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Chronodisruption: Bringing Time into Public Health

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Introduction:

The timing of everyday life has become an environmental exposure. As modern societies increasingly organize work, sleep, eating, and light exposure in ways that conflict with human circadian biology, chronodisruption persistent misalignment of the body’s temporal organization with environmental and behavioural time cues is emerging as a potentially important determinant of population health.^[1,2]

Life evolved in a temporally predictable environment. Stable daily and seasonal cycles generated by the Earth’s rotation and orbit shaped the evolution of endogenous circadian clocks. These central (suprachiasmatic nucleus in brain) and peripheral clocks (present in virtually every organ) coordinate physiological processes from gene expression to hormone secretion and remain synchronized with the external environment through recurring time cues such as the lightdark cycle, food intake, and physical activity.^[2] Within just a few generations, however, the temporal environment has been transformed beyond anything human physiology evolved to accommodate.^[2]

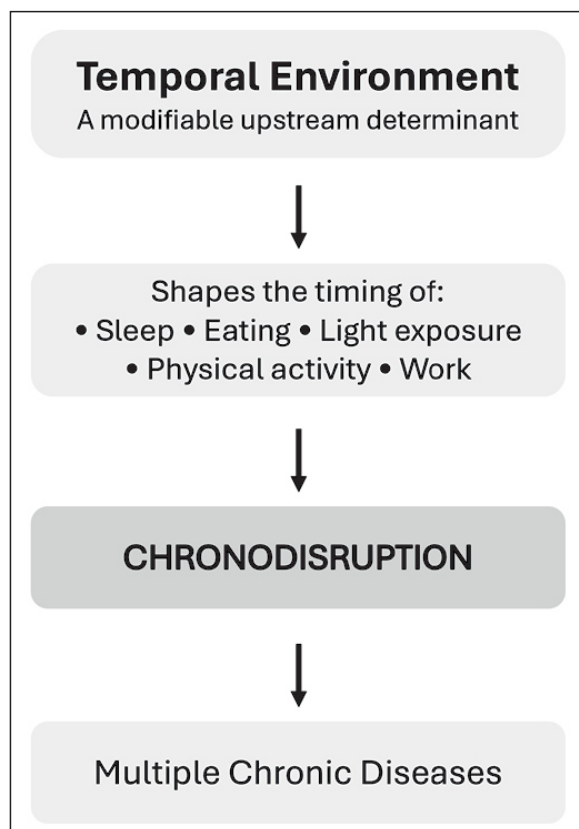
Disruption of this alignment forms the basis of chronodisruption. As originally conceptualized by Erren and Reiter, chronodisruption arises from misalignment between endogenous circadian rhythms and environmental or behavioural time cues, including light

exposure, sleepwake schedules, meal timing, and work patterns.^[1] Contemporary societies expose individuals to multiple and often coexisting sources of chronodisruption. Artificial light at night (ALAN) suppresses nocturnal melatonin secretion, shift work requires wakefulness and food intake during the biological night, social jetlag repeatedly shifts biological timing without changes in geography, and late or irregular eating may uncouple peripheral metabolic clocks from central circadian regulation.^[2,3] Together, these exposures produce cumulative temporal disorganization that has become a characteristic feature of modern living rather than an exceptional circumstance.^[2]

From a public health perspective, chronodisruption merits consideration alongside other recognized environmental exposures because its principal sources are identifiable, measurable, and potentially modifiable. Shift work, light pollution, social jetlag, irregular sleep, and mistimed eating can be assessed using actigraphy, light monitoring, chronotype instruments, and circadian biomarkers.^[2,3] Equally important, many of their upstream determinants including lighting design, workplace scheduling, school start times, and urban planning are amenable to population-level intervention.^[2] The critical question is not whether chronodisruption occurs, but what the accumulated evidence reveals about its contribution to human disease

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Figure 1. Conceptual framework illustrating how the temporal environment, as a modifiable upstream determinant of health, shapes the timing of key behavioural and environmental exposures. Persistent disruption of this temporal organization (chronodisruption) contributes to the development of multiple chronic diseases.



and population health.

Chronodisruption and Health: Current State of the Evidence

Evidence linking chronodisruption to chronic disease has expanded rapidly over the past two decades. Evidence from experimental circadian misalignment studies, prospective cohorts, systematic reviews, and umbrella reviews indicates that chronodisruption affects multiple physiological systems, although the strength of evidence varies across health outcomes.^[2,5]

The strongest evidence concerns cardiometabolic disease. Experimental studies consistently demonstrate impaired glucose metabolism, insulin sensitivity, blood pressure regulation, autonomic function, and inflammatory signalling during circadian misalignment. Importantly, although sleep restriction and shift work frequently coexist in real-world settings, experimental studies controlling for total sleep time demonstrate that

circadian misalignment independently impairs metabolic and autonomic function.^[4] Complementing these mechanistic findings, prospective cohorts and systematic reviews report increased risks of obesity, type 2 diabetes, myocardial infarction, and cardiovascular disease among long-term shift workers.^[2,4,5]

Moderately consistent evidence from systematic reviews and meta-analyses links chronodisruption to depression, anxiety, cognitive dysfunction, sleep disorders, adverse pregnancy outcomes, immune-related disorders, and gastrointestinal disorders, although the certainty of evidence varies across outcomes.^[2]

Emerging evidence also suggests possible associations with accelerated biological ageing, neurodegenerative disorders, and musculoskeletal disease, supported by growing mechanistic and observational evidence but comparatively fewer prospective epidemiological studies.^[2]

Cancer represents a more nuanced area of evidence. The most convincing human evidence concerns prolonged night-shift work, which the International Agency for Research on Cancer (IARC) has classified as probably carcinogenic to humans (Group 2A).^[6] Associations with breast cancer are the most consistently reported, whereas evidence for colorectal, prostate, endometrial, and other cancers continues to evolve.^[6]

Collectively, these findings suggest that chronodisruption functions as a systems-level exposure rather than an organ-specific risk factor. By disrupting multiple interconnected physiological processes, it may contribute to the development of a broad spectrum of chronic diseases.^[2] Important methodological limitations nevertheless remain, including heterogeneous exposure assessment, residual confounding, healthy-worker effects, and the absence of standardized metrics for chronodisruption.^[7]

Despite these limitations, the evidence has progressed well beyond hypothesis generation. The more pressing question is no longer whether chronodisruption warrants scientific investigation, but how its growing evidence base should inform public health policy and prevention.

Chronodisruption in Public Health Practice

The growing evidence linking chronodisruption with chronic disease may invite an apparently straightforward conclusion: people should sleep more regularly, reduce evening light exposure, and avoid late-night eating. Such behaviours undoubtedly matter. Yet this interpretation overlooks a fundamental principle of public health that health behaviours are rarely determined by individual choice alone. They are shaped by the environments in which people live, work, study, and interact.^[8]

Here, we use the term *temporal environment* to describe the social, occupational, technological, and physical conditions that collectively determine when people sleep, work, eat, and are exposed to light. Just as food environments influence dietary behaviour, built environments and neighbourhood design shape physical

activity, temporal environments shape the timing of health behaviours. Modern societies increasingly determine not only what people do, but also when they do it often in ways that conflict with human circadian biology.^[2]

Many of the determinants of chronodisruption lie beyond individual control. Employers determine work schedules, schools determine start times, cities influence light pollution, digital technologies extend wakefulness, and labour policies shape working hours. Consequently, chronodisruption should not be viewed solely as a matter of sleep hygiene or personal responsibility. Like other environmental health exposures, it arises largely from conditions created by institutions and policies, making it a legitimate target for population-level intervention.^[2,8]

The workplace provides perhaps the clearest example. Shift workers, healthcare professionals, emergency responders, transport personnel, and many industrial employees rarely choose when they sleep or eat. Rotating schedules, overnight duties, and unpredictable working hours impose circadian misalignment as an occupational condition rather than a personal failing.^[9]

Beyond the workplace, early school start times illustrate how institutional schedules can conflict with human biology. Adolescence is accompanied by a physiological delay in circadian timing, causing teenagers to fall asleep and wake later than younger children.^[10] Early school schedules therefore require many students to wake before their biological clock is optimally aligned for wakefulness, resulting in chronic sleep restriction and circadian misalignment.^[10] Evidence that delaying school start times improves sleep duration, daytime alertness, mental well-being, and, in some settings, academic performance and road safety has prompted organizations such as the American Academy of Paediatrics to recommend later school start times for adolescents.^[10,11] This provides a compelling example of circadian biology already informing public policy.

Urban light pollution and pervasive digital technologies similarly shape temporal environments beyond workplaces and schools, extending chronodisruptive exposures across everyday life.^[2,12]

These temporal pressures are not distributed equally across society. Individuals with the least control over their working conditions often experience the greatest chronodisruptive burden, making circadian health an issue of health equity as much as biology.^[8,9]

This perspective has important implications for public health practice. Rather than establishing entirely new programmes, circadian health can be integrated into existing health promotion, occupational health, school health, and non-communicable disease (NCD) prevention strategies. Examples include evidence-informed shift scheduling and healthier workplace lighting for night-shift workers,^[9] later school start times for adolescents,^[10,11] reducing unnecessary artificial light at night,^[12] and health promotion messages that encourage regular sleepwake schedules, morning daylight exposure, consistent meal timing, and dimmer indoor lighting during the evening.^[2] Public health

responses span the entire prevention continuum from primordial strategies that create healthier temporal environments to tertiary approaches that support circadian health as part of chronic disease management (Table 1).

Implementation, however, should remain proportionate to the evidence. Current uncertainties including heterogeneous exposure assessment, limited implementation research, and the absence of standardized measures of chronodisruption preclude sweeping recommendations.^[7] At present, chronodisruption is best regarded as an emerging environmental determinant of health whose prevention can be progressively integrated into existing public health systems while the evidence base continues to mature.

Research Priorities: From Association to Action

Research on chronodisruption has evolved from experimental chronobiology to a substantial epidemiological literature linking temporal disruption with multiple chronic diseases.^[2,7] The next challenge is no longer simply demonstrating association, but

Table 1. Illustrative public health strategies for prevention of chronodisruption across the prevention continuum.

Level	Public Health Goal	Illustrative Public Health Strategies
Primordial	Create healthier temporal environments	Evidence-informed shift scheduling policies; later school start times; reduction of artificial light at night; circadian-friendly lighting policies in workplaces and public spaces; labour policies supporting healthier working hours.
Primary	Promote circadian alignment	Regular sleepwake schedules; morning daylight exposure; consistent meal timing; health promotion to reduce evening screen exposure; dimming indoor lighting during the evening.
Secondary	Identify chronodisruption and high-risk groups	Periodic health assessment for long-term shift workers; screening for sleep disorders; cardiometabolic risk monitoring; assessment of sleep and circadian health in high-risk groups.
Tertiary	Reduce complications and improve outcomes	Incorporation of circadian health into chronic disease management; addressing sleep and circadian disruption during long-term care.

Examples are illustrative and represent current and emerging opportunities for integrating circadian health into public health practice

generating the evidence needed to translate these findings into public health policy and practice.

The first priority is measurement. Despite growing recognition of chronodisruption, heterogeneous definitions and diverse measurement approaches continue to limit comparisons across studies. Developing standardized operational definitions, validated multidimensional exposure metrics, and practical surveillance tools should therefore be a research priority rather than a methodological detail.^[7]

The second priority is causal inference. Longitudinal cohort studies and intervention trials are needed to clarify dose response relationships, interactions with established risk factors, and whether improving circadian alignment translates into meaningful reductions in chronic disease.^[7]

The third priority is implementation. Biological plausibility alone is insufficient for public health action. Policymakers require evidence that circadian-health interventions are feasible, scalable, equitable, and cost-effective. Implementation science, pragmatic trials, and health economic evaluations will therefore be essential for translating chronobiological discoveries into routine public health practice.^[13]

Finally, the evidence base must become more globally representative. Most epidemiological evidence originates from high-income countries, despite rapid urbanization, expanding 24-hour economies, and epidemiological transition in many low- and middle-income countries.^[2,13] In these settings, chronodisruptive exposures may arise under distinct social and occupational conditions, including irregular and poorly regulated shift work in informal labour sectors, increasing night-time economic activity, and occupational heat requiring adaptations of work schedules, such as moving agricultural and outdoor work to cooler evening or night hours^[14] Future research must better characterize these context-specific exposures if circadian health is to inform global public health policy.

The principal barriers to progress are no longer conceptual. They are methodological, translational, and

political. Addressing these challenges will determine whether chronobiology remains primarily a laboratory science or becomes an integral component of population health.

Conclusion

Public health has repeatedly expanded its understanding of the environmental determinants of health from infectious agents and contaminated water to tobacco smoke, air pollution, unhealthy diets, and the built environment. The convergence of epidemiological, experimental, and mechanistic evidence now suggests that another dimension deserves consideration: the temporal organization of everyday life.

Recognizing chronodisruption as an environmental exposure broadens, rather than replaces, existing risk factor frameworks by acknowledging that the health effects of light, food, physical activity, work, and sleep depend on when they occur as well as their quantity and quality.

Important uncertainties remain, and they should guide future research rather than delay thoughtful public health action. Many opportunities to promote circadian health already exist within current public health systems, requiring integration rather than reinvention.

As the global burden of chronic disease continues to rise, recognizing the temporal environment as a modifiable determinant of health may represent one of the next important opportunities for disease prevention.

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Clinical and Socio-demographic Profile of Patients Attending Anti-Retroviral Therapy Centre in a Tertiary Care Hospital in Dehradun

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Abstract:

Introduction: HIV remains a major global health challenge, with 37.7 million people living with HIV worldwide and India bearing the second-highest burden at 2.32 million PLHIV (prevalence 0.22%). Antiretroviral therapy (ART) under the National AIDS Control Organization (NACO) has transformed HIV into a manageable chronic condition, yet regional variations in patient profiles necessitate ongoing assessments for targeted interventions.

Objectives: The study aimed to identify key risk factors, common clinical presentations and potential areas for improving care and support systems to better manage the HIV epidemic in this region. **Methods:** Ethical approval was obtained from the Institutional Ethics Committee. Current cross-sectional study reviewed records of 360 HIV-positive patients registered at the ART centre from January 2021 to January 2024. Data from patients' white cards included socio-demographics (age, gender, occupation, education, residence), clinical details (WHO staging, baseline CD4 count, mode of transmission) and personal habits. Data was analysed using SPSS v 29.0 with descriptive statistics (means, frequencies) and chi-square tests ($p < 0.05$). **Results:** Males predominated (63.9%; $n=230$), mean age was 35.29 ± 12.74 years, mostly 30-40 years (35.8%). Rural residence (68.8%), married (73.9%), unemployed/homemakers (31.3%) and graduates (37.2%) were common. Sexual transmission was predominant (76%) followed by mother-to-child. Most presented at WHO Stage 1 (80.6%) with baseline CD4 ≥ 350 cells/mm³ (37.2%). **Conclusion:** Early-stage presentations reflect effective screening and ART access in Dehradun but male predominance, rural burden and behavioural risks highlight needs for gender-specific outreach, stigma reduction and prevention in productive-age groups to optimize HIV management.

Keywords: AIDS, ART, HIV, Immune system, Infections

Introduction:

The Human Immunodeficiency Virus (HIV) infection is a significant global health challenge, with approximately 37.7 million people living with HIV

worldwide.^[1] India has the second-highest HIV burden globally, with an estimated 23.19 lakh People Living with HIV (PLHIV), despite a relatively low national prevalence rate (0.22% as of 2020).^[1] Antiretroviral

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Therapy (ART) has basically changed the picture of HIV management, transforming it from a fatal diagnosis into a chronic, manageable condition. National AIDS Control Organization (NACO), provides free ART services at designated centers across the country, significantly improving access to treatment and care.^[2] Understanding the specific profiles of patients accessing these ART centers is crucial for designing and implementing targeted, effective public health interventions and support services. However, the clinical and socio-demographic profiles can vary across different regions and populations served by various ART centers. Therefore, there is a continuous need to assess the characteristics of the patient population to ensure optimal service delivery and to address specific regional challenges.

This study aims to describe the socio-demographic and clinical profile of patients attending Anti-Retroviral Therapy center in Northern India. By analyzing these profiles, the study aimed to identify key risk factors, common clinical presentations, and potential areas for improving care and support systems to better manage the HIV epidemic in this region.

Methods:

Study Type: A Record based cross-sectional study

Study setting: ART centre of a tertiary care hospital in Dehradun, providing free consultation, treatment and care for PLHIV under NACO program.

Study period: 3 years (January 2021 to January 2024)

Study Population: All patients who were HIV positive and registered at the ART Centre of a tertiary care hospital during the study period were included in the study. The patients with incomplete records like missing data on socio-demographic profile were excluded from the study which was 4 in number.

Sample Size: A total enumeration of 364 registered HIV confirmed patients was taken from January 2021 to January 2024 but due to missing data of 04 patients, sample size came out to be 360.

Data Collection Tools and Techniques

Data was collected from routine patient treatment record (white card) at ART center of a tertiary care

hospital in Dehradun. Records of 360 PLHIV of all ages attending the antiretroviral clinic were studied. The demographic information of the subjects was collected, along with the clinical profile and the treatment details. The clinical staging of HIV/AIDS was done according to the WHO clinical staging of HIV/AIDS 2005. Stage I- HIV infection is Asymptomatic and not categorized as AIDS, Stage II- includes, minor muco-cutaneous manifestations and recurrent upper respiratory tract infections and unexplained weight loss (<10% of presumed or measured body weight), Stage III- includes unexplained chronic diarrhea for longer than a month, severe bacterial infections and pulmonary tuberculosis and unexplained weight loss (>10% of presumed or measured body weight), stage IV- includes, Toxoplasmosis of the brain, Candidiasis of the esophagus, Trachea, Bronchi or lungs and Kaposi's Sarcoma; these diseases are indicators of AIDS. The functional status of the subjects was done as working, Ambulatory and bed ridden.

The information collected was divided into two main sections: In first section we have covered the sociodemographic profile like Age, Gender, Marital status, Education level, Occupation, etc. Also, in second section following parameters were covered like mode of HIV transmission, WHO clinical staging at presentation/ ART initiation, baseline CD4 count (cells/mm³) at the time of study or ART initiation.

Data Analysis

Data Entry: The data was collected by medical interns after training them and was entered into a secure database using Microsoft Excel and analyzed using Statistical Package for the Social Sciences (SPSS) version 29.0 software. Descriptive Statistics was used to summarize the data. Categorical variables (like gender, marital status) were presented as frequencies and percentages.

Ethical Considerations

Ethical approval for the study was obtained from the Institutional Ethics Committee (IEC) of Shri Guru Ram Rai Institute of Medical and Health Sciences vide letter number SGRR/IEC/05/23. Patient confidentiality was strictly maintained throughout the study; all data were

anonymized using unique study identification numbers, and no personal identifiers were recorded in the study database.

Results:

Out of the 360 HIV-positive patients enrolled, majority resided in rural areas (248, 68.8%) compared to urban areas (112, 31.2%) with a male predominance (230; 63.9%), followed by females (126; 35.0%) and transgenders (4; 1.1%). The mean age of the participants was. 35.29±12.74 years. The majority belonged to the productive age group of 30–40 years (129; 35.8%) followed by 19-29 years (102;28.3%). Participants aged

≤18 years and >60 years constituted a small proportion (24; 6.6%) and (13;3.6%) respectively.

Majority of study participants were unemployed/homemakers and students (140: 38.8%), predominantly females (83;65.8%). Service sector employees (government/private) formed the next major group (98; 27.2%), largely males (82;35.6%). Unskilled workers accounted for (66;18.3%), reflecting a sizable labor class. Businessmen class constituted (27;7.5%) of participants. Skilled and semi-skilled workers and retired individuals, formed smaller proportions.

A relatively high proportion were graduates (134;

Table 2: Socio-demographic characteristics of the study participants

Socio-demo graphic variables		Male n (%) (230; 63.9%) n (%)	Female (126; 35%) n (%)	Transgender (4; 1.1%) n (%)	Total (360;100%)
Placeof residence	Rural	174 (75.65)	70 (55.55)	4 (100)	248 (68.88)
	Urban	52 (22.60)	60 (47.61)	0(0.0)	112(31.11)
Age group	≤ 18	9 (3.9)	15 (11.9)	0 (0.0)	24 (6.6)
	19-29	72 (31.3)	29 (23.0)	1 (25.0)	102 (28.3)
	30 40	86 (37.3)	40 (31.7)	3 (75.0)	129 (35.8)
	41-51	25 (10.8)	30 (23.8)	0 (0.0)	55 (15.2)
	52-62	28 (12.1)	9 (7.1)	0 (0.0)	37 (10.2)
	> 62	10 (4.3)	3 (2.3)	0 (0.0)	13 (3.6)
Occupation	Service (Govt./ Pvt.)	82 (35.6)	16 (12.6)	0 (0.0)	98 (27.2)
	Business	23 (10.0)	3 (2.3)	1 (25.0)	27 (7.5)
	Unemployed/ Homemaker	48(20.87)	91(72.22)	1 (25.0)	140 (38.88)
	Semi skilled Worker	7 (3.04)	1 (0.79)	1 (25.00)	9 (2.5)
	Skilled Worker	13 (5.65)	0 (0.0)	0 (0.0)	13(3.61)
	Unskilled worker	50 (21.7)	15 (11.9)	1 (25.0)	66 (18.3)
	Retired	7 (3.0)	0 (0.0)	0 (0.0)	7 (1.9)
Education	Illiterate	16 (6.9)	22 (17.4)	0 (0.0)	38 (10.5)
	Primary School	30 (13.0)	23 (10.3)	1 (25.0)	54 (15.0)
	Middle School	52 (22.6)	23 (10.3)	3 (75.0)	78 (21.6)
	High School	22 (9.5)	13 (10.3)	0 (0.0)	35 (9.7)
	Intermediate	12 (5.2)	7 (5.5)	0 (0.0)	19 (5.2)
	Graduate	98 (42.6)	36 (28.5)	0 (0.0)	134 (37.2)
	Post-graduate and above	0 (0.0)	2 (1.5)	0 (0.0)	2(0.5)
Socio-economic Status (B.G.Prasd classification 2025)^[3]	Lower	88 (38.2)	85 (67.4)	0 (0.0)	173 (48.0)
	Upper Lower	0 (0.0)	3 (2.3)	0 (0.0)	3(0.8)
	Lower Middle	2 (0.8)	4 (3.1)	0 (0.0)	6 (1.6)
	Upper Middle	13 (5.6)	4 (3.1)	0 (0.0)	17 (4.7)
	Upper	127 (55.2)	30 (23.8)	4 (100.0)	161 (44.7)

37.2%), suggesting good educational attainment in the study population. Middle school education was reported by (78; 21.6%), followed by primary schooling (54; 15.0%). Illiteracy was seen in (38; 10.5%, more common among females (22; 17.4%). Very few participants were post-graduates (2; 0.5%). Participants were mainly distributed at the extremes: Lower socio-economic class (173; (48%) and Upper class (161; 44.7%). Very few belonged to upper-lower, lower-middle, or upper-middle classes (Table-1).

Most participants were married (266, 73.9%), with (94, 26.1%) being unmarried. Among the 266 married patients, the majority lived together with their spouses (243, 91.4%), while (7, 2.6%) were separated or divorced, and (16, 6.0%) were widows or widowers. Spouse's HIV status was found positive in (139; 52.3%) and (67; 25.2%) were negative while status of (60; 22.6%) of spouses was unknown. (Table 2)

Out of 360 participants, (137; 38.1%) reported alcohol consumption. Alcohol use was predominantly seen amongst males (128; 55.7%), while (7; 5.6%) were females and transgenders were (2; 50%). The majority of females (119; 94.4%) and slightly more than two-fifths of males (102; 44.3%) reported no alcohol use. Smokeless tobacco consumption was reported by (79; 21.9%) participants, exclusively among males. None of the females or transgender reported smokeless tobacco use. Overall, (281; 78.1%) participants did not consume smokeless tobacco. Most of the participants were nonsmokers (244; 67.8%). Smoking was reported by (116; 32.2%) participants. A marked male predominance was observed (109; 47.4%) for smoking. Smoking was uncommon among females (6; 4.8%) and was reported by one transgender (1; 25%). (Table 3)

Table 2: Distribution of Study participants according to marital status and their spouse's HIV status.

Factors		Number (%)
Place of Residence	Rural	248 (68.8)
	Urban	112 (31.2)
	Total	360
Marital Status	Unmarried	94 (26.1)
	Married	266 (73.9)
Living Arrangement (n = 266)	Living Together	243 (91.4)
	Separated / Divorced	07 (2.6)
	Widow/ Widower	16 (6.0)
Spouses HIV status	HIV Positive	139 (52.3)
	HIV Negative	67 (25.2)
	Unknown	60 (22.6)

Table 3: Distribution of study participants according to personal habits

Alcohol	Male (230) n (%)	Female (126) n (%)	Transgender (4) n (%)	Total (360) n (%)
Yes	128 (55.7)	7 (5.6)	2 (50)	137 (38.1)
No	102 (44.3)	119 (94.4)	2 (50)	223 (61.9)
Tobacco Smokeless				
Yes	79 (34.3)	0 (0)	0 (0)	79 (21.9)
No	151 (65.7)	126 (100)	4 (100)	281 (78.1)
Smoking				
Yes	109 (47.4)	6 (4.8)	1 (25)	116 (32.2)
No	121 (52.6)	120 (95.2)	3 (75)	244 (67.8)

The sexual route was the most common mode of transmission, reported in (275 ;76%) study participants, accounting for over three-fourths of the cases. Mother-to-child transmission was reported in (17;5%) participants, while intravenous route accounted for (13;4%) cases. Blood transfusion was the least common mode of transmission, reported by (10 ;3%) participants. Although in (45;12%) participants, mode of transmission was unknown. (Figure 1)

Based on WHO clinical staging at the time of assessment, the majority of participants were classified as Stage1 (290;80.6%). This was followed by Stage2 in (35;9.7%) participants and Stage3 in (28;7.8%) participants. Only a small proportion was in advanced disease, with Stage 4 observed in (7;1.9%) participants. At ART initiation, the largest proportion of participants had a CD4 count >350 cells/mm³ (134;37.2%), indicating relatively preserved immune status at

Figure 1: Distribution of study participants according to Mode of transmission

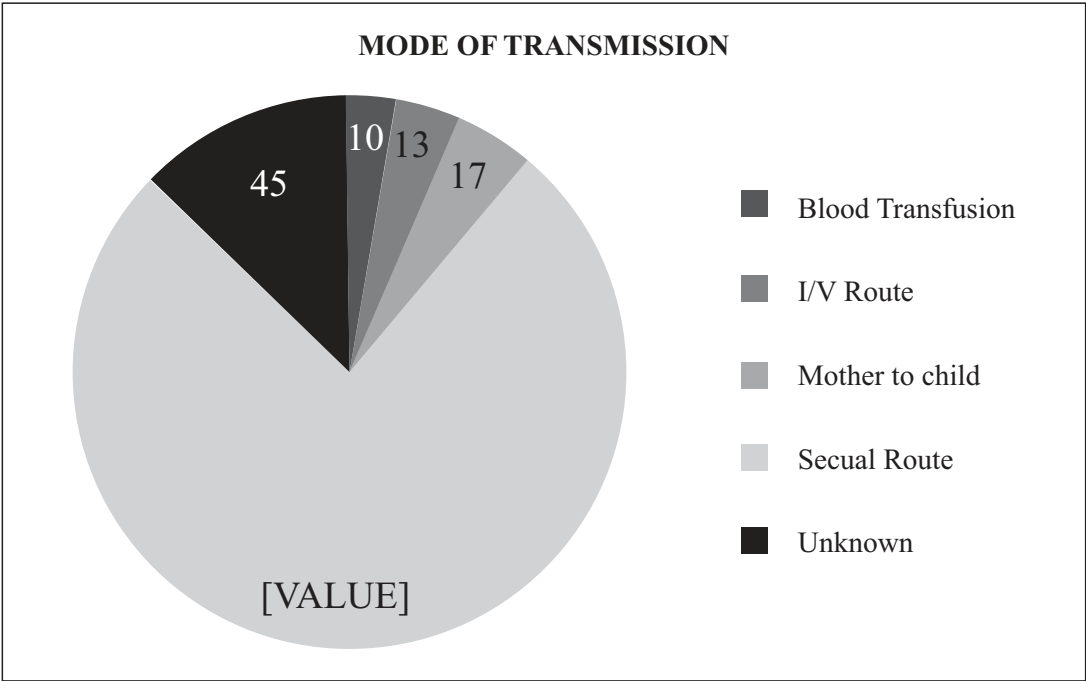


Table 4: Distribution of study participants according to clinical profile

Factors	Male (230) n (%)	Female (126) n (%)	Transgender (4) n (%)	Total (360) n (%)
WHO staging of AIDS				
Stage 1	190 (82.6)	98 (77.8)	2 (50.0)	290 (80.6)
Stage 2	21 (9.1)	12 (9.5)	2 (50.0)	35 (9.7)
Stage 3	19 (8.3)	9 (7.1)	0 (0.0)	28 (7.8)
Stage 4	5 (2.1)	2 (1.6)	0 (0.0)	7 (1.9)
CD4 count at the time of initiation of ART				
d" 50 cells/mm3	12 (5.2)	9 (7.1)	1 (25.0)	22 (6.1)
51-150 cells/mm3	39 (17.0)	18 (14.3)	0 (0.0)	57 (15.8)
151-250 cells/mm3	43 (18.7)	13 (10.3)	0 (0.0)	56 (15.6)
251-350 cells/mm3	38 (16.5)	23 (18.3)	1 (25.0)	62 (17.2)
>350 cells/mm3	86 (37.4)	46 (36.5)	2 (50.0)	134 (37.2)
Unknown	12 (5.2)	16 (12.7)	0 (0.0)	28 (7.8)

treatment start. This was followed by 251–350 cells/mm³ (62;17.2%), 51–150 cells/mm³ (57;15.8%) 151–250 cells/mm³ (56; 15.6%). Severe immunosuppression (≤ 50 cells/mm³) was noted in (22; 6.1%) participants. CD4 count data was not available for (28;7.8%) participants.

Lower CD4 counts (≤ 150 cells/mm³) were more commonly observed among males compared to females and transgender participants. However, higher CD4 counts (> 350 cells/mm³) were also predominantly seen among males, reflecting their larger representation in the study population. Transgender participants constituted a very small proportion across all CD4 categories. (Table 4)

Discussion:

The study found that substantial number of HIV patients resided in rural areas (68.8%) which suggest higher HIV's hold into rural India, aligning with national trends where rural PLHIV often outnumber urban counterparts despite lower reported prevalence, driven by migration and limited local screening. Similar findings were observed in the study done by Doshi M et al^[4] and Agarwal AK et al^[5] in Gwalior, Madhya Pradesh. However, some studies contradict the findings and show higher representation 59.5% of urban areas as study done by Naik R et al^[6] in Maharashtra and that done by Jha. A. et al^[7] in New Delhi where 69.4% participants were from urban areas

In the current study, males predominated among ART center attendees (63.9%), followed by females (35.0%) and a small proportion of transgender individuals (1.1%). This male skew aligns with national patterns reported by the National AIDS Control Organization (NACO)^[2], where males constituted about 60-65% of those registered at ART centers, reflecting higher male testing uptake and possibly greater mobility for care-seeking. The underrepresentation of females may stem from gender barriers, including stigma, household responsibilities and lower HIV awareness, as highlighted in NFHS-5 data from similar urban-rural settings^[8]. Transgender representation, though low, mirrors NACO's estimates (0.5-2%), underscoring the need for targeted outreach to this high-risk group. Similar gender pattern was reported by Singh et al.^[9] in

Punjab and Kumari et al.^[10] in Banaras UP. However studies by Tiruvaipati et al.^[11] in Guntur and Uma T et al.^[12] in Chennai, have reported near equal or high female distribution.

Majority of patients were in the productive age group of 30-40 years (35.8%), and 28.3% were aged 19-29 years, which is consistent with the epidemiological shift in India's HIV epidemic towards younger adults due to sexual route of transmission. Only 6.6% were ≥ 18 years, likely reflecting vertical transmission prevention successes via programs like Prevention of Parent-to-Child Transmission (PPTCT). Older age groups (3.6%) were minimal, possibly due to competing morbidities or late diagnosis. This distribution emphasizes the socioeconomic burden on working-age populations, informing resource allocation for adherence support and livelihood programs. Similar findings were reported by studies done by Kotoky et al.^[13] in Assam, Rajasekar et al.^[14] in Tamil Nadu, Agarwal A K et al.^[6] in Gwalior, Naik R et al.^[7] in Maharashtra.

