim to improve the quality of care and have proven effective in reducing CLABSI rates. According to Matlab AA study CLABSI rates are highly dependent on the knowledge and practices of healthcare providers.<sup>[13]</sup>

In our study, the isolated organisms are depicted in Figure 6, showing no repeats except for Burkholderia, which was identified three times at different periods and locations. While this pattern suggests the absence of a direct cross-contamination event in the ICU, it may indicate a potential lapse in environmental cleaning and disinfection practices, as Burkholderia species are known to persist in moist hospital environments.<sup>[14]</sup> An Indian study reported that the most common organisms causing CLABSI were *Acinetobacter* spp., followed by *Klebsiella pneumoniae*, *Enterobacter aerogenes*, and MRSA.<sup>[15]</sup> In contrast, a network-based surveillance study identified *Enterococcus faecalis* and coagulase-negative staphylococci as the most frequently isolated organism.<sup>[16]</sup>

To reduce CLABSI rates in our hospital, we conducted structured training programs for healthcare workers as part of both induction and periodic revision sessions. These sessions focused on best practices in IPC, including hand hygiene, environmental disinfection, and strict adherence to protocols for the insertion and maintenance of intravascular devices..

## Conclusion

Implementing and adhering to strict central line insertion and maintenance protocols is critical in reducing the risk of Central Line-Associated

Bloodstream Infections (CLABSI) and improving patient safety. Following maximal barrier precautions, proper hand hygiene, optimal catheter site selection, and aseptic techniques ensures a safe and infection-free central line insertion process.

Routine catheter necessity assessments, proper dressing changes, and aseptic handling of needless connectors play a crucial role in minimizing infection risks during maintenance. By integrating these evidence-based practices, healthcare facilities can significantly reduce CLABSI rates, improve patient outcomes, and enhance overall infection control standards

### Clinical significance

Adhering to strict infection prevention protocols significantly reduces the incidence of CLABSI, thereby decreasing patient morbidity and mortality, shortening hospital stays, and reducing healthcare costs. In this study, the same bacterial pathogen was isolated on three separate occasions, suggesting the possibility of persistent environmental contamination. However, the study has limitations, including a small sample size and the absence of molecular typing to confirm clonal relatedness. Future research should involve larger, multicenter studies with molecular analysis to better understand pathogen transmission and assess the effectiveness of targeted environmental disinfection interventions.

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**Ethical Clearance:** This study was approved by institutional Review Board (IRB) of Hinduja

Hospital (Project code- 1533-22-CR) dated 1st February 2023.

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## Prevalence and Antibiotic Resistance Profiles of Uropathogens in Haldia, an Industrial City in Eastern India

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### Abstract

**Background:** A significant health concern in the community with the highest morbidity is urinary tract infection (UTI). Moreover, age, comorbidity and bacterial drug-resistance worsen the situation. Changes in ecological and host factors plus misuse of drugs promote bacterial uropathogens becoming antibiotic-resistant.

**Objectives:** Presently, we evaluate UTI prevalence and causative bacterial antibiotic-resistance-patterns in an industrial-town with educational-hub situated in eastern part of India. Age- and gender- wise comparison of bacterial susceptibility-resistance was performed.

**Materials and methods:** A total 83 individuals (23 males and 60 females) from the city hospital and local pathological-centers provided urine samples maintaining proper norms. Routine microbiological/pathological tests and detailed drug-resistance screening were performed.

**Results:** The major infecting organisms *E. coli*, *K. pneumoniae* and *P. aeruginosa* are prevalent with approximately 25:6:1 ratio in all age groups. But age wise, 60% of >31 years group is infected by *E. coli* the rest two groups; 31-60 and >60 years are infected ~80% by *E. coli*. When compared to the WHO data, *E. coli* infection is more in the studied area (78% vs 67%). Genderwise, female is more affected by *E. coli* and male is more affected by *P. aeruginosa*.

**Conclusions:** Among patient-derived bacterial isolates, only 35.17% of antibiotics were effective against *E. coli*, and 23.66% were effective for *Klebsiella sp.* indicating a high level of resistance. In summary, *E. Coli* is resistant to the majority of medications. Nitrofurantoin and amikacin are found to be the most sensitive to the uropathogens

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**Key words:** Urinary tract infection (UTI), Eco-Industrial environment, *E. coli* and *K. pneumoniae*, Antibiotic resistance, Nitrofurantoin and amikacin.

## Introduction

Because of the contagious nature of uropathogen, urinary tract infections (UTIs) are the most common diseases and a significant public health concern that affect individuals of all ages and genders. However, women have a higher incidence than men because of their biological makeup [1]. Worldwide, around 150 million individuals are affected yearly and being diagnosed/treated for UTIs. In a normal physiological system, wastes are filtered in the kidney and the output from the kidneys is eliminated via urinary tracts and in the urogenital system consisting upper and lower segments of the urinary tract.<sup>1</sup> The bacterial infection in this portion, however, predominates over other microorganisms.<sup>1</sup>

While UTIs are said to affect people of all genders, women of younger ages are said to be more susceptible to the infection.<sup>2,3</sup> A lower UTI can spread to the upper urinary system, potentially affecting the kidneys and ureters in advanced infection and, if timely treatment is not received.<sup>4</sup> Comorbidity and antibiotic resistance are the direct factors that increase the severity of UTI.<sup>5,6</sup> Other confounding factors are health-hygiene, sanitation, environmental pollution, socio-demographic profile, etc.<sup>7</sup> Other disease or pandemic situation might have some influence on prevalence and/or severity of UTIs. It is noteworthy to mention Covid-19 influenced the severity of UTIs during its period because of immune-suppression, inflammation.<sup>8</sup>

Urinary obstruction, renal failure, calculi and invasive catheters are among the factors that can lead to complicated UTIs.<sup>9,10</sup> Common symptoms of a lower urinary tract infection include burning or pain during urination, inflammation and irritation of the bladder and urethra lining. In contrast, upper UTIs include chills, trembling, nausea, and high fever.<sup>11</sup> Epidemiological data suggest that, in West Bengal, a state in eastern India, UTIs are a common health issue, similar to other regions in India.<sup>12-14</sup> Introspective studies show unhygienic lifestyles and lower of sanitation-hygiene are the main causes of UTI, which primarily affects women.<sup>14</sup> The most frequent microorganisms linked to urinary tract infections

are *Escherichia coli* and *Klebsiella pneumoniae*. Very few *Pseudomonas aeruginosa* infections in both males and females have been reported. *Escherichia coli* was the most abundant uropathogen with a prevalence rate of 67.1%, followed by *Klebsiella spp.* (22%) and *Pseudomonas spp* (6%).<sup>12</sup>

The growing resistance of uropathogenic bacteria to drugs is a worrying trend. The antibiotic resistance pattern of two principal UTI pathogens, *E. coli* and *Klebsiella spp.* in West Bengal appears to be like the other places. Higher than 50% resistance were noticed for broad-spectrum penicillin. Fourth-generation cephalosporin and macrolide seem to be the choice of drug in treating UTIs in eastern India.<sup>12,13</sup> Misuse of antibiotics causes drug-resistant bacterial strains to evolve, which makes managing UTIs more difficult. To treat UTIs, multimodal approaches are needed, including promoting appropriate antibiotic use and increasing public awareness.

In this background, the objectivity of the current study was to evaluate the prevalence and drug resistance nature of major UTI causing bacteria's in Haldia, West Bengal, India. Biochemical and physiological identification was performed to screen the pathogen. Haldia is a river-sea coastal port city with a large number of heavy industries. The aim of this study was to assess the nature of drug-resistance of uropathogens and to develop public awareness about UTI and its post complications. First time, this type of evaluation is monitored in this region. Ecological-environmental impact in this economic zone is important for assessing the infection associated health issues.

## Materials and Methods

### Study area

Samples were procured from the town hospital and from some accredited regional pathological centers in Haldia, West Bengal. After preliminary studies, further analyses were conducted in the institute lab. The industrial port city, Haldia is located close to the mouth of the Hooghly River, one of the Ganges' distributaries (22.03°N 88.06°E) (fig 1). Haldia is famous for petrochemical companies



### Bacteria culture maintenance

The isolates were sub cultured periodically according to the requirement in the following media. *E. coli*- Sorbitol-Macconkey agar media, *K. pneumoniae* strains developed as yellow mucoid colonies on an agar medium containing ornithine, raffinose, and Koser citrate at 24 hours, and there was a little increase in colony size at 48 hours. Cetrimide Agar serves as a selective medium in the process of isolating *Pseudomonas aeruginosa* from various sources such as pus, sputum, and drainage.

### Antibiotic Susceptibility Testing

The VITEK2 Compact system (bioMérieux) was used to evaluate the bacterial isolates for antibiotic susceptibility. Pure bacterial colonies were suspended in sterile saline to create a bacterial solution that met the 0.5 McFarland turbidity requirements. Following

the manufacturer's directions, the standardized suspension was then inoculated into the relevant AST card, which was then put into the VITEK 2 Compact system. The Clinical and Laboratory Standards Institute (CLSI) 2024 recommendations were used in order to interpret the test results.

### Statistical analysis

In the current study SPSS Statistics 22.0 program was used for several analysis. The distribution pattern of uropathogens in different age and gender groups were calculated and expressed as percentage. Those were compared with the corresponding WHO data and expressed as bar diagram. Age and gender wise occurrence rate of three uropathogens were analyzed by  $\chi^2$  analysis (95% CI). F value was derived from the ANOVA (Analysis of Variance) from the mean differences of the occurrence rate of the studied pathogens.

**Table 1: Distribution and clinical manifestations of UTI cases with demographic features.**

n=83	%
<b>Gender</b>	
Female	72.3
Male	27.7
<b>Age</b>	
<31 years	18.5
31-60 year	53.1
>60 years	28.4
<b>Symptoms</b>	%
Fever	12.3
Dysuria, polyurea	11.4
Cystitis	7.9
Haematuria	2.0
Comorbidity	5.8

### Socio-economy and Demography

Rural and semi-urban, inadequate hygiene and sanitation, prevalent under-nutrition, mostly lower- and middle-income group.

### Results

In the current study, a total 83 UTI patients were included. Out of which, 72.3% is female and 27.7% male (table 1). The majority belongs to rural and semi-urban with inadequate hygiene and sanitation. A significant number of patients were

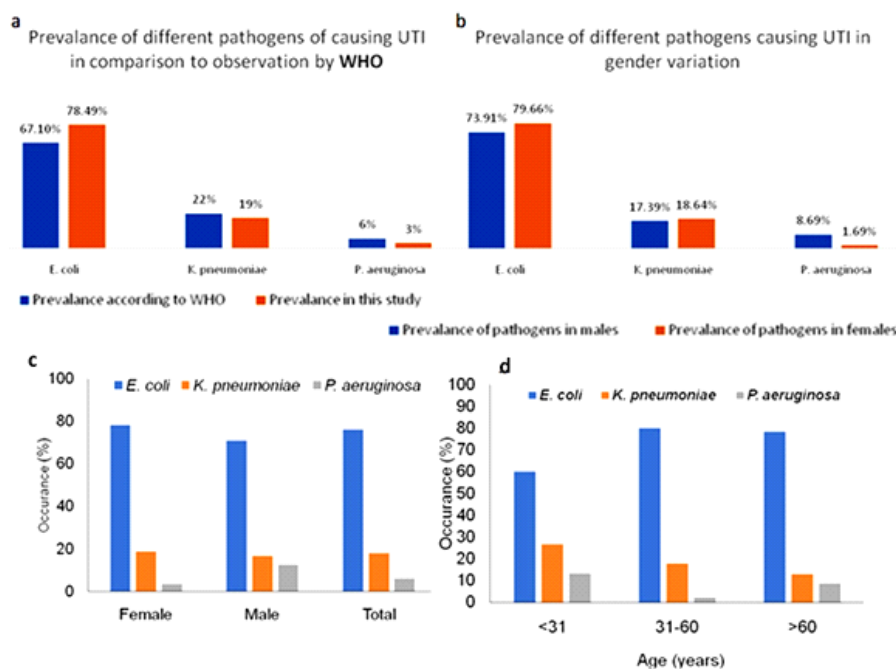
undernourished and came from mostly lower- and middle-income group family. Certain percentages of patients manifested different symptoms/ comorbidities (table 1).

### Comparative prevalence of UTI in West Bengal (WHO) and Haldia, present study location

In this study, the dominance of *E. coli* is major than other organisms when it is compared to the rest part of the state. The same trend is also noticed when it is compared to WHO global data.<sup>12</sup> Our data indicate *E. coli* has 78.49%, *K. pneumoniae*, 18.51% and

*P. aeruginosa* has 3% of occurrence rate in the current study location. In comparison to the WHO, prevalence

of UTI pathogens in West Bengal are presented in the graphical representation in the following figure 2.



Gender-wise distribution of uropathogens

Figure 2. Gender- and age-wise distribution of uropathogens

Certain bacteria were more common in females than in males; for instance, the prevalence of *E. coli* infection was higher in females (79.66%) than in males (73.91%). *K. pneumoniae* infections accounted for 17.39% of UTIs in men and 18.64% in women. An 8.69% of UTIs in men and 1.69% in women were caused by *P. aeruginosa*. Males and females had different prevalence rates of various illnesses, as seen in Figure 2. It has been noticed that people in distinct age groups have variable infection prevalence. People’s age groups demonstrate their diverse immune systems and capacity to fend off illness. This explains why different age groups are impacted

by different infections. The prevalence of various illnesses and their age-wise distributions were statistically evaluated and found to be significant at a low level due to the smaller sample size, intra-individual variability, and bigger SD/SE (table 2). The  $\chi^2$  results suggest that there are significant differences among age-wise and gender-wise distribution pattern of different uropathogen infection (table-2). Present ANOVA results suggest that the mean ages (44 to 49 years) of the affected individuals by three uropathogens are not significantly different ( $F=0.494$  and  $p = 0.612$ ).

Table 2 Prevalence and statistical outcome of pathogen variations in different age groups. Superscript a designate the *t* value of the corresponding group mean.

Gender wise distribution		Female	Sex	Male		Total				
Causative_UTI_Pathogen	<i>E. coli</i>	46	77.97	17	70.83	63	75.9	2.502a	2	0.286
	<i>K. pneumoniae</i>	11	18.64	4	16.67	15	18.07			
	<i>P. aeruginosa</i>	2	3.39	3	12.5	5	6.02			
Total	Total	59	100	24	100	83	100			

Continue.....

Age wise distribution		<31	Age_ Cat 31-60			>60		Total				
Causative_ UTI_Pathogen	E. coli	9	60	36	80	18	78.26	63	75.9	4.236 a	4	0.375
	K. pneumoniae	4	26.67	8	17.78	3	13.04	15	18.07			
	P. aeruginosa	2	13.33	1	2.22	2	8.7	5	6.02			
Total	Total	15	100	45	100	23	100	83	100			

When different pathogen distribution pattern is studied it is noticed that *E. coli* is the most dominant in female, male and in total populations. But in male, *P. aeruginosa* is was found to be little more dominant (fig 2). When age-wise pattern is studied it is noticed that in lower age group (<31), infection appeared more uniformly distributed among younger individuals, with *E. coli* being the dominant pathogen (fig 2).

According to earlier national statistics on *E. coli* susceptibility, certain antibiotics, such as imipenem, gentamycin, and nitrofurantoin have higher sensitivity rates, which is consistent with the current investigation. Ipenem, fosfomycin, and gentamycin are more widely used and have demonstrated a significantly higher range of sensitivity against uropathogenic *E. coli* (UPEC) across all age groups (fig 3). The frequency of *P. aeruginosa* infection has been incredibly low in our investigation. Most of the people in the study were susceptible to levofloxacin, imipenem, and meropenem. The bacteria that cause UTIs are opportunistic. Ipenem, ofloxacin, nitrofurantoin, and netimicin are the

main medications that responders are vulnerable to, according to previous data from national research (fig 4). In addition, individuals under 30 years with *P. aeruginosa* have demonstrated significant susceptibility to cefoperazone-sulbactam. Individuals over 60 years and those between the ages of 31 and 60 have significant sensitivity against gentamycin (fig 4).

**Discussions**

Upon examining the findings, we observed a notable difference between the observed drug sensitivity patterns of the uropathogenic bacteria and previously reported national/global results. Our data corresponds WHO reported prevalence rate for West Bengal. *Escherichia coli* are a common uropathogenic bacterium in all age groups, including males and females. The WHO reported prevalence of uropathogens in West Bengal and eastern India is 67.10% for *Escherichia coli*, 27% for *Klebsiella pneumoniae*, and 6% for *Pseudomonas aeruginosa*<sup>12</sup> compared to that of our data 78.49%, 19%, and 3%, respectively.

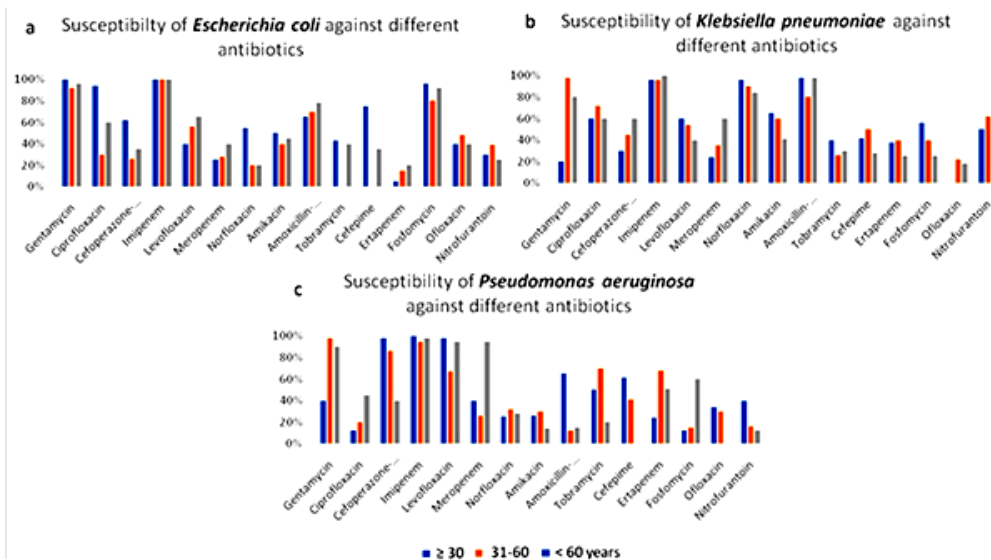


Figure 3. Age wise distribution of susceptibility pattern of three pathogens against different antibiotics

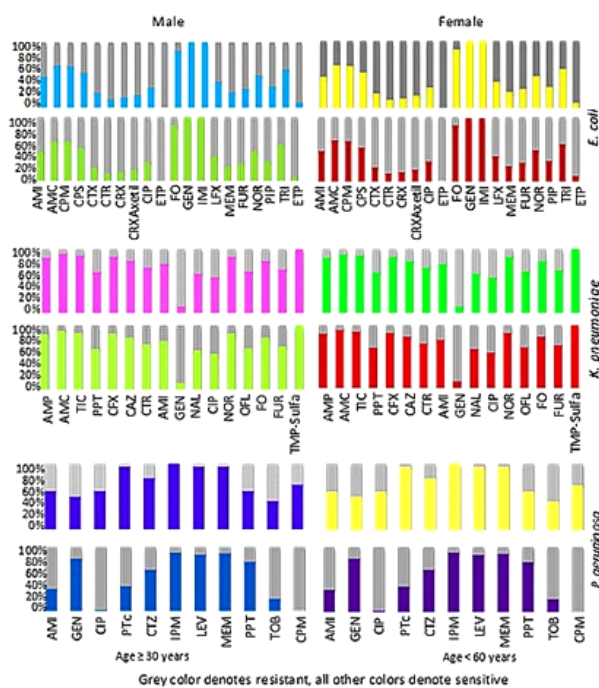
The studied eco-environmental status might have some influence of pathogen lifecycle and host-parasite interaction. UTIs caused by *Klebsiella pneumoniae*, particularly hospital-acquired typically exhibits the highest level of susceptibility to medications such tobramycin, ofloxacin, imipenem and netimicin at national level. We observed that ceftazidime, amikacin, ampicillin, amoxy-clav, trimethoprim/sulfamethoxazole demonstrate major sensitivity among all the age groups especially people less than 31 years and above 60 years. Report reveals weak polymorphic mutants of *E. coli* found in clinical isolates has no direct relation to its drug resistance.<sup>17</sup>

According to our research and a number of other studies, pathogenic *E. coli* has developed a variety of antibiotic resistances, which has led to an increase in its prevalence. This idea is consistent with another research that shows *Escherichia coli* virulence factors are frequently encoded by genetic components such plasmids, bacteriophages, transposons, and pathogenicity islands. And this adaptive strategy may be common for any pathogenic namely UTI and gastroenteritis causing *E. Coli*.<sup>18</sup> Notwithstanding, hotspot mutations may be highly prevalent in *E. Coli* core genes, leading to short-term positive selection. This dynamic pattern is in line with the source-sink concept of virulence evolution.<sup>18</sup>

Usually, in a rural or semi urban care center, patients with UTI are prescribed and treated one or the other antibiotic until getting the urine culture-report. Long term misuse of antibiotics results in drug resistance.<sup>19</sup> One earlier report suggested some point-of-care (POCT) rapid diagnostic kit (Rapidogram) has predicted validation report.<sup>20</sup> According to their report, which is consistent with our findings, *E. coli*, which has been found to be particularly sensitive to nitrofurantoin and amikacin, affects the greatest number of people. These people were initially given another medication in several instances, which led to a complex situation.

In extreme peripheral health care settings where some facilities are unavailable, empirical therapy might be helpful.<sup>12</sup> In conformity with this report our study indicates that *Escherichia coli* were the most prevalent and drug resistant uropathogen, followed by and *Klebsiella spp.* Penicillin was the least effective medication against *E. coli*, whereas fourth generation of cephalosporins showed the greatest susceptibility.<sup>21</sup> Higher than 50% resistance were observed for broad-spectrum penicillin. Some women with recurrent UTIs may have inherited characteristics. The mechanical and/or physiological factors that impact bladder emptying are significantly linked to this recurrence.<sup>22</sup> Infants, elderly and pregnant women, patients with catheters, patients with diabetes, and patients with urologic disorders are among the specific sub-populations with increased UTI risk.<sup>23</sup> Report suggests diverse resistance patterns indicating a heterogeneous population of uropathogenic *E. coli* isolates that circulate in this region of India and raise queries on significant concern on therapeutic and infection-control issues.

Globally, particular attention has been drawn to pathogens that are positive for extended spectrum beta lactamase (ESBL) and emerging threats such multi-drug-resistant (MDR) clones (e.g. *E. coli* 131 (ST131) and *K. pneumoniae* ST258). In these cases, the use of older antibiotics, like fosfomycin, is justified by the increased prevalence of MDR. It limits the treatment options available for infections, as well as the lack of new antibiotics.<sup>24</sup> Amikacin and nitrofurantoin ought to be designated as effective medications to treat this infection<sup>25</sup> which is in agreement with our current study. Finding the region specific drug resistance



**Figure 4. Susceptibility and resistance patterns of different drugs against different uropathogens in two different age groups  $\geq 30$  years and  $>60$  years.**

pattern is essential for customized antibiotic therapy in urgent situation.<sup>26</sup> When nitrofurantoin, amikacin, colistin have shown appreciable effects, amikacin, doxycycline, and nitrofurantoin have shown significant side effects in human.<sup>27</sup>

To distinguish natures of hospital-acquired or community-acquired UTI further analysis is required. An estimate of patients suffering from UTI may rise to 75% in the female population by their age of 24, and 15–25% of this group will suffer from a relapse of this disease.<sup>22</sup> Several birth control methods raise the risk of UTIs. Spermicides may irritate skin, which makes it possible for bacteria to infiltrate. Urinary flow may be slowed by diaphragms, which promotes bacterial growth. In addition to putting strain on the bladder and its regulating muscles, constipation and obesity can also result in or worsen UTIs.<sup>28</sup> *E. coli* showed high resistance to sulfonamide SXT (double-strength trimethoprim-sulfamethoxazole) and to fluoroquinolone ciprofloxacin in nine European countries, United States and in Brazil.<sup>29</sup> Regarding the diversity, different causative organisms have different mechanistic approach to manifest their pathogenicity. As for example, the most uropathogenic *E. coli* UPEC structure comprises type 1 and P fimbriae as well as additional fimbriae and non-fimbrial adhesions.<sup>30</sup> Despite the fact that UTI is the third most common infection found in India, only a few studies on UTI have been reported.<sup>31</sup> Especially, in an industrial belt, the nature of infection and the drug resistance pattern has been less focused. When creating broad-spectrum treatment plans, it is helpful to know that no organism creates a clear outlier cluster. Resistance to amikacin and nitrofurantoin varies statistically significantly amongst organisms.

Regarding limitations, current sample size is small; larger sample sizes in future research could boost the statistical power. Additional research might be done on the pattern of antibiotic responses and clinical manifestations by individual patient who might reflect inter-individual variability and genetic factor. Public antibiotic campaigns and patient-facing materials should address UTIs, prevention, non-pharmaceutical “self-care” advice, and justification. As older are more vulnerable to UTI, our results highlight the necessity of better diagnostic and risk prediction strategy to direct the customized drug prescription for suspected UTIs in these groups.

## Conclusion

In Haldia, Eastern India, urinary tract infections (UTIs) are common and affect people of all ages and genders. It is observed that women are more likely than men to develop UTIs. *Escherichia coli* is the most common cause of UTIs, which is more than the WHO data from the state and India. *Klebsiella pneumoniae* and *Pseudomonas aeruginosa* have also been identified as dominant uropathogens. These uropathogens exhibit a variety of antibiotic resistances, and worries about multidrug resistance (MDR) and extended-spectrum beta-lactamases (ESBLs) are growing on a global scale. Bacterial antibiotic resistance in patients is a result of improper use and misuse of antibiotics. Self-medication and the unrestrained availability of antibiotics are major causes of the increasing trend of antimicrobial resistance (AMR) of uropathogens. This case highlights the critical need for region-specific empirical treatment guidelines that take into account local patterns of antibiotic susceptibility in addition to national or international data.

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**Informed Consent:** was procured by the authority from hospital/clinic based patients, participants

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# Association between Knowledge of the Recommended Physical Activity Guidelines and Physical Activity Levels among Adults

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## Abstract

**Background:** Physical activity has enormous health benefits reduces risk of mortality and morbidity due to Non communicable diseases Studies conducted in Indiaprovides information about factors affecting activity levels. However, to the best of our knowledge, no studies have been reported on assessing the knowledge about guidelines in the study population. Individuals can change their behaviour from considering being active to really participating in the necessary amounts of physical exercise by being aware of the guidelines. This study aimed to know the association between knowledge of the recommended physical activity guidelines and physical activity levels among adults.

**Methods:** Approval from Institutional review committee obtained for study and an observational cross sectional study design of adult aged 18-44 years residing in Bengaluru, India was conducted. A self -developed questionnaire using modified Delphi process to explore knowledge about recommended guidelines and International physical activity level questionnaire to assess self-reported activity level were sent via social media platform for participants who provided consent for participation in the study.

**Results:** Among 398 participants only 48.87% of total participants were able to identify the correctly recommended guidelines. Spearman' co relation between physical activity level and awareness showed 0.072 indicating no relationship between awareness about guideline and physical activity level among the participants.

**Conclusion:** The results provide that future studies should systematically evaluate physical activity level and detail analysis of the factors that affect or influence the knowledge and activity levels to improve communication strategies to enhance awareness about the recommended guidelines and to increase participation of adults in physical activity levels to enhance health benefits.

**Keywords:** Physical activity, Knowledge, Recommended guidelines, Adults.

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## Introduction

According to the World Health Organization (WHO), physical activity is described as any bodily movement produced by skeletal muscles that require energy expenditure.<sup>(1)</sup> Individuals who engage in insufficient physical activity face a 20% to 30% higher risk of developing lifestyle-related diseases compared to those who are adequately active.<sup>(1)</sup> Non-communicable diseases (NCDs) account for the mortality of forty-one million people globally.<sup>(1)</sup> Engaging in physical activity has been shown to offer numerous health benefits and effectively lowers the risk of NCDs.<sup>(2)(3)</sup> The WHO provides guidelines for physical activity levels to overcome this burden. Adaptation and implementation of recommended guidelines have huge health and economic benefits<sup>(2)</sup>. Awareness of physical activity can positively influence activity levels. Individuals can change their behaviour from considering being active to really participating in the necessary amounts of physical exercise by being aware of the guidelines<sup>(4)</sup>. Several surveys conducted in the United States<sup>(5)</sup> Africa<sup>(6)</sup>, and Asia<sup>(7)</sup> aimed to evaluate the awareness of the guidelines and knowledge of dosage recommendations. The findings revealed that less than 50% of respondents were aware of the recommended guidelines and only 2-22% correctly identified the appropriate recommendations.

A study conducted on Indian physiotherapists, with an average age of 28 years, found that only 19% could correctly answer all three domains: moderate intensity, vigorous intensity physical activity, and strengthening exercises<sup>(8)</sup>. Despite their lack of awareness regarding the guidelines, 70% still achieved the recommended activity levels<sup>(8)</sup>. This indicates a lack of relationship between the recommended guidelines and actual physical activity levels. To the best of our knowledge, no studies have been reported on assessing the knowledge about physical activity guidelines on community-dwelling adults in Bengaluru. This highlights the need for study.

## Objective

The objective of the study is to explore the association between knowledge of recommended

physical activity guidelines, assessed through a developed questionnaire, and self-reported physical activity levels among adults, using the International Physical Activity Questionnaire.

## Methodology

### Study design and sampling

The study used observational cross-sectional methods for adults aged 18-44 years residing permanently or on a long-term basis within geographical area limits of Bengaluru city using survey method for data collection.

The sample size obtained was 384 since the recent population estimation is not available. The population of Bengaluru was considered undefined, and the population proportion was estimated with specified absolute precision using the formula from Lwanga and Lem show's sample size determination manual<sup>(9)</sup>. Subjects were categorized into three groups based on age 18 -24 years, 25-34 years, and 35 -44 years. To divide the number of samples equally in all groups the sample size was considered 390 and recruited based on convenience.

Operational definition of resident of Bengaluru, "Person living permanently or long term (minimum of a year) within the geographical area limits of Bengaluru city, Karnataka."

### Study criteria

Study included adults aged 18-44 years residing in Bengaluru urban or rural areas for at least a year provide consent for participation and were recruited for study. The geographical area limits of Bengaluru was classified based electoral commission as Bengaluru urban and rural having seven and four talukas respectively were equally classified and general message requesting participation was sent to participants via social media platform. The individuals who responded to message were approached individually and a formal informed consent was obtained and were recruited for the study. The inclusion criteria for the study were participants ability to use phone or social media platform and to read and understand English. Individuals who have medical reasons that restrict their physical activity

either by choice or as recommended by medical professionals for more than 2-4 weeks were excluded from the study.

### Procedure

Study was divided into two phases. In the phase one approval for conducting study was obtained from IRC (Institutional research committee), JSS College of Physiotherapy. To assess knowledge about guidelines in adult's questionnaire was developed using modified Delphi process. Modified Delphi process involved three rounds, in the first round, post to literature search the question was clearly defined along with the guidelines sent to five experts via mail. The questions obtained from five experts using the given guidelines were analysed and sent for consensus voting. In the third round the question which has not met the consensus were asked again and requested to mark yes or no. Results obtained in third round was face validated and utilized to develop final questionnaire to assess knowledge among adults.

In the phase two a feasibility test was conducted prior to implementation of the data collection. To assess knowledge about recommended guidelines questionnaire self-developed using modified Delphi's method and to assess self-reported physical activity level International Physical Questionnaire short form (IPAQ-SF) was used. A knowledge questionnaire formed via modified Delphi process and IPAQ-SF along with consent for participation in survey was converted to Google Forms version 0.8 and sent as a link via social media platform WhatsApp for participants. Time period of four weeks was given to fill the form, and a reminder message was sent weekly.

The responses obtained were collected and stored in the survey tool Google Forms. Once the required sample size was met the responses obtained were exported on Microsoft Excel spreadsheet version 18.2503.12711.0 and used for data analysis. Data analysis was done using Jamovi software version 2.6.44. The demographics and covariates such as hobbies, occupation etc were analysed by descriptive statistics and Spearman's correlation was used to obtain the strength and

direction of association between knowledge about the recommended guidelines and physical activity level among adults.

### List of tables

Table no	Contents	Page no
1	Demographic characteristics of participants	9-10
2	Responses of participants to the questionnaire on awareness about recommended PA guidelines	11-12
3	Correlation between awareness about the physical activity guidelines and physical activity level among adults	13

### List of figures

Sl.no	Contents	Page no
1	Awareness of recommended activity guidelines and physical activity levels of the participants based on IPAQ-SF	12

### Results

The demographic characteristics of the study participants involved are essential for interpreting the findings. The geographical area limits of Bengaluru were classified based electoral commission as Bengaluru urban and rural having seven and four talukas respectively. A total of 398 who provided consent for participants were involved for analysis. The representation of the population could not be controlled due to online survey methods owing to the result of 377 participants from Bengaluru urban and only 4 participants from Bengaluru rural. The study had a notable overrepresentation of female participants, with 75% of the total being women that is 228 females and 170 males. In terms of education, 42 participants had qualifications below a bachelor's degree, while 89.44% that is 356 participants held a bachelor's degree or higher. The detailed demographic characteristics of the study participants are shown in table 1 below.

**Table 1: Demographic characteristics of the participants**

<b>Demographics details</b>	<b>Number of participants</b>	
Total number of Participants	398	
Gender	Male	170
	Female	228
Area of residence	Bengaluru Urban	377
	Bengaluru Rural	4
	Others/Not clear	17
Education level	Primary (1st- 4th standard)	3
	Mid Primary (5th -7th Standard)	1
	High school/Secondary School Leaving Certificate (SSLC)	12
	Pre-University (PU) /Senior Secondary	26
	Undergraduate (bachelor's degree)	236
	Post graduation (master's degree)	114
	PhD/ Doctoral degree	6
Employment status	Employed full time	187
	Employed part time	16
	Student	138
	Housewife/Home maker	03
	Freelancer	9
	Unemployed	23
	Other	12
Presence of Co-morbidities	Thyroid disorder	12
	Hypertension	9
	Diabetics mellitus	7
	Multiple comorbidities	6
	Others	8
<b>Demographics details</b>	<b>Number of participants</b>	
Occupation	Agriculture (involving farming, horticulture, fishery etc.)	03
	Business administration (administration of a commercial enterprise business, finance or occupations)	45
	Government officials/civil services (including police, politicians, chief officers, local administrators)	03
	Owner/Self-employed (own commercial shops/Business owner)	15
	Health Care professional (Includes medical and paramedical professions)	60
	Teacher /Lecturer /Professor	45
	Engineering	34
	Transportation services (Involves public (buses, railway, aero plane) and private (cabs, auto) services)	01
	Laborer (involves repairmen like electrician, plumber and garment worker)	01
	Artist (Art, media or entertainment)	02
	Home maker	17
	Student	138
	Others	34

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Hobbies	Recreational activities like playing outdoor/ indoor sports/ games that require physical exertion	134
	Recreational activities like playing indoor games (board games, computer/ mobile games)	69
	Reading books or writing poetry or stories	92
	Arts and crafts	70
	Others	33
Habits	No Habits	371
	Drinking/ Alcohol consumption	15
	Smoking	7
	Others	5

The study participants' age group was between 18- 44 years of which 187 were from age group of 18-24 years, 134 were from 25-34 years and 77 were from 35 - 44 years. The average age of the participants falls in mean and standard deviation of  $27.04 \pm 7.70$  and number of years of residence in Bangaluru is  $13.89 \pm 10.32$ . Thirty-five participants out of 398 participants that is 8.79%, reported to be hospitalized and advised by doctors to limit their physical activity by more than 2-4 weeks

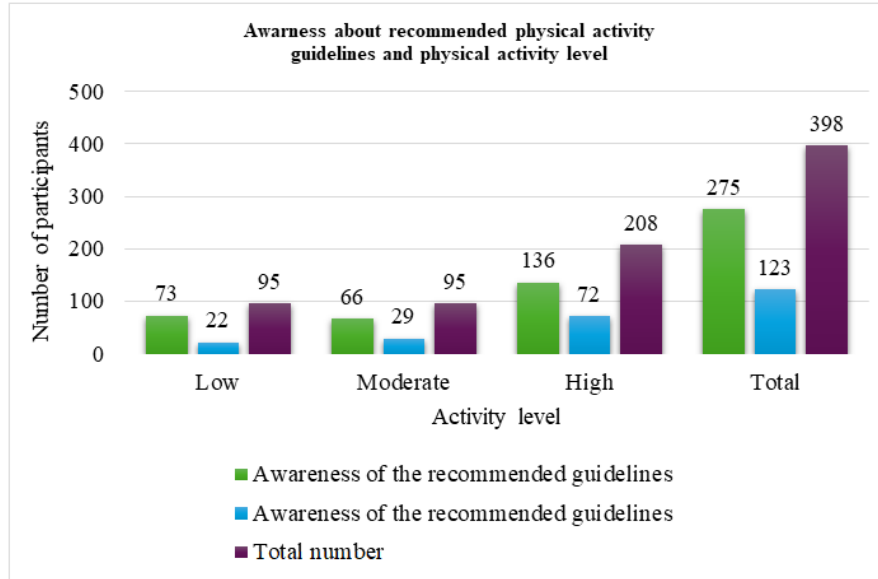
Among 398 participants 123 participants, which is 30.90%, reported as not aware of the guidelines and 276 participants, which is 69.90%, were aware of the guidelines. Average of 48.87% answered the following questions on guidelines correctly whereas 51.42% reported incorrect answers. Table 2 provides the details of the responses of participants to the questionnaire on awareness about recommended physical activity guidelines.

**Table 2: Responses of participants to the questionnaire on awareness about recommended PA guidelines.**

Questions	Responses obtained		
	Answer/Responses	Frequency of the response	Percentage
Are you aware that there are set guidelines for performing Physical activity for adults?	Yes	276	69.36%
	No	123	30.96%
According to guidelines, physical activity means	Correct response	97	24.37%
	Incorrect response	301	75.62%
According to the guidelines-physical activity is important for,	Correct response	299	75.12%
	Incorrect response	99	24.87%
What is the general recommended physical activity levels for adults?	Correct response	139	34.9%
	Incorrect response	259	65.07%
Is Yoga a substitute for Physical activity?	Correct response	108	27.1%
	Incorrect response	290	72.86%

Questions	Responses obtained		
	Answer/Responses	Frequency of the response	Percentage
Is it necessary to do intense muscle exercises/ strengthening exercises every day a week?	Correct response	206	51.7%
	Incorrect response	192	48.24%
According to guidelines, replacing sedentary time (tending to spend much time seated inactive) with light physical activity can provide health benefits.	Correct response	311	78.14%
	Incorrect response	87	21.85%

The physical activity level of the participants obtained from IPAQ-SF was analyzed and categorized into three categories low, moderate and high. Out of 398 participants, 208 participants belonged to the high category and 95 each belonged to the moderate and low-level category. Physical activity level among the participants 52.26% reported as being highly active, 23.86% belong to moderate and 23.86% belong to low level of activity respectively. Figure 1 represents the participants’ awareness about guidelines and physical activity level.



**Figure 1: Awareness of recommended activity guidelines and physical activity levels of the participants based on IPAQ-SF**

Participants who were aware of the guidelines, 26.5%, were low, 24% moderate and 49.4% belonged to a high level of physical activity. Those who were not aware of the guidelines were 17.8% low, 23.57%

moderate and 58.5% high level of physical activity level. Table 3 represents the correlation between awareness about physical activity guidelines and physical activity level among adults.

**Table 3: Correlation between awareness about the physical activity guidelines and physical activity level among adults**

Correlation matrix	Spearman’s rho	Degrees of freedom	p-value
Physical activity level and awareness about the recommended guidelines	0.072	398	0.150

Spearman’ co relation between physical activity level and awareness showed spearman’s rho indicates a very weak positive relationship between awareness about guideline and activity level but the effect is very minimal as p-value of 0.150 is greater than the conventional significance threshold (e.g., 0.05). This means that the observed correlation is not statistically significant there is no strong evidence to conclude a meaningful association between physical activity levels and awareness about the guidelines. Thus, there is no relationship between awareness about guideline and physical activity level.

**Discussion**

To explore association between knowledge about recommended physical activity guidelines and self-reported physical activity levels among adults a cross-sectional research design was conducted using the survey method. Participants were recruited based on predefined inclusion and exclusion criteria. The age-standardized prevalence of insufficient physical activity among adults in India was found to be 41.4% in a study <sup>(10)</sup> which included 69.6% of respondents in the 18–44 age group. In contrast, 45.72% of participants in the current study were in the

18–24 age group, and 52.26% of participants reported being highly active. One explanation for the study population's increased exercise levels may be their educational background as 89.4% of the participants had completed a bachelor's degree or more. An observational study<sup>(11)</sup> found a positive correlation between physical exercise and higher education on average, one additional year of education leads to a 0.62-unit higher overall activity levels in adults.

In the study 30.90% reported as not being aware of the guidelines. Average of 48.87% answered the following questions on measuring awareness about recommended guidelines correctly whereas 51.42% reported incorrect answers which are in line with the similar study conducted in Australia 55.6% of the participants couldn't identify the correct recommended guidelines<sup>(12)</sup>.

The main findings of the study is that there is no relation between awareness about the guidelines and activity level which is similar to the study conducted on Finnish men<sup>(13)</sup> which reported that no significant associations were found between knowledge and activity behavior, whereas fitness variables were positively associated with correct knowledge of both aerobic and muscular strength.

Research demonstrates that this knowledge is not the only factor that is associated with physical activity behaviour. Physical activity as a behaviour influenced by many factors examples the hobbies, habits of the participants etc.<sup>(14)</sup>. Levels of reported physical activity depends on participants perception, cultural norms, inadequate time, and motivation like social desirability and recall bias in the study participants, use of different measurement tools, methods of data collection online or face to face interview might have led to over or under reporting of activity levels<sup>(15,16)</sup>

### **Strength of the study**

Large sample size of adults, which enhances the generalizability of the results obtained in the study population. Use of a standardized IPAQ-SF to assess the physical activity level, and a questionnaire developed using modified Delphi process

### **Limitations of this study and novel findings of this study**

Use of Google form might have led to high recall and subjective bias due to social desirability and behaviour. Controlling number of men and women were challenging due to online survey and convenience sampling leading to overrepresentation that is 75% of female participants and 94.7% of participants were from Bengaluru urban area hence, findings may therefore not generalizable to entire population However the main findings of the study is that there is no relationship between awareness about the guidelines and physical activity level. Involvement in physical activity is not solely dependent on knowledge of the guidelines. Research highlights that awareness is just one of many factors associated with physical activity behaviour<sup>(17)</sup>

### **Future directions**

The correlation between awareness about guidelines and the physical activity level showed no relationship only 48.87% of the total population answered correctly to the questions regarding the recommended guidelines hence there is need to enhance the communication strategies to improve awareness about the recommended guidelines Future study should systematically evaluate activity level objectively to reduce subjective bias. A detailed analysis of the factors that affect or influence physical activity behavior among adults can be considered to fill gaps in the research findings.

### **Conclusion**

In conclusion, in this study awareness about recommended physical activity guidelines among the study population is low hence there is need to improve communication strategies to raise awareness. The physical activity level showed a no relationship demonstrating that knowledge is not the only factor that is associated with physical activity behaviour and future study should systematically evaluate physical activity level and in detail analysis of the factors that affect or influence the activity level to enhance health benefits.

Research offers valuable insights into the challenges of promoting physical activity. Study emphasizes the necessity of enhancing communication

tactics that successfully encourage behaviour change in addition to increasing awareness.

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**Ethical Clearance/Statement of Ethics:** The study is approved from Institutional research committee, JSS College of physiotherapy dated 19/06/2024 Reference number JSSCPT /IRC/SO- 2023 -2024

**Conflicts of interest:** Authors reports no conflict of interest.

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# Prevalence of Self-Medication Among Medical Students at Science and Technology University, Sana'a Yemen 2024: A Cross-Sectional Study

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## Abstract

**Background:** Self-medication is a common practice in developing countries especially among medical students, due to easy access to medications.

**Aim:** To determine the prevalence of self-medication among medical students and identify the types of medications used, reasons for self-medication, and sources of information.

**Method:** A cross-sectional study was conducted from February 1 to February 15, 2024, involving 319 medical students. A structured questionnaire was distributed, to determine the frequency of self-medication, types of medications used, reasons for self-medication, and sources of information. Data were analyzed using IBM SPSS Statistics Version 20, with descriptive statistics and chi-square tests.

**Results:** About 98% of student responded to the questionnaire ,and 80% of students reported self-medication. The prevalence increased with advancing years of study. The most common reasons for self-medication were easy availability of medications (38%) and quick relief (30%). The primary medications used included analgesics (61%) and antibiotics (47%), with headaches (66%) and flu symptoms (50%) being the most reported indications.

**Conclusion:** Self-medication is prevalent among medical students, particularly in advanced years, raising concerns about the potential misuse of medications.

**Key words:** Abuse, Health, students, use, prevalence, Drug

## Introduction

Self-medication, as defined by the World Health Organization (WHO), is the use of drugs without a

doctor's prescription. The consumer identifies the symptoms and uses a drug that was either prescribed previously to him or to another family member.<sup>(1)</sup> In

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addition, self-medication may involve the usage of non-prescribed substances, through the consumption of food, caffeine, or alcohol.

Self-medication aims to treat minor illnesses before seeking professional assistance.<sup>(2)</sup> Self-medication is time-saving, easy, and helpful in urgency when a doctor is not available.<sup>(3)</sup> Nevertheless, self-medication can result in complications, such as the inappropriate use of antibiotics.<sup>(4)</sup>

In most developing countries including Yemen, many drugs are obtained over the counter (OTC). Self-medication is high among the young population, particularly among students.

Medical students have good information about diseases and their treatment, which increases the prevalence of self-medication among them.<sup>(5)</sup> On the other hand, medical students often have a better understanding of pharmacology and health-related issues, which might influence their decisions regarding self medication.

The practice of self-medication among doctors develops during their training period.<sup>(6)</sup> The medical staff must seek proper medical assistance when they have health issues, yet physicians themselves do not do it. Self-medication among physicians may lead to improper self-treatment.<sup>(7)</sup>

As far as our current understanding, no investigation has been done to study the prevalence of medical students' self-medication in Yemen.

According to previous studies, the prevalence of self-medication among medical students is 70% on average, but it varies from 30-95% depending on the country.<sup>(8)</sup>

Factors that increase the risk of self medication in medical students include the following, possession of home-pharmacy, female gender, older age, lower father's education, high alcohol intake, depression, and low physical activity.<sup>(9)</sup> Other risk factors include marital status and available health insurance.<sup>(10)</sup>

This study aims to determine the prevalence of self-medication among medical students at Science and Technology University, Sana'a Yemen 2024.

## Material and method

An institutional-based cross-sectional study was conducted on medical students of Science and Technology University, Sana'a Yemen from

February 01 to February 15, 2024. Sample size was calculated using open-info program to be 266. To avoid drop-outs, 20% of the estimation sample was added, producing the final sample size of 319.<sup>(11)</sup>

A questionnaire was distributed randomly to students from all study levels according to the percentage of students in each level. Ethical approval was obtained from the institution's ethical committee. Each participant signed a written consent.

The questionnaire was prepared from previous studies. The main variables included were the study year, frequency of self-medication during the last year, reasons for self-medication, types of medications used, and primary information source. The questionnaire was a multiple-choice question.

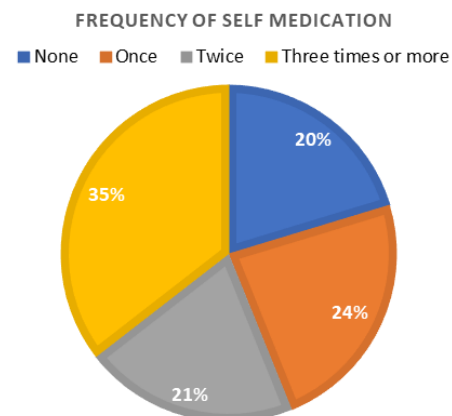
Data were analyzed by IBM SPSS Statistics Version 20 for analysis. Chi-square was used and the confidence interval was 95%.

Results were described using percentage, mean, and standard deviation (SD). Frequency Tables and graphs were used to summarize the findings.

## Results

A total of 314 students responded (98%) to the questionnaire. Three questionnaires were canceled due to incomplete data. About 52% were females and 48% were males

Self-medication is reported in 80% of medical students of Science and Technology University at all levels. (Fig 1)



**Figure 1: Frequency of self-medication among medical students of Science and Technology University**

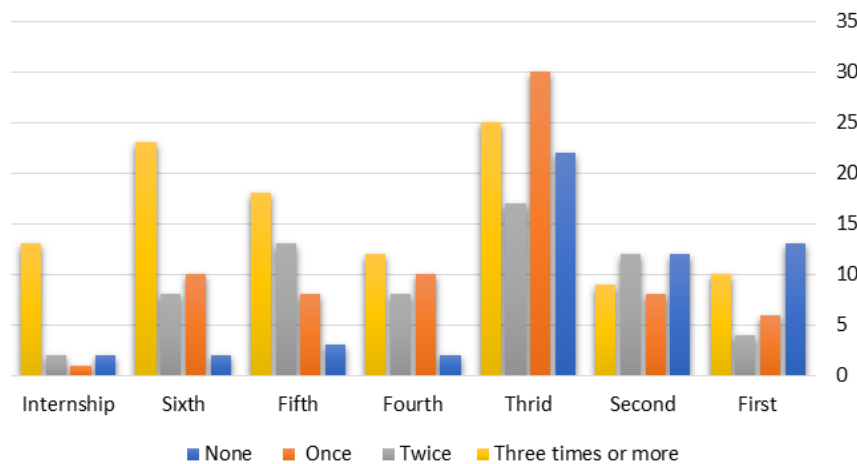
A number of students participated and categorized according to the year of study and the frequency of self-medication during the last year is shown in Table 1, Figure 2. The frequency of self-medication increases in students in the advanced

year of studying ( $p < 0.0001$ ). Students of the first three years reported significantly less frequency of self-medication compared to students in the fourth, fifth, sixth year, and internship students ( $p < 0.0001$ ).

**Table 1: Number of students in each year of study and the frequency of self-medication during the last year**

Year of Study		Self-medication during the last year								
Year of the study	Number of students	%	None	%	Once	%	Twice	%	Three times or more	%
First	33	11	13	37	6	17	4	11	10	29
Second	41	13	12	29	8	20	12	29	9	22
Third	94	32	22	22	30	31	17	17	25	25
Fourth	32	10	2	6	10	31	8	25	12	38
Fifth	42	14	3	7	8	19	13	31	18	43
Sixth	43	14	2	5	10	22	8	18	23	51
Internship	18	6	2	11	1	6	2	11	13	72
Total	311	100	56		73		64		110	

**Frequency of self medication according to the year of study**



**Figure 2: Frequency of self-medication in each year of study**

The indications of self-medication are shown in Table 2, Figure 3. According to the answers of the in the questionnaire, headache was the most common indication of self-medication 78%, followed by flu and common cold symptoms 58%, then cough, stomach pain, and fever 35%, 36%, and 44%, respectively. About 13 -20 % of self-medication was due to diarrhea, constipation, toothache, menstrual symptoms, allergy, or vomiting. A less common cause of self-medication was to treat anxiety, insomnia, eye infection, ear infection, skin infection, colic, and muscle spasm, about 1-9%.

**Table 2: Indications, types, Reasons, and sources of information for self-medication among medical students of Science and Technology University**

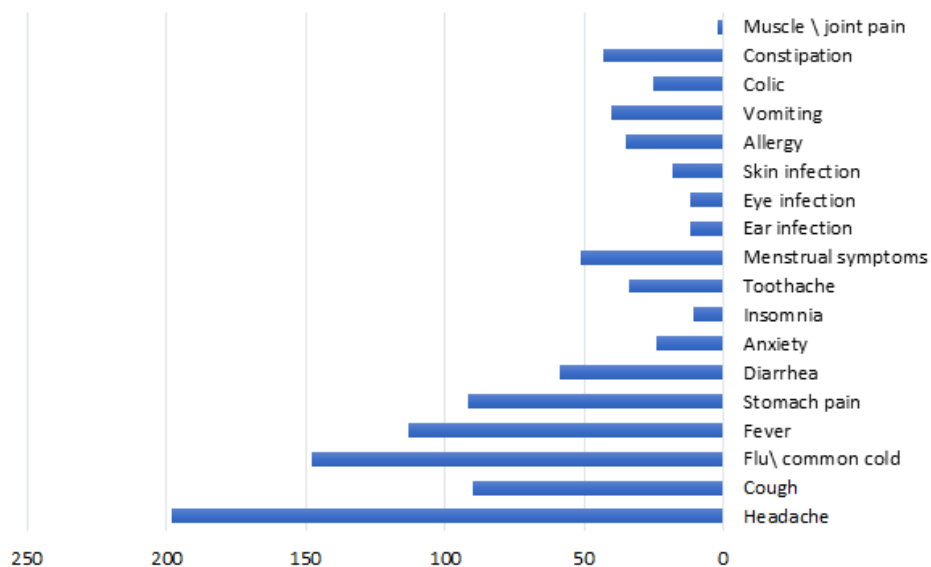
Indication for self-medication	No.	(Frequency /255)
Headache	198	78
Cough	90	35
Flu\ common cold	148	58
Fever	113	44
Stomach pain	92	36

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Diarrhea	59	23
Anxiety	24	9
Insomnia	11	4
Toothache	34	13
Menstrual symptoms	51	20
Ear infection	12	5
Eye infection	12	5
Skin infection	18	7
Allergy	35	14
Vomiting	40	16
Colic	25	10
Constipation	43	17
Muscle \ joint pain	2	1
<b>Type of drugs</b>	<b>No.</b>	
Sedative	56	22
Antacids	70	27
Antibiotics	140	55
Antiemetics	25	10
Antidiarrheal	47	18
Antipyretics	71	28
Analgesics	183	72
Vitamins and minerals	126	49
Cosmetic creams	29	11
Herbs	18	7

Antihistamine	4	2
Laxatives	1	0.4
Antitussive	2	0.8
Muscle relaxant	1	0.4
<b>Reason for self-medication</b>	<b>No.</b>	
Emergency use	72	28
Easily available medicine	109	43
Lack of time to consult the doctor	73	29
Quick relief	85	33
Sufficient pharmacological knowledge	75	29
Minor illness	102	40
<b>Source of information</b>	<b>No.</b>	
Family members and relatives	82	32
Pharmacist	116	45
seniors \ classmates	42	16
Reading materials	103	40
Previous prescription	87	34
Media	32	13

**Indications of self medication**



**Figure 3: Indications of self-medication among medical students as reported from the questionnaire of Science and Technology University**

The types of drugs used in self medication are shown in Table 2 and Figure 4. The most common

drugs used are analgesics followed by vitamins and antibiotics, which are 72, 49 and 55% respectively.

While the used of antipyretics, antidiarrheal, antacid, sedatives and cosmetic creams varies between 11-28%. Less than 10% of students used antiemetics,

herbs, antihistamines, laxatives, anti-tussive and muscle relaxant as self medication drugs.

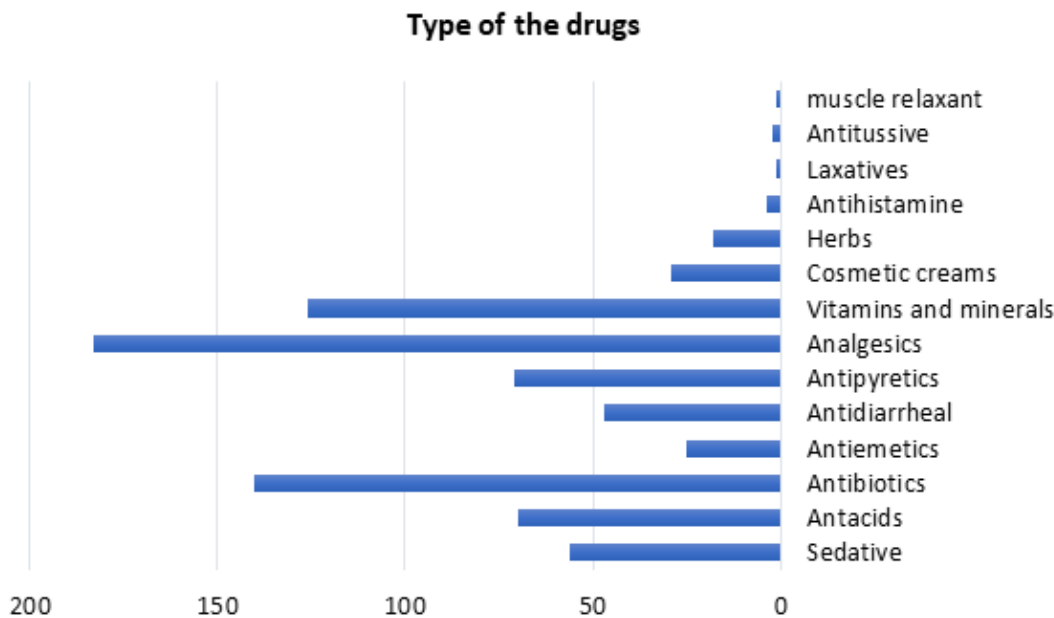


Figure 4: drugs used in self-medication among medical students of Science and Technology University

The reasons for self-medication are shown in Table 2 and Figure 5. The main reason for self-medication was the easy availability of medicine, followed by minor illness and quick relief 43-40-33% respectively). Less common reasons of self medication are lack of time to consult the doctor, sufficient pharmacological knowledge and emergency use about 28-29%.

Most students reported that the main sources of information are the pharmacist (45%), followed by reading materials (40%). Family/relative members (32%) and Previous prescription (34%) are also a source of information, while media (13%) and seniors/classmates (16%) are the least sources of information. (Table 2, Figure 6)

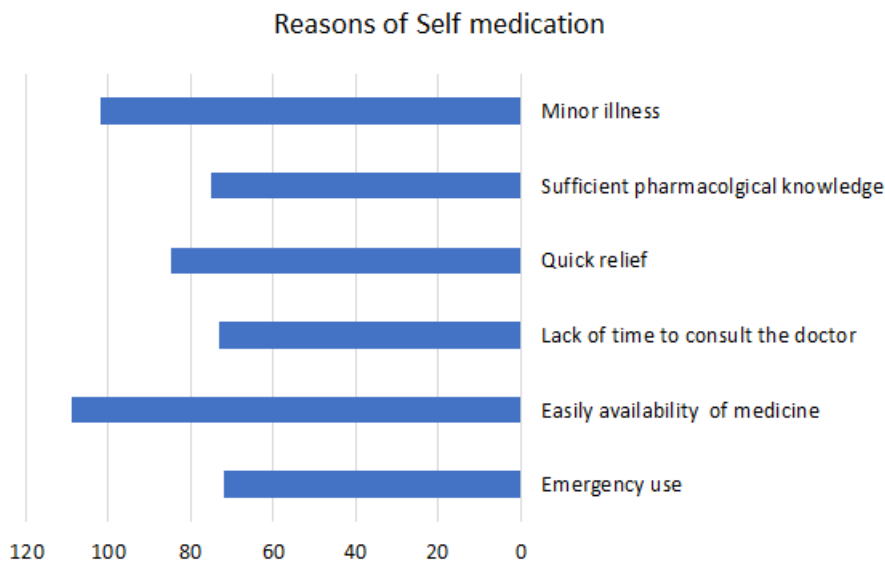
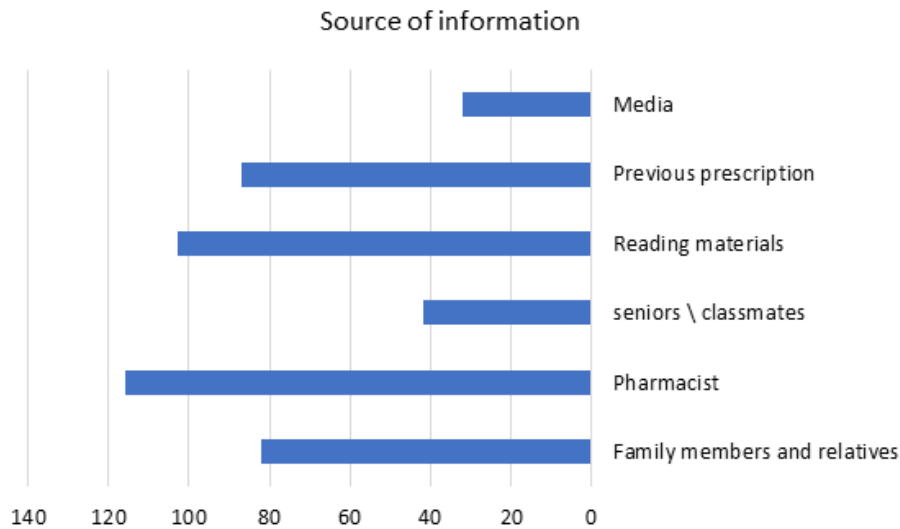


Figure 5: Reasons for self-medication among medical students of Science and Technology University



**Figure 6: source of information for self-medication among medical students of Science and Technology University**

### Discussion

The prevalence of self medication among medical students in science and technology university is similar to the prevalence of self medication in other countries such as India, Iran, Jordan and Siberia.<sup>(6, 9, 12)</sup> However some studies indicated that the rate of self medication higher than 90%.<sup>(13)</sup>

The prevalence of self medication increases with advance study levels students, these result is also shown in other studies.<sup>(6, 14)</sup> This may be due to the increasing knowledge and self-confidence among students in higher levels of education.<sup>(15)</sup>

The main indications of self medication was headache, common cold/ flu and fever. These results were similar to those found in a previous study.<sup>(14B, 16)</sup> This may be because these symptoms are treated with over-the-counter drugs and the students have easy access to the drugs. Other symptoms includes allergy, skin infection, vomiting, eye and ear symptoms, menstrual syndrome and others minor problems, are also reported to be an indication of self medication in medical students.<sup>(12A, 14B, 14C)</sup> Only one student indicated unusual indicators such as muscle spasms.

The drugs most commonly used by students in our study were analgesics followed by vitamins and minerals then antibiotics. Other studies reported that analgesics were the most common drugs.<sup>(16C, 17)</sup>

Antibiotic use in our study was higher than in many studies.<sup>(12A, 16C, 17B)</sup> However, our result was similar to other studies in India and Jordan.<sup>(3, 13A, 18)</sup> In addition, studies have a higher prevalence of antibiotic use.<sup>(19)</sup>

This could be due to the lack of local regulations for antibiotics prescriptions, which may result in, misusing of antibiotics.

The main reasons for self-medication were easy availability of medicine, followed by minor illness and quick relief, these results in parallel to other studies.<sup>(20)</sup>

The pharmacist was the main source of information in our study and other studies.<sup>(12C, 17B, 18, 21)</sup> Other studies stated that the main three sources of information are the pharmacist, reading materials and previous prescription similar to our's.<sup>(6, 22)</sup> The reason for this is the easy availability of the drug procured from the pharmacy, and the accessibility present between the students and the pharmacist. Also the familiarity of the students with the prescription forms, drugs and their doses, medical conditions and their management. This makes buying drugs from local pharmacies more easy.

Our study was based on a questionnaire that measures the prevalence and reasons for self-medication. Further studies must be done to assess the knowledge, attitude, and practice of self-mediation in medical students.

## Conclusion

Self medication is a common practice among medical students in science and technology university, specially in advanced years of the studies. Headache common cold and fever are main indications of self medication among, so they are using analgesics and antibiotics extensively. The student background made it easy for them to get access of the drugs from pharmacies.

## Limitations of the study

The limitation of this study includes self-reporting bias, as participants may have underreported or overreported their self-medication. Additionally, the cross-sectional design limits the ability to establish causal relationships, and the focus on a single university may not adequately represent the broader population of medical students in Yemen.

Future research should consider qualitative methods such as interviews or focus groups to gain deeper insights into students' motivations and attitudes. Comparative studies across different universities and demographic groups would further enrich the understanding of self-medication trends.

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**Conflicts of interest disclosed :** The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

**Ethical board approval :** 1445/008/REC/UST / Science and technology university ethical committee board 14 -Feb -2024.

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# Applicability of PALM-COEIN Classification for Categorization of Abnormal Uterine Bleeding: A Clinico-Confirmatory Comparison in Women from South India

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## Abstract

**Background:** Abnormal uterine bleeding (AUB) is a common gynecological complaint with varied etiologies that require systematic evaluation. PALM-COEIN classification provides a structured approach to diagnose the cause of AUB. Despite its widespread adoption, the correlation between clinical findings and histopathological diagnosis remains unexplored. This study evaluates the applicability of the PALM-COEIN classification and its concordance with histopathological outcomes in women with AUB.

**Methods:** A prospective observational study was carried out among women with AUB attending the gynecology outpatient department at Southern Railway Headquarters Hospital, Chennai from June 2017 to May 2019. All 205 women included in this study were categorized clinically using PALM-COEIN with the help of history, clinical examination and imaging. It was followed by appropriate laboratory testing and histopathological examination to obtain confirmatory diagnosis. The clinical and confirmatory diagnosis were compared using chi-square test.

**Results:** In clinical diagnosis, leiomyoma (38%, n=78) was the most common cause followed by ovulatory dysfunction (27.32%, n=56), but in the confirmatory diagnosis, adenomyosis (46.83%, n=96) contribute to most of the cases as it was underdiagnosed in 55 patients. The test was statistically significant ( $p < 0.05$ ) in the category of adenomyosis ( $p < 0.001$ ) and malignancy & endometrial hyperplasia ( $p = 0.04$ ), as histopathology examination could diagnose more cases.

