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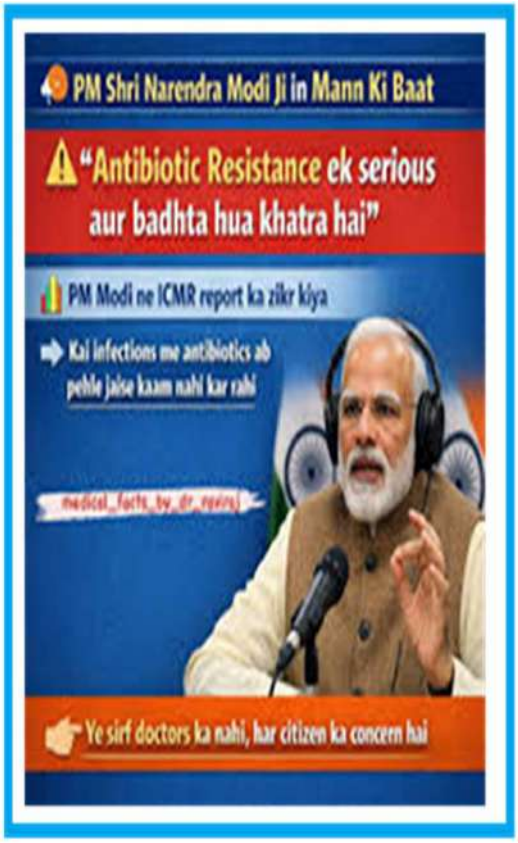

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ACKNOWLEDGEMENT TO REFEREES

Acknowledgement to Referees

Dear Reader,

Welcome to the first issue of *National Board of Examinations – Journal of Medical Sciences (NBEJMS)* for 2025.

We would like to start by thanking the authors of the articles published in *National Board of Examinations – Journal of Medical Sciences (NBEJMS)* over the course of 2025. The skill and dedication of these experts is critical to the continued success of the journal.

The quality of published articles is also testament to the significant efforts of the peer reviewers, whose commitment ensures that the journal's content is held to the highest possible standard. We would like to thank the following individuals who acted as reviewers for *National Board of Examinations – Journal of Medical Sciences (NBEJMS)* in the last 12 months:

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We are also extremely grateful to the members of the journal's Honorary Editorial Board, who provided guidance on journal content.

The editorial program for 2026 is well under way, and we are looking forward to continuing to bring you many high-quality and authoritative articles in the field of Medical Sciences over the coming year. Print has become much less important in publishing, hence our publication mode always will be E-Only.

Best wishes

Minu Bajpai and Abhijat Sheth

Editors-in-Chief, *National Board of Examinations – Journal of Medical Sciences (NBEJMS)*

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EDITORIAL

Antimicrobial Resistance (AMR) Prevention is a Shared Responsibility

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Antimicrobial resistance could be prevented by good practices in COMMUNITY & HOSPITALS

Prime Minister Narendra Modi has spoken about AMR (Antimicrobial Resistance), and the medical fraternity welcomes this with great seriousness and appreciation, as it reflects concern over this growing threat. AMR occurs when patients do not take medicines as prescribed—either by self-medicating, buying drugs from chemists without a prescription, or by not completing the full course. In such cases, microbes become resistant, leading to drug resistance, which makes future treatment difficult and sometimes ineffective. AMR can also develop when patients delay doses or stop medication before the prescribed duration, even when antibiotics are recommended by a doctor. This causes long-term harm, as patients may not respond to treatment later. Urge all patients never to take antibiotics without a doctor's prescription. Antibiotics should be taken only as prescribed by qualified doctors, strictly following the advised dose and duration:

Antimicrobial Resistance (AMR)

Preventing a Growing Public Health Threat through Good Practices in the Community and Hospitals

Antimicrobial Resistance (AMR) has emerged as one of the most serious global health threats of the 21st century. The recent emphasis placed on AMR by Hon'ble Prime Minister Shri Narendra Modi is both timely and significant, and the medical fraternity welcomes this leadership with seriousness and appreciation. AMR threatens to reverse decades of medical progress by rendering common infections difficult—or sometimes impossible—to treat.