Among the total patients attending ART centre, the majority were unemployed or homemakers (38.88%), followed by those in the service sector (27.2%) and unskilled workers (18.3%). Similar findings were seen in a study done by Kotoky et al.^[13] in Dibrugarh. Lower socioeconomic status (48%) and high illiteracy (10.5%) or primary education (15%) levels were found as vulnerabilities in ART recipients, where low education correlates with delayed presentation, ignorance and poorer adherence to ART. This reflects that high-risk behavior is more among the unemployed who usually belong to the low socioeconomic status. Similar findings were reported by Uma T et al.^[12] in Chennai, Jayarama S. et al^[15] and Safren SA et al^[16] in Chennai where the majority of the attendees had low literacy and belonged to a lower socio-economic background.

Among the patients attending ART centre, majority were married (73.9%), which underscores the heterosexual route as the most common in India. This finding is comparable to the study done by Nirmal et al^[17] in Chennai where 60% of the respondents were married, Jayarama S et al^[15] who reported that 70.3% of HIV-positive individuals were married and Joge US et al^[18]

where 78% of participants were married. The current study showed that (52.3%) had spouses who were HIV positive, which is almost double that of spouses who were HIV negative. This is similar to the studies done by Naik et al^[7] in Maharashtra where (61%) of patients had HIV-positive spouses and Balasundaram A et al^[19] in Pudducherry who reported 75% HIV positive spouses.

Tobacco smoking, smokeless and alcohol consumption was found to be 32.2%, 21.9%, and 38.1% respectively in the present study. Similarly, Palanisamy et al^[20] in their study reported 40% use of tobacco and alcohol amongst PLHIV. Almost similar finding for tobacco smoking and smokeless tobacco was reported by Naik et al^[7] although their findings differ with alcohol use. However, in a study by Uma T^[12] 68% PLHIV were having at least any one of the habits, like alcohol, smoking and intravenous drug usage. 27% prevalence of tobacco use among men was reported by Mdege et al^[21] who collected data from 28 low-income and middle-income countries.

The present study revealed that 80.6% PLHIV were in stage 1 at the initiation of ART followed by stage 2,3 and 4. So, overall, most individuals were diagnosed and/or initiated treatment during the early stages of HIV disease. This finding is consistent with the findings of Kumawat S. et al.^[22] in Rajasthan but is different from the study by Nayak, et al^[23] who reported only 13.72% patients in stage 1.

The current study reveals sexual route as the most common mode of transmission of HIV and in 4% cases, route of transmission was intravenous. Almost similar finding (70.5%) was reported by Kumari et al.^[10] as the predominant mode of transmission and 3.4% as intravenous transmission. Where as in the study by Baghel et al.^[24] heterosexual route being the commonest mode of transmission contributed to approximately 82%.

The CD4 count is one of the most reliable investigations for clinical staging of patients and used to make decisions on treatment initiation. In the current study highest proportion of participants had a CD4 count >350 cells/mm³ (134;37.2%), indicating relatively

preserved immune status at treatment start which is similar to findings of Sonani et al^[25] from Surat. Severe immunosuppression (≤ 50 cells/mm³) was noted in (22; 6.1%) participants. However, the findings are in contrast to the findings by Kumari et al^[10].

Limitation: The study is based on only one site that restricts the applicability of the findings to broader populations.

Conclusions:

This study describes a predominantly male (63.9%), rural (68.8%), productive-age (30-40 years) population attending the Dehradun ART centre, with sexual transmission (76%) and early HIV presentations (WHO Stage 1: 80.6%). These profiles confirm effective NACO-supported early diagnosis and ART access in Northern India, addressing the objective of characterizing regional patient characteristics for targeted interventions. The findings highlight needs for gender-sensitive outreach, stigma reduction in rural areas, and prevention amid high-risk behaviours, informing policy makers to optimize HIV care and curb transmission. Future multi-centre studies could enhance generalizability and assess long-term outcomes.

Recommendation: Based on the study findings, there should be enhanced gender-specific outreach programs targeting females and transgender individuals (1.1% representation) through community awareness campaigns to overcome stigma and improve ART centre attendance, given male predominance (63.9%). Strengthening of rural HIV screening and linkage-to-care initiatives, as 68.8% of patients were rural, to sustain early presentations (WHO Stage 1: 80.6%) and leverage NACO services effectively. Integration of behavioural counselling for high-risk habits (alcohol 38.1%, smoking 32.2%, predominantly males) within ART protocols should be there to boost adherence and reduce transmission risks in productive-age groups (35.8% aged 30-40 years). Prospective multi-centre studies across Northern India should be conducted to validate findings and evaluate long-term CD4 trends and adherence, addressing single-site limitations.

Declaration:

Conflict of Interest: NIL

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Musculoskeletal Comorbidities and Physical Activity Patterns in Adults Aged 50 Years and Above with Acute Low Back Pain in Rural Goa

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Abstract:

Introduction: Low back pain (LBP) is a leading cause of disability worldwide and particularly burdensome among older adults, who often have multiple musculoskeletal complaints and low physical activity levels. **Objectives:** To describe the demographic profile, musculoskeletal comorbidities, body mass index (BMI) and physical activity patterns among adults aged 50 years and above with acute LBP attending Rural Health & Training Centre (RHTC) in Goa, and to explore differences by gender and age group. **Methods:** A hospital-based cross-sectional descriptive study was conducted among 150 consecutively recruited participants using convenience sampling attending an acute low back pain screening camp at RHTC Mandur, Goa. Sociodemographic data, BMI, comorbid musculoskeletal pain and physical activity were recorded using a structured proforma & standard scales. Descriptive statistics (means with standard deviations, frequencies and percentages) and gender and age-stratified distributions were generated. **Results:** The mean age was 64.3 years (SD 9.15; range 51–87), and 55.3% were female; 58.7% were older than 60 years. Comorbid musculoskeletal complaints were frequent: knee pain (24.7%), hip pain (19.3%), shoulder pain (17.3%), ankle pain (13.3%) and generalised body pain (12.7%). Joint-specific pains commonly coexisted with LBP, with modest variation by gender. **Conclusion:** Among adults aged ≥50 years attending a rural screening camp with acute LBP, females and those over 60 years predominated, with high levels of multi-site musculoskeletal pain and suboptimal physical activity. These findings highlight the need for early identification and comprehensive management of musculoskeletal complaints, alongside counselling on appropriate activity levels, to reduce LBP-related functional limitations in rural clinic populations.

Keywords: Exercise, Low back pain, Musculoskeletal Diseases, Rural Health

Introduction:

Low back pain (LBP) is a leading cause of disability worldwide and affects individuals across all age groups. Musculoskeletal conditions, including LBP, contribute substantially to years lived with disability and impose a

considerable economic burden on individuals, families, health systems and society.^[1]

Epidemiological studies have consistently highlighted gender differences in the prevalence and impact of LBP, with women frequently reporting higher prevalence and

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greater disability compared to men. Comorbidities and psychosocial factors are also often more common among women with LBP, which may further influence symptom severity and care-seeking behaviour.^[2]

Although low back pain (LBP) has been extensively studied worldwide, most available evidence originates from high-income countries or urban populations. Recent global estimates indicate that LBP remains the leading cause of years lived with disability, with its burden expected to increase substantially due to population ageing and demographic changes.^[3] In India, systematic reviews have demonstrated a considerable prevalence of LBP across different population groups; however, most studies have focused on occupational risk factors or the overall prevalence of LBP rather than the coexistence of musculoskeletal comorbidities among older adults. Furthermore, evidence describing physical activity patterns and associated musculoskeletal conditions in rural primary healthcare settings is limited.^[4]

Several factors have been hypothesised to influence the occurrence and severity of LBP, including age, gender, BMI, occupational exposures and physical activity patterns. Very low levels of activity and prolonged sedentary behaviour can contribute to deconditioning, poor posture and stiffness, whereas high levels of heavy or repetitive physical work can also provoke or exacerbate back pain. Musculoskeletal comorbidities affecting the knee, hip, ankle and shoulder joints may coexist with LBP, reflecting shared biomechanical loads or degenerative processes, and may compound functional limitations.^[5]

Understanding the profile of older adults with acute LBP who seek care in rural health facilities is important for planning targeted preventive and rehabilitative strategies. In particular, documenting coexisting joint pains and physical activity patterns can inform comprehensive management approaches that go beyond isolated treatment of the lumbar spine.

Despite the high burden of low back pain among older adults, there is limited evidence from rural primary care settings in India—particularly from Goa—describing the coexistence of musculoskeletal

comorbidities, body mass index, and physical activity patterns among adults aged 50 years and above presenting with acute low back pain. This study was therefore undertaken to address this important knowledge gap and provide evidence to support comprehensive musculoskeletal care in rural health settings.

Materials and Methods

Study setting and design

This was a cross-sectional descriptive study conducted at the Rural Health & Training Centre (RHTC), Mandur, Goa. Data was collected during an acute LBP screening camp organised at the centre.

Study population and Eligibility criteria

The study population comprised adults aged **50 years and above** who attended the acute low back pain (LBP) screening camp conducted at the Rural Health & Training Centre (RHTC), Mandur, Goa, and were clinically diagnosed with acute LBP. Acute LBP was defined as pain localized between the lower rib margin and the gluteal folds, with or without leg pain, of **up to six weeks' duration**. Participants who provided written informed consent were included in the study. Individuals with chronic LBP (pain lasting more than three months) or specific spinal pathologies such as malignancy, spinal infection, or recent spinal trauma, as well as those who declined to provide informed consent, were excluded.

Sample size and Sampling technique

Since this was a camp-based cross-sectional descriptive study, a formal sample size calculation was not performed. All consecutive eligible adults aged 50 years and above with acute low back pain who attended the screening camp during the study period and fulfilled the eligibility criteria were invited to participate. A total of 150 participants were enrolled using consecutive (total enumerative) sampling.

Data collection tools and variables

Data was collected using a structured case record form and two standardised questionnaires: the International Physical Activity Questionnaire (IPAQ)^[6] and the Musculoskeletal Health Questionnaire (MSK-HQ)^[7]. Sociodemographic details (age, gender),

anthropometric measurements (weight, height for BMI calculation)^[8] and clinical information on LBP and other joint pains (knee, hip, ankle, shoulder, generalised body pain) were recorded.

According to WHO standard cutoffs, BMI was classified as underweight (<18.5), normal (18.5–24.9), overweight (25–29.9), and obese (≥30). The IPAQ was used to classify physical activity into vigorous, moderate, mild and no activity (sedentary) based on self-reported duration and intensity of activities in a typical week. The MSK-HQ was used to capture musculoskeletal symptoms and their impact on function; for the present analysis we report primarily the presence of joint-specific pain and generalised body pain.

Statistical analysis

All data were coded and analysed using IBM SPSS Statistics version 22. Continuous variables such as age were summarised as mean and standard deviation (SD), and categorical variables such as gender, BMI category, joint-specific pain and physical activity categories were

summarised as frequencies and percentages. To explore differences by gender and age group, the chi-square test as appropriate, was used for categorical variables, and the independent-samples t-test was used for comparison of mean age between groups. A p-value of less than 0.05 was considered statistically significant.

Ethical considerations

The study protocol was reviewed and approved by the Institutional Ethics Committee. All participants provided written informed consent prior to enrolment. The study adhered to the principles of the Declaration of Helsinki.

Results

Table 1 shows the characteristics of the 150 adults aged 50 years and above presenting with acute low back pain (LBP). The mean age of the study participants was 64.3 years (SD 9.15), with a median of 63.0 years and an age range of 51–87 years, and nearly three-fifths of participants were older than 60 years (58.7%). Females constituted a slight majority (55.3%), and more than half

Table 1: Distribution of study participants according to sociodemographic and clinical characteristics (N = 150).

Characteristic	Category	n	%
Age (years)	Mean ± SD	64.3 ± 9.15	–
	Median (IQR)	63.0	–
	Range	51–87	–
Age group	50–60 years	62	41.3
	>60 years	88	58.7
Gender	Female	83	55.3
	Male	67	44.7
Body mass index (BMI)	Underweight	35	23.3
	Normal	85	56.7
	Overweight	18	12.0
	Obese	12	8.0
Low back pain comorbidities	LBP only	33	22.0
	Generalised body pain	19	12.7
	Knee pain + LBP	17	11.3
	Shoulder pain + LBP	16	10.7
	Hip pain + LBP	12	8.0
	Rheumatoid arthritis + LBP	9	6.0
	Other combinations	63	42.0

Abbreviations: BMI = Body Mass Index; IQR = Interquartile Range; LBP = Low Back Pain; SD = Standard Deviation.

Table 2: Association between gender and musculoskeletal pain among study participants (N = 150).

Pain site	Female, n (%)	Male, n (%)	Total, n (%)	χ^2	p-value
Ankle pain	10 (12.0)	10 (14.9)	20 (13.3)	0.27	0.606
Hip pain	17 (20.5)	12 (17.9)	29 (19.3)	0.16	0.692
Shoulder pain	12 (14.5)	14 (20.9)	26 (17.3)	1.07	0.300
Generalised body pain	10 (12.0)	9 (13.4)	19 (12.7)	0.06	0.800
Knee pain	15 (18.1)	22 (32.8)	37 (24.7)	4.35	0.037*
Total participants	83 (55.3)	67 (44.7)	150 (100.0)	—	—

Abbreviation: χ^2 = Chi-square test.

Statistically significant at $p < 0.05$.

Table 3: Association between gender and physical activity level among study participants (N = 150).

Physical activity level	Female, n (%)	Male, n (%)	Total, n (%)	χ^2	p-value
Vigorous	19 (22.9)	11 (16.4)	30 (20.0)		
Moderate	14 (16.9)	15 (22.4)	29 (19.3)		
Mild	50 (60.2)	41 (61.2)	91 (60.7)		
Total	83 (100.0)	67 (100.0)	150 (100.0)	0.95	0.622

χ^2 = Chi-square test.

of the sample had a normal BMI (56.7%), while 23.3% were underweight and 20.0% were either overweight or obese.

Table 1 also summarises the distribution of LBP comorbidities, indicating a substantial burden of multi-site musculoskeletal pain. Only 22.0% of participants reported LBP alone, whereas the remainder had additional complaints such as generalised body pain (12.7%), knee pain with LBP (11.3%), shoulder pain with LBP (10.7%), hip pain with LBP (8.0%) and rheumatoid arthritis with LBP (6.0%), with other combinations accounting for a further 42.0% of cases.

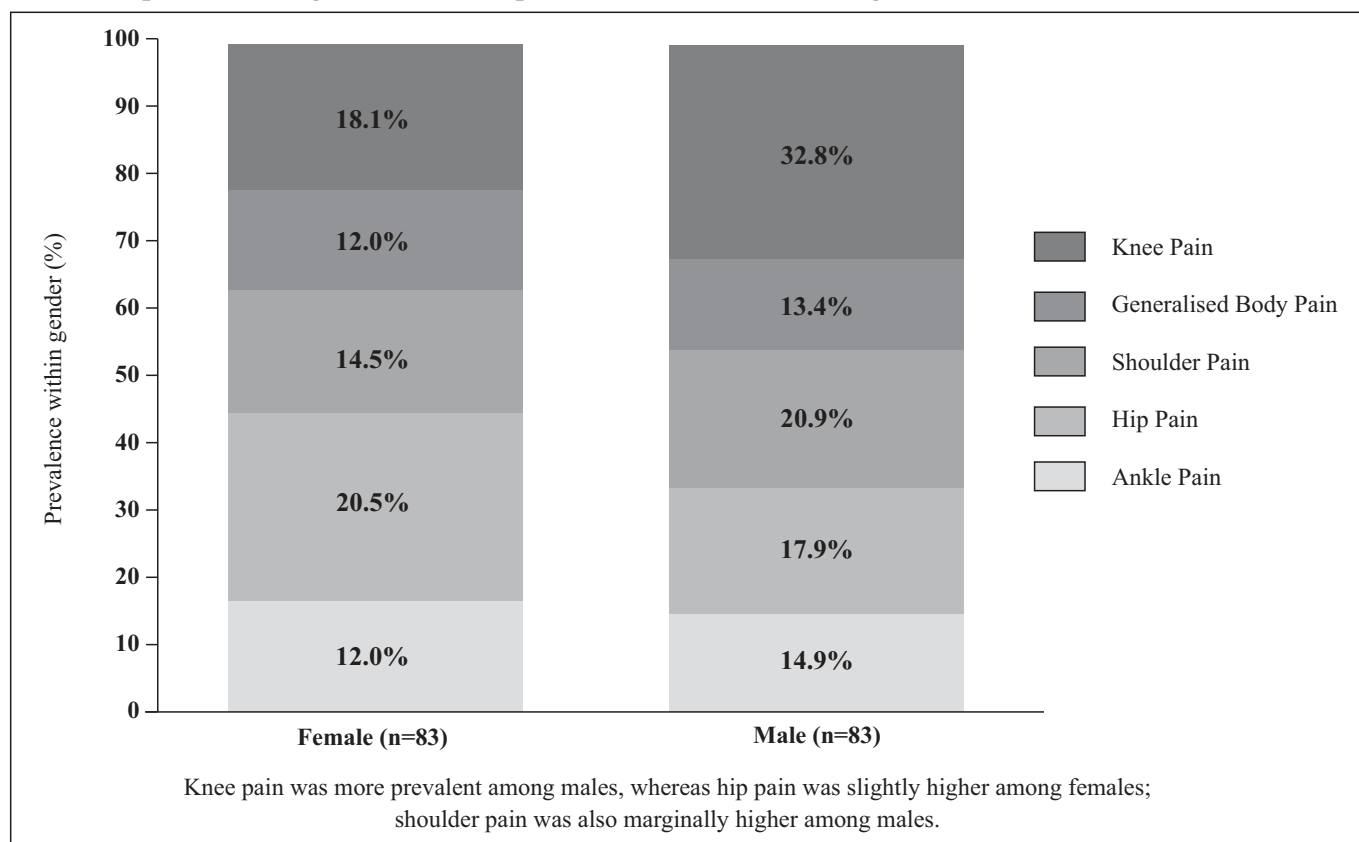
Table 2 presents musculoskeletal pain by gender. Ankle pain was reported by 13.3% of participants, with no significant difference between females and males ($p=0.606$). Hip pain was present in 19.3% of participants and was also not significantly different by gender ($p=0.692$). Shoulder pain showed no significant gender difference ($p=0.300$), and generalised body pain was

similarly distributed between females and males ($p = 0.800$). Knee pain was the most frequent joint-specific complaint and was significantly more common in males than females (32.8% vs 18.1%; $p=0.037$).

Table 3 shows that most participants were **mildly active** (91/150, 60.7%), followed by vigorous activity (30/150, 20.0%) and moderate activity (29/150, 19.3%). Among females, 60.2% were mildly active, 22.9% reported vigorous activity, and 16.9% reported moderate activity; the corresponding proportions among males were 61.2%, 16.4%, and 22.4%, respectively.

Figure 1 shows the gender stratified prevalence of ankle, hip, shoulder, generalised body and knee pain, expressed as percentages within each gender. Among females, hip pain and knee pain are the most frequent complaints (around one-fifth of women), whereas among males, knee pain is clearly dominant, affecting nearly one-third of men, followed by shoulder and hip pain at lower but still substantial levels.

Figure 1.: Gender-wise distribution of musculoskeletal pain among adults aged ≥ 50 years with acute low back pain attending the health camp at Rural Health & Training Centre, Goa



Discussion

The present study demonstrated that acute low back pain predominantly affected older adults, with nearly three-fifths of participants aged above 60 years. Similar findings have been reported by **Shetty et al.**, whose systematic review and meta-analysis demonstrated that the prevalence of low back pain increases progressively with advancing age because of degenerative spinal changes and cumulative biomechanical stress.^[9] Likewise, **Tiwari et al.**, using nationally representative LASI data, reported significantly higher prevalence of musculoskeletal disorders among adults aged 60 years and above, supporting the age distribution observed in the present study.^[10] A slight female predominance was observed in the present study, which is consistent with the findings of **Shetty et al.**, who reported higher prevalence of low back pain among women across Indian studies.^[9] Similarly, **Sharma et al.** demonstrated that older Indian women had significantly higher odds of experiencing back pain and multisite musculoskeletal

pain than men, highlighting the influence of biological and social factors on musculoskeletal health.^[9]

An important observation of the present study was the high burden of multisite musculoskeletal pain, with only 22% of participants presenting with isolated low back pain. Similar findings were reported by **Muthunarayanan et al.**, who observed that low back pain among elderly individuals in rural Tamil Nadu commonly coexisted with knee pain, hip pain, and other musculoskeletal disorders.^[11] Likewise, **Tiwari et al.** reported that musculoskeletal disorders among older Indian adults frequently occur concurrently rather than in isolation. These findings suggest that elderly patients presenting with acute low back pain should undergo comprehensive musculoskeletal evaluation rather than assessment focused solely on the lumbar spine, thereby facilitating early diagnosis of associated joint disorders and improving overall functional outcomes.^[10]

Knee pain was the most frequent musculoskeletal comorbidity among older adults with acute low back

pain, whereas ankle pain, hip pain, shoulder pain, and generalized body pain showed no significant gender differences. Similar findings were reported by **Mohanty et al.**, who observed that lower-limb musculoskeletal pain among older adults in India was predominantly knee pain, while hip pain was comparatively less frequent. They also reported that the burden of pain increased with advancing age, indicating that degenerative musculoskeletal disorders are primarily age-related.^[12] Similar findings were reported by Chard et al., who observed that shoulder disorders were common among community-dwelling older adults. Although women had a somewhat higher prevalence than men, shoulder pain represented an important musculoskeletal complaint in both genders.^[13] Comparable findings were reported from the Longitudinal Ageing Study in India, where ankle/foot pain constituted a smaller proportion of musculoskeletal complaints than joint pain among middle-aged and older adults.^[14]

In the present study, knee pain was significantly more common among males than females. This finding contrasts with the study by **Sengupta et al.**, who reported that knee pain was the most common musculoskeletal complaint among older adults in rural West Bengal and was more frequently observed among women. The higher prevalence among males in the present study may be attributed to greater occupational exposure to physically demanding activities such as farming, prolonged standing, squatting, and manual labour.^[15] Furthermore, reports from the **National Programme for Health Care of the Elderly** have consistently identified knee osteoarthritis as one of the leading musculoskeletal conditions among older Indians, emphasizing that knee pain commonly coexists with low back pain and should be routinely assessed during clinical evaluation.^[16]

In the study majority of older adults with acute low back pain were mildly physically active, whereas fewer participants engaged in moderate or vigorous physical activity. Similar findings were reported by **Gupta et al.**, who observed that light-to-moderate activity predominated among older adults in Delhi, with advancing age and musculoskeletal pain limiting

participation in higher-intensity activities.^[17] Likewise, the **ICMR-INDIAB study** conducted by **Anjana et al.** demonstrated that physical inactivity is highly prevalent among Indian adults, with only a small proportion participating in vigorous physical activity.^[18] Similar findings have been reported by **Stubbs et al.**, who demonstrated that older adults with chronic musculoskeletal pain, particularly chronic low back pain, were significantly less physically active than those without pain. Chronic pain was associated with reduced participation in moderate and vigorous physical activities, which may explain the predominance of mild physical activity observed in the present study.^[19]

No significant gender differences in overall physical activity were observed in the present study. A similar pattern was reported by Lee, who found that although older women participated more in household activities and men engaged more in leisure-time physical activity, differences in overall activity reflected the type of activity performed rather than marked disparities in total physical activity.^[20] Furthermore, **Stubbs et al.** reported that pain-related fear of movement and functional limitations often reduce participation in moderate and vigorous exercise among individuals with low back pain, resulting in reliance on light daily activities.^[19] In view of the **World Health Organization** recommendations for regular moderate-to-vigorous physical activity among older adults, the present findings highlight the importance of incorporating structured exercise and physiotherapy into the management of acute low back pain to improve functional capacity and reduce future disability.^[20]

Acute low back pain in this rural Goa clinic sample is largely a problem of older adults, with the majority clustered between 60 and 70 years and relatively few participants at the youngest and oldest ends of the spectrum. This finding is consistent with the systematic review by **de Souza et al.**, which reported that low back pain is highly prevalent among adults aged 60 years and above and is frequently associated with functional disability and reduced independence.^[21] Similarly, the systematic review and meta-analysis by **Shetty et al.** demonstrated that the burden of low back pain in India

increases with advancing age, with the highest prevalence observed among older adults, particularly women and rural populations. The authors attributed this pattern to age-related degenerative spinal changes, cumulative occupational exposure, and declining musculoskeletal function.^[9]

Furthermore, **Bayartai et al.** showed that frailty is closely associated with greater low back pain intensity and disability among community-dwelling older adults, highlighting the need to incorporate frailty assessment into routine clinical evaluation.^[22] Similarly, **Wong et al.** emphasized that older adults with low back pain often experience age-related functional decline, sarcopenia, and reduced mobility, necessitating a comprehensive geriatric approach rather than symptom-focused management alone.^[23]

Multisite musculoskeletal pain was common among older adults with acute low back pain, with knee pain being the most frequent associated complaint. Similar findings were reported by **Goyal and Mohanty**, who analysed data from the Longitudinal Ageing Study in India (LASI) and found that joint pain, back pain, and lower-limb pain commonly coexisted among middle-aged and older adults. Although their study reported a higher prevalence of multisite pain among females, the present study observed significantly higher knee pain among males, possibly reflecting differences in the study population and occupational characteristics. These findings highlight the importance of comprehensive musculoskeletal assessment in older adults with low back pain.^[14]

Limitations

This study has some limitations. First, its cross-sectional design captures information at a single point in time and does not allow conclusions about causality or the temporal sequence between LBP and musculoskeletal comorbidities. Second, the use of convenience sampling at a single Rural Health & Training Centre limits the generalisability of the findings to other settings, including urban populations or other regions.

Third, data on physical activity and pain symptoms were self-reported using the IPAQ and MSK-HQ, and are therefore subject to recall and reporting biases. Objective measures of activity (e.g., accelerometry) and clinical assessments of joint pathology were not available. Fourth, the sample size, although adequate for a descriptive exploration, may not be sufficient to detect small differences between subgroups.

Fifth, several potentially important confounding factors such as occupation type, psychosocial stress, duration and severity of pain, and medication use were not fully captured and could not be examined in detail. Finally, the focus on acute LBP means that chronic and recurrent pain patterns were not addressed, and longitudinal outcomes could not be assessed.

Conclusion

In this cross-sectional descriptive study of adults aged 50 years and above attending a Rural Health & Training Centre in Goa with acute LBP, females and individuals older than 60 years formed the majority of clinic attendees. Comorbid musculoskeletal complaints, particularly involving the knee, hip, ankle and shoulder, were common, and a substantial proportion of participants had either low or no reported physical activity.

These findings highlight the importance of early identification and comprehensive management of musculoskeletal health in older adults with acute LBP in rural settings. Integrating assessment of multi-site pain, BMI and physical activity patterns into routine care, along with patient education on appropriate activity and ergonomics, may help reduce functional limitations and the longer-term burden associated with LBP.

Recommendations

Based on the high proportion of older adults with acute low back pain who also reported musculoskeletal complaints involving the knee, hip, ankle and shoulder, routine clinical assessment at Rural Health & Training Centres should include screening for pain at these commonly affected sites. Early identification of coexisting musculoskeletal complaints may facilitate comprehensive management and appropriate referral for physiotherapy or specialist care when indicated.

As a considerable proportion of participants reported low or no physical activity, routine assessment of physical activity status should be incorporated into the clinical evaluation of older adults presenting with acute low back pain. Individualised counselling on maintaining regular, moderate physical activity appropriate for age and functional status may help improve musculoskeletal health and reduce functional limitations.

Further longitudinal and community-based studies involving larger and more representative rural populations are recommended to better understand the temporal relationship between physical activity, body mass index, coexisting musculoskeletal complaints and acute low back pain, and to evaluate interventions aimed at improving musculoskeletal health in older adults.

Declaration

Conflict of Interest

The authors declare that there is no conflict of interest related to this study.

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Use of AI

All data analysis, interpretation of results and final approval of the content were performed by the authors, who take full responsibility for the integrity and accuracy of the work.writing.

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Bridging the Gap: Foot Care Practices and Diabetic Foot Risk Among Patients with Diabetes Attending an NCD Clinic in Chennai - A Cross-Sectional Study

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Abstract:

Background: Diabetic foot complications are a major cause of morbidity among patients with diabetes and are preventable through appropriate foot care practices. Early risk identification and foot care assessment helpsto prevent diabetic foot complications. **Methods:** A cross-sectional study was conducted among patients with diabetes who were attending the Non-Communicable Disease (NCD) clinic of a tertiary care hospital in Chennai over a period of two months. Data were collected using an interviewer-guided questionnaire. Foot risk assessment and Foot practices was assessed using the 60-Second Foot Screening Tool and a validated structured questionnaire. Statistical analysis included the fisher test for association and the ANOVA for comparison of means. **Results:** Among the 175 participants with diabetes, 52.5% were classified as Category-0, 16.5% as Category-1, 14.2% as Category-2, and 16.5% as Category-3 foot risk. Overall, 38.6% demonstrated good foot care practices, 42.0% had moderate practices and 19.4% had poor practices. A significant association was observed between the duration of diabetes and foot risk category($p < 0.001$). Duration of diabetes was also significantly associated with foot care practices($p = 0.001$). **Conclusion:** According to the outcomes, the frequency of diabetic foot complications amongst the patients with diabetes is extremely high and linked to many controllable factors, such as inadequate foot hygiene, inappropriate glycemic control in the body, inappropriate footwear and barefoot walking.

Keywords: Diabetic Foot Problems, Foot Care Practices, 60 Second Foot Screening Tool, Barriers to Good Foot Care Practice

Introduction:

Diabetes is one of the biggest health problems in the world, affecting more than 500 million adults. The International Diabetes Federation (IDF) says that 8.8% of adults have diabetes. According to the most recent numbers, 463 million people around the world have diabetes, and 374 million are prediabetic. By 2045, this number is expected to rise to 700 million people with diabetes and 548 million people with Impaired Glucose Tolerance, a 51% rise from 2019^[1].

India has the most diabetes cases in the world, with 77 million in 2019. By 2023, this number is expected to rise to 100 million, which is one-fifth of the global burden. This increased prevalence is due to rapid urbanisation and socioeconomic and dietary pattern modifications^[2]. Though diabetes has stabilised in some developed states, it continues to increase in many regions, highlighting the need for state-specific policies and interventions to control the growing burden of diabetes^[3]. Statistics show a higher prevalence in urban

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populations (20–30%) than in rural populations, due to sedentary lifestyles and consumption of processed foods^[4].

Diabetic foot ulcer (DFU) is a complication of diabetes, with a lifetime risk of 15–25% among diabetic patients^[5]. Foot ulcers can lead to lower extremity amputations in up to 85% of cases. This causes substantial morbidity due to repeated infections, prolonged hospital stays, and high mortality rates, exceeding 50% within 5 years after major amputation^[6]. These ulcers also reduce quality of life through pain, limited mobility, social isolation and psychological distress^[7]. They remain the leading cause of non-traumatic lower-limb amputations^[8].

The development of diabetic foot complications occurs due to neuropathy, peripheral arterial disease and biomechanical abnormalities that predispose the foot to injury, infection, delayed healing and lower-limb amputation^[9]. Loss of protective sensation due to neuropathy leads to repeated unnoticed trauma, while autonomic dysfunction causes skin dryness and fissuring that facilitate ulcer formation. Vascular insufficiency increases ischemia and delays wound healing^[10].

India bears a disproportionately high burden of diabetic foot disease owing to its large population of individuals with diabetes and socioeconomic challenges. Approximately 15–25% of individuals with diabetes develop a DFU during their lifetime, of whom nearly 50% develop infections requiring hospitalization and about 20% undergo lower-limb amputation^[11]. This high burden is mainly driven by delayed diagnosis, poor glycemic control, and socioeconomic factors. Factors like low literacy, financial constraints, barefoot practices and inappropriate footwear increase the risk of foot trauma and ulceration. Despite improved healthcare strategies, several barriers prevent good foot care practices, particularly in lower-income settings. Lack of awareness regarding regular foot examination and preventive foot care leads many patients to seek medical attention only after symptoms appear. Cultural practices such as walking barefoot during temple visits or religious rituals may increase the risk of foot injuries

among individuals with diabetic neuropathy. Occupational exposures such as construction work, prolonged standing, and wet work may also cause repeated minor trauma and infections affecting the feet^[12].