**Conclusion:** PALM-COEIN classification helps in diagnosing all possible etiologies of AUB in a woman clinically. Consideration of laboratory testing and histopathological examination will establish a more accurate and consistent diagnosis.

**Keywords:**

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## Introduction

Abnormal uterine bleeding (AUB) is a common problem among women of reproductive age group. Prevalence of AUB in India is 17.9%<sup>1</sup>. In India, AUB affects 9 to 14% of menstruating women<sup>2</sup>. "Abnormal uterine bleeding is defined as bleeding from uterine corpus that is abnormal in regularity, volume, frequency or duration and occurs in the absence of pregnancy<sup>3</sup>. Abnormal uterine bleeding may be acute or chronic. Acute AUB is defined as an episode of heavy menstrual bleeding that is of sufficient quantity to require immediate intervention to minimize or prevent further blood loss<sup>3</sup>. Chronic AUB is defined as bleeding from the uterine corpus that is abnormal in duration, volume, frequency, and/or regularity for the preceding 6 months<sup>3</sup>. AUB is associated with significant social and physical morbidities with serious underlying pathology. Impact of abnormal uterine bleeding are iron deficiency anemia, pain and premenstrual symptoms, decreased in work productivity, sickness absenteeism, cost of sanitary pads use, decrease in quality of life and psychological effects of women. In view of its huge disease burden, to standardize the categorization of AUB, the International Federation of Gynecology and Obstetrics have published the PALM-COEIN classification system in 2011 which was subjected to modifications in 2018. The FIGO AUB system 2018 introduced two systems, Definitions and Terminology of the bleeding pattern (FIGO AUB System 1) and the PALM-COEIN classification for causes of AUB (FIGO-AUB System 2). The PALM (Polyp, Adenomyosis, Leiomyoma, Malignancy and Hyperplasia) denotes the structural causes of AUB can be imaged and defined by histopathological examination. The COEIN (Coagulopathy, Ovulatory dysfunction, Endometrial, Iatrogenic, and Not yet classified) are non-structural causes as they cannot be diagnosed by imaging but need a detailed history, clinical examination and sometimes supporting laboratory investigations to diagnose them<sup>4</sup>. Hence, FIGO system 1 helps describe the specific bleeding patterns whereas system 2 helps pinpoint the underlying reasons for those patterns and helps in deciding therapy. Previous studies on the PALM-COEIN classification have primarily emphasized either clinical or histopathological aspects of abnormal uterine bleeding (AUB), with limited literature

directly comparing the diagnostic accuracy of clinical evaluation against histopathological confirmation. This disconnect can lead to misclassification and suboptimal management decisions.

The present study was conducted with the aim to study the bleeding pattern of women presenting with AUB and to categorize them using PALM-COEIN classification. The comparison of structural causes (PALM) with histopathological examination and non-structural causes (COEIN) with appropriate testing and histopathological examination was studied.

## Materials and methods

This is a prospective observational study was conducted in the department of obstetrics and Gynecology of a tertiary care center (Southern Railway Headquarters hospital) in Chennai, from June 2017 to May 2019. All women presented with abnormal uterine bleeding to the gynecology outpatient department who consent for the study were included. The women presented with postmenopausal bleeding, bleeding prior to menarche and pregnancy related bleeding were excluded from the study. The sample size was calculated assuming the expected proportion of any particular PALM-COEIN category as per previous study<sup>5</sup> as 50.23%. The other parameters considered for sample size calculation were 7% absolute precision and 95% confidence level. The required sample size as per the above-mentioned classification was 196 subjects. To account for a non-participation rate of 5% another 10 subjects will be included. Hence a total of 205 subjects will be sampled at the time of recruitment.

Approval was obtained from institutional ethical committee (Reference no: HQ/MD/156/I/EC/2017/02, 26.08.2017) and all participants gave written informed consent. All women included in this study have been asked about previous and current menstrual history, medical history, history of contraceptive use and family history of malignancy followed by clinical examination. Laboratory investigations like thyroid function test and serum prolactin were done (wherever required) to rule out ovulatory dysfunction. As per FIGO guidelines<sup>3</sup>, Patients who were screen positive by history suggestive of coagulopathy (heavy menstrual bleeding since menarche, postpartum bleeding, surgery, or dental

work-related bleeding, two or more of bruising/epistaxis one or two times per month, family history of bleeding symptoms and frequent gum bleeding), coagulation profile was done. Patients with abnormal coagulation profile were further investigated for factor assay or von Willebr and factor in opinion with hematologist. Transabdominal and/or transvaginal ultrasonography was done by radiologist to assess Uterine size, endometrial thickness, presence of polyp, fibroids, adenomyosis and ovarian status. All women with abnormal uterine bleeding >40 years or < 40 years with risk factors for endometrial malignancy were subjected to endometrial aspiration biopsy (office pipelle biopsy) and sent for histopathology examination. Patients with inconclusive endometrial aspiration biopsy or transvaginal sonography suggestive of focal endometrial lesion or technical difficulty in obtaining sample due to obesity, previous surgery were subjected to diagnostic hysteroscopy and directed biopsy as a daycare procedure. Myomectomy/ Hysterectomy (vaginal or laparoscopic or abdominal) done only for indicated individuals and subjected to histopathology analysis to determine malignancy or premalignant lesions and to confirm the diagnosis obtained clinically using PALM-COEIN. Categorization of women was done as per FIGO PALM-COEIN recommendations 2018. All women included in this study, were categorized initially by detailed history, clinical examination and imaging (clinical diagnosis). This was followed by histopathological examination of endometrial sample or hysterectomy specimen wherever indicated to confirm the structural causes (PALM) and non-structural causes (AUB-O, AUB-E) whereas, appropriate laboratory testing like hormone assay, coagulation profile and factor assay were done to confirm AUB-C and AUB-I. Women who cannot be categorized by any of the above methods were categorized as AUB-N. The categorization by history, clinical examination and imaging (clinical diagnosis) was compared with histopathological examination and appropriate laboratory testing (confirmatory diagnosis) (Table 1).

#### Statistical analysis:

Descriptive analysis was carried out by mean and standard deviation for quantitative variables, frequency and proportion for categorical variables.

Non-normally distributed quantitative variables were summarized by median and inter quartile range (IQR). The clinical diagnosis was compared with the confirmatory diagnosis using chi square test with the later as the gold standard. P value < 0.05 was considered statistically significant. IBM SPSS version 22 was used for statistical analysis (IBM SPSS Statistics for Windows, Version 22.0. Armonk, NY: IBM Corp).

### Results

Totally 205 subjects were included in the final analysis. In the study population, the mean age of the patients was 41.64 years (SD= 9.44), the minimum age was 15 years and maximum age was 55 years. Majority of them were aged between 40-49 years (n=119, 58.05%). Most of the patients were multiparous in which 55.61% had a parity of 2 (n=114) and 16.51% had a parity of 3 (n=40). The distribution of acute and chronic AUB was 28.29% (n=58) and 71.71% (n=147) respectively. The most common presenting complaints of the patients was heavy menstrual bleeding (38.05%, n=78) followed by heavy and prolonged menstrual bleeding (16.59%, n=34) (Table 2).

According to the clinical diagnosis, leiomyoma was the most common cause of AUB (38.05%, n=78) followed by ovulatory dysfunction (27.32%, n=56), but in the confirmatory diagnosis, adenomyosis (46.83%,n=96) contribute to most of the cases as it was underdiagnosed in 55 patients. In clinical diagnosis, 23 women had polyp and 78 women had leiomyoma while histopathology examination have found 2 and 4 additional cases with polyp and leiomyoma respectively. None of the patient had suspicion of malignancy in clinical diagnosis but histopathology found 4 women with pre-malignant lesions. Out of 4 patients assigned to AUB-C by clinical diagnosis, only 2 patients were categorized to the same by confirmatory diagnosis, while other 2 had normal coagulation profile and factor assay. The histopathological examination contributes to 3 additional cases of chronic endometritis and were recategorized to AUB-E. There is no much change in ovulatory dysfunction and iatrogenic cases of AUB. Women who cannot be categorized to any of the above category by clinical diagnosis were 9, was

reduced to 5 patients by confirmatory diagnosis. Multiple pathologies contribute to the causes of AUB in a single woman and each cause was categorized separately to compare the accuracy of the clinical diagnosis with confirmatory diagnosis. The test was statistically significant ( $\leq 0.05$ ) in the category

of adenomyosis and malignancy & endometrial hyperplasia, as histopathology examination could diagnose more cases of adenomyosis ( $p < 0.001$ ) and malignancy & endometrial hyperplasia ( $p = 0.04$ ) (Table 3).

**Table 1: Methodology of clinical and confirmatory categorization:**

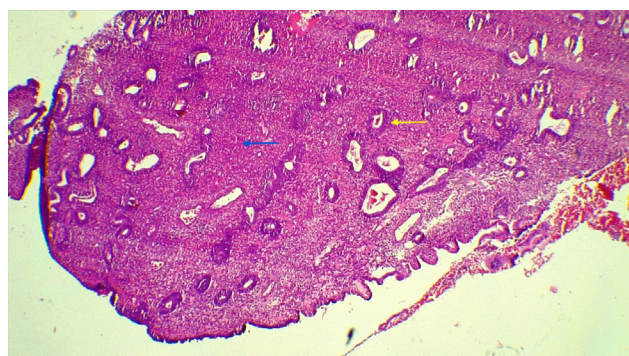
PALM-COEIN	CLINICAL DIAGNOSIS	CONFIRMATORY DIAGNOSIS
AUB-P	History, clinical examination, presence of polyp in transvaginal ultrasonography, diagnostic hysteroscopy	Histopathology examination of endometrial aspiration biopsy or diagnostic hysteroscopy or hysterectomy specimen
AUB-A	Clinical examination, presence of adenomyosis according to transvaginal sonography criteria suggested by the morphological uterus sonographic assessment (MUSA) group <sup>2</sup>	Histopathology examination of hysterectomy specimen
AUB-L	Clinical examination, Transabdominal and transvaginal ultrasonography	Histopathology examination of hysterectomy/ myomectomy specimen
AUB-M	History, clinical examination, presence of risk factors for endometrial carcinoma, transvaginal ultrasonography.	Histopathology study of endometrial aspiration biopsy or diagnostic hysteroscopy with targeted biopsy or hysterectomy specimen suggestive of endometrial carcinoma, leiomyosarcoma, or atypical endometrial hyperplasia
AUB-C	Screening history positive for coagulopathy	Diagnosis of abnormal coagulation profile/ factor deficiency
AUB-O	History, clinical examination, hormone assay, ultrasonography	Hysterectomy specimen/Pre-menstrual endometrial sample showing proliferative endometrium or benign hyperplasia.
AUB-E	Presence of regular menstrual cycle with normal clinical examination and ultrasonographic feature	Hysterectomy/ premenstrual endometrial sample showing secretory phase endometrium or chronic endometritis.
AUB-I	Intrauterine contraceptive device, history of gonadal hormone therapy or anticoagulant	presence of intrauterine device, coagulation abnormality due to anticoagulant drug. Hormone assay disturbances such as hyperprolactinemia due to iatrogenic drugs.
AUB-N	Patients cannot be categorized by above category	Patients who cannot be categorized even after thorough structured history and detailed examination, investigations and histopathological evaluation.

**Table 2: Distribution of symptoms of AUB:**

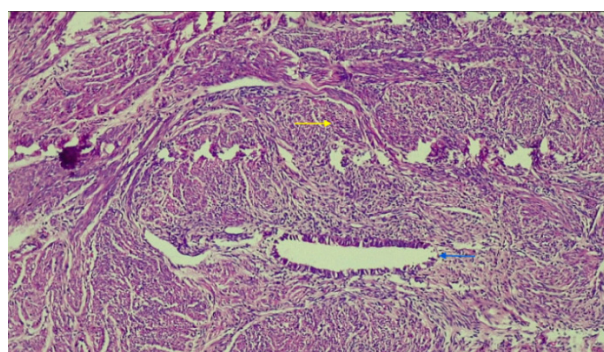
Menstrual History	Frequency(n=205)	Percentages
Heavy menstrual bleeding (HMB)	78	38.05%
Heavy and Prolonged Menstrual bleeding (HPMB)	34	16.59%
Intermenstrual bleeding (IMB)	15	7.32%
Frequent menstrual bleeding	25	12.20%
Infrequent menstrual bleeding	8	3.90%
Irregular bleeding	20	9.76%
Breakthrough bleeding	2	0.98%
Prolonged menstrual bleeding	17	8.29%
Shortened menstrual bleeding	3	1.46%
Amenorrhea	3	1.46%

**Table 3: Comparison of clinical diagnosis and confirmatory diagnosis at different AUB levels (N=205)**

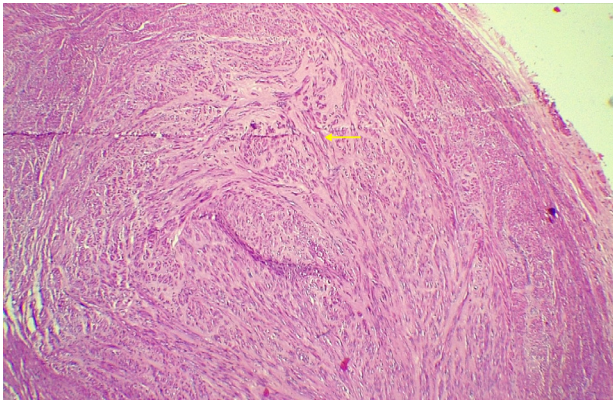
Parameter	Clinical diagnosis	Histopathological Diagnosis	P value
AUB-P	23(11.2%)	25 (12.2%)	0.76
AUB-A	41(20%)	96 (46.8%)	<0.001
AUB-L	78 (38%)	80 (39%)	0.84
AUB-M	0 (0%)	4 (2%)	0.044
AUB-C	4 (2%)	2 (1%)	0.412
AUB-O	56 (27.3%)	55 (26.8%)	0.9124
AUB-E	12 (5.9%)	15 (7.3%)	0.55
AUB-I	13 (6.3%)	13 (6.3%)	1.00
AUB-N	9 (4.4%)	5 (2.4%)	0.275



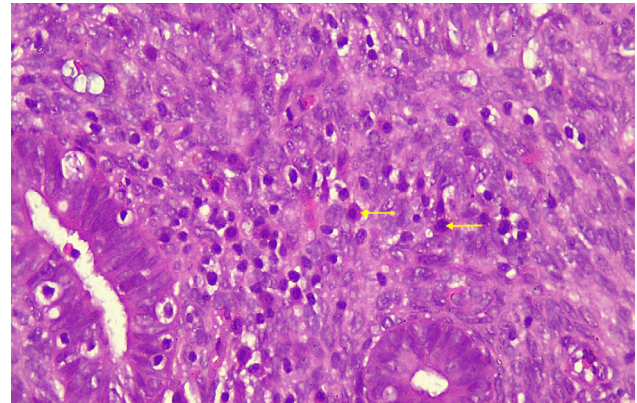
**Figure 1: Localized polypoid projection of the endometrial tissue with dense, fibrous stroma (blue arrow) and glands (yellow arrow) embedded in it suggesting endometrial Polyp.**



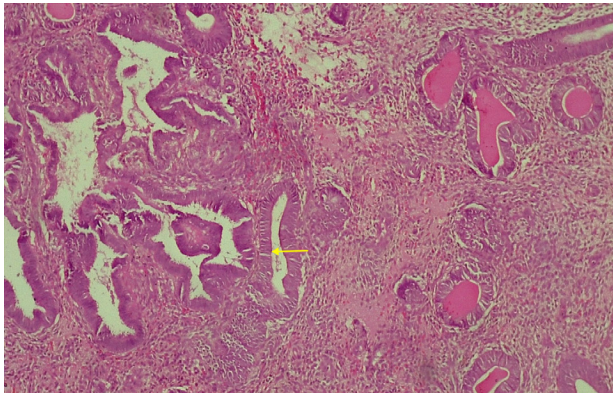
**Figure 2: Glandular structures (blue arrow) embedded within the smooth muscle tissue (yellow arrow) suggesting Adenomyosis.**



**Figure 3: Bundles of elongated, spindle-shaped smooth muscle cells (yellow arrow) arranged in intersecting and whorled pattern consistent with Leiomyoma**



**Figure 6: Presence of plasma cells (yellow arrow) within the endometrial stroma. The endometrial stromal cells showing increased density and spindled reflecting Chronic endometritis.**



**Figure 4: Endometrial glands are densely packed with altered epithelial cytology (yellow arrow) compared to the surrounding normal glandular arrangement revealing glandular crowding reflecting Endometrial Intraepithelial Neoplasia.**



**Figure 5: Proliferation of endometrial glands with reduced intervening stroma (yellow arrow). The glands exhibit irregular shapes, varying sizes and dilated suggesting Benign endometrial hyperplasia.**

### Discussion

The present study found that the PALM-COEIN classification helps in categorizing all causes of AUB methodically without missing any possible etiology. The structural causes contribute to most of the cases of AUB in reproductive age group. The difference in clinical and histopathological diagnosis was statistically significant in case of adenomyosis and endometrial hyperplasia & malignancy. The present study found HMB as the most common abnormal bleeding pattern (78 patients, 38.05%) which was in accordance with other descriptive observational study done in Indian population<sup>6-8</sup>.

Several previous studies have studied the PALM-COEIN classification for categorization of AUB. In a retrospective study, leiomyoma and ovulatory dysfunction were the most common cause<sup>9</sup>. In another descriptive study on perimenopausal women, leiomyoma followed by ovulatory dysfunction and leiomyoma followed by adenomyosis were the most common clinical and histopathological diagnosis respectively<sup>5</sup>. However, these studies were done in a specific age group and analyzed only the accuracy of clinical and histopathological diagnosis. In the present study, women with AUB of reproductive age group were studied and each category of AUB have been compared between clinical and confirmatory diagnosis. In the present study, leiomyoma followed by ovulatory dysfunction and adenomyosis followed by leiomyoma were the most common clinical and confirmatory diagnosis respectively.

In AUB-P(polyp), the difference in clinical and histopathological diagnosis was not statistically significant ( $p$  value = 0.76), as most of the endocervical polyps were diagnosed by clinical examination and endometrial polyp were diagnosed by transvaginal ultrasonography. The histopathological diagnosis was slightly higher than the clinical diagnosis (12.2% vs 11.2%) due to the diagnosis of higher number of endometrial polyps in histopathological examination but not to significant proportion. Similar result was found in other study<sup>5,9</sup>.

In AUB-A(adenomyosis), the difference in clinical and histopathological diagnosis was significant,  $p$  value < 0.001 (20% vs 46.8%), more cases were diagnosed by histopathology than clinical diagnosis. This is due to the fact that signs and symptoms of adenomyosis and leiomyoma are so similar that it is difficult to differentiate them clinically. As the clinical diagnosis of AUB-A needs a minimum requirement of transvaginal ultrasound criteria, the type of ultrasound machine used and expertise of the radiologist will have an effect on the likelihood of missing adenomyosis pre-operatively. MRI would have helped in better radiological diagnosis of adenomyosis but it is expensive and not readily available, so done in only patients who were in need of conservative management like myomectomy. The result is similar to another study, where adenomyosis was missed preoperatively in 37(46.3%) women<sup>10</sup>.

In AUB-L(Leiomyoma), the difference in clinical and histopathological diagnosis was not significant,  $p$  value = 0.84 (38% vs 39%) as most of the leiomyoma causing abnormal uterine bleeding can be easily diagnosed by clinical examination and ultrasonography. So, leiomyoma is more of clinical diagnosis with histopathology plays a complementary role in confirmation of diagnosis.

In AUB-M (malignancy and endometrial hyperplasia) the difference in clinical and histopathological diagnosis was significant,  $p$  value=0.04 (0% vs 2%) and it was in accordance to another study done in Indian population<sup>9</sup>. No women were categorized under AUB-M clinically in this study due to the fact that clinical picture including menstrual history is not specific for AUB-M and endometrial thickness of perimenopausal women is highly variable. Endometrial hyperplasia with

atypia was missed clinically in 4 cases. It emphasized the importance of histopathological examination in ruling out pre-malignant and malignant lesions.

AUB-C, the least common category in this study (2%). The difference in clinical and confirmatory diagnosis was not statistically significant,  $p$  value = 0.412 (2% vs 1%). Most of the cases of AUB-C could be diagnosed by structured history screen positive and laboratory investigation helped in the confirmation. Inclusion of coagulopathy (AUB-C) in categorization of AUB by FIGO is an eye-opener for clinicians as it is often missed in the differential diagnosis of women with HMB. AUB-O, accounted for the most important non-structural causes of AUB in this study. The difference in clinical and histopathological diagnosis was not statistically significant,  $p$  value=0.9124 (27.3 vs 26.8). Majority of women with ovulatory dysfunction were diagnosed with menstrual history of erratic and unpredictable bleeding. Hence, AUB-O is more of clinical diagnosis but histopathological confirmation by endometrial biopsy is essential in perimenopausal age group to rule out pre-malignant and malignant lesions.

In AUB-E, the difference in clinical and histopathological diagnosis was not statistically significant,  $p$  value = 0.55 (5.9% vs 7.3%). In other studies<sup>5,10</sup>, clinical cases were more than histopathological diagnosis compared to present study as these studies follows FIGO 2011 recommendations where chronic endometritis included under category AUB-N. However, in FIGO 2018 recommendation it clearly states that chronic endometritis should be categorized as AUB-E [4]. In AUB-I, there is no change in clinical and confirmatory diagnosis (6.3% vs 6.3%),  $p$  value = 1.0. As most of the anticoagulant drugs and drugs to interfere with ovulation can be diagnosed by history and intrauterine device can be diagnosed by clinical examination and ultrasonography. In AUB-N, the difference in clinical and confirmatory diagnosis was not significant,  $p$  value = 0.275 (4.4% vs 2.4%). However, histopathology helps in the recategorization of some of the AUB-N to another specific category. The present study had limitation of not including subclassification of leiomyoma which would have helped further in the management of patient. The study was done in a tertiary care hospital and further study in low resource setting will reflect the exact applicability of PALM-COEIN classification.

## Conclusion

PALM-COEIN classification helps in diagnosing all possible etiologies of AUB in a woman clinically. However, it should be followed by further investigations like laboratory testing and histopathological examination to rule out pre-malignant lesions & malignancy and to establish a more accurate and consistent diagnosis thereby improve the management and clinical care of the patient.

## Author Contributions

**Arthi Ekambaram** conducted the study, collected and analysed the data, and prepared the initial manuscript draft. **K.S. Rajarajeswari** contributed to framing the manuscript and provided continuous guidance and supervision throughout the study.

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# Epidemiology of Patients Presenting with Posterior Segment Trauma to a Tertiary Care Eye Hospital in Eastern Uttar Pradesh, Following Closed Globe Injury

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## Abstract

**Purpose:** Closed-globe injuries represent a significant form of ocular trauma leading to a varying degree of vision loss. Posterior segment pathologies are critical components of these injuries, and early diagnosis is pivotal in reducing the disease burden. A comprehensive understanding of demography, injury mechanisms, clinical findings, management strategies, and outcomes can enhance prevention and treatment approaches.

**Methods:** A tertiary care hospital-based retrospective study was done analysing electronic medical records of patients with closed-globe injuries who presented between January 2022-January 2023. Variables studied included age, sex, literacy level, mechanism of injury, primary diagnosis, treatment approach, and posterior segment pathologies. Management and outcomes were evaluated based on medical and surgical interventions and visual prognosis.

**Results:** 43 patients were included in the study predominantly consisting of males(84%), with a mean age of 30.5 years, 56% being illiterate. The common modes of these injuries were road traffic accidents (47%), falls (23%), and wood stick injuries (12%). At presentation, 58% of patients exhibited severe visual impairment. Retinal detachment (46%), traumatic optic neuropathy (21%), and vitreous haemorrhage(14%) were common pathologies observed. 77% of treated patients experienced visual improvement after appropriate intervention.

**Conclusion:** This study underscores the epidemiology of closed-globe injuries and their impact on vision. Posterior segment pathologies such as retinal detachment, traumatic optic neuropathy, and vitreous haemorrhage were relatively more common. Early diagnosis and timely intervention are crucial, directly translating to better visual outcomes. Future efforts should focus on preventive strategies and optimizing surgical interventions to enhance visual prognosis.

**key words:** Ocular Trauma, Posterior Segment Injuries, Retinal Detachment, Vitreous Haemorrhage, Traumatic Optic Neuropathy, Blunt Eye Injury

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## Introduction

Ocular trauma, exceptionally closed globe injuries involving the posterior segment, is a significant cause of visual impairment and blindness worldwide. The global annual incidence of ocular trauma is around 55 million, of which 750,000 cases require hospitalization each year.<sup>[1]</sup> In India, the reported incidence of ocular trauma varies from 1% to 5%<sup>[2]</sup>. Posterior segment pathologies occurring after non-penetrating trauma like traumatic lens dislocation, vitreous haemorrhage, berlin's edema, retinal detachment, choroidal tears, traumatic optic neuropathy, and macular hole<sup>[3,4]</sup>.

Traumatic lens dislocation disrupting the zonules post blunt trauma, leads to lens displacement out of the patellar fossa. This can result in altered refraction, secondary cataract formation, or glaucoma due to angle crowding<sup>[5,6]</sup>. Mild cases may only require optical correction, whereas significant displacement may necessitate surgical intervention, such as lens repositioning or intraocular lens implantation<sup>[3,4]</sup>, and pars plana vitrectomy (PPV)<sup>[5]</sup>. Delayed presentation in closed-globe injuries results in complications such as lens-induced glaucoma or corneal decompensation, leading to a worse visual outcome compared to open-globe injuries [10]. Cases of combined pathologies, including giant retinal tears with subretinal crystalline lens dislocation, worsen the visual outcome and necessitate early surgical intervention<sup>[5,9,11,12]</sup>.

Traumatic vitreous haemorrhage results from trauma-induced rupture of retinal or choroidal vessels, leading to blood accumulation in the vitreous cavity<sup>[4,13,14]</sup>. Patients typically report sudden vision loss or floaters. Persistent haemorrhage may require vitrectomy. Visual outcomes vary; if associated retinal damage is absent, the prognosis is good, but if complicated by proliferative vitreoretinopathy, long-term vision loss is observed.<sup>[13,15]</sup>

Traumatic retinal detachment (TRD) is commonly associated with open or closed-globe injuries<sup>[4]</sup>. The impact of trauma causes retinal breaks, giant retinal tears, or vitreoretinal traction, leading to fluid accumulation under the retina and subsequent detachment. TRD is frequently seen in young males due to sports injuries, motor vehicle accidents, or occupational hazards<sup>[13,16-18]</sup>. Severe cases may

present with profound vision loss, especially if the macula is involved with poor visual prognosis. Diagnosis relies on dilated fundoscopic examination, ocular ultrasonography<sup>[19]</sup> in cases of media opacity, and optical coherence tomography (OCT) to assess macular involvement. Management depends on the severity and extent of detachment. Surgical interventions include pars plana vitrectomy (PPV), scleral buckling, and pneumatic retinopexy. PPV<sup>[16,20]</sup> is the preferred treatment for complex TRD cases and internal tamponade with gas or silicone oil. Advances in microincision vitrectomy surgery (MIVS) have improved surgical outcomes.

Choroidal detachment occurs due to trauma-induced accumulation of fluid or blood in the suprachoroidal space, often due to vascular damage or hypotony<sup>[4,21]</sup>. This condition presents with visual field defects and decreased visual acuity. Management ranges from observation to surgical drainage depending on severity. Prompt treatment can fully recover vision, but complications like hypotony maculopathy can lead to poor visual outcomes<sup>[22]</sup>

Berlin's edema, also known as commotio retinae, is caused by blunt ocular trauma, disrupting photoreceptors and retinal pigment epithelium, leading to intracellular swelling and retinal whitening.<sup>[18]</sup> Patients with transient visual blurring show a milky-white retina, with conservative treatment and good visual recovery. But persistent photoreceptor damage has poor prognosis.

Traumatic optic neuropathy (TON) is a severe condition resulting from craniofacial trauma, affecting 1-5% of patients with closed head injuries, causing field defects and vision loss.<sup>[23]</sup> Optic nerve injury (TON) is a condition resulting from trauma, often caused by accidents, falls, or assaults. Patients often experience sudden vision loss, ranging from mild to complete blindness. Diagnosis involves imaging modalities like CT and MRI, as well as electrophysiological tests like VEP. Management strategies include high-dose corticosteroids to reduce inflammation and edema, but their efficacy is debated. Surgical decompression of the optic canal is another approach, but its benefits are uncertain. The visual prognosis varies depending on the severity of the initial vision loss and intervention timing,

with some patients recovering spontaneously while others suffer permanent deficits. Recent research focuses on neuroprotective therapies and optic nerve regeneration, exploring molecular pathways involved in retinal ganglion cell survival [23-25]. Advancements in neuroprotection and regenerative medicine offer hope for better future treatments.

Traumatic macular holes, caused by blunt trauma, result in full-thickness defects in the central retina, impairing central vision.<sup>[26]</sup> Central scotomas or metamorphopsia are common chief complaints, requiring observation for small holes and surgical intervention such as vitrectomy with internal limiting membrane peeling for larger ones. Early repair improves outcomes, but long-standing holes can cause permanent vision loss.<sup>[27-29]</sup>

The Research gap which this study addresses is that a lot of primary care givers only focus on the visible external injuries and provide symptomatic treatment. The posterior segment injuries get missed which leads to severe complications with limited treatment options and results when they are finally detected.

This study examines the epidemiology, clinical characteristics, management, and visual prognosis of posterior segment injuries from blunt trauma, specifically focusing on cases presenting within 3 months of trauma to a tertiary care hospital in north India from January 2022 to January 2023.

## Methods

A retrospective study was conducted utilizing electronic medical records of patients who presented with closed globe injuries sustained within 3 months at a tertiary care center between January 2022 and January 2023. The study adhered to the tenets mentioned in the Declaration of Helsinki. Comprehensive data were extracted from the electronic medical records of hospital including demographic details (age and sex), detailed ocular history (mode of injury, location of trauma, prior interventions if any, and temporal characteristics of the injury), as well as clinical presentation and management outcomes. Documentation included initial visual acuity (presenting vision) post-trauma and final visual acuity at discharge or at the conclusion of follow-up.

Each patient underwent a thorough ophthalmological evaluation. Anterior segment assessment was performed using slit-lamp biomicroscopy. Intraocular pressure (IOP) was measured using rebound or applanation tonometer after ruling out open globe injury or globe rupture. Posterior segment evaluation was carried out using both direct and indirect ophthalmoscopy. Ancillary investigations, including orbital radiography, computed tomography (CT) scans, ultrasonography (B-scan), and other relevant imaging modalities, were employed where clinically appropriate. Visual acuity (VA) measurements were recorded using Snellen's chart or Landolt's E chart, either best-corrected visual acuity (BCVA) or pinhole VA, depending on the patient's cooperation and the feasibility of accurate assessment. As per the medical records the medical interventions were in terms of antibiotics, steroids and other symptomatic management. Surgical interventions included a pars plana vitrectomy in cases of retinal detachment, posterior dislocation of lens and macular hole.

## Inclusion Criteria

Patients included in the study met specific criteria: they were diagnosed with posterior segment injuries resulting from blunt trauma within 3 months, had complete medical records available, and did not have any penetrating, perforating injuries or pre-existing ocular pathology involving the posterior segment.

## Results

### Patient Demographics

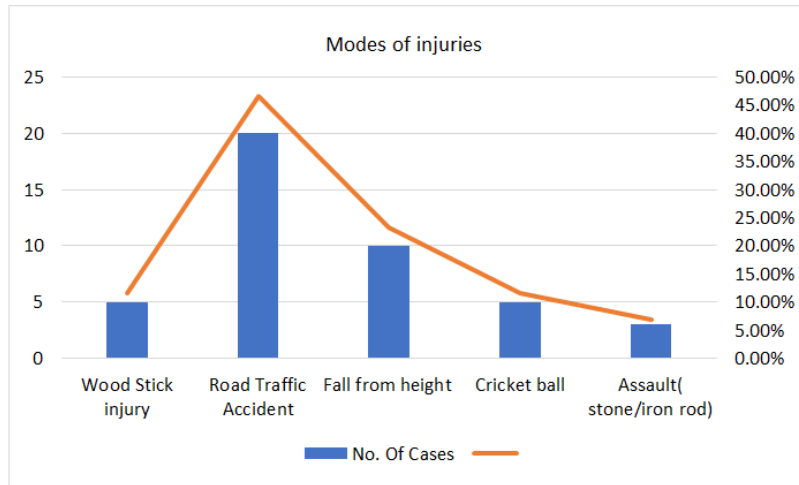
43 patients were analysed, with a mean age of 30.5 years. Predominantly illiterate (56%) men (84%) performing outdoor activities (74%) sustained blunt trauma injuries involving posterior segment.

**Table 1. Age distribution of cases with non-penetrating ocular trauma with posterior segment pathologies**

Age Group	No. of cases	Percentage
0 years - 10 years	1	2.33%
11 years - 20 years	9	20.93%
21 years - 30 years	13	30.23%
31 years - 40 years	12	27.91%
41 years - 50 years	2	4.65%
51 years - 60 years	3	6.98%
61 years - 70 years	3	6.98%
71 years - 80 years	0	0.00%

The Table1 outlines the age distribution of the affected individuals. The 21–30 years age group had the highest number of cases, with 13 individuals (30.23%), followed closely by the 31–40 years group, with 12 cases (27.91%). Together, these two groups account for more than half of the total cases, highlighting a predominance among young to middle-aged adults. The 11–20 years group also had

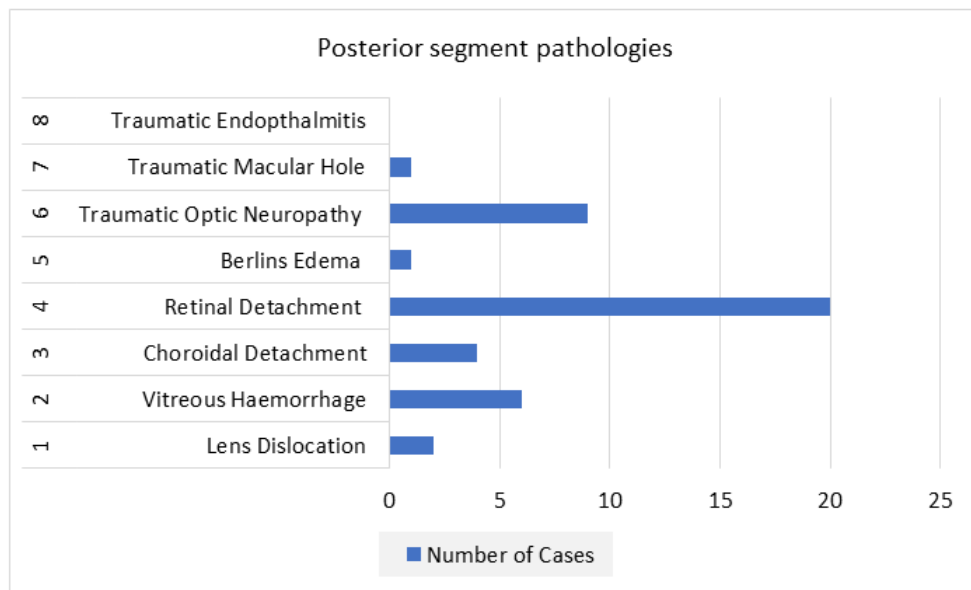
a notable number, with 9 cases (20.93%), indicating that a significant portion of the affected population is under 40. In contrast, older age groups such as 41–50 years (4.65%), 51–60 years (6.98%), and 61–70 years (6.98%) had fewer cases, and no cases were reported in the 71–80 years age group. Only 1 case (2.33%) was observed in the 0–10 years category.



**Graph 1. Clustered bar graph indicating Modes of Injury**

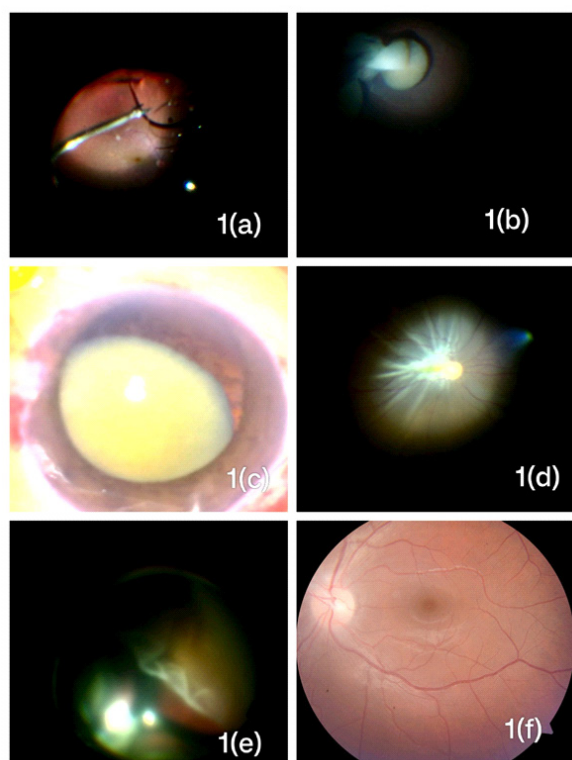
The most common cause of injury was road traffic accidents, accounting for 20 cases (46.51%), making up nearly half of all reported injuries [Graph 1]. Falls from height were the second most frequent mode, with 10 cases (23.26%). Injuries due to wooden sticks and assaults involving stones or iron rods were

equally reported, each contributing 5 cases (11.63%). Lastly, injuries from cricket balls were reported in 3 cases (6.98%). This distribution highlights the predominance of high intensity trauma, such as road traffic incidents, as a leading cause of ocular trauma in the observed group.



**Graph 2. Horizontal bar graph depicting Frequency of Posterior Segment Pathologies**

Posterior segment pathologies observed included retinal detachment, optic nerve injuries, vitreous haemorrhage, choroidal rupture, macular hole, Berlin's edema, lens dislocation [Graph 2]. The most prevalent pathology noted was Retinal Detachment (RD), found in (20)47% of patients followed by Traumatic optic neuropathy (9)21%, vitreous haemorrhage (6) 14%, choroidal tears (3) 9%. Very few cases of lens dislocation (5%), berlins edema(2%) and macular hole(2%) were also seen.[Figure 1]



**Figure 1: various posterior segmented pathologies in patients with closed globe injuries. (a) dropped Intra-ocular lens (b) dropped crystalline lens (c) subluxated crystalline lens (d) retinal detachment (e) retinal detachment and choroidal detachment with vitreous haemorrhage (f) optic neuropathy**

**Table 2. Profile of Retinal Detachment (RD) patients**

Total cases of Retinal Detachment	20	
Exclusive RD	2	10.00%
RD+VH	2	10.00%
RD+ CD	2	10.00%
RD+CD+VH	8	40.00%
RD+CD+TRON	3	15.00%
RD+CD+VH+ LENS DILOCATION	0	0.00%
RD+ BERLIN +CD	3	15.00%

The Table 2 presents the distribution of 20 total cases of retinal detachment (RD), highlighting various combinations of associated ocular conditions. Only 2 cases (10.00%) involved exclusive retinal detachment without any accompanying complications. Several patients had RD with additional findings: 2 cases (10.00%) had vitreous haemorrhage (VH), and another 2 cases (10.00%) had choroidal detachment (CD). The most common presentation, seen in 8 cases (40.00%), involved a combination of RD, CD, and VH, indicating a more complex pathology. 3 cases (15.00%) showed RD with CD and traumatic retinal optic nerve (TRON) damage, while another 3 cases (15.00%) had RD, CD, and Berlin's edema. Notably, there were no cases involving lens dislocation along with RD, CD, and VH.

**Table 3. Visual Acuity at the time of presentation to the hospital**

Visual Acuity at presentation	Number of Cases	Percentage
No Light Perception	1	2.33%
Perception of light	6	13.95%
Hand Movements	3	6.98%
Finger Count Close to Face	3	6.98%
0.5\60-6\60	12	27.91%
6\36->6\60	8	18.60%
6\12->6\36	5	11.63%
6\6->6\12	5	11.63%

The Table 3 presents the distribution of visual acuity among patients at the time of presentation. Out of all the cases, 1 patient (2.33%) had no light perception, indicating complete blindness. 6 patients (13.95%) could only perceive light, while 3 patients each (6.98%) were able to detect hand movements or count fingers close to the face. A significant portion, 12 patients (27.91%), had visual acuity ranging from 0.5/60 to 6/60, and 8 patients (18.60%) had acuity between 6/36 and greater than 6/60. Additionally, 5 patients each (11.63%) had visual acuity in the ranges of 6/12 to 6/36 and 6/6 to 6/12, indicating relatively better vision. Overall, the data shows a wide spectrum of visual impairment among the cases, with the 58% with severe visual impairment range which is visual acuity less than 6/60.

**Table 4. Treatment Taken Before Hospital Visit**

Primary Treatment	Total	Percentage
Local pharmacy	9	20.93%
Home Remedy	1	2.33%
Previous Hospital Visit	2	4.65%
First Visit to Hospital	31	72.09%

Table 4 outlines the primary treatment approaches taken by patients before or during their current medical encounter. The majority, 31 patients (72.09%), were making their first visit to a hospital. 9 patients (20.93%) initially approached a local pharmacy for treatment, while 2 patients (4.65%) had a previous hospital visit elsewhere, suggesting unresolved or ongoing issues. Only 1 patient (2.33%) relied on a home remedy.

**Table 5. Visual outcomes of Managed cases**

Visual Gain Post- medical / surgical management	33	76.74%
No Visual Gain Post Management	10	23.26%

The Table 5 illustrates the visual outcomes following medical or surgical management. Out of the total cases, 33 patients (76.74%) experienced a visual gain, indicating a significant improvement in vision post-treatment. In contrast, 10 patients (23.26%) showed no visual gain after management, suggesting either irreversible damage or limited effectiveness of the treatment in those cases.

## Discussion

Comparative analysis with previous studies highlights important trends and variations in ocular trauma. Kuhn et al. (2006)<sup>[31]</sup>, in their study of blinding trauma using the United States Eye Injury Registry, found that posterior segment involvement significantly increased the risk of blindness. Additionally, Nirmalan et al. (2004)<sup>[32]</sup> in a rural South Indian population highlighted that blunt trauma accounted for 54.9% of cases and was commonly associated with labor-related injuries. The present study seeks to build on these findings by evaluating the current patterns of modes of injuries, clinical presentations, management and visual outcomes.

The demographic characteristics of our study population were consistent with findings from multiple previous studies on ocular trauma. The mean

age of our study cohort was 30.5 years, aligning with the results in the study by Wagh V et al where the mean age was post-ocular trauma 32.3 years<sup>[22]</sup>. Similarly, Kuhn et al<sup>[36]</sup> noted that the highest incidence of eye trauma occurred in young adults, particularly in the working-age population. In contrast, Nirmalan et al. (2004)<sup>[32]</sup> found a slightly older mean age of 40 years in a rural Indian population, likely reflecting the different occupational hazards faced by agricultural workers.

Regarding gender distribution, our study observed a male predominance (84%), which is consistent with global trends. Previous studies<sup>[31,33]</sup> reported that males accounted for over 80% of ocular trauma cases. Similarly, Nirmalan et al. (2004)<sup>[32]</sup> and the Birmingham Eye Trauma Terminology (BETT) study highlighted that men are disproportionately affected due to greater exposure to risk factors such as outdoor activities, occupational hazards, or involvement in high-risk situations like road traffic accidents, which were also shown to be a major cause of injury in earlier data.

Literacy levels also demonstrated notable differences. In our study, 56% of patients were illiterate, a rate significantly higher than that observed in Brinton et al. (1982)<sup>[33]</sup>, where most patients had some level of education probably due to a study conducted in higher literacy region. Kuhn<sup>[31]</sup> and Nirmalan<sup>[32]</sup> similarly identified that lower literacy rates correlated with a higher incidence of ocular trauma. This could be due to decreased awareness of safety precautions, limited access to protective eyewear, and delays in seeking medical treatment. The Aravind Comprehensive Eye Survey<sup>[34]</sup> emphasized that illiterate individuals had a higher likelihood of presenting with advanced-stage ocular injuries, further complicating treatment and prognosis.

Overall, the demographic trends observed in our study closely mirror those reported in previous literature, underscoring the need for targeted preventive strategies, particularly among young, working-age males with lower literacy levels.

A comparison of injury modes reveals significant variations across studies. In our study, road traffic accidents (47%) were the leading cause of injury, followed by falls (23%) and wood stick injuries or

assault by iron rod or stones injuries both accounting for 12% cases. This is consistent with Jawade, Kuhn and Choovuthayakorn<sup>[10,13,31]</sup> who also found RTAs to be a predominant cause of ocular trauma. However, Nirmalan et al.<sup>[38]</sup> reported that agricultural labour injuries were more common in rural Southern India, which was not a significant factor in our dataset. These variations emphasize the importance of regional differences in occupational and environmental risk factors influencing ocular trauma patterns. The American Journal of Ophthalmology and others<sup>[33,35]</sup> also highlighted firearm injuries as a notable contributor, which was not a significant factor in our dataset. These variations emphasize the importance of regional differences in occupational and environmental risk factors influencing ocular trauma patterns.

A comparison of posterior segment pathologies between our study and previous<sup>[10,22,36,37,42]</sup>, reveals several important trends. In our study, Retinal Detachment (RD) was the most common posterior segment pathology (20)47%, followed by Traumatic optic neuropathy (9)21% , vitreous hemorrhage (6) 14%,choroidal tears (3) 9%. Very few cases of lens dislocation(5%) , berlins edema(2%) and macular hole(2%) were also seen. These findings aligned with the findings of Kuhn et al. (2006)and others<sup>[4,10,13,28,37,38]</sup> who focused on the epidemiology of blinding trauma, highlighting that retinal detachment, choroidal rupture, and vitreous hemorrhage were key predictors of visual impairment. This is consistent with our study, where retinal detachment and vitreous hemorrhage were frequently observed, particularly in cases with severe trauma. However, Dagwar et al. (2020)<sup>[13]</sup> reported a highest incidence of traumatic optic neuropathy in cases of blunt ocular trauma in males due to Road traffic accidents, with optic nerve injuries frequently leading to severe visual impairment which is second most prevalent posterior segment pathology observed in our study. The study by Nirmalan et al. (2004)<sup>[34]</sup>, which examined ocular trauma in a rural Indian population, reported a notable prevalence of lens dislocation and traumatic macular holes, both of which were also present in our study but at lower rates (5% and 2%, respectively). This suggests regional and occupational variations in trauma mechanisms, with rural populations potentially exposed to different injury risks.

Frasure et al ,Dadgostar et al. (2008) and others<sup>[19,36,39]</sup> highlighted the role of ultrasonography in diagnosing posterior segment injuries specially vitreous haemorrhage, retinal detachment, and in cases where clinical examination was hindered by corneal opacity or hyphema. This aligns with our findings, where advanced imaging techniques were crucial in identifying complex retinal and choroidal pathologies. Additionally, the Birmingham Eye Trauma Terminology (BETT) reinforced the need for standardized classification in ocular trauma, aiding in better assessment and treatment planning. Our study benefited from the structured classification of posterior segment injuries, allowing for a more detailed comparison of pathology prevalence and treatment outcomes.

Overall, the comparison underscores the consistency of posterior segment pathologies across different studies while highlighting regional and methodological variations. Retinal detachment, traumatic optic neuropathy, and vitreous haemorrhageremain the most common and visually significant injuries, necessitating early diagnosis and intervention to optimize outcomes.

A comparison of visual acuity at presentation between the present study and previous literature highlights notable trends.<sup>[10]</sup> In this study 58% of cases presenting with severe visual impairment (visual acuity worse than 6/60). Kuhn et al.<sup>[31]</sup> reported that 27.1% of eyes had worse than 20/200 vision at final follow-up, aligning with the prevalence of significant vision impairmentpost treatment in this study(23%). Nirmalan et al.<sup>[32]</sup> noted that cases with better initial visual acuity had improved prognoses, a trend observed here, where 12% of patients had near-normal vision at presentation which was better than 6/12. These findings reinforce the correlation between initial acuity and treatment outcomes, emphasizing the importance of early intervention.

A significant number of patients (72%) had not received any prior treatment before presenting to the tertiary care centre, highlighting a delay in medical intervention as also observed in Aravaind eye care survey of south Indian rural population and Nirmalan<sup>[10,34]</sup>. Among those who sought initial care, 21% relied on self-medication from local pharmacies, while 4.65% had a previous hospital

visit elsewhere, suggesting unresolved or ongoing issues. Only 2.33% relied on a home remedy. This trend is concerning as delays in proper medical attention can exacerbate posterior segment injuries, leading to poorer visual outcomes. Many patients initially sought care from unqualified practitioners or quacks, further compounding the issue. Unscientific treatments, such as herbal applications and improper eye bandaging, often resulted in infections, increased intraocular pressure, or delayed diagnosis of retinal detachments. Studies<sup>[9,10,34,35,38]</sup> have shown that prompt referral to specialized ophthalmic centres significantly improves prognosis, whereas delays caused by inappropriate treatment contribute to irreversible vision loss. Raising awareness about the dangers of seeking care from unqualified sources and ensuring better access to emergency eye care services is essential to improving patient outcomes.

Traumatic retinal detachment (TRD) is a vision-threatening complication that may arise following blunt or penetrating ocular trauma. Often accompanied by concurrent injuries like vitreous haemorrhage, macular hole, or choroidal rupture as noted in our study. The procedure typically included induction of posterior vitreous detachment, meticulous removal of cortical vitreous, perfluorocarbon liquid-assisted reattachment of the retina, internal limiting membrane (ILM) peeling, and silicone oil tamponade. The inclusion of an encircling scleral band is considered to support vitreous base traction and prevent re-detachment. Similar strategy was used by Samanta et al.<sup>[28]</sup> in a 21-year-old patient post-blunt trauma Giant retinal tear, reported surgical repair via pars plana vitrectomy (PPV) remains the cornerstone. Supporting this, a pivotal study by Chen et al.<sup>[27]</sup> investigated outcomes in patients with traumatic macular hole-related retinal detachment. The study found that PPV with ILM peeling significantly improved anatomical reattachment rates and visual outcomes. Their results emphasize that ILM peeling facilitates closure of the traumatic macular hole by relieving tangential traction, a key factor in preventing re-detachment. They also highlighted the role of intraocular tamponade agents, particularly long-acting gases or silicone oil, to stabilize the retina during healing. Further supporting the role of PPV

in TRD, Novomiejska et al.<sup>[20]</sup> analysed outcomes in adult patients treated with primary vitrectomy alone. Their findings confirmed that early intervention with PPV provides favourable reattachment rates, especially in cases without extensive proliferative vitreoretinopathy (PVR).

The administration of corticosteroids for the treatment of traumatic optic neuropathy (TON) is primarily guided by limited retrospective studies, data drawn from spinal cord injury investigations, and individual reports. Steroid treatment plans are divided into moderate doses (60–100 mg oral prednisolone), high doses (1 g/day IVMP), and mega doses (30 mg/kg IV loading, continuing at 5.4 mg/kg/h for 24 hours). The NASCIS II trial (1990) demonstrated a slight neurological improvement in patients with spinal cord injuries who were treated with mega doses of steroids started within an 8-hour window. The CRASH trial was stopped prematurely because it found a significantly higher rate of mortality among traumatic brain injury patients given mega doses of steroids. In contrast to most studies, the International Optic Nerve Trauma Study showed that the highest improvement in visual acuity was 57%, followed by corticosteroids at 52% that natural recovery may exceed the benefits of medical intervention. In our study all patients enduring Traumatic optic neuropathy were given pulse therapy of IV Methyl Prednisolone for 5 days and showed significant visual improvement.

Of total patient who presented within 3 months of sustaining non-penetrating blunt trauma and received appropriate treatment, 33 patients (77%) experienced a visual gain, indicating a significant improvement in vision post-treatment. In contrast, 10 patients (23%) showed no visual gain after management, suggesting either irreversible damage or limited effectiveness of the treatment in those cases. Further pressing on the issue of timely and just management of Posterior segment trauma. As also observed in studies such as those by Pieramici et al. (1997)<sup>[40]</sup>, Choovuthayakorn et al. (2020)<sup>[10]</sup> and Blanch et al. (2024)<sup>[24]</sup> have demonstrated that early intervention in cases of posterior segment trauma, particularly in retinal detachment and traumatic optic neuropathy, significantly improves visual prognosis.

Pieramici et al<sup>[15,38,40]</sup> found that surgical intervention within 72 hours of trauma led to improved anatomical success and reduced the incidence of proliferative vitreoretinopathy. Similarly, Blanch et al. reported that patients who received specialized ophthalmic care within the first week of injury had a 40% better chance of retaining functional vision compared to those with delayed referrals. These findings emphasize the importance of structured referral pathways to minimize treatment delays and optimize visual outcomes.

Overall, the data reflects a generally positive outcome, with a substantial majority benefiting from medical or surgical intervention.

The highlight of the paper is that when the posterior segment pathologies occurring due to the closed globe injuries were detected and treated early the results were very favourable, in contrast to when they were detected late due to the lack of awareness among the primary care givers to look for the same. Future public health interventions should focus on increasing awareness regarding eye protection, workplace safety, and the importance of timely medical intervention to mitigate the long-term visual impact of posterior segment trauma.<sup>[10,34]</sup>

### Conclusion

This study underscores the epidemiology of non-penetrating trauma leading to posterior segment pathologies, presenting visual acuities, pre-treatments and importance of timely intervention in closed-globe injuries. The presence of Retinal detachment, Traumatic optic neuropathy, and Vitreous haemorrhage significantly influenced visual prognosis. Comparison with previous studies demonstrates a consistent trend in the epidemiology and outcomes of posterior segment trauma. Future efforts should focus on early detection, preventive strategies, and optimizing surgical interventions to improve visual outcomes in affected patients. Additionally, integrating ultrasonography as a standard diagnostic tool and promoting awareness about early and appropriate treatment options could help mitigate the long-term visual disability associated with these injuries.

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# Prevalence of Depression, Anxiety and Stress among Tuberculosis Patients of Belagavi

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## Abstract

**Objective:** To determine the prevalence of depression, anxiety and stress among tuberculosis patients of Belagavi.

**Methodology:** A cross-sectional study was conducted among tuberculosis patients of Belagavi who were registered in NIKSHAY. Patients who aged between 18-60 were included in the study. Customized BRICS NINR Social determinants of Health, PHQ-9, GAD-7 and PSS scales were used to collect data from the participants.

**Results:** Among the 190 participants the prevalence of depression was found to be 66.8% and the mean±SD of the scores were 5.04±5.393. Prevalence of anxiety was 66.8% and the mean±SD of the scores were 4.26±4.803. Prevalence of stress was 66.3% and the mean±SD of the stress scores were 12.29±9.12.

**Conclusion:** Mental health disorders were highly prevalent among tuberculosis patients. There is a need to provide appropriate interventions to tuberculosis patients to deal with their mental health conditions.

**Key words:** Mental Health, Tuberculosis, TB, Depression, Anxiety, Stress.

## Introduction

The aim of public health is to promote healthy lifestyles, to detect, prevent and respond to diseases. Prevalence of mental health conditions that affect individuals, physical and social well-being makes

it essential to deal with mental health to achieve public health goals. The capacity of each individuals to lead fulfilling life depends on their mental health.<sup>1</sup> Mental disorders, particularly depression, are a major concern to public health and a cause of

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disability around the world.<sup>2</sup> Mental health (MH) is a state of well-being that allows people to deal with life's stresses, realize their skills, hone them, and contribute to society.<sup>3</sup> Patients with mental illnesses have a higher risk of contracting TB because they are more likely to be homeless and live in shelters and group homes. Smoking, inadequate diet, viral diseases and additional metabolic syndrome, which include DM, HIV and Hypertension are among the main risk factors for TB that patients with mental illnesses also carry.<sup>4</sup>

TB is caused by the bacteria *Mycobacterium tuberculosis*.<sup>5</sup> More than two-thirds of the world total cases of TB were from India, Indonesia, China, the Philippines, Pakistan, Nigeria, Bangladesh, and the Democratic Republic of the Congo.<sup>6</sup> As per the Global report on TB 2024, the estimated frequency of other forms of TB in India for 2020 was 199 per 100,000 population.<sup>7</sup> Depression is a common comorbidity of TB, and linked to deprived treatment compliance for a number of illnesses.<sup>8</sup>

Depression is a common MH condition that is present with depressed mood, loss of interest or pleasure, decreased energy, feelings of guilt or low self-worth, disturbed sleep or appetite, and poor concentration.<sup>9</sup> Depression is a common complaint globally, disturbing an estimated 3.8% of the population, including 5.0% of adults and 5.7% of adults over the age of 60 approximately 280 million people are estimated to be living with depression.<sup>11</sup> Depression is of significant public health concern due to its prevalence as well as the associated suffering, dysfunction, morbidity, and economic burden.<sup>12</sup> Approximately half of population diagnosed with depression were seen to have anxiety disorder, according to the Anxiety and Depression Association of America.<sup>13</sup> According to the National Mental health Survey (NMHS) 2015-2016 reported a 6.9% lifetime prevalence and a 3.5% current prevalence of depressive disorders in individuals aged 60 and older. The Global Burden of Disease (GBD) study indicated a prevalence of 65% among the older<sup>24</sup>

Depression as a disorder has always been a focus of interest for researchers in India due to the morbidity.<sup>15</sup> Anxiety is frequently associated with melancholy. Lack of control over a circumstance can cause stress, anxiety, and even depression.<sup>14</sup>

Tuberculosis is not only a medical problem nor a nutritional one but also a psychological one. It holds a great

deal towards Public Health and towards the community. There is a need to assess the mental health of TB patients as it holds a great prominence towards their well-being. It has been observed that mental health disorder such as depression is very prevalent in many chronic diseases. It becomes essential to assess their mental health condition, which affects them psychologically and worsen their condition. Previous studies which were conducted were solely on, depression among TB patients and there is a need to assess stress and anxiety. This present study was conducted to determine the prevalence of depression, anxiety and stress and among tuberculosis patients of Belagavi.

## Materials and Methods

A Cross-sectional study was conducted from May 2022 to March 2023, among the National Tuberculosis Elimination Programme (NTEP) registered tuberculosis patients of Belagavi after ethical approval for the institution ethical committee. Prevalence of depression in TB patients in previous studies was 50.5%.<sup>15</sup> Based on the prevalence sample size was calculated by using formula  $Z^2pq/d^2$  at 95% Confidence Interval, Allowable error 15% and Attrition rate 10% respectively. Sample calculated was 184 participants and was rounded to 190.

Civil hospital of Belagavi was considered as the primary sampling unit. The study recruited patients listed in NIKSHAY (NI=End; Kshay=TB, is the web enabled patient management system for TB control under the NTEP) and those diagnosed with tuberculosis within the past year. Sampling technique used was simple random sampling, with inclusion criteria being the patients who were registered in NTEP, who were of age group 18-60 years. Study was explained to the participants in a vernacular manner. Written informed consent was obtained from each participant.

Data collection was done using the customized BRICS (Brazil, Russia, India, China, and South Africa) NINR (National Institutes of Nursing Research) Social Determinants of Health for Socio-demographic variables has been chosen to address the social, economic, and environmental factors that influence health, BRICS countries can develop more effective and equitable health policies and interventions. Patient Health Questionnaire item 9 (PHQ-9) was used for Depression, Generalized Anxiety Disorder Assessment (GAD-7) was used for Anxiety and Perceived Stress Scale (PSS) was used for Stress.

### Data processing and analysis:

Data collected was entered into MS Excel, and the entered data was coded. Depression, anxiety and stress scores were calculated and categorised. Frequency distribution was done for all the nominal variables. Association of the categorical variables was done by using chi-square test and fishers exact test. Analysis was performed in IBM SPSS software 22.0.

## Results

### Sociodemographic Variables

In age the maximum number of TB patients 117 (61.6%) were in the age group of 20-39 years, followed

by 60 (31.6%). The Male to Female ratio was seen to be 112:78, which accounts higher male than compared to female i.e., 58.9% and 41.1%. Profile of patients by Family type, Family Income and Family history of TB shows that the of majority of the patients 120 (63.2%) were from nuclear family. In family income majority of the patients 79 (41.6%) belong to 5001-10000 income group. In family history of TB majority 165 (86.8%) have no history, while 25 (13.2%) have a family history of TB. Marital status shows that the majority of the participants 144 (75.8%) were married. Education shows that the majority of the participants 54 (28.4%) have studied only till High school (10th), 39 (20.5%) were Illiterates, 27 (14.7%).

**Table 1. Sociodemographic Variables**

Variables	Categories	Frequency	Percent (%)
Age	Teenage (13-19)	4	2.1
	Young Adults (20-39)	117	61.6
	Middle-aged Adults (40-59)	60	31.6
	Old Adults (>69)	9	4.7
Sex	Male	112	58.9
	Female	78	41.1
Domicile	Urban	73	38.4
	Rural	117	61.9
Marital Status	Married	144	75.8
	Un-married	43	22.6
	Divorced	2	1.1
	Widowed	1	0.5
Educational Status	Graduate	26	13.7
	Higher Secondary (12th)	24	12.6
	High School (10th)	54	28.4
	Middle School (7th)	20	10.5
	Primary School	27	14.2
	Illiterate	39	20.5
Family Type	Nuclear	120	63.2
	Joint	62	32.6
	Single Parent	8	4.2
Family Income	<5000	31	16.3
	5001-10000	79	41.6
	10001-15000	33	17.4
	15001-20000	13	6.8
	20001-25000	25	13.2
	>25000	25	13.2
Family History of TB	Present	25	13.2
	Absent	165	86.8

### Depression, Anxiety and Stress

Table no. 2 Prevalence of Depression, Anxiety and Stress shows that Among the total participants 33.2% were not having depression, while the prevalence of Depression was 66.7%. The mean±SD of depression score shows 5.04±5.39 respectively. Accordingly, it was seen that 33.2% were not having anxiety, while

the prevalence of Anxiety was 66.7%. The mean±SD of anxiety score shows 4.26±4.80. And it has been seen that 33.7% were not having stress, while the prevalence of Stress was 66.3%. The mean±SD of stress shows 12.29±9.12 respectively. None of these patients were clinically diagnosed with any mental illness.

**Table 2. Prevalence of Depression, Anxiety and Stress**

Depression Score	Frequency	Percentage	Mean±SD
No Depression	63	33.2	5.04±5.39
Minimal Depression	41	21.6	
Mild Depression	47	24.7	
Moderate Depression	28	14.7	
Moderately Severe Depression	8	4.2	
Severe Depression	3	1.6	
Total	190	100	

Anxiety Score	Frequency	Percentage	Mean±SD
No Anxiety	63	33.2	4.26±4.80
Minimal Anxiety	58	30.5	
Mild Anxiety	47	24.7	
Moderate Anxiety	14	7.4	
Severe Anxiety	8	4.2	
Total	190	100	

Stress Score	Frequency	Percentage	Mean±SD
No Stress	64	33.7	12.29±9.12
Low Stress	3	1.6	
Moderate Stress	121	63.7	
High Stress	2	1.1	
Total	190	100	

### Association of socio-demographic variables with depression

Table no. 3 Association of socio-demographic variables with Depression shows that Family type is also associated with depression showing

significant p-value <0.01, Frequency of smoking is also associated with depression showing significant p-value <0.01 and Smoker category also showed a significant association of 0.03.

**Table 3. Association of socio-demographic variables with depression.**

Variables		Depression category		p value
		Depression n(%)	No Depression(%)	
Age	Teenage (13-19)	1 (0.8%)	3 (4.8%)	0.314 <sup>#</sup>
	Young Adults (20-39)	79 (62.2%)	38 (60.3%)	
	Middle-aged Adults (40-59)	40 (31.5%)	20 (31.7%)	
	Old Adults (>69)	7 (5.5%)	2 (3.2%)	

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Gender	Male	77 (60.6%)	35 (55.6%)	0.503 <sup>\$</sup>
	Female	50 (39.4%)	28 (44.4%)	
Domicile	Urban	49 (38.6%)	24 (38.1%)	0.948 <sup>\$</sup>
	Rural	78 (61.4%)	39 (61.9%)	
Family Type	Nuclear	86 (67.7%)	34 (54%)	<0.01 <sup>##</sup>
	Joint	33 (26%)	29 (46%)	
	Single Parent	8 (6.3%)	0 (0.0%)	
	>25000	18 (14.2%)	7 (11.1%)	
Smoked 100 cigarettes in life	Yes	33 (26%)	9 (14.3%)	0.067 <sup>\$</sup>
	No	94 (74%)	54 (85.7%)	
Frequency of smoking	Everyday	21 (16.5%)	8 (12.7%)	<0.01 <sup>##</sup>
	Some days	18 (14.2%)	0 (0.0%)	
	Not at all	88 (69.3%)	55 (87.3%)	
Smoker Category	Former smoker	21 (16.5%)	5 (7.9%)	0.03 <sup>##</sup>
	Never smoker	84 (66.1%)	53 (84.1%)	
	Smoker, unknown status	22 (17.3%)	5 (7.9%)	
Total		127 (66.7%)	63 (33.3%)	

Statistically significant at <0.05, \$=chi square value, #=fisher exact value, \*= significant.

**Association of socio-demographic variables with Anxiety**

p-value of <0.01, Frequency of smoking shows significant p-value of 0.02, and smoker category showed <0.01 significant p-value.