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AMR develops primarily due to inappropriate use of antimicrobial agents. In the community, a major contributor is self-medication—patients purchasing antibiotics over the counter without a valid prescription. Incomplete treatment courses, skipped doses, or premature discontinuation of antibiotics once symptoms improve further accelerate resistance.

Even when antibiotics are appropriately prescribed, failure to adhere strictly to the recommended dose and duration allows surviving microbes to adapt, resulting in resistant strains that compromise future treatment effectiveness.

Good Practices in the Community

- Preventing AMR begins at the community level. Antibiotics must never be taken without a prescription from a qualified doctor. Patients should be educated that antibiotics are ineffective against viral illnesses such as common colds or flu. Strict adherence to prescribed dosage, timing, and full course completion is essential, even if clinical improvement occurs early. Public awareness campaigns, regulation of over-the-counter antibiotic sales, improved sanitation, vaccination, and infection prevention measures are critical to reducing unnecessary antibiotic use.

Good Practices in Hospitals

- In hospitals, AMR prevention requires robust antimicrobial stewardship programs. These include evidence-based prescribing, culture-guided therapy, de-escalation of broad-spectrum antibiotics, and strict infection prevention and control practices such as hand hygiene, environmental cleaning, and isolation protocols. Regular audits, clinician education, and multidisciplinary stewardship teams help ensure rational antibiotic use. Accurate documentation, timely review of antibiotic therapy, and adherence to standard treatment guidelines are essential safeguards.

A Shared Responsibility

- AMR prevention is a shared responsibility of policymakers, healthcare professionals, pharmacists, and patients alike. Rational prescribing, ethical dispensing, patient education, and system-level safeguards must work together. Antibiotics are a precious, finite resource; preserving their effectiveness requires disciplined, informed, and collective action—today, to protect the health of future generations.

Prime Minister Narendra Modi's message for Medical Fraternity in Mann ki Baat on December 28, 2025:

"Antibiotics are a shared national resource—prescribe wisely, protect the future."

A Shared Responsibility

AMR is a National Threat, Not Just a Clinical Issue

- **Doctors are Gatekeepers of Antibiotics; Avoid Overuse and Misuse of Antibiotics**
- **Prescription Discipline Is Critical; No Antibiotics Without Prescription**
- **Patient Education Is a Professional Responsibility**
  Doctors must ensure patients understand why antibiotics are given, why full courses matter, and why stopping early is harmful.
- **Infection Prevention Reduces Antibiotic Dependence**
  Hand hygiene, asepsis, vaccination, and hospital infection control are powerful tools against AMR.
- **Stewardship and Surveillance Must Be Strengthened**
  Hospitals should implement antimicrobial stewardship programmes, audits, and resistance surveillance aligned with national guidelines.
- **AMR Requires Interdisciplinary Action**
  Collaboration across clinicians, microbiologists, pharmacists, nurses, public health professionals, and policymakers is essential.
- **Protecting Antibiotics Is a Moral and Professional Duty**
  Preserving antibiotic efficacy for future generations is an ethical obligation of the medical profession.

Every antibiotic prescription is a decision that affects not only today's patient, but tomorrow's population.

Every antibiotic prescription is a decision that affects

not only today's patient, but tomorrow's population.

Efficiency of treatment outcomes is being affected due to the overuse of antibiotics & its adverse consequences are evident at the community level:

Overuse and misuse of antibiotics directly reduce the efficiency of treatment outcomes at the individual level and create serious downstream consequences on the community level.

The impact is both clinical and systemic.