Financial constraints limit access to appropriate footwear and regular medical care, leading to delayed treatment. Difficulty accessing specialised foot care services, long travel distances, and the need for multiple hospital visits may discourage timely care. Social dependency on family members and misunderstanding of medical instructions regarding foot care practices may also contribute to poor adherence to preventive measures. Understanding these barriers is essential for developing interventions to improve foot care practices and reduce diabetic foot complications^[13]. Despite recommendations for annual foot examination, newly diagnosed patients often receive limited counselling regarding foot care, and preventive practices are frequently initiated only after complications occur^[12].

Despite awareness of diabetic foot conditions among diabetes patients, a gap still exists between knowledge and foot care practices. Hospital-based studies in India show that although 69% of diabetic patients have adequate awareness, only 41.6% practice appropriate foot care, such as daily self-foot examinations and proper nail hygiene. This difference results from poor self-management behaviours, educational challenges, and limited counselling during clinical visits^[13].

Objectives:

1. To describe the clinical profile of adult patients with diabetes attending the NCD clinic and to determine the association between various factors and diabetic foot risk.
2. To classify participants according to diabetic foot risk using the 60-Second Diabetic Foot Screening Tool.
3. To assess foot self-care practices using a validated foot care questionnaire.

Methodology

Study setting

A cross-sectional study was designed to assess foot care practices and evaluate the risk of diabetic foot problems among adult patients with diagnosed diabetes attending the Non-Communicable Disease (NCD) Clinic of a tertiary care teaching hospital in Chennai, Tamil Nadu, India.

Sample size

For the sample size in this research, the formula used was $N = Z^2 pq / d^2$, based on George H et al., the estimated prevalence rate of good footcare practice was 67%^[14]. With the confidence interval at 95% ($Z=1.96$) and allowable error set at 7%, the calculated sample size was 175 subjects. Sampling was done consecutively, whereby all diabetic patients attending the OPD were included until the desired sample size was met.

Study population

Inclusion criteria: Participants aged 18 years and above who were diagnosed with diabetes, were receiving treatment and were willing to provide written informed consent.

Exclusion criteria: Diabetic foot problems are uncommon in children and are predominantly associated with Type 1 diabetes, where foot care is generally managed by caregivers^[15,16]. Participants with gestational diabetes, steroid-induced diabetes, recently diagnosed diabetes at the time of the interview, severe mental retardation, critical illness, or inability to walk due to causes other than diabetes were also excluded from the study.

Questionnaire and data collection

Data collection started after obtaining approval from the Institutional Ethics Committee. After explaining the study protocol, written informed consent was obtained from all participants. Data were collected using a pre-tested semi-structured questionnaire adapted from previously validated tools used in community-based studies assessing diabetic foot care practices^[17]. Face-to-face interviews and clinical examinations were conducted to obtain information.

The questionnaire consisted of five sections and 38 questions covering demographic details, clinical characteristics of diabetes, foot screening using a standardised clinical tool, foot care practices, and barriers to foot care practices.

Data on age, sex, duration of diabetes, mode of therapy, fasting capillary blood glucose, smoking habit, and alcohol intake were obtained. Duration of diabetes was categorised as <1 year, 1– <5 years, 5– <10 years, and >10 years. Smoking habit was classified as active smokers, passive smokers, and never smokers according to the definitions of the Centres for Disease Control and Prevention^[18]. Alcohol intake was classified as current drinker, ex-drinker, and abstainer according to World Health Organisation definitions^[19].

Clinical examination of the feet was performed using the 60-Second Diabetic Foot Screen Tool, a validated screening instrument for categorising foot problems^[24]. The tool assesses parameters such as skin status, nail status, presence of callus or ulceration, foot deformities, loss of protective sensation, vascular status, and type of footwear.

Peripheral neuropathy was assessed using a 10g monofilament test to detect loss of protective sensation^[15]. Sensory testing was performed at standard plantar sites, and absence of sensation at one or more sites was considered indicative of loss of protective sensation.

Vascular status was assessed by palpation of pedal pulses. Additional features such as dependent rubor, cool feet, hallux mobility, deformities including Charcot changes or hammertoes, and type of footwear were noted. The presence of comorbidities such as retinopathy, nephropathy, cardiovascular disease, peripheral arterial disease, and smoking was also recorded as these are risk factors for diabetic foot complications^[17].

Foot care practices were assessed using a pre-validated 15-item semi-structured questionnaire adapted from previously published studies^[17]. The questionnaire evaluated practices such as daily foot inspection, drying between toes, footwear habits, nail care practices, inspection of footwear before use, avoidance of barefoot walking, use of moisturisers, avoidance of sharp

instruments for callus removal, and protection from extreme temperatures, with a maximum score of 15.

Participants were also asked to identify barriers to appropriate foot care practices using a checklist including lack of awareness regarding foot care, religious or cultural practices such as barefoot walking, occupational exposures, financial constraints affecting footwear purchase, difficulty accessing specialised foot care facilities, time constraints due to multiple hospital visits, dependence on family members for healthcare access, and misunderstanding of foot care instructions [21,22].

Following data collection and clinical examination, all participants were provided brief health education on appropriate diabetic foot care practices, including daily inspection, proper hygiene, and use of appropriate footwear, in line with standard diabetes care recommendations.

Statistical analysis

The data from the questionnaire were entered into Microsoft Excel 2020. All data were analysed and assigned binary scoring. Duration of diabetes, smoking, and alcohol consumption were categorised using a predefined scoring system.

Foot condition was assessed using the 60-Second Diabetic Foot Screening Tool. Parameters such as loss of protective sensation (LOPS), peripheral arterial disease (PAD), and foot deformity were scored, and the average of assigned scores was calculated for each parameter. These were converted into binary variables, where a score of more than 50% was considered “present” (1) and less than 50% as “absent” (0). Other clinical parameters included history of ulcer, active ulcer, prior lower extremity amputation, and nephropathy, which were also categorised as binary variables (1 = present, 0 = absent). Based on these variables, foot risk was classified into five categories:

- A. Category-0: No LOPS and no PAD
- B. Category-1: Presence of LOPS or PAD
- C. Category-2: LOPS with PAD, or LOPS with deformity, or PAD with deformity

D. Category-3: LOPS or PAD along with one or more of the following: history of ulcer, lower extremity amputation, or nephropathy

E. Category-4: Presence of active ulcer

Foot skin and nail conditions were assessed by summing the assigned scores. Foot care practices were evaluated using a structured questionnaire adapted from a previous study. Mean percentage score was calculated for foot self-care practices using the formula: $\text{Sum of scores obtained} / \text{Maximum possible score} \times 100$. These scores were categorised into good and poor using a cut-off of 50% [21]. A score of 1 was given to each good practice and 0 to each poor practice, and the total score was converted into a percentage using the formula: $(\text{Obtained score} / 15) \times 100$. Scores greater than 50% were categorised as good practice (1) and less than 50% as poor practice (0) for further analysis.

Fisher’s exact test was used to assess associations between categorical variables including duration of diabetes and foot risk category, duration of diabetes and foot care practices, smoking and foot risk category, and alcohol consumption and foot risk category. A p-value < 0.02 was considered statistically significant. Analysis of Variance (ANOVA) was used to compare mean foot care practice scores across different duration groups. Barriers to foot care practices were analysed descriptively and presented using charts and graph.

Results

We enrolled 175 patients with diabetes visiting the NCD clinic in a tertiary care hospital in the study. The mean age of the participants was 58.61 ± 9.8 years. The study population comprised 95 (54.3%) males and 80 (45.7%) females. With regard to antidiabetic therapy, 131 (74.9%) patients were receiving oral hypoglycemic agents (OHA) alone, 18 (10.3%) were on insulin therapy alone, and 31 (17.7%) were receiving a combination of OHA and insulin. **Table 1** shows the distribution of participants according to duration of diabetes and foot risk category. A total of 175 participants, 21% had <1 year of diabetes duration, 32% had 1- <5 years of diabetes duration, 29% had 5- <10 years of diabetes duration, and 17% had >10 years of diabetes duration.

Among the study participants, 52.5% were categorised as Category-0, 16.5% as Category-1, 14.2% as Category-2 and 16.5% as Category-3 foot risk, as per the 60 Second Foot Screening Tool Category.

The relationship between the duration of Diabetes with 60 Second Foot Screening Tool Category was assessed through a cross-tabulation. Owing to sparse cell counts and zero frequencies in the contingency tables, the assumptions of the Chi-square test were not met. Therefore, Fisher's exact test was used to assess the association between duration of diabetes and diabetic foot risk category. To facilitate statistically valid analysis, adjacent categories were combined into clinically meaningful groups (IWGDF Categories 0-1 vs. 2-3)

To assess the relationship between Diabetes Duration and Foot Practice Score, Fisher's exact test was done, and it revealed a statistically significant association between the duration of diabetes and foot practice score ($p < 0.001$). But 80% of cells had expected counts below 5, meaning a key assumption of the chi-square test was not met; Therefore, Fisher's exact test

was used to assess the association between duration of diabetes and foot care practice. To facilitate statistically valid analysis, adjacent categories were combined into clinically meaningful groups (low & Moderate vs High). Table 2 illustrates the association between the duration of diabetes and foot practice score.

As depicted in Table 3, A one-way ANOVA was used to compare mean foot practice scores among the different groups of diabetes duration

As shown in Table 3, a one-way analysis of variance (ANOVA) was conducted to compare mean foot practice scores across the different duration-of-diabetes groups. This test provided a statistically significant result of $F = 352.077$ and $p < 0.001$, suggesting that the duration of diabetes significantly influences foot care practices.

Correlation analysis revealed a very strong positive relationship between duration of diabetes and foot practice score, with Spearman's $\rho = 0.946$ ($p < 0.001$). This indicates that foot care practice scores significantly improve as the duration of diabetes increases

Table 1: Distribution of Participants by Duration of Diabetes and 60 Second Foot Screening Tool Category (Merged Categories) (n = 175)

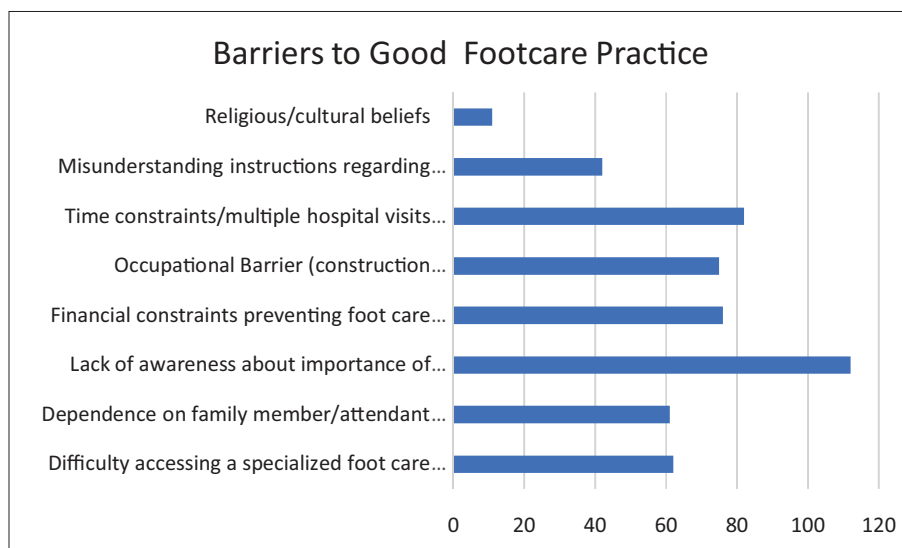
Duration of	60 SECOND FOOT SCREENING TOOL Category 0-1	60 SECOND FOOT SCREENING TOO Category 2-3	Total
<5 year	93	0	93
≥5 years	28	54	82
Total	121	54	175

Table 2: Association between Duration of Diabetes and Foot Practice Score (n = 175)

Duration	Low(1-5) & Moderate (6-10)	High(1115)	Total
<5year	93	0	93
≥5 years	36	46	82
Total	129	46	175

Table 3: ANOVA of Foot Practice Score by Duration of Diabetes

Source	Sum of Squares	df	Mean Square	F	p-value
Between Groups of Duration of Diabetes	1161.825	3	387.275	352.077	<0.001
Within Groups of Duration of Diabetes	188.095	171	1.100		
Total	1349.920	174			



The barriers to good foot care practices reported by the study participants are presented in **Figure 1**. The most reported barrier in this study was a lack of awareness about the importance of foot care in 112 participants, indicating a significant gap in patient education. This was followed by time constraints in 82 participants, financial limitations 76 participants, occupational barriers such as prolonged standing or construction-related work 75 participants, difficulty in accessing specialised foot care facilities due to long travel distance 62 participants, dependence on family members for healthcare access 61 participants and religious or cultural practices, including barefoot walking 11 participants which may hinder regular foot care practices. Additionally, misunderstanding of foot care instructions was reported by 42 participants, needing for clearer communication by healthcare providers. Overall, both knowledge and socio-economic factors influence foot care practices among patients with diabetes.

Discussion

The study assessed diabetic foot risk and foot self-care practices among adults with diabetes who attended a tertiary-care NCD clinic. The mean age was 58.6 years, with a slight male predominance, and most participants were on oral hypoglycaemic agents. Although over half were classified as low risk (Category 0), a considerable proportion fell into higher-risk categories (2 and 3), indicating a substantial burden of established or

impending foot complications. Most participants had diabetes for more than five years, and poor glycaemic control was commonly observed, indicating a high-risk clinical profile. A statistically significant association was observed between the duration of diabetes and diabetic foot risk. Foot self-care practice scores also improved significantly with increasing duration of diabetes, while lack of awareness was identified as the most common barrier to appropriate foot care.

The findings of this study revealed that foot care practices were predominantly moderate. About 19.4% of participants had poor practices, while only 38.6% demonstrated good adherence. Previous studies conducted in India and other low-resource settings have reported

similar findings, with suboptimal awareness and adherence to foot care practices. The moderate adherence observed in this study may be due to lower awareness and insufficient structured educational programs^[23,24].

The presence of foot deformities in this study was notable, with nail deformities (40.9%) and skin changes (35.8%) being the most common findings, followed by loss of protective sensation (27.8%). These findings are consistent with previous studies that identified neuropathy and foot lesions as early indicators of diabetic foot problems^[25].

An important finding of this study is the statistically significant association between foot care practices and

loss of protective sensation. Participants with poor foot-care practices had a higher prevalence of neuropathy than those with good practices. This highlights the protective role of proper foot care behaviours in preventing complications. Similar relationships have been reported in earlier studies, emphasising the importance of patient education and behavioural modification strategies^[21].

Duration of diabetes was significantly associated with foot problems, with patients having diabetes for five years or more showing a higher prevalence of complications. Prolonged exposure to hyperglycaemia can lead to vascular and neural damage. This finding supports previous studies that report the duration of diabetes as an important determinant of complications and quality of life among diabetic patients^[26,27]. Persistent hyperglycaemia may lead to impaired circulation, reduced immune response, and delayed wound healing^[28].

The present study further demonstrated a statistically significant association between duration of diabetes and foot self-care practices. Participants with diabetes duration of ≥ 5 years had significantly better foot practice scores than those with shorter disease duration. In addition, ANOVA and Spearman's correlation analyses showed that foot care practice scores increased significantly with increasing duration of diabetes, suggesting that prolonged exposure to diabetes care and repeated counselling may improve self-care behaviours. However, despite better practices, patients with longer disease duration continued to have a higher risk of diabetic foot complications, emphasising the need for regular foot screening and reinforcement of preventive practices.

This study also found a higher occurrence of foot problems among individuals wearing poorly fitted footwear. In patients with neuropathy, inappropriate footwear may lead to repeated injuries, pressure points, and ulceration. Therefore, encouraging diabetic patients to wear appropriate footwear is an important preventive measure^[29].

There was a statistically significant association between walking barefoot and loss of protective sensation. Walking barefoot increases the likelihood of unnoticed injuries due to environmental hazards. This practice is common in some populations because of cultural habits and lack of awareness, highlighting the need for targeted health education^[30].

Foot complications were also significantly associated with smoking habits. Smoking increases the risk of peripheral vascular disease and reduces peripheral blood flow, which may delay wound healing. Encouraging smoking cessation is therefore important in diabetes management^[31].

A moderate negative correlation was observed between foot care practices and fasting glucose levels, suggesting that better foot care practices may be associated with improved glycaemic control. In contrast, a positive correlation between duration of diabetes and foot-related problems indicates that complications tend to worsen over time. Hence the cumulative effects of chronic hyperglycaemia continue to increase the risk of diabetic foot complications.

From a public health perspective, these findings emphasise the need for stronger preventive strategies in diabetes management. Although healthcare services are available, greater attention is needed for patient education, behaviour modification, and routine screening. Regular foot examinations using simple screening tools, combined with patient education on foot care, can significantly reduce complications. Training healthcare professionals in preventive foot care is also essential.

Another important finding was that lack of awareness was the most commonly reported barrier to appropriate foot care, followed by time constraints, financial limitations, occupational exposure, difficulty accessing specialised foot care services, dependence on family members, and misunderstanding of foot care instructions. The study suggests that both educational and socioeconomic factors influence adherence to recommended foot care practices and should be addressed through comprehensive diabetes education programmes.

Limitations

This study has several strengths, including the use of a standardised assessment tool, an adequate sample size, and data collection in a real clinical setting. However, some limitations should be considered. The cross-sectional design prevents conclusions about causality. Recruitment from a single tertiary care centre may limit generalizability. As foot care practices were self-reported, recall and reporting bias may have occurred. The study also did not evaluate long-term outcomes such as ulcer progression or amputation, and socioeconomic or educational factors were not fully assessed.

Recommendations

Future research should consider longitudinal studies across multiple centers to better understand the progression of diabetic foot complications. Educational interventions, community awareness programmes, and improved access to protective footwear to strengthen preventive foot care practices. The barrier analysis highlighted the factors affecting proper foot care, including lack of awareness, financial constraints, limited access to specialized care, time constraints due to repeated hospital visits, dependence on family members, and misunderstanding of medical advice. Addressing these barriers is important to improve adherence to foot care practices and reduce diabetic foot complications.

Conclusion

According to the outcomes of the study, the frequency of diabetic foot complications amongst the patients diagnosed with diabetes is exceedingly high and linked to many controllable factors, such as inadequate foot hygiene, inappropriate control of the glucose level in the body, incorrect footwear, barefoot walking and smoking.

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Conflict of Interest:

We declare that we have no conflict of interest.

Use of Artificial Intelligence:

AI tools were used solely for sentence rephrasing and grammatical improvement of the manuscript. AI was not

used for data analysis, interpretation of results, or generation of scientific content. All content was reviewed and approved by the authors, who take full responsibility for the manuscript.

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Medication Adherence And Associated Factors Among Geriatric Population With Chronic Diseases In Rural Northern Kerala: A Cross-sectional Study

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Abstract:

Introduction: Medication adherence among elderly patients with chronic diseases is crucial for effective disease control but often remains inadequate. Limited evidence from India and the inadequate assessment of medication adherence among older adults warranted an evaluation of its determinants and impact. **Objectives:** This study aimed to assess medication adherence and associated factors among the geriatric population suffering with chronic disease using the Morisky Medication Adherence Scale (MMAS-8). **Methods:** A community-based cross-sectional study was conducted among 292 geriatric individuals aged ≥ 60 years with chronic diseases, selected through simple random sampling from a sampling frame of 537 eligible individuals in a rural field practice area of a tertiary care centre in Northern Kerala, India, in 2025. Data were collected through face-to-face interviews using a structured questionnaire, and medication adherence was assessed using the MMAS-8 scale. Data were analyzed using SPSS version 26. Chi-square test and multivariable logistic regression analysis were performed to identify factors associated with medication adherence. **Results:** Medication adherence among geriatrics showed that 62.3% had low adherence and 37.7% had high adherence. Higher adherence was independently associated with higher education (AOR=2.31), upper socioeconomic status (AOR=1.94), living with family (AOR=2.47), shorter duration of illness (AOR=2.62), having a single chronic condition (AOR=3.45), regular follow-up with healthcare providers (AOR=2.11), and absence of cost-related medication barriers (AOR=2.78). Additionally, younger elderly age, female gender, motivation to take medications, shorter waiting times, receipt of counseling, medication availability, and satisfaction with healthcare services showed significant associations with medication adherence in bivariate analysis ($p < 0.05$). **Conclusion:** Low medication adherence was observed in nearly two-thirds (62.3%) of geriatric patients with chronic diseases. Medication adherence was influenced by multiple socio-demographic, clinical, behavioral, and healthcare system factors.

Keywords: Chronic Diseases, Compliance, Geriatrics, Aged, Medication Adherence, Patient compliance, Therapeutics, Health Services Accessibility

Introduction:

Medication adherence among geriatric patients with chronic diseases remains a significant global challenge,

with nearly half of patients failing to follow prescribed treatment regimens. Poor adherence compromises treatment outcomes and increases healthcare expenditures.^[1] WHO defines adherence to long term

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therapy as the extent to which a persons behavior, such as taking medication, following a diet, and/or executing lifestyle changes correspond with agreed recommendations from a healthcare provider.^[2] Globally, adherence to treatment for chronic illnesses is estimated to be around 50%, and the rate is even lower in developing countries such as India.^[3] The Geriatric population is more prone to various chronic and recurrent illnesses like diabetes mellitus, hypertension, arthritis, neurodegenerative, gastrointestinal, ocular, genitourinary, respiratory disorders, etc., which may require chronic medication with multiple medications.^[4]

Measuring medication adherence is challenging because it reflects individual patient behavior. Various approaches have been used to assess adherence, including patient self-reports, pharmacy refill records, biomarker testing, and electronic monitoring devices. Among these methods, the Morisky Medication Adherence Scale (MMAS-8) is one of the most widely used self-report tools for assessing medication adherence behavior, with reported sensitivity and specificity of 93% and 53%, respectively.^[5] India's elderly population is expanding rapidly, currently accounting for 8.1% of the total population, and is projected to increase to 20% by 2050, with more than 70% of them having chronic diseases.^[2-5]

Despite the critical importance of adherence in chronic disease management, it is often under-assessed in routine clinical practice. The scientific rationale of this study was that suboptimal medication adherence among the geriatric population with chronic diseases contributes to poor disease control, increased complications, and a higher healthcare burden, necessitating the identification of influencing factors. In addition, there is a lack of comprehensive region-specific data on medication adherence among the geriatric Indian population.^[3-5] Therefore, this study was conducted to assess the level of medication adherence and identify associated factors among geriatric individuals with chronic diseases using the MMAS-8 scale, with the goal of generating evidence to guide targeted interventions and improve patient outcomes.

2. SUBJECTS AND METHODS

2.1 Study Design, Setting, Duration

A cross-sectional field study was conducted among the geriatric population in the rural field practice area of a tertiary healthcare facility in northern Kerala, India, over a three-month period from September to November 2025.

2.2. Study population, Sample size, and Sampling

Inclusion criteria: The study population comprised geriatric individuals aged 60 years and above residing in Puzhakkattiri Panchayat, the rural field practice area of the Rural Health Training Centre attached to MES Medical College, Perinthalmanna, Kerala, who were diagnosed with one or more chronic diseases by a registered medical practitioner and had been on prescribed medication for at least six months. Individuals who were willing to participate and provide informed consent were included in the study.

Exclusion criteria: Individuals with cognitive impairment or severe illness that prevented them from providing responses were excluded from the study.

The sample size was calculated using the formula $n = 4pq/d^2$. The prevalence (p) of low medication adherence among chronic disease patients was taken as 63.33% based on a study by Shakeel Ahmad Mir et al. (2018).^[2] Accordingly, . With an absolute precision (d) of 6%, the minimum required sample size was calculated to be 258 participants. "Although the minimum required sample size was 258, a 10% non-response rate was anticipated during the planning stage. Accordingly, the minimum sample size was adjusted to 284 participants ($258 \times 1.10 = 283.8$, rounded to 284). During data collection, 292 eligible participants were available and consented to participate; therefore, all were included in the study."

A comprehensive list of geriatric individuals along with their morbidity profile was available in the field area health records maintained at the rural health centre. A total of 537 eligible geriatric individuals with chronic diseases constituted the sampling frame. From this sampling frame, eligible individuals were identified, assigned unique identification numbers, and selected

using a simple random sampling technique with the aid of a computer-generated random number table, thereby ensuring an unbiased and representative sample.

2.3 Method of data collection

The data were collected through face-to-face interviews using a structured questionnaire. Eligible geriatric individuals were selected from the sampling frame through simple random sampling, and their residential addresses were obtained from the field area health records. Household visits were then conducted to interview the selected participants. In households with more than one selected eligible individual, each selected participant was interviewed separately.

The questionnaire consisted of multiple sections that were developed by incorporating items from validated questionnaires used in previous studies and tailoring them to address the specific objectives of the study.^[3-6] The first section collected socio-demographic information. The second section included disease-related details such as the type and number of chronic diseases, duration of illness, and history of complications. The third section explored treatment-related and patient-related factors including the number of medications, complexity of the drug regimen, side effects, forgetfulness, motivation, and beliefs regarding medication, as well as health system-related factors such as frequency of follow-up visits, access to healthcare providers, availability of medicines, and financial burden of treatment.

Medication adherence was assessed using the 8-item Morisky Medication Adherence Scale (MMAS-8),^[5] a validated self-report questionnaire consisting of seven dichotomous (Yes/No) items and one Likert-scale item. Items 1-4 and 6-7 are scored as Yes = 0 and No = 1, while item 5 is reverse-scored (Yes = 1, No = 0). Item 8 is scored on a Likert scale ranging from “Never/Rarely” (1.00), “Once in a while” (0.75), “Sometimes” (0.50), “Usually” (0.25), to “All the time” (0.00). The total MMAS-8 score ranges from 0 to 8, with a score of 8 indicating high adherence, 6 to <8 indicating medium adherence, and <6 indicating low adherence according to the scoring criteria described by Morisky et al.^[5]

The MMAS-8 was administered in Malayalam through interviewer-assisted face-to-face interviews. The original English version was translated into Malayalam by the investigators and subsequently back-translated into English by an independent bilingual expert to ensure conceptual equivalence. The translated version was reviewed by subject experts from the Department of Community Medicine for clarity, content validity, and cultural appropriateness before use in the study. The MMAS-8 questionnaire was adapted from the original scale developed by Morisky et al. and used with appropriate citation.^[5] Furthermore, a pilot study was conducted in the field among 10% of the calculated sample size to assess feasibility and clarity, and necessary modifications were made accordingly. All questionnaires were checked for completeness at the time of data collection, and missing data were minimized through on-site verification by the investigators. No missing data were identified in the final dataset, and all 292 participants were included in the analysis.

2.4 Operational definitions

- Geriatric population: Individuals aged 60 years and above.
- Chronic disease: A medical condition diagnosed by a registered medical practitioner that has persisted for at least six months and requires ongoing medication or follow-up.
- Medication adherence: Adherence was assessed using the 8-item Morisky Medication Adherence Scale (MMAS-8).^[5] Based on the original scoring criteria, participants with a score of 8 were classified as having high adherence, those with scores from 6 to <8 as having medium adherence, and those with scores <6 as having low adherence. Although adherence was initially categorized as high, medium, and low according to the original MMAS-8 scoring criteria, for analytical purposes, participants with MMAS-8 scores ≥ 6 (high and medium adherence categories) were combined and classified as having high adherence, whereas those with scores <6 were classified as having low adherence. This dichotomization was performed to facilitate statistical analysis and interpretation of

factors associated with adequate medication adherence.

- Educational status: Educational status was categorized as high education (higher secondary/intermediate or diploma, graduate, and professional education) and low education (high school, middle school, primary school, and illiterate).
- Occupational status: Occupational status was categorized as high occupation (professional, semi-professional, clerical/shop owner/farmer, and skilled worker) and low occupation (semi-skilled, unskilled, and unemployed/retired).
- Socioeconomic status (SES): Socio-economic status was assessed using the Modified BG Prasad Scale and categorized as upper socio-economic status (Classes I, II, and III) and lower socio-economic status (Classes IV and V).

2.5 Data analysis and ethical considerations

Data collected were entered and analyzed using Statistical Package for the Social Sciences (SPSS) version 26. Descriptive statistics were expressed as frequencies and percentages, and cross-tabulation was performed for relevant variables. Chi-square test was used for bivariate analysis, and a p-value ≤ 0.05 was considered statistically significant. To account for potential confounding, multivariable logistic regression analysis was performed. Adjusted odds ratios (AORs) with 95% confidence intervals (CIs) were calculated.

All participants were assured of confidentiality and anonymity, participation was voluntary, and written informed consent was obtained prior to data collection. Ethical approval was obtained from the Institutional Ethics Committee of the MES Medical College, Perinthalmanna, Kerala, India, with reference number IEC/MES/UG64/2025 dated 11th September 2025.