Table no. 4 Association of socio-demographic variables with Anxiety shows that Family type shows significant

**Table 4: Association of socio-demographic variables with Anxiety**

Variable	Anxiety Category		p-value	
	Anxiety	No Anxiety		
Age	Teenage (13-19)	1 (0.8%)	3 (4.8%)	0.272 <sup>#</sup>
	Young Adults (20-39)	77 (60.6%)	40 (63.5%)	
	Middle-aged Adults (40-59)	42 (33.1%)	18 (28.6%)	
	Old Adults (>69)	7 (5.5%)	2 (3.2%)	
Gender	Male	77 (60.6%)	35 (55.6%)	0.503 <sup>\$</sup>
	Female	50 (39.4%)	28 (44.4%)	
Domicile	Urban	53 (41.7%)	20 (31.7%)	0.183 <sup>\$</sup>
	Rural	74 (58.3%)	43 (68.3%)	
Family Type	Nuclear	86 (67.7%)	34 (54%)	0.005 <sup>##</sup>
	Joint	33 (26%)	29 (46%)	
	Single Parent	8 (6.3%)	0 (0.0%)	
Smoked 100 cigarettes in life	Yes	33 (26%)	9 (14.3%)	0.067 <sup>#</sup>
	No	94 (74%)	54 (85.7%)	
Frequency of smoking	Everyday	23 (18.1%)	6 (9.5%)	0.020 <sup>##</sup>
	Some days	16 (12.6%)	2 (3.2%)	
	Not at all	88 (69.3%)	55 (87.3%)	
Smoker Category	Former smoker	20 (15.7%)	6 (9.5%)	0.009 <sup>##</sup>
	Never smoker	83 (65.4%)	54 (85.7%)	
	Smoker, unknown status	24 (18.9%)	3 (4.8%)	
Total		127 (66.7%)	63 (33.3%)	

Statistically significant at <0.05, \$=chi square value, #=fisher exact value, \*= significant.

### Association of socio-demographic variables with Stress

Table no. 5 Association of socio-demographic variables with Stress shows gender showed a significant p-value of 0.03, Family type showed a

significant p-value of <0.01, Smoked 100 cigarettes in life showed a significant p-value of 0.001, Frequency of smoking shows a significant p-value of 0.01, smoker category showed a significant p-value of <0.01 respectively.

**Table 5: Association of socio-demographic variables with Stress**

Variable		Stress Category		p-value
		Stress	No stress	
Age	Teenage (13-19)	1 (0.8%)	3 (4.7%)	0.383 <sup>#</sup>
	Young Adults (20-39)	78 (61.9%)	39 (60.9%)	
	Middle-aged Adults (40-59)	41 (32.5%)	19 (29.7%)	
	Old Adults (>69)	6 (4.8%)	3 (4.7%)	
Sex	Male	81 (64.3%)	31 (48.4%)	0.036 <sup>\$*</sup>
	Female	45 (35.7%)	33 (51.6%)	
Domicile	Urban	49 (38.9%)	24 (37.5%)	0.852 <sup>\$</sup>
	Rural	77 (61.1%)	40 (62.5%)	
Family Type	Nuclear	88 (69.8%)	32 (50%)	<0.001 <sup>##</sup>
	Joint	30 (23.8%)	32 (50%)	
	Single Parent	8 (6.3%)	0 (0.0%)	
Smoked 100 cigarettes in life	Yes	37 (29.4%)	5 (7.8%)	0.001 <sup>\$*</sup>
	No	89 (70.6%)	59 (92.2%)	
Frequency of smoking	Everyday	25 (19.8%)	4 (6.2%)	0.017 <sup>\$*</sup>
	Some days	14 (11.1%)	4 (6.2%)	
	Not at all	87 (69%)	56 (87.5%)	
Smoker Category	Former smoker	19 (15.1%)	7 (10.9%)	0.003 <sup>\$*</sup>
	Never smoker	82 (65.1%)	55 (85.9%)	
	Smoker, unknown status	25 (19.8%)	2 (3.1%)	
Total		126 (66.3%)	64 (33.7%)	

Statistically significant at <0.05, \$=chi square value, #=fisher exact value, \*= significant.

## Discussion

### Depression

In this present study majority of the participants 24.7% were having mild depression, followed by 21.6% were having minimal depression, 14.7% were moderately depressed, 4.2% were moderately severely depressed and 16% were having severe depression. The prevalence of depression was found to be 66.8% respectively. Associations were seen with type of TB, family type, frequency of smokers, and smoker category. None of these patients were clinically diagnosed with any mental illness.

A similar study was conducted in Srinagar district among 263 participants it has been seen that majority of the participants 34.2% were having moderate depression, followed by 24.7% mild depression, 19% moderately severe depression, 16.3% being severe depression and 5.7% being minimal depression. The prevalence seen in this study about depression was 68% respectively.<sup>16</sup> Another study was conducted by in North India, among 202 participants, where it showed that majority 36.1% were having moderate depression, 25.2% were having mild Depression, 24.3% having no depression/minimal depression, 12.9% having moderately severe depression and 1.5% were having severe depression. The prevalence of

depression in this study was 50.5% respectively.<sup>15</sup> A study was conducted in Ethiopia, where gender, old age was positively associated and level education and perceived social support were negatively associated.<sup>17</sup> A similar study was conducted in Ethiopia where age, gender and comorbidity showed significant association for depression.<sup>18</sup> Study was conducted at Peshawar where the gender was not associated with depression.<sup>19</sup>

### Anxiety

In this study it has been seen that 30.5% were having low anxiety, followed by 24.7% mild anxiety, 7.4% having moderate anxiety, 4.2 having severe anxiety and 33.2% were having no anxiety. And the prevalence of anxiety was 66.8% respectively.

A similar study was conducted in China, where the prevalence of anxiety was 53.29%. Association was seen with self-esteem, drug resistance, perceived TB stigma and duration of TB.<sup>20</sup> Another study was conducted in Srinagar district where it showed that majority 44.5% were having no/mild severity, followed by 29.7% moderate anxiety and 25.9% were having severe anxiety. The prevalence of anxiety was 54%. Anxiety was associated with illiterates.<sup>16</sup> A study was conducted in Nepal where age, single status and side effects were associated with anxiety.<sup>21</sup>

### Stress

In this present study it is seen that majority of the participants 63.7% were having moderate stress, while 1.6% were having low stress, 1.1% were having high stress and 33.7% having no stress. The prevalence of stress obtained in this study was 66.3% respectively.

A study was conducted in Eastern Ethiopia, where it's seen that the prevalence of stress was 63%.<sup>22</sup> Another study was conducted in South-west Ethiopia, shows that majority 54.4% were having high stress, while 45.6% were having low to average stress respectively.<sup>23</sup>

### Conclusion

#### Limitations

This study's cross-sectional design prevents us from establishing a cause-and-effect relationship between TB and mental health disorders. The data,

based on self-reported questionnaires, may be subject to bias and does not constitute a clinical diagnosis. The study was conducted at a single site, limiting the generalizability of the findings. Key variables like type of TB, treatment duration, and medication side effects were not included, which may have influenced the results. Finally, the focus on patients registered within the last year could have introduced selection bias.

### Highlights

This study found a high prevalence of mental health disorders among tuberculosis patients in Belagavi, with 66.8% showing signs of depression and anxiety, and 66.3% exhibiting stress. This highlights a critical need to integrate mental health services into TB treatment plans. The findings also suggest that social and behavioural factors, such as family type and smoking, are associated with these conditions. Addressing the psychological well-being of TB patients is essential for improving their overall health outcomes and treatment compliance.

### Recommendation

It has been observed that the Tuberculosis patients are suffering from depression, anxiety and stress. Further qualitative studies should be conducted to gain insight of their conditions in detail.

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# Beyond Hospitals: NCD Knowledge, Attitudes and Practices for Healthier Futures Among Rural Population of Central Gujarat: A Block Level Observational Study

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## Abstract

**Background:** India is undergoing a rapid epidemiological transition, with a rising burden of Non-Communicable Diseases (NCDs) posing a significant public health challenge. Despite national control programs, a critical gap remains in understanding community-level knowledge, attitudes, and practices (KAP) that influence the uptake of primary prevention services. This study aimed to conduct a comprehensive KAP assessment for a broad range of NCDs in a rural population in Anand District, Gujarat, to inform the design of context-specific health interventions.

**Methods:** A community-based, cross-sectional study was conducted between June and September 2024 across 44 villages in Anand, Gujarat. A multi-stage sampling design with a random walk method was used to select 656 adults. Data on socio demographics, NCD knowledge, attitudes and preventive practices were collected using a pre-tested, structured questionnaire. The primary outcome, a composite knowledge score, was analyzed using descriptive statistics and Pearson's Chi-square test was used to assess associations.

**Results:** NCD knowledge in the community was exceptionally low, with 93.1% of participants having 'Poor' knowledge. While awareness of behavioral risk factors was high, knowledge of specific diseases was lacking; 75.8% had never heard of cervical cancer. A striking contradiction was observed in attitudes, where 88.6% of participants disagreed that screening for cervical cancer is important. Screening practices were correspondingly poor, with 80.3% unable to recall ever having a cervical cancer screening. Lower knowledge levels were significantly associated with younger age, lower education ( $p < 0.001$ ), and non-professional occupations.

**Conclusion:** This study uncovers profound and specific failures in NCD-related knowledge and attitudes, particularly a widespread, negative stance against cervical cancer screening. The findings indicate that current public health strategies are insufficient to counter potent misinformation. There is an urgent need to move beyond generic awareness campaigns and develop targeted, culturally-tailored educational interventions that address these specific knowledge gaps.

**Key words:** Knowledge, Attitudes, Practice; Non-Communicable Diseases; Cervical Cancer Screening; Health Literacy; Rural Health; India.

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## Introduction

India is experiencing a significant epidemiological transition, characterized by a shift from communicable diseases to a rising prevalence of Non-Communicable Diseases (NCDs), occurring alongside rapid urbanization and economic development.<sup>[1]</sup> This transition is associated with profound lifestyle modifications, including increased consumption of processed foods, increased tobacco use, and reduced physical activity. Consequently, NCDs such as cardiovascular disease, diabetes, and stroke have emerged as primary public health challenges nationwide.<sup>[2]</sup> Contrary to the historical perception of NCDs predominantly affecting affluent nations, these conditions now impose a substantial burden on developing countries, presenting a dual threat to both population health and socioeconomic progress.<sup>[3]</sup>

The escalating NCD burden in India is particularly concerning due to its increasing impact on younger demographics, contributing to premature mortality. In 2005, NCDs accounted for 53% of all deaths and 44% of disability-adjusted life-years (DALYs) lost nationally. Projections estimate that NCDs could be responsible for up to 67% of all deaths in India by 2030, underscoring the urgent need for effective prevention and control strategies.<sup>[4]</sup>

Implementing national NCD programs, such as the National Program for Prevention and Control of Cancer, Diabetes, CVD and Stroke (NP-NCD)<sup>[5]</sup>, faces considerable challenges in resource-constrained settings like India. Recognizing this, Krishnan et al.<sup>[6]</sup> highlighted the need for implementation research focusing on social, cultural, and behavioral determinants influencing the uptake of NCD control services. While a community-based program operational since 2016 has made strides in improving treatment adherence for diagnosed individuals, this post-diagnosis approach does not address the crucial risk factors driving the NCD epidemic. <sup>[7]</sup> A critical gap remains in understanding the community's foundational knowledge, attitudes and practices regarding primary prevention and early detection, which are essential for curbing the incidence of new cases and reducing long-term healthcare costs.

Anand district's economy, heavily shaped by its renowned dairy cooperatives, may foster unique

dietary patterns and lifestyle factors in rural settings. Understanding the prevailing KAP in this specific socio-economic context is therefore vital for tailoring effective NCD prevention strategies. This study is among the first to conduct a comprehensive KAP assessment for a broad range of NCDs in this specific rural population after the rollout of national and local NCD programs. The findings are expected to identify potential knowledge gaps that influence the attitude and practices towards NCD care, thereby informing the design of more effective, context-specific interventions for rural populations, particularly women, in India and other low- and middle-income countries (LMICs).

## Methods

### Study Setting:

A community-based, cross-sectional study was conducted between June and September 2024. The study was conducted in the Anand Taluka (block) of Anand District, Gujarat, India. According to the 2011 Census of India, the taluka comprises 44 villages with a rural population of 345,478, which constitutes 56.7% of the taluka's total population.<sup>[8]</sup> The region is characterized by a predominantly agrarian economy.

### Data Collection Methods

This study utilized primary data collected between December 24 to February 2025. The Institutional Ethics Committee (IEC) of Bhaikaka University [IEC/BU/2025/EX./318/05/2025] granted ethical approval before data collection began. The data was collected through a structured questionnaire used previously <sup>[9]</sup> however certain dialects and grammatical changes were made to fit in the study context to ensure cultural and linguistic appropriateness in the present study setting. Written informed consent was obtained from all participants after explaining the study objectives and ensuring confidentiality. The questionnaire was pre-tested on a small sample of 20 individuals in a non-study village to check for clarity and flow and final adjustments were made accordingly. The instrument collected information across five domains: (i) sociodemographic characteristics (age, gender, education, occupation, etc.); (ii) knowledge of NCDs (hypertension, diabetes, stroke, heart attack)

and their primary behavioral risk factors (tobacco, alcohol); (iii) specific knowledge of breast and cervical cancer, including symptoms and screening methods; (iv) attitudes towards NCD prevention and the importance of screening; and (v) self-reported practices regarding cancer screening in the past three years. Access to the completed questionnaires was restricted to the Principal Investigator (PI) and Research team.

### Sample size & Sampling Strategy

The sample size was estimated for an infinite population by using the formula  $4pq/d^2$  where the percentage scores of knowledge, attitude and practices of NCDs in rural settings was 60%.<sup>[11]</sup> The required precision of the estimate (d) was set at 4%. Using the above-mentioned formula, the sample size was estimated to be 600. After adding the non-response error of 10%, an additional 60 subjects were included. Thus, a minimum of 660 subjects were supposed to be selected for executing this study.

As per district data available on public domain<sup>[10]</sup>, a list of 44 villages are enlisted in Anand Block (Taluka), Anand District. A multi-stage sampling design was implemented. First the 44 villages within Anand Block were to ensure comprehensive geographic coverage of the taluka. Later a fixed quota of 15 individuals was sampled from each of the 44 villages. The selection of households within each village was conducted using a random walk method- a technique commonly used in community surveys. From a central, easily identifiable point in the village (e.g., the village square or temple), a random direction was chosen by spinning a pen. The first household was selected using a simple lottery method from among the first few houses along that path. Subsequently, every third household was approached systematically until the village-level sample size of 15 respondents was met. In each selected household, one eligible adult who consented to participate was interviewed. If a selected household was found to be locked, or if no eligible member was available or willing to participate after two visits, the next immediate household was approached as a replacement. This systematic process resulted in a final sample of 656 participants.

### Statistical Analysis

Statistical analysis was performed using Stata19. Descriptive statistics, including frequencies and percentages, were calculated to summarize all sociodemographic, knowledge, attitude, and practice variables. To assess for associations between categorical sociodemographic variables and the categorized NCD knowledge level, Pearson's Chi-square test was employed. A p-value of less than 0.05 was considered statistically significant for all tests.

The primary outcome variable was the level of NCD knowledge. A composite knowledge score was constructed based on 29 key knowledge-based questions related to risk factors, disease symptoms, and prevention. Each correct answer was assigned one point, while incorrect or "Don't know" answers were assigned zero points, yielding a total possible score ranging from 0 to 29. Based on a modified Bloom's cut-off methodology, this continuous score was categorized into three distinct levels: Poor (0-16 points, corresponding to <60% correct), Average (17-22 points, 60-79% correct), and Good (23-29 points, 80-100% correct). Independent variables included sociodemographic factors such as age, gender, education level, and occupation.

### Results

A total of 656 participants from 44 villages satisfactorily completed the survey. The sociodemographic characteristics of the study sample are detailed in Table 1. The sample was composed of slightly more males (361, 55.0%) than females (295, 45.0%). The largest proportion of participants fell into the 45-60 year age group (240, 36.6%), followed by the 30-45 year group (227, 34.6%). Educational attainment was modest; approximately one-third of participants (228, 34.7%) had received only primary education (up to 8th standard), and 85 (12.9%) were illiterate. Homemakers constituted the largest occupational group (232, 35.6%), followed by those in professional jobs (140, 21.3%). Nearly half of the participants (47.3%) resided in kutchra or semi-pacca housing.

**Table 1: Sociodemographic Characteristics of Study Participants (n=656)**

Characteristic	Category	Frequency (%)
Age (years)	<30	76 (11.6)
	30-45	227 (34.6)
	45-60	240 (36.6)
	>60	113 (17.2)
Gender	Male	361 (55.0)
	Female	295 (45.0)
Age at Marriage (years)	<18	198 (30.2)
	>=18	331 (50.5)
	Don't know / Not applicable	127 (19.4)
Current Type of Residence	Kaccha house	75 (11.4)
	Semi-pacca house	235 (35.8)
	Pacca house	346 (52.7)
Education	Illiterate	85 (12.9)
	Primary education (1-8 std)	228 (34.7)
	Secondary/ Higher secondary (9-12 std)	244 (37.2)
	Graduate and above	99 (15.1)
Occupation	Agriculture	89 (13.6)
	Homemaker	232 (35.4)
	Labourer	97 (14.8)
	Business	57 (8.7)
	Retired	41 (6.3)
	Professional job	140 (21.3)

### Knowledge of NCDs and Associated Risk Factors

Overall NCD knowledge within the community was exceptionally low. Based on the composite knowledge score, an overwhelming majority of participants (611, 93.1%) were classified as having 'Poor' knowledge, with only 43 (6.6%) demonstrating 'Average' knowledge and a mere 2 (0.3%) exhibiting 'Good' knowledge.

As shown in Table 2, general awareness of behavioral risk factors was higher than knowledge

of specific diseases and their complications. The vast majority of participants recognized that chewing tobacco (88.6%), drinking alcohol (88.3%), and smoking (83.2%) were detrimental to health. However, knowledge of the specific diseases caused by smoking was limited; while 66.4% correctly identified cancer as a consequence, very few mentioned heart attack (14.1%) or stroke (5.8%).

Awareness of hypertension (BP) and diabetes was nearly universal, with 96.7% and 98.5% of participants, respectively, having heard of these conditions. Despite this high name recognition, deeper understanding was lacking. For instance, while 90.3% agreed that regular BP monitoring is important, there was confusion about the recommended frequency, and a substantial portion (32.3%) believed regular checks were unnecessary. Similarly, awareness of stroke was significantly lower (57.8%) compared to heart attack (96.9%).

**Table 2: Participant Knowledge Regarding NCD Risk Factors, Symptoms, and Screening (n=656)**

Knowledge Domain	Response	Frequency (%)
<b>Risk Factors</b>		
Can smoking affect health?	Yes	546 (83.2)
	No / Don't know	110 (16.8)
Can tobacco chewing affect health?	Yes	581 (88.6)
	No / Don't know	75 (11.4)
Can alcohol affect health?	Yes	579 (88.3)
	No / Don't know	77 (11.7)
<b>Hypertension, Diabetes and Others</b>		
Heard about Blood Pressure (BP)?	Yes	634 (96.7)
Heard about Heart Attack?	Yes	636 (96.9)
Heard about Stroke?	Yes	379 (57.8)
Heard about Diabetes?	Yes	646 (98.5)

Continue.....

<b>Breast Cancer</b>		
Heard about Breast Cancer?	Yes	323 (49.2)
	No	333 (50.8)
Aware of any signs of breast cancer?	Yes (any sign)	180 (27.4)
	No / Don't know	476 (72.6)
<b>Cervical Cancer</b>		
Heard about Cervical Cancer?	Yes	159 (24.2)
	No	497 (75.8)
Aware of any signs of cervical cancer?	Yes (any sign)	110 (16.8)
	No / Don't know	546 (83.2)

### Knowledge of Common Cancers

Knowledge regarding common cancers was alarmingly deficient (Table 2). A slight majority of respondents (333, 50.8%) reported that they had never heard of breast cancer. This lack of awareness was corroborated by the finding that 476 participants (72.6%) were unable to name a single sign or symptom of the disease. The knowledge gap was even more pronounced for cervical cancer. Approximately three-quarters of the participants (497, 75.8%) had never heard of cervical cancer, and an overwhelming 546 (83.2%) were unaware of any of its signs or symptoms.

### Attitudes Towards NCD Prevention and Screening

Participant attitudes, summarized in Table 3, revealed significant uncertainty and several deeply concerning contradictions. There was considerable ambivalence regarding the preventability of heart attacks, with 42.2% of respondents being unsure. A similar pattern was observed for the link between hypertension and stroke; a majority (339, 51.7%) were uncertain whether individuals with high blood pressure were more likely to suffer a stroke.

The most paradoxical findings emerged in attitudes towards cancer screening. While a majority (368, 56.1%) agreed that screening was important for the early detection of breast cancer, a striking 581 participants (88.6%) explicitly *disagreed* that

screening interventions are important for the early detection of cervical cancer. This indicates not just a lack of knowledge, but a strongly held negative belief regarding the utility of cervical cancer screening.

**Table 3: Participant Attitudes Towards NCD Prevention and Screening (n=656)**

Attitude Domain	Response	Frequency (%)
Can a heart attack be prevented?	Agree	231 (35.2)
	Disagree	148 (22.6)
	Unsure	277 (42.2)
People with high BP are more likely to have a stroke?	Agree	118 (18.0)
	Disagree	199 (30.3)
	Unsure	339 (51.7)
Screening is important to detect breast cancer early?	Agree	368 (56.1)
	Disagree	6 (0.9)
	Unsure	282 (43.0)
Screening is important to detect cervical cancer early?	Agree	75 (11.4)
	Disagree	581 (88.6)
	Unsure	0 (0.0)

Self-reported practices related to cancer screening were consistent with the observed gaps in knowledge and attitudes (Table 4). A vast majority of participants (455, 69.4%) reported never having undergone any form of breast cancer screening. For cervical cancer, the lack of awareness was reflected in the responses, with 527 participants (80.3%) stating they could not remember if they had ever been screened, a likely proxy for never having been screened or not understanding what the screening entails. Only 23 participants (3.5%) affirmatively reported having undergone cervical cancer screening.

**Table 4: Self-Reported Preventive Health Practices for Cancer Screening (n=656)**

Practice Domain	Response	Frequency (%)
Ever had breast cancer screening in the past?	Yes	79 (12.0)
	No	455 (69.4)
	Do not remember	122 (18.6)
Ever had cervical cancer screening in the past?	Yes	23 (3.5)
	No	106 (16.2)
	Do not remember	527 (80.3)

### Factors Associated with NCD Knowledge

The association between key sociodemographic characteristics and the categorized NCD knowledge level was examined using Pearson's Chi-square test (Table 5). A statistically significant association was found between knowledge level and participants' age ( $\chi^2=23.7$ ,  $p<0.05$ ), education level ( $\chi^2=55.4$ ,  $p<0.05$ ),

and occupation ( $\chi^2=40.1$ ,  $p<0.05$ ). Specifically, older participants, those with higher levels of education, and those employed in professional jobs were more likely to have 'Average' or 'Good' knowledge scores. In contrast, there was no statistically significant association observed between gender and NCD knowledge level ( $\chi^2=0.19$ ).

**Table 5: Association Between Sociodemographic Characteristics and NCD Knowledge Level (n=656)**

Characteristic	Poor Knowledge (<60%), n (%)	Average/Good Knowledge ( $\geq 60\%$ ), n (%)	Total	p-value*
Overall	611 (93.1)	45 (6.9)	656 (100)	
<b>Age (years)</b>				<b>0.0002</b>
<30	75 (98.7)	1 (1.3)	76 (100)	
30-45	218 (96.0)	9 (4.0)	227 (100)	
45-60	216 (90.0)	24 (10.0)	240 (100)	
>60	102 (90.3)	11 (9.7)	113 (100)	
<b>Gender</b>				<b>0.905</b>
Male	336 (93.1)	25 (6.9)	361 (100)	
Female	275 (93.2)	20 (6.8)	295 (100)	
<b>Education</b>				<b>&lt;0.001</b>
Illiterate	84 (98.8)	1 (1.2)	85 (100)	
Primary	220 (96.5)	8 (3.5)	228 (100)	
Secondary/Higher secondary	220 (90.2)	24 (9.8)	244 (100)	
Graduate and above	87 (87.9)	12 (12.1)	99 (100)	
<b>Occupation</b>				<b>0.0001</b>
Agriculture	88 (98.9)	1 (1.1)	89 (100)	
Homemaker	224 (96.6)	8 (3.4)	232 (100)	
Labourer	94 (96.9)	3 (3.1)	97 (100)	
Business	53 (93.0)	4 (7.0)	57 (100)	
Retired	34 (82.9)	7 (17.1)	41 (100)	
Professional job	118 (84.3)	22 (15.7)	140 (100)	

\*p-value from Pearson's Chi-square test. 'Average' and 'Good' categories were combined due to small cell counts in the 'Good' category.

### Discussion

This community-based study in rural Gujarat reveals profound deficits in knowledge, ambivalent and often contradictory attitudes, and poor preventive practices regarding NCDs. Four principal findings emerge with significant public health implications. First, there is an overarching low level of comprehensive NCD knowledge, with over 93% of the population scoring poorly, despite high surface-level awareness of common conditions

like diabetes and hypertension. Second, the study reveals a critical and dangerous lack of awareness regarding the symptoms of and screening for breast and cervical cancer. Third, a conflicting and deeply concerning negative attitude towards the efficacy of cervical cancer screening is prevalent. Finally, lower knowledge is significantly associated with younger age, lower educational attainment, and non-professional occupations, identifying key demographics for targeted interventions.

The finding of low overall NCD knowledge is consistent with, and reinforces, low awareness of NCD risk factors and the importance of early detection among women conducted across rural Rajasthan. [9] Our study adds to this body of evidence by quantifying this knowledge gap in a heterogeneous population. Nearly all participants were aware of "BP" and "diabetes", however adjacent with the low awareness of stroke (58%) suggested that existing awareness sessions have been successful in getting the fact that public health messaging has succeeded in familiarizing the community to chronic risk factors but has failed to convey the critical link between these factors and acute, life-threatening events.

A striking finding of this study is the abysmal level of knowledge and the actively hostile attitude towards screening for female cancers. That three-fourth of a general population sample had never heard of cervical cancer, and that nearly 90% believe screening for it is unimportant, represents a critical area of public health intervention. This possibly suggests the presence of false information, fear, stigma, or mistrust in the health system's ability to manage these cancers. Our findings corroborate with a study where women report shame and structural barriers as deterrents to seeking care for female health problems.[9] We could hypothesise that for cancer, the primary barrier may not be access alone, but a fundamental rejection of the notion of early detection within the community.

We suggest the following: our health education systems must be radically redesigned. This includes explicitly linking chronic conditions to their acute outcomes (e.g., creating visual aids showing how uncontrolled hypertension leads to stroke) and, most critically, launching aggressive campaigns to counter the specific misinformation surrounding cervical cancer and its screening. This may involve leveraging trusted local figures, creating women's support groups, and using narrative-based education to demystify the screening process and emphasize its life-saving potential.[12]

There is ample evidence which highlight the systemic barriers that plague rural healthcare in India: poor geographical accessibility, chronic workforce shortages, inadequate training of health workers, and a lack of essential equipment and diagnostic facilities.

[13] Our findings strongly recommend measures either to train existing human resources or move to a task shifting based shift strategy.[7]

### **Strengths and Limitations**

This study has a good number of strengths, including its community-based design, enhancing the external validity of the findings for similar rural settings. A relatively large sample size, drawn from all 44 villages in the block, providing a robust and representative snapshot of the community's KAP.

Nevertheless, the study is subject to several limitations that must be acknowledged. First, its cross-sectional design precludes any inference of causality between sociodemographic factors and KAP. Second, the data on health practices were self-reported and may be subject to recall bias and social desirability bias, potentially over- or under-estimating the true prevalence of screening behaviors. Third, the study was conducted in a single administrative block of one district in Gujarat; therefore, the findings, particularly the culturally specific attitudes towards cancer screening, may not be generalizable to other states or regions of India with different socio-cultural contexts.

### **Conclusion**

In conclusion, this study uncovers critical and specific failures in NCD-related knowledge and attitudes in a rural Indian community especially in Gujarat. The findings move beyond the general observation of low awareness to pinpoint an alarming, widespread rejection of the value of cervical cancer screening. This suggests that current public health strategies are not merely inadequate but may be failing to counteract potent sources of misinformation. These results serve as an urgent call to action for public health programs and policymakers to abandon generic messaging and instead develop culturally tailored, targeted educational strategies.

### **Authors Contribution**

The authors are justifiably credited with authorship, according to authorship criteria. Dr. Priya Mistri - conception, design, analysis,

Dr. Swati - acquisition of data and draft of manuscript

Final revision and modifications of final manuscript was given by Dr. Kallol Roy

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# Physical Activity and Its Impact on Sleep Quality and Sleep Hygiene Among Physiotherapy Students: A Cross-Sectional Study

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## Abstract

**Background:** Sleep plays a critical role in physical health, mental well-being and academic performance, especially among young adults. Physical activity is known to influence sleep outcomes, but the nature of this relationship in medical students remains underexplored. Therefore this study aimed to assess the relationship between physical activity levels, sleep quality and sleep hygiene among physiotherapy students.

**Material and Methods:** The study was observational in nature involved 73 physiotherapy students aged 18–27 years from University College of physiotherapy, selected through convenient sampling were included in the study as per selection criteria. After obtaining informed consent, the students were categorized into Physically Inactive (n=20), Minimally active (n=28) and Very Active (n=25) based on their physical activity levels by using International Physical Activity Questionnaire (IPAQ). Then the students were assessed for Sleep quality by using the Pittsburgh Sleep Quality Index (PSQI) and Sleep Hygiene by Sleep Hygiene Index (SHI).

**Results:** Statistical analysis revealed a significant difference in Pittsburgh Sleep Quality Index (PSQI) and Sleep Hygiene Index (SHI) scores among the Inactive, Minimally Active and Very Active groups ( $p < 0.001$ ). Post-hoc analysis using the Tukey HSD method indicated that the Very Active Group had significantly better PSQI and SHI scores compared to the Inactive Group, while the difference between minimally and Very Active groups was not statistically significant.

**Conclusion:** The study concluded that physically active students had significantly better sleep quality and sleep hygiene compared to those who did not engage in physical activity. Promoting an active lifestyle may serve as an effective strategy to enhance sleep and overall well-being among student populations.

**Keywords:** Physical activity, Physiotherapy students, Sleep Hygiene, Sleep Quality.

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## Introduction

Sleep is essential for overall health and well-being across all age groups, playing a critical role in cognitive functioning, mood regulation, mental health, and cardiovascular, cerebrovascular, and metabolic processes. Importantly, growing evidence shows a close relationship between sleep and physical activity.<sup>1,2</sup> Insufficient sleep and low physical activity have harmful effects on overall health.<sup>3</sup> A population-based survey in Delhi reported that 4% of males and 2.5% of females suffer from obstructive sleep apnea. Poor sleep not only impacts physical and mental health but can also impair higher functions such as moral judgment.<sup>4</sup> It has further been linked to adverse outcomes, including cardiovascular disease, diabetes, obesity, depression, reduced academic performance, and lower productivity.<sup>5</sup> On the other hand, people who exercise regularly have better sleep and overall health.<sup>6</sup> Despite being essential, sleep disturbances are highly common among young adults, particularly university students. Surveys indicate that over 60% of college students report poor sleep quality, often characterized by short sleep duration, irregular bedtimes, and the use of stimulants such as caffeine or electronic devices before sleep.<sup>7</sup> Poor sleep can be caused due various other factors including sleep disorders these are the group of condition which disturb normal sleep patterns which include insomnia, Sleep-Disordered Breathing, central disorders of hypersomnolence, parasomnias etc<sup>8</sup> Another important concept is sleep hygiene, which refers to modifiable behaviors and environmental practices that support better sleep quality and duration. Poor sleep hygiene, such as irregular sleep schedules and late-night electronic use, has been strongly linked to insomnia and poor sleep quality.<sup>9</sup> Sleep quality refers to the overall experience of sleep, including its initiation, maintenance, duration, efficiency, and the sense of restfulness upon awakening. It combines both subjective satisfaction and measurable components such as sleep duration, latency, and continuity.<sup>10</sup> Sleep and physical activity are two essential health behaviors that greatly influence physical, cognitive, and mental well-being. Adequate sleep along with regular physical activity reduces the risk of chronic diseases such as hypertension, cardiovascular disorders, type 2 diabetes, and cancer.<sup>11,12</sup> Yet, many students report

poor sleep quality and irregular sleep hygiene due to academic stress, lifestyle habits, and low activity levels. As Physiotherapy is a growing profession and students in this field represent a unique group who face significant academic and clinical demands that may impact both physical activity levels and sleep quality. Their training involves long hours of study, physical exertion and practical clinical placements, all of which can influence sleep hygiene and quality. By focusing on this specific cohort, this study aims to explore the impact of physical activity on sleep quality and sleep hygiene among students.

## Material and Methods

### Study Design and setting

This was an observational study with a cross-sectional design. The study was conducted at University College of Physiotherapy, Baba Farid University of Health Sciences, Faridkot.

### Participants

The data was collected from March 2025 to July 2025 using convenient sampling. The study included undergraduate physiotherapy students aged 18 to 27 years, both male and female, enrolled across all four academic years, who willingly and voluntarily provided informed consent to participate. Students were excluded if they had sleep disorders (including sleep apnoea or breathing-related conditions), recent visits to healthcare facilities for conditions such as rheumatoid arthritis, cardiovascular, neurological or psychiatric disorders (e.g., hypomania), were taking sleeping pills or drugs affecting sleep, or self-reported an inability to engage in physical activity. Exclusion also applied to those with pulmonary diseases, illnesses that limit lung capacity (e.g., cold, flu), recent musculoskeletal injuries or a history of illness or surgery restricting physical exertion.

### Procedure

Students from all academic years were invited to participate. The study details were explained to them, confidentiality was ensured and written informed consent was obtained from those who agreed to take part. A total of 76 students were initially considered, out of which 3 were excluded (Sleeping disorder: n = 2; Neurological disorder: n

= 1). Finally, 73 students were included in the study after fulfilling the inclusion and exclusion criteria. The students were then categorized into Physically Inactive (n = 20), Minimally Active (n = 28), and Very Active (n = 25) groups based on their physical activity levels using the International Physical Activity Questionnaire (IPAQ). Sleep quality was assessed using the Pittsburgh Sleep Quality Index (PSQI), and sleep hygiene was evaluated using the Sleep Hygiene Index (SHI). (Fig.1).

#### Outcome measures:

**International Physical Activity Questionnaire (IPAQ):** The International Physical Activity Questionnaire (IPAQ) collects information on the frequency and duration of activities at different intensity levels.<sup>13</sup> It consists of seven questions with reliable measurement properties for assessing physical activity in various settings. The tool evaluates three key aspects: intensity (light, moderate, or vigorous), frequency (days per week), and duration

(time spent per day).<sup>14</sup>

**Pittsburgh Sleep Quality Index (PSQI):** The PSQI is a self-reported questionnaire developed to assess sleep quality in both clinical and non-clinical populations.<sup>15</sup> Participants completed 19 questions assessing various aspects of sleep quality, including sleep duration, latency, and frequency of sleep-related problems over the past 7 days. These items were grouped into seven components, each scored on a 0–3 scale. The sum of these components produced a global PSQI score (range 0–21), with higher scores reflecting poorer sleep quality.<sup>16</sup>

**Sleep Hygiene by Sleep Hygiene Index (SHI):** This self-reported index assesses environmental and behavioral factors that can contribute to inadequate sleep. The scale consists of 13 items, each rated on a five-point Likert scale. Scores are calculated by summing the responses, yielding a total between 13 and 65. Higher scores reflect poorer sleep hygiene.<sup>17</sup>

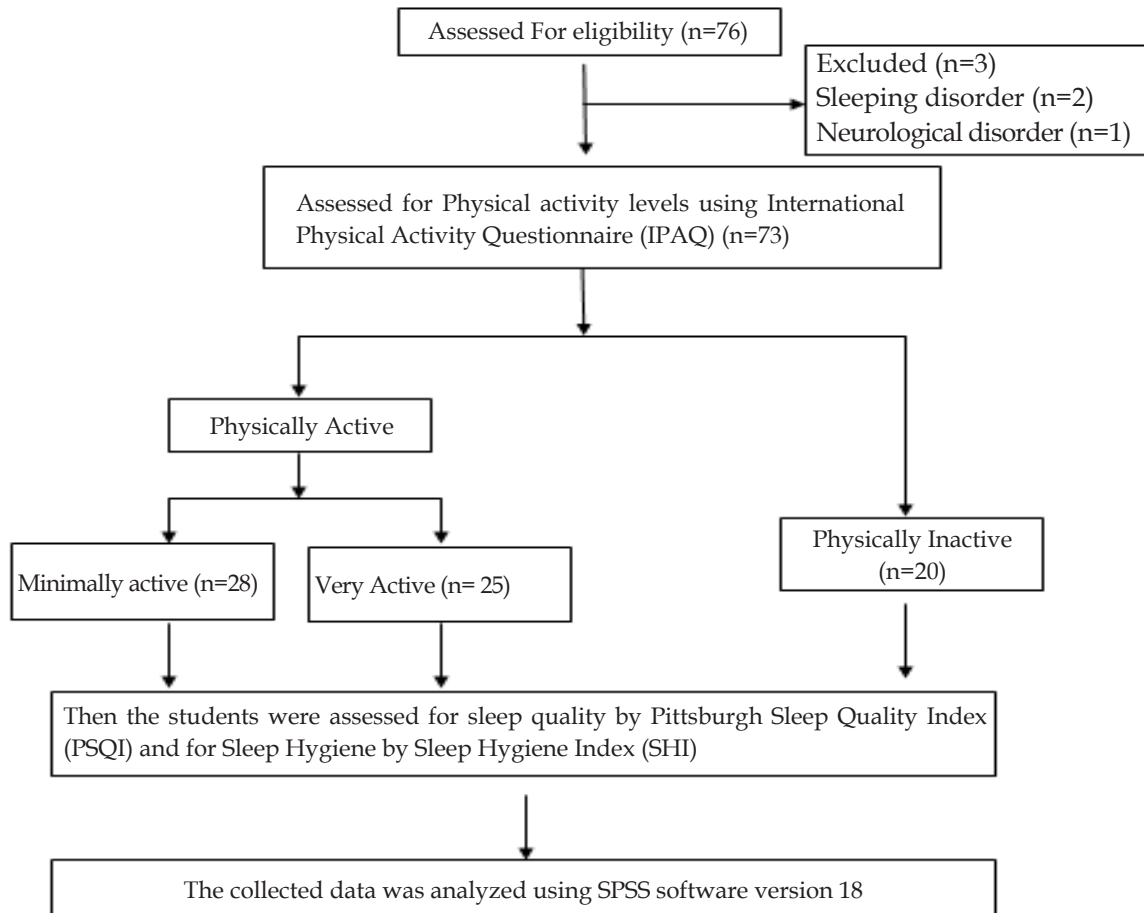


Fig. 1: Flow diagram for study participants

**Statistical Analysis:** Descriptive statistics were calculated for all variables. To assess differences in sleep quality (PSQI) and sleep hygiene (SHI) across physical activity levels, ANOVA and MANOVA

were applied. Post Hoc analysis was performed using the Tukey HSD test. A *p*-value of less than 0.05 was considered statistically significant.

**Results**

**Table 1: Demographic profile of the students according to physical activity levels**

Categories	N,%	Mean Age (years)	S.D.	Males	Females
Inactive	20 (27.4%)	21.10	1.744	5	15
Minimally Active	28 (38.4)	20.96	2.202	9	19
Very Active	25 (34.2)	20.56	1.685	8	17
ANOVA	—	F = 0.504	—	—	—
p-value	—	0.605	—	—	—

The demographic characteristics of students are summarized in Table 1. The Inactive group (N=20) had a mean age of 21.10 ± 1.744 years (5 males, 15 females), the Minimally Active group (N=28) had a mean age of 20.96 ± 2.202 years (9 males, 19 females), and the Very Active group (N=25) had a mean age

of 20.56 ± 1.685 years (8 males, 17 females). ANOVA indicated no significant differences in age among the groups (F = 0.504, p = 0.605), confirming that the groups were comparable in terms of age and gender distribution.

**Table 2: Sleep quality and sleep hygiene based on physical activity level**

PSQI	Mean ± S.D	MANOVA-F	MANOVA- p value
Physically Inactive	8.35 ± 1.496	11.429	<0.001
Minimal Active	6.285 ± 1.997		
Very Active	5.88 ± 1.855		
SHI	Mean ± S.D	MANOVA-F	MANOVA- p value
Physically Inactive	35.75± 0.786	75.630	<0.001
Minimal Active	29.571 ± 2.348		
Very Active	28.880 ± 2.297		

\* PSQI- Pittsburgh Sleep Quality Index, SHI- Sleep Hygiene Index

The effect of physical activity level on sleep quality (PSQI) and sleep hygiene (SHI) was examined using MANOVA. The analysis revealed statistically significant differences in PSQI scores (Inactive: 8.61 ± 2.50, Minimally Active: 6.42 ± 2.55, Very Active: 5.99 ± 2.29; F = 11.429, p < 0.05) and SHI scores (Inactive:

36.05 ± 8.39, Minimally Active: 28.50 ± 6.74, Very Active: 29.52 ± 6.56; F = 75.630, p < 0.05) among the physical activity groups, indicating measurable group-wise differences in both outcomes measures. (Table 2)

**Table 3: Tukey HSD Post Hoc Comparison of Sleep Quality and Sleep Hygiene based physical activity level**

Comparison	Mean Difference	Result
Inactive vs. Minimally Active	6.179	Significant
Minimally Active vs. Very Active	0.691	non-Significant
Inactive vs. Very Active	6.870	Significant

The Tukey HSD post hoc comparison of sleep quality (PSQI) and sleep hygiene (SHI) scores across different physical activity levels. The analysis showed that inactive participants had significantly higher scores compared to both minimally active (mean difference = 6.179,  $p < 0.05$ ) and very active participants (mean difference = 6.870,  $p < 0.05$ ), indicating poorer outcomes in the inactive group. In contrast, the comparison between minimally active and very active groups (mean difference = 0.691) was non-significant, suggesting comparable outcomes between these two groups. (Table 3)

### Discussion

The primary objective of this study was to examine the relationship between physical activity, sleep quality and sleep hygiene among physiotherapy students. According to physical activity level, the minimally active and very active groups had significantly better sleep quality and hygiene scores than the inactive group. Specifically, inactive participants recorded the highest PSQI and SHI scores, indicating poorer sleep quality and hygiene, while minimally active and very active students showed comparatively lower scores of PSQI and SHI, reflecting healthier sleep outcomes.

This aligns with findings by Narayana et al. (2023)<sup>18</sup> and Liu et al. (2025)<sup>19</sup>, who reported a moderate inverse association between physical activity and PSQI scores. Higher physical activity was linked to better sleep quality, while individuals with low activity levels more frequently reported poor sleep. These results suggest that physical activity plays a significant role in improving sleep quality among healthy individuals. Another study by Turgay Altunalan et al. (2024)<sup>20</sup> supports the current findings, reporting that physically active individuals had significantly better perceived sleep quality and sleep hygiene compared to less active participants. Several mechanisms may explain the positive impact of physical activity on sleep hygiene. Regular physical activity can enhance the production of melatonin, a hormone that regulates the sleep-wake cycle, thereby facilitating a smoother transition to sleep and improving overall sleep quality.<sup>21</sup>

Kathrin Wunsch et al. (2017)<sup>22</sup> conducted a study on the effect of physical activity on sleep quality,

well-being and affect during academic stress periods. Their findings support the current study, highlighting that maintaining adequate activity levels during high-stress periods can prevent negative impacts on sleep, overall well-being and emotional health. This emphasizes the importance of physical activity not only for general health but also for sustaining academic performance and coping with academic stress among students. Physical activity helps reduce stress, which is a common barrier to falling asleep and maintaining restorative sleep.<sup>23</sup> It also enhances mood, promoting greater engagement in physical activity and creating a positive feedback loop that further supports healthy sleep patterns.<sup>24</sup>

Physical activity in college students is not only important for improving sleep quality and sleep hygiene but also plays a critical role in managing stress and coping with academic pressures. Engaging in regular physical activity can help students buffer the negative effects of academic stress, maintain emotional well-being, and enhance overall cognitive performance, thereby supporting both their physical health and academic outcomes.

These findings emphasize the importance of implementing sleep education programs in academic institutions to raise awareness about healthy sleep practices. Colleges and universities may have to begin initiatives such as wellness workshops, fitness programs, and awareness campaigns to promote healthy sleep and physical activity. Encouraging structured physical activity can be an effective strategy to support better sleep habits. Additionally, improving sleep hygiene may enhance sleep quality, concentration, academic performance, and emotional regulation. Therefore, combining physical activity with sleep education and institutional wellness initiatives could provide a comprehensive approach to supporting students' physical and mental health.

### Conclusion

The study concluded that physically active students had significantly better sleep quality and sleep hygiene compared to those who did not engage in physical activity, highlighting the importance of regular physical activity in promoting restful sleep and overall well-being. However, the study had limitations, including reliance on self-reported

questionnaires without objective sleep measures, a small sample size and a cross-sectional design that limits causal inferences. Factors such as diet, lifestyle habits, academic stress, mental health and physical fitness were not evaluated.

Future research should involve larger, more diverse samples, incorporate objective sleep assessments and examine additional factors like diet, stress and health conditions. Including students from other healthcare disciplines and exploring the impact of the timing of physical activity on sleep quality and hygiene would further enhance understanding in this area.

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**Declaration of conflicts of interest statement if applicable:** No

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# Bacteriological Spectrum and Antibiotic Susceptibility of Non-Fermenting Gram-Negative Bacilli in Bloodstream Infections

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## Abstract

**Introduction:** Bloodstream infection (BSI) is one of the major challenges faced in hospitals as it increases patient stay, healthcare cost, and mortality rate. Non-fermenting gram-negative bacilli NFGNB have emerged as a significant pathogen in hospital settings and BSI due to these NFGNB are on the rise. Due to the extensive resistance of NFGNB to antimicrobials, it becomes crucial to understand the antibiotic susceptibility pattern of these organisms in different clinical settings.

**Aim and objective:** To determine the prevalence of non-fermenting gram-negative bacilli (NFGNB) and their antibiotic susceptibility pattern in admitted patients with bloodstream infections (BSI) at a tertiary care hospital.

**Material & Methods:** A retrospective analysis of blood culture samples was done over a period of 1 year (1st April 2022 to 31st March 2023) in the Department of Microbiology at a tertiary care hospital. All samples were processed as per standard microbiological techniques. Antimicrobial susceptibility was interpreted according to CLSI 2022 guidelines.

**Results:** In this study, the prevalence of NFGNB was 3.42%. The most common NFGNB isolated were *Acinetobacter* species and *Pseudomonas* species. The other NFGNB isolated were *Stenotrophomonas maltophilia*, *Sphingomonas paucimobilis*, Burkholderiaceae complex, *Elizabethkingiameningoseptica* and *Achromobacter denitrificans*. *Acinetobacter* species showed multidrug resistance while other NFGNB were susceptible to commonly tested antibiotics.

**Conclusion:** The NFGNB which were previously considered as contaminants or commensals have emerged as important pathogens causing serious infections. This study depicts the increasing number of non-fermenters in bloodstream infections among patients admitted in tertiary care hospital. Hence identification of NFGNB and their appropriate antimicrobial susceptibility testing can help clinicians to initiate the empirical treatment.

**Keywords:** Non-fermenting gram-negative bacilli (NFGNB), bloodstream infection (BSI), antibiotic susceptibility, blood culture.

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## Introduction

Bloodstream infections (BSI) are characterized by the presence of viable microorganisms in the blood that elicit or have elicited an inflammatory response characterized by the alteration of clinical, laboratory and hemodynamic parameters(1). The BSI incidence ranges from 1.13 to 2.04 per 1000 population worldwide(2-4). In India BSI rate is 5.3 to 7.3 per 1000 patient days(5,6). For laboratory confirmation of the clinical diagnosis, paired blood cultures collected aseptically from different sites before administration of antibiotics is advisable. Timely diagnosis and treatment of BSI is crucial for better patient outcome. The common causes of BSI are gram-positive bacteria like *Staphylococcus aureus*, *Streptococcus pneumoniae*, Enterococcus species and coagulase-negative staphylococci and gram-negative enteric bacilli like Salmonella species, *Escherichia coli*, *Klebsiella pneumoniae*, Enterobacter species and non-fermenting gram-negative bacilli (NFGNB). The prevalence changes according to geographical location, age group, and hospital settings(7,8) BSI due to non-fermenting gram-negative bacilli (NFGNB) is a growing concern in the hospital setting especially in patients with comorbidities due to the emergence of drug resistance in NFGNB. Non-fermenting gram-negative bacilli are a group of aerobic, non-spore-forming bacilli that do not either use carbohydrates as a source of energy or degrade them through metabolic pathways other than fermentation(9). The treatment of BSI due to NFGNB has become a major challenge, leading to significant mortality and morbidity(10,11). These infections prolong the duration of hospital stay, thereby increasing healthcare costs (10). In the Indian setting, the prevalence of NFGNB in bloodstream infection accounts for 3 to 4%(10,11). *Pseudomonas aeruginosa*, Acinetobacter baumannii complex, *Stenotrophomonas maltophilia*, *Sphingomonas paucimobilis* and Burkholderiaceae complex are the most commonly isolated NFGNB from blood culture(7,10-14) The epidemiology and antimicrobial profile of BSIs varies between hospitals necessitating analysis of local trends(15). Hence the study was undertaken with the following aims and objectives:

## Aims and objective

1. To determine the prevalence of NFGNB in cases of BSI in patients admitted in a tertiary care hospital.
2. To study antibiotic susceptibility patterns of NFGNB isolates.

## Material and Method

A retrospective cross-sectional study was conducted in the Department of Microbiology, Lokmanya Tilak Municipal Medical College & General Hospital, Mumbai, over a period of 1 year (1<sup>st</sup> April 2022 to 31<sup>st</sup> March 2023). Clinicians collected blood culture samples from clinically suspected BSI cases admitted in various wards and ICUs of this hospital. Samples were collected in conventional or automated BacT/Alert bottles as per their availability. The ethical clearance was taken from the Institutional Ethics committee Human Research (IEC/44/17) dated 27.06.2018. 5-10 ml and 1-5 ml of blood (from adults and children respectively) were aseptically collected by clinicians and added in BacT/Alert aerobic culture media bottles (Biomerieux, India Pvt Ltd.) or conventional blood culture bottles containing Trypticase Soy Broth (TSB) (50 and 25 ml for adult and pediatric respectively). The bottles were sent to the microbiology laboratory either as single or paired blood culture samples. On receipt, the bottles were incubated in BacT/Alert 3D automated blood culture system (Biomerieux, India Pvt Ltd.) or an incubator (conventional bottles) at 37°C. On getting a positive flag, a Gram stain was carried out on positive BacT/Alert bottles and subcultured on 5% sheep blood agar, chocolate agar and MacConkey agar plates, while broth from conventional blood culture bottles was subcultured after 18-24 hours on the same media, 2<sup>nd</sup> and 3<sup>rd</sup> subcultures from conventional bottles were carried out after 48 and 96 hours respectively. The culture plates were incubated aerobically at 37°C for 24 hours. The gram-negative isolates were identified using conventional biochemical tests. Some isolates which could not be identified by conventional techniques were identified using the Vitek 2 system. Antimicrobial susceptibility testing was done using the Kirby Bauer disk diffusion method and by the Vitek 2 system where minimum inhibitory concentration (MIC) was required. Interpretation of the antibiotic susceptibility test (AST)

was done according to CLSI 2022 guidelines(16). The patient details were entered on an Excel sheet and data for analysis (for non-repeating isolates) was obtained from the Excel sheet.

## Results

A total of 10094 blood samples were received for

culture in the Department of Microbiology during the study period. 3348 (33.17%) had growth, of which 886 were gram-negative bacilli. Amongst these gram-negative bacilli, 345 were non-fermenting gram-negative bacilli (NFGNB) giving a prevalence of 3.42% as shown in Figure 1.

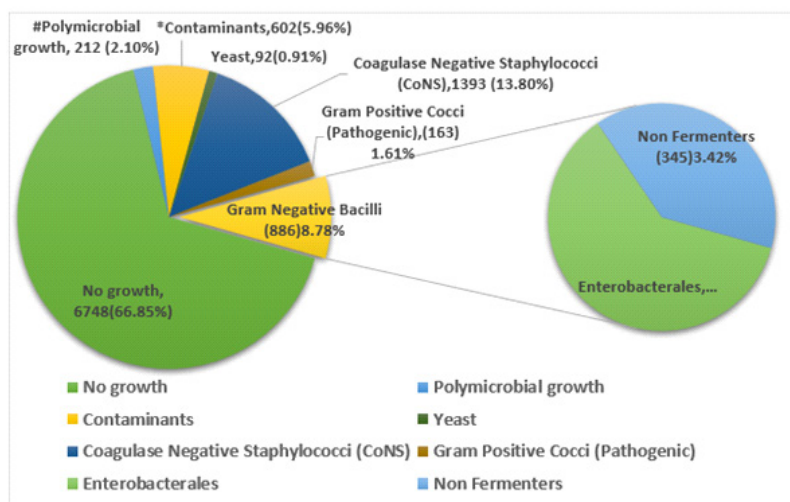


Figure 1: Distribution of isolates from blood culture specimens.

\*Contaminants include *Micrococcus* species, *Bacillus* species, *Diphtheroid* species, and *Pseudomonas stutzeri*.

# Polymicrobial flora: more than 1 organism is isolated.

Table 1: Species distribution of non-fermenting gram-negative isolates (NFGNB) from blood culture specimens.

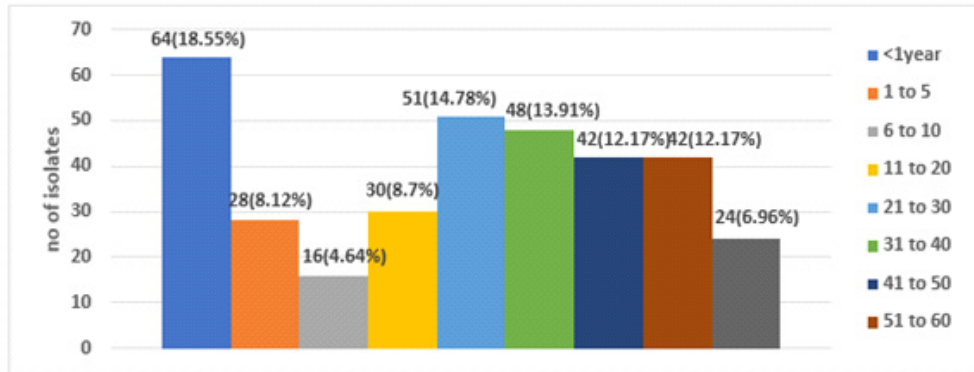
Non-Fermenting Gram Negative Bacilli (NFGNB)	No of isolates (n=345)	Percentage (%)
<i>Acinetobacter baumannii</i> complex	222	64.35 %
<i>Acinetobacter</i> species	58	16.81 %
<i>Acinetobacter lwoffii</i>	8	2.32 %
<i>Pseudomonas aeruginosa</i>	21	6.09 %
<i>Pseudomonas</i> species	5	1.45 %
<i>Stenotrophomonas maltophilia</i>	15	4.35 %
<i>Sphingomonas paucimobilis</i>	11	3.19 %
Burkholderiacepacia complex	3	0.87 %
<i>Elizabethkingiameningoseptica</i>	1	0.29 %
<i>Achromobacter denitrificans</i>	1	0.29 %
TOTAL	345	100 %

Table 1 shows the distribution of different NFGNB isolated from blood culture. The most common isolate was *Acinetobacter* species (288, 83.47%) followed by *Pseudomonas* species (26, 7.53%). *Stenotrophomonas maltophilia* (15, 4.35%) and *Sphingomonas paucimobilis* (11, 3.29%) and 3

isolates of Burkholderiacepacia complex were also identified by conventional techniques. In addition, one isolate each of *Elizabethkingiameningoseptica* and *Achromobacter denitrificans* were identified using the Vitek 2 identification system.

Amongst the patients with NFGNB isolates in blood, 176 (51.01%) were from ICUs, most commonly

from Medical ICU (MICU) (22.90%) followed by Neonatal ICU(NICU) (13.62%).



**Figure 2: Age distribution of patients with BSI due to NFGNB.**

The age distribution shows a higher rate of isolation of NFGNB in children less than 1 year of age (64, 18.55%) followed by young adults of age group 21 to 30 years (51, 14.78%) and 31 to 40 years (48, 13.91%) while the geriatric population had a low prevalence of NFGNB (6.96%) as shown

in Figure 2.

Males (195,56.52%) were more commonly affected than females (150,43.48%) with male to female ratio of 1.3:1.

**Table 2: Predisposing risk factors in patients with NFGNB isolation from blood specimen(n=345).**

Underlying Risk Factors	Total No of Patients	Adults (n=232)	Paediatrics (n=113)
Post-operative cases	33	31 (93.93%)	02 (6.06%)
Diabetes Mellitus	30	30 (100%)	00 (0%)
Chronic Kidney Disease	27	27 (100%)	00 (0%)
Preterm Birth	27	00 (0%)	27 (100%)
Cancer	18	07 (38.89%)	11 (61.11%)
Tuberculosis	10	09 (90%)	01 (10%)
Burns	06	05 (83.34%)	01 (16.67%)
Heart Disease	05	05 (100%)	00 (0%)
No Known Underlying Condition	189	118 (62.43%)	71 (37.56%)
<b>TOTAL</b>	<b>345</b>	<b>232 (67.24%)</b>	<b>113 (32.75%)</b>

In most patients (189, 54.78%), underlying risk factors could not be identified. Diabetes mellitus, chronic kidney disease and surgery were common underlying risk factors in adults.

Pretermneonates and children with leukemias had higher isolation of NFGNB from their blood culture as seen in Table 2.

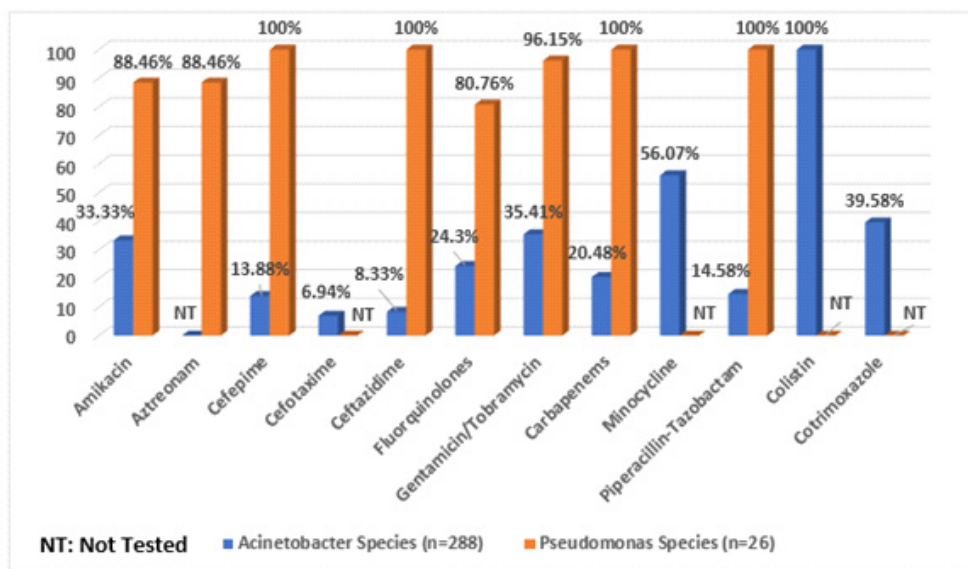


Figure 3: Antimicrobial susceptibility pattern of common NFGNB (n= 314).

Figure 3 shows the antibiotic susceptibility pattern of common NFGNB where *Pseudomonas* species showed good susceptibility to almost all

classes of antibiotics hence colistin was not tested while *Acinetobacter* species was multidrug resistant.

Table 3: Antimicrobial susceptibility pattern of NFGNB other than *Acinetobacter* species and *Pseudomonas* species (n=31).

Antibiotic tested	<i>Stenotrophomonas maltophilia</i> (n=15)	<i>Sphingomonas-paucimobilis</i> (n=11) *	<i>Burkholderiacepacia</i> complex(n=03)	<i>Elizabethkingia-meningoseptica</i> (n=01) *	<i>Achromobacterdenitrificans</i> (n=01) *
Amikacin	NT	09 (81.81%)	NT	0(0%)	0(0%)
Gentamycin	NT	11 (100%)	NT	0(0%)	0(0%)
Ceftazidime	NT (MIC recommended)	10 (90.90%)	0(0%)	1(100%)	1(100%)
Cefepime	NT	10 (90.90%)	NT	1(100%)	1(100%)
Levofloxacin	09 (60%)	11 (100%)	NT (MIC recommended)	1(100%)	1(100%)
Piperacillin tazobactam	NT	11 (100%)	NT	1(100%)	1(100%)
Cotrimoxazole	13 (86.66%)	NT	3(100%)	1(100%)	1(100%)
Meropenem	NT	8 (72.72%)	3(100%)	1(100%)	1(100%)
Minocycline	15 (73.33%)	NT	3(100%)	1(100%)	1(100%)
Aztreonam	NT	NT	NT	1(100%)	1(100%)

\*MIC determined using Vitek 2 AST system.

As shown in Table 3, amongst the other NFGNB, *Sphingomonaspaucimobilis* was susceptible to almost all commonly tested antibiotics as per their MIC values determined by the Vitek 2 system. *Stenotrophomonasmaltophilia* showed

good susceptibility to cotrimoxazole (86.66%), minocycline(73.33%), andlevofloxacin (60%), *Burkholderiacepacia* complex was sensitive to meropenem, cotrimoxazole, minocycline however it showed 100% resistance to ceftazidime. MIC of

ceftazidime and levofloxacin was not performed for *Stenotrophomonas maltophilia* and Burkholderiacepacia complex respectively due to resource constraints.

The *Elizabethkingiameningoseptica* and *Achromobacterdenitrificans* as per the MIC value, were reported susceptible to most of the antibiotics except aminoglycosides.

## Discussion

Bloodstream infections (BSIs) are one of the major life-threatening infections encountered in clinical practice. In addition, BSI due to non-fermenting gram-negative bacilli (NFGNB) pose challenges in diagnosis in resource-limited settings. They are responsible for prolonged hospital stays, high healthcare costs, and significant mortality. The epidemiology and antimicrobial profile of BSIs varies between hospitals necessitating analysis of local trends(15).

The prevalence of NFGNB in bloodstream infection cases from this study (3.42%) was concordant with a study carried out by Kumar et al(3.24%) and Nazir et al(3.97%)(10,11) Debosmita et al reported a prevalence of 4.15%(12) whereas Baruah et al reported a slightly higher prevalence of 4.90% among cancer patients(14). Varghese et al, and Deb et al had a low prevalence of 1.07%, and 1.24% respectively(13,17). These differences in prevalence might be because of the different hospital infection control practices in various institutes, different geographical areas, and demographic parameters.

Kumar et al, Nazir et al, Varghese et al, Deb et al, Panda et al, and Khurana et al reported *Acinetobacter* species as the most common organism followed by *Pseudomonas* species which is similar to this study(7,10,11,13,17,18) However, *Pseudomonas* species was the most common NFGNB isolated by Krishnan et al and Grewal et al in contrast to this study(19,20).

In the study done by Kumar et al, the isolation rate of *Stenotrophomonas maltophilia* (16.36%), *Sphingomonas paucimobilis* (5.45%) and Burkholderiacepacia complex(4.54%) was higher

as compared to this study (4.35%),(3.19%) and (0.87%) respectively(10). Deb et al reported 4 isolates of *Elizabethkingiameningoseptica* and Vibha et al reported 10 isolates of *Achromobacterdenitrificans* while this study could report only 1 isolate of *Elizabethkingiameningoseptica* and *Achromobacterdenitrificans* each(13,21).

Nazir et al reported 75% NFGNB from patients admitted in ICUs as compared to 51.01% in this study(11).

In this study, a low prevalence of NFGNB was noted among patients in the age group more than 60 years (6.96%) which was discordant with other studies by Nazir et al (32.5%), Deb et al (36.2%) where it showed higher isolation rates in the geriatric population(11,13).

The study conducted by Agarwal et al showed a similar isolation rate in the age group 21 to 30 years (14.56%)(22).

The male-to-female ratio of 1.3:1 was similar to a study conducted by Nazir et al(11)(BacT/Alert).

Comorbidities like diabetes mellitus, chronic kidney disease, and heart disease were lower in this study (17.97%) in contrast to that reported by Choudhary et al (29.23%)(23).

*Acinetobacter species* showed multidrug resistance similar to the studies conducted by Nazir et al and Deb et al(11,13). In this study, *Pseudomonas* species were susceptible to all commonly tested antibiotics including fluoroquinolones (80.76%) and cephalosporins (100%) whereas Kumar et al reported low susceptibility to both groups(40%),(25%) respectively while Deb et al reported lower susceptibility only to fluoroquinolones(59%)(10,13)

*Sphingomonas paucimobilis* was susceptible to almost all tested antibiotics, concordant with a study by Kumar et al however, Agarwal et al reported multidrug-resistant isolates of *Sphingomonas paucimobilis*(10,22).