1. Impact on Efficiency of Treatment Outcomes (Individual Level)

a. ***Reduced Drug Effectiveness:*** *Repeated or inappropriate antibiotic exposure selects resistant organisms. When resistance develops: First-line antibiotics fail. Treatment requires broader-spectrum, more toxic, or more expensive drugs. Time to clinical improvement is prolonged.*

b. ***Delayed Recovery and Higher Complications Resistant infections are associated with:*** *Longer hospital stays Higher rates of treatment failure, Increased ICU admissions and need for invasive support Greater risk of secondary infections (e.g., Clostridioides difficile).*

c. ***Escalation of Care:*** *Overuse forces clinicians to escalate therapy earlier: From oral to intravenous antibiotics From single agents to combinations From standard protocols to salvage regimens. This increases adverse*

effects, drug interactions, and monitoring burden.

d. ***Loss of Predictability in Clinical Practice:*** *Standard treatment guidelines become unreliable as resistance patterns shift, reducing clinician confidence and increasing empirical overtreatment.*

2. What This Means at the Community Level

a. ***Community-wide Resistance****: Reservoir Resistant bacteria do not remain confined to hospitals: They spread through households, schools, daycare centres, and communities. Previously, "simple" infections become difficult to treat at the primary-care level.*

b. ***Increased Healthcare Costs and Inequity****: More diagnostic tests, longer treatments, and costly drugs are required. Families face higher out-of-pocket expenses. Vulnerable populations are disproportionately affected.*

c. ***Higher Morbidity and Mortality:*** *Infections that were once easily curable can become life-threatening, especially in Neonates and children Elderly individuals Immunocompromised patients.*

d. ***Pressure on Public Health Systems****: Increased hospital admissions and bed occupancy Overburdened laboratories and pharmacies. Reduced capacity to manage outbreaks effectively.*

e. ***Loss of Trust in Healthcare:*** *When treatments fail repeatedly, community confidence in doctors and health systems erodes, fueling self-medication and further misuse—a vicious cycle.*

The Larger Meaning At the community level:

Antibiotic overuse converts a curable infection into a public health risk. What begins as an individual prescribing decision ultimately determines:

- Whether standard therapies remain effective
- Whether future generations will have reliable treatments
- Whether healthcare remains affordable and accessible

At one glance:

☐ **FIVE KEY STEPS HOSPITALS CAN TAKE to prevent antimicrobial resistance:**

- **Implement Antimicrobial Stewardship Programs (ASPs):** Establish multidisciplinary teams (including physicians, pharmacists, and microbiologists) to create and enforce guidelines for appropriate antibiotic use. This includes ensuring the right antibiotic is used at the right dose, for the right duration, and only when necessary.
- **Strengthen Infection Prevention and Control (IPC):** Rigorously promote and monitor adherence to IPC protocols, such as proper hand hygiene (using alcohol-based hand rubs or soap and water), use of personal protective equipment (gloves, gowns), and effective environmental cleaning and disinfection.
- **Enhance Surveillance and Reporting:** Implement active surveillance systems to track antibiotic resistance patterns and the incidence of healthcare-associated infections (HAIs)

within the facility. The data collected should be analyzed and used to inform local prescribing guidelines and identify potential outbreaks.

- **Improve Diagnostics:** Utilize rapid and accurate diagnostic tests to identify the specific pathogen causing an infection and its resistance profile. This allows for targeted therapy rather than the use of broad-spectrum antibiotics, which contribute more to resistance.
- **Provide Education and Training:** Offer continuous education and training for all healthcare workers (including doctors, nurses, and pharmacists) on the principles of antimicrobial stewardship, proper hygiene practices, and the risks of antibiotic misuse. Educate patients as well about the importance of using antibiotics correctly and not demanding them for viral infections.

☐ **FIVE KEY STEPS AT THE COMMUNITY LEVEL to prevent antimicrobial resistance:**

- **Use antibiotics only when necessary:** and prescribed antibiotics only work against bacterial infections, not viral infections like colds, flu, or most sore throats and ear infections. Do not demand antibiotics from your healthcare provider if they determine they are not needed; ask for advice on how to relieve symptoms instead.
- **Complete the full course of treatment:** Always take antibiotics exactly as prescribed by your doctor. Do not stop taking the medication even if you start feeling better, as stopping early can allow some bacteria to survive, potentially mutate, and develop resistance.
- **Never share or use leftover antibiotics:** Antibiotics are prescribed for a specific infection and person. Using someone else's medication or saving leftovers for a future illness can lead to improper use and promote resistance. Dispose of unused or expired medications properly, as advised by your pharmacist or local drug take-back programs.
- **Practice good hygiene to prevent infections:** Proper hygiene reduces the spread of all germs, including resistant bacteria, which in turn reduces the overall need for antibiotics.
- **Hygiene:** Wash your hands thoroughly with soap and water regularly, especially after using the toilet, before handling food, and after touching animals. Cover your mouth and nose with a tissue or your elbow when coughing or sneezing. Stay home when you are sick to avoid spreading infections to others.