3. RESULTS

3.1 Sociodemographic characteristics (n=292)

Among the 292 participants, the majority belonged to the age group >76 years (34.2%), followed by 6065 years (28.1%). Females constituted a slightly higher

proportion (51.4%). Most participants were in the low occupation category (76.0%) and had lower education (72.6%). A majority were married (71.9%) and belonged to the lower socio-economic class (76.0%). Most were living with spouse or family (82.9%), had a duration of illness >5 years (62.3%). Regarding disease burden, 34.9% of participants had two chronic conditions, 33.6% had one chronic condition, and 31.5% had three or more chronic conditions. (Table 1)

3.2 Patient-related treatment factors and health system-related factors (n=292)

A high proportion of participants believed that medications help control their disease (93.2%), were motivated to take them as prescribed (95.3%), and were aware of the purpose of their medications (95.8%). Meanwhile, a smaller proportion reported experiencing complexity in the medication schedule (16.7%) or side effects causing hesitation (9.9%). Use of aids or reminders was notably low (4.2%), and only one-fourth (25.0%) reported receiving assistance from family members or caregivers. (Table 2)

Most participants reported regular follow-up with healthcare providers (83.3%), easy communication with doctors (97.4%), and easy access to required medications (93.2%). A majority had also received education or counseling regarding the importance of medication adherence (80.7%). Barriers such as missing medications due to high cost (8.9%), long waiting times affecting follow-up (14.6%), and unavailability of prescribed medications (12.5%) were reported by a relatively small proportion of participants. Overall, patient satisfaction with healthcare services was high. (Table 3)

3.3 Medication Adherence (n=292)

Medication adherence among geriatrics was assessed using the MMAS-8 questionnaire, which showed that 110 participants (37.7%) had high adherence, while 182 (62.3%) had low adherence. This indicates that a greater proportion of the geriatric population demonstrated low adherence compared to high adherence. (Figure 1)

Table 1: Sociodemographic and clinical characteristics of the study participants (n = 292)

Variable	Frequency (n)	Percentage (%)
Age (years)		
60-65	82	28.1
66-70	60	20.5
71-75	50	17.1
>76	100	34.2
Gender		
Female	150	51.4
Male	142	48.6
Occupation		
High	70	24.0
Low	222	76.0
Education		
Higher	80	27.4
Lower	212	72.6
Marital Status		
Married	210	71.9
Others	82	28.1
Socio-economic Status		
Upper	70	24.0
Lower	222	76.0
Living Arrangement		
With family	242	82.9
Alone	50	17.1
Duration of Illness		
<1-5 years	110	37.7
>5 years	182	62.3
Number of Chronic Conditions		
1	98	33.6
2	102	34.9
≥3	92	31.5

Table 2: Patient-related treatment factors influencing medication-taking behavior among the geriatric population (n-292)

Patient-related factors	YES n (%)	NO n (%)
Felt medication schedule complex or confusing	49 (16.7)	243 (83.3)
Believe that the medications help control your disease	272 (93.2)	20 (6.8)
Motivated to take your medications as prescribed	278 (95.3)	14 (4.7)
Use aids/reminders to remember medication	12 (4.2)	280 (95.8)
Experienced any side effects that made you hesitant to take medications	29 (9.9)	263 (90.1)
Knows the purpose of each of the medications used	280 (95.8)	12 (4.2)
Receive help from a family member or caregiver to take medications	73 (25.0)	219 (75.0)

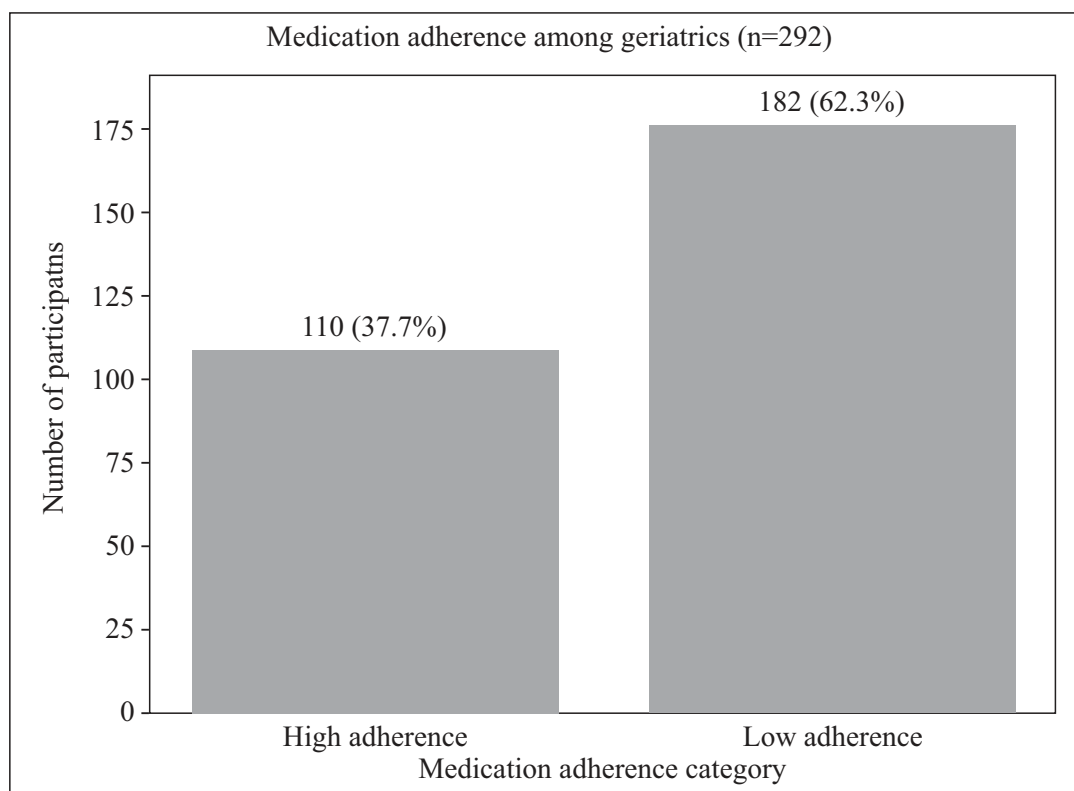
3.4 Medication adherence and sociodemographic characteristics (n=292)

Higher medication adherence was more common among individuals aged 60-65 years, with adherence declining as age increased ($\chi^2=76.91$, $p<0.001$). Females

demonstrated better adherence compared to males ($\chi^2=7.71$, $p=0.005$). Participants with higher occupation, higher education, upper socio-economic status, and those who were married showed significantly better adherence ($p<0.05$). Similarly, those living with family

Table 3: Health system-related factors influencing medication-taking behavior among the geriatric population (n=292)

Health system-related factors	Yes n (%)	No n (%)
Regular follow-up with the healthcare provider	243 (83.3)	49 (16.7)
Able to communicate concerns to the doctor easily	284 (97.4)	8 (2.6)
Easy to access the medications needed	272 (93.2)	20 (6.8)
Ever missed taking medicines due to high cost	26 (8.9)	266 (91.1)
Long waiting times at health centers affected follow-up	43 (14.6)	249 (85.4)
Received education or counseling about the importance of taking medications from healthcare providers	236 (80.7)	56 (19.3)
Ever found prescribed medications unavailable at nearby pharmacies or facilities	37 (12.5)	255 (87.5)

Figure 1: Medication adherence among geriatric patients assessed using MMAS-8 (n=292)

had higher adherence than those living alone ($\chi^2=9.94$, $p=0.011$). In terms of clinical factors, shorter duration of illness (<5 years) and having a single chronic condition were significantly associated with higher adherence ($p<0.001$). (Table 4)

3.5 Medication adherence and different factors (n=292)

A statistically significant association was observed across patient and health system-related factors. Higher adherence was consistently seen among those who were

motivated to take medicines (38.8% vs 14.3%), had regular follow-up (39.1% vs 30.6%), did not miss medications due to cost (39.5% vs 19.2%), and were not affected by long waiting times (40.2% vs 23.3%). Similarly, participants who received counseling (39.0% vs 32.1%), did not experience medication unavailability (40.4% vs 18.9%), and were satisfied with their doctor (38.4% vs 12.5%) demonstrated better adherence compared to their counterparts. (Table 5)

Table 4: Sociodemographic characteristics and their association with medication adherence (n=292)

Variable	Category	High adherence n (%)	Low adherence n (%)	Chi-square	P value
Age (years)	60–65	58 (70.7)	24 (29.3)	76.91	<0.001
	66–70	27 (45.0)	33 (55.0)		
	71–75	14 (28.0)	36 (72.0)		
	>76	11 (11.0)	89 (89.0)		
Gender	Female	68 (45.3)	82 (54.7)	7.71	0.005
	Male	42 (29.6)	100 (70.4)		
Occupation	High	43 (61.4)	27 (38.6)	22.10	0.010
	Low	67 (30.2)	155 (69.8)		
Education	Higher	48 (60.0)	32 (40.0)	23.30	<0.001
	Lower	62 (29.2)	150 (70.8)		
Marital status	Married	93 (44.3)	117 (55.7)	13.90	0.010
	Others	17 (20.7)	65 (79.3)		
SES Upper	44 (62.9)	26 (37.1)	24.80	<0.010	
	Lower	66 (29.7)	156 (70.3)		
Living arrangement	With family	101 (41.7)	141 (58.3)	9.94	0.011
	Alone	9 (18.0)	41 (82.0)		
Duration of illness	<1–5 years	63 (57.3)	47 (42.7)	15.82	<0.001
	>5 years	47 (25.8)	135 (74.2)		
No. of chronic conditions	1	61 (62.2)	37 (37.8)	38.80	<0.001
	2	29 (28.4)	73 (71.6)		
	≥3	20 (21.7)	72 (78.3)		

Table 5: Different factors associated with medication adherence among the geriatric population (n=292)

Factor	Category	High adherence n (%)	Low adherence n (%)	P value
Motivated to take medicines	No	2 (14.3)	12 (85.7)	0.018
	Yes	108 (38.8)	170 (61.2)	
Regular follow-up	No	15 (30.6)	34 (69.4)	0.002
	Yes	95 (39.1)	148 (60.9)	
Missed medication due to cost	Yes	5 (19.2)	21 (80.8)	<0.001
	No	105 (39.5)	161 (60.5)	
Waiting time affected follow-up	Yes	10 (23.3)	33 (76.7)	<0.001
	No	100 (40.2)	149 (59.8)	
Received counseling	No	18 (32.1)	38 (67.9)	0.004
	Yes	92 (39.0)	144 (61.0)	
Medication unavailable	Yes	7 (18.9)	30 (81.1)	0.003
	No	103 (40.4)	152 (59.6)	
Satisfied with the doctor	No	1 (12.5)	7 (87.5)	<0.001
	Yes	109 (38.4)	175 (61.6)	

3.6 Multivariable logistic regression findings

In multivariable logistic regression analysis, higher education (AOR=2.31, p=0.008), upper socioeconomic status (AOR=1.94, p=0.042), living with family (AOR=2.47, p=0.027), shorter duration of illness (<5

years) (AOR=2.62, p=0.002), having a single chronic condition (AOR=3.45, p<0.001), regular follow-up with healthcare providers (AOR=2.11, p=0.041), and absence of cost-related medication barriers (AOR=2.78, p=0.039) were independently associated with better

Table 6: Multivariable logistic regression analysis of factors associated with medication adherence among geriatric patients with chronic diseases (n=292)

Variable	AOR	95% CI	p value
Higher education	2.31	1.24–4.31	0.008
Upper SES	1.94	1.02–3.68	0.042
Living with family	2.47	1.11–5.52	0.027
Duration <5 years	2.62	1.42–4.83	0.002
One chronic condition	3.45	1.78–6.69	<0.001
Regular follow-up	2.11	1.03–4.34	0.041
Missed medication due to cost (No)	2.78	1.05–7.36	0.039
Received counseling	1.84	0.94–3.58	0.074
Medication unavailable (No)	2.07	0.88–4.89	0.095

medication adherence. Although receipt of counseling (AOR=1.84, $p=0.074$) and absence of medication unavailability (AOR=2.07, $p=0.095$) showed higher odds of adherence, these associations were not statistically significant. (Table 6)

4. DISCUSSION

The present study assessed medication adherence among geriatric patients with chronic diseases and found that 62.3% exhibited low adherence, while 37.7% had high adherence, indicating a substantial burden of non-adherence. Similar findings were reported by Regina Antony et al.^[6], who observed noncompliance rates ranging from 40-75%, Shakeel Ahmad Mir et al.^[2], who reported low adherence in 63.33% of patients, Awad et al.^[7], who documented poor adherence in 54.7% of geriatric patients, Jin et al.^[12], who found 52.5% low adherence, Angela Francis et al.^[14] and Smaje et al.^[15], both of whom reported low adherence in more than half of the study participants. Likewise, Khaizer et al.^[17] reported 47.1% medium-to-poor adherence, Shruthi et al.^[18] observed nearly 55% low adherence, Andhi et al.^[19] documented only 27.12% high adherence, and Lakshmi et al.^[22] reported 53.84% low adherence, 31.63% medium adherence, and 14.5% high adherence, all supporting the finding of suboptimal adherence among older adults. In contrast, Punnapurath et al.^[8] reported high, medium, and low adherence rates of 74%, 25%, and 1%, respectively, while Lemay et al.^[9] observed low adherence in only 24% of participants. Similarly, Cardona et al.^[13] reported only 6% low adherence, Angadi et al.^[20] documented 58.5% adherence, Sharma et al.^[21] reported 80.3% good

adherence and 19.7% poor adherence, and Polat et al.^[16] found more than 90% high adherence, indicating considerably better adherence than that observed in the present study. These similarities may reflect the common challenges of chronic disease management in the elderly, whereas the observed differences may be attributed to variations in socio-demographic characteristics, healthcare accessibility, patient awareness, healthcare delivery systems, and socio-cultural factors across different study settings.

The sociodemographic profile of the participants in the present study was broadly comparable to that reported in previous studies among elderly populations with chronic diseases. Females constituted a slightly higher proportion (51.4%), similar to Sharma et al.^[21] (56.6%), whereas male predominance was reported by Shruthi et al.^[18] (60.2%), Antony et al.^[6] (51.3%), and Udupa et al.^[10] (>70%). A majority of participants in the present study had lower educational status (72.6%) and belonged to lower socioeconomic groups (76.0%), which was comparable to findings by Awad et al.^[7] where 60% had low education, and 88.7% were unemployed, and Udupa et al.^[10], where most participants belonged to the lower socioeconomic class. The proportion of married participants in the present study (71.9%) was also comparable to Jin et al.^[12] (81.3%) and Antony et al.^[6] (82.8%). Furthermore, most participants were living with family members (82.9%), similar to Sharma et al.^[21], where 63.9% lived in joint families. These similarities suggest that the study population was largely representative of geriatric populations evaluated in previous medication adherence studies.

In the present study, a high proportion of participants believed that medications help control their disease (93.2%), were motivated to take them as prescribed (95.3%), and knew the purpose of their medications (95.8%), indicating good awareness regarding disease management. These findings were comparable to Lemay et al.^[9], who reported that patients perceiving medications as necessary were more likely to adhere. However, despite this high level of awareness and positive perception, adherence remained suboptimal, suggesting a gap between knowledge and actual practice. Similar observations were reported by Udupa et al.,^[10] where 94% believed in the benefits of adherence, yet only 72% demonstrated actual adherence, indicating that favorable attitudes alone may not ensure consistent medication-taking behavior. This disparity may be due to the influence of behavioral, psychological, and practical barriers such as forgetfulness, polypharmacy, side effects, and limited social support that hinder the translation of knowledge into consistent medication-taking behavior.

Healthcare system factors, including regular follow-up, medication availability, shorter waiting times, patient satisfaction, and receipt of counseling, showed significant associations with better adherence, consistent with K J et al.^[11], who identified healthcare access and continuity of care as key determinants. Similarly, Awad et al.^[7] reported that healthcare system barriers such as accessibility and medication-related burden influenced adherence behavior. Financial constraints, although affecting a smaller proportion of participants, were strongly associated with adherence, in line with Punnapurath et al.^[8], which identified financial dependence as a barrier. Furthermore, improved adherence among those who received education or counseling was comparable to findings by Morisky et al.^[5], emphasizing the role of patient engagement and effective communication in promoting adherence.

Findings from Jin et al.^[12], Angela Farances et al.^[14], Smaje et al.^[15], and Cardona et al.^[13] were largely consistent with the present study, as they collectively highlighted the role of education, socio-economic status, patient satisfaction, counseling, healthcare access, and

multimorbidity as significant determinants of medication adherence, similar to the socio-demographic and healthcare-related factors identified in the present study. However, Polat et al.^[16] reported higher adherence motivation among males and professionally active individuals, in contrast to the present findings, where better adherence was observed among females. These similarities and variations may be attributed to differences in healthcare systems, socio-cultural context, and patient behavior across study populations.

Findings from Shruthi et al.^[18], Shakeel Ahmad Mir et al.^[2], and K J et al.^[11] were consistent with the present study, as factors such as higher education, female gender, younger elderly age, regular follow-up, and lower treatment complexity were associated with better adherence, while lower literacy and polypharmacy were linked to non-adherence. Similarly, Angadi et al.^[20] and Sharma et al.^[21] highlighted the influence of socio-economic status, occupation, and awareness, which corresponded with the present findings on occupation, socio-economic class, and financial constraints. Studies by Andhi et al.^[19] and Lakshmi et al.^[22] further emphasized the role of regimen complexity, number of comorbidities, and barriers such as forgetfulness and duration of therapy, aligning with the present observation that multiple chronic conditions and longer illness duration reduced adherence. Meanwhile, Udupa et al.^[10] reported limited influence of socio-demographic factors, contrasting with the present findings, and Khaizer et al.^[17] identified gender differences in outcomes, though in a different context. These similarities and differences may be explained by variations in healthcare access, patient awareness, treatment complexity, and behavioral factors across different populations. These variations may also reflect contextual differences in healthcare access, cultural factors, and patient support systems.

Taken together, medication adherence among geriatric patients showed considerable variability across different settings, with consistently suboptimal levels despite good awareness and positive attitudes toward treatment. Both individual factors, such as socio-demographic profile, disease burden, and behavioral

aspects, as well as healthcare system factors like accessibility, counseling, and continuity of care, were found to influence adherence. The discussion overall indicates a persistent gap between knowledge and practice, shaped by contextual, behavioral, and system-level determinants

5. LIMITATIONS

The study used a validated medication adherence assessment tool (MMAS-8) and employed community-based random sampling, which enhanced the reliability and representativeness of the findings. In addition, a wide range of socio-demographic, clinical, patient-related, and healthcare system factors were evaluated to provide a comprehensive assessment of medication adherence among geriatric patients. The findings of this study should be interpreted in light of certain limitations. The cross-sectional design precludes the establishment of causal relationships between the identified factors and medication adherence. Adherence was assessed using the self-reported MMAS-8 scale, which may have been subject to recall bias and social desirability bias, whereby participants might have overreported adherence behaviors. In addition, no objective measures of adherence, such as pill counts or pharmacy refill records, were used for validation. As the study was conducted in a single rural Panchayat, the findings may have limited generalizability to other populations and healthcare settings.

6. CONCLUSION

Medication adherence among geriatric patients with chronic diseases was suboptimal, with 62.3% of participants exhibiting low adherence and only 37.7% demonstrating high adherence. Better adherence was observed among younger elderly individuals, females, those with higher educational and socioeconomic status, those living with family, and participants with a lower disease burden. Healthcare-related factors such as regular follow-up, absence of cost-related barriers, counseling, and medication availability were also associated with improved adherence. Multivariable logistic regression identified higher education, upper socioeconomic status, living with family, shorter

duration of illness, having a single chronic condition, regular follow-up, and absence of cost-related barriers as independent predictors of medication adherence. These findings highlight the multifactorial nature of medication adherence among older adults with chronic diseases.

7. RECOMMENDATIONS

Targeted interventions should be implemented to improve medication adherence among the geriatric population with chronic diseases, focusing on both individual and healthcare system factors identified in the study. Structured patient education and counseling should be strengthened to enhance understanding of treatment importance, while regular follow-up mechanisms and reminder systems should be incorporated to address forgetfulness. Improving accessibility and affordability of medications may be achieved through strengthening the availability of essential medicines at public health facilities, promoting the use of low-cost generic medications, and expanding government-supported drug distribution schemes. Reducing waiting times through appointment-based services, streamlined patient flow, and dedicated geriatric clinics may further help minimize treatment-related barriers and improve medication adherence. Furthermore, promoting effective patient-provider communication and encouraging the involvement of family members or caregivers can support sustained adherence. These measures should be integrated into routine clinical practice and community health programs to achieve better disease control and reduce the overall healthcare burden.

8. DECLARATIONS

Conflict of Interest: No

Funding: Self-funded study

Use of AI: Artificial intelligence was used during manuscript preparation to assist with grammar correction, paraphrasing, and sentence refinement. The AI tool used was ChatGPT. No AI tools were used for study design, data collection, or data analysis.

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Maternal and Newborn Factors Associated with LATCH Score and Breastfeeding Practices: A Cross-Sectional Study in a Tertiary Care Facility in Ahmedabad

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Abstract:

Introduction: LATCH is an acronym that stands for Latch, Audible swallowing, Type of nipple, Comfort and Hold. It helps in determining the breast-feeding effectiveness in post-natal mothers. **Objectives:** 1. To determine LATCH score in post-natal mothers. 2. To explore factors associated with LATCH score in a tertiary healthcare setup. **Methods:** A cross-sectional observational study was conducted in OBGY department of a tertiary care hospital in Ahmedabad among 100 post-partum mothers and their newborns selected purposively. LATCH score was assessed post observation & primary data was collected using pre-validated and semi-structured questionnaire. Chi-square statistics was utilized to determine the maternal and newborn factors associated with LATCH. **Results:** Majority of the participants (51%) had a LATCH score of <8, indicating ineffective breast feeding. The mean LATCH score was found to be $7.24 \pm 1.86SD$, with 5% of participants having lowest LATCH score of 0-3. Lower scores (<8) were significantly associated with caesarean (LSCS) delivery (**Conclusion:** LATCH score among post-natal mothers is primarily poor. Major determinants of lower LATCH scores are delayed initiation, improper positioning, and lack of skin-to-skin contact. Key clinical and maternal risk factors include preterm or C-section delivery, low birth weight, primiparity, low confidence and high maternal stress.

Keywords: Feeding, Infant, Postpartum Period

Introduction:

Breastfeeding, a vital childhood intervention remains an optimal method of infant feeding, conferring substantial short- and long-term health benefits for both neonates and mothers. These benefits include improved infant immunity, decreased risk of infectious and chronic diseases, better neurodevelopmental outcomes, and reduced maternal risks of postpartum haemorrhage, breast cancer etc.^[1] Despite these advantages, many

infants remain devoid of these benefits owing to numerous challenges faced by mothers, particularly in the initial postpartum period. Lack of confidence to breastfeed, problems associated with infant latching or suckling, breast pain or soreness, perceptions of insufficient milk and absence of personalized encouragement from healthcare providers during early postpartum are some of the common reasons for early breastfeeding discontinuation.^[2]

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Early postpartum assessment of breastfeeding in the hospital before discharge may help

in identifying the problems faced by mothers associated with breastfeeding, providing necessary support and motivation, thus improving breast feeding efficiency and infant outcomes. For standardized evaluation of breastfeeding appropriateness, several clinical tools have been developed, among which the LATCH scoring system is most widely utilized. Originally introduced by Jensen, Wallace, and Kelsay in 1994, the LATCH tool acts as a simple, bedside method to document and quantify breastfeeding performance in a consistent and reproducible manner.^[3] The acronym LATCH represents five key elements of breastfeeding performance: Latch, Audible swallowing, Type of nipple, Comfort (breast/nipple), and Hold (positioning), each scored on a scale of 0 to 2, yielding a maximum total score of 10.

The LATCH score being similar to APGAR score format, helps healthcare providers to objectively assess breastfeeding technique, identify specific problem areas, and develop targeted interventions. However, various factors like mothers age, parity, birth weight of child, maternal stress, type of delivery etc have been found to affect LATCH score.^[2] Inappropriate latching during early phases of birth often leads to insufficient breast milk transfer thus becoming a conduit for degrading infant health further hampering normal growth & development in child.

Thus, this study was devised to determine LATCH score in post-natal mothers and explore various maternal and newborn factors affecting it.

Methods:

Study Design

A hospital-based cross-sectional study was conducted from January 2025 to March 2025 in the postpartum ward of a tertiary care teaching hospital.

Sample size

The sample size was calculated using Cochrane formula: $n = Z^2 pq / l^2$. Based on a previous Indian study by Boora MR et al.^[4] which reported the prevalence of unsatisfactory LATCH score (<8) as 60.3% at 24–48

hours postpartum, with a 95% confidence level and an absolute precision of 10%, the minimum sample size was calculated to be 96, which was rounded up to 100.

Study Population- Inclusion/exclusion criteria

All the mothers delivered and their respective newborn in OBGY department of tertiary care hospital during the study period were included in the study. Babies with congenital abnormalities like cleft lip, cleft palate, down's syndrome, birth weight <1.8 kg, gestational age <35 weeks and mothers with known psychiatric illness and/ or not willing to participate were excluded from the study.

Data Collection tools & technique

Data was collected after obtaining prior consent from the mothers. Post-birth breastfeeding initiation time was recorded, followed by LATCH score assessment using the LATCH charting system (Table 1) between 24 to 48 hours of birth. A LATCH score of 0-3 was regarded as poor, 4-7 as moderate, and 8-10 as good.^[3] Participants were further classified as having satisfactory LATCH score (≥ 8) and unsatisfactory LATCH score (<8).

Stress among mothers was assessed using the 10-item Perceived Stress Scale (PSS).^[5] Screening and diagnosis of postpartum stress were done based on PSS, with 0-13 graded as 'mild', 14-26 as 'moderate', and 27-40 'severe'. For simplifying the study calculations, scores of 0-26 was re-graded as low stress and 27-40 as high stress. It was rated on a five-point scale ranging from 'never' to 'very often'. PSS scores were obtained by reversing responses (e.g., 0=4, 1=3, 2=2, 3=1 and 4=0) to the four positively stated items (4, 5, 7, and 8) and then summing across all scale items.

Maternal Confidence was assessed using breast feeding self-efficacy scale short form (BSES-SF).^[6] Participants were evaluated for 14 items and scored on a 5-point Likert scale ranging from 1 (not at all confident) to 5 (always confident). The total score ranged from 14 to 70, with lower scores of 14-52 reported as low self-efficacy/confidence and 53-70 as high self-efficacy/confidence.

Observation Technique- Breastfeeding was observed unobtrusively by a single investigator (principal investigator) between 24-48 hours of delivery using the standardized LATCH assessment tool. Before commencement of data collection, the investigator underwent training in LATCH scoring under the supervision of the faculty from the Department of Community Medicine and the Department of Obstetrics & Gynaecology to ensure uniform application of the scoring criteria. The investigator evaluated infant latch, audible swallowing, maternal nipple type and comfort, and the assistance required for positioning and holding the infant. Scores for each component were recorded immediately after the feeding session using the standardized LATCH assessment form. Pre-existing conditions like hypertension, diabetes mellitus, hypothyroidism etc were reported as co-morbidities based on previous diagnosis & treatment history of the participants. Positioning and attachment of the baby was assessed in accordance to Infant & Young Child feeding (IYCF) & Integrated Management of Neonatal and Childhood Illness IMNCI guidelines.^[7,8]

Sociodemographic and birth related data were obtained by conducting a one-on-one interview using a

pre-validated and semi-structured questionnaire in vernacular language.

Ethical approval was obtained from Institutional Review Board (IRB) (NHLIRB/2026/22April/26/234). After securing necessary permissions from hospital authorities, post-natal mothers were identified and explained about the purpose of the study. Informed consent was obtained followed by LATCH related observation and interview of the participants. No incentives were provided to the participants.

Statistical Analysis

The data was entered in Microsoft Excel and data analysis was performed using SPSS version 21 software. Associations between LATCH scores and maternal /newborn factors were tested using Chi square tests. Statistical significance was considered at $p < 0.05$.

Results:

The total of 100 mothers and their children participated in the study, thus the percentages mentioned in the study corresponds to the actual frequencies. It was observed in the study that mean age of the mothers studied was 25.68 ± 3.9 years (minimum 19 and maximum 36) with majority of the mothers (88%)

Table 1: LATCH charting system ^[3]

Parameters	0	1	2
L: Latch	Too sleepy or reluctant, no latch achieved	Repeated attempts hold suck nipple in mouth stimulate	Grasps breast, tongue down lips flanged rhythmic suction
A: Audible swallowing	None	A few with stimulation	Spontaneous and intermittent <24 hours Spontaneous and frequent >24 hours old
T: Type of nipple	Inverted	Flat	Everted (after stimulation)
C: Comfort (Breast/nipple)	Engorged cracked, bleeding, large blisters, or bruises. Severe discomfort.	Filling reddened/small blisters or bruises mild/moderate discomfort	Soft, non-tende
H: Hold (positioning)	Full assist (Staff holds infant at breast)	Minimal assist (i.e., elevate head of bed; place pillows for support.) Teach one side; mother does other side. Staff holds and then mother takes over	No assist from staff mother able to position/hold infant

Table 2: Maternal and Newborn Characteristics (N=100)

Variables	Categories	Frequency (%)
Maternal Characteristics		
Age groups (in years)	≤25	20
	>25	80
	Mean Age: 25.68 ± 3.91	
Education	Primary	12
	Above Primary	88
Parity	Primipara	51
	Multipara	49
Type of Delivery	Normal	32
	C-Section	68
Newborn Characteristics		
Gestational Age	Full term	73
	Pre term	27
Birth weight	Normal	80
	LBW	20
Breastfeeding Initiation time	≤ 1 hour	24
	>1 hour	76
Signs of Good Attachment	Present	80
	Absent	20
Signs of Good Positioning	Present	82
	Absent	18
Skin-to-Skin Contact	Given	44
	Not given	56

Figure 1: Participant wise LATCH score (N=100)

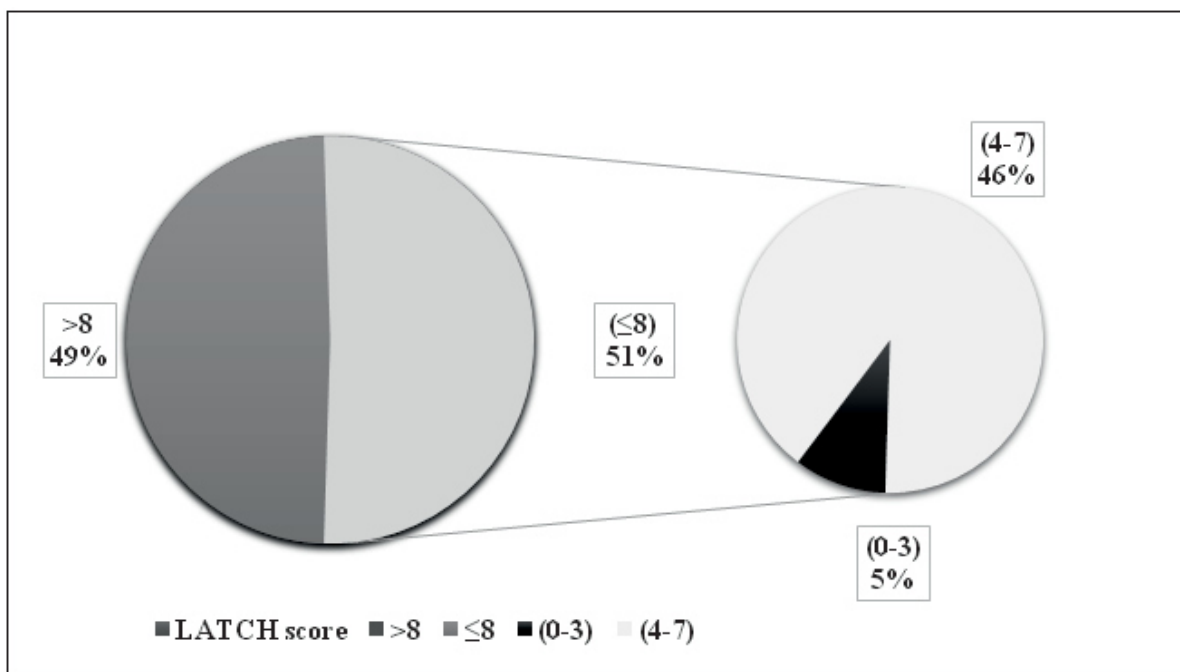


Table 3: Association between Maternal/Neonatal factors and LATCH score

Variable	Category	LATCH score	LATCH score	Chi square X ² Value	P value
		<8 (n=51)	≥8 (n=49)		
Age of mother	≤25 years	26 (47)	29 (53)	0.68	0.409
	>25 years	25 (56)	20 (44)		
Birth weight of baby	≤2.5 kg	18 (90)	2 (10)	15.21*	<0.001
	>2.5 kg	33 (41)	47 (59)		
Parity	Primipara	19 (70)	32 (30)	5.74*	0.016
	Multipara	30 (61)	19 (39)		
Type of delivery	Normal	8(25)	24 (75)	12.73*	<0.001
	C-section	43 (63)	35 (37)		
Gestational age of baby	Pre-term	19 (70)	8 (30)	5.55*	0.018
	Full-term	32 (44)	41 (56)		
Immediate skin to skin contact	Given	8 (18)	36 (82)	33.86*	<0.001
	Not given	43 (77)	13 (23)		
Confidence of mother	Less confidence	20 (87)	3 (13)	15.45*	<0.001
	High Confidence	31 (40)	46 (608)		
Maternal stress	High	32 (82)	7 (18)	24.66*	<0.001
	Low	19 (31)	42 (69)		
Good positioning of the baby	Present	35 (43)	47 (57)	12.61*	<0.001
	Absent	16 (88)	2 (12)		
Co-morbidity risk	Present	12 (71)	4 (29)	3.14	0.070
	Absent	39 (47)	45 (53)		
Breast feeding initiation time	Within 1 hour of birth	4 (17)	20 (83)	14.89*	<0.001
	After 1 hour of birth	47 (62)	29 (38)		
Maternal education	Upto primary level	7 (58)	5 (42)	0.293	0.58
	Above primary level	44 (50)	44 (50)		

*' denotes p value <0.05 (significant association)

having education above primary level. Almost half of the mothers (51%) in the study were primiparous with 61% of them showing signs of maternal stress post-delivery. Prior to the delivery, only 16% of the mothers were diagnosed with co-morbidities. Among the study participants, majority of the mothers delivered full term (73%) while LSCS (68%) remained the most common mode of delivery. Though 80% of the babies had a birth weight >2.5 kg (mean birth weight = 2.85 ± 0.60 kgs), breast feed was initiated after 1 hour of birth in majority (76%) of the babies. It was observed that positioning of the babies was good by 82% of the mothers, however immediate skin to skin contact was provided to just 44% of the babies. (Table 2)

Majority of the participants (51%) had a LATCH score of <8, indicating ineffective breast feeding. While 49% of the mothers achieved a LATCH score ≥ 8 ,

indicating effective breastfeeding (mean LATCH score being 7.24 ± 1.86), 46% had a LATCH score of 4-7 and 5% with LATCH score 0-3.

"Lower scores (<8) were significantly associated with caesarean (LSCS) delivery ($\chi^2=12.73$, $p<0.001$), delayed initiation (>1 hour post-delivery) of breastfeeding ($\chi^2=14.89$, $p<0.001$), absence of immediate skin-to-skin contact ($\chi^2=33.86$, $p<0.001$), preterm delivery ($\chi^2=5.55$, $p=0.018$), low-birth-weight ($\chi^2=15.21$, $p<0.001$), primiparity ($\chi^2=5.74$, $p=0.016$), poor positioning ($\chi^2=12.61$, $p<0.001$), higher maternal stress ($\chi^2=24.66$, $p<0.001$) and lower maternal confidence ($\chi^2=24.66$, $p<0.001$)"

Discussion:

The present study explores LATCH score among mothers in a tertiary healthcare setup and its association

with various maternal and neonatal factors. The mean LATCH score was found to be 7.24 ± 1.86 , which was considerably higher than a similar study conducted by Halgar K et al,^[2] and Lakshmi et al.^[9]

Maternal factors like parity, type of delivery, maternal stress, maternal confidence, early initiation of breast feeding and positioning of baby had significant association with satisfactory LATCH score (≥ 8). Some of the factors like parity and type of delivery found similarities when compared to the findings by Halgar K et al.^[2] A deeper look into the findings suggested that primiparous mothers were significantly more likely to have a LATCH score < 8 (chi square = 5.74, $p < 0.05$) similar to the findings by Gerçek et al,^[10] while neonates of confident mothers and mothers experiencing lower stress levels were significantly more likely to achieve a LATCH score ≥ 8 (chi square = 15.45 and 24.66, $p < 0.05$ respectively). This is likely due to the lack of previous breastfeeding experience, which can impact confidence, positioning skills, and early self-efficacy compared to multiparous mothers.