In this study, 83% isolates of *Stenotrophomonas maltophilia* were susceptible to cotrimoxazole in contrast to Kumar et al (50%)(10).

The susceptibility pattern for *Burkholderiacepacia* was similar to the study by Kumar et al whereas Agarwal et al reported multidrug-resistant isolates. (10,22)

*Elizabethkingiameningoseptica* was multidrug-resistant in the case series reported by Govindaswamy et al, whereas the single isolate reported in this study was found to be susceptible to all antibiotics which were concordant with a study by Agarwal et al (22,24).

*Achromobacterdenitrificans* showed a similar pattern of susceptibility in a study conducted by Vibha et al (21).

### Conclusion

In this study, the prevalence of NFGNB from admitted patients with BSI was 3.42%. The most common isolate was *Acinetobacter* species. The study could also identify other NFGNB like *Stenotrophomonas maltophilia*, *Sphingomonas paucimobilis* and *Burkholderiacepacia complex* by conventional techniques. Automated techniques which were reserved for isolates that could not be identified by conventional techniques, helped in identifying *Elizabethkingia meningoseptica* and *Achromobacterdenitrificans*. Most *Acinetobacter* species isolates were multidrug-resistant.

The increasing antimicrobial resistance observed in non-fermenting Gram-negative bacilli (NFGNB) poses a substantial clinical challenge, as therapeutic options become progressively limited. This trend highlights the critical need for robust surveillance systems, the implementation of rapid and accurate diagnostic methodologies, and the development of targeted antimicrobial strategies to guide effective patient management.

Hence clinicians need to remain updated with the prevalence and antimicrobial susceptibility pattern of the circulating pathogens in the selection of the antimicrobials to be used for empiric therapy. More importantly, these organisms have great potential to survive in a hospital environment so improved antibiotic stewardship and infection-control measures are required to prevent or slow the emergence and spread of multidrug-resistant NFGNB in the healthcare setting.

### Limitations:

Automated techniques for identification and AST were not used for all isolates due to resource-limited settings and hence Minimum Inhibitory Concentration (MIC) could not be determined for all the isolates.

### Drawbacks:

Paired blood samples were not received for all patients.

**Conflict of interest:** NIL

**Funding:** NIL

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# Comparative Analysis of Perception of MBBS Students on Foundation Course: A Questionnaire Based Study

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## Abstract

**Introduction:** The Foundation Course was designed to provide a sound foundation for learning in the MBBS curriculum and later in students' professional careers. Although the document on CBME was prepared by doyens in the medical field after years of toil, it is only natural for any program to face difficulties during the implementation phase. Faculty members are facing new, technology-enhanced teaching methods at the institutional level, with varied lectures on professionalism, ethics, communication, skill acquisition, language development, spirituality, and miscellaneous brainstorming lectures to induce confidence in managing problems in medical practice.

**Objective:** Primary Objectives: To evaluate students' perception of the foundation course and to evaluate the perception of faculty members about the foundation course.

Secondary objective: To assess the gap between the foundation course program schedule and its implementation.

**Materials and Methods:** Study design: This was a single-center, cross-sectional, observational study conducted as an educational design study.

**Study Population:** The entry batches of 2022 and 2023 were the intended population (group 1). Responses from the entry batches of 2021 and 2020 were also taken for comparison (group 2).

**Sampling technique:** Total enumeration.

**Method of data collection:** Data was collected via a self-administered questionnaire. Feedback from all six modules was taken using a modified Likert scale. Feedback from teachers was recorded using a different Google Form that had modified Likert scoring and scope for individual responses.

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**Duration:** 2 months.

**Results:** There was good consensus among students about all modules of the foundation course in the early response group (group 1), with positive response rates ranging from 75% to 96%. The responses were similar in the late response group, except for the professional development and ethics module and the language and computer module. The difference was statistically significant (p-values < 0.016 and 0.007, all <0.05). Feedback from teachers was also positive, with scope for modifications and suggestions for individual modules.

**Conclusion:** We conclude that in our study, there is good consensus among students and faculty members regarding the perception and continuation of the foundation course. The statistics show that 80% responded positively. The positive response rate from group 2 (2020 and 2021) was lower, as there were initial implementation hurdles in a new medical college. With time, these hurdles were overcome, and the responses improved.

**Key words:** Perception of foundation course, Teachers' review on foundation course, Foundation course and CBME

## Introduction

Educational technology has become modernized, and medical knowledge has been growing exponentially. What has not kept pace with these changes is the medical curriculum, especially in India until 1997, when the Government of India, under the direction of the Medical Council of India (MCI), which is now National Medical Commission (NMC) brought out a gazette notification on "Regulations on Graduate Medical Education," which is considered an important milestone in the history of medical education in India. The next major overhaul in medical education was the introduction of Competency-Based Medical Education (CBME) in 2019. [1]

Since the inception of the NMC, importance has been given to the mandatory implementation of the foundation course. Initially, it was emphasized that the first two months should be dedicated to the Foundation Course. During the pandemic, the time frame changed to one or two weeks; the recent 2023 guideline recommends it should be for an initial week, with the rest of the course to be blended with regular classes throughout the academic year. [2]

Orientation programs are designed and implemented by different academic institutions globally for students transitioning from high school to an undergraduate course, with the objective of familiarizing the students with the campus environment and course curriculum, thereby helping them in their adaptation. The NMC has introduced Competency-Based Medical Education (CBME) to produce Indian Medical Graduates (IMG) who can function efficiently as basic doctors and first-contact

physicians. CBME emphasizes learner-centered approaches, integrated learning, and continuous assessment to ensure IMGs are practice-ready. Traditional methods, on the other hand, often rely on lecture-based teaching, rote memorization, and time-bound assessments, which may not adequately prepare students for the complexities of clinical practice.

One of the important components of CBME is the introduction of a one-month Foundation Course for all new entrants to the MBBS Curriculum before they start their formal training. Students enter a medical college from different walks of life. They start their undergraduate journey with little knowledge about their course and its future. They encounter many hurdles in the form of background, cultural, and socioeconomic differences; language proficiency; adjustments to the new campus environment; and challenges of the new curriculum. The course has been created to sensitize the fresh medical student with the required knowledge and skills that will assist them in acclimatizing to the new professional environment. While institutions are expected to follow the general guidelines, institutional-level changes can be made depending on the content and requirements. [3]

In the 2019 Graduate Medical Education Regulation (GMER), the Foundation Course was envisaged to be a one-month-long program (later modified to 1-2 weeks) with continued support throughout the year for students to acquire language, ethics, attitude, communication, and computer-assisted skills. The Foundation Course is designed specifically to address most of these issues so that students can have a smooth metamorphosis from

a highly protected school environment to the challenging professional environment of a medical college. During this month, they imbibe and inculcate the basics of medicine in terms of its history, the role of an IMG in society, community orientation, ethical principles, national health needs and policies, universal precautions, immunization, the doctor-patient relationship, stress and time management, the importance of a balanced life, skills in information technology and language, communication skills, etc.,<sup>[4]</sup> and upon its completion, they will embark on their journey of life-long medical education with confidence and competence. An orientation program is considered valuable in lowering the anxiety of a new workplace and can benefit both faculty and new entrants. Resource faculty from various medical disciplines are incorporated. The modules of the Foundation Course are: 1) Orientation module, 2) Skills module, 3) Community Orientation module, 4) Professional Development and Ethics module, 5) Language and Computer Skills, and 6) Sports and Extracurricular Activities.<sup>[5-8]</sup>

Faculty members are facing new, technology-enhanced teaching methods at the institutional level, with varied lectures on professionalism, ethics, communication, skill acquisition, language development, spirituality, and miscellaneous brainstorming lectures to induce confidence in managing problems in medical practice.

## Aims and Objectives

### Aim:

To explore the perception of the foundation course from the perspectives of students and faculty.

### Primary Objectives:

To evaluate students' perception of the foundation course.

To evaluate the perception of faculty members about the foundation course.

### Secondary objective:

To assess the gap between the foundation course program schedule and its implementation.

## Materials and Methods

**Study Population:** All students from four batches of MBBS (each batch had 100 students; the average number of respondents in each batch was 80).

**Sample size calculation:** The study aimed to find out the perception of the foundation course among all batches of undergraduate students, so a total enumeration technique was applied; no student was exempted.

**Type of study:** Single-center, cross-sectional, observational study.

**Sampling technique:** Total enumeration.

**Method of data collection:** Data was collected via a self-administered questionnaire.

**Duration:** 2 months.

**Selection criteria:**

**Inclusion criteria:** MBBS students of the 2020, 2021, 2022, and 2023 entry batches.

**Exclusion criteria:** Unwilling or absent students.

The foundation course had different modules: orientation, skills module, field visit to a community health center, professional development including ethics, language/computer skills, and sports and extracurricular activities. The number of hours allotted in each batch differed due to the pandemic and subsequently due to changes in guidelines from the NMC and the state university. During the pandemic, the time frame changed to one or two weeks; the recent 2023 guideline recommends it should be for an initial week with the rest of the course to be blended. All students received the course as per the guideline of that year. All activities were conducted by faculty members of the institution except for language, computer, and sports and extracurricular activities, for which instructors from other institutions were hired.

**Validation of questionnaire:** A structured questionnaire was designed, validated (in-house, during a presentation at the nodal center, and by one expert from the regional center), and used to assess the performance of students. The validity of the questionnaire was checked by qualitative research experts from other institutes. Test-retest reliability was checked in an initial group of 15 students. Cronbach's alpha was used to check reliability during the initial validation (score was 0.76). The perception of students was assessed through a feedback form via Google Forms. Two types of feedback were taken

(first regarding the topics and second regarding the effect of the module).

Content and objectives were assessed as a closed-ended response of yes or no. Organization and interaction were assessed with a modified Likert scale. Feedback on the teaching and learning sessions was also taken at the end of the foundation course, and responses were recorded.

Feedback form scores: 4, 3, 2, and 1

4 - excellent

3 - satisfactory

2 - good

1 - needs more understanding.

For ease of analysis, we considered scores of 3 and 4 as a better response and analyzed them accordingly.

We wanted to analyze the responses of first-year students in two subsequent batches—2022 (after one whole year of completion) and 2023 (after completion of one month of the foundation course in September)—and compare their responses with two previous batches (2021 and 2020 entry batches). Our institute is a newly established medical college, and the 2020 batch was the first admission batch. For analysis, we grouped the 2022 and 2023 batches as group 1 (early or immediate feedback). The 2021 and 2020 batches were grouped as group 2 (late feedback).

Feedback from teachers was taken with a different questionnaire where qualitative and quantitative input was taken. This questionnaire had one open-ended question where they could provide their viewpoint or suggestion to improve the existing module.

**Inclusion criteria:** All faculty members and senior residents of the institution were included in the study. All faculty members had completed a basic teacher training course and orientation to the foundation course. All classes were conducted after discussion with the medical education unit of the institution. Senior residents assisted in the teaching program with faculty.

**Exclusion criteria:** Unwilling doctors.

A concept map was prepared in consultation with other departments, like Pharmacology and General Surgery. This process was completed in five weeks (from the last week of July to August).

**Data Analysis and presentation plan:** Statistical analysis was done using SPSS software. Descriptive statistics like mean, standard deviation, frequencies, and percentages were used to present the study. An ANOVA test was used to compare means between groups. Categorical variables were analyzed using the Chi-square test. A probability (p) value was calculated to test statistical significance at the 5% level.

## Observation & Results

A total of 202 responses were collected from four batches. Data collection was started in September (three batches: 2020 to 2022) and completed in October (2023). The highest response rate was seen in the 2022 batch, which had completed one year with all modules and extracurricular activities spread over the whole year. The 2023 batch responded least, as modules had just finished, and they needed a lot of explanation on how to proceed with their responses. These batches (Group 1) could accurately remember the details of the class schedule but agreed that they needed more practical exposure to understand each module, such as doctor-patient interaction, the responsibility of doctors, and the application of computer classes.

Feedback from previous batches (group 2) was recorded. We wanted to review their feedback to know if they had a different interpretation after being exposed to clinical postings, where they understood the implications of the modules in everyday practice. They had a lot of recall bias but mentioned their depth of understanding and the implications were more profound compared to when they were in the first phase. These responses were not documented but were revealed more through interpersonal interactions or one-on-one interviews.

Each batch was given a description for their response, and the response portal was open for two weeks; no further responses were accepted after this period.

As evident from Table 1, most of the responses were positive in group 1. The two groups were sex-matched. The age difference between the two groups was significant; the first group had a younger population. Responses from group 2 were lower for the professional development and ethics module and the language and computer classes module (p-values were significant) (Fig 1).

#### Input from faculty

We had 37 responses within one week: professors = 6 (16.21%), associate professors = 9 (24.32%), and assistant professors = 22 (59.5%). Twenty-two faculty members had participated actively in teaching the foundation course; five had not. There were nine faculty members from phase 1, nine from phase 2, and 19 from phase 3 (parts 1 and 2). All faculty members had basic teacher training; seven had additional training (six CISP and one with both CISP and ACME). We have divided this group into senior faculty (professors and associate professors) and

junior-tier faculty (assistant professors) for analysis (Fig 2).

The response from faculty members is summarized in Table 2. Module 5, computer and language classes, was taken by teachers from other institutes without any involvement of college faculty, so it was not included for rating.

A detailed review from faculty members is summarized in Table 3. Apart from all the above, five faculty members refused to participate, stating verbally that they thought the course was useless; they did not write this on the proforma. The reasons they gave were that this course had no impact, students in their early days did not understand the implications, and students did not attend classes. These views were revealed during more informal discussions; as these were not documented, these responses were not analyzed. Among the documented responses, more faculty members responded positively.

**Table 1: Response of all 4 batches**

Topic 1	Group 1 Batch 2022/23 (N1=112)	Percentage of positive response of group 1	Group 2 Batch 21/20 (N2=90)	Significance P value
F:M	67:45		61:29	.304
Age	20.58±1.66		21.87 ± 1.19	<0.001
State (others : WB)	97:15		80:10	.672
Module 1 (orientation)				
Content	104:8	92.8%	83:7	.99
Objective	90:22	80.35%	76:14	.46
Organization (better response )	102: 10	91.1%	81: 9	0.812
Interaction ( Better response	91:21	81.25%	78:12	.34
Module 2 (skill)				
Content	105:7	93.75%	81:9	.433
Objective	91:21	81.25%	75:15	.71
Organization (better response )	98: 14	87.5%	73: 17	.24
Interaction	89:23	79.5%	76:14	.46
Module 3 (community orientation)				
content	108:4	96.4%	86:4	.99
Objective	96:16	85.7%	77:13	.99
Organization	100:12	89.3%	76:14	.39

Continue.....

Interaction	97:15	86.6%	76:14	.69
Module 4: Professional development and ethics				
Content	104:8	92.8%	73:17	.016
Objective	92:20	80.35%	68:22	.29
Organization	97:15	86.6%	72:18	.25
Interaction	93:19	83%	73:17	.85
Module 5 (Language and computer)				
Activity	92:20	80.35%	54:36	.0008
Duration	93:19	83%	55:35	.0007
Interaction	84:28	75%	54:36	.032
Module 6 (sports )				
Content	91:21	81.2%	67:23	0.3
Objective	88:24	78.5%	69:21	.86
Organization (better response )	81:31	72.3%	60:30	.44
Interaction (better response)	81:31	72.3%	65:25	.99
Overall satisfaction	99:13	88.3%	73:17	.17

Table 2: Rating of modules according to faculties

Rating of modules (better response 3, 4)	Designation	Active participation
	Senior: Junior	-Yes: No
Modules 1	13/15 (86.67%): 18/22 (81.82%)	19/22 (86.4%): 12/15 (80%)
Module 2	12/15 (80%): 16/22 (72.7%)	17/22 (77.27%): 11/15 (73.33%)
Module 3	12/15 (80%): 17/22 (77.27%)	20/22 (90.9%): 9/15 (60%)
Module 4	12/15 (80%): 13/22 (59.1%)	16/22 (72.7%): 9/15 (60%)
Module 6	9/15 (60%): 16/22 (72.7%)	14/22 (63.6%): 11/15 (73.33%)

Table 3: Teachers review summarized

Type of response	Number of responses
1. No improvement	3
2. Foundation course should be stopped	2
3. No specific suggestion	14
4. Good but needs modification	
a. Stable time table	3
b. More time for language	1
c. More time for yoga	2
d. More interactive session	1

Continue.....

e. More classes on art of communication	2
f. Proper alignment	1
g. responsibility of doctors should be clarified	1
h. course should be taught after students have understood basic science	1
i. more well-defined modules	1
5. Good but needs inclusion/ suggestion	
a. More faculties/ departments	2
b. Mentorship program	1
c. Gate keeping training (for prevention of suicide)	1
d. Assessment post course	1

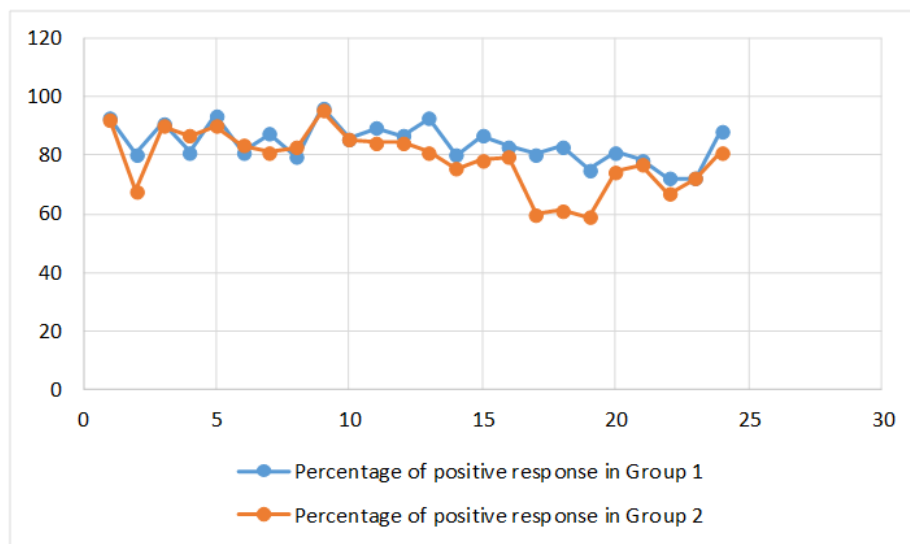


Fig 1: Percentage of positive response between two groups

Fig 2: Distribution of faculties as per designation

**Discussion**

A one-month foundation course was introduced throughout India in August 2019 as a compulsory module at the beginning of the MBBS course to sensitize students to the information, lifestyle, and practical skills required to sail through their training. The aim of our study was to assess the effect of the foundation course among undergraduate students and teachers. We also tried to assess if the perception or implication of different modules changes with time in students; therefore, we included four batches, categorizing them as an “immediate feedback” group and a “late feedback” group.

As is evident from our study, most students gave positive feedback regarding the implementation of

the foundation course (the rate of positive feedback ranged from 80% to 96%). There was a difference in module 4, as students in group 2 did not remember the class schedule for ethics and professionalism correctly. The 2020 entry batch was the first batch of our institute, so there were many hurdles in implementation, and faculty members were also new to various aspects. Consequently, that cohort felt that things could have been a little better for them to get better oriented, especially regarding topics with a more theoretical aspect. The class schedule for language and computer skills also changed repeatedly, which was problematic for the external instructors who were new to the place. These issues were all revealed during informal discussions. A few of them also had recall bias. According to group 2, there was a gap in the implementation of the foundation course (class schedule, topic content,

etc.), but not in group 1 (where all classes were on time, with proper duration and content).

Other than the difference in response to these two modules, all other responses were positive.

The study by Suman in 2007 on the introduction of a Foundation Course for MBBS students at the entry level is similar to our study. They also concluded that a foundation course for medical students at the entry level is a way to facilitate their familiarization with the campus. It also broadens their horizon on the clinical application of knowledge and improves their behavioral patterns and initial experiences with teachers and patients. [9] A similar experience was noted in a study by Srinath in 2014. [10]

The study by Modi et al. in 2015 also concluded that professionalism is an integral part of the medical profession and that the implementation of a foundation course in the early days smoothens the transition to professional life; therefore, it is a crucial part of the medical curriculum. [11]

Mahsood and Khan, in 2019, also carried out a six-week foundation module. They concluded that the foundation course would help in the better understanding and application of basic science knowledge. As it is intricately modifiable by student feedback, it will be helpful in improving the quality of the curriculum. [12]

Ruprai et al. in 2020 found that the foundation course was a wonderful ice-breaking session among students. It also helps to break the initial barrier of teacher-student interaction. The students got familiarized with each other as well as with the institutional campus. [13] It also reduces various psychological barriers to learning.

Velusami D et al. also found that students showed good consensus, with a high percentage (>75%) in all modules of the foundation course. [14]

In our study, after analyzing teachers' feedback, we found that most documented responses mention it is a well-thought-out course for initial ice-breaking and better interaction. A few faculty members suggested inclusions, such as involving more faculty members or departments or creating more interactive classes in specific areas. The positive response in module 6 was lower (60%) than in other modules,

the reason being that many of these extracurricular activities were monitored by teachers from non-medical institutes, so faculty in our college were not all aware of their nature.

This is similar to the study by Velusami D. [14] They reported that faculty members suggested that Yoga and Computer sessions required further improved session planning, and they emphasized incorporating more interactive sessions in small groups. In our study, the response varied as we included four batches, and the pandemic and post-pandemic protocols were different. Although many faculty members had mixed responses, most projected a positive outcome.

## Conclusion

Our study concluded that there is good consensus among students and faculty members regarding the implementation of the foundation course. The statistics show an 80:20 ratio in favor of continuing the course. Faculty members are also motivated to implement it, as it works as an ice-breaker for students in a new environment.

There are a few limitations to this study that also guide the way for future studies. Student responses could have been open-ended with the scope for providing suggestions. As we have taken four batches, the late-response group had significant recall bias. This could be eliminated by conducting a multicenter study with the same entry year. Still, most of the responses were positive. There is also a component of bias, as students may have been hesitant to provide negative responses because the interviewer was a faculty member, out of respect for the student-teacher relationship. Although responses were recorded anonymously, identifying the batch year within a single institution is a significant identifier that may have compromised full anonymity.

Participation from students was limited. The batch that completed an entire year, with year-long time to experience and complete all modules properly, responded the most.

The response from faculty members was open-ended as it was not obligatory, and many skipped providing any suggestions. The responses could have been collected after a focused group discussion, incorporating more qualitative study techniques.

Our study concludes that the foundation course is well-perceived among students and faculty. In the beginning phase at our center, there was a gap in implementation due to various hurdles in a new setup, but with time, these hurdles were overcome, and the content and intent of the foundation course were clearly and effectively communicated.

**Ethical committee clearance:**

Date: 12.06.2021

Reference number: IEC/PGMCH/2021/008  
Committee name: Institutional Ethics Committee, Deben Mahata Government Medical College & Hospital, Purulia

**Source of funding:** None

**Conflict of interest statements:** None

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# Association of Physical Factors (BMI and WHR) with Physical Activity Level (PAL) and Gender-wise Comparison among College Students

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## Abstract

**Background:** Assessment of physical factors such as Body Mass Index (BMI) and Waist Hip Ratio (WHR) and their association with Physical Activity Levels (PAL) is essential among college student population for assessing their health risk & creating a healthy environment through the implementation of effective strategies by educational institutions.

**Methods:** A cross sectional study was conducted on 202 adult college students (male:105 & female: 97) of Kolkata, West Bengal, India, under the age group 18-23 years. They were randomly selected through Convenient sampling method and their PAL(MET-Min/Week) was estimated and classified using the guideline of International Physical Activity Questionnaire (IPAQ) Short. Their BMI & WHR were also measured and categorized as per WHO guideline. Co-relation of the BMI & WHR with their PAL has been analysed and the risk of chronic disease was observed. The study was approved by the Institutional Human Ethical Committee.

**Conclusions:** Majority (82.18%) of students had 'High' physical activity levels, with males showing significantly higher total mean PAL & WHR than females ( $p < 0.05$ ). Physically inactive were (4.46%) & Obese were 10.40% yet 25.25% of students were found at high cardiovascular & other health risk. While physical activity is crucial for overall health, its impact on BMI & WHR can be inconsistent as individual variability in response to exercise, dietary habits, metabolic rate and genetic predispositions etc. and also some other health matrices or hidden factors which should be explored through further research. While PAL had no significant correlation with BMI or WHR, the PAL-WHR correlation (Beta coefficient = 0.034) was comparatively stronger than PAL-BMI (Beta coefficient = 0.006), suggesting WHR is a more significant health indicator than BMI. This study thus highlighted the need for targeted health interventions in college student's populations especially the females to address obesity and the associated risks of cardiovascular and other chronic diseases.

**Key words:** 1. Body Mass Index (BMI), 2. Chronic Diseases, 3. Health Risk, 4. Metabolic Equivalent of Task (MET), 5. Physical Activity Levels (PAL), 6. Waist-Hip Ratio (WHR)

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## Introduction

The rising prevalence of chronic diseases among young adults is a growing public health concern, impacting academic performance and long-term well-being. Adult students face unique health risks like obesity and cardiovascular issues, influenced by academic stress, lifestyle habits, and low physical activity<sup>1</sup>. Monitoring key health metrics is vital for developing prevention strategies tailored to this group.

Assessing Physical Activity Level (PAL), Body Mass Index (BMI), and Waist-to-Hip Ratio (WHR) is crucial for understanding physical health in students. This knowledge helps design interventions to lower obesity and cardiovascular disease risks. The sedentary academic lifestyle, marked by long study hours, further raises chronic disease risks<sup>2</sup>.

Regular physical activity reduces risks of cardiovascular disease, obesity, diabetes, depression, and anxiety. Yet many students struggle to stay active due to academic pressures<sup>3</sup>. Addressing these health risks is a public health priority. This paper examines key physical factors and their co-relation to PAL among male and female students, using research-based evidence.

BMI and WHR are common health indicators. While BMI measures body composition and obesity, it has limitations. WHR better predicts cardiovascular and metabolic risks by reflecting fat distribution<sup>4</sup>.

Higher PAL is associated with lower risks of obesity, diabetes, and heart disease, with activity levels assessed through the International Physical Activity Questionnaire<sup>5</sup>. Gender differences exist, with males typically reporting higher PAL due to lifestyle and social factors<sup>6</sup>. Despite the benefits of physical activity, many college students remain inactive, increasing health risks<sup>7</sup>. Research suggests WHR may more strongly predict health risks in young adults than BMI<sup>8</sup>.

The main objectives of our study are:

1. To assess the PAL, BMI and WHR among college student population.
2. To categorise their PAL, BMI and WHR.
3. To assess the risk of obesity, cardio-vascular disease and other lifestyle-oriented diseases.
4. To study the association of PAL with BMI and WHR.

5. To compare the PAL, BMI and the WHR (health risks) between the male and female participants.
6. To find out which of the physical factors between BMI and WHR is a better indicator of the health risk in student population.

## Materials and Methods

A cross-sectional study was conducted with 202 undergraduate students (105 males and 97 females) from Netaji Nagar Day College, Kolkata, West Bengal, India. The study was carried out between November 2022 and April 2023. Solvin's formula has been applied for sample size calculation. PAL of 464 participants has been estimated using IPAQ. All the 464 participants have been invited in the laboratory to participate in BMI & WHR measurement but only 272 turned out. Following exclusion criteria only the measurement of 202 students were considered for the study. So, association of PAL of those 202 students with their BMI & WHR has been analysed and their health status has been studied. The age of the participants ranged between 18 and 23 years. A convenient sampling method was employed ensuring representation from diverse socio-economic backgrounds. Eligibility criteria includes, participants to be healthy male or female adults aged 18-23 years and enrolled in an undergraduate general degree program. All participants provided informed consent before taking part in the study. Individuals younger than 18 or older than 23, as well as those with any known illness or physical disability, were excluded. The study protocol was reviewed and approved by the University of Calcutta Human Ethical Committee.

### PAL Estimation Procedure

The PAL score was determined based on energy expenditure, measured in Metabolic Equivalent Task minutes per week (MET-min/week), using the International Physical Activity Questionnaire (IPAQ). The questionnaire was administered through Google Forms. The validity and reliability of the IPAQ short form have been evaluated across multiple nations, confirming its suitability for large-scale research<sup>9</sup>.

The MET values for vigorous, moderate, and walking activities were calculated using the IPAQ short form<sup>10</sup>. The total PAL score, expressed in MET-min/week, was obtained by summing up these three values. Based on the scores, participants were classified as Low, Moderate, or High Physical Activity (PA) categories, following standard IPAQ guideline and scoring protocols.

Low PAL: < 600 MET-minutes/week  
 Moderate PAL: 600-3000 MET-minutes/week  
 High PAL: > 3000 MET-minutes/week

**BMI Measurement Procedure**

BMI was calculated using the formula of Corrada et al., 2006<sup>11</sup> (weight in kg/height in m<sup>2</sup>) and categorized according to WHO standards (underweight, normal weight, overweight and obese)<sup>12</sup>.

BMI<18.5	Underweight
BMI18.5–24.9	Normal weight
BMI 25.0–29.9	Overweight
BMI ≥30.0	Obesity

**1. Weight Measurement:** A calibrated scale was used to measure the weight in Kilogram (Kg) ensuring the individual is in light clothing and without shoes.

**2. Height Measurement:** The individual’s height was measured in meters (m) using an Anthropometric rod.

**Method for Measuring Waist-Hip Ratio**

WHR was measured by measuring the waist and Hip circumferences, using a measuring tape. The WHO report emphasizes that WHR is a significant indicator of health risks, independent of BMI.<sup>13</sup>.

**Calculating the Waist-Hip Ratio (WHR)<sup>14</sup>.**  
**Formula:** WHR is calculated by dividing the waist circumference by the hip circumference:  
 WHR=Waist Circumference/ Hip Circumference.

This ratio is used to assess the distribution of body fat and the associated risk of cardiovascular and other obesity-related diseases.

- Low risk:** ≤ 0.90 (for men) and ≤ 0.85 (for women).
- Moderate risk:** 0.91 - 0.99 (for men) and 0.86 - 0.89 (for women).
- High risk:** ≥ 1.00 (for men) and ≥ 0.90 (for women).

**Statistical Analysis**

PAL, BMI and WHR scores are presented as mean ± Standard deviation. BMI and Health risk categorization has been shown in terms of percentage. Bar diagrams have been used and independent sample t-test was done to show the comparison of PAL, BMI and WHR between male and female participants. The normality and linearity analysis were applied to all variables. The comparative co-relation of PAL scores with BMI and WHR has been shown by Multiple regression analysis. The SPSS 26.0 for Windows was used to carry out the statistical analysis.

**Results and Discussion**

**Table 1: Independent sample t-test of the Means of Physical Activity Level (PAL) categories, Body Mass Index (BMI) and Waist-Hip Ratio (WHR), showing gender wise comparison (values are shown in terms of Means ± Standard deviation; t-test was done and values are found to be significant, p<0.5)**

	PAL (IPAQ)				BMI	WHR
	Total PAL (MET-Min/ Week)	High PAL (MET-Min/ Week)	Moderate PAL (MET-Min/ Week)	Low PAL (MET-Min/ Wee)		
	(p=0.02)*	(P=0.08)	(P=0.54)	(P=0.17)	(P=0.42)	(P=0.01) *
All Participants (N=202)	6224.36 ± 4007.99	7175.31 ± 3778.36	2152.41 ± 870.36	900.56 ± 306.16	23.98 ± 4.69	0.87 ± 0.08
Male (n=105)	6850.36 ± 4169.27	7649.37 ± 3890.74	2004.56 ± 880.12	1030.8 ± 333.86	23.72 ± 4.2	0.88 ± 0.09
Female (n=97)	5546.73 ± 3729.62	6600.11 ± 3578.98	2226.33 ± 881.3	737.75 ± 194.24	24.26 ± 5.17	0.85 ± 0.05

The study revealed that mean & SD of PAL scores of all participants is  $6224.36 \pm 4007.99$ . When the means of total PAL score and WHR score of male

and female are compared, the difference has been found statistically significant ( $p < 0.5$ ), with males having higher values than females.

**Table 2: Gender wise comparison of Physical Activity Level (PAL) categorization (IPAQ), Body Mass Index (BMI) Categorization (WHO) & Health risk Categorization (WHO) (Values are shown in terms of percentage)**

(n=202)	PAL (IPAQ)			BMI (WHO)				WHR/Health risk (WHO)		
	High PAL	Moderate PAL	Low PAL	Normal weight	Over weight	Obese	Under weight	High risk	Moderate risk	Low risk
All Participants	166 (82.18%)	27 (13.36%)	09 (4.46%)	104 (51.48%)	55 (27.23%)	21 (10.40%)	22 (10.89%)	51 (25.25%)	36 (17.82%)	115 (56.93%)
Male (105)	91 (86.67%)	9 (8.57%)	5 (4.76%)	53 (50.48%)	34 (32.38%)	7 (6.67%)	11 (10.47%)	6 (5.71%)	3 (2.86%)	96 (91.43%)
Female (97)	75 (77.32%)	18 (18.56%)	4 (4.12%)	51 (52.58%)	21 (21.65%)	14 (14.43%)	11 (11.34%)	45 (46.39%)	33 (34.02%)	19 (19.59%)

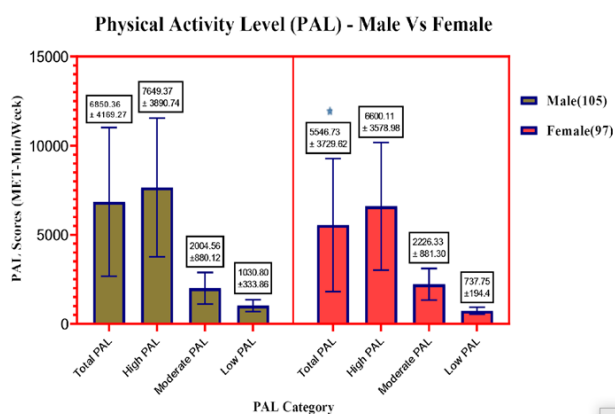
A significant majority (82.18%) fell into the High PAL category. Such findings suggest that as a whole, the student population demonstrates a commendable level of physical activity, which could help lower the risk of chronic diseases. A study by Sahin et al., 2017<sup>15</sup> found that 59.1% of students at a Turkish university engaged in adequate physical activity, with the rest reporting low or no activity. Similarly, our results are consistent with the findings. Young adults may be motivated to stay active due to social influence from their peers and an increased awareness of the importance of physical health and its long-lasting benefits, which may drive them to maintain higher physical activity levels<sup>16</sup>.

The BMI analysis revealed that the mean and SD of BMI values of all participants is  $23.98 \pm 4.69$  (Table-1). 27.23% of the students were classified as Overweight and 10.40% were Obese (Table-2). The results underscore a significant proportion of students, who are overweight or obese, reflecting potential concerns related to their nutritional intake and overall lifestyle. The data suggests a need for interventions focused on balanced nutrition and weight management<sup>17</sup>.

Males showed a higher percentage of 'Overweight' (32.38%) compared to females (21.65%). Conversely, a higher percentage of female were 'Obese' (14.43%) compared to male (6.67%) (Table-2 & Fig-2).

The WHR results indicated that the mean & SD of WHR value of all participants is  $0.87 \pm 0.08$  (Table-1). 56.93% of students had a low risk of cardiovascular diseases, 17.82% were at moderate risk, and 25.25% were at high risk. (Table: 2). Similar observation has been made by Flint et.al 2010<sup>18</sup> who found that "both higher BMI and larger waist circumference were independently associated with an increased risk of Coronary Heart Disease (CHD). Importantly, waist circumference provided additional predictive value for CHD risk beyond BMI, suggesting that central obesity (indicated by waist circumference & waist-hip ratio) may be a stronger predictor of heart disease than overall obesity. This research highlights the significance of measuring waist-hip ratio in assessing cardiovascular risk, supporting the use of waist circumference along with BMI in clinical settings for a more accurate risk assessment. The distribution suggests that while a majority of students are at lower risk, a significant portion still faces a higher risk of cardiovascular and other chronic diseases.

Central adiposity is associated with elevated levels of visceral fat, which is metabolically active and strongly linked to insulin resistance, inflammation, and increased CVD risk. Studies suggest that even in younger populations, such as college & university students, elevated WHR is associated with an increased likelihood of developing metabolic syndrome and other chronic conditions over time if preventive measures are not taken<sup>19</sup>.

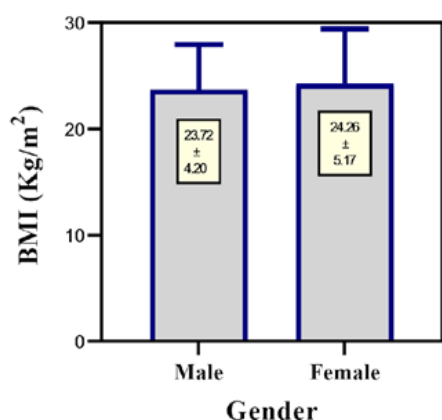


**Figure-1: Comparison of Physical Activity Level Categories between Male and Female (values are Mean ± Standard deviation; “t” test was done and \*p < 0.05 was considered to be significant.)**

The results indicated a statistically significant difference in the mean of total PAL scores between male and female (p-value < 0.05). Specifically, male students exhibit a higher mean PAL compared to females. (Table-1,2 & Figure-1). These findings are consistent with the studies of Wang et al., 2021<sup>20</sup>, that have noted gender differences in physical activity patterns and body composition. The probable cause behind this may be the metabolic and Physiological differences (Body composition & Hormonal influences)<sup>21</sup>. Dietary and Eating Habits<sup>22</sup> & Socio-cultural and Psychological Factors<sup>23</sup>.

The BMI scores revealed statistically insignificant difference between male and female (p value >0.05) (Table-1 & Figure-2). Al-Isa et.al; (2004)<sup>24</sup> observed similar patterns among Kuwaiti adolescents.

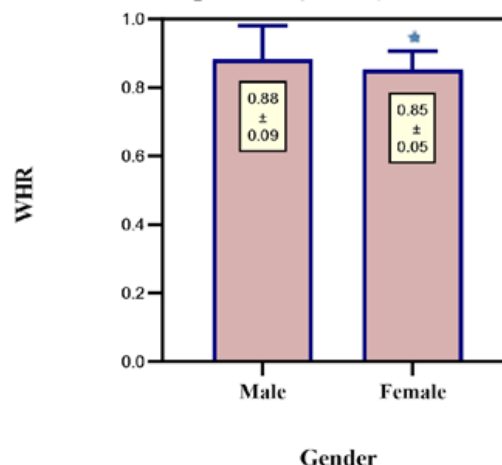
**Body Mass Index (BMI) Male Vs Female**



**Figure-2: Comparison of Body Mass Index (BMI) between Male and Female (values are Mean ± Standard deviation; “t” test was done and p > 0.05 was considered to be insignificant).**

A higher percentage (91.43%) of male students were classified under ‘Low risk’ compared to females (46.39%). Females had a higher percentage of ‘High risk’ (19.59%) compared to their male counterparts (2.86%) (Table:2 & Fig:3).

**Waist-Hip Ratio (WHR) Male Vs Female**



**Figure 3: Comparison of Waist-Hip Ratio (WHR) between Male and Female (values are Mean ± Standard deviation; “t” test was done and \*p < 0.05 was considered to be significant).**

This study emphasizes the importance of waist circumference & WHR as useful measures for assessing obesity-related health risks.

Results revealed that majority of students fall within a moderate to high level of physical activity, with a significant portion at risk for chronic diseases due to elevated BMI and WHR. Females are significantly more under obese category (indicated by BMI) and at a higher risk to cardio-vascular diseases (indicated by WHR) than the males. Although the WHR data aligns with the BMI findings yet more proportion of female are under high risk (46.39%) than the obese (14.43%) (Table-2) indicating that Central obesity/WHR is a more significant indicator of the health status within this population. This finding also corroborates with the finding of Lee C.M et.al 2008<sup>25</sup> which revealed that the Indices of abdominal obesity (Waist circumference & WHR) are better discriminators of cardiovascular risk factors than BMI.

The analysis of the correlation between PAL scores and the two health-related measures i.e., BMI and WHR, yielded results indicating that PAL scores do not significantly explain the variance in either independent variable, suggesting a lack of statistical significance in these relationships.

Although not statistically significant, the correlation between PAL scores with WHR ( $\beta = 0.034$ ) was slightly stronger than with BMI ( $\beta = 0.006$ ), indicating a marginally better association of PAL score with WHR than BMI. (Table-3)

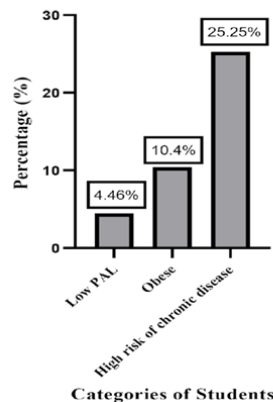
**Table 3: PAL co-relation with BMI &WHR (PAL- Dependent variable, BMI &WHR- Independent variable)**

Co-relation	p-value	Standard co-efficient Beta
PAL with BMI	0.928	0.006
PAL with WHR	0.632	0.034

This observation is consistent with findings from a study by Slentz et al., 2004<sup>26</sup>, which reported that physical activity may have a more pronounced effect on body fat distribution than on overall body weight. These results highlight the complexity of the relationship between physical activity and various health matrices. Factors such as individual variability in response to exercise, dietary habits, and genetic predispositions may contribute to the observed lack of significant correlation. Future research should consider these factors and explore more precise models that account for the multifaceted nature of physical activity and health.

This study raised a critical question that in spite of high PAL value (82.18%) and Low percentage of Obese (10%) observed among college student population why a significant no. of students (25.25%) falls under the category of high risk of chronic disease? (Figure- 4)

**Comparison of percentage of students with low PAL, Obese and High risk of chronic diseases**



**Fig 4: Comparison of percentage of students with Low PAL, Obese and High risk of chronic diseases (Values are shown in percentage)**

## Conclusion

This study underscores the importance of examining the relationship between Physical factors like BMI and WHR with physical activity levels (PAL) and the risk of chronic disease among college students. While physical activity is essential, its effects on BMI and WHR are influenced by factors such as diet, metabolism, and genetics. The lack of significant correlation between PAL and WHR suggests that physical activity alone does not determine health status. Despite high PAL among students, elevated rates of overweight and central obesity point to other contributing factors. WHR proves to be a more specific indicator of central obesity risk than BMI, especially among females who, despite normal BMI, show higher obesity risk. Comprehensive health programs promoting physical activity, balanced diets, and regular check-ups are crucial. Educational institutions must actively support such initiatives. Limitations include self-reported PAL data, small sample size, and unexamined behavioural factors, warranting further research.

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## Conflict of interest: Nil

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**Ethical clearance:** Ethical clearance has been taken from Institutional Human Ethical Committee, Department of Physiology, University of Calcutta, Ref.no. IHEC/AC/P89/2019 dated 18.12.2019.

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# A Comparative Study of Diseases Prevalence among Tribal Women in Different Villages of Khowai District, Tripura: A Hospital Data - Using GIS

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## Abstract

The both communicable and non-communicable diseases that are interfering with normal biological functions which cause mortality or misery on a physical, psychological, or social level impact. Numerous things might cause it, such as infections, genetic flaws, dietary inadequacies, environmental influences, or even lifestyle decisions. The present study is made to assess the disease's prevalence among tribal women in different villages of Khowai district in Tripura. The study focuses on understanding the health conditions of tribal women based on the government hospital registry. The mapping of spatial distribution and pattern of women cases is carried out using GIS (Geographic Information System) the study shows the diffusion of diseases across the district. In order to determine the frequency of the diseases in the district, the side specification of 499 cases were analysed, and the result revealed that the categorization of diseases, such as; fever, stomach discomfort, anaemia, weakness, infections, and respiratory issues, are classified. The most affected age-group of 21-30, and 41-50 are found in the three villages namely; Kalyanpur, Tulakshikhar, and Champa Hour. The results revealed that a Chi-square value ( $X^2$ ) of 15.03, and p-value  $< 0.005$ , and hence, the disease prevalence is statistically high significant with the age groups of 21-30 and 41-50, are the most affected susceptible women community in the district. The study also examined variables that may impact disease transmission and healthcare availability, such as temperature, slope, and rainfall. This study emphasises the need for improved healthcare infrastructure, education, and prompt treatment among tribal communities.

**Key words:** Communicable and Non-communicable diseases, spatial distribution, health care delivery services, women community, Geographic Information System (GIS)

## Introduction

The availability and accessibility of hospitals, including primary health centres (PHCs), sub-centres, and private hospitals and health clinics in

various places are referred to as the spatial dispersion of healthcare delivery services. The unequal distribution of healthcare facilities in Khowai district, thickly populated tribal areas, frequently reported

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issues like stretched travel times, a lack of health care clinical service centres, and hospitals with poor infrastructure facilities. Further influencing healthcare-seeking behaviour are traditional beliefs and reliance on indigenous healing methods, which can occasionally postpone or replace contemporary medical interventions among the tribal community. To find service delivery gaps and provide the efficient health care clinical services, it is crucial to comprehend the spatial distribution of healthcare services in the Khowai district. The purpose of this study is to evaluate the current healthcare system, how easily tribal groups may use it, and what all the factors affect clinical service utilisation. Teenage gestation, practices, and utilisation of Reproductive and Child Health (RCH) Services by the ethnic and Non- ethnic population of West and South Tripura shows the frequency of adolescent gestation.

The use of reproductive and child health (RCH) services by both tribal and non-tribal people in West and South Tripura are excavated<sup>1,2</sup>. Outbreak of waterborne acute diarrheal disease in a South District village of Tripura needs a public health emergency in the Northeast region of India<sup>3</sup>. Pulmonary function of adolescents from Tripura gives the information on respiratory health and evaluates the pulmonary function of teenagers among the racial inhabitants in the area, Tripura<sup>4</sup>. A determinant of child commerce rate in West and South Tripura, India provides the information on demographic trends of tribal communities<sup>1</sup>. A Comprehensive Rural Health Project highlights the contribution of village healthcare

workers enhancing the health of tribal and rural communities<sup>5</sup>. The accessibility and economic aspects are important to tribal women when it comes to institutional births in rural India<sup>6,7</sup>. The mixed-methods provides how cultural practices, beliefs, and perceptions affect how people seek medical attention and how they use maternal and new-born health services in Northeast Indian among the tribal communities<sup>8</sup>. A study of non-communicable diseases risk factors among the tribal population of Tripura, facing tribal adolescent girls in Tripura, to use various ailments, and provides information on the life-course<sup>9</sup>.

### Study Area

Khowai district, in the north-eastern state of Tripura, India, is distinguished by its various tribal people and distinctive natural features. The Atharamura range to the east and the Baramura range to the west border the district, which is named after the Khowai River. The district's healthcare system consists of one district hospital (Khowai Hospital), five Public Health Centres (PHCs), and 43 health sub-centres (Fig.1). The district's rugged terrain, extensive forests, and scattered rural settlements all have an impact on healthcare service accessibility and distribution. The tribal tribes rely heavily on traditional medicine and government-provided healthcare, but access is inconsistent across the region. The district's healthcare system consists of one district hospital, several Public Health Centres (PHCs), health sub-centres, and a few private healthcare providers.

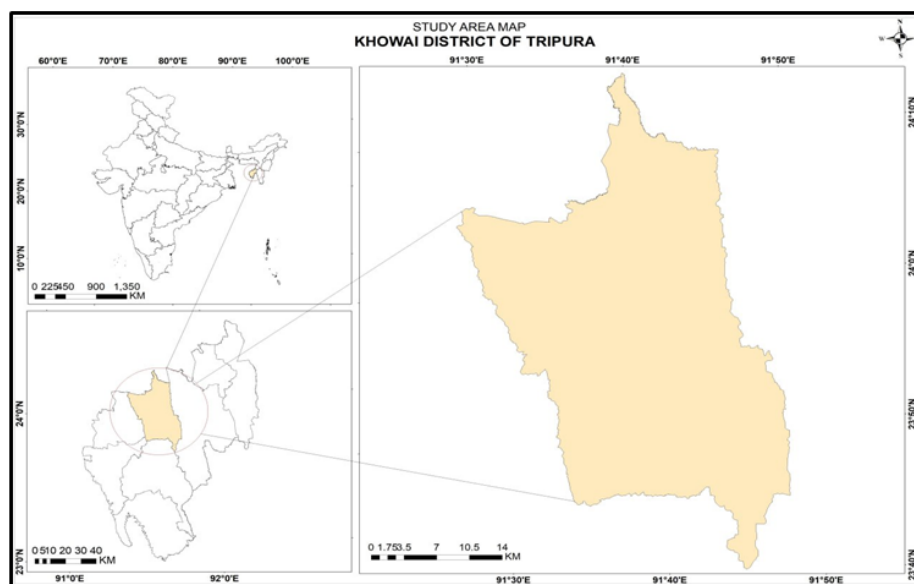


Fig 1. Study area-Khowai District, Tripura

## Objectives

1. To mapping the spatial distribution of women's patients in different villages in Khowai district, Tripura
2. To study the diseases prevalence among tribal women in different villages of Khowai district, Tripura
3. To evaluate the accessibility of the healthcare facilities, and study the healthcare seeking behavior of tribal women in different villages in the Khowai district, Tripura

## Material and Methods

The clinical data are pertaining to the OPD patients of tribal women's patients' collected from the government district hospital registry. The Quantum Geographical Information System (QGIS) 3.30.1 and Statistical Package for Social Scientists (SPSS) IBM SPSS Statistics 21.0 are used for mapping the spatial distribution and the geographical analysis of the patient's clusters of both vertical and horizontal structure of the diseases. Totally, 499 tribal women's patients are collected from district hospital Khowai,

Tripura, and are exported to the QGIS platform for mapping the spatial distribution of tribal women patients for the period of 2020 -2024. The longitudes and latitudes are generated from the Google map and Google earth pro for mapping patient's household site specification. Hospital OPD data are analysed using geo-statistical tools to assess the affected vulnerable age groups.

## Result and Discussion

The mappings of spatial distribution of 499 women's patients in Khowai district are carried out the year 2020-2024 (Fig.2). It is observed that the patient's site specifications are found ubiquitous and random spatial distribution in the different villages across the district. The most affected villages of Khowai district, which have the highest concentration of patients. Among the 499 cases of women's patients these are the most affected villages that have the high suggesting of Khowai area may be a hotspot for women's health care issues.

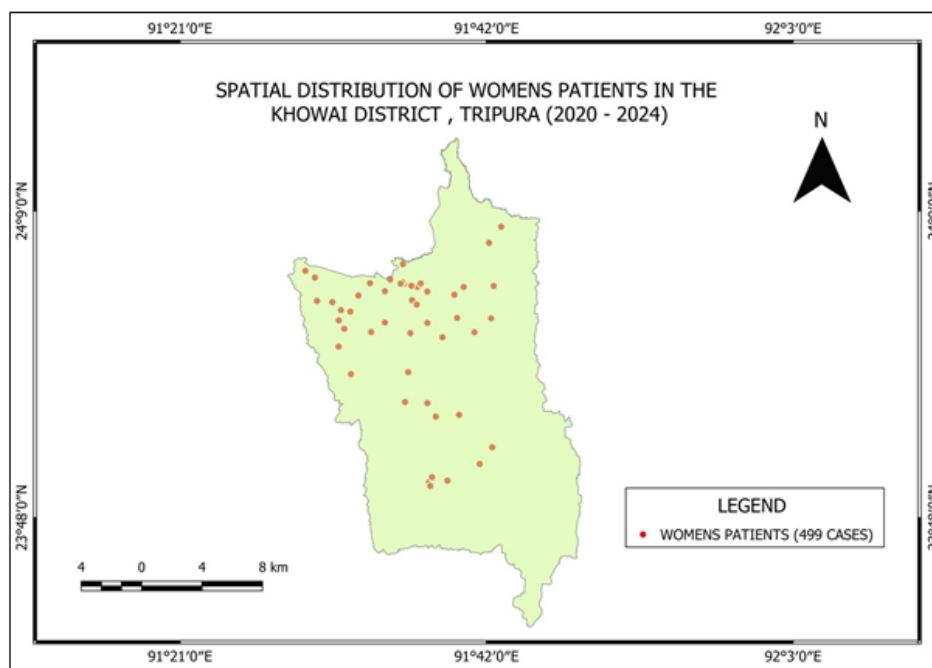
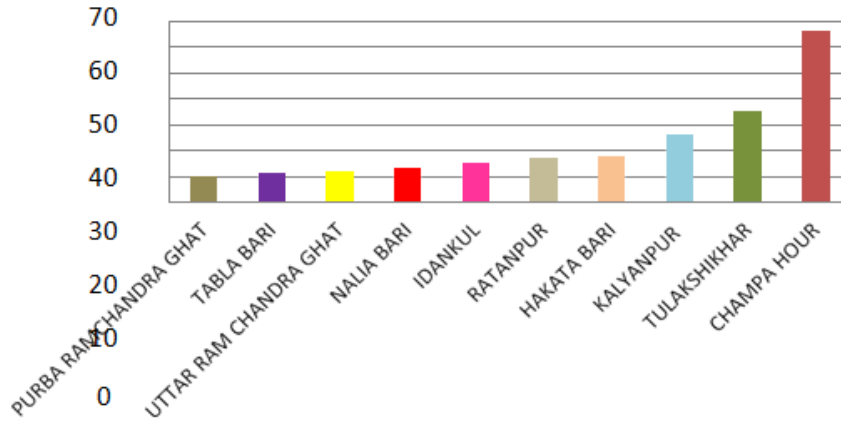


Fig 2. Spatial Distribution of Women's Patients in Khowai District, Tripura

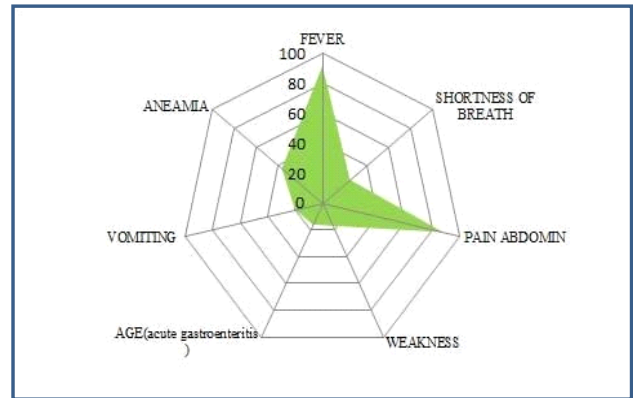


**Fig. 3. Most affected villages Women's Patients in Khowai District, Tripura**

From the year 2020 to 2024 these are the most villages are situated in the areas which are easier to undergo better health care clinical services due to good transportation network systems, villages like Champa Hour, Tulakshikhar, and Kalyanpur are located in the district's middle and southern regions, which display a cluster of high patient counts. Hence, Champa Hour is the most impacted community, with 66 patients (13.2%) reported there alone. A regional health concern or environmental, climate and socio-economic risk factors are playing vital role in the incidence of diseases. Tulakshikhar and Kalyanpur are located in semi-urban areas with comparatively superior health infrastructure, which perhaps helps explain the higher reporting rates with 35 and 26 instances reported, respectively. Moderate-case villages like Hakata Bari and Ratanpur, which had 18 and 17 patients reported, respectively, are the examples of places where there area less number of patients at this time but not yet at a critical level. Purba Ramchandra Ghat and Uttar Ramchandra Ghat are two examples, which badly need of new health care clinical service centres nevertheless of population size in the village (Fig 3).

The most prevalent health apprehensions of 499 women patients in the Khowai district are classified as *Fever* (92 patients) and *Abdomen Pain* (88 patients), *Shortness of Breath* (25 patients), *Vomiting* (20 patients), *Weakness* (17 patients), and *Severe Gastroenteritis* (16 patients) (Fig.4). Most of the health issues are caused by infections, poor food and water hygiene, and an inadequate health care services. *Anaemia* was identified in 37 women,

indicating that poor nutrition is also a serious concern (Fig.4).



**Fig.4 Graphical Presentation of High Impacted Disease (2020-2024), Khowai district, Tripura**

Abdominal discomfort is the most prevalent health problem, affecting 88 women, because, in rural regions, women frequently refer to "pain in the stomach" when they are ill, even when the condition may be connected to menstruation, digestion, urinary tract infections, or other internal problems. There were also 2 patients of *Gastritis* this can cause pain in the upper abdomen, it is often described as burning, 2 patients of *Epigastric Pain*, 1 patient of burning micturition this causes the discomfort when urinating, burning or pain during urination, 1 patient of *Dysmenorrhoea* menstrual discomfort, 1 patient of *Ascitic Fluid* this causes the fluid that builds up in the abdomen, and 1 patient of *Polytrauma* this causes multiple pain to different parts of the body or organ system, it can also include severe pain, bleeding, etc. Despite the fact that these problems are

prevalent among women, these figures are quite low. It's likely that the local health care centres don't have the necessary tools or skilled staff to identify specific

diseases, so doctors record broad symptoms like "abdominal pain" (Fig. 5).

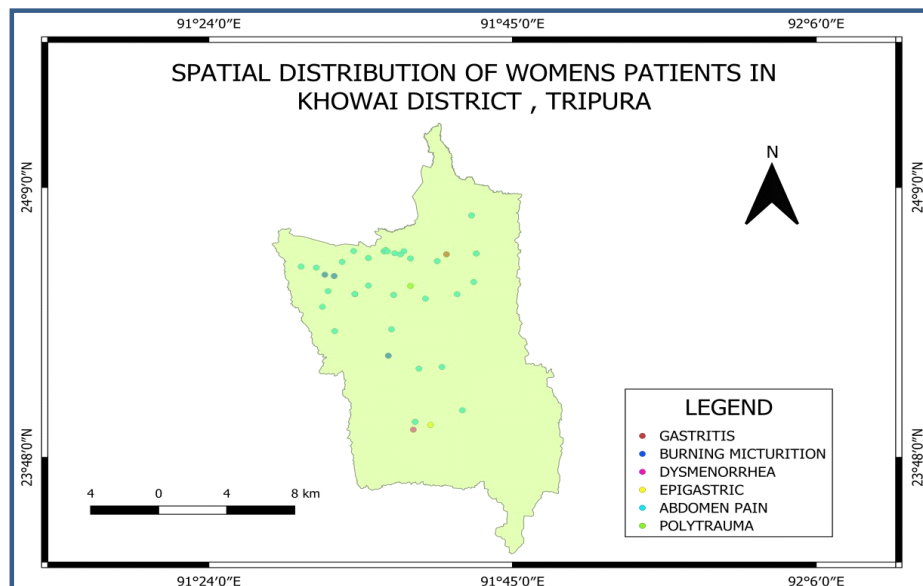


Fig. 5 Spatial Distributions of Women’s Patients in Khowai District, Tripura

Fever is the most commonly reported health issues in the study villages, recorded 92 women cases, it clearly shows that fever is a widespread problem in the region may be linked to infections such as seasonal flu, malaria, and water-borne diseases, etc. Fever is also a typical early sign of many illnesses. The second problems was *Acute Gastroenteritis* (AGE), which affected 16 women’s. This illness is mainly caused by drinking hazardous water or unsanitary food. It produces symptoms such as diarrhoea, vomiting,

and abdominal pains. Back pain, which is reported in 6 women’s, is another common problem, particularly among women in rural areas who frequently do heavy housework, farming, and physical works. If not treated properly, this might result in chronic physical pain, and 3 cases reported with *Accidental Falls*, these might occur as a result of bad flooring in homes, slippery outdoor settings, or even health concerns such as dizziness or poor vision (Fig. 6).

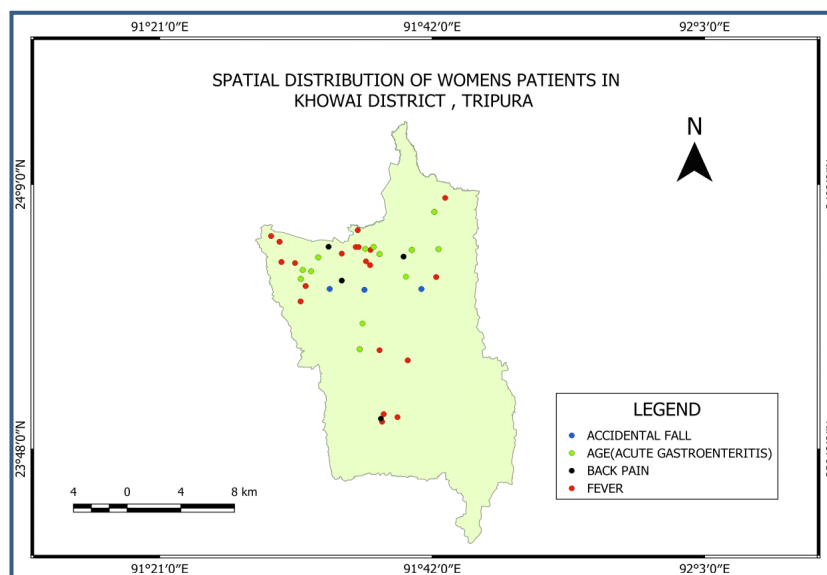


Fig. 6. Spatial Distribution of Women’s Patients in Khowai District, Tripura

The women patients in Tripura, Khowai district are described on their health concern relevant to the body pain, among the 499 patients, 6 patients are having back discomfort with pain, making it most prevalent type of pain both *Knee Pain* and *Leg Pain* having with 1 case in each. Back pain that continues over time might result from straining the muscles and spine while carrying heavy goods, firewood, or water, and the issue may worsen if you sleep on hard or uneven surfaces or have poor posture. *Leg* and *Knee Pain* may be caused by ageing, joint stress, or minor injuries, but even though the numbers are low, they indicate that musculoskeletal problems exist and should be addressed because many women may not seek treatment until the pain becomes severe. This highlights the Based on the data, *Shortness of Breath* is the most common among these patients, and

25 patients are recorded with severe symptoms of heart disease, lung infections, or asthma. *Chest Pain* with 11 patients is the indication of cardiac disease, but it might be because of acidity or strained muscles. In order to rule out dangerous illnesses, early diagnosis is essential. *Cold and Cough* with 4 patients, although these are typical seasonal issues, improper treatment might result in more severe respiratory infections. Headache and Reeling with 8 patients are recorded as stress, weakness, inadequate nutrition, or underlying illnesses like high or low blood pressure may be connected to these symptoms. In hypertension (high blood pressure) with 4 patients identified, if untreated, it can result in heart disease and stroke, on the consequence; they should be undergone for periodical health check-up (Fig 7a, b).