In essence: Antibiotic overuse trades short-term reassurance for long-term treatment failure—affecting not just one patient, but the health security of the entire community. Staying up to date on vaccinations Immunization, is an effective way to prevent many infectious diseases, both viral and bacterial. By preventing infections, the demand for antibiotics is reduced, which helps in the fight against antimicrobial resistance.

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ORIGINAL ARTICLE

Patterns and Trends of Homicide Cases Autopsied at a Tertiary Care Hospital in Visakhapatnam: A Retrospective Study (2023–2024)

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Abstract

Homicide is defined as the killing of one human being by another which continues to evolve with modern methods, though its underlying causes remain rooted in longstanding social and psychological factors. This retrospective inquest, hospital and autopsy records based study aimed to identify the patterns and trends of homicidal deaths among cases subjected to autopsy at Andhra Medical College/King George Hospital, Visakhapatnam, during the years 2023–2024. Among the 3779 autopsies conducted in two years, data from a total of 44 homicide cases (1.16%) were analysed. The majority of victims were in the 30–39 years age group (n=14). Males constituted 31 cases, while females accounted for 13 cases. Of the 31 cases with available data on the accused, most perpetrators (n=12) were between 20–29 years of age. Most homicides were premeditated and occurred during nighttime hours, with the accused often being known to the victim. The majority of victims were young, employed or self-employed males from urban backgrounds. Blunt force injuries accounted for more deaths than sharp force injuries, with head injury being the predominant cause of death. The study endorses the fact that interpersonal relationships, familiarity between victim and offender, and the use of blunt force remain key factors influencing homicidal deaths in and around Visakhapatnam city.

Keywords: Homicide, Autopsy, Cause of Death, Assault, Violence, Murder

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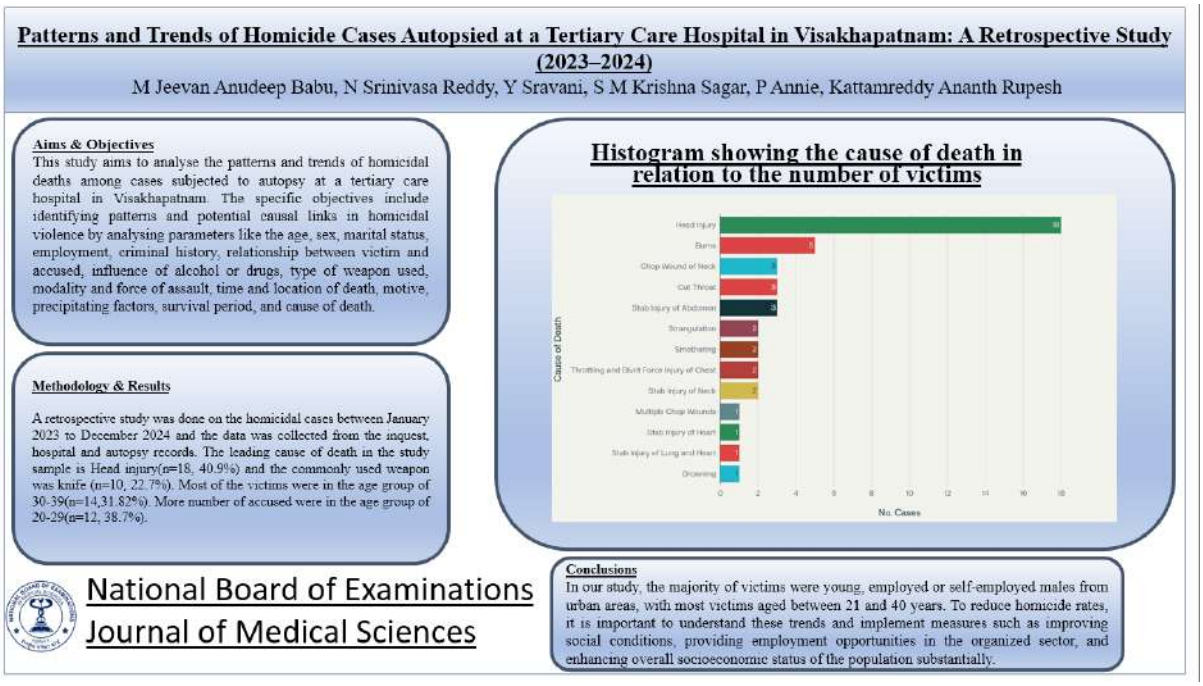