Early initiation of breastfeeding within one hour of birth resulted in a significantly higher LATCH score ≥ 8 (chi square = 14.89, $p < 0.05$), with 83% of these newborns scoring successfully which is in line with the findings of a similar study conducted in Karnataka,^[11] reiterating the fact that early initiation leverages the newborn's peak alertness in the first hour.

Key findings related to the delivery process and newborn status included mode of delivery where neonates born via vaginal delivery were found to have a significantly higher LATCH score ≥ 8 (chi-square = 12.73, $p < 0.05$) compared to C-section deliveries which is similar to the study done by Ýsik et al,^[12] and Pillai et al,^[13] possibly due to C-section mothers experiencing delayed physical recovery, higher stress, and a delay in the initiation of breastfeeding due to the operative setting. A similar study conducted by Ýsik Y et al.^[12] and Cetisli et al^[14] suggested that the mothers who delivered their babies by caesarean section had problems related to maternal attachment and breastfeeding more often than those who delivered vaginally and hence the lower LATCH scores.

Consecutively babies who received immediate skin-to-skin contact were overwhelmingly more likely to score LATCH ≥ 8 (chi square = 33.86, $p < 0.05$), with 82% of this group achieving a successful score. Neonatal factors like low birth weight ($< 2.5\text{kg}$) and pre-term babies had a significantly higher prevalence of LATCH scores < 8 (chi square = 15.21 and 5.55 respectively, $p < 0.05$) which likely attributes to the newborn's immaturity, weaker suck/swallow reflex, thus requiring greater assistance for a sustained latch.

The study identified a critical practice of providing ample support to the mothers for positioning to be a crucial component as good positioning of baby was significantly associated with a LATCH score ≥ 8 (chi square = 12.61, $p < 0.05$). Since the "Hold" component of the LATCH score is directly linked to the assistance provided for positioning, the need for healthcare providers to train and support mothers during breastfeeding becomes paramount.

Limitation:

The main limitation of the study was that the assessment of LATCH score was done by observing a single feeding session at one point in time and not a composite score of several consecutive feedings. Breastfeeding by mothers was not followed beyond 48 hours. Hence, other facets related to breastfeeding that appear later could not be assessed. Neonates who were born with congenital anomalies leading to feeding difficulties or requiring NICU admission who may be at risk of improper breastfeeding were not included in the study.

Conclusions:

It can be concluded from the study that a majority of the participants had unsatisfactory LATCH score (< 8), indicating ineffective breast feeding. The main risk factors of unsatisfactory LATCH score were found to be poor breast-feeding practices such as delayed initiation (later than 1 hour after delivery) of breastfeeding, improper positioning, preterm & C-section delivery, lack of immediate skin-to-skin contact, low birth weight ($< 2.5\text{kg}$) and important maternal factors like primiparity, low confidence and raised stress level of mothers. It

underscores a greater need for the healthcare providers to train the mothers in proper technique during antenatal phase and assist them in post-natal phase to achieve better LATCH scores and infant outcomes.

Recommendation:

Routine LATCH score assessment should be incorporated within 24–48 hours of delivery to identify mothers requiring breastfeeding support before discharge. Additional counselling and hands-on assistance by trained healthcare provider should be prioritized for mothers with caesarean delivery, primiparity, preterm birth, low-birth-weight infants, high maternal stress, and low breastfeeding confidence, as these factors were significantly associated with lower LATCH scores. Healthcare providers should also ensure early initiation of breastfeeding, immediate skin-to-skin contact, and correct positioning and attachment to improve breastfeeding effectiveness.

Declaration:

Conflict of Interest: None declared

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Use of AI: None

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Nutritional Challenges Among Under-five Children of Migrant Construction Workers in Ahmedabad, Gujarat: A Cross-Sectional Convergent Mixed-Methods Study

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Abstract:

Introduction: Migrant construction workers' children often live in temporary settlements with limited access to nutrition and health services, increasing their vulnerability to undernutrition. Evidence on their nutritional status in rapidly urbanizing Gujarat remains limited. **Objectives:** To assess the nutritional status of under-five migrant children, analyze feeding practices, examine socio-demographic determinants and evaluate access to nutrition and health services. **Methods:** A cross-sectional mixed-methods study was conducted between August to November 2025 among 175 under-five children residing at construction sites across seven zones of an urban district in Gujarat. Data were collected through caregiver interviews, anthropometric assessments and qualitative inquiry. Quantitative analysis included mean, SD, chi-square tests and logistic regression; qualitative data underwent thematic analysis. **Results:** Among 175 under-five children of migrant construction workers, mean age was 29.8±15.4 months. Undernutrition was common, with 39.4% stunted, 36.0% underweight, 20.0% wasted and 4.6% having severe acute malnutrition. Exclusive breastfeeding for six months was reported in 38.3% children, while age-appropriate meal frequency was observed in 41.1%. None of the children received ICDS services and only 42.3% had adequate access to healthcare services. Stunting was independently associated with low household income (AOR 2.31, 95% CI 1.29–4.13), maternal illiteracy (1.87, 1.04–3.36), limited healthcare access (2.42, 1.31–4.25), and residence <1 year (1.74, 1.02–3.12). Qualitative findings revealed knowledge gaps explaining suboptimal young child feeding. **Conclusion:** Undernutrition among migrant children is high and influenced by poverty, maternal illiteracy, inadequate services and mobility. Strengthening outreach, improving scheme portability and targeted support for migrant families are urgently needed.

Keywords: Children, Feeding behaviour, Health service accessibility, Migrant worker, Nutrition

Introduction:

India has witnessed increasing trends in internal migration over the last three decades. The absolute number of internal migrants increased from 232.11 million in Census 1991, 314.54 million in 2001 to 455.78

million in 2011^[1]. The total population of migrant children also increased from 44.35 to 92.95 million between Censuses 1991 to 2011. In 2011, one in every five internal migrants was a child^[1]. In India, migrant children are not a homogeneous group and their reasons for movement and vulnerabilities vary. For some

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children, migration may open possibilities and is associated with expanding social and economic spheres, but for many others, it may bring serious risks. Socio-economic vulnerability is much more severely impact the child health than the migration status of the children^[1]. Further, migrants with children may leave their children behind in several aspects such as health, nutrition, education and so on, while pursuing economic opportunities^[2]. Previous studies found that migrants families face several challenges in availing appropriate, efficient, comprehensive and continuum of quality care services especially to younger children^[2]. India faces a significant public health challenge in addressing child malnutrition, with the National Family Health Survey (NFHS-5) reporting that 32% of children under five years are underweight, 36% are stunted and 19% are wasted^[3]. Gujarat, a rapidly urbanizing state, mirrors this national crisis, with approximately 39% of children under five being stunted, 39.7% underweight and 25.1% wasted^[3]. Among the most vulnerable groups are the children of migrant construction workers, who often reside in informal settlements at construction sites^[4].

Children at construction site

Construction work is considered conducive to family-based migration as it provides work to male and female members of a family. When women migrate, they tend to bring their children along, especially when the child is younger and is in need of care. While one can witness large presence of children at most construction sites, there has been no official exercise to enumerate them^[5]. Here, we focus on this context of migration and informal work environment to understand how it shapes childrens nutritional status.

In this study we specifically focus on undernutrition among children of migrant construction workers. Extant literature has established that undernutrition has long term (morbidity and mortality, chronic diseases, cognitive and physical impairment among others) as well as short term consequences (reduced immunity and susceptibility to infections, metabolic alteration.) for children. Research has also found that undernutrition affects physical and cognitive development, schooling and productivity. Researchers note that poor nutrition in

childhood lowers the ability to perform well in school and in later years at work. Reduced efficiency means sub-optimal income opportunities in adulthood. This impacts households or individuals economic status, as well as countrys economic potential. Black et al. estimate that undernutrition reduces “a nations economic advancement by at least 8% (direct productivity losses, losses via poorer cognition and losses via reduced schooling)”^[6].

Despite the large number of workers involved in construction works in major cities, there is limited information available or research carried out on the impact of such migration on the nutrition and educational status of the migrant workers children. Among the existing studies, most are focused on the access and availability of basic services (like drinking water, sanitation and housing etc.), health aspects and occupational hazards faced by the construction workers^[7]. There is a lack of evidence on the education and malnutrition among the children both at the macro and micro levels.

Objectives:

1. To assess the nutritional status of under-five children of migrant construction workers using anthropometric indicators such as weight-for-age, height-for-age and weight-for-height.
2. To analyze dietary intake and feeding practices, including breastfeeding, complementary feeding and meal frequency among children in the study population.
3. To assess the socio-economic and demographic characteristics of migrant construction worker families and their association with child nutritional status.
4. To evaluate the accessibility and utilization of government nutrition and health programs, such as ICDS (Anganwadi), Public Distribution System, immunization and health check-ups.

Methods:

A cross-sectional convergent mixed-methods study was undertaken in city of Ahmedabad, located in Gujarat, India between August to November 2025.

Ahmedabad is experiencing rapid urban expansion and hence construction sector attracts migrant workers from various parts of the country. Study was conducted after receiving approval from Institutional Ethics Committee. Based on formula $(1.96)^2 \cdot p \cdot q / L^2$, where p is $26^{[8]}$, q is 74 & L as 25% of p i.e. 6.5 for which sample size comes to 175 . Ahmedabad city selected has 7 zones. To ensure geographic representation, construction sites were identified purposively within each zone based on the presence of migrant construction workers. Investigators visited multiple eligible construction sites in each zone. At each selected site, all under-five children meeting the eligibility criteria and present during the study visit were invited to participate. Recruitment continued across construction sites within each zone until 25 children were enrolled from each zone, resulting in a total sample of 175 participants. Piloting of the questionnaire was done amongst 10% of decided sample size within the field practice area of current institute and after finalization of the questionnaire actual data collection was done through interview of parents of selected under-five children at selected construction sites. All eligible parents or caregivers approached agreed to participate in the study. Data collected in piloting and refining of the questionnaire was not included in the final result. Written informed consent was obtained from parents/guardians prior to data collection. Along with interview of parent/guardian, anthropometric measurement of child was done. Instrument calibration was done before the study and calibrated instruments were used consistently throughout the study. Weight was measured using a calibrated digital weighing scale to the nearest 0.1 kg, and height/length was measured using a stadiometer/infantometer to the nearest 0.1 cm following standard procedures. Data collected was entered in MS Excel and analysed using MS Excel and Statistical Package for Social Science version 26 . Mean, SD, chi-square test, logistic regression tests were applied. Independent variables were chosen based on evidence from previous studies and their biological plausibility. Open-ended responses were analyzed using manual thematic content analysis and codes were grouped into themes. Multiple responses were allowed. Qualitative information was collected

concurrently with the quantitative survey through a small number of open-ended questions administered to all participating caregivers during the interview. These questions explored caregivers' perceptions of a healthy child, understanding of child nutrition and perceived barriers to accessing nutrition and healthcare services. The qualitative findings were intended to complement the quantitative results by providing contextual explanations for observed feeding practices and healthcare utilization. Open-ended questions were asked to all 175 participants during the survey. All variables included in the regression analysis had complete data, so no imputation was needed.

Inclusion criteria:

- Children of construction workers who have migrated for work and are resident of another state/district
- Currently residing at or near the construction site (temporary shelters/slums)

Exclusion criteria:

- Children with diagnosed chronic illnesses (e.g., congenital anomalies, chronic systemic diseases) that could independently affect growth were excluded
- Children who were severely ill at the time of data collection or whose caregivers were not available or unwilling to participate were excluded
- Migrant families with permanent housing in the city and were not residing at construction sites were excluded.

Operational definition:

- Migration: Migration was defined as movement from another district/state for employment within the past one year
- Adequate access to healthcare service: Adequate access to healthcare services was defined as availability and utilization of nearby health facility for child health needs, including immunization, growth monitoring and treatment of illness, as reported by the caregiver

- Adequate meal frequency: Adequate meal frequency was defined as per WHO IYCF guidelines: minimum number of meals appropriate for age and breastfeeding status of the child
- Underweight: Underweight was defined as weight-for-age Z-score (WAZ) < 2 standard deviations (SD) from the median
- Stunting: Stunting was defined as height-for-age Z-score (HAZ) < 2 SD
- Wasting: Wasting was defined as weight-for-height Z-score (WHZ) < 2 SD
- Severe acute malnutrition: Severe Acute Malnutrition (SAM) was defined as WHZ < 3 SD.

Results:

A total of 175 under-five children of migrant construction workers were enrolled from all 7 zones of metropolitan area.

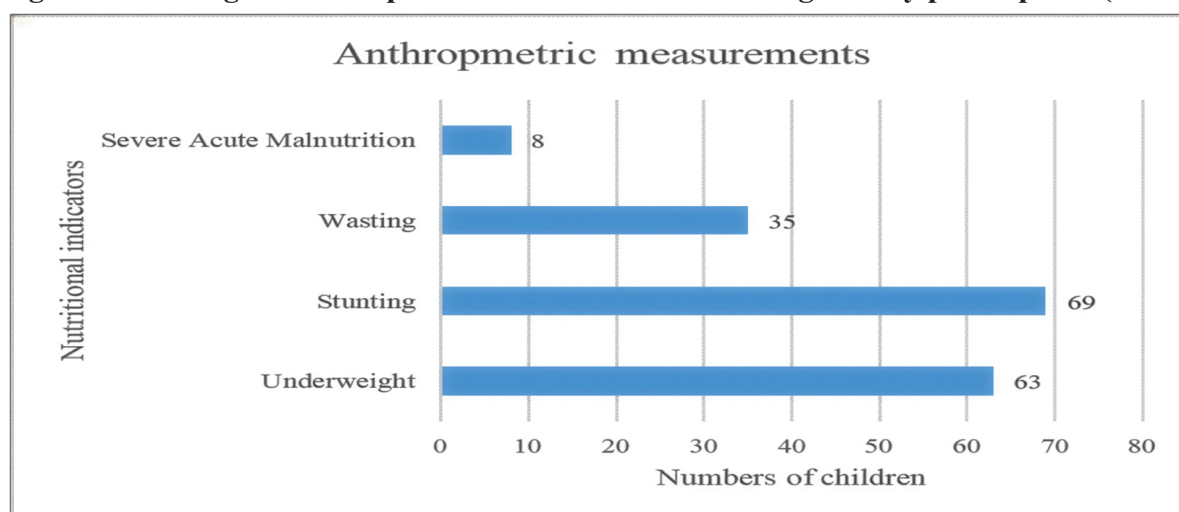
Socio-demographic Profile: Mean age of the children was 29.8 ± 15.4 months. Most respondents for the study were mothers (n=144; 82.3%). Intrastate migrant was more common (n=105; 60%) amongst participants. Most household had monthly income below 10000 (n=171; 97.7%), mothers were illiterate (n=84; 48%), father had primary education (n=93; 53.1%) and family lived in on-site temporary shelters with frequent mobility (n=163; 93.1%).

Nutritional Status: Low birth weight of the child was reported by 40 (22.9%) while 51 (29.1%) participants couldnt recall birth weight. Height and weight measurement of under-five children in last 6 months by healthcare professional was reported by 83 (47.4%) participants. Fever was the most commonly reported illness among under-five participants in the last three months (n=61; 34.9%), followed by diarrhoea (n=39; 22.3%) and respiratory infections (n=26; 14.9%). Only 49 (28%) reported that their child didnt suffer from any health issue in past 3 months. Nearly half of the participants (79; 45.1%) reported that their child appeared thin or smaller than expected for their age.

Anthropometric measurements: As shown in Figure 1, Out of 175 under-five children, prevalence of underweight was 63 (36%), stunting was 69 (39.4%), wasting was 35 (20%) and Severe Acute Malnutrition (SAM) was 8 (4.6%).

Feeding practices: Exclusive breastfeeding for 6 months was practiced amongst 67 (38.3%) children. Complementary feeding was introduced before 6 months in 44 (25.1%), at 6 months (recommended age) in 97 (55.4%) and after 6 months in 34 (19.5%) participants. Meal diversity for under-five children consisted mainly of rice, roti, dal, vegetables like potato, onion & tomato, biscuits and packaged snacks. Proper meal frequency appropriate for age was met in only 72 (41.1%) participants.

Figure 1: Findings of anthropometric measurements amongst study participants (n=175)



Source: Primary data collected from migrant construction workers in Ahmedabad, Gujarat

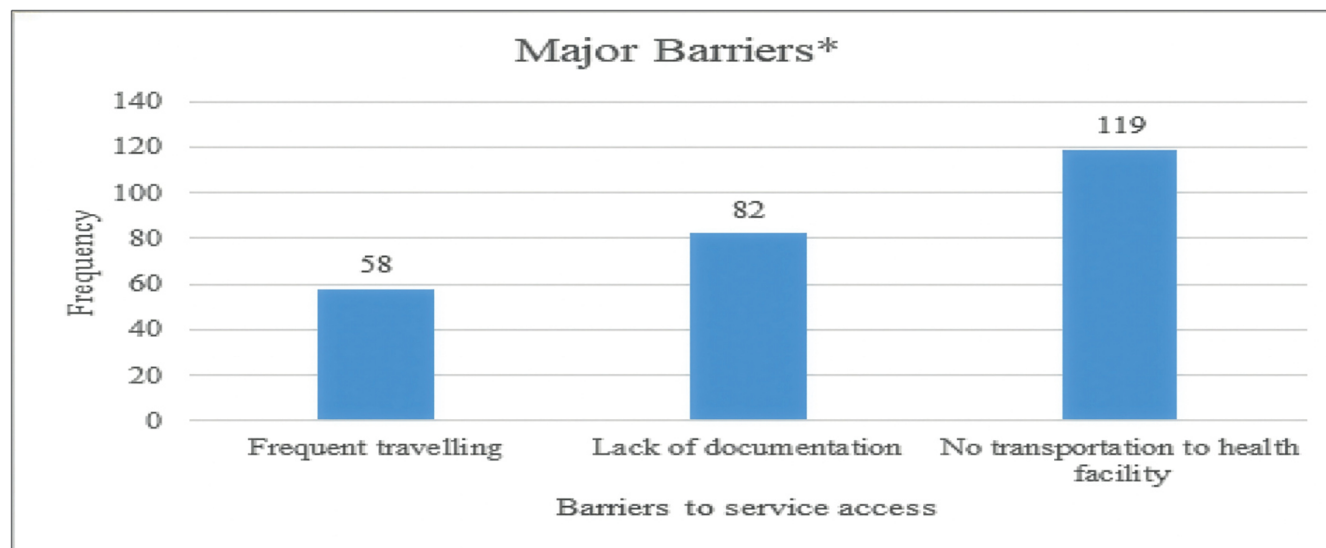
Access to Nutrition and Healthcare services: None of the participant children received ICDS (Anganwadi) services. Rations were provided solely by construction site owners. Participants couldnt avail the benefit of Take-home Ration provided by the government mainly due to non-availability of Ration card and distance between PDS shop and construction site. However, 42 (24%) participants did inform they received the benefit of low cost meal provided by the Government of Gujarat for labourers. Healthcare service utilization was also limited. Only about 74 (42.3%) participants reported of adequate access to health-related services, while 101 (57.7%) felt that they didnt receive adequate health related services. In past 6 months, Immunization services were availed by 104 (59.4%), Vitamin A supplementation by 51 (29.1%) and deworming by 40 (22.9%) participants. Major Barriers reported by participants in accessing Nutrition & Healthcare

services are given in Figure 2. Barriers included frequent travelling (53; 33%), lack of documentation (82; 47%) & No transportation to health facility (119; 68%).

A total of 45 (25.7%) participants reported that they do not seek professional help when their child was sick and managed on own or brought medicine directly from a pharmacy store nearby. In remaining 81 participants who reported that their child suffered from sickness in last 3 months, most common place of seeking healthcare for the child was nearby Private clinic 45 (55.6%) followed by government hospital 30 (37%) and traditional healer 6 (7.4%).

When inquired about what was the definition/perception of a healthy child to study participants, the answers received are given in Table 1. Responses were coded into multiple themes where applicable.

Figure 2: Major Barriers reported by participants in accessing Nutrition & Healthcare services (n=175)



*- Multiple responses allowed

Source: Primary data collected from migrant construction workers in Ahmedabad, Gujarat

Table 1: Thematic analysis of responses of study participants to their perception/definition of a healthy child (n=175)

Responses*	Frequency (%)
Proper physical growth (height and weight)	76 (43.4%)
Active & playful child	62 (35.4%)
Free from illness	63 (36.0%)
Good Eating and sleeping habit	14 (08.0%)

*- multiple responses allowed

Out of the total study participants, 102 (58.3%) reported that they had knowledge regarding child nutrition, while 73 (41.7%) stated that they did not have adequate knowledge. However, further probing during informal discussions revealed that even among those who reported having knowledge, the understanding was often basic and incomplete. Gaps were particularly noted in areas such as components of a balanced diet, importance of micronutrients and appropriate complementary feeding practices.

Regarding willingness to participate in educational interventions, a substantial proportion of participants 147 (84%) expressed interest in attending sessions on child nutrition, whereas 28 (16%) were not interested.

A statistically significant association was observed between access to health services and stunting among study participants which is given in Table 2. Similarly, meal frequency showed a significant association with underweight status which is given in Table 3.

Multivariable logistic regression analysis was performed to identify independent predictors of stunting among study participants ($n = 175$). The analysis revealed that **low household income (< 10,000 per month)** was significantly associated with higher odds of stunting, with children from low-income families having **2.31 times higher odds** of being stunted compared to those from higher-income households (**AOR = 2.31; 95% CI: 1.294.13; $p = 0.005$**). **Maternal illiteracy** was also found to be a significant predictor, with children of illiterate mothers having **1.87 times higher odds** of

stunting (**AOR = 1.87; 95% CI: 1.043.36; $p = 0.036$**). In addition, **lack of access to healthcare services** showed a strong association, with **2.42 times increased odds** of stunting among those without access (**AOR = 2.42; 95% CI: 1.314.25; $p = 0.003$**). Children with a **duration of stay less than one year** in the current residence were also at significantly higher risk of stunting (**AOR = 1.74; 95% CI: 1.023.12; $p = 0.041$**). However, **exclusive breastfeeding status** did not show a statistically significant association with stunting (**AOR = 1.39; 95% CI: 0.792.46; $p = 0.24$**).

Discussion:

The present study highlights the high burden of undernutrition and suboptimal child care practices among under-five children of migrant construction workers in an urban metropolitan setting. The findings underscore the compounded vulnerability of migrant populations due to socioeconomic deprivation, poor living conditions and limited access to health and nutrition services.

The socio-demographic profile of the study population reflects a highly disadvantaged group, with the majority of families living below 10,000 monthly income, high levels of maternal illiteracy and frequent mobility. Similar profiles have been reported in studies among migrant populations in India, where informal employment, lack of documentation and unstable housing conditions significantly impact health outcomes.^[9]

Table 2: Association between access to health services and stunting among study participants ($n = 175$)

		Stunting		Total	Chi-square (p value)
		Present	Absent		
Health services	Adequate	20	54	74	8.209 (0.0042)
	Inadequate	49	52	101	
	Total	69	106	175	

Table 3: Association between meal frequency and underweight among study participants ($n = 175$)

		Underweight		Total	Chi-square (p value)
		Present	Absent		
Meal frequency	Adequate	19	53	72	8.209 (0.0042)
	Inadequate	44	59	103	
	Total	63	112	175	

The prevalence of stunting (39.4%), underweight (36%) and wasting (20%) observed in this study was higher than corresponding national averages reported in the National Family Health Survey (NFHS-5), which documented stunting (36%), underweight (32%) and wasting (19%) among under-five children in India.^[3] This indicates that migrant children constitute a nutritionally more vulnerable subgroup, likely due to food insecurity, poor dietary diversity and inadequate health service utilization. Similar findings have been reported in studies among urban poor and migrant populations.^[10,11]

Feeding practices in the present study were suboptimal, with only 38.3% of children exclusively breastfed for six months, which is lower than the NFHS-5 estimate (64%).^[3] Early or delayed initiation of complementary feeding and poor dietary diversity were also evident. These findings are consistent with other Indian studies showing inappropriate infant and young child feeding (IYCF) practices among marginalized populations.^[12] Inadequate meal frequency was significantly associated with underweight status, reinforcing the importance of adequate feeding frequency as a key determinant of nutritional status.

Healthcare utilization was found to be inadequate, with only 42.3% reporting adequate access to health services. Immunization, Vitamin A supplementation and deworming coverage were also suboptimal. Notably, none of the children were receiving services from the Integrated Child Development Services (ICDS), highlighting a critical gap in outreach to migrant populations. Barriers such as lack of documentation, transportation issues and frequent migration have also been reported in previous studies as major impediments to service utilization.^[13,14]

The significant association between access to health services and stunting observed in this study emphasizes the role of healthcare accessibility in preventing chronic undernutrition. Similarly, inadequate meal frequency was significantly associated with underweight,

indicating the importance of feeding practices in acute nutritional outcomes. These findings are consistent with existing literature demonstrating the interplay between service access, feeding practices and child nutrition.^[6]

Multivariable analysis further identified low household income, maternal illiteracy, lack of healthcare access and shorter duration of stay as significant predictors of stunting. These findings align with established evidence that social determinants such as poverty and maternal education are strong predictors of child nutritional status.^[15,16]

Perception of a healthy child among participants was largely limited to visible physical attributes such as growth, activity and absence of illness, with less emphasis on nutrition and developmental aspects. Despite this, a high proportion of participants expressed willingness to attend nutrition education sessions, indicating a favourable opportunity for behaviour change interventions.

Limitation:

- The study was conducted among migrant construction workers in a single metropolitan city. Therefore, the findings may not be applicable to all migrant populations.
- The purposive selection of construction sites and inclusion of only eligible children present during the study visits may have introduced selection bias. Highly mobile families or those absent at the time of data collection may not have been represented, potentially affecting the representativeness of the study population.
- Information on feeding practices and healthcare utilization was based on caregiver recall and may be subject to recall bias.
- As the study was cross-sectional, cause-and-effect relationships cannot be established.
- Multicollinearity was not formally assessed during the original statistical analysis.

Conclusion:

- The study reveals a high burden of undernutrition among under-five children of migrant construction workers, exceeding national averages.
- Children belong to a highly vulnerable group characterized by low income, maternal illiteracy, poor living conditions and frequent mobility.
- Suboptimal feeding practices (low exclusive breastfeeding, poor dietary diversity, inadequate meal frequency) contribute significantly to malnutrition.
- Limited access to healthcare and nutrition services, along with barriers like lack of documentation and transportation, further aggravate the problem.
- Despite knowledge gaps, there is high willingness for nutrition education, offering scope for intervention.

Recommendation:

- There is a need for migrant-sensitive public health strategies, including strengthening ICDS outreach, ensuring portability of entitlements and promoting community-based nutrition education.

Declaration:

Conflict of Interest: NIL

Funding: NIL

Use of AI: AI was not used at any stage of the study

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Sleep Hygiene Practices and Their Association with Sleep Quality Among Undergraduate College Students of a North Indian City: A Cross-Sectional Study

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Abstract:

Introduction: Sleep hygiene refers to behavioural and environmental practices that promote healthy and restorative sleep. **Objectives:** This study aimed to assess sleep hygiene practices and their association with sleep quality among undergraduate students in a North Indian city. **Methods:** A cross-sectional study was conducted among 600 randomly selected undergraduate students of four colleges. Sample size was calculated using formula $n = (Z^* \sigma / E)^2$, where σ is standard deviation and E is margin of error. Data were collected using a Google form having a semi-structured questionnaire, Sleep Hygiene Index (SHI), and Pittsburgh Sleep Quality Index (PSQI). Descriptive statistics, correlation analyses, and multiple linear regression were performed. **Results:** The mean age of participants was 20.51 ± 1.84 years and the proportion of female participants was 59.0%. The mean SHI score was 18.85 ± 7.57 among participants. Common poor practices included using the bed for non-sleep activities, irregular sleep-wake schedules, and pre-sleep worrying. A positive correlation was observed between SHI and PSQI scores ($r = 0.302$). Regression analysis identified female gender (aOR, 95% CI: 1.67 (0.32- 3.02, p value= 0.016), poor sleep quality [adjusted odds ratio (aOR), 95% confidence interval (CI): 2.69 (1.37- 4.02, p value< 0.001], and higher non-academic screen time (aOR, 95% CI: 0.09 (0.002- 0.017), p value= 0.013) as predictors of poorer sleep hygiene. **Conclusion:** Poor sleep hygiene is strongly associated with impaired sleep quality. Targeted interventions focusing on reducing recreational screen use, promoting regular sleep routines, and stress management are essential to improve students' sleep health and well-being.

Keywords: Sleep hygiene, Sleep quality, Screen time

Introduction:

Sleep hygiene refers to a set of behavioural and environmental practices that are essential for promoting healthy, consistent, and high-quality sleep. Originally introduced as a treatment strategy for mild to moderate insomnia, sleep hygiene is now widely recognised as a

preventive approach for sleep-related problems across populations.^[1,2] Practicing good sleep hygiene supports the body's circadian rhythm and improves sleep initiation, continuity, and overall quality.^[3] Among college students, the transition to college life brings about increased academic responsibilities, autonomy in

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daily routines, and lifestyle changes.^[4,5] Poor sleep practices in students can negatively impact physical health, mental well-being, academic performance, and increase vulnerability to mood disorders such as anxiety and depression.^[6,7,8]

Most of the studies worldwide are focused on prevalence of sleep quality. Few studies assessing sleep practices using the Sleep Hygiene Index have reported that poor sleep hygiene is highly prevalent among university students. A study conducted in Qatar, reported poor sleep hygiene patterns in 79% of the university students.^[9] Other studies conducted in Ethiopia and Egypt among medical students reported poor sleep hygiene practices in 48.1% and 93.7% respectively.^[10,11] In the Indian context also, available studies are mostly limited to medical students reporting with nearly 47-75% of medical students demonstrating poor sleep hygiene practices.^[12,13]

Limited research has focused on sleep hygiene practices across a diverse undergraduate student population in India. Evaluating sleep hygiene practices and their association with sleep quality across various undergraduate streams is crucial to design appropriate interventions and promote better sleep health among students. This study aims to assess sleep hygiene practices and their association with sleep quality among undergraduate college students of a North Indian City.

MATERIAL AND METHODS

Study Design, and Study Setting:

This cross-sectional study was conducted from June 2023 to September 2023 among students enrolled in four different colleges in a North Indian city, viz. one government medical college, two government colleges with paramedical courses, and one private college offering other graduate courses [non-professional courses like B.A. (Bachelor of Arts), B.Com (Bachelor of Commerce), BCA (Bachelors in Computer Application), BSc (Bachelors in Science) etc. Students undergoing internships (MBBS and Physiotherapy), 4th year Nursing students and post-graduate degree were excluded from the study as they had different duty hours

than other undergraduate students (including night duties), and it might affect their normal sleep cycle.

Sample size :

The sample size was calculated by using the formula $n = (Z * \sigma / E)^2$ where n is the required sample size, Z is the standard normal variate corresponding to the desired confidence level (1.96 for 95% confidence), σ is the standard deviation of the Sleep Hygiene Index (SHI) score taken from study conducted by Seun-Fadipe et al (Mean $\pm$ Standard Deviation = 19.0 ± 6.31), E is the margin of error (2.8% of the mean value).^[14,15] Taking into consideration the rate of non-participation and incompletely filled questionnaire as 10%, the calculated sample size was 596. We decided to take the final sample size of 600 students (200 each from medical, paramedical and other graduate course students).