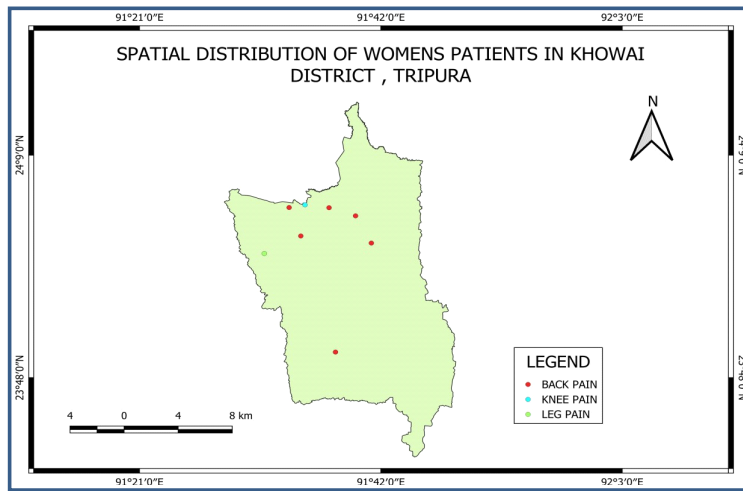


Fig. 7(a). Spatial Distribution of Women’s Patients in Khowai District, Tripura

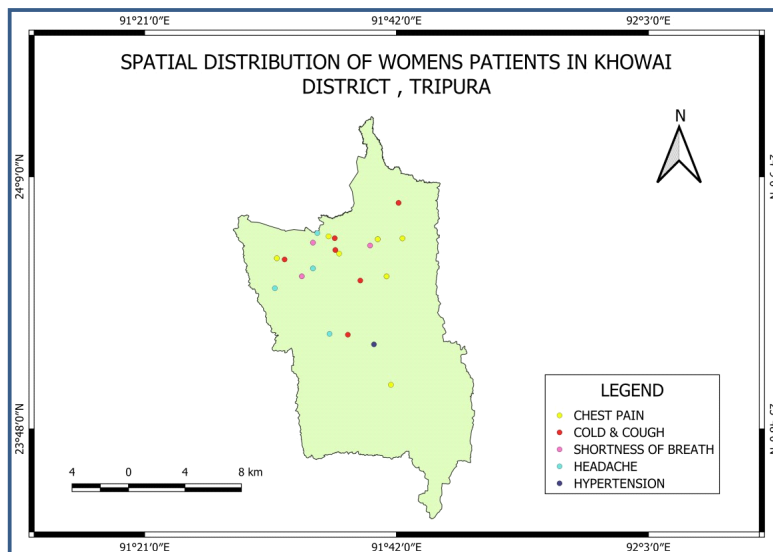
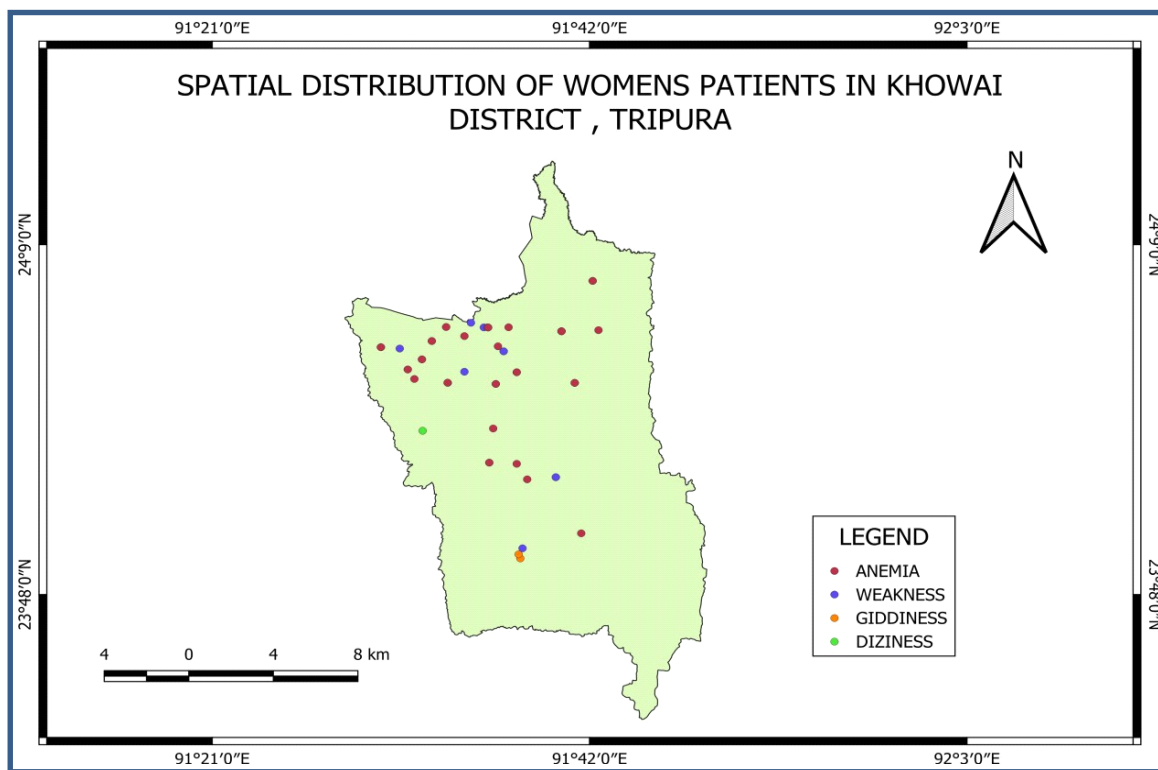


Fig. 7(b). Spatial Distribution of Women’s Patients in Khowai District, Tripura

The general health issues like malnutrition, *Anaemia*, irregular menstrual flow, and chronic disease are found common in the villages of Khowai district, and 37 *Anaemia* cases are recorded during the study period mainly caused due to insufficient vitamin, and minerals among the women patients, and most specifically, below the Indian Council of Medical Research (ICMR), and World Health Organization (WHO) standard of health indicators, are causing fatigue, pale skin, and poor energy, which makes it hard for women to go to their everyday work (Fig. 8). Another case is *Weakness* recorded 17 patients along with anaemia, *giddiness* 7 patients, and

*dizziness* 3 patients caused by etiological effect, such as; poor diet, excessive labour, or lack of sleep could be the cause of this disease. These symptoms may be appeared minor, but they can indicate underlying concerns such as low blood pressure, dehydration, or iron deficiency. Women who frequently feel dizzy or faint may be at risk of injury or falling and should be evaluated on a regular basis. These symptoms indicate that nutritional health is a major concern for women in the region. There is a need to enhance nutrition quality, boost anaemia awareness, and urge women to seek treatment early (Fig 8).



**Fig. 8. Spatial Distribution of Women's Patients in Khowai District, Tripura**

Body pain with oedema 5 women patients are reported, mainly due to overwork, exhaustion, and lack of sleep are most prevalent in the rural communities, where women are engaged as daily wage physical workers involved in the agricultural farm, construction, and the small scale industries. Additionally, there were isolated instances of particular pains: 1 incidence of *Lumbar Spine* discomfort, which is a term used to describe *lower backpain*. This might result from bending for extended periods of time at work or from lifting large objects. *Shoulder Ache* with (1 women

patient) which could be caused by joint problems or repetitive activities. There was additional *Swelling* with (2 patients), manifested as overall body swelling. This can cause due to of poor circulation, fluid retention, infection, and injuries can all contribute to swelling. Despite being few in comparison to other diseases like *fever* or *anaemia*, these symptoms are nonetheless significant. They are a reflection of physical stress and potential long-term conditions that can interfere with a woman's everyday life and professional capacity (Fig 9).

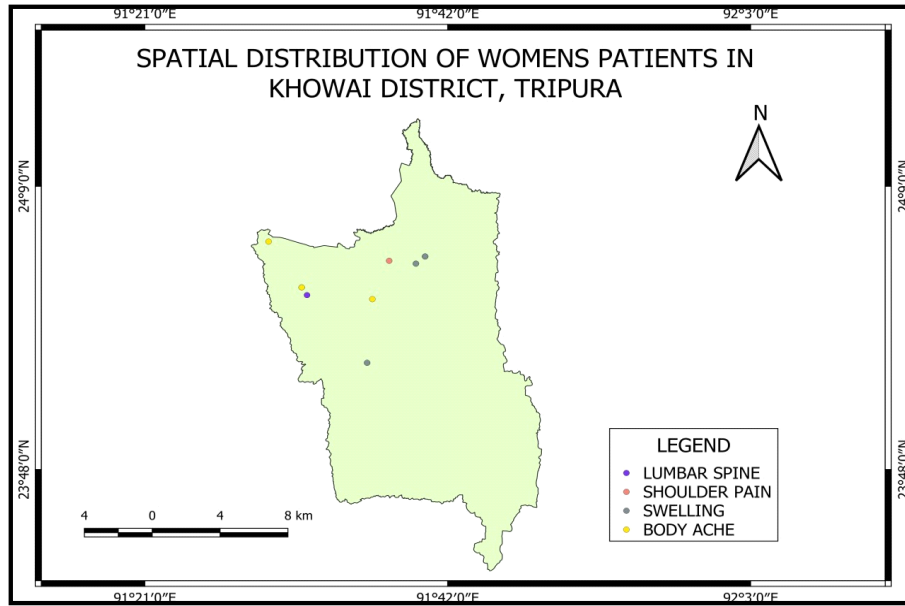


Fig. 9. Spatia l Distribution of Women’s Patients in Khowai District, Tripura

In the Khowai district, women were found to have digestive and urinary difficulties. Constipation was the most common issue among this group, with seven recorded cases. *Constipation* can be induced by a low-fibre diet, insufficient water intake, or a lack of physical activity. It might cause discomfort, stomachache, and loss of energy. There were also 5 cases of *loose motion* or *Diarrhoea*, which is typically

caused by illnesses, dirty water or food, or poor hygiene. Though it may appear to be a minor issue, if not addressed appropriately, it can result in dehydration and weakness, only one case of *Lack of Appetite* was reported, but it is nonetheless significant, and is concerned about their basic digestive and urinary health (Fig.10).

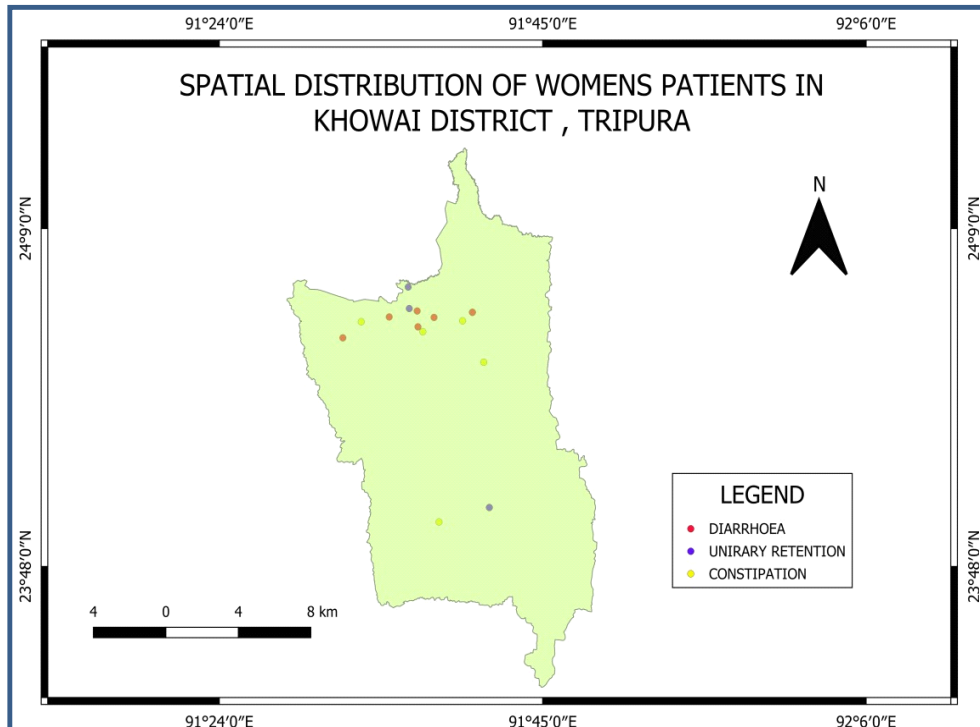
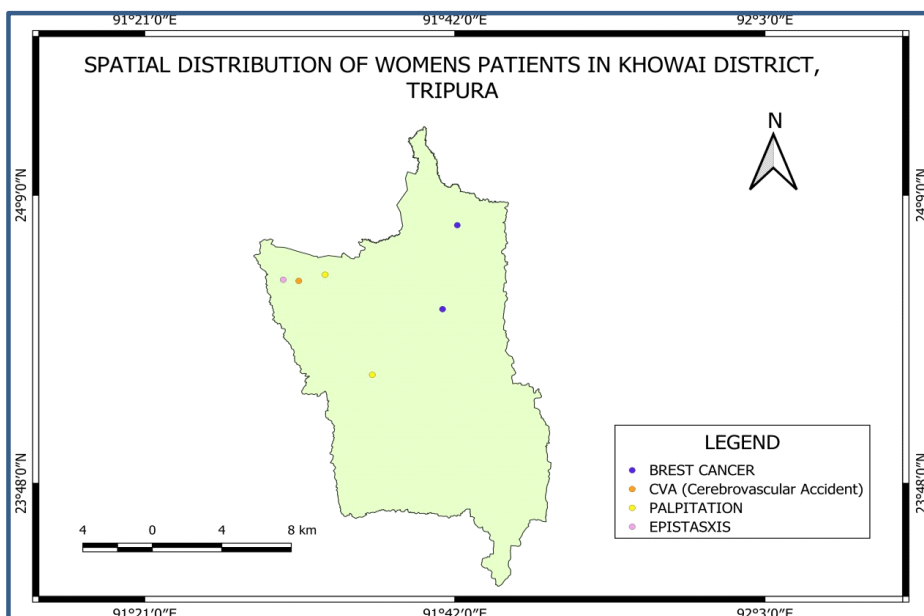


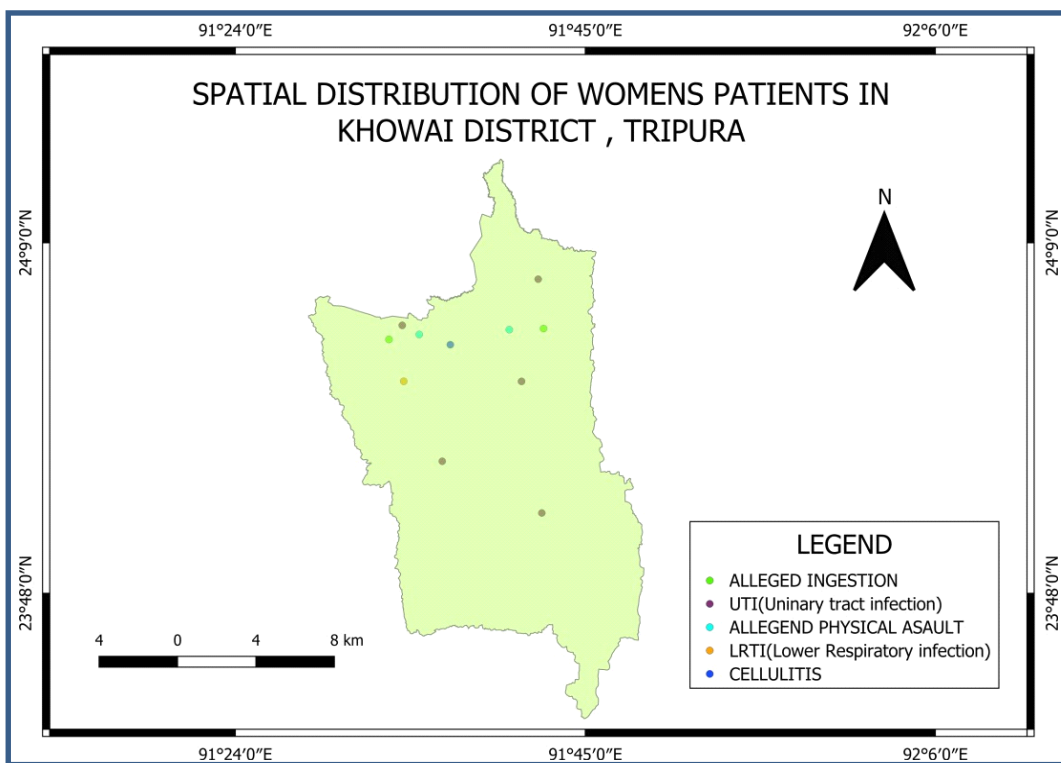
Fig. 10. Spatial Distribution of Women’s Patients in Khowai District, Tripura



**Fig. 11. Spatial Distribution of Women’s Patients in Khowai District, Tripura**

Breast cancer was reported 2 cases, despite the modest number; this ailment is dangerous, emphasizing the importance of frequent check-ups, awareness, and early identification in rural settings. CVA (stroke), reported with 2 cases, it is a major health concern, particularly among older women and

those with high blood pressure or other underlying conditions. *Palpitations* with 2 cases are registered irregular or fast heartbeats, 1 patient shows epistaxis (nose bleeding) and 1 case was identified with *Chronic Liver Disease (CLD)*, which could be caused by hepatitis, prolonged alcohol use (Fig.11).



**Fig. 12. Spatial Distribution of Women’s Patients in Khowai District, Tripura**

Patients with *Ingestion Incidents* 3 cases, and 1 *Acid Ingestion* case were among the most serious issues identified. There were two recorded incidences of *Alleged Physical Assault*, highlighting the continued threat to women's safety and domestic abuse. One case of LRTI (Lower Respiratory Tract Infection) was reported. Early identification and antibiotic therapy are critical for controlling these infections. *Cellulitis*, a bacterial skin infection, was found in one patient and can be deadly, if left untreated, particularly in those with diabetes, one case with *Urinary Tract Infection* (UTI) was registered, and are found common and followed by *Abdominal Pain* (88 cases) are recorded (Fig 12).

*Shortness of breath* with (25 patients), which could indicate a respiratory illness, asthma, or cardiac problem. *Vomiting* was reported with (20 patients), and it was frequently associated with *Acute Gastroenteritis* (AGE), which included 16 instances, indicating that digestive health concerns are also prominent. *Anaemia* affected with (37 women), indicating significant nutritional deficits. *Weakness* (17 cases), *Headache or Reeling* (8), and *Giddiness* (7) were also often reported, most likely due to anaemia or other underlying issues. *Back discomfort*, *Low Back Pain* (LBP), *Body Ache*, and *Chest Pain* all accounted for more than 30 instances, indicating the need for musculoskeletal health care. *Constipation* -related problem such as *Not Passing Stool/Constipation* (7 patients) and *Not Passing Urine/Urinary Retention* (5 patients) also occurred. There were also ten cases of *General Infection and Poisoning*, as well as a few serious disorders such as *Malaria with PF* (3 patients) and *Renal Tubular Acidosis* (4 patients). Some women have reported *Dizziness*, *Black Stool*, and *Passing Blood in Their Stool*, which suggests gastrointestinal problems. Other prominent complaints were *Unintentional Falls* (3 patients), *Epileptic-Related Hemiplegia* (3 patients), and *Claimed Ingesting* (3 patients), which could indicate self-harm. Overall, the data reveals a significant number of cases related to infections, abdominal issues, and fever among women in the community. A few emergency cases, such as poisoning, accidental falls, and shortness of breath, highlight the importance of quick response services. The occurrence of significant but uncommon instances such as malaria, hemiplegia, and renal problems emphasises the necessity for accessible medical care.

The miscellaneous data reveals a wide spectrum of less common but substantial health issues reported by women, although most diseases only have one or two cases. These, though fewer in number, nevertheless reflect the diverse healthcare needs of the community. In certain situations, digestive and gastrointestinal issues may arise, such as ache gastritis, acid reflux, epigastric discomfort, and upper gastrointestinal haemorrhage. These symptoms may indicate underlying infections, gastrointestinal abnormalities, or possible dietary problems. Furthermore, there are cases of chronic illnesses like breast cancer, hypothyroidism, CVA (stroke), and chronic liver disease (CLD), indicating that certain people are affected by long-term health problems (Fig 13).

Musculoskeletal difficulties, which can be brought on by ageing, bad posture, or strenuous physical labour, include knee pain, lumbar spine issues, shoulder discomfort, neck pain, and spondylosis. The need for emergency care services was highlighted by the reports of trauma-related injuries, including polytrauma, ear trauma, knee injuries, and body trauma. Cases such as *Bilateral Salpingo-Oophorectomy* (BSO) and *dysmenorrhea* were documented in relation to reproductive health, highlighting the significance of gynaecological assistance. *Fibroadenoma*, *Burning Micturition*, and *Dyselectrolytemia* are further isolated disorders that need to be evaluated and treated by a doctor. Additionally, uncommon genetic and metabolic conditions such as *Mucopolysaccharidoses* (MPS) were discovered. The range of issues is further expanded by neurological or psychological disorders such as *Post-Traumatic Amnesia* (PTA) and cardiovascular symptoms like palpitations. The age group between 21 and 30 are reported 94 cases, followed closely the age group of 41 and 50 recorded 88 cases, and those between the ages of 31 and 40 and 51 and 60 (each age group recorded 69 cases). The disease occurrence mostly among the young to middle-aged adults groups like, conditions linked to lifestyle may be more common in the age group between 21 and 50, and the age group between 21 and 30 is found under a stress which leads to health problems (Fig 14).

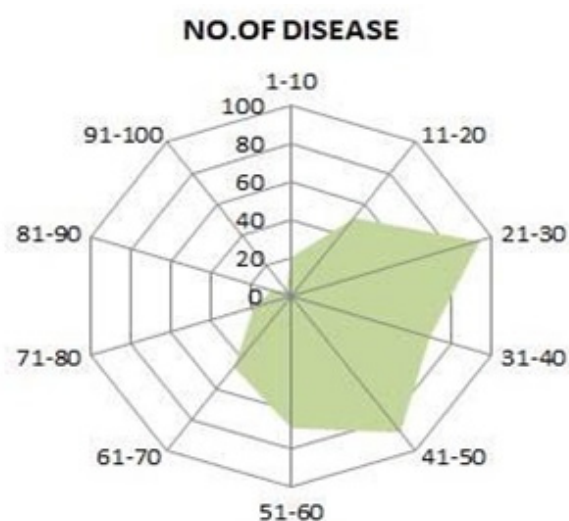
This is important to observe that, with 21 and 4 cases, respectively, the youngest age groups (1-10

years) and oldest (91–100 years) have the fewest diseases reported. Although the low number in the extremely elderly may seem unexpected, it could be because of the smaller population in that age group because people in this range might not receive as many diagnoses or have less access to healthcare. Better childhood vaccinations and less exposure to chronic

disorders are responsible for the comparatively low frequency of diseases among children below the age of 1 to 10, 55 cases are recorded in the age group of 11–20, and the occurrence of diseases in the 61–80 age group gradually decreases from 46 (61–70) to 19 (71–80), indicating either a decline in the population or improved chronic condition.

**Table 1: Comparative Analysis of Age Group and Disease Prevalence (2020–2024)**

Year	Chi-square Value ( $X^2$ )	Degrees of Freedom (df)	p-value	Statistical Significance
2020	15.03	4	0.0046	Significant ( $p < 0.01$ )
2021	6.73	5	0.2416	Not Significant
2022	7.55	4	0.1096	Not Significant
2023	11.36	3	0.0099	Significant ( $p < 0.01$ )
2024	6.11	5	0.2956	Not Significant



**Fig. 14. Chart Represent the Number of Diseases in Age Group**

The result shows the middle-aged adults especially those between the age group 21 and 50, is the greatest vulnerability  $p$  value  $< 0.005$ . The distribution of disease prevalence across different age groups during 2021 indicates that there was no significant difference in disease prevalence among the different age groups. In other words, the occurrence of disease appeared to be relatively evenly distributed across the various age groups,  $p$  value  $> 0.01$ . The disease prevalence among different age groups for the year 2022, is not statistically significant, and shows that there was no difference in the prevalence

of disease among the different age groups in 2022, and thus, the distribution of disease cases across the age groups was relatively evenly distributed  $p$  value  $> 0.05$ . The distribution of disease prevalence among different age groups in 2023, has statistically high significant, and thus, the prevalence of disease is not evenly distributed across the age groups; and the age groups of 21–30 and 41–50 are most affected susceptible to disease infection  $p$ -value  $< 0.01$ , which indicates that there was a significant difference in disease prevalence among the various age groups for the year 2023. The distribution of disease cases was relatively even across the different age groups in 2024, with no particular age group being extremely affected  $p$  value  $> 0.05$ .

## Conclusion

Across the five-year study period, a significant variation in disease prevalence among age groups was observed only in the years 2020 and 2023. In 2020 age group of 21–30 and 2023 age group of 41–50, this showed that a significant difference ( $p < 0.01$ ), that some age groups were more affected than others age group during these years. However, in 2021, 2022, and 2024, the results were not significant ( $p > 0.05$ ), indicating that the disease cases were almost equally distributed across all age groups. Overall, this suggests that while age played an important role in disease prevalence during some years, in other years,

the effect of age group was not reliable. The women patients between 21 and 50 years old are suffered the most. Children and older people have fewer reported cases, but that might be due to underreporting or less exposure.

**Competing Interests:** Authors have declared that no competing interests exist.

**Ethical standards:** Not applicable

**Source of funding:** Nil

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# Geographical analysis of Hepatitis-B and Hepatitis-C patients in the selected two districts of Tripura, India-using GIS

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## Abstract

**Introduction:** In India, Hepatitis-B and Hepatitis-C viruses pose serious public health risks, especially in the Tripura, North-Eastern state of India, where high infection rates are caused by inadequate healthcare facilities, risky medical procedures, and a lack of awareness. The purpose of this study is to examine the distribution of Hepatitis-B (HBV) and Hepatitis-C (HCV) cases in the South and Gomati districts of Tripura during 2022-2024 in terms of spatial distribution, gender, and age. Both districts' rural and tribal communities had extremely high rates of HBV and HCV infections.

**Methods:** Hepatitis-B and Hepatitis-C viruses infected patients in the South Tripura and Gomati Districts of Tripura State are collected from the District Headquarters Government Hospital located in Santir Bazar and Udaipur, The total numbers of Hepatitis-B infected patients from 2022-2024 is 59 and total Number of Hepatitis-C infected patients from 2022-2024 is 25 in South Tripura District. The total number of Hepatitis-B infected patients is 80, and Hepatitis-C is 22 in the Gomati Tripura District during 2022-2024. The total Hepatitis-B and Hepatitis-C virus infected patients records are exported to the Quantum Geographical Information System (QGIS) 3.4 Madeira, the Google Earth pro for mapping and are analysed to assess the association between the socio-demographic factors.

**Results and Discussion:** While Gomati district showed higher treatment adherence for HCV, South Tripura had a higher concentration of HBV patients. Geographical clusters and the pattern of HBV and HCV cases are found in random distribution. The age group of 21-40 is the most infected HBV in the South Tripura district;  $\chi^2 = 15.18$ , p-value = 0.0096; and Gomati Tripura:  $\chi^2 = 14.77$ , p-value = 0.0114). Age and HCV prevalence, however, neared statistical significance, suggesting changing patterns of transmission (South Tripura: p-value = 0.0737; Gomati district: p-value = 0.0523).

**Conclusion:** The prevalence of both infections is found highest among the young adult age group of 21-30. In 2024, both illnesses had spread into larger age groups, with elderly populations in Gomati experiencing an increase in instances. In order to effective control measures on Hepatitis-B and C virus infection in the Tripura state, the

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study emphasizes the value of GIS in identifying high-risk villages and thus, increase of infrastructure resource allocation for improving vaccination coverage, especially for the age group of 21-50.

**Key words:** Hepatitis-B virus (HBV), Hepatitis-C virus (HCV), spatial distribution, disease pattern, Geographical Information Systems (GIS)

## Introduction

Hepatitis-B (HBV) and Hepatitis-C (HCV) are among the most pressing global health challenges, affecting hundreds of millions of people and contributing to severe liver disease, economic strain, and social inequity worldwide<sup>[1]</sup>. Significant records of the worldwide viral hepatitis burden, with an estimated 40 million individuals living with a chronic HBV infection and 6 to 12 million with an HCV infection<sup>[1]</sup>. These viral infections are leading causes of chronic liver conditions, including cirrhosis, liver cancer, and liver-related deaths, with an estimated 1.1 million fatalities annually. Despite significant medical advancements, Hepatitis-B and C virus infections remain persistent threats due to gaps in prevention, diagnosis, and treatment, particularly in vulnerable and underserved populations<sup>[2-7]</sup>. HBV and HCV are primarily transmitted through contact with contaminated organs or blood, but their epidemiological profiles differ<sup>[1-10]</sup>. While Hepatitis-C is most frequently acquired through blood-to-blood contact, such as improper injections or unsterilized medical equipment, Hepatitis-B is extremely contagious and frequently spreads through perinatal transmission, unsafe medical practices, or sexual contact. In India, Hepatitis-C is mainly spread by exposure to contaminated blood, which frequently occurs as a result of unsterilized medical equipment, intravenous drug use, and unsafe tattooing practices<sup>[3,5,7-9]</sup>. In contrast, Hepatitis-B is frequently spread through mother-to-child transmission, unsafe injections, and contaminated blood transfusions<sup>[9]</sup>. In many countries, conflicting health goals, political unpredictability, and economic inequality have caused action to be delayed.

A comprehensive epidemiological overview of the spatial distribution of Hepatitis-B virus and Hepatitis-C virus (HCV) prevalence in South Tripura over a period of three-years from 2022 to 2024, and the gender-wise analysis of HBV and HCV cases in Gomati district, Tripura, reveals the significant trends inform targeted public health strategies<sup>[11,12]</sup>.

India has particular difficulties in fighting viral hepatitis because of its poor healthcare system, exorbitant medical expenses, gaps in vaccination coverage, and pervasive stigma. Despite the fact that new-borns are vaccinated against HBV under the Universal Immunization Programme (UIP), adult immunization rates are still low. Direct-acting antivirals (DAAs) provide a cure for HCV, but widespread access to therapy is hampered by their high cost and inconsistent availability. Furthermore, a lack of strong surveillance mechanisms in many governments results in underreporting and inefficient policy responses. The National Viral Hepatitis-Control Program (NVHCP), which is introduced in 2018 with the goal of offering free screening and treatment, is one of the measures the Indian government has done to combat this epidemic<sup>[11,12]</sup>. Hepatitis-B and C have emerged as significant public health threats in India's north-eastern states, with prevalence rates substantially higher than the average for the country<sup>[3-7,11,12]</sup>. With incidence rates far above the national average, Hepatitis-B and C have become serious public health concerns in north-eastern India<sup>[11,12]</sup>.

## Background of the study

Hepatitis-B and C have become pressing public health issues in Tripura, with prevalence rates indicating an increasing burden that necessitates immediate action. The Tripura State AIDS Control Society's annual report (2019-2020) reveals that Hepatitis-B surface antigen (HBsAg) 4.2% of the general population had this condition<sup>[11]</sup>, surpassing the national average of 3-4%. Regarding Hepatitis-C, the 2022 surveillance data from the State Health Department shows a seroprevalence of 2% in the general population, with certain high-risk groups, such as people who inject drugs, experiencing rates as high as 4.3%. The National Viral Hepatitis-Control Program's 2023 report highlights Tripura as one of the north-eastern states facing distinct challenges in managing hepatitis<sup>[12]</sup>. Although the state has initiated Hepatitis-B vaccination through

the Universal Immunization Programme, coverage in remote regions remains inadequate, according to data from Tripura Health Services in 2023<sup>[12]</sup>. These findings emphasize the critical need for targeted interventions that address the distinct geographical, cultural, and healthcare infrastructure challenges faced by South Tripura and Gomati districts in order to mitigate the rising hepatitis burden.

### Study Area

Tripura is located in the North-Eastern Region of India; it has spatial extension area of 10,491 square kilometres. It is geographically located between latitudes 22°7' and 24°2' North, and longitudes 91°0' and 92°0' E, with total population 36,73,917. Study area includes both the South and Gomati districts of Tripura. South Tripura is located between

latitudes 23.2317° N, and 91.5596° E longitude. South Tripura district in Tripura has a geographical area of approximately 1514.322 square kilometres and a population of 4,30,499 as per the 2011 census. The population density of the district is 299 population per square kilometre. And As per the 2011 census, the district had 4,14,426 rural residents and 38,653 urban residents. Among them ST population in the district is 1,62,463, which is 35.85% of the total population. And South Tripura has a sex ratio of 957 females for every 1000 males, and overall literacy rate is 85.41% and literacy rate is 93.39% for male and 79.44% for female According to 2011 census. Gomati District of Tripura which is located between latitudes 23.5639° N, and 91.6761° E longitude. Total geographical area of this district is the total geographical area of Gomati district in Tripura is 1,522.8 square kilometres.

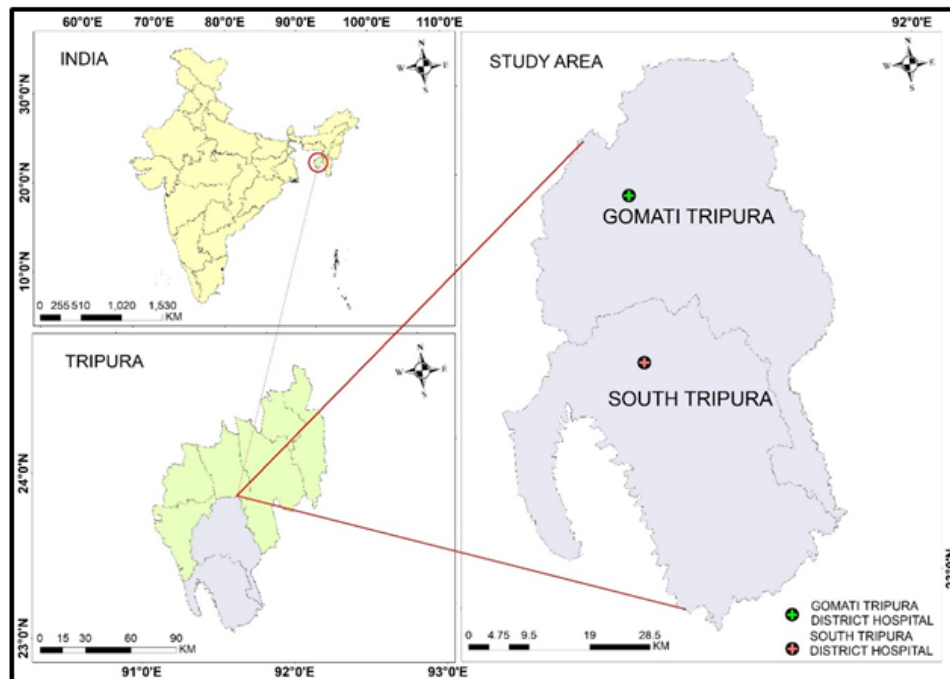


Fig. 1: Study Area Map

### Objectives

1. To mapping the Spatial distribution of Hepatitis-B and Hepatitis-C patients in South and Gomati Districts of Tripura.
2. To analyse the gender wise distribution of Hepatitis-B and Hepatitis-C patients in South and Gomati District of Tripura.
3. To identify the vulnerable age group of the Hepatitis-B and Hepatitis-C patients in South and Gomati District of Tripura.

### Materials and Methods

Hepatitis-B and Hepatitis-C viruses infected patients in the South Tripura and Gomati Districts of Tripura State are collected from the District Headquarters Government Hospital located in Santir Bazar and Udaipur. The total numbers of Hepatitis-B infected patients from 2022-2024 is 59 and total Number of Hepatitis-C infected patients from 2022-2024 is 25 in South Tripura District. The total numbers of Hepatitis-B infected patients is

80, and Hepatitis-C is 22 in the Gomati Tripura District during 2022-2024. The Hepatitis-B and Hepatitis-C virus infected patients data is imported to the Quantum Geographical Information System (QGIS) 3.4 Madeira, the Google Earth pro and the MS Excel 2007 for mapping and to assess the association between the socio-demographic factors.

## Results and Discussion

### Spatial Distribution of HBV and HCV patients in South Tripura (2022-2024)

The spatial distribution of Hepatitis-B (HBV) and Hepatitis-C (HCV) patients in South

Tripura's during 2022-2024 is carried out, and are represented by green dots on the map, while those with an HCV patients are represented by red dots. Obviously, the linear spatial pattern is observed, however, most of the cases are found ubiquitous across the district. While HCV patients (red dots) are more widely dispersed, with a sizable portion located in the center and southern regions of the district, HBV patients (green dots) seem to be concentrated in the northern and central parts of the district (Fig.2). The presence of cases across the entire district indicates that these diseases are not confined to just one region, but impact people from various regions.

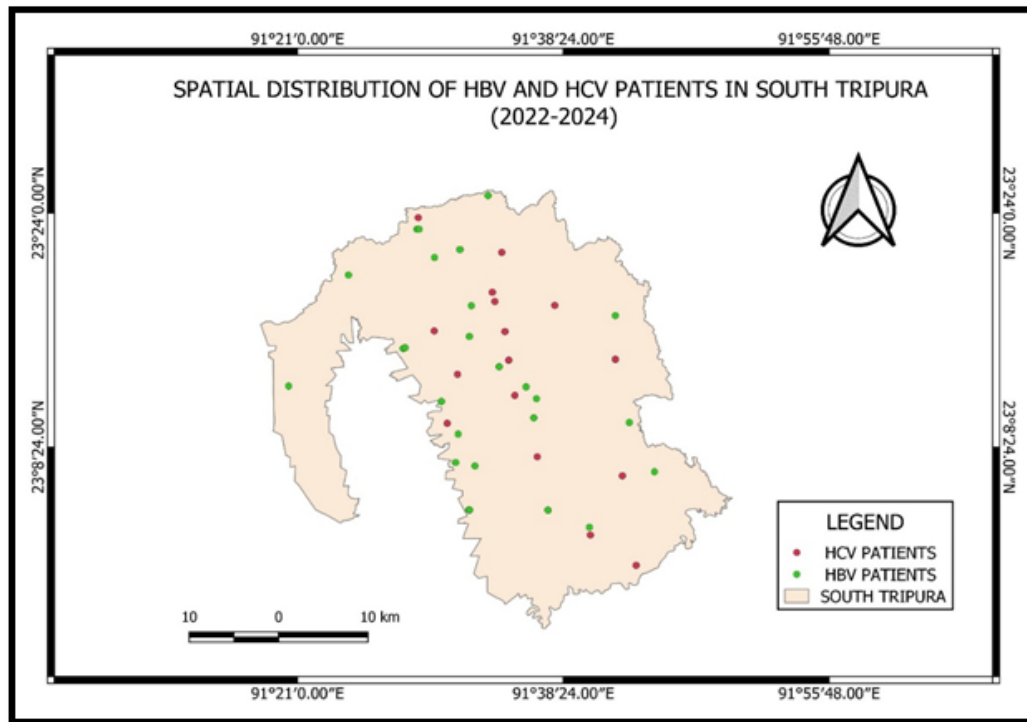


Fig. 2: Spatial Distribution of HBV and HCV patients in South Tripura (2022-2024)

### Spatial Distribution of HBV and HCV patients in South Tripura (2022)

The distribution of Hepatitis-B (HBV) and Hepatitis-C (HCV) in South Tripura in 2022 is shown on this map. Patients with HBV are represented by each red dot, whereas those with HCV are represented by each green dot. With 28 patients dispersed pretty evenly around the district, it is immediately apparent

that HBV cases are far more prevalent. However, HCV appears to be significantly lower, with only 6 instances, which are centered in the area's center (Fig.3). This indicates that Hepatitis-B is currently a greater problem for the area, and initiatives such as immunizations, awareness campaigns, and screenings may need to be given priority where red dots are most prevalent.

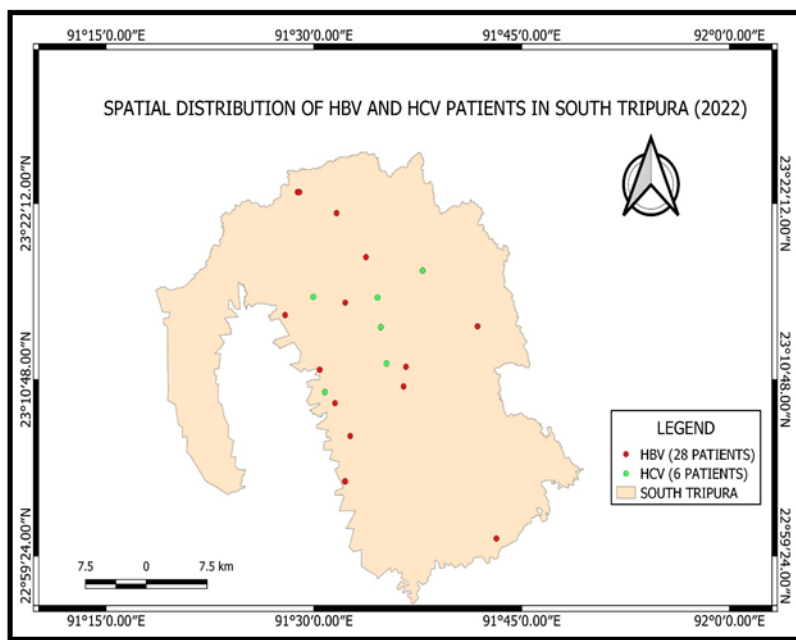


Fig. 3: Spatial Distribution of HBV and HCV patients in South Tripura(2022)

**Spatial Distribution of HBV and HCV patients in South Tripura(2023)**

Hepatitis-B (HBV) and Hepatitis-C (HCV) are spread across South Tripura district in 2023. Every dot on the map represents a patient; HCV and HBV are illustrated on the map as red and green colour

respectively. The distribution of HBV prevalent are more evenly distributed, but HCV instances are reported from the central region shows clustered pattern in South Tripura, and a small number of cases found in the southern and eastern regions (Fig.4).

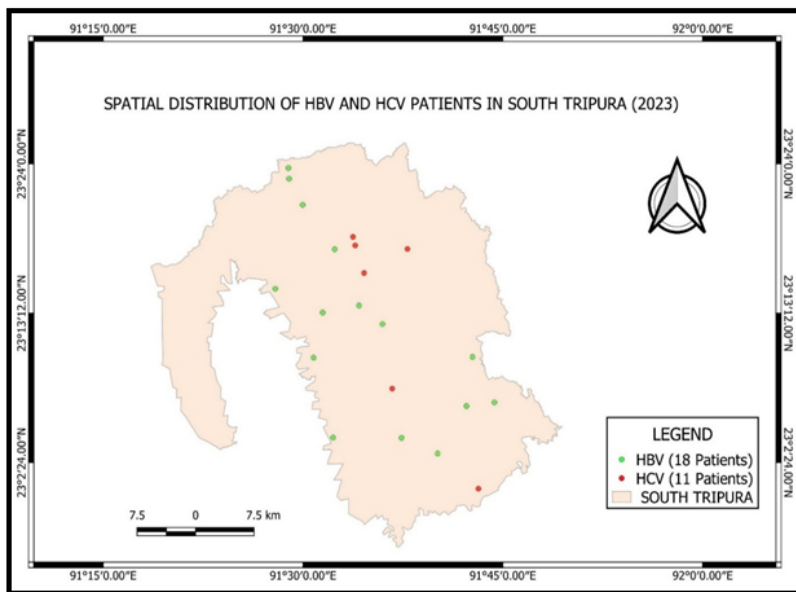


Fig.4. Spatial Distribution of HBV and HCV patients in South Tripura(2023)

**Spatial Distribution of HBV and HCV patients in South Tripura(2024)**

This map provides a clear visual representation of the geographic distribution of individuals afflicted

with Hepatitis-B (HBV) and Hepatitis-C (HCV) in South Tripura in 2024, while the red and green dots, respectively, stand for 15 and 8 patients having HBV and HCV infected. With red dots showing up in both

the central and bordering regions of South Tripura (Fig 5), it is observed that HBV cases are more common throughout the district. HCV cases, on the

other hand, are less common and more concentrated in the central and southeast regions.

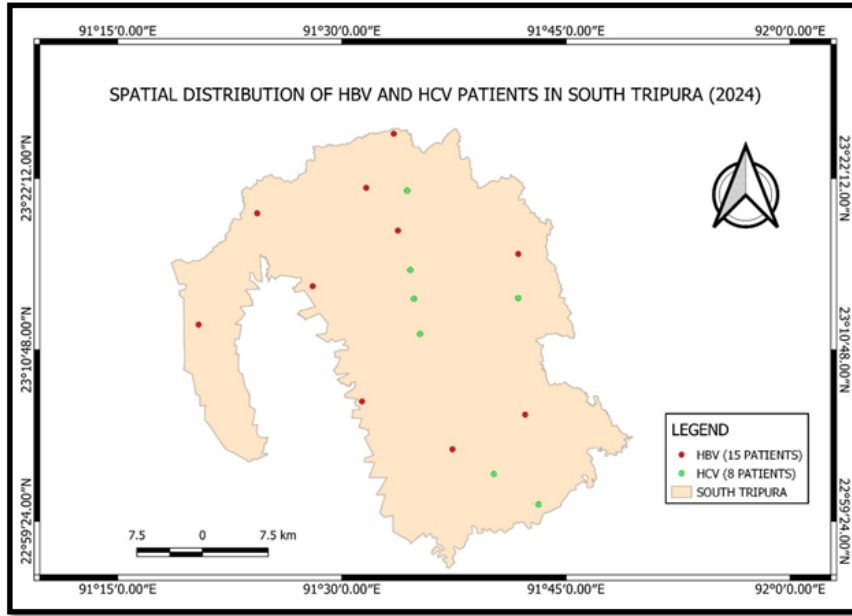


Fig. 5: Spatial Distribution of HBV and HCV patients in South Tripura(2024)

**Gender wise distribution of HBV and HCV Patients in South Tripura (2022-2024)**

The distribution of HBV and HCV cases of male and female patients in South Tripura during the period of 2022-2024, are not limited to a single gender or geographic area, but rather are dispersed throughout the district, impacting both men and women in different regions. Male and female cases are shown by blue and pink dots, with 46 and 39, respectively, suggesting a slightly higher incidence among males.

The fact that both genders are equally distributed throughout the region (Fig.6), however, emphasizes that hepatitis is a public health issue that affects all populations, irrespective of location or gender. This highlights the necessity of awareness campaigns, focused interventions, and gender-inclusive healthcare strategies across the area. Furthermore, the map highlights the necessity of a district-wide public health strategy that covers all of South Tripura rather than simply high-density metropolitan areas.

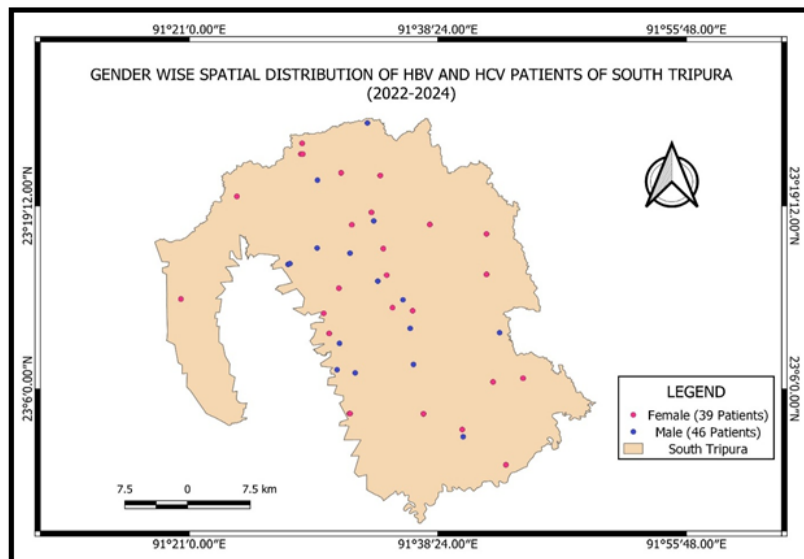


Fig. 6: Gender wise spatial distribution of HBV and HCV Patients in South Tripura (2022-2024)

### Age Group Wise HBV Patients in South Tripura(2022-2024)

The age group wise distribution of Hepatitis-B Virus (HBV) patients reported in South Tripura between 2022 and 2024 (Fig.7a, b, and c), is revealed that the young individuals are the most infected with HBV, especially, the age group of 21-30 (23 patients), and are active in economic and commercial activities and socially mobile, and hence, are at higher risk of infection, as evidenced by the 14 cases occurred in the age group of 31-40. Moderate incidence is found

in the age group of 11-20, 41-50, and 51-60. On the other hand, there are a few or no cases reported among the young children 1-10 years, and aged people above 70 years. Consequently, concluded that the circumstances are more prevalent in younger and middle-aged populations. Further, the results highlight the necessity of focused public health initiatives, particularly immunization and awareness programs, aimed at the age group between 21 and 40, and lower the incidence of HBV in South Tripura.

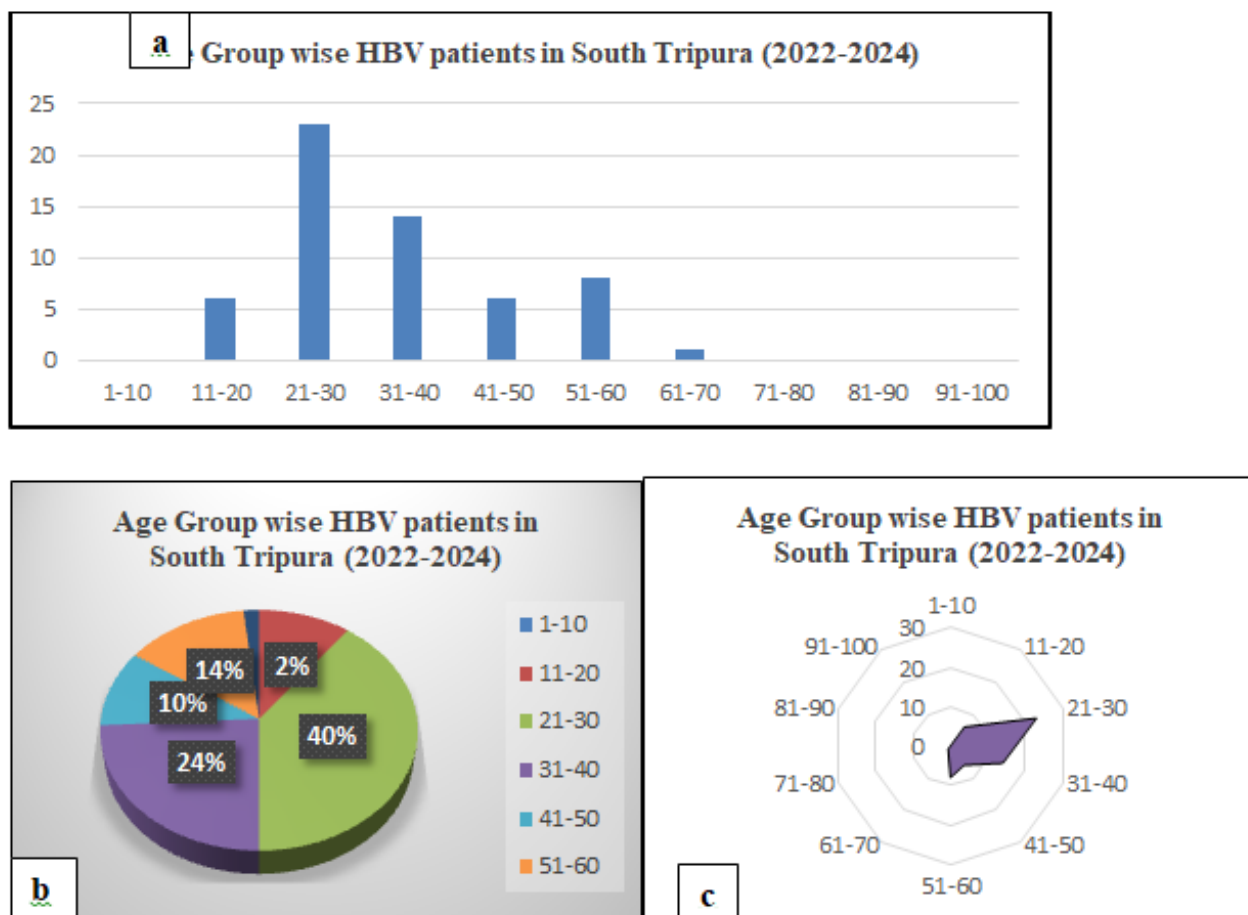


Fig. 7a,b, and c. Age Group wise HBV Patients in South Tripura (2022-2024)

### Age Group Wise HCV Patients in South Tripura (2022-2024)

The distribution of Hepatitis-C Virus (HCV) cases in South Tripura by age groupwise during 2022-2024, shows that young and middle-aged groups are most affected huge number of HCV cases. The age group of 21-30 are recored 12 patients, followed by 31-40 years (9 patients) and 11-20 years (6 cases), and

thus, people in this region are most likely to have HCV in the age group of 11-40, it could be because of increased exposure to risky behaviors or unsafe medical practices, or limited access to preventive healthcare centres during the study period. On the other hand, extremely young people (less than ten years old) and the elderly (over fifty) are recorded very low or zero record of HCV (Fig.8a, b and c).

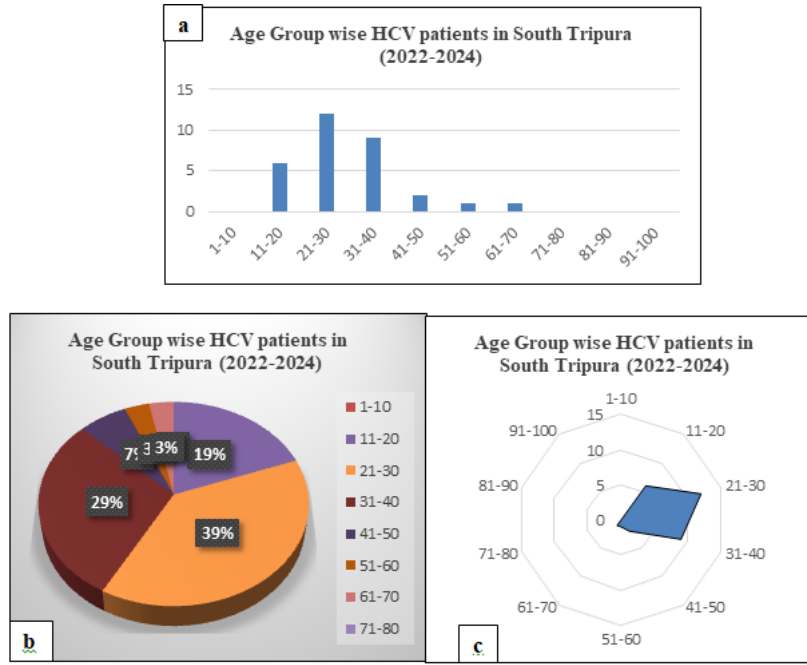


Fig.8a, b and c Age Group wise HCV Patients in South Tripura (2022-2024)

**Spatial Distribution of HBV and HCV patients in Gomati Tripura (2022-2024)**

The mapping of spatial distribution of Hepatitis-B Virus (HBV) and Hepatitis-C Virus (HCV) patients across Gomati district, Tripura is carried out for the period of 2022-2024, which shows the HCV 21 cases by green dots, and HBV 81 cases with red dots. The district’s western and south-western areas have a significant concentration of both HBV

and HCV infections (Fig.9). These regions are the most affected in the densely populated rural areas, and a few random distributions are occurred in the northern, central, and southeast regions, on the other hand, most of infected cases are concentrated in the western belt, and hence, HBV are more common and are transmitted widely across Gomati district than the HCV cases during the study period.

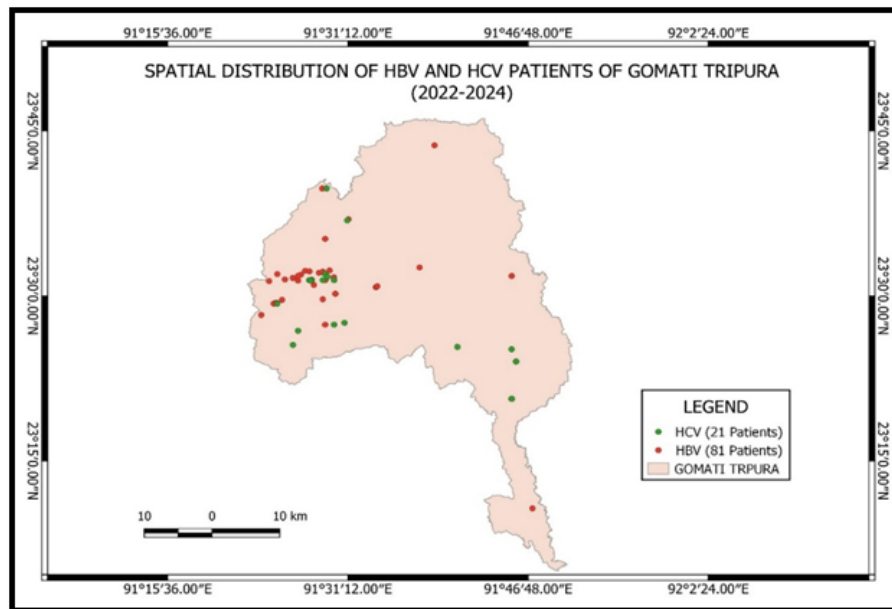


Fig. 9: Spatial Distribution of HBV and HCV patients in Gomati Tripura (2022-2024)

### Gender wise HBV and HCV patients in Gomati Tripura (2022-2024)

The gender wise spatial distribution of Hepatitis-B (HBV) and Hepatitis-C (HCV) cases in Tripura’s Gomati district during 2022-2024 are mapped, 45 male cases are depicted in blue colour dots, and 57 female cases are depicted in pink colour dots, which indicates a clear presence of both male

and female cases are registered in a clustered pattern in the Udaipur town along with Kakraban region, however, few cases recorded across the district. Further, the distribution indicates that although there are few or no instances reported in some regions of the district, the concentration in other areas suggests that targeted intervention is necessary.

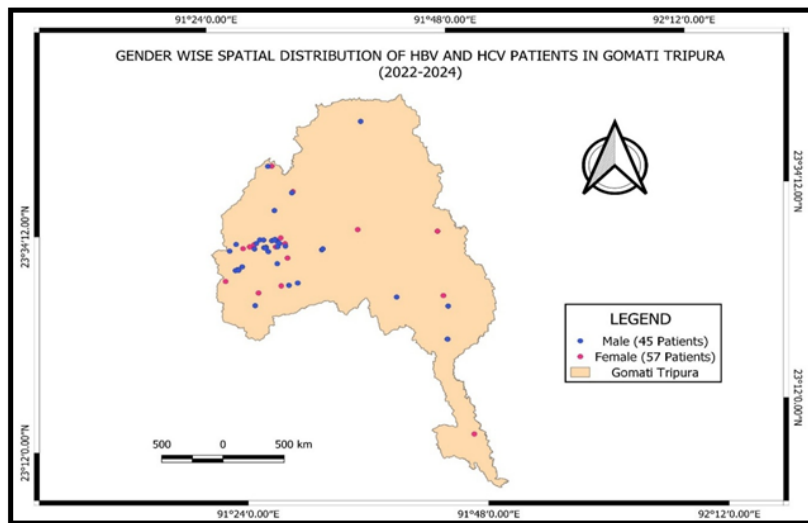


Fig 10: Gender wise Distribution of HBV and HCV patients in Gomati Tripura (2022-2024)

### AGE GROUP WISE HBV PATIENTS IN GOMATI TRIPURA (2022-2024)

Based on the records on HBV (Hepatitis-B virus) patients in Gomati, Tripura by age group during 2022-2024, young adults are the most commonly infected group. The age group of 21-30 is the most affected 23 HBV cases, followed by the age group of 31-40 is

recorded 17 HBV cases. A considerable burden of the disease is observed among the middle-aged group of productive workers, as evidenced by the 11 cases reported by other age groups, including 11-20, 41-50, and 51-60. Only one case is reported in the age group of 1-10, and fewer cases are registered in the senior citizen age group > 60 and below 15 years children (Fig.11).

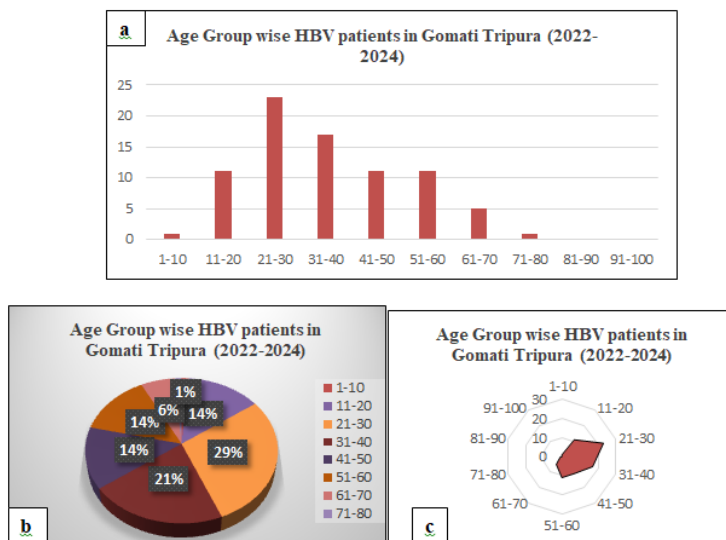
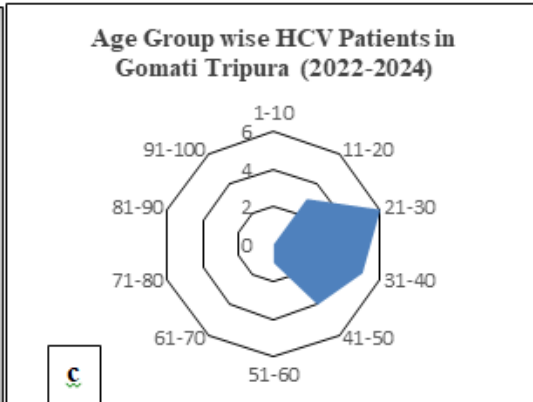
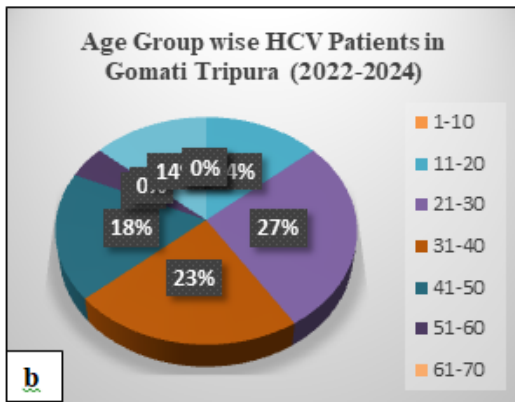
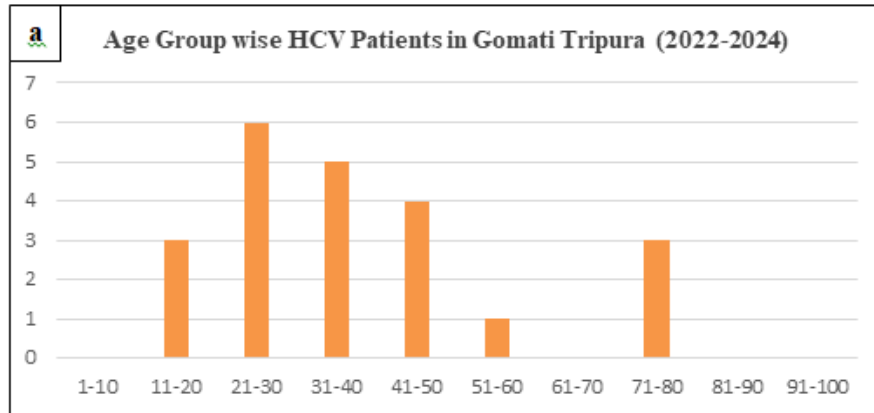


Fig.11a, b and c Age Group wise HBV Patients in Gomati Tripura (2022-2024)

**Age Group Wise HCV Patients in Gomati Tripura (2022-2024)**

The age group of 21-30 affected 6 confirmed HCV cases, the age group of 31-40 registered 5 cases, and the age group of 41-50 recorded 4 cases in Gomati district, Tripura during 2022-2024. A considerable burden of the disease is observed among the middle-aged group of productive workers, as evidenced

by the 9 cases are reported by other age groups, including 11-20, 41-50, and 51-60. It shows that the age group of 21- 50 are more vulnerable to c HCV infection. It also observed that 3 number of HCV cases are found between age group 71-80, no cases are registered in the age groups of children aged 1-10 and elderly people aged >80 (Fig.12a,b,and c).



**Fig.12a, b and c. Age Group wise HCV Patients in Gomati Tripura (2022-2024)**

**Chi - Square Test of HBV Patients in South Tripura (2022-2024)**

A statistically significant variation in the age-group distribution of cases is ascertained by the chi-square test performed on the age-wise distribution of HBV patients in South Tripura during 2022-2024 ( $X^2 = 15.18$ ,  $df = 5$ ,  $p\text{-value} = 0.0096$ ). The null hypothesis of equal distribution is rejected since the p-value is below 0.05, suggesting that the age groups do not have a uniform distribution of HBV cases. In particular, the age group of 21-30 reports significantly more cases than predicted, whereas the age groups of 11-20 and 61-70 report fewer cases than expected.

**Chi - Square Test of HCV Patients in South Tripura (2022-2024)**

The Chi-Square Test, which is given to South Tripura HCV patients between 2022 and 2024: those aged 11-20, 21-30, and 31-40. There are 28 cases in total, with the observed (O) frequencies for these groups being 6, 15, and 7, respectively. For all age group, the expected (E) frequencies are consistently determined to be 9.33333333. Following the determination of the disparities between the observed and expected frequencies, the inconsistencies are further investigated by squaring the differences and dividing by the expected frequencies. Notably,

the calculated chi-squared value  $X^2 = 5.214285714$ ,  $p$ -value = 0.073, suggesting the statistical significance of the results in understanding HCV distribution across these age demographics.

### **Chi - Square Test of HBV Patients in Gomati Tripura (2022-2024)**

The calculated Chi-Square value ( $X^2$ ) for the Chi-Square test performed on Gomati Tripura HBV patients between 2022 and 2024 is 14.76923077. According to Chi-Square distribution tables, the critical value at the level of significance  $\alpha < 0.05$ , and a statistically significant correlation is found between the age groups and the frequency of HBV infection, as indicated by the  $p$ -value  $< 0.01$ , which falls below 0.05 as the significance level, proving that and thus, Acceptance of the null hypothesis, and indicating that among study participants, age has an important effect on the rate of HBV.

### **Chi - Square Test of HCV Patients in Gomati Tripura (2022-2024)**

A Chi-Square test performed on Gomati Tripura HCV patients between 2022 and 2024 can be seen in the following table. Patient age categories are divided into intervals such as 11-20, 21-30, 31-40, 41-50, 51-60, and 71-80. The observed (O) and expected (E) values for each age group are listed first, and then the differences (O-E), their squares, and their normalized ratios  $((O-E)^2/E)$  are calculated. The estimated Chi-Square statistic ( $X^2$ ) is 4.18181780<sup>2</sup>,  $p$ -value  $< 0.05$ , provides the evidence on the findings' statistical significance in relation to the age distribution of HCV patients similar to South Tripura district.

### **Conclusion**

The study shows that HBV is more common than HCV in South Tripura and Gomati (2022-2024), with notable age and gender differences. Hepatitis-B (HBV) cases are more common and continuously more frequent than Hepatitis-C (HCV) cases in both the Gomati and South Tripura districts. HBV displayed a wider geographic dispersion, particularly in Gomati's western and south-western areas, as well as in central and northern South Tripura district, according to spatial analysis conducted with QGIS. In south-western Gomati and southern South Tripura, HCV cases showed localized clustering, albeit in

smaller numbers. In each district, a different gender pattern is observed. Male and female HBV prevalence in South Tripura are almost comparable (31 males and 32 females), indicating consistent exposure risks. However, a notable female predominance of HBV is seen in Gomati (48 females and 31 males), which may indicate increased exposure because of cultural or reproductive health variables or better health-seeking behaviour among women. Males are significantly more likely to have HCV in both districts (South Tripura: 18 males vs. 8 females; Gomati: 12 males vs. 8 females), which shows the high-risk behaviours such as intravenous drug use or hazardous work practices.