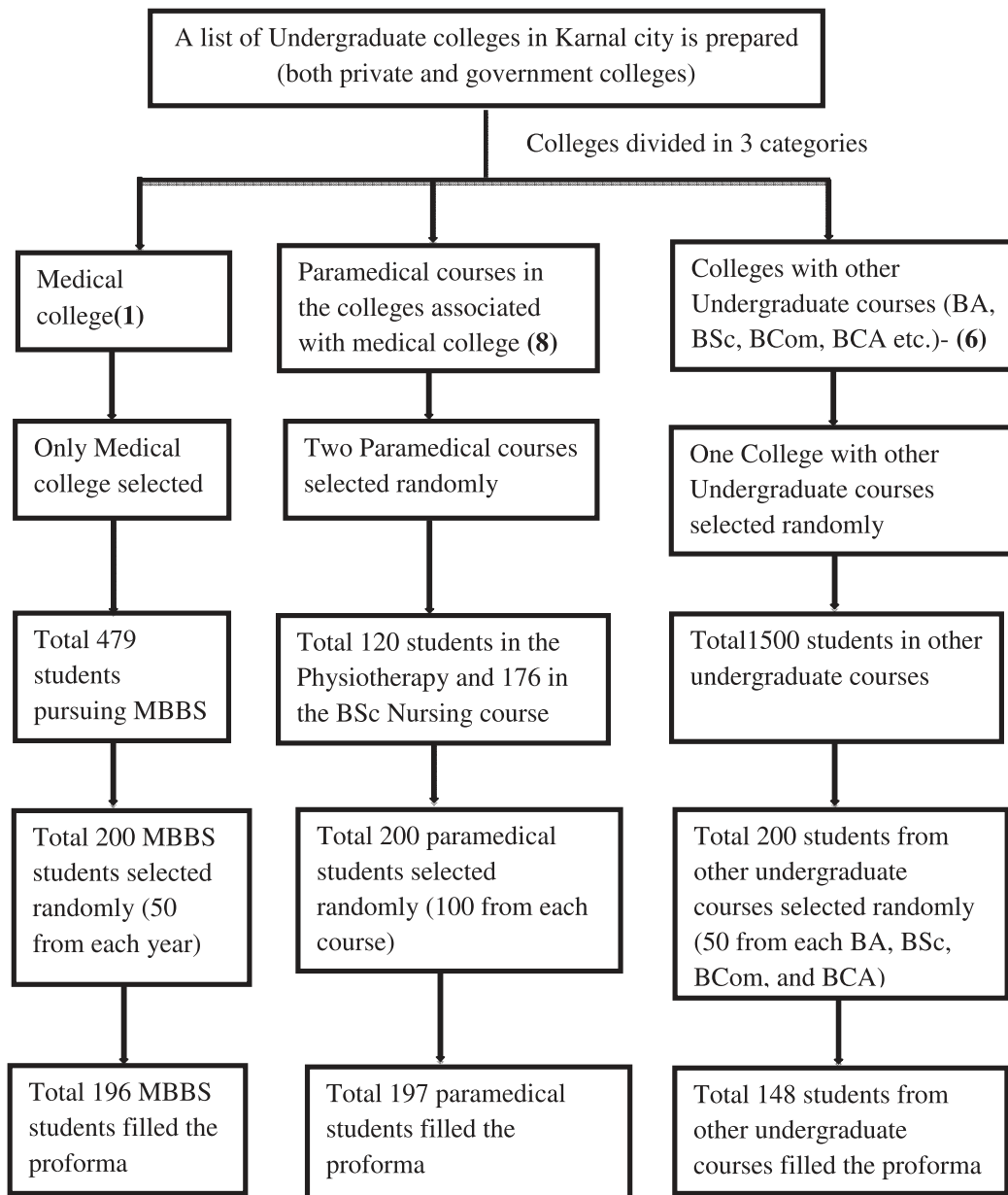
Sampling Strategy:

The details of sampling strategy are depicted in Figure 1 through the flow diagram. Of the three categories of colleges, one medical, two paramedical (as the students enrolled were less in paramedical courses) and one college offering other graduate courses were randomly selected. Further, stratified random sampling with equal allocation was used to select students from each college. A list of class roll numbers was used as the sampling frame and roll numbers of students were selected randomly by using a computer-generated random number table.

Data Collection

The students were contacted in their classroom to explain the study and its purpose. A Google form questionnaire and the randomly selected roll numbers list were shared with the students in their class WhatsApp groups. Before initiating the response to the questions in the Google form, we explained the purpose of the study, the confidentiality of the data, and the consent form. If the student consented, then only he/she could proceed to fill out the questionnaire. To safeguard and enhance their voluntariness, the email IDs of the students were not collected. In Google Forms, the Names

Figure 1. Flow diagram showing selection of study participants



and Roll numbers of the students were not included in the questionnaire to maintain anonymity.

Data Collection Tools

A semi-structured questionnaire was used to collect data on the demographic details of students, screen time, and any substance abuse. To validate this questionnaire, a pilot study was conducted among ten students, and any necessary modifications were made based on the collected responses. These students were not included in the final sample size.

To explore the habits and behaviour of the students related to sleep, the Sleep Hygiene Index was administered. It is a 13-item self-administered index to assess the behaviours that compromise sleep quality. Cronbach's α for the Sleep Hygiene Index is 0.66 and has good test-retest reliability ($r = 0.71$, $p < 0.01$). Total scores range from 0 to 52, with a higher score indicating worse sleep hygiene.^[16] The responses of various sleep hygiene practices in the Sleep Hygiene Index were recorded on the five-item Likert scale as Never, Rarely, Sometimes, Frequently and Always. These five

responses were categorized into two categories to analyse their association with sleep quality. We did not use cut off for sleep hygiene index as the Youdens index was low in ROC (Receiver Operating characteristic) analysis. (Supplementary Table 1)

The Pittsburgh Sleep Quality Index (PSQI) was used to assess the sleep quality of students in the past month. Its global score ranges from 0 to 21 with a higher score indicative of poorer sleep quality. A global PSQI score greater than 5 yielded a diagnostic sensitivity of 89.6% and specificity of 86.5% ($\kappa = 0.75$, $p < 0.001$) in distinguishing between good and poor sleepers. Therefore, participants with a PSQI score of ≤ 5 were considered to have good sleep quality, whereas those with a PSQI score > 5 were classified as having poor sleep quality.^[17]

The International Physical Activity Questionnaire - Short Form (IPAQ-SF) was used to assess the physical activity level of the students. It is an open-ended self-reported questionnaire that measures the type of intensity of physical activity and sitting time in daily life in the last 7 days in people aged 15 years and above. It is a validated tool having a good test-retest reliability and stability ($\alpha < 0.80$).^[18] As the IPAQ-SF does not provide a single composite score, the duration of moderate-to-vigorous physical activity and sitting time were used for analysis in accordance with the study objectives.

Self-reported percentage of marks in the last university exams (for the 1st year students, last board exam marks) and subjective satisfaction with the academic performance were used to determine the academic performance of the students. The subjective satisfaction level regarding academic performance was collected on a 5-item Likert scale. The categories of fully satisfied and satisfied to some extent were combined as satisfied, and unsatisfied and extremely unsatisfied as unsatisfied for analysis purposes. As the students were well-versed in the English Language, only the English versions of these scales were used for data collection.

Statistical Analysis

Data from Google Forms was downloaded into Microsoft Excel and analysed using the Statistical

Package for Social Sciences (SPSS version 28.0). Qualitative data were presented as frequency and percentages, and quantitative data as means and standard deviations. Normality of data was checked using a histogram, Q-Q plot, skewness, and kurtosis. The unpaired T-test and One-Way Anova were used to compare the mean SHI score among different demographic variables. Pearsons Chi-square test was used to see the association between individual hygiene practices and the prevalence of poor-quality sleep. To explore correlation between sleep hygiene index score and Global PSQI score, the Pearson correlation coefficient was calculated. Spearmans rho was used to see the correlation between sleep hygiene index score and duration of different quantitative variables. Multiple linear regression analysis was used to adjust for confounders for the mean score of the poor sleep hygiene index. The cutoff level for statistical significance was ≤ 0.05 .

Ethical consideration

The study was performed in accordance with the Declaration of Helsinki. Ethical approval was obtained from the Institutional Ethical Committee of the medical college vide letter no: KCGMC/IEC/2023/137 dated 15th June 2023. Written permission was also taken from the principals of the participating colleges. Informed consent was obtained from the participants before data collection. The participants were explained the aims of the study, their rights regarding participation in the study and the confidentiality of their responses before they responded to the questionnaire

RESULTS

The study questionnaire was shared with 600 randomly selected undergraduate students, out of which 541 completed it, yielding a response rate of 90.2%.

The mean age of participants was 20.51 ± 1.84 years and the proportion of female participants was 59.0%. This may be attributed due to a greater number of female students in paramedical courses or a higher response rate among female students. The number of students in the 4th year was only 10.7%, which could be due to exclusion of BSc 4th year Nursing students and

Table 1: Distribution and Association of demographic and lifestyle variables with mean SHI score among study participants

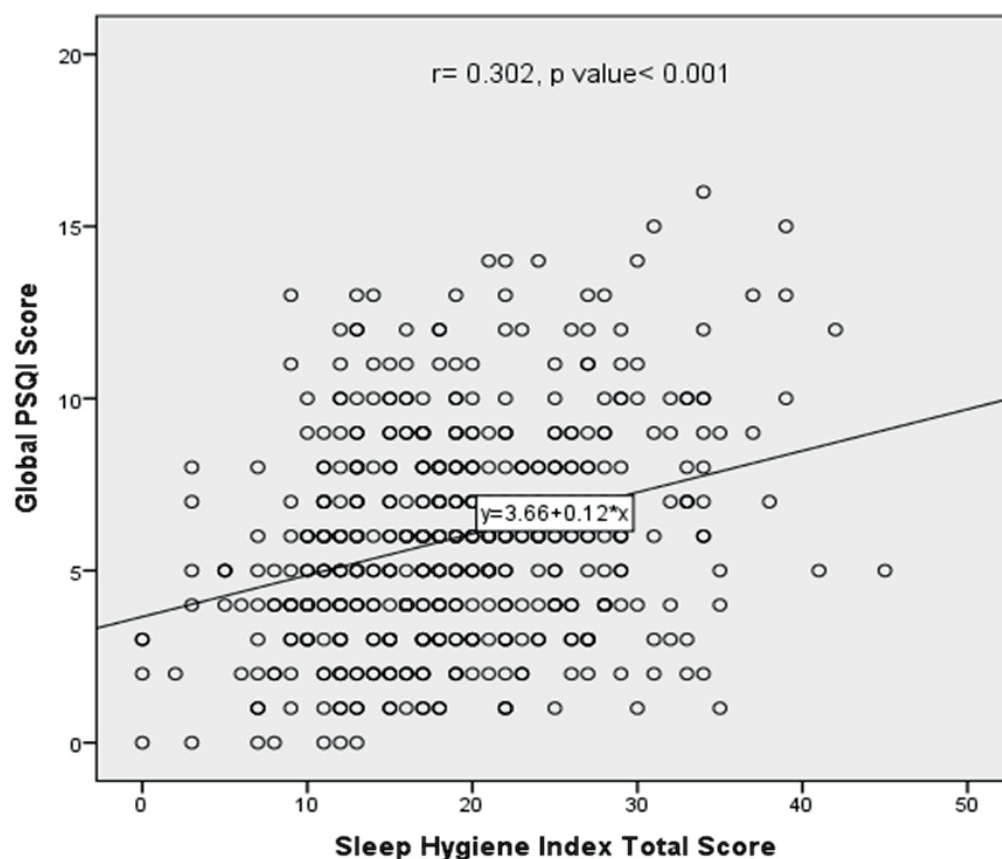
Variables		Frequency (N= 541) (Percentage)	SHI Score (Mean± SD)	Value of t- test or F- statistics	p value
Gender	Male	222 (41%)	17.91±7.91	-2.400	0.017*
	Females	319 (59.0%)	19.50±7.23		
Family Background	Rural	279 (51.6%)	18.63±7.77	-0.684	0.494*
	Urban	262 (48.4%)	19.08±7.35		
Type of Accommodation	Hostel	304 (56.2%)	19.44±7.20	14.239	<0.001#
	Paying Guest	69 (12.8%)	21.75±6.88		
	At home with parents or relatives	168 (31.0%)	16.58±7.92		
Study Course	MBBS	196 (36.2%)	19.53±6.75	13.127	<0.001#
	Paramedical courses (Physiotherapy and Nursing)	197 (36.4%)	20.14±7.66		
	Other Graduate courses	148 (27.4%)	16.22±7.88		
Year of study in the course	1st Year	232 (42.9%)	17.99±7.67	2.239	0.083#
	2nd Year	125 (23.1%)	19.95±8.04		
	3rd Year	126 (23.3%)	18.86±7.06		
	4th Year	58 (10.7%)	19.86±6.93		
Substance Abuse	Smoking	Yes	20 (3.7%)	2.055	0.040*
		No	521 (96.3%)		
	Alcohol	Yes	21 (3.9%)	2.728	0.007*
		No	520 (96.1%)		
	Other Drug Abuse (like bhang, ganja, cocaine, etc.)	Yes	05 (0.9%)	1.890	0.059*
		No	536 (99.1%)		
Screen Use	Smartphone	Yes	538 (99.4%)	1.650	0.100
		No	03 (0.6%)		
	Computer/ Laptop/ Tablet	Yes	204 (37.7%)	0.993	0.321
		No	337 (62.3%)		
	Television	Yes	128 (23.7%)	2.503	0.013
		No	413 (76.3%)		
Physical Activity	Play on Play station	Yes	110 (20.3%)	1.103	0.271
		No	431 (79.7%)		
	Walking for at least 10 minutes at a time	Yes	526 (97.2%)	0.577	0.564*
		No	15 (2.8%)		
	Moderate or vigorous physical activity other than walking	Yes	346 (63.96%)	2.339	0.020*
		No	195 (36.04%)		
Subjective Satisfaction with Academic Performance	Unsatisfied	90 (16.6%)	20.38±8.04	4.656	0.010#
	Neutral	153 (28.3%)	19.63±7.61		
	Satisfied	298 (55.1%)	17.98±7.31		
Sleep Quality	Good Quality (PSQId"5)	354 (65.4%)	16.51±7.45	-5.355	<0.001*
Poor Quality	(PSQI>5)	187 (34.6%)	20.08±7.35		

*Unpaired t-test,#One way ANOVA

Table 2. Distribution of individual Sleep hygiene practices among study participants

Sr. No	Sleep Hygiene Index Items	Responses [freq. (%)][n/N (N= 541)]				
		Never	Rarely	Sometimes	Frequently	Always
1	Daytime naps lasting two or more hours.	75 (13.9%)	155 (28.7%)	206 (38.1%)	52 (9.6%)	53 (9.8%)
2	Go to bed at different times from day to day.	72 (13.3%)	134 (24.8%)	178 (32.9%)	81 (15.0%)	76 (14.0%)
3	Get out of bed at different times from day to day	99 (18.3%)	175 (32.3%)	165 (30.5%)	52 (9.6%)	50 (9.2%)
4	Exercise to the point of sweating within 1 hour of going to bed.	267 (49.4%)	134 (24.8%)	93 (17.2%)	15 (2.8%)	32 (5.9%)
5	Stays in bed longer than one should two or three times a week.	121 (22.4%)	172 (31.8%)	51 (9.4%)	166 (30.7%)	31 (5.7%)
6	Use alcohol, tobacco, or caffeine within 4 hours of going to bed or after going to bed.	457 (84.5%)	36 (6.7%)	36 (6.7%)	08 (1.5%)	04 (0.7%)
7	Do something that may wake me up before bedtime (for example: play video games, use the internet, or clean).	210 (38.8%)	107 (19.8%)	141 (26.1%)	44 (8.1%)	39 (7.2%)
8	Go to bed feeling stressed, angry, upset, or nervous	122 (22.6%)	147 (27.2%)	190 (35.1%)	47 (8.7%)	35 (6.5%)
9	Use my bed for things other than sleeping (for example: watch television, read, eat, or study)	53 (9.8%)	95 (17.6%)	170 (31.4%)	95 (17.6%)	128 (23.7%)
10	Sleep on an uncomfortable bed (for example: poor mattress or pillow, too much or not enough blankets).	313 (57.9%)	109 (4.1%)	70 (12.9%)	22 (4.1%)	27 (5.0%)
11	Sleep in an uncomfortable bedroom (for example: too bright, too stuffy, too hot, too cold, or too noisy)	291 (53.8%)	107 (19.8%)	82 (15.2%)	26 (4.8%)	35 (6.5%)
12	Do important work before bedtime (for example: pay bills, schedule, or study)	71 (13.1%)	99 (18.3%)	194 (35.9%)	82 (15.2%)	95 (17.6%)
13	Think, plan, or worry when in bed.	82 (15.2%)	114 (21.1%)	172 (31.8%)	66 (12.2%)	107 (19.8%)

Figure 2. Correlation between sleep hygiene practices and sleep quality among study participants



differences in course duration as summarized in Table 1. Majority of the students walked for at least ten minutes at a time daily. However, nearly one third of students were not engaged in moderate or vigorous physical activity. The average total screen time was 281 minutes/day (nearly 5 hours/ day).

The mean score of the Sleep Hygiene Index among students was found to be 18.85 ± 7.57 . On bivariate analysis, sleep hygienic practices were poor (as indicated by significantly higher mean SHI scores) among females, students staying in hostel or in paying guests, enrolled in the MBBS and paramedical courses, smokers, alcohol users, lack of moderate to vigorous physical activity and academic dissatisfaction. Students with poor sleep quality had significantly higher SHI scores compared to those with good sleep quality (Table 1).

The most common poor sleep hygiene practice among study participants (in 41.3%) was regularly using the bed for things other than sleeping (for example:

watching television, reading, eating, or studying). Other frequently reported behaviours included, staying in bed longer than needed (36.4%); engaging in important work before bedtime like in study (32.7%); thinking, planning, or worrying in bed (32%), and everyday going to bed at different times (29%) as shown in Table 2.

Mean Sleep hygiene index score was positively correlated with sitting hours per day, duration of screen for non-academic purposes and total screen time. Moderate to vigorous physical activity duration per day showed a significant negative correlation with sleep hygiene index indicating that an increase in physical activity led to better sleep hygiene (Supplementary Table 2). A significant positive correlation between SHI and Global PSQI scores, indicating that poorer sleep hygiene was associated with poorer sleep quality is depicted in Figure 2.

The student having sleep hygiene practice to go and get out of bed at different times; use of beds for things

Table 3. Association of Sleep Quality with Individual Sleep Hygiene Practices

Sleep Hygiene Practices	Response on Likert scale	Good Quality (PSQId">5)	Poor Quality (PSQId">5)	P value
Daytime Nap of ≥ 2 hours	Never, Rarely, Sometimes Frequently, Always	152 (34.9%) 35 (33.3%)	284 (65.1%) 70 (66.7%)	0.767*
Go to bed at different times	Never, Rarely, Sometimes Frequently, Always	149 (38.8%) 38 (24.2%)	235 (61.2%) 119 (75.8%)	0.001*
Get out of bed at different times	Never, Rarely, Sometimes Frequently, Always	161 (36.7%) 26 (25.5%)	278 (63.3%) 76 (74.5%)	0.032*
Moderate/Vigorous exercise within 1 hour of bedtime	Never, Rarely, Sometimes Frequently, Always	170 (34.4%) 17 (36.2%)	324 (65.6%) 30 (63.8%)	0.809*
Stay in bed longer than expected	Never, Rarely, Sometimes Frequently, Always	122 (35.5%) 65 (33.0%)	222 (64.5%) 132 (67.0%)	0.561*
Use alcohol/ tobacco/ caffeine within 4 hours of going to bed or after going to bed.	Never, Rarely, Sometimes Frequently, Always	185 (35.0%) 02 (16.7%)	344 (65.0%) 10 (83.3%)	0.233#
Use things that wake me up before bedtime (internet or play videogames)	Never, Rarely, Sometimes Frequently, Always	170 (37.1%) 17 (20.5%)	288 (62.9%) 66 (79.5%)	0.003*
Go to bed feeling stressed, angry, upset or nervous	Never, Rarely, Sometimes Frequently, Always	175 (38.1%) 12 (14.6%)	284 (61.9%) 70 (85.4%)	<0.001*
Use of bed for things other than sleeping	Never, Rarely, Sometimes Frequently, Always	126 (39.6%) 61 (27.4%)	192 (60.4%) 162 (72.6%)	0.003*
Sleep on an uncomfortable bed	Never, Rarely, Sometimes Frequently, Always	175 (35.6%) 12 (24.5%)	317 (64.4%) 37 (75.5%)	0.120*
Sleep in an uncomfortable bedroom	Never, Rarely, Sometimes Frequently, Always	172 (35.8%) 15 (24.6%)	308 (64.2%) 46 (75.4%)	0.082*
Do important work before bedtime	Never, Rarely, Sometimes Frequently, Always	129 (35.4%) 58 (32.8%)	235 (64.6%) 119 (67.2%)	0.540*
Think, plan, and worry when in bed	Never, Rarely, Sometimes Frequently, Always	139 (37.8%) 48 (27.7%)	229 (62.2%) 125 (72.3%)	0.022*

*Pearson's chi-square test, #Fisher Exact test

Table 4. Multiple linear regression analysis for predictors of Sleep Hygiene Index Score

Variables		Sleep Hygiene Index Score ^a OR (95% CI)	p-value
Gender	Male	Reference Category	0.016
	Female	1.67 (0.32- 3.02)	
Sleep Quality	Good	Reference Category	<0.001
	Poor	2.69 (1.37- 4.02)	
Duration of screen use for non-academic purposes		0.09 (0.002- 0.017)*	0.013
Duration of screen use for academic purposes		-0.011 (-0.018- -0.004)*	0.004

aOR: adjusted odds ratio, CI: Confidence Interval, *beta coefficient (β)

other than sleeping like studying, eating or watching television; use of things like the internet before bedtime; to go to bed feeling stressed, angry, upset or nervous; and worry, think or plan when in bed had a significantly higher prevalence of poor sleep quality (Table 3).

A multiple linear regression analysis was conducted to examine the predictors of sleep hygiene, as measured by the total Sleep Hygiene Index (SHI) score and to adjust for potential confounding. The dependent variable was the total SHI score, and covariates were variables with a p-value <0.20 in the bivariate analysis. After adjusting covariates, female gender, poor sleep quality, and increased non-academic screen time were significantly associated with higher SHI scores indicating poorer sleep hygiene. In contrast, greater screen time for academic purposes was associated with better sleep hygiene (Table 4).

DISCUSSION

This cross-sectional study aimed to evaluate sleep hygiene practices and their association with sleep quality among undergraduate students. The mean score of sleep hygiene index was 18.85 ± 7.57 , comparable to that reported by **Seun-Fadipe et al** among Nigerian Undergraduate Students (Mean SHI of 19.0 ± 6.31).^[15] **Kaur et al** reported a higher mean SHI (31.27 ± 6.09) in their study among undergraduate students of Chandigarh city, India which is attributed to different scoring of the Likert scale from 1- 5 instead of 0-4 in our study and studies conducted in other countries.^[19] Other studies conducted in India and other countries reported higher mean SHI score. It might be due to inclusion of different streams of students and cultural context regarding sleep practices.^[6,10]

This study findings revealed that female students had 1.64 times more likely to have higher SHI score than males. This is consistent with a previous study by **Molla et al**.^[9] It may be due to higher stress sensitivity, hormonal fluctuations, and difference in psychological status in females.^[20,21] Another significant predictor of higher SHI score is screen use for non-academic purposes. Specifically, each additional minute spent on

non-academic screen use was associated with a 0.09-point increase in SHI score. In contrast, greater screen time for academic purposes was associated with better sleep hygiene. This distinction between academic and non-academic screen time suggests that the purpose of screen use, rather than total duration alone, may be more relevant in determining its impact on sleep behaviours. There might be possibility that screen use for academic purpose may be during the daytime while for non-academic purposes may be just before sleeping after finishing off the days tasks which negatively affects the sleep. This is also evident from association of internet use before bedtime (a component of sleep hygiene practice) with poor sleep quality. Studies of **Rezaei et al** and **Kumari et al** also reported that mobile use before going to bed had a significant association with poor sleep quality.^[22,23] Exposure to blue light from screens, particularly before bedtime, can delay melatonin secretion and disrupt circadian rhythms, thereby impairing sleep quality and sleep-related behaviours. Light emitting devices also delay the chosen bedtime and alertness.^[24,25,26]

This study found a significant positive correlation between sleep hygiene and sleep quality, as measured by the Sleep Hygiene Index (SHI) and the Pittsburgh Sleep Quality Index (PSQI), respectively. Other studies also reported similar results.^[11,13] Students with poor sleep quality are 2.69 times more likely to have worse sleep hygiene compared to those with good sleep quality underscoring the detrimental impact of poor sleep hygiene practices on sleep outcomes. These findings are consistent with existing literature that supports a strong link between sleep hygiene behaviours and sleep quality among college students.^[6,24,27]

Certain individual sleep hygiene behaviours were significantly associated with poor sleep quality on bivariate analysis. Participant behaviour of going to bed and getting out of bed at different times is significantly associated with poor sleep quality. Irregular sleep-wake schedules are known to disturb circadian rhythms and delay sleep onset.^[28] Additionally, using the bed for activities other than sleep can weaken the cognitive association between the bed and sleep, thereby impairing

sleep onset and maintenance.^[29] Psychological factors of sleep hygiene practices also played a notable role in sleep quality. Students who went to bed feeling stressed, angry, or upset, or those who engaged in thinking, planning, or worrying in bed, exhibited significantly poorer sleep quality. These findings align with previous research identifying cognitive hyper arousal as a contributor to sleep disturbances, particularly insomnia.^[30]

Strengths and Limitations:

This study included diverse samples of undergraduate students from medical, paramedical, and non-professional courses using stratified random sampling, enhancing representativeness. The use of validated instruments (SHI, PSQI, IPAQ-SF) strengthens measurement reliability. Multivariable regression analysis further improves the robustness of findings by adjusting for potential confounders. This study has some limitations. Due to the cross-sectional nature of the study design, a causal relationship between outcome and independent variables could not be established. Reliance on self-reported data may be subject to recall or social desirability bias. As the study was conducted in a single North Indian city, generalization to other regions, age groups, or non-college populations should be done with caution.

Conclusion

This study highlights the prevalent sleep hygiene practices leading to poor sleep quality among undergraduate students enrolled in various professional and non-professional courses. Female gender and higher non-academic screen use are associated with poorer sleep practices. The findings underscore the need for targeted interventions at individual levels such as promoting regular sleep schedules, limiting recreational screen exposure before bedtime, fostering stress management skills, and encouraging active lifestyles to improve sleep hygiene and overall well-being among students. Educational programs promoting healthy sleep habits should be integrated into university wellness initiatives to support students' academic and mental well-being.

Declaration:

Conflict of Interest: There is no conflict of interest.

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Use of AI: Artificial intelligence (AI) tools were used only to assist with language refinement in the manuscript. AI was not used for study design, data collection, data analysis, interpretation of findings, generation of scientific content, or drawing conclusions. All outputs were reviewed, verified, and approved by the authors, who remain fully responsible for the final content of the manuscript.

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Family Adoption Programme: Perception and Feedback of Families- A Cross-Sectional Study

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Abstract:

Introduction: The Family Adoption Programme (FAP), introduced under the Competency-Based Medical Education curriculum of the National Medical Commission, links undergraduate medical education with community-based healthcare. Evidence from the perspective of adopted families remains limited. This study was conducted to assess the perception and feedback from adopted families regarding the family adoption programme. **Methods:** A community based cross-sectional study was conducted in one village of Bhavnagar, Gujarat during May – June 2026. All adopted families available during the period of data collection of 7 days were approached and 103 families participated. One adult respondent from each family was interviewed at home using semi-structured questionnaire. Data were summarized using descriptive statistics. **Results:** Medical students were the primary source of information regarding FAP for 85.4% of the respondents. Most of the families (66%) perceived FAP primarily as a means of receiving free healthcare at home and it facilitates early disease detection (86.4%). Health education, blood pressure measurement, anthropometric assessment and information on government schemes were found to be the most expected services of families. Most of the respondents (96.1%) rated student's communication skills as good and 75.7% said students were confident. However, 90.3% families reported irregular follow-up by students. Help in healthcare assess and increasing the frequency of family visits were most frequently suggested improvements. **Conclusion:** The adopted families perceived FAP positively for early diseases detection and providing free healthcare and valued student's communication and knowledge skills. However, most families reported irregular follow up by students and requested support in navigating healthcare services.

Keywords: Family, Health Knowledge, Medical Education, Rural Population, Undergraduate

Introduction:

The National Medical Commission (NMC) introduced the Family Adoption Programme (FAP) under the Competency-Based Medical Education (CBME) curriculum in 2022 with the objective of exposing undergraduate medical students to real-life community health problems while simultaneously strengthening preventive, promotive, and primary healthcare services at the household level. Under this programme, medical students adopt families residing in rural or underserved communities and periodically visit

them to assess health needs, provide health education, monitor chronic diseases, promote healthy behaviours, facilitate access to healthcare services, and develop long-term doctor patient relationships.¹

The FAP has been modelled on successful community-oriented education programme of the Sewagram Model of the Mahatma Gandhi Institute of Medical Sciences (MGIMS), which has demonstrated that continuous interaction between students and families promotes mutual trust and facilitates early identification of health problems.²

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Previous studies evaluating the family adoption programme have primarily focused on students learning experiences, competency development, and faculty perspectives.³⁶ However, the ultimate beneficiaries of the programme are the adopted families, whose perceptions regarding the acceptability, usefulness, quality and effectiveness of the programme remain relatively underexplored. The success and sustainability of FAP also depends on the acceptance and active participation of the families and communities. Therefore, understanding families experiences is essential for identifying programme strengths, implementation gaps and opportunities for improvement.

The present study was therefore undertaken to assess the perception and feedback from adopted families regarding the family adoption programme.

Methodology:

A community-based cross-sectional study was conducted to assess the perception and feedback regarding the family adoption programme (FAP) among adopted families in May-June 2026. This study was conducted in a village where families were adopted under FAP in 2023 by medical college of Bhavnagar, Gujarat. The study population comprised family members belonging to adopted families. There were total 213 adopted families in village. All the adopted families available during data collection period were included in study and data of 103 adopted families were collected in duration of 7 days by the investigators. One respondent from each family was interviewed. Preference was given to the head of the family whenever available; otherwise, another available adult family member was interviewed. Families which were unavailable during visits and unwilling to participate in study were excluded.

Data were collected using a pre-designed, semi-structured questionnaire developed to assess socio-demographic characteristics, awareness regarding the FAP, expectations from medical students, perceived benefits, communication experiences, confidence of students, suggestions for improvement and overall feedback. The questionnaire was pilot tested before the commencement of study and necessary modifications were made. Investigators conducted house-to-house visits for data collection and ensured confidentiality after obtaining informed verbal consent.

For this study, regular follow up was defined as contact with adopted families by student at least once every one or two months, either through a telephonic conversation or an in-person visit. The categories used to assess communication skills and confidence of students knowledge were based on Likert scale response options included in questionnaire. Regarding suggestions for improvement in FAP, suggestions were collected through an open-ended question, allowing respondents to express their views. The responses were subsequently reviewed and grouped into common categories.

Collected data were entered into Microsoft Excel and analysis was done. Descriptive statistics were used to summarize the findings. Ethical approval for the study was obtained from the Institutional Ethics Committee.

Result

A total of 103 adopted families were included in study. One adult respondent represented each family. Among the respondents, 84 (81.6%) were female and 19 (18.4%) were male. Female respondents included 31 (30.1%) wives and 30 (29.1%) daughters-in-law of the head of the family; 29 (28.2%) respondents were heads of families, 7 (6.8%) were daughters, and 6 (5.8%) were sons. Regarding the education status of respondents, 75 (72.8%) had received formal schooling and rest were illiterate. Monthly family income was below Rs. 10,000 in 37 (35.9%) families, Rs. 10,000 - 25,000 in 46 (44.7%), and 25,000-50,000 in 10 (9.7%); 10 (9.7%) preferred not to disclose income.

Regarding awareness and perception, medical students were the main source of information about FAP for 88 (85.4%) respondents. Sixty-eight (66.0%) families perceived free healthcare at home as the primary purpose of FAP. (Table 1) Most of the families expected students to provide health education on nutrition and diet (52.9%) and prevention of diseases (49%). Majority of the families (67%) said that they trusted and followed the advice given by students during house visit.

When families were asked about their perception on effectiveness of FAP, 89 (86.4%) respondents said that FAP facilitates early disease detection, more than 90% considered it beneficial for strengthening of community health and expressed willingness for continuation with programme. However, only 9 (8.7%) reported newly

Table 1. Awareness, perception and expectations of families regarding the family adoption programme (N = 103)

Variable	Response	n (%)
Main source of information	Medical students	88 (85.4)
	Accredited Social Health Activist (ASHA)	4 (3.9)
	Anganwadi worker	7 (6.8)
	Neighbours	4 (3.9)
Perceived primary purpose of FAP	Free healthcare at home	68 (66.0)
	Student learning	13 (12.6)
	Hospital linkage	7 (6.8)
	Not aware	15 (14.6)
Expected activities from students*	Provide health education	74 (72.0)
	Blood pressure measurement	43 (41.7)
	Anthropometry	37 (35.9)
	Information on government schemes	37 (35.9)
	Asking about health problems	24 (23.3)
	Give Treatment/medicines	23 (22.3)

*Multiple responses allowed

(Note: The variable 'main source of information' is presented as an awareness-related programme exposure variable; it does not by itself establish whether respondents understood the formal NMC objectives of FAP. The categories of perceived primary purpose should therefore be interpreted as respondent's perceptions rather than as evidence of alignment with NMC-defined programme objectives.)

Table 2. Family's feedback and suggestions for improving the family adoption programme (N = 103)

Variable	Response	n (%)
Communication skills of students	Good	99 (96.1)
	Poor	4 (3.9)
Confidence in students knowledge	Very confident	78 (75.7)
	Somewhat confident	16 (15.6)
	Neutral	4 (3.8)
	Not confident	5 (4.8)
Regular follow-up by student	Maintained	10 (9.7)
	Not Maintained	93 (90.3)
Assistance during hospital visits	Received assistance	12 (11.6)
	Needed but not received	22 (21.4)
	Never required	69 (67.0)
Suggestions for improvement in FAP*	Help in healthcare access	52 (50.5)
	Increase visit frequency	44 (42.7)
	More health education	42 (40.7)
	No changes required	26 (25.3)

*Multiple responses allowed

detected conditions such as anaemia, hypertension or diabetes in family by FAP implementation. Seventy-eight (75.7%) respondents considered FAP to be a long-term sustainable programme.

Most of the families (96.1%) appreciated medical students communication skills and reported as good, also 75.7% said that the medical students seemed well trained and very confident in their knowledge. However, 90.3% families reported irregular follow-up by students because they were visiting families only once a year. Regarding suggestions for improvement in programme, 50.5% respondents suggested that they need help in accessing healthcare facilities, while increasing visit frequency (42.7%) and increasing health education (40.7%) were common suggestions. (Table 2)

When respondents were asked about the problems or inconvenience faced due students visits at their house. Eighty-six (83.5%) reported no problem. Nine (8.7%) reported that expectations from the visit were not met, 7 (6.8%) found the time of visit inconvenient, and 6 (5.8%) reported that students asked repetitive questions.

Discussion

The present study evaluated the perception and feedback regarding the family adoption programme among adopted families in a rural village of Bhavnagar, Gujarat. Medical students were the main reported source of information for 85.4% of the respondents. This finding indicates that direct interaction between students and families remain the primary mechanism through which awareness regarding programme is generated. Majority of them perceived FAP as a source of free healthcare at home. A qualitative study conducted by Shree A, et al. (2026)⁷ also reported that receiving medical guidance or referral and emotional support were the thematic perspectives as per adopted families. This suggests that rural families primarily value free healthcare at doorstep, health education and guidance because it is a direct and immediately useful benefit that they can apply to their daily lives. Because the questionnaire assessed perceived purpose rather than respondents actual knowledge on objectives of FAP implementation, these findings does not establish inadequate awareness of objectives of FAP among rural population.

Families primarily expected students to perform blood pressure measurement, anthropometric assessments and awareness regarding government health schemes. This finding suggests that rural families give more importance to basic health check-ups and are often interested in getting themselves examined at home, because to avail these services they have to visit health facility from their daily work.

Majority (86.4%) of the families believed that FAP contributes to early detection of diseases and over 90% believed that it strengthens the community health. These findings were consistent with the findings of Gupta P, et al (2025)⁸, in which around 94% of participating families considered FAP useful for early disease detection and improving community health. Basic health screening at home, health education, counselling and advices on referral are likely to contribute to these perceptions.

In present study, less than 10% of the respondent reported detection of illness in family underprogramme implementation. NMC has suggested the medical colleges to conduct diagnostic medical camp in the village where in identification of communicable and non-communicable diseases and other local problems should be addressed.¹ However, the limited diagnostic facilities available during household visits and reliance on basic clinical screening and students skills may have restricted the programme's ability to identify new disease.

NMC has suggested total of 20 visits to the adopted family by medical students in three professional years which includes total of nine visits in first year, six visits in second year and five visits in third year, which should be arranged by institute.¹ However, in present study 90.3% families reported that regular follow up was not maintained by medical students and they were only visiting families one time in a year. Also, twenty-two (21.4%) families, which required help during hospital visit for illness related cause said that they did not receive assistance when required. These findings reflect less follow-up visits than recommended by NMC. However, irregularity of visits should not necessarily be attributed to lack of student participation or lack of compliance by student. Additionally, families may not have clear channels to contact students.

Familys suggestions like assistance in accessing healthcare facilities, increasing frequency of visits and health education for improvement of programme, indicates that beneficiaries expect the programme to move beyond periodic household visits. Future multicentric studies involving larger populations would provide stronger evidence regarding the long-term impact of the programme.

Conclusions

The present study found that adopted families under FAP were perceiving programme as an effective initiative for facilitating early disease detection and promoting community health. Providing free healthcare services at home was perceived as a primary purpose of FAP implementation as per families.

Medical students were having good communication skills and were confident in their knowledge as per families. As per the respondents, regular follow up of family was not maintained by the students. Providing assistance in healthcare access, increasing frequencies of house visits and providing health education were the common suggestions from the families for programme improvement.

Limitations

This study was conducted in a single village involving 103 families, which may not represent the perceptions of rural communities in other geographic settings. The information was collected from one member representing the family, which is also subjected to recall bias and social desirability bias, particularly because respondents may have wished to provide favourable opinions regarding medical students and also it may not capture differing views among other family members. The study did not objectively verify the number of visits completed against the NMC schedule, and therefore the reasons for the reported low frequency of visits cannot be established.

Recommendations

Based on the study findings, the institute should ensure implementation of the prescribed schedule of family visits as per NMC norms. A structured schedule for follow-up visits should be developed and monitored by concerned department. During these visits, students should provide or facilitate assistance with hospital visits

and referrals when required, with appropriate documentation of such support.

Declaration:

Conflict of Interest: nil

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Use of AI: nil

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Awareness of Sexual and Reproductive Health among School Going Adolescents of Thiruvananthapuram Corporation

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Abstract:

Introduction: Despite escalating adolescent reproductive health risks, high-literacy regions like Kerala exhibit a paradox where advanced development indicators mask critical youth knowledge gaps. **Objectives:** This study aims to assess sexual and reproductive health (SRH) awareness and its key determinants among higher secondary school students in the urban setting of Thiruvananthapuram Corporation, Kerala. **Methods:** A school based cross sectional study was conducted among 420 adolescents in ten higher secondary schools of Thiruvananthapuram corporation. Stratified two-stage cluster sampling was employed to select the study participants. Data was collected using self-administered semi structured questionnaire. Chi square test was done to find out factors associated with higher awareness and multivariable analysis was done using binary logistic regression. **Results:** Majority (67.9%) of the study participants had moderate awareness. In the domain of pregnancy half of the participants had poor awareness. Less than two thirds of participants could identify STD other than HIV/AIDs. Only half (49%) of the participants had received formal sex education. Studying in the biology stream ($p = 0.002$), following the Central Board of Secondary Education (CBSE) syllabus ($p = 0.01$), and the ability to communicate about sex-related matters with cousins ($p = 0.008$) were significant determinants of sexual and reproductive health awareness on multivariable analysis. **Conclusion:** Most participants had only moderate sexual and reproductive health awareness, with notable gaps in awareness of pregnancy, STDs, social and legal aspects. Awareness was significantly influenced by academic stream, syllabus, and the ability to discuss sex-related matters with cousins.

Keywords: Puberty, Reproductive Health Services, Sexual behaviour, Sex Education, sexually transmitted diseases

Introduction:

The World Health Organization (WHO) defines sexual health as a “state of physical, emotional, mental,

and social well-being related to sexuality, requiring a positive, respectful approach and the protection of sexual rights”^[1] and reproductive health is “complete

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physical, mental, and social well-being in all matters relating to the reproductive system, its functions, and processes, and not merely the absence of disease or infirmity.”^[2]

Adolescence represents a critical transitional period characterized by profound physical, cognitive, emotional, and social development.^[3] They are an important demographic for sexual and reproductive health (SRH) awareness and services as they are in a formative stage of developing sexual identities and behaviors that can have a lasting influence on attitudes and practices in adulthood.^[4] India has one of the largest adolescent population in the world, with every fifth person belonging to this age group.^[5]

Globally, adolescents and young adults bear a disproportionate burden of sexually transmitted diseases, with over one million new infections occurring each day.^[6] In addition, approximately 21 million pregnancies occur annually among adolescents, nearly half of which are unintended, and a substantial proportion end in abortion.^[7]

In India, sexual abuse and violence against children and adolescents are alarmingly increasing with sexual offences accounting for nearly 39% of the registered crimes.^[8] This may directly contribute to the adolescent fertility rate of 43 per 1000 women aged 15-19 years.^[9]

Available evidence suggests that SRH awareness among Indian adolescents remains inadequate, with nearly half demonstrating poor levels of awareness.^[10] Similarly, a study among adolescent girls reported that only 57.8% were aware of contraceptive methods, while knowledge of sexually transmitted diseases (STDs) was limited to 14%.^[11] This lack of awareness may predispose adolescents to misconceptions and unhealthy practices related to reproduction and sexuality which can have significant public health implications.^[3,12]

Kerala, despite its high literacy rates and relatively advanced health indicators, is not immune to these challenges. This presents a unique paradox: although general education and access to healthcare are superior, specific knowledge gaps in SRH may still exist and may be masked by the state's overall development indices. This underscores the need for localized evidence-based assessment of SRH awareness.

Therefore, this study was designed to address this crucial gap by systematically evaluating the awareness of sexual and reproductive health among adolescents in a specific, high-literacy urban setting. The findings may provide important evidence for policymakers and educators to design and implement targeted, context-specific interventions that empower adolescents to make informed, healthy, and safe decisions regarding their sexual and reproductive health. The objective of the study was to assess the current state of SRH awareness and its key determinants among higher secondary school students in Thiruvananthapuram corporation.

Methods

Design and setting

A school-based, cross-sectional study design was conducted from April 2021 to December 2022 in both government and private higher secondary schools of Thiruvananthapuram corporation after obtaining clearance from Institutional Ethics Committee of Government Medical College Thiruvananthapuram (HEC No. 04/09/2021/MCT). Thiruvananthapuram corporation spans an area of 214.86 km² and serves a population of approximately 957,730 across 100 municipal wards.

Study participants

Adolescents enrolled in higher secondary schools within Thiruvananthapuram corporation, who provided written informed assent to participate, along with written informed consent from parents or guardians, were included in study. Those absent on the day of data collection or unable to participate due to illness or cognitive/communication difficulties were excluded.

Sample size and sampling

Sample size was estimated using the prevalence of sexual health awareness as 28%^[14] with a relative precision of 5.6% (20 % of prevalence) at 5 % significance level. After applying a design effect of 1.5 and 10 % non-response rate the sample size was estimated to be 420.

A stratified two-stage cluster sampling was employed, with the higher secondary schools serving as clusters. The list of higher secondary schools of

Thiruvananthapuram corporation was obtained from the District Education Officer (DEO). Each school division comprised an average of 45–55 students.

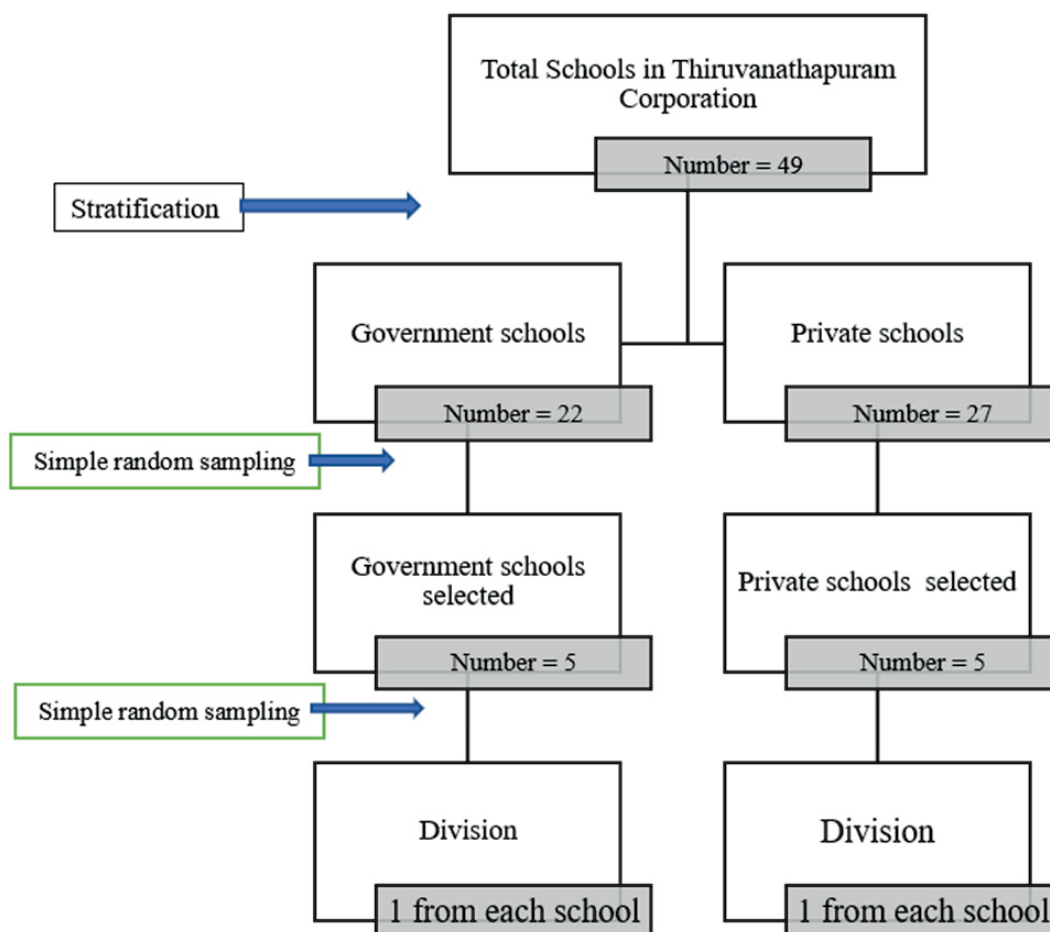
In the first stage, schools were stratified based on private and government categories. After obtaining the list of the schools in each stratum, using computer-generated random numbers, five schools were selected from each stratum by simple random sampling, yielding a total of 10 schools.

In the second stage, one division was randomly selected from each school using computer-generated random numbers. The minimum required division strength needed was $420/10 = 42$ students. If the selected division had fewer than 42 students, the next division was selected using the subsequent random number. All students in the selected divisions were enrolled until the required sample size was achieved. (Figure 1)

Data collection tool and technique

After obtaining permission from District Education Officer (DEO), the institutional heads, written assent from the study participants and written informed consent from parents/guardians, data were collected using a semi structured questionnaire which was self-administered. It was face and content validated and pilot-tested before administration, and it showed good internal consistency (Cronbach's $\alpha=0.878$). The content validation of the questionnaire was performed by a panel of 6 subject experts with expertise in community medicine, adolescent health and reproductive health. The experts reviewed the questionnaire for relevance, clarity, comprehensiveness, and appropriateness of the items, and the tool was revised based on their feedback. The questionnaire was pilot tested among 50 adolescents not included in the main study to assess clarity, acceptability,

Figure 1: Flow chart showing the sampling technique used in the study



and completion time. Necessary modifications were made before final administration. The questionnaire included items on sociodemographic characteristics and the domains on sexual and reproductive organs and secondary sexual characteristics (7 items); pregnancy (5 items); sexually transmitted infections and HIV (31 items); sexual practices (6 items); contraceptives (18 items); and sociocultural and legal aspects (8 items). Each correct response was scored 1 and each incorrect response as 0 (no negative marking), with a maximum score of 75. Awareness scores were categorized using an a priori modified Bloom's cutoff framework.^[15] Participants scoring more than 60 (80% of total score) were classified as having good awareness, those scoring 30 to 60 as having moderate awareness, and those scoring less than 30 (40% of total score) as having poor awareness. Domain wise cut-offs were also made using the same criteria.

The primary outcome variable was awareness of sexual and reproductive health. The independent variables were sociodemographic variables namely age, gender, religion, socioeconomic status (based on ration card), family type, parental education and occupation; school related factors, including type of school, syllabus and stream), communication-related factors, including receipt of formal sex education, source of first-hand information on sex-related matters, and communication regarding sex-related issues.

Strict confidentiality and privacy were maintained throughout data collection with all the data used exclusively for research purposes.

Data analysis

Data was entered in Microsoft Excel and was analyzed using IBM SPSS 27 version (Armonk, NY, USA). The awareness of sexual and reproductive health was expressed in terms of frequency and proportion.

Chi-Square test was done to assess the statistical significance between the determinants like sociodemographic factors (age, gender, religion, class, type of school, syllabus, stream, education status of father and mother, occupation of father and mother, income status, type of family), whether they received formal sex education or not, ability to communicate

regarding sex related matters and from where the study participants received first-hand knowledge about sex related matters and level of awareness regarding sexual and reproductive health. Since the scores followed a non-normal distribution Kruskal Wallis test was used to compare the scores across variables like age, religion, school management and source of firsthand knowledge regarding sex related matters.

A multivariable binary logistic regression model was constructed using the "Enter" method to determine independent predictors of sexual and reproductive health. Participants with moderate or good awareness were categorised as having good awareness, while rest were classified as having poor awareness, this dichotomisation was used for binary logistic regression to facilitate clear interpretation and communication of the findings. All factors that demonstrated a p value < 0.05 during bivariable analyses were included in constructing the final model. The overall model fit was measured using Nagelkerke's R-squared, while model calibration was assessed through the Hosmer–Lemeshow test.

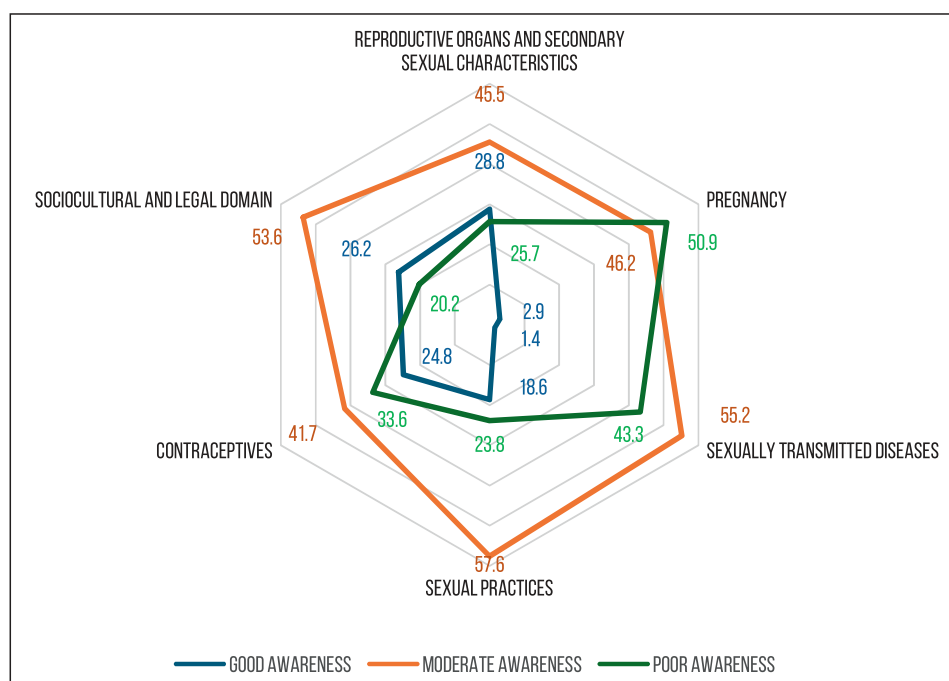
Results

Our study included 238 (56.7%) females and 182 (43.3%) males with mean age of 16.67 (0.61) years. Majority of the students followed Hindu religion 305 (72.6%). A total of 130 (31.0%) students studied in 11th class, and rest 290 (69.0%) studied in the 12th class. Most of 302 (71.9%) the students followed state syllabus and 118 (28.1%) followed CBSE syllabus. Biology-mathematics 124 (29.5%) was the most common stream, followed by computer-mathematics 100 (23.8%). Majority 254 (60.5%) were from Above Poverty Line (APL) families. Education level above high school was present in 243 (55.7%) fathers and 270 (64.3%) mothers. However, only a small proportion 124 (29.5%) of mothers were skilled workers compared to 292 (69.5%) fathers. (Table 1)

Majority of the study participants [285 (67.9%)] had moderate awareness and 117 (27.9%) had poor awareness of SRH. In all the domains also, majority had moderate awareness. Domain wise awareness is depicted in Figure 2.

Table 1: Baseline Information of Study Participants

Baseline characteristic	n	%
Age		
15	11	2.6
16	136	32.4
17	252	60
18	21	5
Gender		
Male	182	43.3
Female	238	56.7
Religion		
Hindu	305	72.6
Muslim	61	14.5
Christian	51	12.1
Others	3	0.7
Class		
11	130	31
12	290	69
Type of school		
Government	210	50
Private school	210	50
School management		
Central Government	39	9.3
Unaided school	79	18.8
Aided school	131	31.2
State Government	171	40.7
Syllabus		
CBSE	118	28.1
State syllabus	302	71.9
Stream		
Biology Mathematics	124	29.5
Computer Mathematics	100	23.8
Commerce	97	23.1
Bio Psychology	31	7.4
Humanities	31	7.4
Biology Hindi	23	5.5
Biology Sanskrit	14	3.3
Income level		
Above Poverty Line	254	60.5
Below Poverty Line	166	39.5
Type of family		
Joint/extended	69	16.4
Nuclear	351	83.6
Father's education		
Intermediate degree or more	234	55.7
High school degree or less	186	44.3
Mother's education		
Intermediate degree or more	270	64.3
High school degree or less	150	35.7
Father's occupation		
Skilled worker or more	292	69.5
Less than skilled work	128	30.5
Mother's occupation		
Skilled worker or more	124	29.5
Less than skilled work	296	70.5

Figure 2: Spider Diagram Showing Domain-wise Awareness Of SRH Among Study Participants.

Only 197 (46.9%) were aware that night emission is a normal physiologic process and 97 (23.1%) were aware of the most fertile period of menstrual cycle. Regarding sexually transmitted diseases, 387 participants (92.1%) correctly recognized HIV/AIDS as an STD, while fewer than two-thirds identified other STDs. The awareness of contraceptives other than condom was less than 50%. While 363 (86.4%) knew about the legal age of marriage of men, only 43.3% knew the women's legal age of marriage. (Table 2)

Only 206 participants (49.0%) had received formal sex education. Although 324 participants (77.1%) reported being able to discuss sex-related matters with friends, only 166 (39.5%) and 44 (10.5%) could do so with their mothers and fathers, respectively. Communication with mothers was reported by more than half of the female participants (138, 58.0%), compared with 28 (15.4%) male participants. In addition, only 222 participants (52.9%) expressed a positive opinion regarding communication about sexual matters with health professionals. The majority of the study participants reported friends as their primary source of first-hand information on sex-related matters (183, 43.6%), followed by social media and the internet (67, 16.0%).

For bivariable analysis using chi square test study participants having good and moderate awareness were considered as having good awareness about sexual and reproductive health and those having poor awareness was considered as having poor awareness about sexual and reproductive health. Awareness of sexual and reproductive health was associated with studying in the biology stream, APL family status, nuclear family type, higher parental education, higher parental occupational status, receipt of formal sex education and communication about sex related matters with fathers and cousins (Table 3).

Differences in sexual and reproductive health scores based on demographic and educational variables were analysed using the Kruskal-Wallis test. Statistically significant differences in final scores were observed only across age categories and school management types. (Figure 3)

Binary logistic regression was done to find out the determinants of good awareness about sexual and reproductive health. Factors that were found to have a significant association in the bivariable analysis were included in the model. The model to assess the determinants of good awareness about sexual and reproductive health was found to be significant at p

Table 2: Table Showing Domain Wise Awareness Regarding Sexual and Reproductive Health

Statement	Correct awareness	
	n	%
Reproductive organs and secondary sexual characteristics		
Babies are delivered through vagina	366	87.1
Penile discharge during ejaculation contains sperm	271	64.5
Pubic hair and axillary hair growth are secondary sexual characteristics	310	73.9
Night emission is a normal physiologic process	197	46.9
Pregnancy		
Most fertile period during the menstrual cycle is 12-16 days before menstruation	97	23.1
Absence of menstruation is an indicator of pregnancy	318	75.7
Sexually transmitted diseases		
Syphilis	121	28.8
Herpes	82	19.5
HIV/AIDS	387	92.1
Hepatitis B	109	26
Route of transmission of STDs		
Sexual contact	392	93.3
Through contaminated syringes	297	70.7
Symptoms		
Foul smelling genital discharge	113	26.9
Burning sensation during micturition	119	28.3
Swelling in genital area	109	26.0
Ulceration in genital area	67	16.0
Complications		
Abortion	177	42.1
Infertility	163	38.8
Cancer	96	22.9
Sexual practises		
Multiple sexual partners is a risky sexual practise	286	68.1
Sex with condoms is a safe sexual practise	262	62.4
Sex with HIV positive individual is risky	327	77.9
Sex under the influence of drug is risky	229	54.5
Contraceptive methods		
Condoms	347	82.6
Copper T	185	44.0
Implants	132	31.4
Sociocultural legal domain		
Legal age of marriage of men	363	86.4
Legal age of marriage of women	182	43.3
Age of valid consent for an act of sexual intercourse	231	55.0
Heard about MTP Act	144	34.3

Table 3: Bivariable Analysis of Factors Associated with Awareness of Sexual and Reproductive Health

Factor	Good awarenessn (%)	Poor awarenessn (%)	P	OR (95% CI)
Gender				
Male	131 (72.0)	51 (28.0)	0.95	0.99 (0.64-1.52)
Female	172 (72.3)	66 (27.7)		
Class				
12	217 (74.8)	73 (25.2)	0.07	1.52 (0.97-2.38)
11	86 (66.2)	44 (33.8)		
Type of school				
Private	156 (74.3)	54 (25.7)	0.33	1.24 (0.81-1.89)
Government	147 (70.0)	63 (30.0)		
Syllabus				
CBSE	111 (94.1)	7 (5.9)	<0.001	9.08 (4.09-20.19)
State syllabus	192 (63.6)	110 (36.4)		
Stream				
Studies biology	161 (83.9)	31 (16.1)	<0.001	3.14 (1.97-5.03)
Does not study biology	142 (62.3)	86 (37.7)		
Income status				
APL	198 (78.0)	56 (22.0)	0.001	2.05 (1.33-3.17)
BPL	105 (63.3)	61 (36.7)		
Type of family				
Nuclear	261 (74.4)	90 (25.6)	0.022	1.84 (1.09-3.19)
Joint/extended	42 (60.9)	279 (39.1)		
Father's education				
Intermediate degree or more	194 (82.9)	40 (17.1)	<0.001	3.43 (2.19-5.36)
High school degree or less	109 (58.6)	77 (41.4)		
Mother's education				
Intermediate degree or more	217 (80.4)	53 (19.6)	<0.001	3.05 (1.96-4.74)
High school degree or less	86 (57.3)	64 (42.7)		
Father's occupation				
Skilled worker or more	227 (77.7)	65 (22.3)	<0.001	2.39 (1.53-3.74)
Less than skilled work	76 (59.4)	52 (40.6)		
Mother's occupation				
Skilled worker or more	106 (85.5)	18 (14.5)	<0.001	2.96 (1.7-5.16)
Less than skilled work	197 (66.6)	99 (33.4)		
Received formal sex education				
Yes	164 (79.6)	42 (20.4)	0.001	2.11 (1.36-3.27)
No	139 (65.0)	75 (35.05)		
Talk with father				
Yes	38 (86.4)	6 (13.6)	0.026	2.65 (1.09-6.45)
No	265 (70.5)	111 (29.5)		
Talk with mother				
Yes	127 (76.5)	39 (23.5)	0.11	1.44 (0.92-2.26)
No	176 (69.3)	78 (30.7)		

Talk with siblings

Yes	69 (76.7)	21 (23.3)	0.28	1.35 (0.78-2.32)
No	234 (70.9)	96 (29.1)		

Talk with cousins

Yes	100 (81.3)	23 (18.7)	0.007	2.01 (1.20-3.37)
No	203 (68.4%)	94 (31.6%)		

Talk with friends

Yes	239 (73.8%)	85 (26.2%)	0.17	1.41 (0.86-2.29)
No	64 (66.7%)	32 (33.3%)		

Talk with teachers

Yes	60 (64.5%)	33 (35.5%)	0.06	0.63 (0.38-1.03)
No	243 (74.3%)	84 (25.7%)		

Talk with health professionals

Yes	165 (74.3%)	57 (25.7%)	0.29	1.26 (0.82-1.93)
No	138 (69.7%)	60 (30.3%)		

Figure3: Boxplot A. Boxplot showing total score of awareness of sexual and reproductive health based on school management B. Boxplot showing total score of awareness of sexual and reproductive health based on the age of study participants

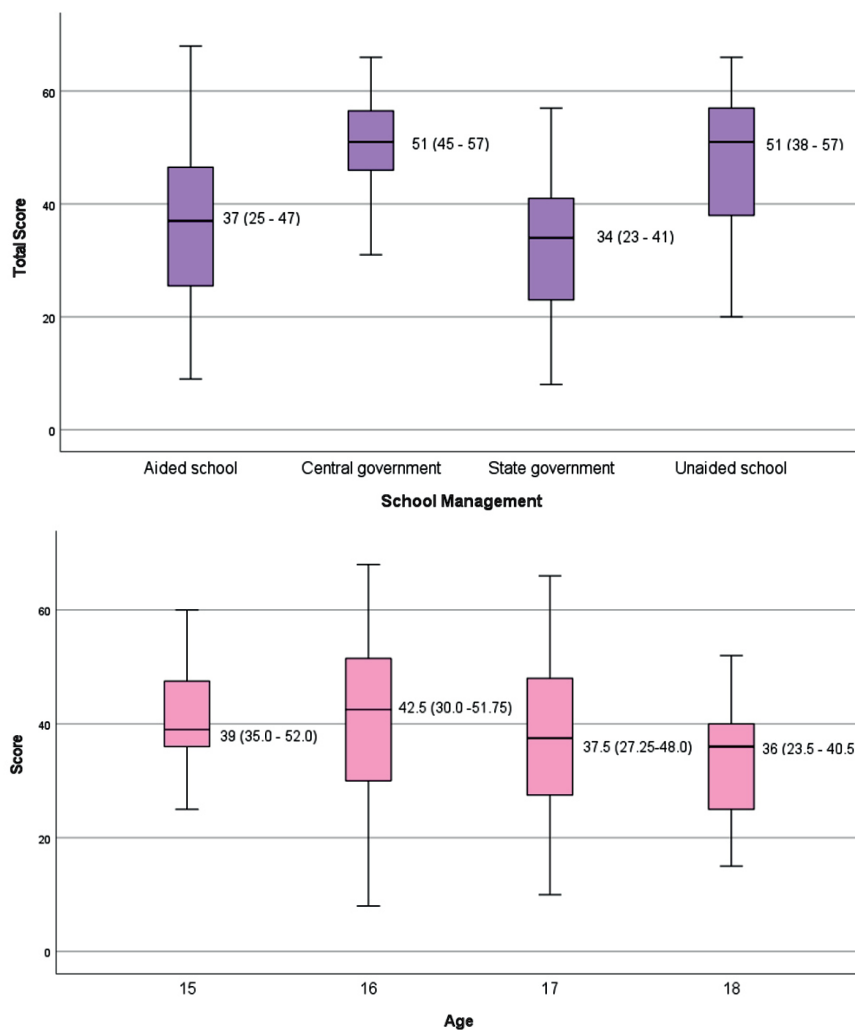
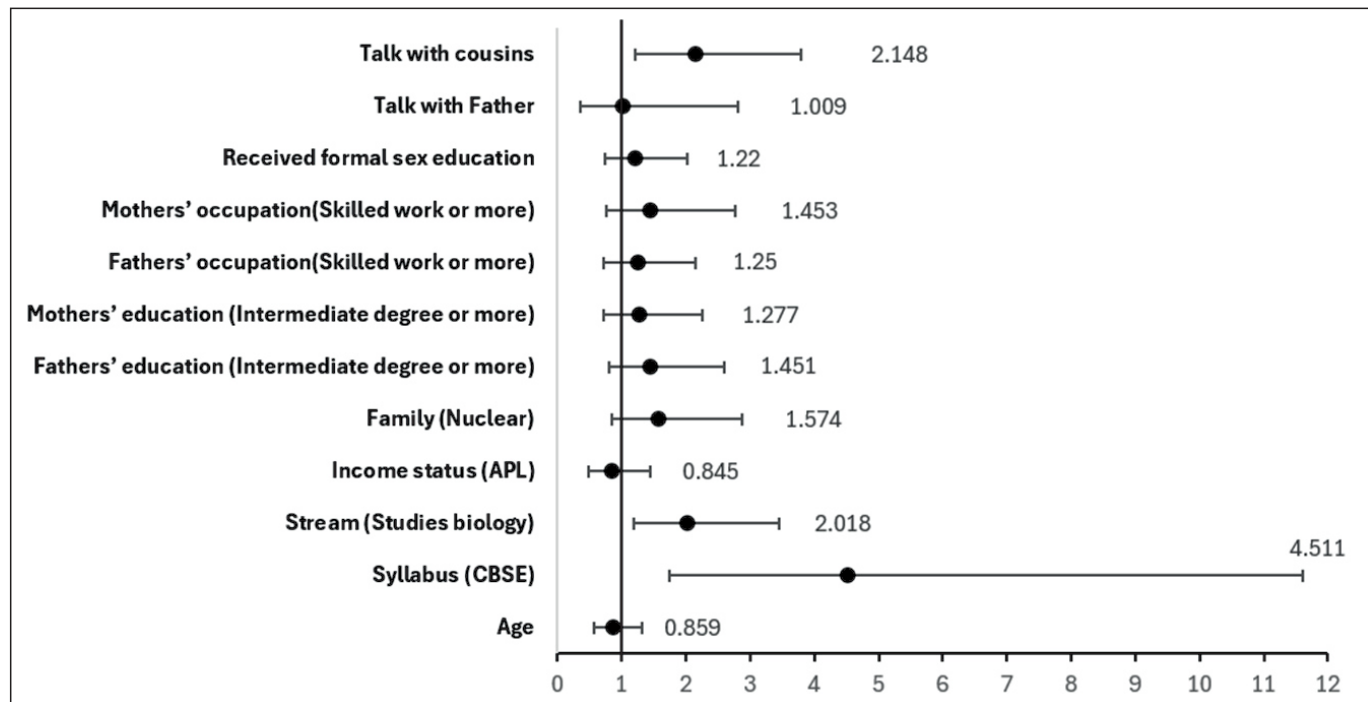