Patient's age group between 21 and 50 made up the majority of HBV and HCV cases in both districts, especially those between the ages of 21 and 30 and 31 and 40. This age group is the most economically productive in the population, which may indicate greater vulnerability because of gaps in adult immunization, occupational exposure, or social mobility. Children and the elderly had very little incidence, which is probably due to the benefits of early childhood immunization regimens and less exposure in later life. In South Tripura and Gomati, the pattern held true for both HBV and HCV. The HBV prevalence  $p$ -value  $< 0.01$  indicates that Gomati is statistically significant, with higher-than-expected cases occurring in the 21-30 age groups. While the trend indicated an age-based clustering, the correlation for HCV is only marginally non-significant ( $p$ -value  $< 0.05$ ). Similarly, the age-related risks are also observed in the South Tripura, highlighting the necessity of age-focused screening and intervention techniques.

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**Ethical Clearance:** Not applicable

**Statement of Conflict of Interest:** The authors, we have no conflict of interest in the manuscript publication

**Artificial Intelligence (AI):** No AI has been used to write the manuscript

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# Socio Demographic and Occupational Risk Factors as Determinants of Musculoskeletal Disorders among Women in Unorganized Sectors

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## Abstract

**Introduction:** Informal sectors provide employment opportunities to women to a large extent. Musculoskeletal discomforts (MSD) have been reported in majority of the informal sectors which needs specific attention. The present study aims to identify the socio demographic, individual and occupational risk factors that contribute to the MSDs.

**Methods:** A cross sectional survey of 693 women employed in three different units namely dyeing, fish processing and food processing units was carried out. A pretested interview schedule was used to collect data and details of MSD were gathered adapting Nordic questionnaire. Data was analyzed using chi square, ANOVA and binary logistic regression to identify the confounding factors contribution to MSDs.

**Results:** The mean age of the participants was 33.46±13.20 years. The mean work experience was 11±10.96 years. Bivariate logistic regression analysis indicated that work experience had higher Odds (2.3; CI =1.1- 4.4) for neck discomfort. Low back pain for women above 45 years was likely to occur 5 times more when compared to women below 25 years of age (OR=5.1; CI=1.73 to 15.58). Work experience had higher odds (3.39; CI=1.5-7.2) for discomforts in legs. The sector in which the women were employed contributed to higher level of MSD. Work hours exceeding 8 hours also was one of the contributing factors for MSD.

**Conclusion:** The study highlights the impact of age, work hours, years of work on prevalence of MSD among women. Ergonomic workspaces can minimize the rate of MSDs among women in informal sectors.

**Key words:** low back, women, fish processing, food processing, unorganized.

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## Introduction

Informal or unorganized sectors have congested work spaces, poor working conditions that co-exist with extreme environmental conditions such as temperature and humidity. Majority of the workers employed in informal sectors are women. The sectors include garment units, textiles units, food processing units, fish processing units, handicraft units, weaving and construction units. Workers in these sectors are more prone to work related musculoskeletal disorders (1,2). Work-related musculoskeletal disorders, or WRMSDs, are commonly occurring ailments that mainly impact tendons, muscles, joints, ligaments, nerves, and bones. Musculoskeletal symptoms might include discomfort, pain, and swelling, all of which can become incapacitating. The most frequent occupational risk factors for these work-related musculoskeletal problems include weight lifting, repeated motions, static body positions, and prolonged muscular contractions forceful effort, repetitive work, inappropriate posture, lack of recovery time, vibration, kind of hand grasp (3).

Individual characteristics that contribute significantly to the prevalence of these conditions include age, gender, body mass index, obesity, diabetes, smoking, and anthropometry (4,5,6 7). Psychosocial factors, such as job dissatisfaction, perceived stress/workload, monotonous work, limited social support, limited job control, feeling depressed, time constraints, etc., have also received significant attention from researchers (8).

Musculoskeletal symptoms impact individuals of all ages, from 20 to 80 as a result of which they are increasingly viewed as a rising public health concern. According to a recent survey in multiple nations among various categories of workers, the prevalence of work-related musculoskeletal complaints ranged from 55% to 85. In addition, a survey on worldwide burden of disease, carried out between 2010 to 2016 cites that musculoskeletal pain ranked sixth, out of the ten diseases and was the major cause of physical injuries and impairments. Thus musculoskeletal disorders have severe global ramifications for public health, society, and the economy. Studies on musculoskeletal discomforts (MSD) among women working in the informal sector are limited and often lack an analysis of the relationship between occupational settings and socio-demographic

profiles. Therefore, the present study aims to assess the prevalence of MSD among this population and to examine the extent to which socio-demographic and occupational factors contribute to these discomforts.

## Materials and Methods

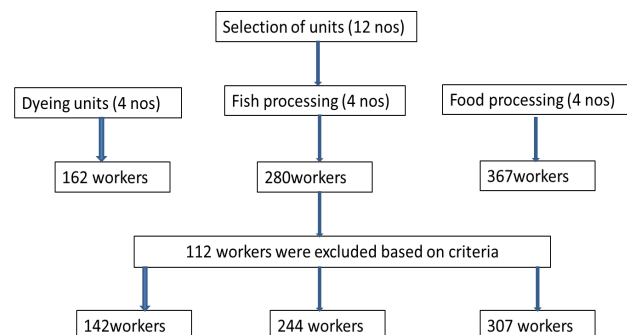
### Study design

This study is a cross-sectional survey of women workers employed in informal units which are a major employment providers. Women working in three different sectors—dyeing, fish processing, and food processing—were randomly selected for the study, as these sectors employed more than 50% of the women workers in their respective units. A total of twelve units were randomly chosen, with four units from each sector. From each of the twelve units, a minimum of 10% of the workers were selected, resulting in a total sample size of 809 individuals.

### Participants and inclusion criteria

A total of 809 individuals participated in the study (Figure 1). The following inclusion criteria was applied to the data:

- Individuals who were employed in the main activities of the processing units for at least a year alone were considered for the study. Women who were employed in the office work were not included in the study since their work environment is different from the main processing area. This reduced the sample size to 756.
- Participants who were willing to disclose the information related to the prevalence of musculoskeletal discomforts alone were included. This further reduce the sample size to 693.



**Figure 1: Selection of participants**

## Data collection

A pretested interview schedule consisted of two sections – Section ‘A’ and ‘B’. Section A had selected demographic variable like age, marital status, level of education, details of family and occupational details like age of entry, work experience and work hours. Section B included the details of the musculoskeletal discomforts which was adopted from the Nordic questionnaire<sup>(9)</sup>. A body map was shown to the workers to identify the prevalence of discomforts and its periodicity. All the workers were interviewed during the work hours. The study was carried out after the approval from the institution Committee (No. B4/UGC/50-C30AT/ E-GOI- DST/E-28ZK dt. 3.4.23), proprietors and with the oral consent from the workers.

## Analysis of data

The data collected from the participants were analysed using SPSS 29 version. Descriptive statistics, analysis of variance and chi-square test were used to find the difference / association between the workers employed in different units. Further analysis was carried out on musculoskeletal discomforts of body parts that reported highest prevalence using bivariate logistic regression to study the impact of socio demographic and occupational factors on the periodicity of musculoskeletal discomforts of workers between two groups namely the group that reported prevalence of discomforts during the past 12 months for more than 30 days (everyday) and other group of

workers who did not report discomforts everyday during the same period.

## Results

The results of the cross sectional study of women in informal sectors is presented in Table 1. The mean age of the total sample was  $33.46 \pm 13.20$  years. Further analysis by the units indicated that women working in fish processing units were much younger ( $22.23 \pm 8.08$  years) when compared to food processing ( $38.22 \pm 11.37$ ) and dyeing units ( $42.43 \pm 10.71$ ). Majority of the women workers in fish processing were young. There was a significant difference between the mean age of the workers employed in these units. Chi square analysis indicates that there is a significant difference between the different age groups in the three selected units. More than three fourth of the women in all the units were unmarried. With reference to the educational level, majority of the workers were educated upto high school level. This may be one of the reasons for women taking up work in such informal sectors. The overall mean work experience was 11 years and there existed a significant difference between the three units. Further analysis of the work experience indicates that majority of women in fish processing units (76 percent) had less than five years of experience. Analysis of the age of entry also confirms that women venture into such informal sectors at young age with low level of education.

**Table 1: Socio demographic and occupational profile of the women workers in the selected units**

Parameters	Total sample (n=693)	Dyeing unit (n=142)	Fish processing (n=244)	Food processing (n=307)	P value
<b>Age (years)<sup>a</sup></b>	33.46±13.20	42.43±10.71	22.25±8.08	38.22±11.37	236.19 <sup>c</sup>
Less than 25 <sup>b</sup>	252(36.4)	5(3.5)	199(28.7)	48(6.9)	3.48 <sup>d</sup>
25-45 <sup>b</sup>	214(30.9)	78(54.9)	39(5.6)	165(23.8)	
Above 45 <sup>b</sup>	227(32.8)	59(41.6)	6(9)	94(13.6)	
<b>Marital status</b>					
UnMarried <sup>b</sup>	548(79.1)	113(79.6)	199(81.6)	236(76.9)	40.30 <sup>d</sup>
Married <sup>b</sup>	101(14.6)	23(16.2)	45(18.4)	33(10.7)	
Separated/ widow <sup>b</sup>	44(6.3)	6(4.5)	--	38(12.4)	
<b>Education</b>					
Illiterate <sup>b</sup>	29(4.2)	13(9.2)	9(3.7)	7(2.3)	1.24 <sup>d</sup>
High school <sup>b</sup>	535(77.2)	115(81.0)	138(56.6)	282(91.9)	
Higher secondary <sup>b</sup>	129(18.6)	14(9.9)	97(39.8)	18(5.9)	

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<b>Work experience (years)<sup>a</sup></b>	11.44±10.96	22.16±11.67	4.2±4.3	11.98±9.6	212.79 <sup>c</sup>
Less than 5 <sup>b</sup>	296(42.7)	12(5.6)	234(76.2)	101(32.9)	2.88 <sup>d</sup>
5 to 10 <sup>b</sup>	124(17.9)	16(7.5)	52(16.9)	72(23.5)	
Above 10 <sup>b</sup>	273(39.4)	26.8(86.9)	21(6.9)	134(43.6)	
<b>Age of entry(years)<sup>a</sup></b>	21.98±8.69	19.52±5.70	18.19±7.10	26.11±9.20	77.55 <sup>c</sup>
Less than 20	571(82.4)	109(76.8)	197(80.7)	114(37.1)	1.59 <sup>d</sup>
20-25	41(5.9)	17(12.0)	18(7.4)	56(18.2)	
Above 25	81(11.7)	16(11.3)	29(4.2)	137(44.6)	

a= Mean ±SD

b= Data expressed as frequency (percentage)

c=one way anova

d=chisquare test

Table 2 presents data of the musculoskeletal discomforts of women workers employed in different units. The discomforts were assessed using a five point scale with no discomfort as 1 and extreme discomfort as 5. It could be observed from the table that forty four per cent of the workers reported moderate

discomforts in low back and the severe discomfort by twenty five percent. Moderate level of discomfort was reported in legs (39%), upper arm (32%) and shoulders (32%). Severe discomfort was expressed by almost ten per cent of the workers in all the body parts. Extreme discomfort was reported by less than three per cent of the workers as this discomfort will result in complete cessation from the task. Statistical analysis indicates that there is a significant difference in the levels of discomforts among different body parts.

**Table 2: Musculoskeletal discomforts of workers employed in different units**

Body parts	Rating of discomforts (n=693)					Mean ±SD	F value
	No discomfort	Mild discomfort	Moderate discomfort	Severe discomfort	Extreme discomfort		
Neck	182 (26.3)	250 (36.1)	191(27.6)	62(8.9)	8(1.2)	2.23±0.97	174.646
Shoulder	121(17.5)	260(37.5)	228(32.9)	76(11.0)	8(1.2)	2.41±0.93	34.106
Upper arm	227(32.8)	181(26.1)	226(32.6)	54(7.8)	5(0.7)	2.18±1.00	175.397
Low back	50(7.2)	139(20.1)	309(44.6)	179(25.8)	16(2.3)	2.96±0.91	63.087
buttock	402(58.0)	151(21.8)	62(8.9)	77(11.1)	1(0.1)	1.74±1.02	1.235
Thigh	233(33.6)	230(33.2)	138(19.9)	88(12.7)	4(0.6)	2.13±1.03	273.447
legs	93(13.4)	215(31.0)	270(39.0)	105(15.2)	10(1.4)	2.60±0.95	40.469

Further analysis of musculoskeletal discomforts of workers by their units as indicated in the Table 3 clearly depicts that in dyeing units where workers adopt awkward postures for dyeing resulted in severe discomforts in low back (33%), buttock (54%) and thighs (45%). Analysis of the discomforts of the workers employed in fish processing units indicated that the low back (29%), thighs (25%) and legs (17%) were the regions

that experienced moderate level of discomforts. The lower extremities experienced higher levels of discomfort due to long hours of standing at work. Workers employed in food processing units reported higher levels of moderate discomfort in neck(38%), shoulder(45%), low back(52%, legs (51%) and upper arm (46%). Figure 2 presents the mean discomforts of different body parts by the units in which they were employed.

**Table 3: Musculoskeletal discomforts of women workers employed in dyeing, fish processing and food processing units**

Body parts	No discomfort	Mild discomfort	Moderate discomfort	Severe discomfort	Extreme discomfort	Mean ±SD	Chi square value
Dyeing unit (n=142)							
Neck	-	53 (37.3)	68 (47.9)	21(14.8)	-	2.77±0.69	24.35**

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Shoulder	-	78(54.9)	58(40.)	6 (4.2)	-	2.49±0.58	58.36**
Upper arm	-	68(47.9)	68(47.9)	6(4.2)	-	2.56±0.58	54.14**
Low back	1(0.7)	15(10.6)	78(54.6)	48(33.8)	-	3.22±0.65	100.64**
buttock		11(7.7)	53(37.3)	77(54.2)	1(0.7)	3.48±0.65	107.55**
Thigh	-	13(9.2)	64(45.1)	64(45.1)	1(0.7)	3.37±0.66	93.54**
legs	-	53(37.3)	71(50)	18(12.7)	-	2.75±0.67	30.69**
Fish processing units (n=244)							
Neck	150 (61.5)	81(33.2)	6(2.5)	7(2.9)	-	1.46±0.68	353.25**
Shoulder	113(46.3)	43(17.6)	32(13.1)	47(19.3)	993.7)	2.03±1.05	127.76**
Upper arm	181(74.2)	41(16.8)	14(5.7)	6(2.5)	2(0.8)	1.38±0.77	466.61**
Low back	47(19.3)	85(34.8)	71(29.1)	32(13.1)	9(3.7)	2.47±1.07	75.26**
buttock	238(97.5)	6(2.5)	-	-	-	1.02±0.12	917.45**
Thigh	77(31.6)	78(32)	62(25.4)	24(9.8)	3(1.2)	2.17±1.02	92.92**
legs	68(27.9)	102(41.8)	42(17.2)	25(10.2)	7(2.9)	2.18±1.05	116.11**
Food processing units (n=307)							
Neck	32(10.4)	116(37.8)	117(38.1)	34(11.1)	8(2.6)	2.58±0.91	171.64**
Shoulder	31(10.1)	91(29.6)	139(45.3)	42(13.7)	4(1.3)	2.66±0.88	187.18**
Upper arm	46(15.0)	72(23.5)	144(46.9)	42(13.7)	3(1.0)	2.62±0.93	178.48**
Low back	2(0.7)	39(12.7)	160(52.1)	99(32.2)	7(2.3)	3.23±0.72	295.19**
buttock	164(53.4)	134(43.6)	9(2.9)	-	-	1.50±0.56	132.08**
Thigh	156(50.8)	139(45.3)	12(3.9)	-	-	1.53±0.57	121.03**
legs	25(8.1)	60(19.5)	157(51.1)	62(20.2)	3(1.0)	2.86±0.86	226.01**

\*\* P<0.001

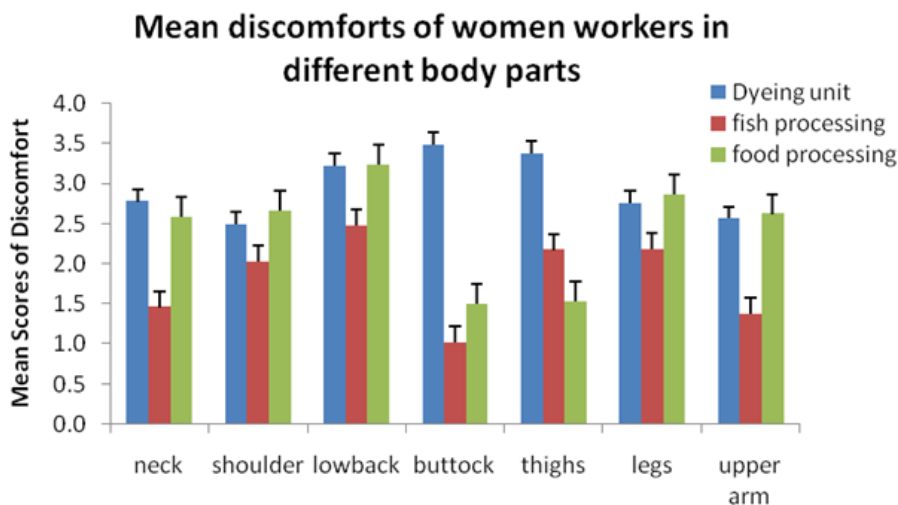


Figure 2: Mean discomforts of women workers in different body parts

Table 4 presents the bivariate logistic regression between the selected variables namely age, sector, marital status, education, work experience, age of entry and work hours on the musculoskeletal discomforts reported every day for the past 30 days in different body parts.

Participants who were educated below high school experienced pain by 1.6 times higher than those

with high school education and above. Participants who entered at age 20 or older had a prevalence rate 1.2 times higher than those who entered before age 20. Analysis of work experience by the discomforts revealed that women having 5 to 10 years had 2.3 times higher shoulder pain when compared to women with less than five years of service. Similarly women with more than 10 years of service are more

likely to have 3.3 times higher shoulder pain, 2.5 times higher low back pain, 3.3 times higher leg pain and 1.19 times higher upper arm pain. Longer work hours (more than 8 hours / day are consistently associated

with higher pain and follows a similar trend to work experience for shoulder and leg pain. (OR=1.25 for < hours).

**Table 4: Bivariate logistic regression for prevalence of musculoskeletal discomforts by select variables**

Body parts	Variables	Category	Odds Ratio	95.0% C.I.for EXP(B)		p value
				Lower	Upper	
Neck	Age(yrs)	Less than 25	1			
		25-45	0.376	0.130	1.087	0.071
		Above 45	0.577	0.166	2.001	0.386
	Education	Above high school	1			
		Up to high school	1.641	1.030	2.613	0.037
	Marital status	Unmarried	1			
		Married	0.237	0.103	0.543	0.001
		Separated	0.576	0.274	1.214	0.147
	Sector	Dyeing	1			
		Fish processing	0.007	0.002	0.026	0.000
		Food processing	0.574	0.310	1.064	0.078
	Age of entry(yrs)	Less than 20	1			
		20-25	1.244	0.628	2.465	0.531
		Above 25	0.813	0.404	1.637	0.563
	Work experience (yrs)	Less than 5	1			
		5 to 10	2.310	1.172	4.552	0.016
		Above 10	1.976	0.944	4.135	0.071
	Work hours	less than 8	1			
8 to 10		1.666	0.891	3.117	0.110	
above 10		1.047	0.527	2.077	0.896	
Shoulder	Age(yrs)	Less than 25				
		25-45	1.729	0.764	3.912	0.189
		Above 45	1.590	0.547	4.617	0.394
	Education	Above high school	1			
		Up to high school	1.659	1.058	2.601	0.027
	Marital status	Unmarried	1			
		Married	0.948	0.515	1.745	0.864
		Separated	0.593	0.271	1.297	0.191
	Sector	Dyeing	1			
		Fish processing	0.044	0.017	0.111	0.000
		Food processing	0.124	0.055	0.278	0.000
	Age of entry(yrs)	Less than 20				
		20-25	1.412	0.716	2.784	0.319
		Above 25	1.010	0.503	2.026	0.978
	Work experience (yrs)	Less than 5				
		5 to 10	2.350	1.367	4.039	0.002
		Above 10	3.306	1.679	6.510	0.001
	Work hours	less than 8	1			
8 to 10		1.084	0.503	2.336	0.838	
above 10		1.474	0.662	3.280	0.342	

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Low back	Age(yrs)	Less than 25	1			
		25-45	2.200	0.930	5.206	0.073
		Above 45	5.195	1.731	15.589	0.003
	Education	Up to high school	1			
		Above high school	1.208	0.787	1.854	0.387
	Marital status	Unmarried	1			
		Married	0.732	0.443	1.212	0.225
		Separated	0.738	0.241	2.257	0.594
	Sector	Dyeing	1			
		Fish processing	9.113	3.940	21.079	0.000
		Food processing	37.061	17.026	80.672	0.000
	Age of entry(yrs)	Less than 20	1			
		20-25	0.956	0.493	1.854	0.894
		Above 25	0.786	0.353	1.752	0.556
	Work experience (yrs)	Less than 5	1			
		5 to 10	3.099	1.744	5.507	0.000
		Above 10	2.554	1.130	5.771	0.024
	Work hours	less than 8	1			
8 to 10		0.891	0.448	1.772	0.741	
above 10		0.748	0.348	1.605	0.456	
Legs	Age(yrs)	Less than 25	1			
		25-45	1.637	0.699	3.835	0.257
		Above 45	3.949	1.326	11.762	0.014
	Education	Up to high school	1			
		Above high school	0.638	0.400	1.018	0.060
	Marital status	Unmarried	1			
		Married	1.460	0.854	2.495	0.167
		Separated	1.760	0.567	5.458	0.328
	Sector	Dyeing	1			
		Fish processing	0.211	0.095	0.467	0.000
		Food processing	2.989	1.576	5.668	0.001
	Age of entry(yrs)	Less than 20	1			
		20-25	1.162	0.584	2.310	0.669
		Above 25	1.235	0.575	2.653	0.589
	Work experience (yrs)	Less than 5	1			
		5 to 10	2.334	1.266	4.305	0.007
		Above 10	3.393	1.587	7.253	0.002
	Work hours	less than 8	1			
8 to 10		1.290	0.673	2.473	0.443	
above 10		1.254	0.598	2.630	0.549	

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Upper arm	Age(yrs)	Less than 25	1			
		25-45	2.281	0.793	6.558	0.126
		Above 45	2.109	0.592	7.511	0.249
	Education	Up to high school	1			
		Above high school	0.919	0.557	1.517	0.741
	Marital status	Unmarried	1			
		Married	0.662	0.288	1.520	0.331
		Separated	1.082	0.489	2.395	0.846
	Sector	Dyeing	1			
		Fish processing	0.012	0.004	0.039	0.000
		Food processing	0.118	0.060	0.232	0.000
	Age of entry(yrs)	Less than 20	1			
		20-25	1.171	0.582	2.356	0.658
		Above 25	0.832	0.418	1.655	0.601
	Work experience (yrs)	Less than 5	1			
		5 to 10	1.102	0.524	2.316	0.798
		Above 10	1.903	0.866	4.179	0.109
	Work hours	less than 8	1			
8 to 10		0.664	0.334	1.323	0.244	
above 10		0.728	0.343	1.541	0.406	

When comparing the age it could be inferred that shoulder pain was 1.72 times higher for women in the age group of 25 to 45 when compared to women with less than 25 years. Low back pain was 5 times higher for women above 45 years and leg pain was higher by 3.9 times for women above 45 years. Pain in the upper arm was 2.28 times higher for women above 25 years when compared to women below 25 years. Women with low education had 1.65 times higher prevalence of shoulder pain when compared to women with higher education level. Women who entered into work between the age of 20 to 25 years have higher prevalence of shoulder pain (1.42 times), leg pain (1.23 times) and 1.17 times higher for upper arm. Married women experienced 1.4 times higher leg pain than unmarried women. Women employed in dyeing units had higher prevalence of low back pain than those employed in food and fish processing units

### Discussion

In the unorganized sector, musculoskeletal disorders are a serious problem, MSDs can be acute or chronic in nature, incapacitating and many times

escalating the bills for health systems particularly in the case of chronic pain. Employees who work long hours or sit still are more susceptible to MSDs<sup>(10)</sup>. Older age<sup>(11)</sup> and long years of working are significant risk factors for MSDs. Female workers in several occupation have higher prevalence of MSDs when compared to their male counter parts<sup>(5,12,13)</sup>. Several epidemiological studies have cited higher prevalence rates of MSD with increasing age and long years of work<sup>(6)</sup>. MSDs are complex and multifactorial disorders including genetic, morphological, psychological, and biomechanical aspects. Long-term, consistent muscle activation without much change in exposure can cause ischemia and hypoxia, which can build up metabolites and eventually cause damage to tendons and muscle fibers. Awkward postures<sup>(6)</sup>, monotonous, repetitive duties<sup>(14)</sup>, long workdays without breaks, poor equipment and furniture, and pressure are some of the factors that might lead to MSD symptoms in the workplace. The observation of the postures adopted by the women workers in the informal sector is one of the major contributing factor for increased level of MSD. Work environment and precision task may also be one of the confounding factors.

The findings of the present study indicate that the sector in which the women workers were employed had a greater impact on the prevalence of MSD especially in the low back<sup>(1, 15,16)</sup>. A study on the bamboo workers which is also an informal sector also reports higher prevalence in the low back with a frequency of 4.5 and for palm and fingers was 3.73<sup>(2)</sup>. A study on the hair dresses showed the highest prevalence rate was observed in shoulder 53.7% ( $n=350$ ) followed by 53.4% ( $n=348$ ) neck and 53.2% ( $n=347$ ) low back<sup>(8)</sup>. The present study also confirms the findings that age of the worker, age of entry and work hours and work experience has an impact on the prevalence of MSD on the workers. The findings of the present study is in accordance with a similar study conducted among the handicraft workers which revealed that age, work experience, prolonged work hours, sustained awkward posture, continuous work without break, extensive work pressure, and poor job control increased the risk of MSD symptoms in different body regions, while with a higher level of education, MSDs in the neck and lower back regions reduced<sup>(17, 18,19, 20)</sup>. MSD can further be aggravated by lack of proper furniture to carry out the task, awkward posture adopted by the workers, long hours of maintaining the posture, lack of adequate rest breaks/ work pause and lack of awareness on provision of better work environment<sup>(21, 22, 23, 24)</sup>.

The present study highlights that socio-demographic factors—such as age, marital status, education level, and work experience—as well as occupational factors like work hours, age at job entry, and work environment, significantly influence the levels of musculoskeletal disorders (MSDs) experienced by women workers.

The findings underscore the need for targeted strategies to minimize musculoskeletal discomforts in the workplace. These include improving the work environment through the provision of ergonomic, multi-user workstations, ensuring recommended lighting levels, adequate ventilation, and noise reduction, and promoting the use of personal protective equipment (PPE).

Additionally, workplace policies should emphasize the importance of adequate rest breaks and job rotation, which can be addressed through public health education and sensitization of both employers and workers.

Encouraging workers to access available social security schemes can also contribute to improving occupational health and safety. Implementing and regularly monitoring these interventions will help create a healthier and more sustainable work environment in the long term.

### **Limitations of the study**

There may have been recollection bias because the MSD prevalence was determined by self-reporting. Furthermore, the severity of MSD was only subjective and not objective. Data were gathered from workers in different types of units and had women workers in different age groups.

### **Conclusion**

The study elucidates the factors contributing to higher level of MSDs among women in informal sectors. Socio demographic, individual and occupational factors associated with higher level of prevalence of MSD need to be addressed to minimize the risk factors through managerial solutions. Ergonomic interventions are imperative to evade adverse consequences on the occupational health of women employed in informal sector. Sensitisation of the workers and the management on positive impact of ergonomically designed workspace will help in alleviating the MSDs in the near future. Governments, companies, legislators, and stakeholders should work together to preserve the health and well-being of the workers in these factories.

**Conflict of interest:** Nil

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# Impact Assessment of Monthly Informal Health Awareness Sessions, as a Part of the Village Adoption Scheme on the Knowledge, Attitude and Practices of Menstrual Health and Hygiene, in Young Women, Over Three Years in a Rural Setting in Central Maharashtra

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## Abstract

Menstrual health is often overlooked in rural and tribal regions of India, where cultural taboos, misinformation, and poor hygiene practices persist. This study assessed the impact of monthly informal menstrual health awareness sessions, conducted as part of an institutional village adoption program, on knowledge, attitudes, and practices (KAP) among women in a tribal village in central Maharashtra. A community-based mixed-methods study was carried out from 2019 to 2022 using a pre- and post-intervention design. Monthly sessions were led by trained medical students. Data collection involved door-to-door surveys using a structured KAP questionnaire and focus group discussion. Quantitative data were analyzed using Chi-square and t-tests, while qualitative data were thematically analyzed. Seventy-five women aged 18–45 completed the baseline questionnaire, and 86 participated post-intervention. Significant improvements were seen in menstrual knowledge: understanding of the physiological basis of menstruation rose from 32.0% to 67.4% ( $p < 0.001$ ), and awareness of its reproductive role increased from 49.3% to 75.6% ( $p < 0.01$ ). Self-reported menstrual-related absenteeism declined from 17.3% to 8.1% ( $p = 0.04$ ), and restrictive practices like temple avoidance dropped from 46.7% to 22.1% ( $p < 0.01$ ). Qualitative findings highlighted greater openness and confidence among adolescent girls and reduced stigma in community discussions. The study demonstrates that sustained, informal awareness sessions can significantly improve menstrual health literacy and reduce stigma in low-resource settings. This scalable, low-cost model holds potential for wider implementation to support health education, school attendance, and women's well-being in similar communities.

**Keywords:** Menstrual health, rural women, KAP study, menstrual hygiene, India, stigma, village adoption scheme

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## Introduction

Menstruation is a natural physiological process, yet it remains enveloped in silence, stigma, and misinformation across many parts of India, particularly in rural and tribal communities. Historically, menstruation has been perceived as unclean, giving rise to a host of taboos and restrictive practices—including prohibitions on cooking, religious participation, bathing, and physical activity during menstruation—that adversely affect women's health, hygiene, and social participation.<sup>[1-4]</sup> Such beliefs not only perpetuate gender-based discrimination but also hinder the adoption of safe menstrual hygiene practices, contributing to negative health outcomes and psychosocial stress.

In the past five years, India has witnessed a notable shift in public discourse and policy regarding menstrual health. Social entrepreneurs, most notably Arunachalam Muruganantham (Padma Shri, 2016), have pioneered the production and distribution of affordable sanitary products, while grassroots initiatives such as Eco Femme, Goonj's Not Just a Piece of Cloth (NJPC), and Anandi Pads have promoted menstrual health education and women's empowerment.<sup>(5,6)</sup> The release of the feature film "Padman" (2018) further catalyzed national conversation, fostering greater awareness and advocacy efforts.<sup>(7,8)</sup>

Despite these advances, recent surveys in diverse regions—including Maharashtra, Gujarat, Pondicherry, Punjab, and Haryana—continue to document the persistence of menstrual taboos and their detrimental impact on women's health and well-being. Similar patterns have been observed in other low- and middle-income countries, underscoring the global relevance of this issue.<sup>[9-21]</sup> Comparative studies on menstrual products in resource-limited settings further highlight the need for contextually appropriate interventions to improve menstrual hygiene management.<sup>[22-25]</sup>

India's flagship initiatives—such as Beti Bachao Beti Padhao, Swachh Bharat, and Swasthya Bharat—have sought to improve women's education and health outcomes. However, there remains a critical need to assess whether these changes have permeated marginalized rural and tribal populations, where deeply entrenched cultural norms and limited access to health education may persist.

Village adoption scheme in which one village is adopted per batch of medical students in medical colleges in Maharashtra, with monthly personalized health awareness sessions as an intervention that aims to increase community participation in their health.

To address this gap, we conducted a Knowledge, Attitude, and Practice (KAP) study in a village in central Maharashtra to evaluate the impact of monthly informal health awareness sessions. The primary objective was to assess changes in menstrual knowledge and practices among women of reproductive age following these interventions. Secondary objectives included exploring beneficiaries' perceptions through focus group discussions.

## Methodology

### Study Design

A three-year, community-based, mixed-methods study employing a pre- and post-intervention design to evaluate the impact of monthly informal health awareness sessions was conducted in a rural tribal village in central Maharashtra. The sessions included awareness about good hygiene practices, cleanliness, diseases, natural physiological processes like menstruation, and other relevant topics.

### Setting

The study was conducted in a village located 12 km from Mahatma Gandhi Institute of Medical Sciences (MGIMS), Wardha, with a population of 2,186 across 439 households

### Ethical Considerations

Approval was obtained from the Institutional Ethics Committee (IEC) of MGIMS. Permission was also secured from the village Panchayat. Verbal informed consent was obtained from survey participants, and written informed consent from participants in focus group discussions (FGDs). Confidentiality and anonymity were maintained throughout the study.

### Participants and Sampling

#### Eligibility criteria:

- Survey and FGD: All menstruating women aged 18–45 years, residing in the village for at least three years and consenting to participate, were eligible.

**Sampling:**

- All eligible women present during each survey round were included. Those absent were revisited twice before being marked as not contacted. For qualitative components, purposive sampling was used.

**Intervention**

Monthly informal menstrual health awareness sessions were conducted by trained medical students over three years periodically. Sessions included interactive discussions on menstrual physiology, good hygiene practices, cleanliness, product use and disposal, and addressed local taboos and myths, diseases, and other relevant topics.

**Data Collection**

- **Timing:**
  - o Baseline (pre-intervention) assessment was conducted in October 2019, prior to the initiation of the awareness sessions.
  - o Endline (post-intervention) assessment was conducted after 36 months of intervention in November 2022
- **Quantitative Component:**
  - o Door-to-door surveys were conducted by medical students at both baseline and endline using, standardized questionnaire (31 items; closed and open-ended) administered via Google Forms on smartphones. The questionnaire assessed demographic characteristics, knowledge, attitudes, and practices (KAP) regarding menstruation and menstrual hygiene.
- **Qualitative Component:**

A baseline FGD with local young womens' groups helped define the gaps and develop the Information Education and Communication (IEC) tools for menstrual taboos, hygiene practices, and perceptions of menstruation. Discussions were facilitated by trained social workers and audio-recorded.

**Variables**

- **Primary outcomes:** Changes in knowledge and practices related to menstruation and

menstrual hygiene, measured through pre- and post-intervention surveys.

- **Secondary outcomes:** Perceptions and experiences of beneficiaries regarding the awareness sessions, explored through FGDs and interviews.

**Data Management and Analysis**

- **Quantitative data:**
  - o Data were exported from Google Forms to Microsoft Excel for cleaning and analysis. Descriptive statistics (means, standard deviations, frequencies, percentages) were computed for demographic and KAP variables. Differences between pre- and post-intervention data were assessed using the Chi-square or Fisher's exact test for categorical variables and independent Student's t-test for continuous variables. A p-value <0.05 was considered statistically significant.
- **Qualitative data:**
  - o Audio recordings from FGDs and interviews were transcribed verbatim and analyzed thematically to identify recurring patterns and themes.

**Quality Control**

Data collectors were trained in standardized procedures. Data quality was ensured through double-checking entries and regular supervision. Participant identities were anonymized, and data were securely stored with restricted access.

**Results**

An analysis was performed comparing data from the pre-intervention survey in 2019 and the post-intervention survey in 2022. All women aged 18–45 years who had lived in the village for at least three years and provided consent were included in both survey rounds. Educational attainment was comparable across both surveys. (Table 1).

**Knowledge and Awareness**

There was a significant improvement in menstrual knowledge and awareness following the intervention (Table 2). The proportion of women who understood

the physiological basis of menstruation increased from 32.0% to 67.4% ( $p < 0.001$ ), and awareness of its reproductive implications rose from 49.3% to 75.6% ( $p < 0.01$ ). More women learned about menstruation before menarche post-intervention, and the role of school-based education increased.

### Menstrual Material Use

Exclusive use of disposable sanitary pads at home increased slightly (78.7% to 80.2%), and use when away from home reached 86%. Use of cloth/towel alone decreased, and more women reported using reusable pads. Discomfort with cloth remained the primary reason for switching to pads.

### Disposal Practices (2022)

At home, 59.3% washed and burned used pads, while 15.1% disposed of them in household rubbish. When away from home, 25.6% disposed of pads in latrine bins and an equal proportion in on-site bins. Over half (52.3%) wrapped pads in plastic before disposal.

### Hygiene and Washing Practices (2022)

- 82.6% always used the same location for urination at home during menstruation; 72.1% did so when away.
- On the heaviest day, 41.9% changed pads twice, 36% thrice, and 15.1% wore the same pad until the next day.
- 15.1% washed and reused menstrual material; 4.6% used repurposed cloth.
- 73.3% always used soap/detergent to wash material; 50% dried it outside, 57.1% dried it

covered, and 21.4% sometimes used it before fully dry.

- 3.5% ironed menstrual material before use.

### Handwashing and Bathing (2022)

- 51.2% washed hands every time before changing material; 87.2% after changing.
- 59.3% bathed once per day during menstruation, 18.6% twice, and 10.5% three or more times per day.
- 45.3% always used soap to wash genitals, 38.4% sometimes, and 16.3% never.

### Menstrual Health and Satisfaction

Reported irritation or irregular discharge decreased significantly from 22.7% to 11.6% ( $p = 0.04$ ). Satisfaction with menstrual material remained high (90.7% to 95.3%), and mean comfort and freedom of movement scores improved significantly. (Table 3)

### School/Work Absenteeism

Self reported Absenteeism due to menstruation decreased significantly from 17.3% to 8.1% ( $p = 0.04$ ), with mean days missed dropping from 9 to 4 per year ( $p = 0.02$ ). The average out-of-pocket expenditure per cycle remained similar (35.3 INR to 37.5 INR,  $p = 0.21$ ).

### Taboos and Social Restrictions

There was a significant reduction in reported menstrual taboos (61.3% to 38.4%,  $p < 0.01$ ). Notably, the proportion of women avoiding temples during menstruation declined from 46.7% to 22.1% ( $p < 0.01$ ). (Table 4)

**Table 1. Age and Educational Attainment of Study Participants in 2019 and 2022 Surveys**

Parameter	2019 Survey (n = 75)	2022 Survey (n = 86)
<b>Age (years)</b>		
Mean $\pm$ SD	26.1 $\pm$ 9.05	29.1 $\pm$ 8.14
Minimum	18	18
Maximum	47	48
<b>Education</b>		
Higher education	19 (25.3%)	26 (30.2%)
High school (9th–12th)	44 (58.7%)	47 (54.7%)
Middle school (5th–8th)	10 (13.3%)	11 (12.8%)
Primary school (till 4th)	2 (2.7%)	2 (2.3%)

**Table 2. Menstrual Knowledge and Awareness, Pre- and Post-Intervention**

Indicator	2019 (%)	2022 (%)	p-value*
Knew what menstruation was	92.0	98.8	0.07
Understood physiological reason for menstruation	32.0	67.4	<0.001
Aware of implication for pregnancy	49.3	75.6	<0.01
Learned about menstruation after menarche	56.0	34.9	<0.01
Main source: mother	44.0	32.6	0.12
Main source: school/teacher	22.7	36.0	0.04

\*Chi-square test

**Table 3: Menstrual Health and Satisfaction**

Indicator	2019 (%)	2022 (%)	p-value*
Irritation/irregular discharge	22.7	11.6	0.04
Satisfied with menstrual material	90.7	95.3	0.29
Mean comfort score (1-10)	7.9	8.5	0.03
Mean freedom of movement score (1-10)	7.7	8.2	0.05

**Table 4. Menstrual Taboos and Restrictions**

Indicator	2019 (%)	2022 (%)	p-value*
Experienced taboos	61.3	38.4	<0.01
Did not enter temple	46.7	22.1	<0.01
Did not cook	8.0	3.5	0.18
Did not pray	6.7	3.5	0.29

## Discussion

This study demonstrates the significant impact of sustained, community-based menstrual health awareness sessions in improving menstrual knowledge, hygiene practices, and attitudes among women in a village in central Maharashtra. Conducted over three years, this intervention offers evidence that culturally sensitive, informal educational approaches can address entrenched taboos, enhance hygiene practices, and reduce period-related discomfort and absenteeism in underserved communities.

### Improved Knowledge and Early Education

A notable finding was the increase in understanding of the physiological basis of menstruation, from 32.0% at baseline to 67.4% post-intervention ( $p < 0.001$ ), and in awareness of its reproductive implications from 49.3% to 75.6% ( $p < 0.01$ ). Furthermore, a significant shift was observed in the timing and source of menstrual education –

more women learned about menstruation before menarche in 2022 compared to 2019, and schools and teachers increasingly became the primary source of information. This trend aligns with global best practices in menstrual health management and underlines the importance of incorporating menstrual education into school curricula [26–28].

### Reduction in Period Poverty and Absenteeism

While access to disposable sanitary products was already relatively high, the quality of usage improved. More women adopted practices such as changing menstrual materials more frequently and using soap or detergent to wash reusable materials. Health-related complaints such as irritation or irregular discharge decreased significantly from 22.7% to 11.6% ( $p = 0.04$ ), suggesting better menstrual hygiene.

Crucially, absenteeism from school or work due to menstruation declined from 17.3% to 8.1% ( $p = 0.04$ ),

and the average number of days missed annually dropped from 9 to 4 ( $p = 0.02$ ). This finding mirrors results from the Chitkani study in Rajasthan, where girls reported frequent absenteeism due to period-related stigma and lack of menstrual resources [29].

These findings also resonate with international experiences. In Kenya, comprehensive menstrual interventions—combining education with access to sanitary products—resulted in improved school attendance and reduced psychosocial distress among adolescent girls [30]. This highlights that “period poverty” is not limited to lack of products but encompasses inadequate information, social stigma, and lack of supportive infrastructure.

### Shifting Taboos and Cultural Norms

One of the most promising outcomes of the intervention was the reduction in social taboos. The proportion of women reporting restrictions during menstruation fell from 61.3% to 38.4% ( $p < 0.01$ ). In particular, avoidance of temples decreased markedly from 46.7% to 22.1% ( $p < 0.01$ ). Although practices such as refraining from cooking or praying saw modest declines, the overall shift reflects a broader cultural change and increased agency among women to question restrictive norms. These findings support similar results from Goonj’s Not Just a Piece of Cloth (NJPC) campaign, which has shown that dialogue and education can erode stigma over time [6].

### Qualitative Insights and Community Empowerment

The informal, interactive nature of the sessions facilitated peer learning and encouraged questions, contributing to a more open community environment. Regarding younger girls who have begun menstruating, the study included only participants aged 18 and above, as assent is required for individuals below 18 years of age. During the initial baseline assessment, rapport building was actively underway, as this marked our first engagement with the community.

Medical students conducting the sessions reported gaining valuable insights into rural health education and observed a clear decline in stigma, especially among younger women. Their dual role as facilitators and learners created a unique bridge between the health system and the community—a

model that could be replicated in other rural settings for broader impact [31].

Village adoption scheme is a scheme in which one village is adopted per batch of medical students in medical colleges in Maharashtra. The family adoption program within the village adoption program is a community-based initiative, with monthly personalized health awareness sessions as an intervention that aims to increase community participation in their health. [32]

### Limitations

This study relied on self-reported data, which may be subject to recall or social desirability bias. The absence of a control group limits causal inferences. Findings may not be generalizable beyond the specific rural context studied. Additionally, seasonal variation in menstrual product availability was not assessed. Another limitation of this study is the exclusion of male participants, as the sample size was selected based on ease of rapport building with the community. Future studies should include males to provide a more comprehensive perspective.

### Challenges and the Way Forward

Despite encouraging progress, challenges remain. Improper disposal practices—such as burning used pads and wrapping them in plastic—continue, underscoring the need for environmentally sound disposal options and awareness. Additionally, hygiene practices like drying reusable cloths indoors and sometimes using them before they are fully dry indicate areas where further education is needed.

To sustain and scale the impact of this model, future interventions should incorporate:

- Strengthening school-based menstrual education
- Promoting affordable, eco-friendly products
- Improving WASH (Water, Sanitation, and Hygiene) infrastructure
- Training community health workers to provide ongoing support

### Conclusion

This study affirms the value of consistent, contextually relevant menstrual health education in

transforming attitudes and behaviors in rural India. Informal awareness sessions—delivered through a trusted, community-engaged approach—can significantly reduce stigma, improve hygiene, and promote dignity. Such interventions are essential in addressing period poverty, promoting gender equity, and ensuring that menstruation does not hinder education, employment, or well-being. It also shows the feasibility of a scheme such as village adoption scheme to improve community participation in their health.

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**Ethical Clearance/Statement of Ethics:**

Approval was obtained from the Institutional Ethics Committee (IEC) of MGIMS PRE-(Ref. No. MGIMS/IEC/COMMED/08/2020) Meeting was done on 25 January 2020. POST-(Ref. No. MGIMS/IEC/COMMED/342/2022) Meeting was done on 01 October 2022

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Authors declare no conflict of interests.

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# Preventive Health Check-Up: A Welfare Initiative for the Truck Drivers

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## Abstract

**Background:** Truck driving is a physically and psychologically taxing job that puts drivers at risk for a number of illnesses, most notably non-communicable diseases (NCDs). Conditions including obesity, diabetes, and cardiovascular illnesses are exacerbated by a sedentary lifestyle, long work hours, and unpredictable sleep habits. By holding a preventative health check-up camp in Changsari, Assam, this study sought to evaluate the health status of truck drivers.

**Methods:** The health screening, which involved 325 truck drivers, involved blood pressure, body mass index (BMI), and clinical biochemical analysis utilizing "Mobilab," a portable, battery-powered, Internet of Things (IoT)-enabled biochemistry analyzer. Key health markers pertaining to anaemia, kidney, liver, and cardiovascular health were assessed throughout the examinations.

**Results:** This study revealed, 35% of individuals were at risk for kidney disease and 50.5% had an elevated risk of cardiovascular disease. Among all the drivers who participated in the study, 39% were found to be anaemic, and 18% had liver abnormalities. Furthermore, 21% of the subjects were overweight, and 8% had diabetes. According to BMI categorization, 12% were underweight and 3% were obese. These results show that truck drivers bear a heavy burden of lifestyle-related health concerns.

**Conclusion:** This occupational group urgently needs proactive healthcare treatments due to the significant prevalence of NCD risk factors. Preventive measures, such as regular check-ups with the doctor, lifestyle changes, and health education programs, should be the main focus of a comprehensive health strategy. These hazards can be reduced by promoting healthy eating, frequent exercise, and access to recurring medical examinations. Enhancing the general health and wellbeing of truck drivers may be possible through the implementation of workplace wellness initiatives and the provision of auxiliary tools like ergonomic seating and appropriate rest periods.

**Keywords:** Truck Drivers, Non-Communicable diseases, Portable biochemistry analyzer, Health Screening.

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## Introduction

An essential component of the logistics sector, the trucking business makes it possible to move resources and goods over great distances. Because it makes it possible for raw materials and completed goods to be delivered on time across supply chains, this industry is essential to maintaining market connectedness and economic stability. However, due to the nature of their work, truck drivers are susceptible to a number of occupational health risks, such as long workdays, prolonged periods of inactivity, irregular eating patterns, elevated stress levels, lack of sleep, and restricted access to medical care [1, 2, 3, 4]. When compared to the general workforce, truck drivers have a greater incidence of non-communicable diseases (NCDs) due to the combined effects of these causes.

The disproportionately high prevalence of NCDs, such as diabetes mellitus, hypertension, cardiovascular diseases (CVDs), and chronic renal disease, among truck drivers has been highlighted by a number of epidemiological studies [5, 6, 7, 8]. Their susceptibility to metabolic problems is greatly increased by their sedentary work and unhealthy lifestyle choices, which include smoking, relying on high-calorie, low-nutrition roadside cuisine, and not getting enough exercise [9, 10, 4]. Additionally, the risks of morbidity and death in this population are increased by the lack of routine health examinations, which frequently leads to delayed diagnosis and poorly managed chronic illnesses [11, 12].

Preventive healthcare interventions have become a critical method to lessen the burden of NCDs among truck drivers in light of these alarming health disparities. In order to identify at-risk patients and provide prompt medical assistance, routine health screenings and early intervention programs are essential [13, 14, 15]. In environments with limited resources, health camps, especially those that use point-of-care testing (POCT) equipment, offer a practical and affordable way to perform quick health checks. These portable healthcare solutions improve overall health outcomes and productivity among transportation employees by providing instant diagnostic results, which aid in the early detection and timely management of chronic illnesses.

While research on truck drivers' health risks is expanding, there is a significant gap in studies that focus on the unique challenges faced by truck drivers

in resource-limited regions, such as Assam. Most existing research primarily addresses the general prevalence of non-communicable diseases (NCDs) among truck drivers, but it often overlooks the contextual factors like diet, environmental conditions, and limited access to healthcare that are specific to these areas. Additionally, many interventions focus on raising awareness but do not address the critical need for accessible, affordable diagnostic solutions that can facilitate early detection and management of chronic conditions.

This study seeks to address these gaps by assessing the health status of truck drivers in the Changsari area using the "Mobilab" point-of-care testing (POCT) device. By offering cost-effective and efficient health screenings, it aims to identify key health risks and provide tailored healthcare solutions that can be implemented in resource-limited settings. The findings could contribute to the development of scalable healthcare models that not only improve the health outcomes of truck drivers but also have the potential to be replicated in other similar regions facing similar challenges.

## Material and Methods

### Methodology

#### Study design and settings

The study was carried out in Changsari, Assam, as a preventative health check-up camp as part of this community-based, cross-sectional study. Over the course of 80 hours, 325 truck drivers were enrolled and investigated. Using a standardized screening methodology, the study sought to evaluate important health markers linked to NCDs.

#### Methods of Screening

Comprehensive health evaluations were performed on the participants, and these included:

**(a) Anthropometric Measurements:** Standardized equipment was used to record height, weight, and BMI.

**(b) Vital Signs:** An automatic sphygmomanometer was used to measure blood pressure.

**(c) Biochemical Analysis:** Qualified phlebotomists took around 2 milliliters of venous blood. Centrifugation was used for five minutes at 3,500 rpm in order to separate the serum from the blood

sample. Mobilab, a portable, battery-powered, Internet of Things-enabled biochemistry analyzer with a diagnosis accuracy of over 90%, was used to assess the biochemical parameters.

**Evaluated parameters:**

- (a) **Cardiovascular markers:** LDL, triglycerides, and total cholesterol
- (b) **Tests for liver function:** total protein,

albumin, and bilirubin

- (c) **Kidney function tests:** creatinine and uric acid
- (d) **Hemoglobin** levels are used in haematological evaluation to identify anaemia.
- (e) **Blood glucose** testing at random for diabetes detection.

**Table 1: Biochemical Methods used for test parameters**

SI No	Test Name	AnalyticalMethod-Mobilab
1	Cholesterol (CHOL)	CHOD-PAPmethod <sup>[16]</sup>
2	Triglyceride (TGL)	GPO-PAPmethod <sup>[17]</sup>
3	UricAcid (UA)	UricasePAPmethod <sup>[18]</sup>
4	Glucose (GLU)	GOD-PAPmethod <sup>[19]</sup>
5	Hemoglobin (HB)	Cyanmethemoglobinmethod <sup>[20]</sup>
6	TotalBilirubin (TBIL)	Modified DMSO/Diazomethod <sup>[21]</sup>
7	Creatinine (CRE)	Enzymaticmethod <sup>[22]</sup>
8	LowDensity Lipoprotein-Cholesterol (LDL-C)	Selective Solubilization Method <sup>[23]</sup>
9	Albumin (ALB)	BromocresolGreen <sup>[24]</sup>
10	TotalProtein (TP)	DirectBiuretmethod <sup>[16]</sup>
11	HDL	Calculated <sup>[25]</sup>
12	Globulin	Calculated <sup>[26]</sup>
13	A/G Ratio	Calculated <sup>[26]</sup>

**Table 2: Range of test parameters used for the screening<sup>[26]</sup>**

Test Parameters	Ranges used for the survey				
	Low	Normal	Borderline	High	Units
Total Cholesterol	-	< 200	200 - 239	>240	mg/dL
Triglyceride	-	< 150	150 - 199	> 200	mg/dL
Uric Acid	< 3.5	3.5 - 7.2	-	> 7.2	mg/dL
Glucose	< 70	70 - 140	-	> 140	mg/dL
Haemoglobin	< 13.2	13.2 - 17.3	-	> 17.3	g/dL
Total Bilirubin	-	< 1.2	-	> 1.2	mg/dL
Creatinine	< 0.74	0.74 - 1.35	-	> 1.35	mg/dL
Total Protein	< 6	6 - 8	-	> 8	g/dL
LDL	-	< 130	130 - 159	> 160	mg/dL
Albumin	< 3.5	3.5 - 5.2	-	> 5.2	g/dL
HDL	< 35	35 - 80	-	> 80	mg/dL
Globulin	< 2	2 - 3.5	-	> 3.5	g/dL
A/G Ratio	< 1.1	1.1 - 2.5	-	> 2.5	-
BP	Sys < 90 and Dia < 60	Sys < 130 and Dia < 80	-	Sys > 130 or Dia > 80	mm Hg
BMI	< 18.5	18.5 - 24.9	-	> 24.9	kg/sq. m

### Ethical Consideration

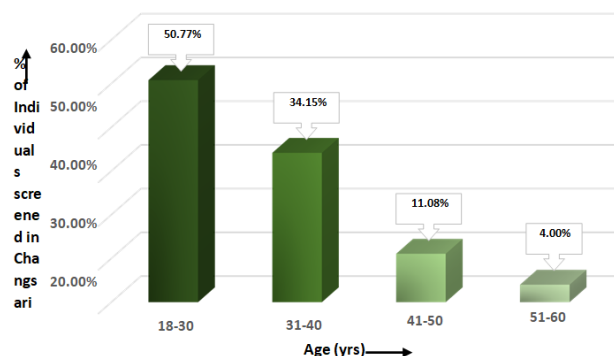
All participants gave their signed, informed consent prior to participation. The study ensured anonymity and voluntary involvement by adhering to ethical norms set forth by the Indian Council of Medical Research (ICMR), Government of India.

### Results

In Changsari, Assam, 325 truck drivers underwent a preventive health test, which yielded important insights into their health risks. Non-communicable diseases (NCDs), such as metabolic disorders, liver abnormalities, kidney dysfunction, cardiovascular diseases, and anemia, were found to be highly prevalent. The results underscore the occupational health burden among truck drivers, primarily attributed to stress, poor dietary habits, sedentary work conditions, and limited access to healthcare [9][5]. Figures 1-5 summarize the statistical analysis results.

#### Health Risk Distribution by Age Group

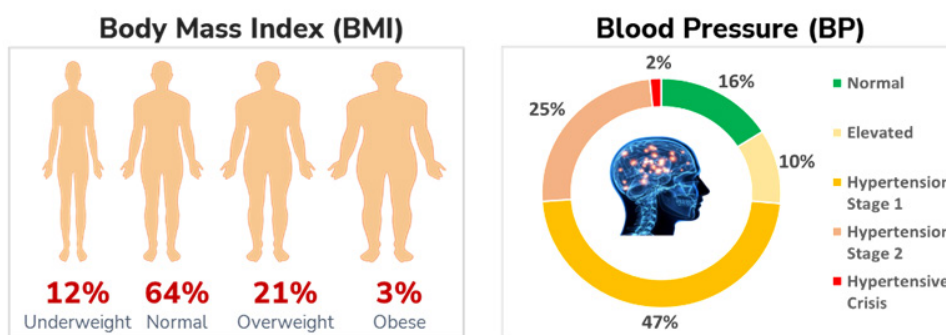
Figure 1 illustrates the distribution of health risks across different age groups. The majority of participants were between the ages of 30 and 50, representing a critical working demographic vulnerable to various illnesses. This finding aligns with prior research indicating that middle-aged truck drivers are particularly susceptible to chronic diseases due to unhealthy lifestyle practices and prolonged occupational stress [9].



**Figure 1:** Age-wise distribution of individuals screened in Changsari. The bar chart shows the percentage of individuals screened across four age groups. The highest proportion, 50.77%, belongs to the 18-30 years age group, followed by 34.15% in the 31-40 years group. The 41-50 years group constitutes 11.08%, while the 51-60 years group accounts for the lowest percentage at 4.00%. This data highlights the age demographics of the screened population.

#### BMI and Blood Pressure Analysis

According to anthropometric measures, 21% of truck drivers were overweight, 3% were obese, and 12% were underweight, while 64% had a normal BMI (Figure 2). Hypertension, a recognized risk factor for cardiovascular disorders, is correlated with abnormal BMI [13]. Research shows that high-calorie diets and sedentary work habits lead to obesity, which raises the prevalence of hypertension [11].



**Figure 2:** Health distribution based on Body Mass Index (BMI) and blood pressure status. The left panel depicts BMI categories, showing the proportion of individuals in each category: 12% are underweight, 64% have a normal BMI, 21% are overweight, and 3% are obese. The right

panel illustrates the distribution of blood pressure categories: 16% have normal blood pressure, 47% have elevated blood pressure, 25% are in hypertension stage 1, 10% are in hypertension stage 2, and 2% are in a hypertensive crisis. These data provide insights into weight and blood pressure-related health conditions.

**Cardiovascular Health Risks**

As illustrated in Figure 3, 50.5% of truck drivers were at risk of cardiovascular diseases (CVDs), with 5.54% classified as high risk. These findings support previous research linking long sitting hours, high-stress work environments, and processed food intake with increased risk of hypertension and dyslipidemia<sup>[13]</sup>. Regular health screenings and dietary interventions are essential in reducing cardiovascular risks in this population<sup>[14]</sup>.

**Kidney Function and Chronic Kidney Disease (CKD)**

According to renal function analysis, 5% of truck drivers had chronic kidney disease (CKD), and 35% had kidney dysfunction (Figure 4). This is in line with studies that demonstrate renal stress is exacerbated by prolonged dehydration, high sodium intake from roadside food, and limited access to restrooms<sup>[9]</sup>. The risk of CKD can be reduced by preventive strategies including regular renal function testing and hydration

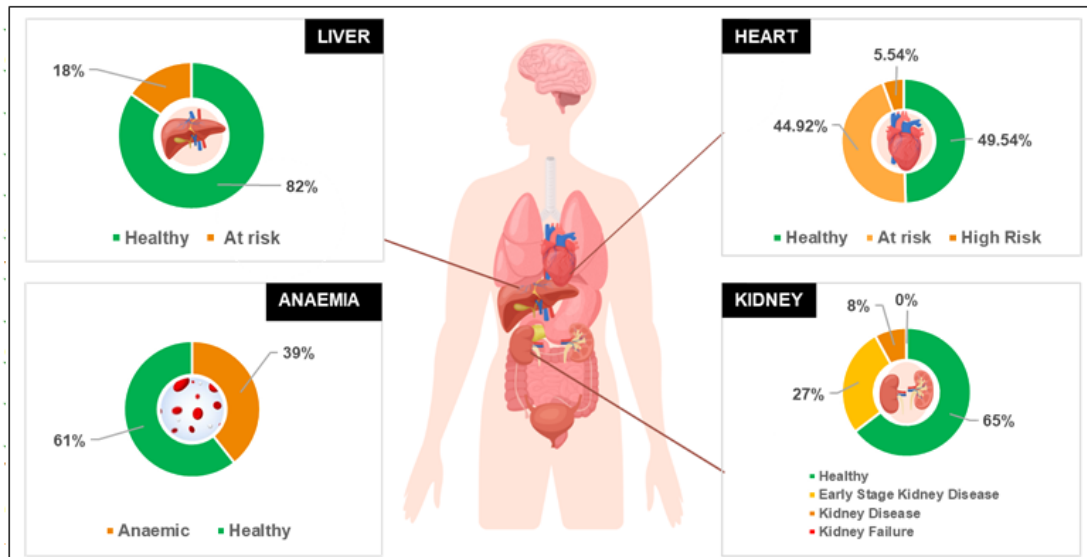
awareness campaigns<sup>[15]</sup>.

**Liver Function Abnormalities**

According to liver function evaluations, 18% of individuals exhibited abnormal liver parameters, which could indicate that they were at risk for non-alcoholic fatty liver disease (NAFLD) (Table 2). The metabolic syndrome, high-fat diets, and excessive alcohol use are major causes<sup>8</sup>. Preventive intervention can benefit from early detection using point-of-care testing (POCT) tools such as Mobilab<sup>[10]</sup>.

**Anaemia Prevalence**

Among truck drivers, anaemia was very common (39%) (Figure 4). Iron-deficient diets, chronic weariness, and the use of NSAIDs for pain management are the reasons for this, which is much greater than the norm for the general population<sup>[16]</sup>. Supplementation and better eating practices are essential for occupational health since anaemia impairs alertness and productivity at work<sup>[17]</sup>.



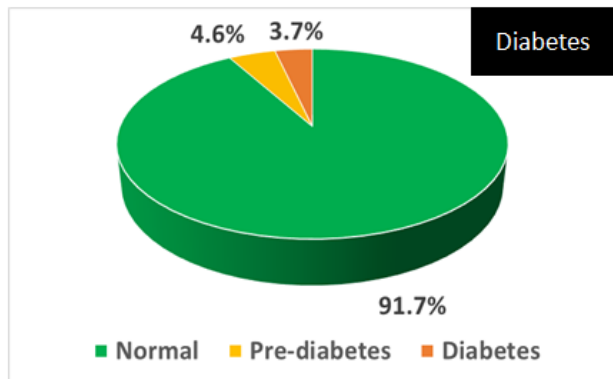
**Figure 4:** The figure illustrates the health status of key organs and anaemia assessment based on clinical parameters. The central image highlights the liver, heart, kidneys, and blood (for anaemia). Surrounding pie charts provide a summary of health conditions for each parameter. For the liver, 82% of individuals are healthy, while 18% are at risk. In the case of the heart, 44.92% are healthy, 49.54% are at risk, and 5.54% are at high risk. For kidney health, 65% of individuals are healthy, 27% have early-stage kidney

disease, 8% have kidney disease, and 0% have kidney failure. Regarding anaemia, 61% of individuals are healthy, while 39% are anaemic. This comprehensive depiction highlights the proportion of individuals at risk or suffering from specific health conditions.

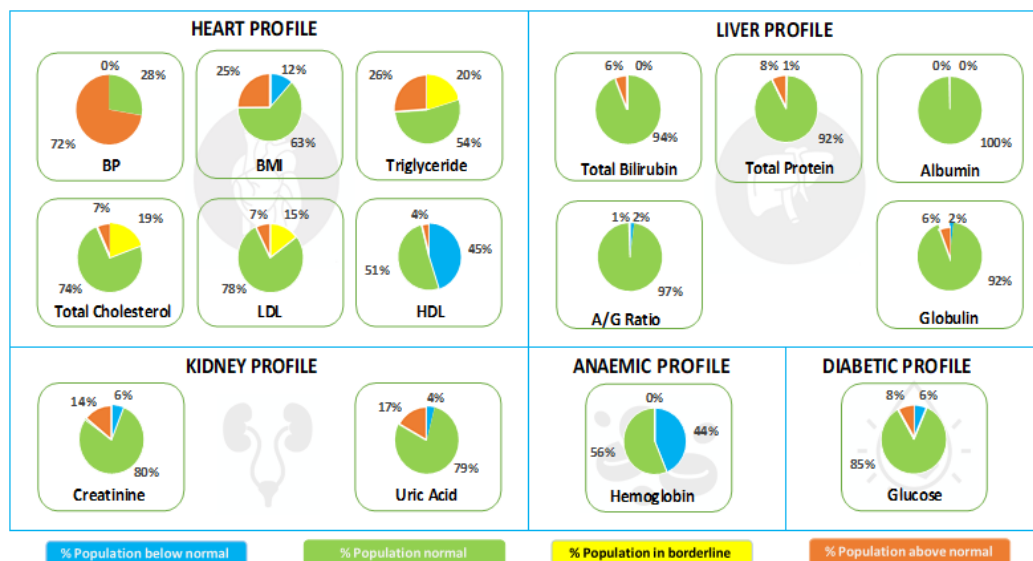
**Diabetes and Blood Glucose Levels**

8% of participants had increased glucose levels, putting them at risk for diabetes, according to blood glucose screening results (Figure 5). According to

research, excessive sugar consumption, irregular meal schedules, and sedentary lifestyles are the main causes (Sharma et al., 2022). This risk can be controlled by promoting balanced eating and physical activity (Verma et al., 2020).



**Figure 5:** This figure illustrates the distribution of diabetes and pre-diabetes among the truck drivers screened during the preventive health check-up. The majority (91.7%) of participants exhibited normal blood glucose levels, while 4.6% were classified as pre-diabetic, indicating an increased risk of developing diabetes in the future. Additionally, 3.7% of the participants were diagnosed with diabetes



**Figure 3:** A comprehensive overview of health profiles categorized by organ function and condition type, highlighting the percentage distribution of clinical parameters associated with potential health risks or diseases. The Heart Profile indicates that 28% of individuals are at risk due to abnormal Blood Pressure (BP), 12% due to abnormal Body Mass Index (BMI), 26% due to elevated Triglycerides, 7% due to high Total Cholesterol, 11% due to elevated Low-Density Lipoprotein (LDL), and 51% due to low High-Density Lipoprotein (HDL). The Liver Profile shows that 6% of individuals have abnormal Total Bilirubin, 8% have abnormal Total Protein, 0% have abnormal Albumin, 1% have abnormal Albumin-to-Globulin (A/G) Ratio, and 6% have elevated

Globulin levels, indicating possible liver dysfunction. The Kidney Profile identifies 14% of individuals with elevated Creatinine and 17% with high Uric Acid, suggesting potential kidney impairment. The Anaemic Profile reveals that 56% of individuals are at risk of anaemia due to low Hemoglobin levels. The Diabetic Profile highlights that 8% of individuals have elevated Glucose levels, indicating a risk of diabetes. These percentages provide a detailed assessment of individuals at risk for various diseases or conditions based on the abnormal ranges of these clinical parameters.

The Changsari health camp’s findings underscore the critical need for preventative healthcare measures by highlighting the substantial health risks faced by

truck drivers. The high prevalence of NCDs in this population is a result of occupational hazards such as extended sitting, unpredictable eating schedules, and restricted access to healthcare.

## Discussion

The present study provides a comprehensive health risk assessment of truck drivers in Changsari, Assam, revealing a concerning prevalence of metabolic disorders, cardiovascular risks, and other non-communicable diseases (NCDs). The findings are consistent with several national and international studies highlighting the occupational vulnerabilities associated with long-haul trucking.

The cardiovascular health profile (Figure 3) shows that 50.5% of drivers had at least one risk factor, with 28% presenting abnormal blood pressure, 26% elevated triglycerides, and 51% low HDL. These numbers align with the results reported by Sharma et al. [4], who observed high levels of dyslipidaemia and hypertension among Indian commercial drivers, attributing the cause to prolonged sedentary hours and poor dietary practices. Similarly, Patel et al. [3] found that truck drivers were at a significantly higher risk for cardiovascular events due to chronic occupational stress and lack of medical monitoring.

The high rate of anaemia (56%) found in this study also mirrors the findings of Mehta et al. [6], who reported anaemia prevalence exceeding 40% among male transport workers, often linked to iron-deficient diets and gastrointestinal disturbances induced by irregular eating patterns and frequent NSAID use. The implications are especially significant in safety-sensitive occupations such as trucking, where reduced alertness due to anaemia can compromise road safety.

In terms of liver and kidney function, 18% and 35% of drivers, respectively, showed signs of hepatic or renal abnormalities (Figure 3), similar to the prevalence observed in studies by Gupta et al. [1] and Verma et al. [5]. These abnormalities were commonly associated with lifestyle factors such as alcohol consumption, poor hydration, and frequent intake of high-sodium processed foods—all prevalent in roadside eating habits. Our results reinforce the urgent need for awareness campaigns around hydration and dietary control.

The diabetic and pre-diabetic prevalence, although relatively low at 3.7% and 4.6% respectively (Figure 5), still highlights a population at risk. As per Singh et al. [2], the gradual rise in type 2 diabetes among transport workers is often preceded by undiagnosed pre-diabetic conditions due to irregular check-ups and lack of early interventions. The early identification of these cases in our study indicates the utility of portable diagnostic tools like Mobilab in providing preventive care in remote or mobile populations.

Overall, our findings are congruent with existing literature and underline the multifactorial risks that truck drivers face. This study adds value by deploying a point-of-care testing (POCT) device for rapid biochemical profiling in field conditions, thereby demonstrating a scalable model for occupational health screening. There remains, however, a need for regular follow-ups and integration of such screenings into routine policy-driven occupational health programs.

## Conclusion

The urgent need for focused health interventions is highlighted by the high frequency of metabolic illnesses, anaemia, liver abnormalities, kidney dysfunction, and cardiovascular risk among Changsari truck drivers. Early detection of non-communicable diseases (NCDs) was made possible by the deployment of Mobilab, a portable IoT-enabled biochemistry analyzer that allowed for quick and precise health assessments. Given the vital role truck drivers play in the logistics industry, organized healthcare programs that include lifestyle changes, preventative care, and recurring Mobilab screenings can greatly improve road safety and truck drivers' well-being. To assess the long-term effects of such healthcare programs, future research should build on these findings using larger sample numbers and longer treatments.

## Limitation of the Study

This study was limited by its cross-sectional design, which provides only a snapshot of the health status of truck drivers at a single point in time. The relatively small sample size and regional focus on the Changsari area may not fully capture the broader

health landscape of truck drivers across different geographies. Additionally, self-reported lifestyle data were subject to recall bias. Future longitudinal studies with more diverse and representative populations are needed to validate these findings and track changes over time.

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**Ethical Clearance/Statement of Ethics:** Not Applicable

**Conflicts of interest statement:** All authors declares no conflicts of interest

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# Assessment of Beneficiaries Satisfaction under Ayushman Bharat Pradhan Mantri Jan Arogya Yojana (AB-PMJAY) in Banda District of Uttar Pradesh

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## Abstract

**Background:** Pradhan Mantri Jan Arogya Yojana, launched in 2018, is a government-funded health insurance scheme under Ayushman Bharat, targeting 12 crore poor families (~50 crore beneficiaries). It provides ₹5 lakh per family per year for cashless hospital care in empanelled hospitals (public & private)<sup>(1)</sup>.

**Objectives:** This study aimed to assess the satisfaction level of beneficiaries utilizing AB-PMJAY services in the Banda district of the Bundelkhand region and to identify factors influencing their healthcare experiences.

**Methods:** A hospital-based cross-sectional study was conducted among 300 AB-PMJAY beneficiaries selected through population proportion sampling from government and private empanelled hospitals. Data were collected using a pretested, semi-structured questionnaire covering demographics, healthcare utilization, satisfaction levels, and encountered barriers. Statistical analysis was performed using descriptive and inferential methods.

**Results:** The study in Banda district reveals that AB-PMJAY effectively serves rural, elderly, and economically vulnerable populations, with 79% from rural areas and 45.33% unemployed. Satisfaction with services was generally high, especially with doctors (72%) and nursing staff (72.3%). Ayushman Mitras had the highest dissatisfaction (7.3%), indicating scope for improvement. Beneficiaries without treatment issues reported greater satisfaction (28.3% extremely satisfied). Positive outcomes strongly influenced satisfaction, while dissatisfaction was higher among those with no improvement. Surgical treatment yielded higher satisfaction despite issues. Interestingly, even those unaware of the scheme reported good experiences, highlighting the impact of service quality on user perception.

**Conclusion:** The study highlights high overall satisfaction under AB-PMJAY but reveals critical areas needing improvement, including procedural simplifications and medication coverage enhancements.

**Keywords:** Patient Satisfaction; Health Services Accessibility; Universal Health Coverage; Ayushman Bharat; Government Health Insurance Scheme.

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## Introduction

Access to affordable healthcare has long been a critical challenge in India, particularly in rural regions where disparities in infrastructure and health-seeking behavior are profound.<sup>[1]</sup> Recognizing the burden of catastrophic healthcare expenses, largely driven by out-of-pocket expenditures (OOPE), the Government of India launched the Ayushman Bharat Pradhan Mantri Jan Arogya Yojana (AB-PMJAY) in 2018.<sup>[2]</sup> As one of the largest publicly funded health insurance schemes in the world, AB-PMJAY was designed to provide a financial safety net, offering ₹5 lakh annual coverage per eligible family for secondary and tertiary healthcare services.<sup>[2,3]</sup> The scheme, leveraging the Socio-Economic Caste Census (SECC) 2011 data, prioritizes vulnerable rural and urban households, aiming to make significant strides towards Universal Health Coverage (UHC) by 2030.<sup>[4,5]</sup>

Despite its ambitious framework, gaps remain between policy intent and actual outcomes, especially in rural areas where challenges like low awareness, limited empanelled facilities, and administrative bottlenecks persist. While AB-PMJAY promises nationwide portability and broad service coverage, the real-world experience of beneficiaries, particularly their satisfaction with services accessed under the scheme, is a crucial yet under-explored dimension. Satisfaction levels directly influence not just healthcare utilization rates but also public trust and the long-term success of health interventions.<sup>[6]</sup>

Banda district, situated in the Bundelkhand region, presents a uniquely important context for evaluating the performance of AB-PMJAY. Characterized by socio-economic vulnerabilities, limited healthcare infrastructure, and a predominantly rural demographic,<sup>[7]</sup> Banda serves as a representative microcosm of the scheme's challenges and potential in rural India.

### Aim and Objective:

To assess satisfaction levels of beneficiaries regarding healthcare services under AB-PMJAY.

### Materials and Methods

The study was conducted in Banda district, located in the Bundelkhand region of Uttar Pradesh, India, a predominantly rural area marked by significant socio-economic vulnerabilities. The

district, characterized by limited healthcare access and high out-of-pocket health expenditures, offered an appropriate context for assessing the satisfaction levels among beneficiaries of the Ayushman Bharat Pradhan Mantri Jan Arogya Yojana (AB-PMJAY). Data collection took place in a combination of government and private healthcare facilities empanelled under the scheme, including Rani Durgawati Medical College, the District Hospital Banda, Kamla Hospital Atra, and MM Hospital Baberu. A hospital-based cross-sectional study design was employed, enabling the collection of real-time data to evaluate beneficiaries' experiences and satisfaction with services accessed under AB-PMJAY.

The study population consisted of residents of Banda district who had utilized AB-PMJAY benefits within the preceding year. To ensure the sample accurately reflected the diversity of healthcare providers, a population proportion sampling was adopted, stratifying by the type of hospital attended. The sample size was determined using the formula for estimating proportions, assuming a 50% satisfaction prevalence for maximum sample variability, a 95% confidence level, and a 6% margin of error, resulting in an initial sample size of 267. Accounting for a possible 10% non-response rate, the final target was set at 294 participants so round figure was 300 participants. On each hospital visit, investigators collected lists of AB-PMJAY beneficiaries scheduled for discharge within 24 hours and conducted bedside interviews after obtaining written informed consent. When direct interviews with patients were not feasible, a close attendant was selected for participation.

A pretested, semi-structured questionnaire was utilized to gather information on sociodemographic characteristics, awareness and utilization of AB-PMJAY services, healthcare expenditures, and the perceived impact of the scheme on family health and financial security. Data were recorded manually and later entered into Microsoft Excel using double-entry to ensure accuracy. Descriptive and inferential statistical methods were applied for analysis, with findings interpreted in the context of the study's objectives. Ethical approval was obtained from the Institutional Ethics Committee of Rani Durgawati Medical College, Banda, Ref No.IEC/RDMC/Cert/19 and strict confidentiality and voluntary participation were maintained throughout the study.

## Results

**Table 1: Demographic and Socioeconomic Characteristics of AB-PMJAY Beneficiaries in Banda District**

Characteristics		Frequency (n=300)	Percentage (%)
Age (Years)	Infant (<1 year)	29	9.67%
	Child (1-12 years)	46	15.33%
	Adolescent (12-18 years)	25	8.33%
	Adult (18-60 years)	86	28.67%
	Geriatric (>60 years)	114	38.00%
Gender	Male	141	47.00%
	Female	159	53.00%
Residence	Urban	63	21.00%
	Rural	237	79.00%
Education	Illiterate	39	13.00%
	Primary school	21	4.00%
	Middle school	24	8.00%
	High school	38	12.66%
	Intermediate	78	26.00%
	Graduate	48	16.00%
	Postgraduate	27	9.00%
	Non-school going child	25	8.30%
Occupation	Semi-professional or above	0	0.00%
	Skilled/Shop/Farmer	44	14.66%
	Semi-skilled	30	11.00%
	Unskilled	90	30.00%
	Unemployed	136	45.33%

In our study, the demographic and socioeconomic profile of AB-PMJAY beneficiaries in Banda district revealed that the majority were elderly (38%) and adults aged 18-60 years (28.67%), with a slightly higher representation of females (53%) compared to males (47%). A significant proportion belonged to rural areas (79%), reflecting the scheme's outreach

among under-served populations. Educational status varied, with 13% illiterate and 26% educated up to intermediate level. Occupationally, 45.33% were unemployed and 30% were unskilled workers, highlighting the economic vulnerability of the beneficiary population, as shown in Table (1).

**Table 2: Satisfaction level of beneficiaries from Paramedical Staff, Ayushman-Mitra, Behaviour of Staff, and Overall Level of Satisfaction.**

	Staff Category	Extremely Satisfied	Satisfied	Neutral	Dissatisfied	Extremely Dissatisfied
Paramedical Staff and Ayushman-Mitra	Nursing Staff	29 (9.7%)	190 (63.3%)	60 (20.0%)	13 (4.3%)	8 (2.7%)
	Ward Boy	26 (8.7%)	199 (66.3%)	53 (17.7%)	14 (4.7%)	8 (2.7%)
	Sweeper	26 (8.7%)	205 (68.3%)	51 (17.0%)	7 (2.3%)	11 (3.7%)
	Ayushman Mitra	38 (12.7%)	187 (62.3%)	48 (16.0%)	16 (5.3%)	11 (3.7%)

Continue.....

Behaviour of Staff	Doctor	33 (11.0%)	216 (72.0%)	36 (12.0%)	6 (2.0%)	9 (3.0%)
	Nursing Staff	20 (6.7%)	217 (72.3%)	39 (13.0%)	15 (5.0%)	9 (3.0%)
	Ward Boy	19 (6.3%)	212 (70.7%)	42 (14.0%)	19 (6.3%)	8 (2.7%)
	Sweeper	22 (7.3%)	218 (72.7%)	42 (14.0%)	9 (3.0%)	9 (3.0%)
	Ayushman Mitra	25 (8.3%)	190 (63.3%)	55 (18.3%)	22 (7.3%)	8 (2.7%)

Satisfaction levels with paramedical staff, Ayushman Mitra, and overall staff behavior indicated that most respondents were satisfied with services received. Nursing staff (63.3%), ward boys (66.3%), sweepers (68.3%), and Ayushman Mitras (62.3%) received high satisfaction ratings. In

terms of behavior, doctors and nursing staff were rated most favorably (72% and 72.3% satisfied, respectively), while Ayushman Mitras had the highest dissatisfaction (7.3%), suggesting room for service quality improvement, as shown in Table (2).

**Table 3: Satisfaction level of beneficiaries with problem faced and outcome**

Category	Subcategory	Extremely Satisfied	Satisfied	Neutral	Dissatisfied
Problem Faced	No	28 (28.3%)	56 (56.6%)	12 (12.1%)	3 (3.0%)
	Yes	9 (4.5%)	129 (64.2%)	39 (19.5%)	24 (11.8%)
Outcome	Cured	—	76 (83.5%)	—	—
	Improved	—	119 (83.2%)	—	—
	No difference	—	—	18 (48.6%)	—
	Deteriorated	—	—	—	9 (31.0%)

Beneficiaries who did not encounter problems during treatment reported significantly higher satisfaction (28.3% extremely satisfied) compared to those who did (4.5% extremely satisfied), with a notable rise in dissatisfaction among the latter (11.8%).

Regarding outcomes, satisfaction was high among those who were cured (83.5%) or improved (83.2%), while neutrality and dissatisfaction were seen in cases with no improvement (48.6%) or deterioration (31%), respectively, as shown in Table (3).

**Table 4. Satisfaction level of beneficiaries during treatment**

Variables		Problem Faced (%)	Extremely Satisfied (%)	Dissatisfied (%)
Modality	Surgical	179 (59.6%)	58(19.2%)	13(4.2%)
	Conservative	2201(73.6%)	17(5.7%)	28(9.4%)
Awareness Status	Used in Past	180(60.0%)	39(13.0%)	21(7.0%)
	Aware but Not Used	178(59.4%)	39(12.9%)	23(7.8%)
	Unaware	257(85.7%)	32(10.8%)	18(5.9%)

Treatment modality and awareness levels also influenced satisfaction. Surgical treatment was associated with higher extreme satisfaction (19.2%) despite a 59.6% problem rate, whereas conservative

treatment had lower extreme satisfaction (5.7%) and a higher problem rate (73.6%). Even among those unaware of the scheme, 10.8% reported extreme satisfaction and only 5.9% were dissatisfied,

indicating a generally positive reception of services regardless of prior knowledge, as shown in Table (4).

### Discussion

The study evaluated the largest proportion of beneficiaries (38%) belonged to the geriatric age group (>60 years), with adults (18–60 years) comprising 28.67%, and children (1–12 years) accounting for 15.33%. This elderly predominance aligns with Nandi et al. (2012)<sup>[4]</sup> and Ghosh et al. (2014)<sup>[5]</sup>, who noted similar trends but highlighted limited benefit utilization among older adults. Female beneficiaries constituted 53%, slightly higher than males (47%), consistent with Dewan et al. (2016)<sup>[8]</sup> and Hooda et al. (2017)<sup>[9]</sup>, who found higher scheme utilization among women due to health vulnerabilities.

A majority (79%) of participants were from rural areas, reflecting the scheme's strong rural outreach, similar to findings by Dewan et al. (2016)<sup>[8]</sup> and Karan et al. (2017)<sup>[10]</sup> who noted higher government scheme reliance among rural populations.

Educational attainment among beneficiaries was modest, with 19.66% of heads of families being illiterate and 21.66% educated up to middle school. These findings align with studies by Nandi et al. (2012)<sup>[4]</sup> and Ghosh et al. (2014)<sup>[5]</sup>, which reported low education levels among rural insurance beneficiaries. Occupationally, 45.33% of participants were unemployed and 30% engaged in unskilled labor, similar to findings by Ghosh et al. (2014)<sup>[5]</sup>, Dewan et al. (2016)<sup>[8]</sup>, and Srivastava et al. (2018)<sup>[11]</sup>.

Overall, 61.4% of beneficiaries reported being satisfied and 12.3% extremely satisfied, closely aligning with Pareek et al. (2018)<sup>[12]</sup> and Angell et al. (2019)<sup>[13]</sup>, although dissatisfaction (9%) still warrants attention for service improvement.

Regarding treatment outcomes, 47.7% of beneficiaries improved and 30.3% were cured. Similar trends were observed by Pareek et al. (2018)<sup>[12]</sup> and Angell et al. (2019)<sup>[13]</sup>, although our study recorded slightly higher deterioration rates (9.7%).

Satisfaction was notably higher among those who did not face problems during service access. Awareness, positive clinical outcomes, and shorter

hospital stays were associated with higher satisfaction levels, a trend corroborated by Khetrapal & Acharya (2019)<sup>[14]</sup> and Venkatesh et al. (2019)<sup>[15]</sup>.

### Conclusion

We concluded that the majority of AB-PMJAY beneficiaries in Banda district reported high satisfaction with healthcare services, especially with doctor care and hospital facilities. However, procedural barriers and partial gaps in medicine coverage persist. Addressing these challenges and enhancing scheme awareness can significantly improve the overall effectiveness and reach of AB-PMJAY in rural populations.

### Future Research Recommendations:

Future research should focus on multi-district or state-wide studies to improve generalizability beyond Banda district. Qualitative studies exploring beneficiary experiences in-depth could help understand the reasons behind dissatisfaction, especially with Ayushman Mitra services. Further investigation into the impact of awareness levels on service utilization and outcomes is needed. Comparative studies assessing satisfaction across different healthcare settings (public vs private empanelled hospitals) under AB-PMJAY would provide valuable insights. Additionally, longitudinal studies examining long-term health and financial outcomes post-treatment could help assess the scheme's sustained impact on economically vulnerable populations and inform targeted service quality improvements.

### Limitations

This study was limited to hospitalized AB-PMJAY beneficiaries in selected facilities of Banda district, which may not capture the experiences of outpatient beneficiaries or non-users. Potential response bias during interviews and the cross-sectional design, which restricts causality assessment, are additional limitations. Broader, multi-district studies could offer more generalizable insights for policy enhancements.

**Conflict of Interest:** None.

**Source of funding:** Nil

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# Barriers to Genetic Counselling and Testing among Breast and Ovarian Cancer Patients in low Middle-income Country Referral Hospital: A Prospective Study

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## Abstract

**Background:** Breast and ovarian cancers pose significant health burdens in India, with hereditary cases contributing to disease incidence. Genetic counselling (GC) and genetic testing (GT) are essential for risk assessment and management, yet their utilization remains limited. This study evaluates barriers to GC and GT among breast and ovarian cancer patients in a low-middle-income country (LMIC) referral hospital.

**Methods:** A prospective study was conducted at a tertiary care hospital in South India. Newly diagnosed breast and ovarian cancer patients were screened for GC and GT eligibility based on modified NCCN guidelines. Patients underwent counseling, testing, or were interviewed regarding barriers to uptake. Statistical analysis was performed using SPSS 22.0.

**Results:** Among 120 eligible patients, 42% underwent GT, while 49% declined both GC and GT. The primary barrier was financial constraints (52%), followed by emotional burden concerns (18%), lack of awareness (16%), and social stigma (9%). Pathogenic mutations were detected in 40% of tested patients, with BRCA mutations being most common.

**Conclusions:** Despite decreasing GT costs, financial burden remains a major barrier. Addressing economic, educational, and social factors is crucial to improving genetic service utilization and enhancing cancer management in LMIC settings.

**Key-words:** Hereditary cancer, genetic counseling, genetic testing, financial barriers, BRCA

## Introduction

Breast and ovarian cancers represent a significant health burden in India, with breast

cancer being the most common malignancy among Indian women. According to the National Cancer Registry Programme's 2022 estimates, India reported approximately 221,757 new breast cancer cases,

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accounting for 15.2% of all cancer cases, and 46,126 new ovarian cancer cases, representing 6.5% of all cancers among women.<sup>1</sup> Despite improvements in cancer awareness and treatment, mortality rates remain high.

The BRCA1 and BRCA2 genes were identified nearly three decades ago as key contributors to the development of hereditary breast and ovarian cancers.<sup>2</sup> It is estimated that approximately 15% of breast cancer cases and 18% of ovarian cancer cases have a hereditary basis (Pal et al., 2005; Couch, Nathanson, & Offit, 2014). Pathogenic mutations in genes such as BRCA1, BRCA2, PALB2, TP53, PTEN, CHEK2, and ATM are commonly associated with an increased risk of these cancers.<sup>3</sup>

Genetic counselling (GC) and genetic testing (GT) have become integral to oncology care. Various guidelines from Indian and international bodies have set criteria to identify patients appropriate for testing and gene-specific recommendations for risk management.<sup>4,5</sup> A genetic counsellor will assess the need for a genetic test, counsel the patient and her family on the implications of a positive test, order an appropriate test, interpret the result, and perform post-test counselling for the patient and the patient's family members to ensure appropriate surveillance and risk reduction strategies.<sup>6,7</sup> However, in India, these services remain largely underutilized and are primarily available in select tertiary care centres and private institutions.<sup>5</sup>

Notwithstanding the potential benefits, various studies have documented a rather limited use of GC and GT.<sup>8,9</sup> While GC and GT are sub-optimally utilized in the Western world, their utilization in low-middle income countries (LMIC) could be even more dismal.<sup>10</sup> Studies suggest that the utilization of GC and GT services in India is significantly lower than in Western countries. A recent review found that only a small fraction of eligible breast and ovarian cancer patients undergo genetic testing, with financial constraints, lack of awareness, and limited availability of trained genetic counselors being the most cited barriers.<sup>11</sup>

Given these gaps, this study aims to assess and elucidate the barriers to genetic counselling and testing in the Indian context, particularly

in a low- and middle-income country (LMIC) setting. Understanding these barriers is essential for developing targeted interventions to improve access, awareness, and utilization of genetic services, ultimately contributing to better cancer prevention and management strategies in India.

## Subjects and Methods

We planned a prospective study in a single centre, tertiary care hospital, in south India. Institutional ethics committee approval (Ramaiah Medical College) was obtained [Approval No. 2269] Ref no. MSRMC/EC/SP-03/11-2021 dated 23<sup>rd</sup> Nov 2021 prior to initiation of the study. Informed consent was obtained from all the participants and the study was conducted in accordance with the good clinical practice guidelines.

### Eligibility:

#### Inclusion Criteria:

Screened using the institutionally adapted version of NCCN 2016 criteria for genetic counselling/testing (GC/GT)

Adult patients ( $\geq 18$  years) who fulfilled all of the following:

1. Newly diagnosed with either:
  - o Ovarian carcinoma at any age, or
  - o Breast carcinoma with any of the following features:
    - Diagnosis at age  $\leq 45$  years
    - History of two primary breast cancers in lifetime
    - Male breast cancer
    - Triple-negative breast cancer
    - First-degree relative with:
      - Breast cancer diagnosed at  $< 50$  years, or
      - Ovarian cancer at any age
2. Attending the breast and gynaecological cancer outpatient clinic of the institution

#### Exclusion Criteria:

Patients who did not meet any of the following criteria were excluded:

1. Age <18 years
2. Diagnosed with cancers other than breast or ovarian
3. Patients with breast cancer not meeting any of the specified clinical or familial risk factors
4. Not attending the specified outpatient clinic
5. Not screened during the designated time frame (Oct 2021–Jan 2022)
6. Incomplete clinical or familial history preventing risk stratification
7. Patients refusing to consent for the study.

#### *Patient assessment:*

Baseline data on demographics, diagnosis, family history, and personal history of cancer were collected from all patients included in the study using a pre-approved proforma. All data were anonymized, and due care and diligence was taken to ensure patient privacy. Each patient was referred to the designated in-house genetic counsellor for consultation. The genetic counsellor at our institute is highly qualified and has extensive experience in the field.

The counsellor provided consultations to all referred patients and recommended genetic testing where appropriate. Since all patients were pre-screened for the necessity of genetic testing, none were deemed ineligible. Both genetic counselling (GC) and genetic testing (GT) services were offered at the following costs: genetic counselling consultation at Rs. 750 (approximately 10 USD), BRCA 1 & 2 testing at Rs. 14,000 (approximately 175 USD), NGS testing at Rs. 19,800 (approximately 248 USD), and MLPA testing at Rs. 16,000 (approximately 200 USD). Patients were also given the option to undergo genetic testing without counselling if they chose not to consult with the counsellor. In patients who undergo testing by NGS, additional MLPA testing was advised in patients with high suspicion of hereditary cancer based on the advice of the genetic counsellor if the initial NGS test was negative.

Patients who declined genetic counselling (GC) and/or genetic testing (GT) after the initial approach were invited for a face-to-face interview to determine the primary reason for opting out. A pre-approved questionnaire was used to assess barriers to these services. Based on a review of the literature, as well as discussions with patient support groups, genetic

counsellors, and oncologists, five main barriers were identified: financial burden, fear of the emotional impact on family or children, lack of sufficient information about genetic services, social stigma, and language barriers.

Patients who chose to proceed with genetic counselling followed by testing were monitored, and their test results were documented. Post-test counselling was provided to all the patients undergoing genetic testing by the genetic counsellor, to educate them about risk reduction strategies and guide further steps.

#### *Outcome:*

The primary objective was to elucidate the primary barriers to genetic counselling and testing in the pre-screened study population. Secondary objectives included evaluating the proportion of patients eligible for genetic testing, the proportion of patients with pathogenic mutations among those tested, and the proportion of patients with pathogenic mutations who opted for preventive surgery or screening strategies.

#### *Statistical analysis:*

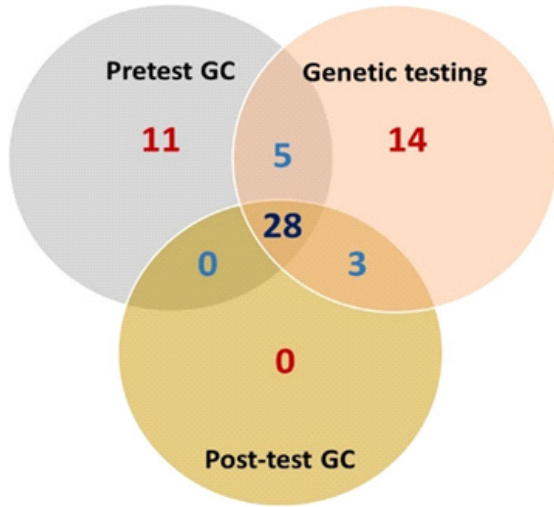
The present study has carried out descriptive and inferential statistical analysis. Results on continuous measurements are presented on Mean  $\pm$  SD (Min-Max), and results on categorical measurements are presented in Number (%). Significance is assessed at a 5 % level of significance. The following assumptions on data are made. Assumption: 1. Dependent variables should be normally distributed, 2. Samples drawn from the population should be random; cases of the samples should be independent. Chi-square test was used to find the significance of study parameters on a categorical scale between two or more groups. Statistical software: Statistical software, namely *SPSS 22.0* and *R environment ver.3.2.2*, was used to analyse the data.

## **Results**

#### *Patient characteristics:*

Between October 2021 to January 2022, 235 patients of newly diagnosed breast or ovarian carcinoma visited the clinic in our institution. Of these 235 patients, 120 (51%) patients were deemed

eligible for inclusion in the study as per the GC and GT criteria. All 120 patients provided the informed consent and hence included in the study. Baseline patient characteristics are provided in Table 1. In those 120 patients, 28 (23%) patients underwent pretest GC, GT followed by post-test GC as per requirement; 14 (12%) patients underwent only GT; and 59 (49%) patients didn't undergo either GC or GT (Figure 1-Venn diagram).



**Figure 1: Distribution of patients who underwent pretest genetic counselling, genetic testing, and post-test genetic counselling.**

*Barrier evaluation:*

Among the 120 patients, 92 (77%) patients didn't undergo the GC or/and GT as per the requirement. The primary barrier among these patients for not undergoing GC and GT have been shown in table 2. Three patients denied to answer the questionnaire. The financial burden was found to be the most common primary barrier for the utilization of genetic services.

*Mutation frequency and distribution of mutation:*

Among the 50 patients who underwent the genetic testing, 20 (40%) patients tested positive for the germline mutations. The frequency of different germline mutations is shown in Table 3. 15 (30%) of the positively tested patients had pathogenic mutation of BRCA. Among the 8 patients who had family history of breast or ovarian cancer, one

patient had pathogenic germline mutation. Of the 30 patients who tested negative, 10 patients were advised additional MLPA testing, but only four patients underwent the test and all were negative for germline mutations. Among the 16 patients having pathogenic germline mutations for HBOC, 14 patients opted for screening strategy and two patients underwent for risk reduction bilateral mastectomy and salphigo-oophorectomy. Five patients with BRCA pathogenic mutations received PARP inhibitors.

**Table 1. Patient characteristics**

Parameters	Screening population (n=235)	Study population (n=120)
Age (years), median, range		53 (23-80)
Sex		
Male	2 (Both breast cancer)	2
Female	233	118
Diagnosis		
Breast carcinoma	208 (88.5%)	93
HR+ and Her 2-negative	120	39
HR+ and Her2-posotive	25	9
Her 2 enriched	21	6
Triple negative	38	37
DCIS	2	0
Not available	2	2
Ovarian carcinoma	26	26
Breast and Ovarian cancer	1	1
Education		
Graduation & above	40	24
High school	116	61
Primary school	52	26
Illiterate	27	9
Family History for Breast/Ovarian cancer positive	8	8

**Table 2. Barriers for undergoing genetic counselling and testing**

Barriers for GC and GT	Number of patients (n=92) N (%)
Financial burden	48 (52%)
Fear of emotional burden on family/children.	17 (18%)
Lack of adequate information regarding genetic services	15 (16%)
Social stigma	8 (9%)
Language barrier	1 (1%)
Denied to answer the questionnaire	3 (3%)

**Table 3. Frequency of germline mutations**

Genetic abnormality	Number of patients (n=20)
BRCA1 - Pathogenic	9
BRCA2 - Pathogenic	5
BRCA1/ATM - Pathogenic	1
PALB2 - Pathogenic	1
BRCA-VUS	1
ATM-VUS	1
FANCA - VUS	1
MLH1 - VUS	1

### Discussion

The recognition and management of patients with inherited cancer risk is of prime importance in the current era of advanced cancer diagnostics and treatment decision making.<sup>6</sup> To achieve this, the core element of oncology services is to have a comprehensive team to take care of pre-test genetic counselling followed by genetic testing and post-test counselling. Even though national and international guidelines have been developed to screen individuals who may derive maximum benefit from GC and GT,<sup>4,5</sup> through our own previous experience it was recognized that the guidelines for referral to genetic services should be concise and clear to the health care workers for better implementation. Hence, for our institute we had adopted a NCCN guidelines<sup>4</sup> with modifications since the inception of the of the genetic counselling and testing program. Through these modifications, we were able to achieve near-

complete referrals for the GC and GT as per our previous internal audit data.

Genetic counsellors are involved in taking a detailed genetic history, educating patient and their family members regarding the need for genetic testing, coordination/ ordering of the test, planning testing in family members (cascade testing) and psychosocial support. Complexity associated with interpretation of genetic data, implications of a positive hereditary genetic test on other family members and psychological overlay makes it essential for a detailed counselling of the patient and family prior to the test.<sup>12,13,14,19,15</sup> Notwithstanding the importance in clinical practice, use of GC and GT remains limited.<sup>16</sup> In general, the uptake of GC and GT in cancer patients varies across different studies, mostly because of the different study designs, place and time of study, social and cultural background of the patients.<sup>17,8</sup> Hence, it would be difficult to compare the outcomes of different studies. As there is a lack of studies analysing the barriers to the uptake of GC and GT in the Indian subcontinent, this study would be one of the first to address it.

In our study, about half of the patients who were eligible didn't undergo either GC or GT. Around 42% of patients underwent GT, which was much less compared to similar studies showing an uptake of up to 75% in the high-income countries.<sup>18</sup> Among patients who underwent GT, 72% had undergone genetic counselling (either Pre/Post), which is similar to one of the large population-based study.<sup>19</sup>

Approximately half of the patients in our study attributed financial burden as the primary cause hindering them in undergoing GC and GT. Even though earlier studies attributed this to the high testing costs, in recent times, the cost of commercial genetic testing has come down significantly.<sup>8,17</sup> As the majority of our patient population lacks health insurance and belongs to lower and lower-middle-class financial backgrounds, the financial constraints appear to drive the uptake in a significant proportion of our patient population.

Fear of emotional burden to the family and social stigma together were attributed in one-fourth of the study population. These barriers are not stressed much in other studies, mostly

due to differences in the social and cultural background of our patients in comparison to the Western population.<sup>20,17,21</sup> India is predominantly a patriarchal society.<sup>22</sup> This can contribute to the fear of social backlash among women if a genetic defect is identified. Concerns about its impact on a daughter's marriage prospects are particularly common among women from uneducated and rural backgrounds, often leading to hesitation in seeking genetic testing for heritable mutations. An expert counsellor may address these unique societal issues during GC.<sup>23</sup>

We observed that about 17% of patients did not undergo GC and GT due to a lack of access to adequate information about GC and GT. It is very well known that healthcare workers who do not perceive the importance of genetic services are less likely to suggest GC to their patients or refer them to genetic services.<sup>24,25</sup> Even though, due to our institutional policy, we were able to achieve 100% referrals of eligible patients for GC and GT, it may suggest a lack of in-depth counselling before referring the patients to a genetic counsellor.

Of patients who underwent genetic testing, 30% demonstrated pathogenic mutations, which is similar to the findings of a study that included 1000 Indian breast cancer patients.<sup>26</sup> Another study showed 54% pathogenic BRCA mutations, mostly due to different eligibility criteria for testing (Only 18% were eligible for GT in this study in comparison to 51% in our study).<sup>27</sup> In patients with ovarian cancer in our patient population, we detected pathogenic mutations in 6 (18.5%) out of 27 ovarian cancer patients, which is similar to other similar studies.<sup>28</sup>

Among 16 patients with pathogenic germline mutations, only 2 (13%) underwent risk reduction surgery, and 5 opted for PARP inhibitor therapy. Studies have shown varied use of risk-reducing surgeries ranging from 10%-78%. Our findings on the uptake of risk-reducing surgeries are lower compared to other studies from Western countries, where risk-reduction therapies are opted for even by unaffected carriers.<sup>29,30</sup> This could be due to educational and socio-economical differences between the patient populations.

This study has certain limitations. First, patients were enrolled regardless of disease stage and cancer-directed therapy. Attitudes and interest in GC and GT may vary based on cancer stage, ongoing treatment, and treatment intent. Second, since only 20% of the study population had some level of college education and primary decision-making often rested with the patient's spouse or children, these factors—though reflective of the social background—could act as potential confounders in the evaluation.

Our study highlights the barriers to genetic counselling and testing in a selected group of Indian patients who were prospectively followed. It also indicates that despite the decreasing cost of genetic testing, financial constraints remain the primary obstacle to the optimal use of genetic services among breast and ovarian cancer patients.<sup>18</sup> Providing financial assistance through government programs, private insurance, or funding agencies could further improve the uptake of GC and GT, provided that adequate manpower and infrastructure are available—an ongoing challenge in low- and middle-income countries.<sup>19,20</sup> Additionally, factors influencing the utilization of cascade testing require further investigation, as our study did not document them.

The new and unexpected finding in our study was that the cost of genetic testing was a significant barrier to providing GC and GT services in our setting, despite a rapid reduction in the prices of these tests. Additionally, we observed limited uptake of post-test interventions—including risk-reducing surgeries and cascade testing—among patients with pathogenic variants, highlighting potential gaps in awareness, access, and decision-making support. Social stigma, particularly concerns related to marriage prospects in women, emerged as a culturally specific and underreported barrier in the Indian context, warranting targeted counselling strategies. Notably, although institutional policy enabled high referral rates, the lack of adequate information before GC referrals suggests that referral alone does not ensure informed patient engagement.

**Support:** Nil

**Conflicts of interest:** Nil

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# Morbidity Profile of Children at a Construction Site: Reaching the last Mile

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## Abstract

**Background:** A research study was planned to assess social determinants of health affecting well-being of children residing in labour camps. The objectives of the study were-1.Understanding Morbidity Profile of children residing in labour camps of construction site.2.Assessment of social determinants based on certain components of SAFE MODEL.

**Methodology:** A Retrospective descriptive study was carried out on data of 118 families and pediatric mega camp data of 311 children from December 2023- March 2024 living in a construction site. Study presents morbidity profile of children in form of 4 D's (Defects, Diseases, Developmental delays, Deficiencies) and qualitatively analyses on some social determinants assessed on basis of SAFE model. Descriptive statistics and WHO reference indicators for anthropometry were used. Observations of survey are presented as qualitative data in form of comments.

**Results/Conclusion:** 26.37% children were suffering from childhood diseases and 28.67% children were having micro nutrient deficiencies. 0.64 % had birth defects, 0.32% had developmental delays. The percentage of underweight children in 0-6 years age group was 30%, in age group of 7-10 years 48% were stunted. 22.50% children had acute respiratory infections. 55% of children had some kind of disease or deficiency. Strategies adopted to survive in new and hostile environment lead to neglect of many important aspects like security, well-being and health of children. We recommend improvement in living conditions of families at labour camp. Effective child protection, education policies, disease protection and health promotion, can go a long way in improving the overall well-being of the families in the lower socio-economic strata.

**Keywords:** Morbidity, Construction site, Social determinants, 4D's, SAFE Model

## Introduction

Mumbai being the financial hub of India, city experiences influx of people looking for

Opportunities. This has always given boost to construction industry as demand for more houses due to urbanization is ever increasing. In this scenario lot of migrant workers flock the city due to poverty,

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these unskilled/semi-skilled workers are absorbed in construction industry. Construction sector provides work to both partners so it becomes conducive for whole family to relocate. While working at building sites these workers and their families live in make shift labour camps provided by builders. Though basic amenities are in place, qualities of amenities are not safe, hygienic and raise concern for their overall well-being<sup>1</sup>. These conditions become pre disposing factor for various infectious diseases especially for children living in labour camps. Being a vulnerable age group, living conditions are unsafe, unhealthy and not favorable for growth. Vicious cycle of infection-malnutrition starts and many children are at risk of getting malnourished affecting their overall growth. Many interrelated social determinants like access to healthcare, unsafe, unhygienic living conditions, piecemeal wages affect well-being of family as a whole<sup>2</sup>. 70% children living in construction sites are malnourished as compared to national average of 21%, unhygienic living conditions, absence of nutritious food are some of the reasons for this<sup>3</sup>.

A study was conducted to know exact number of children residing in labour camp of a construction site, and the social determinants affecting the health of this vulnerable group. Social Factors were assessed on basis of certain components of SAFE MODEL<sup>4</sup>. Safe Model is a right based holistic framework for examining inter-related domains that reflect on child survival strategies that children and families adapt as coping mechanisms<sup>4</sup>. Focus of study being to screen these children on lines of Rashtriya Bal Swasthya Karykaram i.e. 4 D's Deficiencies, Defects, Diseases, Developmental delays and assess social and family background.

### Methodology

A retrospective descriptive study carried out on data of survey and pediatric mega camp conducted from December 2023- March 2024 in labour camps of a Construction site. Permissions of concerned authority at construction site were obtained for survey and pediatric mega camps. Institutional Ethics Committee Approval was received for the study. Study presents a morbidity profile of children and comments on some social determinants assessed on the basis of SAFE model; these social determinants are non- medical factors that affect health outcomes.<sup>5</sup>

The components and sub-components of the SAFE model that were considered for the research are listed here;

### Safety from harm component

- a. Significant proportion of children exhibit signs of neglect( filthy clothes, unbathed, playing in unsafe environments)
- b. Majority of children are exposed to stagnant and /or unclean water.

### Access to healthcare and basic physiological needs components

- c. Access to clean drinking water
- d. Access to nutritious food
- e. Access to safe dry shelter
- f. Access to clean gender separate latrine and bathing facilities.

### Family and connection to others components

- a. Children are unaccompanied

### Education and economic security component

- a. Families can afford basic needs( food, shelter, water and clothing) also factors like native place, whether they own any agricultural land, duration of migration, decision making in family, safety provisions in labour camps, availability of LPG and availability of documents like aadhar card, ration card, accessibility to health facility were recorded. Data of all children in age group of 0-12 years and their families residing in the labour camps of construction site who took part in survey and pediatric camps was considered for study, thus a convenient sampling method was used.

Data of around 118 families was obtained. Rashtriya Bal Swasthya Karykaram screening forms were used to screen children in pediatric camps. Check up and screening of 311 children in age group of 0-12 years was performed by pediatricians along with paramedical staff. Anthropometry of children was done. Digital weighing machine was used to check weight and Stadiometer was used for recording height. The physical examination was well standardized and children were not subjected to any stress or undesirable side-effects. Clinical examination was conducted by pediatricians and symptoms/ morbidity if any, were noted. Physical growth assessment was done on WHO age specific reference indicators for boys and girls. Children identified with minor ailment were provided medicines and those needing referrals to higher centres were given guidance and referral linkages were established.

Children suspected of having congenital heart disease were referred for 2D Echo. Data was entered in Microsoft excel, anonymized for analysis.

Data of pediatric mega camps was analyzed for morbidity and malnutrition profiles using descriptive statistics. Morbidity profile included prevalence of 4D's i.e. Defects at birth, Deficiencies, Childhood diseases, Developmental delays. Assessment of social determinants of health was done on basis of some components of SAFE model. Qualitative findings of survey are presented as observations.

### Results

Malnourishment profile of children in age group of 0-6 years old was arrived at by using weight for age, height for age and weight for height parameters. For age group 7-10 years weight and height for age were considered as per reference used by WHO for particular age group. Body mass index charts of WHO were used for age group 11-12 years. Malnourishment profile of around 311 children was thus arrived at using reference indicators of WHO.

Table no 1 and 2 show malnourishment profile in age group 7-10 years and 11-12 years respectively.

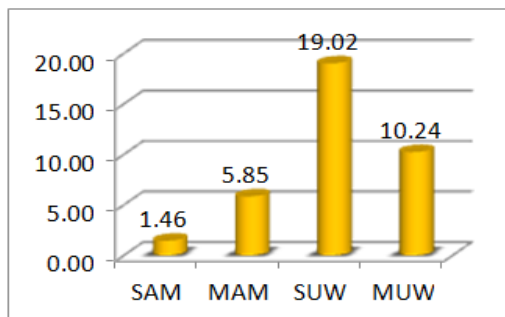


Figure no 1: Malnourishment Profile of 0-6 years

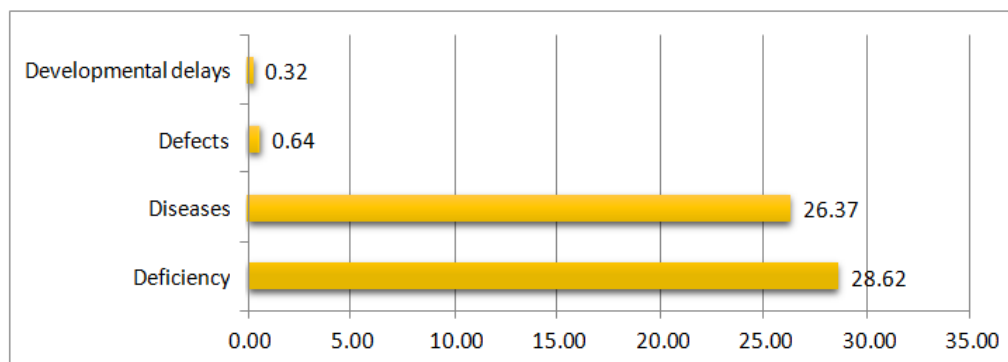


Figure no 2: 4 D's Profile of children

The underweight, wasting and stunting status of 205 children in age group of 0-6 year's is being represented in figure no 1.

Children were severely underweight and 20 were moderately underweight.

Table no 1: Malnourishment profile of age group 7 to 10 years

Total children	Normal	Under weight	Overwe ight	Obese
40	13	13	6	3
	32.50	32.50	15.00	7.50

Table no 2: Malnourishment profile of age group 11 to 12 years

Total children	Normal	Under weight	Overwe ight	Obese
40	13	13	6	3
	32.50	32.50	15.00	7.50

The percentage of underweight children in age group of 7-10years is 22.73%, almost in same range like of 0-6 years. Alarming finding being percentage of stunted children in this age group was 48.48% which indicates chronic malnutrition. 11-12 years age group also presents same picture with around 13 children being underweight and including all age groups 13 were found to be the overweight or

Obese. Morbidity profile of all children can be seen in figure no.2 below. 22.50% children had acute respiratory infections.

### Safety from harm

In survey we found that children living in labour camps exhibit signs of neglect as both parents are not available, like filthy clothes, playing in stagnant water, playing close to the sewage line, unclean bodies. Sometimes children are even left unaccompanied in rooms. Long and strenuous working hours of parents result in neglect and ignorance of children. Significant number of children exhibited signs of neglect like playing unaccompanied, dirty clothes, playing in dirty stagnant water, having bath in open. As both parents work on site they give some pocket money to children on a daily basis from which the unaccompanied children consume lot of unhealthy locally made street food items like fryums, chips, kurkure, biscuits etc. Though none of the respondents directly raised safety issue, many females shared that they never go alone to use washrooms. Some male partners raised safety concerns regarding leaving their female partner alone in rooms when they go to work.

### Access to healthcare and basic physiological needs components

Makeshift houses of labour camps have an area of about 10x10 sq. ft. A small open drainage line runs in front of all houses and there was no ventilation in the room, front door was the only opening the houses had. Toilets though separate for men and women were in same premises. The labour camp had a dedicated dispensary with good supply of medicines and availability of medical officer. Construction site had referral linkage with a nearby general hospital for emergency services. Drinking water source was bottled water in cans of 25 litres from local shop and water for all other use was from local tanker services. In interaction with laborers we found lack of dietary diversity. Rice, dal and non-veg were the preferred food items. Mostly workers working on the construction site were migrants. Figure no 3 represents years of migration of these workers.

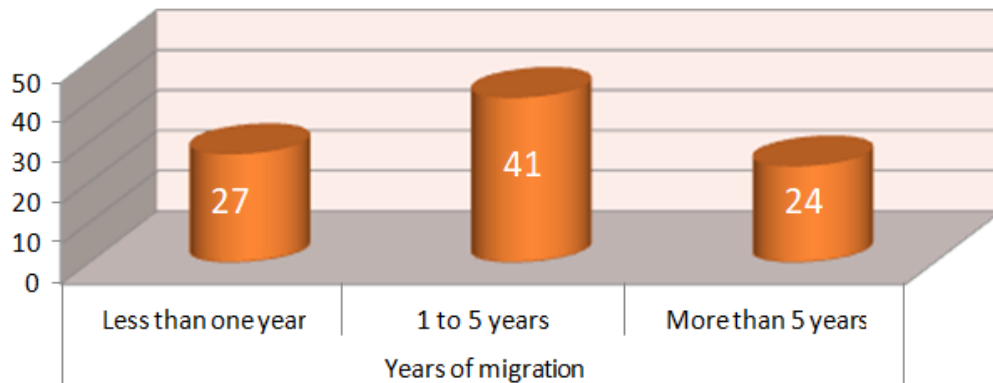


Figure no 3: Years of Migration

### Family and connection to others component:

Survey was conducted on topics listed in table no 3 below. 118 families were surveyed in two phases. 44% of eligible couples staying in labour camps were using some kind of contraception. 80% people had agricultural land in their native place and they themselves or any one of their family member like father, brother, uncle was owner of the land. Participation of female partner in decision making was almost nil, all decisions like where to migrate, where to stay, and education of children, whether

to use contraception or not were taken by male members of family. 55% percent families had some or the other form of addiction present in family. The most common being alcohol and tobacco. Except for 11 families all families were using LPG connection, though the regulators were not registered on their names and were usually brought from black market. 97% families had aadhar card of all family members. Only 3 females confided of having subjected to domestic violence.

**Table no 3: Survey Components**

Family Planning Surgery done	Using any contraceptive device	Migrated	Land holding (yes)	Decision making rights	Safety issues	Addiction present	Having LPG connection	Having Aadhar card/Govt Document	Domestic violence present
34 (28.81%)	19(16.10%)	92 (77.96%)	95 (80.50%)	101 (85.59%)	none of the respondents directly answered as yes	65 (55.08%)	107 (90.67%)	115 (97.45%)	3(2.54%)

### Education and economic security component

Construction site had a mobile crèche which provided basic informal education to children residing in camp. The children above age of 6 years were enrolled in a nearby government school and site provided bus services for to and fro of children. Children enrolled in the crèche were provided with a wholesome breakfast of eggs and fruits before going to school. After returning from school some older children go to crèche for study. Crèche is open from morning 8 to evening 4pm. Lunch and evening snacks are also provided to enrolled children. Crèche also has a support system for adolescent girls and boys.

Only three families did not have aadhar card. Rest all families surveyed had an aadhar card which becomes a necessary document to avail all government facilities. Almost all families had bank accounts. Small tuck shops were available in and around labour camps from where families used to shop for their daily needs. Some got their ration from their native place whenever they visited. Many schemes of labour ministry like distribution of whole set of household utensils were provided to families. Laborers received their payments on time and regularly. The major reason for migration being to come out of vicious circle of poverty, the job at the construction site was helping families to gain some relief. Site was providing them with free shelter, electricity, water and benefit of government welfare schemes. All of these components can be a challenge to survive in a city like Mumbai. Wages though not very good but were better than what they would earn in their villages, so families are able to save at least some portion of that as their basic physiological

needs are taken care of by the site. Site had good safety measures to prevent accidents and hazards.

### Discussion

Rapid urbanization has led to increased job opportunities and one of the major industry that absorbs the skilled and unskilled workforce is the construction industry. Millions of households from rural India undertake short or long term migration to metro cities with a hope of finding work. Construction sites provide work to both the partners thus making them lucrative for the migrant families. They are also provided with free shelter and other amenities like incentives, labour welfare schemes, education for their children, anganwadis or crèche for their children.

Even though all amenities are present they are not enough and up to the mark, but the amenities provide economic security to the family to some extent. We tried to study morbidity profile of children living in labour camps at a construction site in backdrop of certain components of SAFE Model. The Safe Model is a right based holistic framework for examining inter-related domains that reflect on child survival strategies that children and families adapt as coping mechanisms.

We found in the survey that children living in labour camps exhibit signs of neglect like filthy clothes, playing in stagnant water, playing close to sewage line, unclean bodies as both parents are not available. Sometimes children are even left unaccompanied in rooms. Long and strenuous working hours of parents result in neglect and ignorance of children. Study by *Divya Rabindranath et al* also says that informal work

settings of parents lead to nutritionally challenging environment for the children<sup>1</sup>.

The strategies adopted to survive in a new and hostile environment lead to neglect of many important aspects like security, well-being and health of children. *Theresa Betancourt et al* also agrees with our observation<sup>2</sup>. Migrant children are forced to live in hazardous, unsanitary and unsafe conditions where they have limited or no options for education and dietary diversity. Childhood being the most vulnerable period of human life lack of good balanced nutrition, unsafe living conditions and adoption of unhygienic- unfavorable methods for survival cause a major effect on the mental and physical health of the child<sup>2</sup>.

In our study we found that around 55% of children had some kind of disease or deficiency. *Child Rights at Construction Sites in India: A Critique by Vikrant Yadav* also had similar findings<sup>3</sup> 48% of children were found to be stunted in our study while *Child Rights at Construction Sites in India: A Critique by Vikrant*

*Yadav* found the percentage to be 41%<sup>3</sup>. With long strenuous working hours mothers are not left with many options to feed healthy home cooked nutritious food to children, so the consumption of unhealthy, packaged, locally made snack items is higher. This leads to effect on physical as well as mental well-being of children. Packaged food items are high in salt and sugar and so are very harmful for children. Easy access to money, purchasing whatever they feel like without parental supervision can lead the child to think that money can be earned and spent easily. This thought can promote irresponsible behavior in growing years.

Socio-economic and environmental conditions are some social determinants of health. In our study we found that both these determinants are causing a profound effect on overall health of children and families staying in labour camps. *Jumade et al* also says that these social determinants of health have significant impact on overall well-being and health of children and families living at construction site<sup>4</sup>. As per the WHO Social Determinants of Health (SDH) Commission Report (2005), conditions of daily life constituting SDH and are responsible for health

status<sup>5</sup>. Inter-sectoral coordination and Public Private Partnerships can help fill gaps and enhance quality of life of these migrant families.

**Novelty factor:** This study provides better understanding of interventions needed at construction sites to provide comprehensive health services to children residing in labour camps, this will also help in developing collaborations with various institutes and NGO's that can provide and work on various social determinants that affect health of children staying at labour camps.

## Conclusion

We recommend improvement in living conditions of families at labour camp. Benefit of existing social protection schemes can be done in a better way so as to address the out of pocket expenditure related to health. Inter sectoral collaborations and Public Private Partnership models with NGO's working in thematic areas related to health will provide greater opportunities for interventions in education, health promotion and health-care delivery. Migration being major concern for these families, various Public Private Partnership models can help implement skilling and employment programs for youth which will generate jobs in their native place and they won't be forced to migrate for money. Effective child protection and education policies, disease protection and health promotion can go a long way in improving overall well-being of families in lower socio-economic strata.

## Rationale for Sample size selection

Parents of children were daily wage workers at construction site so their availability was limited thus data of children and families present on days of camps and survey was considered as sample size for study. Thus, a convenient sampling technique was used for research.

## Limitations of the study

Sampling technique is one of the limitations of study. This project was done at a single construction site, ideally more research is needed at other construction sites to get a better idea whether the issues are site specific or generalized.

### Future Research Recommendations

We would like to suggest community need assessment surveys at labour camps so that tailored or need specific services can be provided for protecting vulnerable population residing at these construction site labour camps. More such studies focusing especially on children and women living at construction sites should be undertaken. Inter-sectoral collaborations and joint research projects in construction site labour camps are needed to understand overall picture so that provision of services can be made accordingly.

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# Procalcitonin as a Biomarker for Predicting Clinical Utility in Cases of Neonatal Sepsis: Outcomes from a Single-Centric Procalcitonin Monitoring Study

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## Abstract

**Background:** Neonatal sepsis remains one of the main causes of morbidity and mortality among newborns globally. The escalating threat of antibiotic resistance prompted the need for more reliable diagnostic and prognostic tools. Procalcitonin (PCT) was reported to be superior to C-reactive protein (CRP), being more specific for sepsis.

**Methodology:** This prospective observational study aimed to assess procalcitonin (PCT) as a prognostic marker in neonatal sepsis. Among 50 neonates, elevated serum PCT at admission correlated significantly with poor outcomes and longer hospital stays ( $p < 0.0005$ ). The mean PCT level recorded was 1.31ng/mL, and was found to be significantly higher in neonates with poor outcomes compared to those with good outcomes ( $p < 0.001$ ). Kaplan-Meier survival analysis and log-rank tests also verified statistically significant differences in outcomes and hospital stay based on PCT values.

**Conclusion:** Serum procalcitonin at admission, therefore, serves as a valuable predictor of severity in neonatal sepsis. Raised PCT levels are associated with prolonged hospitalisation and poorer outcomes, enforcing antimicrobial stewardship.

**Keywords:** Anti-bacterial agents; Biomarkers; Length of stay; Neonatal sepsis; Procalcitonin

## Introduction

Neonatal sepsis is one of the leading causes of death and long-term complications among newborns, accounting for approximately 11-19% of all deaths<sup>20</sup>. The increasing prevalence of antibiotic-

resistant infections poses a critical challenge, often delaying effective treatment and worsening clinical outcomes. In such scenarios, timely identification of high-risk cases is essential to optimize management and reduce mortality.

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Procalcitonin (PCT), a 116-amino acid precursor of the hormone calcitonin, is secreted from parafollicular cells of the thyroid in bacterial infections<sup>4</sup>. It rises within 2-4 hours of infection onset, peaks around 18-20 hours, and remains elevated for 24-48 hours. Unlike conventional markers like C-reactive protein (CRP), PCT starts to rise earlier and returns to normal more rapidly, allowing for an earlier diagnosis and better monitoring of disease progression<sup>17</sup>. PCT levels thus correlate with the severity of infection, underlining their potential in both diagnosis and prognosis. Though widely studied in adult and paediatric populations, limited data is available regarding its role as a prognosticator in neonatal infections – especially in antibiotic-resistant cases.

Additionally, elevated procalcitonin levels have been associated with prolonged hospitalization in neonatal intensive care settings. Persistently high PCT concentrations might be suggestive of underlying systemic infection or an inappropriate response to antimicrobials– which contribute to extended hospital stays. Several previous studies have examined the relationship between dynamic changes in PCT levels in blood during acute infection and the prognosis of sepsis<sup>15,18</sup>. The monitoring of PCT levels would consequently help us determine whether elevated concentrations are associated with an increased mortality risk and increased length of hospital stay, thereby supporting its use in clinical decision-making.

In spite of widespread use in adult populations, there is a paucity of data available for prognostic utility of PCT in neonatal populace, especially in resource-limited, antibiotic-resistant settings. This single-centric study therefore aims to evaluate PCT as a prognostic biomarker in neonates suffering from septicaemia, and to derive any relationship if present between elevated PCT values and duration of hospital stay.

## Objectives

- (i) To evaluate the role of serum procalcitonin as a prognostic biomarker in septicaemic neonates.
- (ii) To correlate the association of procalcitonin levels with duration of hospital stay.

(iii) To determine the relationship between hospital stay duration and requirement of antibiotic therapy.

## Methodology

### Study Design and Setting

Ethical approval for this prospective observational study was obtained from the Institutional Ethics Committee (IEC) of Medical College, Kolkata (Approval Number: MC/KOL/IEC/NON-SPON/2554/07/2024) dated 20.07.2024. The study was conducted in Neonatal Intensive Care Unit (NICU) and Central Clinical Laboratory, Medical College, Kolkata, for a period of 6 months.

### Study Population

A total of 50 neonates with neonatal sepsis were included in the study. The diagnosis was made based on clinical features and laboratory findings in accordance with the standard infant sepsis criteria and supported by physician judgement.

### Inclusion Criteria

- (i) Neonates  $\leq 28$  days of age.
- (ii) Clinical signs of sepsis (e.g., lethargy, temperature instability, respiratory distress, poor feeding and irritability).

### Exclusion Criteria

- (i) Neonates with congenital anomalies.
- (ii) Neonates already on antibiotic therapy.

### Sample Collection and Laboratory Analysis

Blood samples from 50 such neonates were collected shortly after their admission to the NICU and analyzed for serum PCT levels using the Cobas C 501 fully automated analyser (Roche Diagnostics, Mannheim, Germany). The clinical course of each patient was monitored, and the study specific data was collected in respective case study forms (CSF).

### Statistical analysis

The data from the CSF was transcribed onto a Microsoft Excel database and statistical analysis was done in SPSS software version 20. Continuous variables were expressed using mean, median and

standard deviation, using Shapiro-Wilk test to assess their normality; whereas categorical variables were conveyed through frequencies and percentages. Kaplan-Meier survival analysis plot and log-rank test were used to assess differences in the length of hospital stay based on PCT levels and antibiotic use, with  $p < 0.05$  being regarded as statistically significant.

## Results

Of the 50 patients under study, 52% were female, while the rest 48% were male. The blood samples collected were assessed for procalcitonin levels, and their period of stay in the hospital were noted as well.

**Table 1: Table showing descriptive analysis of Procalcitonin levels and Length of Hospital Stay**

Parameters	Procalcitonin (in ng/mL)	Length of Hospital Stay (in days)
Mean	1.31	11.26
Median	0.21	10.00
Std. Deviation	2.98	7.48
Range	19.08	27.00
Minimum	0.02	5.00
Maximum	19.10	32.00

The descriptive statistics given in table 1 above show the distribution of procalcitonin (PCT) levels and length of hospital stay among neonates infected with sepsis. The standard deviation of 2.98ng/mL reflects the variability of the data so obtained, ranging from 0.02 to 19.10ng/mL.

In terms of hospital stay, the mean duration was found to be 11.26 days, with a high standard deviation of 7.48 days– ranging from 5 to 32 days. These findings seem to suggest that elevated procalcitonin levels may be associated with a manifold increase in the severity of illness, resulting in longer hospital stays.

**Table 2: Table showing percentage of infected neonates without and with antibiotic requirement**

Requirement of Antibiotics	Frequency	Percentage
Without antibiotics	18	36.0
Needed antibiotics	32	64.0
Total	50	100.0

Table 2 above offers a glimpse into the individual percentages of septicaemic neonates who did not require antibiotics and those who were in need. 18 neonates (36%) were found to recover without the institution of any antibiotic, whereas the remaining 32 neonates (64%) had more severe infections, and were given antibiotics based on the drug resistance pattern and in accordance with antimicrobial stewardship guidelines.

**Table 3: Table showing the length of hospital stay in the neonates under study**

Length of Hospital Stay (in days)	Frequency	Percentage
5	16	32.0
7	8	16.0
10	8	16.0
14	10	20.0
17	1	2.0
22	1	2.0
24	1	2.0
26	2	4.0
30	2	4.0
32	1	2.0
Total	50	100.0

The length of hospital stay was found to be spread over a wide range, as shown in table 3, with a minimum of 5 (in 32% of the neonates) and a maximum of 32, found in 2% of the neonates. These values directly collate with the severity of the infection, the type of microorganism infecting the particular neonate and its resistance pattern to the commonly used antibiotics.

**Table 4: Table showing the Comparison of Procalcitonin Levels Based on Clinical Outcomes**

Outcome	Procalcitonin (in ng/mL)	
Poor	Mean	6.94
	Median	4.50
	Standard Deviation	6.93
	N	5
Good	Mean	0.69
	Median	0.15
	Standard Deviation	1.25
	N	45
P Value	0.0000	

Table 4 published above presents a comparative evaluation between the procalcitonin levels obtained and the clinical outcomes of the neonates. Outcome was explicated as good if the neonate recovered without any major complication and was discharged in a stable condition, while poor outcome referred to death of the concerned neonate or requirement of massive intervention. Neonates who experienced poor outcomes (n = 5) showed a markedly higher mean PCT level of 6.94ng/mL, with a large standard deviation of 6.93, indicating both elevated and variable inflammatory responses. On the contrary, those with good outcomes (n = 45) exhibited a substantially lower mean PCT level of 0.69ng/mL and a standard deviation of 1.25. The significant difference in both mean and median values between the two groups, coupled with a p-value < 0.001, suggest that higher procalcitonin levels may serve as a reliable prognostic indicator of poor outcomes in cases of neonatal sepsis, particularly in the context of antibiotic resistance.

A Kaplan-Meier survival analysis was done henceforth to compare the procalcitonin levels with the duration of hospital stay. Classification of the neonates was done according to the PCT levels, into three groups: Negative, Weakly Positive and Strongly Positive - represented in Fig. 1 by blue, green and yellow lines respectively. The curves depicted a positive correlation, with reduced morbidity associated with low PCT values in the Negative cohort.

A log-rank test (Table 5) was run to statistically validate these differences. The differences in the survival distributions across the three PCT level groups were observed to be statistically significantly different, with  $\chi^2(2) = 30.968$  and  $p < 0.0005$ .

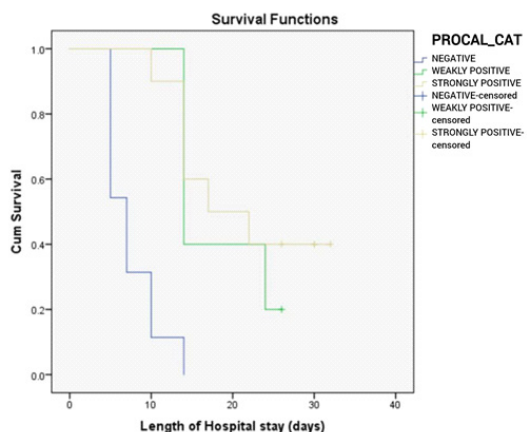


Fig.1: Kaplan-Meier survival curves showing length of hospital stay stratified by PCT levels at admission (Negative, Weakly Positive, Strongly Positive)

Table 5: Table showing Log Rank test for survival analysis based on Procalcitonin levels

	Chi-Square	df	Significance
Log Rank (Mantel-Cox)	30.968	2	0.000

Fig. 2 shows another Kaplan-Meier survival analysis, which reveals a significant difference in the length of hospital stay between neonates requiring antibiotics and those not given so. The population who did not warrant the use of antibiotics, shown by the blue line, were found to have less hospitalisation and were discharged early - probably due to the favourably low serum PCT and decreased severity of systemic infection. However, patients who needed antibiotics had prolonged stay compared to the other group, as indicated by the gradual decline in the survival curve. A log-rank test (Table 6) was run to determine if these differences were statistically significant or not. It yielded the following values:  $\chi^2(1) = 47.652$  and  $p < 0.001$ ; proving that the differences were not due to a chance event. These findings suggest that neonates needing antibiotics have increased hospital stay, likely reflecting greater illness severity or complications in that patient group.