Table 4: Binary Logistic Regression Model to Predict Factors Associated with Good Awareness of SRH

Factor	Crude odds ratio (95% CI)	Adjusted odds ratio (95% CI)	P
Age	NA	0.859 (0.563–1.310)	0.480
Syllabus (CBSE)	9.08(4.09-20.19)	4.511 (1.754–11.602)	0.002
Stream (Studies biology)	3.14(1.97-5.03)	2.018 (1.182–3.444)	0.010
Income status (APL)	2.05(1.33-3.17)	0.845 (0.492–1.451)	0.541
Family (Nuclear)	1.84(1.09-3.19)	1.574 (0.858–2.886)	0.143
Fathers' education (Intermediate degree or more)	3.43(2.19-5.36)	1.451 (0.813–2.591)	0.208
Mothers' education (Intermediate degree or more)	3.05(1.96-4.74)	1.277 (0.726–2.247)	0.397
Fathers' occupation (Skilled work or more)	2.39(1.53-3.74)	1.250 (0.729–2.144)	0.418
Mothers' occupation (Skilled work or more)	2.96(1.7-5.16)	1.453 (0.761–2.777)	0.258
Received formal sex education	2.11(1.36-3.27)	1.220 (0.739–2.014)	0.437
Talk with Father	2.65(1.09-6.45)	1.009 (0.361–2.819)	0.986
Talk with cousins	2.01(1.20-3.37)	2.148 (1.217–3.790)	0.008

Figure 4: Odds ratio plot showing adjusted odds ratio of factors associated with SRH

<0.001 and the Homer and Lemeshow Chi-square test to assess the goodness of fit showed p-value >0.05, indicating a good fit for the model. Those students who had studied in the biology stream, followed the CBSE syllabus, and were able to communicate about sex-

related matters with cousins were associated with higher awareness of SRH, as indicated by the regression model. The model could explain 24.6% of awareness of sexual and reproductive health. (Nagelkerkes' R square = 0.246) (Table 4, Figure 4)

Discussion

This study included 420 adolescents from higher secondary schools in Thiruvananthapuram Corporation. There was a varied level of awareness regarding sexual and reproductive health, with 4.3% of participants demonstrating good awareness and 67.9% exhibiting moderate awareness. The proportion of adolescents with good awareness in our study was lower than that reported in a study from Nepal, where 35% of participants had good knowledge^[16], likely because Nepal constitutionally guarantees sexual and reproductive health rights whereas India relies on policy driven initiatives prone to regional implementation barriers.^[17] Domain-wise, awareness was relatively higher for reproductive organs and secondary sexual characteristics, contraceptives, and sociocultural and legal aspects, whereas lower awareness was observed for pregnancy and sexually transmitted diseases.

In this study, 28.8% of participants had good awareness regarding pubertal changes. This was higher than the level reported in a study from Karnataka, where less than 20% of participants had good awareness.^[18] In contrast, the awareness observed in our study was lower than the study from Nepal, where 63% demonstrated good awareness; this difference may be due to the higher age of students in the Nepal study.^[19] While over 80% knew babies are delivered vaginally, fewer than 75% recognized pubic and axillary hair as secondary sexual characteristics, and under 50% knew nocturnal emissions are a normal physiological process. Despite the inclusion of reproductive health in the high school curriculum itself, poor awareness in more than one-fourth of participants is a significant concern.

Over 90% of participants identified HIV as an STD, while awareness of gonorrhoea, syphilis, hepatitis B, and herpes was less than 50%. This awareness level was higher than previous studies conducted in India and Nigeria but lower than in studies conducted in Germany reflecting the role of sociocultural differences in awareness of STDs.^[20-22] Also, the HIV centric focus in India may be driven by National AIDS Control Programme initiatives and a school curriculum that prioritizes HIV/AIDS over broader STD education.

Only 2.9% of participants had good awareness, while 46.2% had moderate awareness regarding pregnancy and its indicators. While 75.7% correctly identified a missed period as a sign of pregnancy, this remains lower than the 82% reported by Vanusha et al.^[23] Furthermore, only 23.1% of participants accurately identified the most fertile period of the menstrual cycle, compared to 37.3% in a similar study from rural Bangalore.^[24]

Condoms (82.6%) followed by copper T (44%) were the most known contraceptives. Only 68.6% knew that HIV can be prevented by the use of condoms compared to a study in Nepal where 96.1% had correct knowledge regarding condoms as an effective method for the prevention of HIV/AIDS.^[25] The awareness regarding emergency contraception was poor with less than one third knowing the correct timing of emergency contraceptive use. Improving knowledge of pregnancy indicators and contraceptives is critical for the prevention of adolescent pregnancies, which currently contributing to 2.4% of pregnancies according to NFHS 5 data. Also, the awareness on indicators of pregnancy is essential to identify accidental pregnancies early, ensuring access to timely and legal interventions.

Only 34.3 % of study participants had heard about Medical Termination of Pregnancy Act, 64.8 % knew that abortions done by an unauthorised person is illegal and only 56.9 % knew that illegal abortions can lead to maternal and foetal problems. About half of students knew the legally permitted minimum age of marriage for women in contrast to 86.4% knowing about the legally permitted age of marriage for men. The lack of awareness in the legal domain is highlighted in similar studies conducted in India which is an area of concern.^[14,26]

In the present study, friends were the primary source of sexual knowledge (43.6%), followed by social media and teachers. Similar findings were seen in studies in India^[27,28] and across the world^[29], where media accounted as the main source of SRH knowledge. This suggests that students heavily rely on informal sources before sexual health is formally introduced in the curriculum.

Another alarming finding obtained was that about half of the study participants reported they have not received any formal sex education similar to study done in Nepal.^[16] The sociocultural disparities between the nations have had a significant impact on the distribution of sex education levels. As a result, public school sex education in developed countries had higher level of content completion and coverage, while sex education curriculum in the low and lower middle-income countries is primarily in the developmental stage.^[30] This lack of formal education may also be contributed by the hesitation of teachers to teach chapters on sexual and reproductive health.^[31]

Syllabus and stream in which students were studying and communication with cousins as the determinants of good sexual and reproductive awareness. Those students studying in CBSE syllabus and those having biology in their higher secondary curriculum had higher awareness. The higher awareness among CBSE students may partly reflect differences in curriculum structure; however, our study did not examine the curriculum content in detail. Other studies from India have also highlighted the role of school curricula in promoting awareness of sexual and reproductive health among adolescents.^[28] Similar studies also point to higher awareness in those studying biology^[32] which accounts for a need for comprehensive sex education for all the adolescents irrespective of the curriculum and stream in which they were enrolled.

Evidence from this study showed no significant difference in the level of awareness between males and females in contrast to other studies from India where awareness was more in boys.^[14,26] This difference noted may be due to the sociocultural differences between the Indian states and Kerala being high in female literacy and gender equality, equal opportunities are provided for the males and females especially when it comes to matters relating to education.

Even though studies from rural settings in India regarding awareness of sexual and reproductive health were common, only limited studies were conducted in urban settings of India. Our study included students from both private and government schools, as well as from different religious and socioeconomic backgrounds in urban settings. Therefore, evidence from our study

emphasises the need to reform the curriculum to include early-stage SRH education, alongside a mandate for educators to communicate these concepts clearly to their students.

Limitations

Since the questionnaire was self-administered, the responses may be influenced by social desirability bias, especially due to the sensitive nature of sexual and reproductive health topics. As the study was conducted among school-going adolescents in selected schools of Thiruvananthapuram, the findings may not be generalizable to out-of-school adolescents or other settings.

Conclusion

This cross-sectional study among adolescents of Thiruvananthapuram corporation highlights a significant gap in sexual and reproductive health (SRH) awareness, with the majority (67.9%) possessing only moderate knowledge. While awareness of HIV and secondary sexual characteristics is relatively high, there is a critical lack of understanding regarding pregnancy, fertility cycles, diverse STDs, and legal ages of consent. These findings reveal a fragmented support system where informal sources like friends and social media replace formal sex education, and communication with parents remains low. Key determinants of awareness included the students' academic stream, syllabus, and ability to discuss these topics with cousins.

Recommendation

The evidence from our study emphasises the need to reform the school curriculum to include early-stage SRH education, alongside a mandate for educators to communicate these concepts clearly to their students. Strengthening age-appropriate SRH education through the School Health and Wellness Programme, with greater emphasis on curriculum-based learning. Schools should facilitate trained teachers and peer educators to provide accurate, age-appropriate information and promote appropriate help-seeking. Adolescent Friendly Health Clinics' (AFHCs) should be promoted as confidential, accessible referral points for adolescents requiring SRH information, counselling and services. The states should also scale up the peer led education models by leveraging the Rastriya Kishore Swasthya Karyakram (RKSK) framework.

Declaration

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State-Level and Regional Variation in Maternal Healthcare Utilization in India:
An Ecological Analysis of NFHS-6 (2023–24)

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Abstract:

Background: Maternal healthcare utilization is a key determinant of maternal and child health outcomes. Despite substantial improvements in maternal health indicators in India, disparities persist across States and Union Territories (UTs). The study aimed to assess State-Level and Regional Variation in Maternal Healthcare Utilization in India. **Materials and Methods:** An ecological study was conducted using National Family Health Survey-6 (NFHS-6) data. Four nationally recommended maternal healthcare indicators such as first trimester antenatal care (ANC) registration, four or more ANC visits, institutional delivery, and iron and folic acid (IFA) consumption for at least 180 days during pregnancy were combined to calculate Composite Maternal Healthcare Score. **Results:** Considerable inter-state variation in maternal healthcare utilization was observed. Kerala achieved the highest Composite Maternal Healthcare Score (89.38), while substantial disparities were noted across regions. Southern (81.60 ± 7.18) and Western (80.89 ± 3.47) regions demonstrated significantly higher scores than other regions (p=0.001). **Conclusion:** Significant geographical disparities in maternal healthcare utilization persist across India. Policies aimed at reducing regional inequities may contribute to enhanced maternal healthcare utilization.

Keywords: Maternal healthcare utilization, NFHS-6, Ecological study, India, Antenatal care

Introduction:

Maternal health remains a major public health challenge in developing countries and is central to achieving the Sustainable Development Goals.^[1] Antenatal care (ANC) services are primary function of the primary health care delivery system of a country, which aims a healthy society and is a component of continuum of care for controlling maternal morbidity and mortality. One of the important components of Safe Motherhood Initiative is the provision of good ANC to all pregnant women.^[2] Timely and adequate utilization of maternal healthcare services including antenatal care, nutritional supplementation during pregnancy, and institutional delivery, plays a critical role in reducing maternal and neonatal morbidity and mortality.^[3,4] Previous studies revealed that countries which have improved their maternal health care services are successful in dropping the maternal morbidity or mortality rate.^[5,6,7] Globally, 260,000 women died in 2023 due to pregnancy and childbirth related causes. These deaths are disproportionately concentrated in certain regions. For instance, Sub-Saharan Africa and Southern Asia together account for 87% of global maternal deaths, with Southern Asias contribution of 17%, indicating greater regional disparities.^[8]

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Over the past two decades, India has initiated several efforts to reduce MMR due to preventable causes related to pregnancy and childbirth. In 2005, the Government of India launched the National Rural Health Mission (NRHM) in which they focused on maternal and child health through the Reproductive Maternal Neonatal Child and Adolescent Health (RMNCH+A) programme which has changed to RMNCHA+N adding nutritional component to it. The *Janani Suraksha Yojana (JSY)* or Safe Motherhood Scheme was launched in 2005 under the NRHM to reduce maternal and child mortality by promoting institutional delivery through cash incentives to poor and marginalized women. Also, the Maternal and Child Protection (MCP) card was introduced under NRHM, and the Integrated Child Development Scheme (ICDS), was launched as an instrument to ensure that pregnant mothers have access to maternal healthcare services. Despite these efforts, there exists an inter-regional disparity in the utilization of maternal healthcare services and resultant maternal deaths in India.^[8,9] Understanding the geographical distribution of maternal healthcare utilization is essential for identifying underserved regions and guiding evidence-based policy decisions.

The National Family Health Survey-6 (NFHS-6) provides recent state-level estimates of maternal health indicators.^[9] Analysis of these data offers an opportunity to examine geographical patterns in maternal healthcare utilization. The objectives of the study were: (i) to assess inter-state variation in maternal healthcare utilization across India, (ii) to compare maternal healthcare utilization across different geographical regions of India, (iii) to rank States and Union Territories based on a Composite Maternal Healthcare Score.

MATERIALS AND METHODS

An ecological study was conducted using publicly available State and Union Territory fact sheets from the National Family Health Survey-6 (NFHS-6), 202324. NFHS-6 is a nationally representative household survey conducted under the stewardship of the Ministry of Health and Family Welfare, Government of India. The unit of analysis was the State/Union Territory. A total of 35 States and Union Territories for which complete data

were available were included in the study. Study variables included maternal healthcare utilization indicators such as: women who received antenatal care during the first trimester of pregnancy (%), women who had four or more antenatal care visits (%), institutional deliveries (%), women who consumed iron-folic acid tablets for at least 180 days during pregnancy (%). use

A Composite Maternal Healthcare Score was developed as a descriptive summary measure using nationally recognized maternal healthcare indicators reported in NFHS-6. The score was not intended to represent a psychometrically validated index but rather an aggregate measure to facilitate comparison across States and Union Territories. The score was derived using four indicators from the NFHS-6 fact sheets such as first-trimester antenatal care (ANC) registration, receipt of four or more ANC visits, institutional delivery, and consumption of iron-folic acid (IFA) tablets for at least 180 days during pregnancy. Composite Score = (First trimester ANC + Four or more ANC visits + Institutional delivery + IFA consumption e"180 days) ÷ 4. These indicators represent complementary dimensions of the maternal continuum of care, representing timely initiation of antenatal services, adequacy of antenatal care, safe childbirth, and adherence to recommended nutritional supplementation. Equal weighting was given for each indicator because each indicator represents an essential and complementary dimension of maternal healthcare utilization, and no empirical basis existed for assigning differential weights. These indicators are routinely used in NFHS reports and national maternal health monitoring frameworks. This approach was chosen because no validated or empirically established weighting scheme exists for combining these indicators at the state level, and assigning differential weights without a robust empirical basis could introduce subjectivity. Equal weighting is a commonly used and transparent method in composite index construction when individual indicators are considered equally important contributors to the underlying construct. Although recall bias may influence self-reported IFA consumption, this indicator is routinely collected and reported in NFHS surveys and remains an integral

component of national maternal health monitoring frameworks. Therefore, its inclusion enhances the comprehensiveness and policy relevance of the composite measure.

Adopted

States and Union Territories were categorized into six geographical regions: North, South, East, West, Central, and Northeast following classifications commonly used in national demographic and health research in India

Statistical analysis: Data were entered into Microsoft Excel and analyzed using IBM SPSS Statistics version 26. Descriptive statistics including mean, standard deviation, minimum, and maximum values were calculated. Regional differences were also assessed using one-way ANOVA however, given the unequal number of States and Union Territories across regions, these analyses were considered exploratory and were interpreted with caution. Tukey's post-hoc test was used for pairwise comparisons. A p-value less than 0.05 was considered statistically significant.

Ethical considerations: The study utilized publicly available aggregate data from NFHS-6 fact sheets and did not involve human participants or identifiable information. Therefore, ethical approval was not required.

Results

Among the maternal healthcare indicators, institutional delivery demonstrated the highest mean coverage (92.10%; SD: 8.95), with several States and UTs achieving universal institutional delivery. In contrast, iron-folic acid (IFA) consumption for at least 180 days during pregnancy had the lowest mean coverage (44.85%; SD: 19.62), reflecting considerable

gaps in adherence to recommended antenatal nutritional supplementation.

The mean proportion of women receiving antenatal care during the first trimester was 78.28% (SD: 9.50), while the mean proportion completing four or more antenatal care visits was 70.87% (SD: 17.07). The wider standard deviation observed for four or more ANC visits and IFA consumption suggests greater inter-state variability in these indicators compared to institutional delivery and first trimester ANC registration.

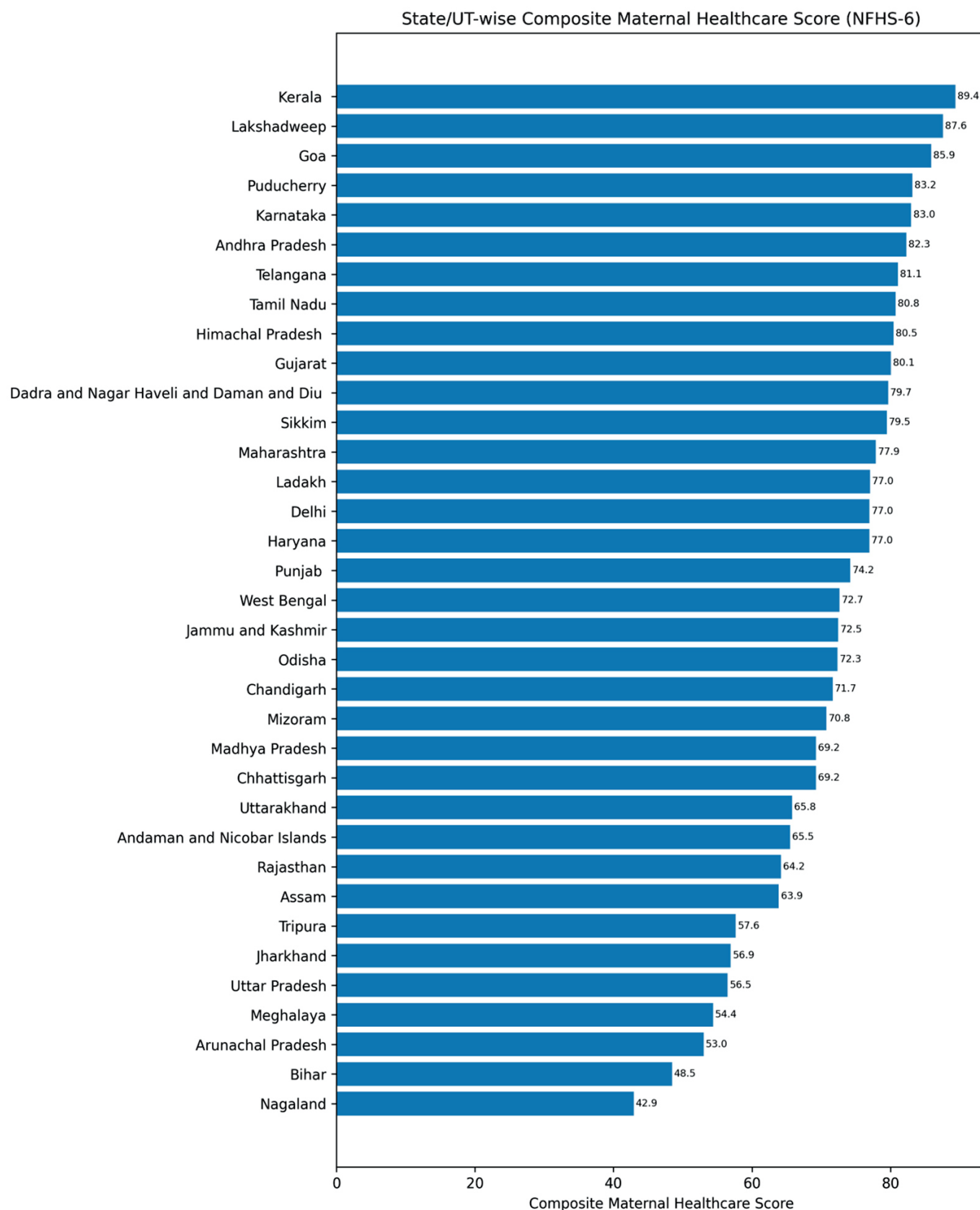
The Composite Maternal Healthcare Score had a mean value of 71.53 (SD: 11.60), with scores ranging from 42.93 to 89.38. This wide range highlights substantial geographical disparities in maternal healthcare utilization across India. The coefficient of variation (CV) indicated substantial interstate heterogeneity in maternal healthcare indicators. IFA consumption for at least 180 days exhibited the greatest variability (CV = 43.7%), followed by completion of four or more ANC visits (CV = 24.1%). In contrast, institutional delivery showed relatively low variability (CV = 9.7%), suggesting more uniform coverage across States and Union Territories. These findings indicate that adherence to antenatal care recommendations and nutritional supplementation remains considerably more uneven across India than institutional delivery services. (Table 1)

The Composite Maternal Healthcare Score ranged widely across States and Union Territories, indicating substantial geographical disparities in maternal healthcare utilization. Kerala achieved the highest score (89.38), followed by Lakshadweep (87.58), Goa (85.90), Puducherry (83.18), and Karnataka (83.00). Other high-performing States included Andhra Pradesh, Telangana, Tamil Nadu, Himachal Pradesh, and Gujarat.

Table 1: Descriptive statistics of maternal healthcare indicators

Indicator	Mean	SD	CV	Minimum	Maximum
First trimester ANC	78.28	9.5	12.1	57.6	96.3
≥4 ANC visits	70.87	17.07	24.1	32.5	95.1
Institutional delivery	92.1	8.95	9.7	62.2	100
IFA ≥180 days	44.85	19.62	43.7	11.2	83.7
Composite Maternal Healthcare Score	71.53	11.6	16.2	42.93	89.38

Figure 1. State/UT wise Composite Maternal Healthcare Score(NFHS-6)



In contrast, several States demonstrated comparatively lower composite scores, highlighting areas requiring greater programmatic attention and strengthening of maternal health services. (Figure 1)

Source: Authors’ analysis of NFHS-6 (202324) State and Union Territory Fact Sheets.

Darker shades indicate higher Composite Maternal Healthcare Scores.

Figure 2 illustrates the spatial distribution of Composite Maternal Healthcare Scores across India. Higher scores were predominantly concentrated in the southern and western regions, particularly Kerala, Karnataka, Tamil Nadu, Andhra Pradesh, Goa, and

Lakshadweep. In contrast, several states in the northeastern and eastern regions demonstrated comparatively lower scores, highlighting persistent geographical disparities in maternal healthcare utilization across the country.

Significant regional differences were observed in Composite Maternal Healthcare Scores across India. The highest mean score was observed in the Southern region (81.60 ± 7.18), followed closely by the Western region (80.89 ± 3.47). In contrast, the Northeast region demonstrated the lowest mean score (60.30 ± 12.16), followed by the Eastern region (64.48 ± 13.89).

Figure 2. Geographical Distribution of Composite Material Healthcare Scores Across Indian States and Union Territories, NFHS-6 (2023-24)

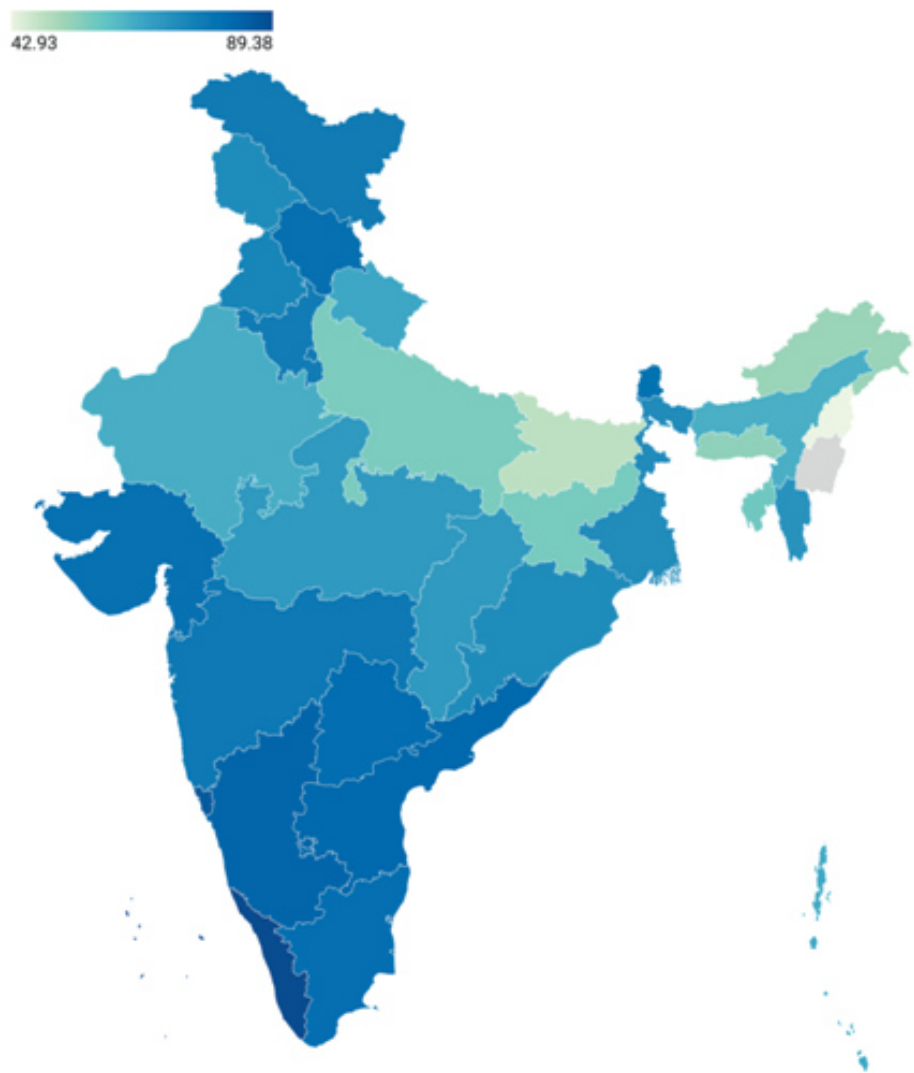


Table 2. Regional variation in maternal healthcare utilization

Region	Number of States/UT	Mean Composite Score $\pm$ SD
Northeast	7	60.30 $\pm$ 12.16
East	3	64.48 $\pm$ 13.89
Central	2	69.23 $\pm$ 0.00
North	11	70.29 $\pm$ 8.28
West	4	80.89 $\pm$ 3.47
South	8	81.60 $\pm$ 7.18
Total	35	71.53 $\pm$ 11.60

One-way analysis of variance revealed statistically significant differences in Composite Maternal Healthcare Scores among regions ($F = 5.469$, $p = 0.001$). The assumption of homogeneity of variances was satisfied (Levene's test $p = 0.052$).

Post-hoc Tukey analysis suggested that Southern and Western regions consistently demonstrated higher maternal healthcare utilization compared with the Northeast and Eastern regions. These findings highlight substantial geographical disparities in maternal healthcare utilization across India.

DISCUSSION

The present ecological analysis of NFHS-6 data revealed substantial inter-state and regional variations in maternal healthcare utilization across India. Southern and western regions demonstrated significantly higher Composite Maternal Healthcare Scores compared to eastern and northeastern regions.

The findings of this study indicate persistent geographical disparities in maternal healthcare utilization despite considerable improvements in maternal health indicators nationally. Southern states, particularly Kerala, Tamil Nadu, Karnataka, and Andhra Pradesh, consistently performed better across maternal healthcare indicators. Similar regional patterns have been reported in previous studies using NFHS data, where southern states demonstrated higher coverage of antenatal care services and institutional deliveries compared with several eastern and northeastern states.^[10,11] Similar findings were seen in study by Gajender Gupta *et al.* where North Eastern Region trails behind in maternal healthcare utilization.^[8] These differences may be attributable to variations in literacy

levels, female empowerment, healthcare infrastructure, health system performance, and socioeconomic development across regions. Among the maternal healthcare indicators, IFA consumption demonstrated the greatest interstate variability, suggesting that adherence to recommended antenatal nutritional supplementation remains a major challenge in several regions of India. Kerala's consistently high performance may reflect its higher female literacy, stronger primary healthcare system, better antenatal care coverage, and long-standing investments in maternal and child health services.

The significant regional variation observed in the present study ($p = 0.001$) suggests that improvements in maternal health services have not occurred uniformly throughout the country. States with lower composite scores may face challenges related to accessibility of healthcare facilities, shortage of skilled healthcare personnel, difficult geographical terrain, and sociocultural barriers to healthcare utilization.^[12,13] Targeted interventions focusing on underperforming regions are therefore essential to reduce inequalities in maternal health outcomes.

The present study has several strengths. First, it utilized the most recent nationally representative NFHS-6 data covering multiple States and Union Territories. Second, a Composite Maternal Healthcare Score was developed using key indicators representing different dimensions of maternal healthcare utilization. Third, the study provides a comprehensive comparison of maternal healthcare utilization across States, Union Territories, and geographical regions using a composite summary measure.

The present study has several limitations. The ecological design based on aggregate State and Union Territory data is subject to ecological fallacy; therefore, findings cannot be interpreted at the individual level. The Composite Maternal Healthcare Score was developed as a descriptive summary measure using equal weighting of four nationally recognized maternal healthcare indicators and has not undergone formal external validation. Although the indicator on iron-folic acid (IFA) tablet consumption for at least 180 days is routinely reported in NFHS surveys, it may be more susceptible to recall bias than the other indicators because it is based on self-reported information. Finally, the number of States and Union Territories within geographical regions was unequal, with some regions containing only a small number of observations. So the results of the regional comparisons using one-way ANOVA should be interpreted with caution, as the limited sample size in certain regions may have affected the robustness of the statistical comparisons.

States with lower maternal healthcare utilization require targeted strengthening of antenatal care services, improved nutritional supplementation programmes, and enhanced access to institutional delivery. Region-specific strategies should be prioritized to reduce interstate inequalities in maternal healthcare utilization. Continued monitoring using nationally representative surveys such as NFHS will be important for evaluating progress toward equitable maternal healthcare utilization.

Availability of data and materials

The data used in this study is publicly available and can be obtained for free by submitting an online request on the International Institute for Population Science (IIPS), Mumbai website (<https://www.iipsdata.ac.in/>).

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