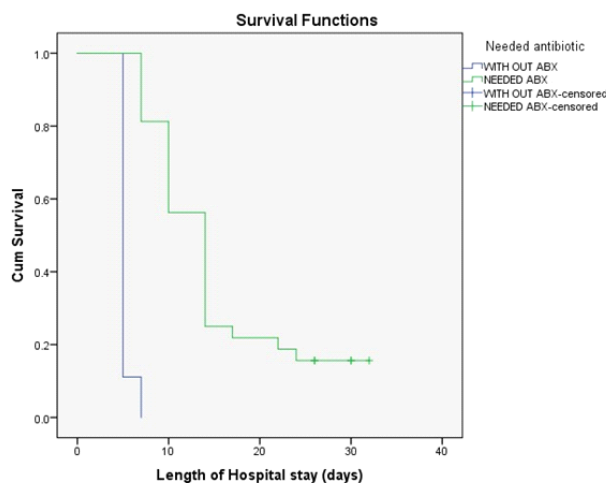


Fig. 2: Kaplan-Meier survival curves comparing length of hospital stay between neonates who required antibiotics and those who did not

Table 6: Table showing Log Rank test for survival analysis based on Length of Hospital Stay

	Chi-Square	df	Significance
Log Rank (Mantel-Cox)	47.652	1	0.000

## Discussion

Sepsis is one of the most common causes of mortality and morbidity among neonates, especially in developing countries - characterised by infection with or without bacteraemia within the first 28 days of life, causing complications like septicaemia, meningitis, pneumonia, arthritis, osteomyelitis and urinary tract infections. It still remains a global health concern among researchers and medical professionals, largely due to its high incidence and alarming infectivity and spread. Mahmoud, *et al* (2023) reports that neonatal sepsis is the third major cause of neonatal deaths, resulting in 203,000 deaths per year<sup>13</sup>. A systematic review and meta-analysis (SRMA) done by Li, *et al*, further revealed a 12.79% increase in the global burden of neonatal septicaemia and related infections from 1990 to 2019<sup>12</sup>. This was particularly demonstrable in middle and low-income countries, (as reported by Dessu, *et al*) with neonatal sepsis accounting for 30-35% of neonatal deaths, next to prematurity and its complications<sup>6</sup>.

Despite major technological breakthroughs, the burden of sepsis continues to be amplified by challenges such as antimicrobial resistance and limited diagnostic capabilities. Prompt diagnosis is therefore critical to enable timely and effective management, preventing further spread of infection among vulnerable neonates. The quick Sequential Organ Failure Assessment (qSOFA) score, used for early detection of severe sepsis, might produce false positive results in patients with hypotension or severe dementia. Moreover, the score is primarily validated for predicting in-hospital mortality in patients not requiring intensive care, while its prognostic value in neonatal sepsis is yet to be determined<sup>19</sup>. These limitations have prompted the search for more reliable blood-based biomarkers to improve diagnostic accuracy.

C-reactive protein (CRP), a conventionally utilised inflammatory biomarker, has long been employed to assess disease status and severity. However, numerous researches highlight its shortcomings - particularly in early diagnosis. A retrospective cohort study by Dhudasia, *et al* (2016) exhibits the limited utility of CRP in detection of early onset neonatal sepsis (EONS)<sup>7</sup>. The findings showed that CRP obtained within  $\pm 4$  hours of blood culture had a sensitivity of 41.7% and specificity of 89.9%, while

repeat tests done 24-72 hours later resulted in an increased sensitivity (89.5%), but lowered specificity (55.7%). Further, research into the response patterns reveals that CRP levels rise prominently only after 10-12 hours of onset of infection, curbing its role in early detection of sepsis<sup>9</sup>. These constraints underline the necessity for efficient and timely biomarkers in the neonatal population.

Described for the first time as a potential biomarker in sepsis by Assicot, *et al*, procalcitonin (PCT) is a peptide precursor of the thyroid hormone calcitonin, the latter being involved in calcium homeostasis in the body<sup>2</sup>. PCT secretion increases manifold during bacterial infections, while remaining relatively unchanged in viral infections or other inflammatory causes. Also, unlike CRP, it rises within 2-4 hours of infection onset, peaks around 18-20 hours and stays elevated for 24-48 hours - making it particularly useful in early detection of neonatal sepsis. Pontrelli, *et al* would go on to propose the cut-off values for sepsis diagnosis to be approximately 2.5 ng/mL, especially for the late onset variant<sup>16</sup>.

To compare the diagnostic utilities of PCT and CRP, Manoli, *et al* in 2024, conducted a study in 100 neonates with suspected septicaemia, and the following results were attained. PCT showed a sensitivity of 69.56% and specificity of 53.84%, while CRP had lower sensitivity (50.00%) but higher specificity (92.30%). The authors concluded that PCT is more effective for early diagnosis, while CRP may be more reliable for confirming infection<sup>14</sup>. Fendler, *et al* also noted the advantage of using PCT to distinguish sepsis from other mimicking conditions, like inborn errors of metabolism (IEM)<sup>8</sup>.

Hospital stay is another essential parameter to be monitored, indicating the morbidity of the disease. Sepsis typically warrants a longer duration of hospital stay, depending on severity of illness, presence of complications and responsiveness to treatment. Longer hospital stay may be accompanied in the commonplace by elevated PCT levels, as observed in the present study. Some previous studies have also associated high procalcitonin values on hospital admission with poor outcome among septicaemic patients<sup>1,3,5,10,11,21</sup>. However, the prognostic importance of the alterations in PCT levels over time is yet to be clearly defined.

The current study evaluated the prognostic role of serum PCT levels in neonatal sepsis and found that elevated PCT at admission had a positive correlation with poorer clinical outcomes and prolonged hospital stays. Kaplan-Meier survival analysis also linked higher PCT levels to extended hospitalisation, likely referring to more severe disease or treatment challenges. Furthermore, neonates requiring antibiotics were found to have longer hospital stays and higher PCT levels. These findings support the role of serum PCT level as a crucial indicator for the necessity of early therapeutic intervention in sepsis – potentially enhancing patient results and alleviating disease burden.

### Limitations and Future Directions

The present study was conducted at a single centre with a relatively small sample size, and without performing serial PCT measurements. Future multicentric studies with greater sample size and repeated PCT assessment would prove beneficial in the study of PCT as an excellent biomarker in neonatal septicaemia and reinforce its prognostic utility.

### Conclusion

This study highlights the potential role of procalcitonin as a prognosticator in the early assessment of neonatal sepsis, especially in the realm of antibiotic resistance. The findings suggest that PCT may aid in clinical decision-making in neonatal sepsis – promoting more targeted and judicious antibiotic use. However, larger studies are warranted to further fortify its prognostic utility and role in antimicrobial stewardship.

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# Environmental Tobacco Smoke and its Impact on Wheezing Disorders and Early Childhood Caries among Children Aged 30-60 Months in Mangaluru, South India

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## Abstract

**Background:** Environmental Tobacco Smoke (ETS) consists of particles much smaller than those in mainstream smoke, and therefore has greater penetrability to the airways of children. Children are exposed to tobacco smoke not only in their homes but also in schools, restaurants, child-care settings, cars, buses and other public places. This study aimed to assess the impact of ETS on wheezing disorders and early childhood caries among children aged 30-60 months diagnosed with wheezing disorders in Mangaluru, South India.

**Methods:** A cross sectional study was conducted from August to October 2017, among the children aged 30-60 months, with wheezing disorders who reported to the paediatrics OPD of the two tertiary care hospitals in Mangaluru, South India. Face to Face interview was conducted with all the parents of the children included in this study. Dental caries was assessed using the WHO oral health assessment form 1997.

**Results:** Among children exposed to ETS at home, 70% presented with a history of wheezing disorders in contrast to 22.8% without history of exposure ( $p < 0.001$ ). Among those exposed to ETS in utero, 57.4% reported with history of wheezing disorders in contrast to 46% without history of exposure. ECC was present among 72.6% children with history of exposure to ETS and in 27.4% without exposure history ( $p = 0.001$ ).

**Conclusion:** ETS exposure significantly contributes to morbidity and mortality in children. Despite the overwhelming evidence of the role of ETS exposure on infant health, a very high proportion of children continue to be exposed.

**Keywords:** Tobacco smoke, dental caries, asthma, children

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## Introduction

Tobacco smoke contains approximately 4,000 toxic chemicals, including oxidative gases, heavy metals, cyanide, and at least 50 carcinogens. Environmental tobacco smoke (ETS) consists of particles much smaller than those in mainstream smoke, and therefore has greater penetrability to the airways of children. Children are exposed to tobacco smoke not only in their homes but also in schools, restaurants, child-care settings, cars, buses, and other public places. ETS is defined as tobacco smoke produced by an active smoker both from the exhalation of smoked tobacco and by the burning end of the cigarette, which is inhaled by nonsmokers.<sup>1</sup>

Thirdhand smoke is a hazardous exposure resulting from cigarette smoke residue that accumulates in cars, homes, and other indoor spaces. Nicotine, can deposit on surfaces and then react with ambient nitrous acid to produce tobacco specific nitrosamines (TSNAs) which include carcinogenic compounds. Exposure to thirdhand smoke can occur through the skin, by breathing, and by ingestion long after smoke has been cleared out of a room. Children who climb on furniture, crawl and play on floors, may be especially susceptible to thirdhand smoke.<sup>2</sup>

Early childhood caries (ECC) is one of the most prevalent chronic diseases among children. The American Academy of Pediatric Dentistry (AAPD) classifies early childhood caries as the presence of one or more decayed (noncavitated or cavitated lesions), missing (due to caries), or filled tooth surfaces in any primary tooth in a child 71 months of age or younger. The infection with *S. mutans* plays an important role in the onset and progression of the disease. In children, habits such as the unlimited use of nursing bottles, sleep while being bottled fed (manufactured fruit juices, sweetened teas, fermented milk, milk containing fermentable carbohydrates such as farinaceous food and sugar) are associated with the development of S-ECC. Children with chronic diseases who use continuous oral medication containing saccharose, such as liquids or chewable pills, with repeated administration sometime just before bedtime, can be at risk if there is no hygiene after the administration of medication.<sup>3</sup>

The results of ETS exposure at home on pediatric dental health could be that, it can reduce concentrations of ascorbates in children, even when the amount of exposure to ETS is minimal. It is also reported that decreased vitamin C levels have been associated with the growth of cariogenic bacteria. ETS exposure may increase cariogenic streptococci in the oral cavity of infants. ECC was significantly associated with the existence of smokers in the home.<sup>4</sup>

ETS exposure during pregnancy and the first years of life has been consistently found to have an impact on the respiratory system including symptoms such as wheezing, cough, bronchitis, respiratory syncytial virus (RSV) bronchiolitis, otitis media and asthma, but also on intrauterine growth, sudden infant death, behaviour and cognitive functioning.<sup>5</sup>

Asthma is defined as an inflammatory disorder of the bronchioles, in which contractions of the bronchial smooth muscle and increased mucous secretion lead to reversible airway obstruction in the patient.<sup>5</sup> The causes of the airway obstruction in asthma are bronchoconstriction led by the contraction of the bronchial smooth muscles, inflammation of the bronchial walls, and increase in mucus secretion.<sup>7</sup> As the prevalence of asthma rises in the pediatric population, it is necessary to examine how this disease affects other areas of health care, most notably oral health. The increased risk of dental caries in asthmatic children is most often associated with the decrease in salivary flow and increase in lactobacilli and *Streptococcus mutans* due to medication. This diminished flow rate jeopardizes the protective ability of saliva to clear the oral cavity of fermentable substance and decreases its buffering capacity.<sup>6</sup> Some sugar (lactose monohydrate) is added within the composition of some inhalers to promote the tolerance of the patient towards the taste of the medication. The highest sugar levels were present within the syrup forms of the medications. Frequent consumption of the cariogenic drinks to remove the taste left by asthma medications in the mouth increases the risk for caries. Ignorance of oral hygiene by patients due to their medical conditions and indulgent attitude of parents towards their children's sugar intake are among the factors that increase the risk for dental caries.<sup>7</sup>

Although ETS exposure has been consistently linked to the above-cited infections, there are almost no recent reviews exist on the mechanisms by which this exposure may cause infections. Therefore, the aim of this study was to assess the impact of environmental tobacco smoke on wheezing disorders and early childhood caries among children aged 30-60 months diagnosed with wheezing disorders.

### Materials and Methods

This descriptive cross-sectional study was conducted among children aged 30-60 months diagnosed with wheezing disorders, who had visited the paediatrics OPD of the two hospitals, (Yenepoya Hospital, Deralakatte and KMC Hospital, Attavar) from August 2017 to October 2017.

Children who were exposed to ETS, who were diagnosed with/ history of wheezing disorders and for whom parental consent was obtained were included in this study. Children or parents who were not willing to participate were excluded. The ethical clearance for the study was obtained from the Institutional ethical committee, (YUEC 2017/135) dated 31/07/2017.. Permission was obtained from Head of the Department (HOD) of Paediatrics of the two hospitals (Yenepoya Hospital, Deralakatte and KMC Hospital, Attavar) in Mangalore city. The study procedure was explained to all the parents of the children who were exposed to ETS in their vernacular and written informed consent was obtained from all the parents of the children before the start of the study.

Face to Face interview was conducted with all the parents of the children who were exposed to ETS, visiting the two hospitals to assess the impact of ETS on wheezing disorders and early childhood caries. A proforma was designed to collect data on demographic details, exposure to ETS: parental tobacco smoking, exposure during pregnancy, exposure during the first year of life, current exposure, number of smokers at home, and oral hygiene practices: mouth rinsing after medicine application, tooth brushing, age of beginning of tooth brushing and frequency of tooth brushing. Information regarding the wheezing disorders, frequency of medication and duration of the use of medication was obtained from their medical records. Dental caries was assessed using the WHO oral health assessment form 1997.

The data collected was entered in Microsoft Excel Software by the examiner. Data analysis was done using SPSS 22.0 (Statistical Package for Social Sciences). Descriptive statistics were used for the analysis of data and distribution of study variables. Chi square test was used to find the association between study variables. The level of significance was set at  $p < 0.05$ .

### Results

The study sample included 147 children aged 30- 60 months among which 91 (61.9%) were males and 56 (38.1%) were females (Table 1). Among the parents of the 147 children with wheezing disorders , 93 (63.3%) of the parents reported the presence of a smoker in their home and 60 (64.5%) of them reported that they smoked both at indoor as well as outdoor places. 68 (73.1%) of the parents reported the presence of a single smoker in their home followed by 23 (24.7%) who reported the presence of two smokers in their home. 47 (32%) of the mothers were exposed to environmental tobacco smoke (ETS) during pregnancy. Of the 147 children, 34 (23.1%) of the children were exposed to ETS on a regular basis within the home during the first year of life. 73 (49.7%) of the children had a history of wheezing or whistling in the chest. When asked about the age at which wheezing had started, 100 (68%) of the parents reported that wheezing had started at the age of 30- 40 months for their children. As reported by the parents, medication for wheezing disorder was consumed by 133 (90.5%) of the children for less than 2 years followed by 14 (9.5%) who had consumed the medication for 2-4 years. When the parents were asked about the medication frequency, they reported that, 87 (59.2%) of the children had consumed the medication twice/ day, followed by 54 (36.7%) who consumed medication once/ day whereas only 6 (4.1%) of them had consumed the medication thrice a day. When asked whether they rinsed their child's mouth after medicine application, 7 (4.8%) of the parents said that they always rinsed their child's mouth after medicine application and 83 (56.5%) of them said that only sometimes they rinsed their child's mouth. As reported by the parents, majority of children, 117 (79.6%) began toothbrushing at the age of 30-40 months and 116 (78.9%) of them reported toothbrushing twice a day.

When the parents were asked about their child's consumption of chocolates, cookies and juice > 4 days a week, they reported that, 86 (58.5%) of the children had consumed chocolates > 4 days a week, 103 (70.1%) of them had consumed cookies > 4 days a week and 32 (21.8%) of them had consumed juice > 4 days a week. (Table 2)

Dental caries was assessed using the WHO oral health assessment form 1997. Among the 147 children, 95 (64.6%) of them had dental caries and 52 (35.4%) of them did not have dental caries. (Table 3) Among the parents who reported the presence of a smoker in their home, 63 (70%) of them reported the history of wheezing in their children and among the parents who reported the absence of a smoker in their home, only 13 (22.8%) reported the history of wheezing in their children and this difference was statistically significant ( $p < 0.001$ ). (Table 4). Among the mothers who were exposed to ETS during pregnancy, 57.4% reported the history of wheezing in the past, and among the mothers who were unexposed to ETS, 46.0% of them reported the history of wheezing in their children and this difference was not statistically significant ( $p = 0.195$ ). (Table 5)

Among the parents who reported the presence of a smoker in their home, 72.6% of the children had dental caries, whereas among the parents who reported the absence of a smoker in their home, only 27.4% of them had dental caries and this difference was statistically significant ( $p = 0.001$ ). (Table 6)

Among the children who consumed medication twice a day, 68.4% of them had dental caries, whereas among the children who reported the consumption of medication once a day, only 25.3% of them had dental caries and this difference was statistically significant ( $p < 0.001$ ). (Table 7)

**Table no 1: Demographic Details**

GENDER	Number (percentage)
Males	91 (61.9%)
Females	56 (38.1%)

**Table no 2: Distribution of the study participants based on the questionnaire**

Questions	Number (percentage)
<b>1. Do you know the ill effects of tobacco</b>	
Yes	91 (61.9%)
No	56 (38.1%)
<b>2. Does a smoker reside in your home?</b>	
Yes	93 (63.3%)
No	54 (36.7%)
<b>3. Where do they smoke?</b>	
Indoor	14 (15.1%)
Outdoor	19 (20.4%)
Both	60 (64.5%)
<b>4. The number of smokers at home?</b>	
One	68 (73.1%)
Two	23 (24.7%)
More than two	2 (2.2%)
<b>5. Maternal history of tobacco use? (Past or current)</b>	
<b>6. For how long did you breastfeed your child?</b>	
Never	0 (0%)
< 4 months	0 (0%)
> 4 months	147 (100.0%)
<b>7. Was the mother exposed to environmental tobacco smoke (ETS) during pregnancy?</b>	
Yes	47 (32%)
No	100 (68%)
<b>8 Was your child exposed to (ETS) on a regular basis within the home during the first year of life?</b>	
Yes	34 (23.1%)
No	113 (76.9%)

Continue.....

<b>9. Was your child exposed to (ETS) on a regular basis within the home during the past 12 months?</b>	
Yes	76 (51.7%)
No	71 (48.3%)
<b>10. Has your child ever had wheezing or whistling in the chest at any time in the past?</b>	
Yes	73 (49.7%)
No	74 (50.3%)
<b>11. At what age did the wheezing start for your child?</b>	
30-40 months	100 (68%)
41-50 months	38 (25.9%)
51-60 months	4 (2.7%)
< than 30 months	5 (3.4%)
<b>12. How many attacks of wheezing has your child had in the last 12 months?</b>	
None	61 (41.5%)
1-3	85 (57.8%)
4-12	1 (0.7%)
<b>13. Duration of the use of medication for wheezing disorder?</b>	
<2 years	133 (90.5%)
2-4 years	14 (9.5%)
>4 years	0 (0%)
<b>14. Medication frequency ?</b>	
Once/day	54 (36.7%)
Twice/day	87 (59.2%)
Thrice/day	6 (4.1%)
<b>15. Rinse the mouth after medicine application?</b>	
Always	7 (4.8%)
Sometimes	(56.5%)
Never	(38.7%)

<b>16. Age of beginning of toothbrushing?</b>	
30-40 months	117 (79.6%)
41-50 months	20 (13.6%)
51-60 months	0 (0%)
< than 30 months	10 (6.8%)
<b>17. Frequency of tooth-brushing</b>	
Once/day	116 (78.9%)
Twice/day	(19.7%)
Thrice/day	2(1.4%)
<b>18. Consumption of chocolate :&gt; 4 days a week?</b>	
Yes	86 (58.5%)
No	61 (41.5%)
<b>19. Consumption of cookies :&gt; 4 days a week?</b>	
Yes	103 (70.1%)
No	(29.9%)
<b>20. Consumption of cheese or yogurt :&gt; 4 days a week?</b>	
Yes	7 (4.8%)
No	(95.2%)
<b>21. Consumption of Ice cream :&gt; 4 days a week?</b>	
Yes	1 (0.7%)
No	(99.3%)
<b>22. Consumption of juice :&gt; 4 days a week?</b>	
Yes	32 (21.8%)
No	115 (78.2%)

**Table no: 3 Number and percentage of study participants with presence and absence of decayed permanent teeth**

Dental caries		MEAN±SD
Present	Absent	1.40± 1.46
95 (64.6%)	52 (35.4%)	

**Table no 4: Association between presence of smoker at home and history of wheezing in the past among the children**

Presence of smoker at home	History of wheezing in the past		p value
	Yes	No	
Yes	63 (70%)	27 (30%)	<0.001*
No	13 (22.8%)	44 (77.2%)	

*\*p value < 0.05 based on chi square test*

**Table no 5: Association between exposure to ETS during pregnancy among the mothers and history of wheezing in the past among the children**

Exposure to ETS during pregnancy	History of wheezing in the past		p value
	Yes	No	
Yes	27 (57.4%)	20 (42.6%)	0.195
No	46 (46.0%)	54 (54.0%)	

*\*p value < 0.05 based on chi square test*

**Table no 6: Association between presence of smoker at home and dental caries**

Presence of smoker at home	Dental caries		p value
	Present	Absent	
Yes	69 (72.6%)	24 (46.2%)	0.001*
No	26 (27.4%)	28 (53.8%)	

*\*p value < 0.05 based on chi square test*

**Table no 7: Association between dental caries and medication frequency**

Dental caries	Medication Frequency			p value
	Once/day	Twice/day	Thrice/ day	
Present	24 (25.3%)	65 (68.4%)	6 (6.3%)	<0.001*
Absent	30 (57.7%)	22 (42.3%)	0 (0.0%)	

*\*p value < 0.05 based on chi square test*

## Discussion

The findings of the present study revealed that 23.1% of the children were exposed to ETS during the first year of life. These results are comparable to a study conducted by Horak E et al.<sup>5</sup> Presence of a smoker at home leads to significant maternal and fetal exposure to ETS and may subsequently affect fetal health. ETS has been associated with adverse effects on pediatric health, including preterm birth, intrauterine growth retardation, perinatal mortality, respiratory illness and neurobehavioral problems.<sup>1</sup>

We also found that in this study, the prevalence of dental caries was 64.6% in children, majority

of them reported the presence of a smoker in their home. These findings were similar to a study conducted by Shenkin et al. This could be due to the fact that tobacco enhances the growth of cariogenic streptococci in vitro. ETS exposure may increase cariogenic streptococci in the oral cavity of infants.<sup>9</sup>

Among the parents who reported the presence of a smoker at home, 70% of the children had history of wheezing in past. This finding was comparable to a study conducted by Horak E et al. There is increasing evidence that ETS exposure in utero and during early childhood is strongly associated with persistent wheezing and asthma.<sup>5</sup>

In the present study, among the mothers who were exposed to ETS during pregnancy, 57.4% of the children had history of wheezing in the past 12 months and these findings were almost similar to a study conducted by Horak E et al. ETS exposure during pregnancy and the first years of life has been consistently found to have an impact on the respiratory system including symptoms such as wheezing, cough, bronchitis, Respiratory syncytial virus (RSV) bronchiolitis, otitis media and asthma.<sup>5</sup>

In the present study, among the children who had dental caries, 68.4% of them had consumed medication twice a day. These findings are comparable to a study conducted by Milano M et al. who reported that those children who used their medication greater than twice daily were more likely to experience dental disease. Asthmatic children are more prone to dental caries due to the decrease in salivary flow and increase in lactobacilli and *Streptococcus mutans* due to medication.<sup>6</sup> Some dry powder inhalers contain sugar (lactose monohydrate) so that the patient can tolerate the taste of the drug when it is delivered. Frequent oral inhalation of these sugar-containing drugs, combined with a decrease in the salivary flow rate may contribute to an increased risk of caries.<sup>12</sup>

In this study it was found that 58.5% of the children had consumed chocolate > 4 days a week and 70.1% had consumed cookies > 4 days a week. These findings are comparable to a study conducted by Jose B et al. Children with ECC generally have a high frequency of sugar consumption, from fluids given in the nursing bottle and also from sweetened solid foods. This dietary characteristic cannot be ignored as being one of the most significant caries risk factors in ECC.<sup>11</sup>

### Conclusion

Despite the increase in smoke-free legislation, tobacco smoke exposure remains a significant public health burden, particularly in young children who have no control over their environment. The data is conclusive that smoking, ETS, and thirdhand smoke all negatively impact childhood respiratory health. Emerging evidence also links tobacco smoke exposure to early childhood caries. This study highlights the significant association between ETS exposure and early childhood caries (ECC), a relationship that

has been relatively underexplored in the literature compared to its well-documented respiratory effects, thereby highlighting a potentially important but often overlooked consequence of tobacco smoke exposure in young children. However, this study has certain limitations. Being a cross-sectional study, it cannot establish a causal relationship between ETS exposure and health outcomes. The data relied on parental reporting, which may be subject to recall bias or underreporting, especially regarding smoking behavior. Additionally, the study was limited to children attending two tertiary care hospitals in Mangaluru, which may limit the generalizability of the findings to other populations or settings. Public health professionals have a vital role in reducing ETS exposure among children by implementing targeted strategies such as public education to raise awareness, community outreach to promote smoke-free homes, and clinical interventions including routine counseling of parents during healthcare visits. They can also advocate for stronger legal and regulatory measures and support monitoring systems to track exposure trends and the impact of interventions. Strengthening public health policy and expanding comprehensive smoke-free legislation are essential steps toward ensuring that children are fully protected from the harmful effects of all forms of tobacco smoke exposure.

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# Knowledge, Attitude, and Practices Regarding Iron Folic Acid Tablets and Coverage of the Weekly Iron Folic Acid Supplementation Programme Among Rural Adolescent Girls in Nagpur District: A Cross-Sectional Study

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## Abstract

Despite years of programmatic efforts, anemia among adolescent girls in India remains a significant public health challenge. This study aimed to assess awareness, practices related to iron and folic acid (IFA) tablet consumption, and coverage of the Weekly Iron and Folic Acid Supplementation (WIFS) program among adolescent girls in rural areas of Nagpur district, Maharashtra.

A cross-sectional design was employed to gather socio-demographic data and assess knowledge (five questions), attitude (three questions), and practices (nine questions) related to government-recommended IFA tablet consumption.

Among 221 randomly selected adolescent girls, 90.5% were aware of IFA tablets, primarily informed by school teachers. Over half knew the purpose of IFA supplementation. Although 94% reported having received IFA tablets in the past, only 88% consumed them. While most did not report adverse effects, one-third did not believe IFA consumption was beneficial. Common barriers to adherence included the bitter taste of the tablets, forgetfulness, and symptoms like nausea or vomiting. The recent coverage of WIFS was observed to be low. In 2017 and 2018 the program coverage was above 75% but dropped below 60% in other years. Only 9% of participants had received an IFA tablet in the past 14 days; of these, 60% consumed two tablets. The primary reason for non-consumption was non-receipt from schools (89%).

The study highlights inadequate knowledge of IFA benefits despite high awareness and suboptimal coverage of the WIFS program. Strengthening program delivery and addressing barriers to IFA consumption are essential to improve adherence and reduce anemia among adolescent girls in rural India.

**Keywords:** Adolescent, anaemia, Folic acid, Knowledge, India, Iron

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## Introduction

Adolescents make up approximately one-fourth of India's population, and anemia has remained a serious health concern among this age group for several decades.<sup>1</sup> The rapid growth during adolescence, coupled with menstruation among girls, exacerbates the risk of anemia and may have far-reaching inter-generational consequences if not addressed in a timely manner.<sup>2,3</sup> Recognizing the critical importance of adolescence as a nutrition-sensitive phase, adolescents were included as the target group under the Weekly Iron Folic Acid Supplementation (WIFS) program in India since 2012. However, despite several years of program implementation, the reduction in the prevalence of anemia among adolescent girls has been limited.

In contrast, recent estimates from the National Family Health Survey (NFHS) indicate an increase in anemia prevalence among Indian adolescents aged 15-19 years, rising from 55.8% in 2005-2006 to 60.2% in 2019-2021 in rural areas.<sup>4</sup> This increase is a serious concern, particularly in light of the World Health Assembly's Global Nutrition Target, which aims for a 50% reduction in anemia in women aged 15-49 years and a 30% reduction in low birth weight by 2025.<sup>5</sup>

The persistently high prevalence of anemia in India may, in part, be attributed to the low uptake of iron-folic acid (IFA) tablets provided under the WIFS program among adolescent girls. The Indian NFHS data currently only covers IFA adherence for pregnant women.<sup>6</sup> Knowledge is a crucial and fundamental factor for changing attitudes and practices, which, in turn, can increase IFA consumption and contribute to anemia control. Health education interventions have proven effective in increasing the consumption of IFA tablets. For example, intensive health education among adolescent girls in Delhi not only boosted their IFA consumption but also improved their knowledge and practices.<sup>7</sup> Similarly, a study in Karnataka reported that educational interventions conducted by teachers were effective in increasing the demand for IFA and enhancing awareness and attitudes related to anemia and its prevention.<sup>8</sup> Therefore, assessing knowledge, attitudes, and practices (KAP) related to IFA tablets distributed under the WIFS programme among adolescent girls becomes crucial.

In efforts to control and prevent anemia, programmatic measures such as the supply of IFA, health education by teachers, biannual deworming, etc. need to align with the compliance to IFA among adolescent girls. A study from West Bengal revealed that 62% of adolescent girls did not receive IFA tablets in the previous month,<sup>9</sup> while another study from Uttarakhand reported that only 45% of adolescent girls had ever received IFA tablets.<sup>10</sup> Estimating the number of beneficiaries who receive and consume IFA, understanding their knowledge, attitudes, and practices (KAP) related to IFA, and ensuring the regular supply of IFA from schools are therefore critical elements in preventing and controlling anemia. This study aims to: 1) Assess the knowledge, attitudes, and practices regarding IFA tablets among adolescent girls, and 2) Evaluate the coverage of the WIFS program.

## Methods

The present study is a part of an institutional-based cross-sectional observational study conducted from December 2019 to March 2020 among school going adolescent girls aged 14-19 years in rural areas of Nagpur district, where educational institutes received aid from the state government.

We recruited 221 apparently healthy rural adolescent girls through population-proportionate random sampling from 24 government schools across 18 villages served by four primary health centres. The subjects were chosen randomly using online random number generator program. Assuming the prevalence of anaemia among rural adolescent girls as 87%<sup>11</sup>, precision of 5%, 95% confidence interval (CI) and 20% non-response rate the minimum required sample size was 214. A comprehensive description of the study methodology can be found elsewhere.<sup>12</sup>

Written informed consent were obtained from the participants. Trained researchers collected data using android tablets to capture information related to socio-demographics, KAP regarding IFA tablets. A pre-tested questionnaire developed with Epi-collect 5 was used.

The level of standard of living was assessed using a method described in NFHS-2.<sup>13</sup> A total of five

questions were used to assess knowledge about IFA tablets. Participants were shown a strip of IFA tablets to aid recognition. The knowledge-related questions explored the source of information about IFA tablets, the health conditions for which these tablets are recommended, and the perceived benefits of their consumption, using both structured and open-ended responses.

Attitudes toward IFA tablets were assessed through three questions, which explored whether the girls experienced any health issues following tablet consumption and their perceptions of the usefulness of IFA for their overall health. Additionally, detailed information was collected on the specific health issues reported after taking the tablets.

A total of nine questions were used to assess practices related to IFA tablet use. These included questions on the receipt and consumption of IFA tablets, the source from which the tablets were obtained, and reasons for non-consumption when applicable. Additional questions covered the receipt of IFA tablets over the past five years, receipt and consumption within the last 14 days, reasons for recent non-consumption, and the timing of tablet intake in relation to meals (before or after eating).

Ethical approval for the study was obtained from Institutional Review Board. Trial Registration Number: CTRI/2020/01/023035.dated 16/9/2019.

### Data analysis

Data collected from the multiple android tablets were synced to the server, downloaded and exported to Microsoft excel. This excel file then exported into Epi-Info version 7.2.5.0 for further analysis. The analysis includes girls who consented to give blood for estimation. In all 221 girls had data on hemoglobin and data regarding KAP variables. We present results as frequencies and percentages.

## Results

The sociodemographic characteristics of the study population are summarized in Table 1.

**Table 1: General characteristics of the population by anemia status**

Variables	N (%)	Anemia proportion n (%)
<b>Age (years)</b>		
14-17	185 (84)	105 (56.7)
18-19	36 (16)	22 (61.1)
<b>SLI Index</b>		
Low-Medium	21 (9.5)	10 (47.6)
High	200 (90.5)	117 (58.5)
<b>Family Type</b>		
Nuclear	129 (58.4)	66 (51.6)
Non-nuclear	92 (41.6)	61 (66.3)
<b>Family size</b>		
< 4	16 (7)	8 (50)
≥ 4	205 (93)	119 (58.1)
<b>Mother's education</b>		
Literate	188 (85.1)	107 (56.9)
Illiterate/ Don't know	33 (14.9)	20 (60.6)
<b>Father's education</b>		
Literate	186 (84.2)	103 (55.4)
Illiterate/ Don't know	35 (15.8)	24 (68.6)

A significant proportion of the girls (84%) belonged to the younger age group and were associated with a high standard of living index (90.5%). Approximately 54% of the girls resided in nuclear family setups, and 93% had family sizes exceeding four members. The majority of these girls had literate parents, with 85% of mothers and 84% of fathers being literate.

Knowledge regarding IFA tablets among adolescent girls is presented in Table 2. The majority of girls (90.5%) could correctly identify IFA tablets. Among those who recognized the tablets, 97% received information about them from their teachers, while the remainder received information from sources like the Primary Health Center (PHC), Accredited Social Health Activist (ASHA), or Anganwadi Worker (AWW). Approximately 56% of the girls accurately answered the purpose for which IFA tablets are prescribed. In terms of structured responses regarding the benefits of IFA tablets, 32.3% mentioned improved strength, 20% believed IFA tablets reduce weakness, 14% associated them with increased intelligence, and 8% pointed to a cheerful and active feeling as advantages. One-fourth of the girls (25.7%) mentioned

additional benefits, with 43.6% emphasizing increased blood, hemoglobin, or iron, 16% attributing it to increased appetite or growth, nearly 10% reporting feeling lighter, better, or nicer, and 6.5% finding IFA beneficial in regularizing menstrual cycles. A smaller percentage (less than 2%) mentioned effects like killing germs, reducing palpitations, or diminishing dark circles under the eyes. Only 3% expressed a neutral view or reported no benefits.

**Table 2: Knowledge towards IFA tablet among study population**

Knowledge related questions	N (%)
<b>Do you know about iron folic acid (IFA) tablets?</b>	
Yes	200 (90.5)
No	20 (9)
Do not know	1 (0.5)
<b>From which source did you happen to know about these tablets?</b>	
Teachers	194 (97)
PHC/ ASHA /AWW	6 (3)
<b>For which of the following condition these IFA tablets are given?</b>	
Having knowledge of anemia	123 (56)
No knowledge of anemia	98 (44)
<b>What are the benefits of IFA tablets according to you (Multiple responses)</b>	
Gives strength	69 (32.3)
Decrease weakness	42 (19.6)
Feel cheerful and active	18 (8.4)
Improves intelligence	30 (14)
Any other	55 (25.7)
<b>Reported other benefits of IFA tablet consumption (Multiple responses)</b>	
Increased appetite or increases weight	10 (16.1)
Keeps body fit or helps in growth	10 (16.1)
Increases blood, hemoglobin or iron	27 (43.6)
Feel better, nice, lighter	6 (9.7)
Reduces palpitation	1 (1.6)
Helps to regularize menstrual cycle	4 (6.5)
Kills germs	1 (1.6)
Reduces dark circles under eyes	1 (1.6)
No benefits or cannot say	2 (3.2)

Table 3 summarizes attitudes toward IFA tablets. Only 8% of girls reported adverse effects after consumption, with nausea being most prevalent (61%). Other symptoms included isolated stomach pain (22%), concurrent nausea and stomach pain (11%), and stomach pain with black stool (5.5%). While 59.3% of girls perceived health benefits from IFA consumption, nearly one-third (29.8%) reported no perceived benefits.

**Table 3: Positive or negative attitude towards IFA tablets among study population**

Positive or negative attitude towards IFA	Frequency (%)
Did you experience any health problems after consumption of IFA tablets	
Yes	18 (8.2)
No	187 (84.6)
Don't Know	16 (7.2)
Responses for health issues associated with IFA tablets consumption	
Stomach pain	4 (22.2)
Feeling of nausea	11 (61.1)
Stomach pain and nausea	2 (11.1)
Stomach pain and black stool	1 (5.5)
Do you find the consumption of IFA tablets has benefited your health	
Yes	131 (59.3)
No	66 (29.8)
Don't Know	24 (10.9)

Table 4 presents recent IFA consumption practices. Among surveyed girls, 94% reported ever receiving IFA tablets, and 88% reported consuming them. A significant portion (over 50%) of the girls complained about the bitter taste of the tablets, which was a common reason for non-consumption. Approximately 19% of the girls mentioned feeling nausea, vomiting, or a burning sensation as reasons for not taking the tablets. Forgetfulness, family prohibition, and lack of awareness about IFA were cited as reasons by the remaining one-fourth of the girls. The educational institute, primarily the school or college, served as the source for the majority of these girls (97%) to receive the tablets, while others obtained

them from sources like the PHC, ASHA, AWW, or private health facilities. In 2019 and 2015, fewer than 50% of the girls reported receiving the tablets, while over three-fourths of the girls mentioned receiving tablets in 2018 (82.5%) and 2017 (77.2%). In 2016, only 60% of the girls received the tablets. Approximately 7% of the girls claimed they never received the tablets. Among the total, fewer than 10% of the girls mentioned that they have consumed tablets in the last 14 days. Of those who did, 35% consumed one tablet, 60% reported consuming two tablets, and 5% mentioned consuming three tablets in the past 14 days. The majority of these girls (90%) reported taking the tablets after their meals. More than 90% of the girls did not consume tablets in the past 14 days, primarily due to not receiving the tablets from their school (89%). Other reasons included absenteeism (6%), lack of awareness (2%), dislike (1.5%), forgetfulness (1%), and family prohibition (0.5%).

**Table 4: IFA tablet receipt, consumption, and recent adherence practices**

Practice related questions	Frequency (%)
<b>Have you ever received IFA tablets?</b>	
Yes	208 (94)
No	13 (6)
<b>Did you consume the tablets which you receive last time?</b>	
Yes	195 (88)
No	16 (7)
Don't know	10 (5)
<b>What was reason for not consuming tablets received last time ?</b>	
Bad or bitter taste, do not like	9 (56.3)
Feeling of nausea or vomiting or burning sensation	3 (18.8)
Prohibition from family	1 (6.2)
Forgot	2 (12.5)
Unaware of IFA tablets	1 (6.2)
<b>From where did you receive IFA tablets last time ?</b>	
School/College	202 (97)
PHC	2 (1)

Continue.....

Private health facility	1 (0.5)
ASHA	1 (0.5)
AWW	2 (1)
<b>In which of the following years you regularly (means once a week ) received IFA tablets ? (Multiple responses)</b>	
2019	88 (49.2)
2018	170 (82.5)
2017	159 (77.2)
2016	122 (59.5)
2015	84 (44.2)
Never received in 2015-2019	15 (6.8)
<b>Have you consumed any IFA tablets within the last 14 days?</b>	
Yes	20 (9)
No	201 (91)
<b>How many IFA tablets have you consumed in the last 14 days</b>	
One tablet	7 (35)
Two tablets	12 (60)
Three tablets	1 (5)
<b>When did you consume these tablets?</b>	
Before meals	2 (10)
After meals	18 (90)
<b>What was the reason for not consuming tablets in last 14 days</b>	
Did not receive	179 (89.1)
Do not like	3 (1.5)
Absent	12 (5.9)
Forgot	2 (1.0)
Unaware	4 (2)
Family prohibition	1 (0.5)

### Discussion

In this institutional based cross sectional study we sought to investigate the knowledge, attitude and practices regarding IFA tablets, reasons for not consuming IFA, coverage of WIFS among rural adolescent girls in Nagpur district.

We assessed the knowledge regarding IFA tablets by showing the girls a strip of IFA tablets. The results indicated that the majority of the girls (90.5%) in our study were aware of IFA tablets. However,

despite this awareness, only 56% of the girls knew the purpose of IFA tablets. Notably, recent studies conducted in other parts of India have reported similarly poor knowledge about anemia among adolescent girls.<sup>14,15</sup> It's worth mentioning that these studies were conducted in urban areas.

Responses regarding the benefits of IFA tablets, such as increased strength, reduced weakness, and improved intelligence, were reported by fewer than 35% of the girls. Additionally, less than 45% of the girls mentioned benefits related to increased blood, hemoglobin, or iron levels. A study conducted in Ahmedabad district found that 47.4% of the girls were unaware of the positive effects of IFA tablets on their health.<sup>16</sup> Another recent study, conducted via social media platforms like Facebook, also reported a lower level of knowledge among younger women.<sup>17</sup> The situation is paradoxical; while we witness a significant increase in the use of social media platforms for various purposes, its potential for promoting health awareness remains largely untapped.

While the majority of girls (97%) reported that they learned about IFA tablets from their teachers, the poor understanding of the tablets' purpose and benefits among adolescent girls is likely attributed to a deficiency in health education efforts by teachers. This suggests that school teachers may be overlooking a crucial opportunity to enhance students' knowledge, attitudes, and practices related to the role of IFA tablets in preventing anemia. A qualitative study from rural Karnataka from 64 in-depth interviews of adolescent girls and six focus group discussion revealed that the girls had very low awareness of anemia and school-based distribution of iron and folic acid supplements and nutrition talks were not seen to be resulting in knowledge and acceptance of the importance of preventing anemia.<sup>18</sup>

Consistent with low perceived health benefits (30%), 8% reported gastrointestinal adverse effects despite 85% overall tolerability. According to guidelines, IFA tablets should be taken after a meal. It's highly likely that some of the girls are taking these tablets on an empty stomach. Addressing these issues can be achieved if teachers ensure that students have eaten before distributing the tablets in class. This can be best accomplished by distributing the tablets in class immediately after the lunch break in accordance

with the National Health Mission's guidelines. These health problems related to IFA consumption may explain why one-third of the girls in our study do not perceive IFA consumption as beneficial for their health.

Adherence to the recommended treatment regimen within the target population is essential for the success of any health program. While 94% of girls reported recent receipt of IFA tablets, only 88% consumed them. Among the 16 non-consumers, bitter taste was the predominant barrier (56%, n=9), followed by forgetfulness or nausea/vomiting. These findings align with existing literature. Bhatt and Mehta (2013) reported 66% discontinuation due to gastrointestinal issues in Gujarat<sup>16</sup> while a study by Sajna et al in Thrissur Corporation found side effects limited adherence to just 15%.<sup>19</sup> Compliance with IFA tablets has remained a significant challenge in the success of the WIFS program in India.

Our study revealed that, in the past 14 days, 40% of the girls did not adhere to the recommended dose of one tablet per week, and 10% of the girls consumed it before meals, contrary to the recommendations. Such unsupervised tablet consumption practices among girls are detrimental to the success of the WIFS program.

Teachers play a critical role in the implementation of the WIFS program for school adolescents, as it involves the coordination of education and the health department. The role of parents in supporting the girls should not be underestimated. Policy planners have recognized the importance of involving parents and have advocated for their orientation on WIFS and nutritional health education during parent-teacher association meetings. Motivation from parents and health education from teachers have been documented as motivating factors for IFA consumption.<sup>20,21</sup> Regular counselling and health education from teachers, with support and cooperation from parents, can enhance adherence and compliance with IFA and generate demand for IFA among the target population.

Enhancing adherence or compliance to IFA is closely tied to its coverage. In our study, the coverage of WIFS in 2018 and 2017 exceeded 75%, while in

other years, it fell below 60%. Additionally, over 90% of the adolescent girls in our study did not consume the tablet in the last 14 days because the majority of them did not receive it. The current evidence of low IFA coverage, coupled with findings from various regions in India raises concerns about WIFS implementation.<sup>9,22,23</sup>

The recent insufficient coverage of IFA among adolescents could be attributed to the lack of coordination between the health and education departments.<sup>24</sup> Furthermore, these findings underscore the importance of managing the components of the IFA supply. Ahmad et al.<sup>25</sup> in their study assessing the IFA supply chain in 58 districts, 116 blocks, 232 sub-centers, 232 schools, and 232 anganwadis in India, identified key issues, such as the absence of a standardized forecasting process, lack of inventory management techniques, the absence of a fixed distribution schedule, inadequate availability of transport vehicles, and the absence of an integrated management information system. Regular sensitization and training workshops for school staff have proven effective in increasing IFA coverage.<sup>24</sup> Low IFA coverage can have a significant impact on adolescent girls, given their higher nutritional requirements during adolescence. This deficiency can lead to anemia, potentially affecting their future reproductive health.<sup>26</sup>

While there are numerous studies addressing KAP related to anemia, to the best of our knowledge, this is the first study to explore KAP and the coverage of IFA tablets in Nagpur district. A study from an adjacent district has examined the supply side of WIFS implementation among adolescents using mixed methods.<sup>27</sup> In contrast, our study emphasizes the demand side of WIFS and addresses a crucial gap that requires attention in the WIFS implementation.

Our study findings are specific to school-going adolescent girls in rural areas. Compliance with IFA tablet consumption was assessed through self-reported data, which may be subject to recall bias, particularly regarding tablet receipt over the past fourteen days or in previous years. Additionally, the study did not include the supply-side perspective—that of key stakeholders such as school principals, block education officers, parents of children and health officials at primary health centres and sub-centres.

These perspectives are essential for a comprehensive understanding of program implementation and should not be overlooked in future research.

## Conclusion

Our study addresses the gaps in understanding the knowledge, attitudes, practices, and coverage of IFA tablets among rural adolescent girls in Nagpur district. We found that awareness regarding IFA tablets was limited. The discouraging factors, such as feelings of nausea and vomiting associated with IFA consumption among adolescent girls, can be mitigated through supervised ingestion of the tablets after ensuring that the girls have had their meals. Moreover, involving parents in the program can provide support and motivation to augment IFA consumption among adolescent girls, ultimately increasing the demand for IFA. The low coverage of IFA emerged as a major reason for non-consumption of IFA in the past 14 days. A key limitation of our study is that we did not assess the supply side of IFA tablets, which would have provided a more comprehensive understanding of the WIFS program implementation in rural Nagpur district, Maharashtra.

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# Study of Histopathological Spectrum of Leprosy with Special Reference to Bacteriological Index in a Tertiary Care Centre

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## Abstract

Leprosy, caused by *Mycobacterium leprae*, remains a challenge in endemic regions despite declining global incidence. Its clinical and histopathological spectrum reflects the host's immune status, ranging from the paucibacillary tuberculoid form to multibacillary lepromatous leprosy. This study retrospectively analyzed 75 skin biopsy specimens from clinically suspected leprosy cases at a tertiary care centre. Using routine hematoxylin and eosin (H&E) and modified Fite-Faraco staining, the lesions were classified according to the Ridley-Jopling spectrum. The results revealed that lepromatous leprosy (LL) was the most common subtype (32%), followed by borderline tuberculoid (BT; 28%), borderline lepromatous (BL; 13.33%), mid-borderline (BB; 9.33%), tuberculoid (TT; 9.33%), and indeterminate leprosy (IL; 8%). The mean patient age was 36.52 years with a slight male predominance (61.33% male). Overall clinico-histopathological correlation was 72%, with 100% agreement in TT cases and only 42.86% in BB. Fite-Faraco staining was positive in 62.66% of cases, with strong acid-fast bacilli detection in LL and BL lesions (BI scores up to grade 6) and negativity in TT. These findings support the integration of clinical evaluation, histopathology, and bacteriological index determination for accurate diagnosis and effective treatment planning in leprosy.

**Keywords:** Bacteriological Index, Clinicopathological Correlation, Fite-Faraco, Histopathology, Leprosy, Ridley-Jopling

## Introduction

Leprosy is a chronic infectious disease which is caused by a bacteria *Mycobacterium Leprae*, which was demonstrated in 1873 by a Norwegian Physician Armauer Hansen.<sup>[1]</sup> The infection mostly affects the

skin, the peripheral nerves, mucosal surfaces of the upper respiratory tract and eyes.<sup>[2]</sup> Although the global incidence of leprosy has declined, it remains endemic in countries such as India, which accounts for more than half of the world's cases.<sup>[3]</sup> Clinically, the disease shows a wide spectrum: at one end, tuberculoid

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leprosy (TT) reflects a strong cell-mediated immune response with granulomatous inflammation and scant bacilli; at the other, lepromatous leprosy (LL) is characterized by weak immunity, numerous foamy macrophages, and high bacillary load. Borderline forms—including borderline tuberculoid (BT), mid-borderline (BB), and borderline lepromatous (BL)—delineate an intermediate immunological spectrum, often posing diagnostic challenges.<sup>[4]</sup>

Histopathological examination is vital for confirming clinical findings in leprosy, especially when lesions are ambiguous.<sup>[5]</sup> The H&E stain demonstrates the inflammatory response and cellular architecture, while the modified Fite–Faraco stain is a critical tool to detect acid-fast bacilli. Moreover, the bacteriological index (BI) calculated on the basis of Ridley’s logarithmic scale further quantifies the load of *M. leprae*, thereby guiding treatment decisions.<sup>[6]</sup>

The main objectives of this study were to assess histopathological spectrum of leprosy and correlate histopathological diagnosis with clinical diagnosis.

By combining clinical evaluation with histopathological and bacteriological techniques, a more accurate diagnosis can be achieved, leading to timely and effective therapy.

## Materials and Methods

### Study Design and Setting

A retrospective hospital-based observational study was carried out in the Department of Pathology at Muzaffarnagar Medical College & Hospital, Uttar Pradesh, India from October 2023 to March 2025. The study spanned 18 months, with 12 months dedicated to data collection and 6 months for analysis.

### Study Population and Sampling

Seventy-five patients with clinically suspected leprosy who underwent skin biopsy were included using purposive sampling. All specimens were collected from the Department of Dermatology, Venereology, and Leprology after informed consent was obtained. Cases with inadequate or poorly preserved specimens were excluded.

### Histopathological Procedure

Biopsy specimens were fixed in 10% buffered formalin, processed routinely, and embedded in paraffin. Serial sections (4–5 µm thick) were stained with:

- **H&E stain:** To evaluate tissue architecture, granuloma formation, and inflammatory infiltrate.
- **Modified Fite–Faraco stain:** To detect acid-fast bacilli of *M. leprae* following a protocol involving dewaxing, rehydration, staining with carbol fuchsin, decolorization with 1% sulfuric acid in 25% alcohol, and counterstaining with methylene blue.<sup>[7]</sup>

### Bacteriological Index (BI)

BI was determined according to Ridley’s logarithmic scale as follows:

- BI = 0: No bacilli observed.
- BI = 1: 1–10 bacilli in 10–100 high-power fields (hpf).
- BI = 2: 1–10 bacilli in 1–10 hpf.
- BI = 3: 1–10 bacilli per hpf.
- BI = 4: 10–100 bacilli per hpf.
- BI = 5: 100–1,000 bacilli per hpf.
- BI = 6: More than 1,000 bacilli or globi observed per hpf.

### Data Analysis

Clinical and histopathological data—including age, sex, lesion characteristics, clinical and histopathological diagnosis, Fite staining results, and BI scores—were recorded in Microsoft Excel and analyzed using SPSS version 17/20. Descriptive statistics (mean, standard deviation, and percentages) were calculated, and the Chi-square test and one-way ANOVA were applied as necessary. A Cramér’s V test was used to assess the strength of associations.

### Ethical Clearance

The study was approved by the Institutional Ethics Committee of Muzaffarnagar Medical College. (Ref. No. MMC/IEC/2023/237) dated 20/03/2023.

**Results**

**1. Histopathological Spectrum**

Skin biopsies were classified as per the Ridley-Jopling system. Table 1 summarizes the distribution.

**Table 1. Histopathological Spectrum of Leprosy (n = 75)**

Subtype	Number of Cases	Percentage (%)
Lepromatous Leprosy (LL)	24	32.0
Borderline Lepromatous (BL)	10	13.33
Mid-borderline (BB)	7	9.33
Borderline Tuberculoid (BT)	21	28.0
Tuberculoid Leprosy (TT)	7	9.33
Indeterminate Leprosy (IL)	6	8.0
Total	75	100.0

LL was the most common histopathological type (32%), indicating a higher bacillary load and diminished immune response.

**2. Demographic Characteristics**

The age of patients ranged from 14 to 81 years

**Table 3. Distribution of Leprosy Subtypes by Age Group**

Age Group (years)	LL(%)	BL(%)	BB(%)	BT(%)	TT(%)	IL(%)
0-9	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
10-19	2 (8.33%)	0 (0%)	0 (0%)	1 (4.76%)	0 (0%)	0 (0%)
20-29	12 (50%)	2 (20%)	2 (28.6%)	5 (23.8%)	1 (14.3%)	1 (16.7%)
30-39	6 (25%)	3 (30%)	2 (28.6%)	8 (38.1%)	4 (57.1%)	2 (33.3%)
40-49	1 (4.17%)	5 (50%)	0 (0%)	6 (28.6%)	2 (28.6%)	1 (16.7%)
50-59	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	2 (33.3%)
60-69	2 (8.33%)	0 (0%)	1 (14.3%)	1 (4.76%)	0 (0%)	0 (0%)
70-79	0 (0%)	0 (0%)	2 (28.6%)	0 (0%)	0 (0%)	0 (0%)
80-89	1 (4.17%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)

**4. Mean Age of Each Subtype**

One-way ANOVA demonstrated a statistically

with an overall mean age of  $36.52 \pm 13.66$  years. There was a slight male predominance (46 males, 61.33% vs. 29 females, 38.67%). Table 2 shows the age and sex distribution.

**Table 2. Age and Sex Distribution (n = 75)**

Age Group (years)	Total Patients	Males n (%)	Females n (%)
0-9	0	0 (0%)	0 (0%)
10-19	3	2 (66.7%)	1 (33.3%)
20-29	23	16 (69.6%)	7 (30.4%)
30-39	25	16 (64.0%)	9 (36.0%)
40-49	15	5 (33.3%)	10 (66.7%)
50-59	2	2 (100%)	0 (0%)
60-69	4	2 (50.0%)	2 (50.0%)
70-79	2	2 (100%)	0 (0%)
80+	1	1 (100%)	0 (0%)
Total	75	46 (61.33%)	29 (38.67%)

**3. Distribution of Leprosy Subtypes by Age**

The frequency of different subtypes varied by age group. Table 3 provides this distribution.

significant difference in the mean age among subtypes ( $p < 0.0001$ ) (see Table 4).

**Table 4. Mean Age  $\pm$  SD by Histopathological Subtype**

Subtype	Mean Age (years) $\pm$ SD
Lepromatous Leprosy (LL)	$33.46 \pm 15.60$
Borderline Lepromatous (BL)	$36.90 \pm 7.92$
Mid-borderline (BB)	$47.43 \pm 22.26$
Borderline Tuberculoid (BT)	$35.57 \pm 10.61$
Tuberculoid Leprosy (TT)	$34.14 \pm 7.01$
Indeterminate Leprosy (IL)	$41.50 \pm 13.05$
Overall	$36.52 \pm 13.66$

## 5. Sex Distribution Among Subtypes

The sex distribution varied among the leprosy types. Table 5 summarizes these findings.

**Table 5. Sex Distribution by Leprosy Subtype**

Subtype	Males n (%)	Females n (%)	Total n (%)
Lepromatous Leprosy (LL)	15 (62.5%)	9 (37.5%)	24 (32.0%)
Borderline Lepromatous (BL)	9 (90%)	1 (10%)	10 (13.33%)
Mid-borderline (BB)	7 (100%)	0 (0%)	7 (9.33%)
Borderline Tuberculoid (BT)	5 (23.8%)	16 (76.2%)	21 (28.0%)
Tuberculoid Leprosy (TT)	4 (57.1%)	3 (42.9%)	7 (9.33%)
Indeterminate Leprosy (IL)	6 (100%)	0 (0%)	6 (8.0%)

M:F ratio was 1.58:1

## 6. Clinico-Histopathological Correlation

Overall, 54 out of 75 cases (72%) showed concordance between the clinical and

histopathological diagnoses; the remaining 21 cases (28%) did not. Table 6 provides a breakdown by subtype.

**Table 6. Clinicopathological Correlation**

Subtype	Total Cases (Histopathology)	Concordant Cases (%)	Discordant Cases (%)
Lepromatous Leprosy (LL)	24	20 (83.33%)	4 (16.67%)
Borderline Lepromatous (BL)	10	8 (80%)	2 (20%)
Mid-borderline (BB)	7	3 (42.86%)	4 (57.14%)
Borderline Tuberculoid (BT)	21	16 (76.19%)	5 (23.81%)
Tuberculoid Leprosy (TT)	7	7 (100%)	0 (0%)
Indeterminate Leprosy (IL)	6	0(0%)*	6(100%)*
Total	75	54 (72%)	21 (28%)

\*Note: Indeterminate lesions were not clinically categorized, hence no clinical correlation is obtainable.

## 7. Fite-Faraco Staining and Bacteriological Index (BI)

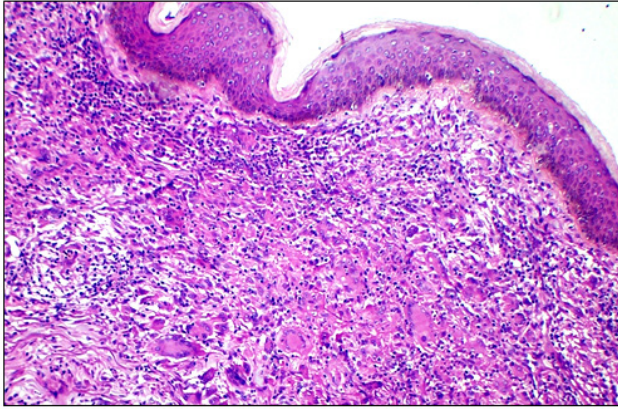
out of 75 cases (62.66%). The distribution of BI scores is detailed in Table 7.

Modified Fite-Faraco staining was positive in 47

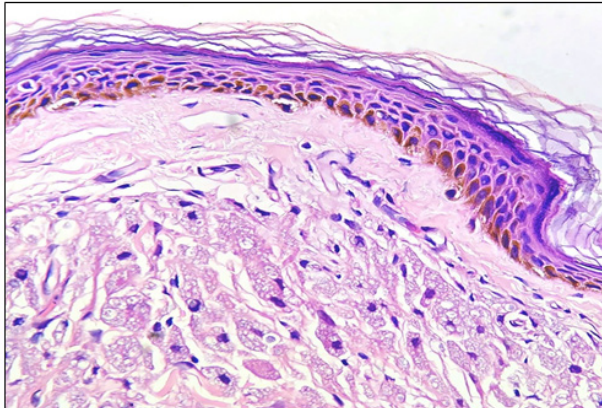
**Table 7. Fite-Faraco Positivity and BI Scores by Subtype**

Subtype	Total Cases	Fite-Positive (%)	BI Grades Observed (Number of Cases)
Lepromatous Leprosy (LL)	24	24 (100%)	BI 1: 4; BI 2: 2; BI 3: 3; BI 4: 4; BI 5: 6; BI 6: 5
Borderline Lepromatous (BL)	10	10 (100%)	BI 3: 3; BI 4: 2
Mid-borderline (BB)	7	5 (71.43%)	BI 0: 2; BI 1: 3
Borderline Tuberculoid (BT)	21	5 (23.81%)	BI 0: 16; BI 1: 5
Tuberculoid Leprosy (TT)	7	0 (0%)	BI 0: 7
Indeterminate Leprosy (IL)	6	3 (50%)	BI 0: 3; BI 1: 2; BI 2: 1
Total	75	47 (62.66%)	-

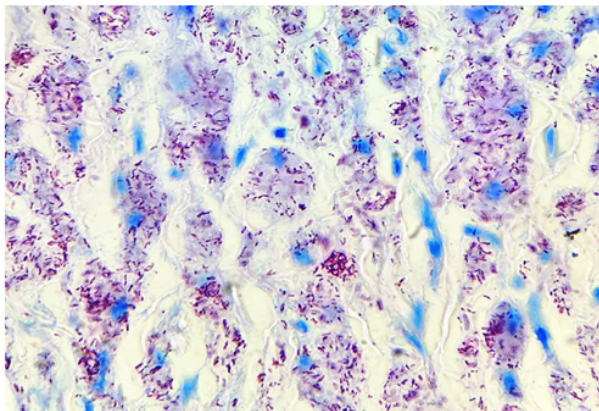
LL and BL subtypes demonstrated consistently high BI scores, reflecting a higher bacillary load, whereas TT cases were uniformly negative.



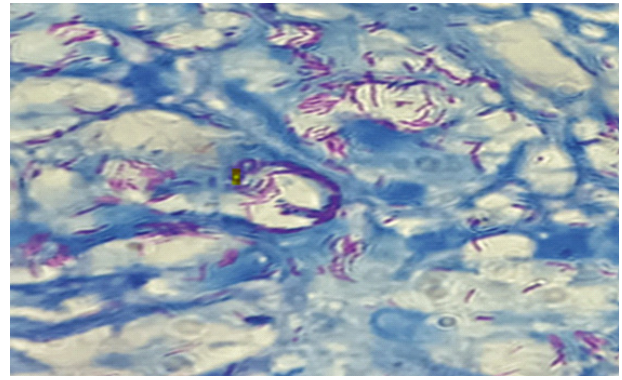
**Image 1: Borderline Tuberculoid Leprosy- Photomicrograph showing granulomas with lymphocytic infiltrates and variable number of Langhans giant cells in the dermis. (H&E, 100X)**



**Image 2: Lepromatous Leprosy- - Photomicrograph showing epidermal atrophy, clear subepidermal Grenz zone and infiltrating foam cells. (H&E 400X)**



**Image 3: Lepromatous Leprosy- Photomicrograph showing numerous lepra bacilli, BI=6 (FF, 1000X)**



**Image 4: Lepromatous Leprosy- Photomicrograph showing numerous lepra bacilli, BI=5 (FF, 1000X)**

### Discussion

This study analyzed 75 skin biopsies from patients with clinically suspected leprosy, classifying them according to the Ridley-Jopling criteria. LL was the most common subtype (32%), which is indicative of a predominant multibacillary disease burden in our tertiary care setting. Previous studies have shown variable distributions, with some reporting a higher incidence of BT.<sup>[8]</sup> Variations may be due to regional epidemiology and differences in health-seeking behavior.

The overall mean age (36.52 years) and male predominance (61.33%) are consistent with earlier studies.<sup>[9]</sup> The findings in Table 2 reveal that patients in their 20s and 30s are most affected, thereby emphasizing the disease's impact on economically productive age groups.

Table 3 illustrates that LL was most commonly observed in the 20–29 age group, whereas TT and BT forms were seen in older age groups. A statistically significant difference in mean age among subtypes ( $p < 0.0001$ ) suggests that the host's immune response to *M. leprae* may change with age.

Clinico-histopathological correlation reached 72% overall (Table 7), with 100% correlation in TT and 83.33% in LL. However, the mid-borderline group (BB) showed only 42.86% concordance. The lower concordance in BB may result from overlapping features along the immunological spectrum. The indeterminate cases, not clinically categorized, further highlight the challenge in early diagnosis.

The Fite–Faraco stain proved critical in detecting acid-fast bacilli; all LL and BL cases were positive, and a high BI (up to grade 6) was recorded in LL. In contrast, TT cases were uniformly negative, supporting the paucibacillary nature of such lesions. [6] These findings have significant therapeutic implications, given that high BI scores are associated with greater transmission potential and may require closer treatment monitoring.

Our study, while robust, has some limitations. The retrospective nature and hospital-based sample may introduce selection bias, and the absence of molecular diagnostic techniques such as PCR limits the detection sensitivity in paucibacillary cases. Future studies should incorporate prospective designs with larger cohorts and utilize molecular methods for improved diagnostic accuracy.

### Conclusion

This study underscores the heterogeneity of leprosy and highlights the critical role of histopathological examination and bacteriological index determination in its diagnosis. With LL being the most common subtype and exhibiting high BI scores, the importance of early diagnosis and aggressive treatment is emphasized—especially in multibacillary cases to interrupt transmission. Clinicopathological in 72% cases supports the integration of clinical, histopathological, and microbiological findings in establishing a definitive diagnosis. Further research employing molecular tools could enhance early detection of indeterminate and borderline forms, thereby contributing to more effective management and control of leprosy.

### Limitations

This study has several limitations that should be acknowledged. Firstly, as a hospital-based study, it cannot be considered representative of the entire population. There is an inherent selection bias as

the sample consists only of individuals who sought medical attention at the hospital. This may not accurately reflect the prevalence and distribution of leprosy in the broader community.

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**Conflict of interest:** None

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