Introduction

Homicide, defined as the killing of one human being by another, has been documented throughout history and remains a significant concern worldwide [1,2]. Societies have long implemented measures to prevent such acts, with punishments evolving over time; from the death penalty to life imprisonment [3]. In many low and middle income nations, blunt and sharp force trauma remains the predominant cause of homicidal deaths whereas countries with permissive firearm laws tend to report higher firearm-related homicide rates. According to WHO data, the global homicide rate in 2019 stood at 6.2 per 100,000 population, while India reported a relatively lower rate of 3.8 per 100,000 [4].

Variations in homicide rates across nations can be attributed to a complex interplay of factors including legal frameworks, law enforcement efficacy, systemic corruption, cultural norms, education, employment, and socioeconomic status of the citizens. Studies consistently link higher homicide rates to poverty, unemployment, and illiteracy [5].

Demographically, individuals involved in organized crime are typically middle-aged, whereas perpetrators of other crimes span across all age groups. Statistically, males commit crimes at a significantly higher rate than females. Psychological factors also contribute to criminal behavior, more so in cases involving serial killers and individuals with psychopathic traits, where actions may occur without clear benefit and are often driven by underlying mental health conditions [6].

This study aims to analyze the patterns and trends of homicidal deaths among cases subjected to autopsy at a tertiary care hospital in Visakhapatnam.

Materials and Methods

This two-year retrospective study based on inquest, hospital and autopsy

records; analyses the sociodemographic and forensic characteristics of homicidal cases subjected to autopsy between January 2023 and December 2024 at the Modern Mortuary, Department of Forensic Medicine and Toxicology, Andhra Medical College, Visakhapatnam. Pertaining to the details of the crime, the data were sourced exclusively from inquest reports provided for autopsy, without incorporating findings from subsequent police investigations since the institution doesn't have access to all such records and the matter is still sub judice in most of the cases.

The study examined parameters like the age, sex, marital status, employment, criminal history, relationship between victim and accused, influence of alcohol or drugs, type of weapon used, modality and force of assault, time and location of death, motive, precipitating factors, survival period, and cause of death.

All collected data were analysed to identify patterns and potential causal links in homicidal violence. The aim was to understand the socio-demographic and situational factors contributing to homicide, thereby generating evidence for future forensic, legal, and public health interventions. All ethical considerations were addressed by the authors and consent for conducting postmortem examinations in homicide cases was obtained from law enforcement agencies. The study was approved by the Institutional Ethics Committee, Andhra Medical College, Visakhapatnam.

Results

A total of 44 homicide cases were recorded among all the autopsies (1852 autopsies in 2023 and 1927 autopsies in 2024) conducted during the two-year study period of January 2023 to December 2024 and all of them were included in the analysis.

Demographic Characteristics of Victims (Table 1)

Table 1. Age and gender wise distribution of male and female victims

Age Group	Female (f)	Female %	Male (m)	Male %	Grand Total	Grand Total %
0–9	0	0%	2	4.55%	2	**4.55%**
10–19	0	0%	2	4.55%	2	**4.55%**
20–29	2	4.55%	8	18.18%	10	**22.73%**
30–39	6	13.64%	8	18.18%	14	**31.82%**
40–49	2	4.55%	3	6.82%	5	**11.36%**
50–59	1	2.27%	4	9.09%	5	**11.36%**
60–69	1	2.27%	1	2.27%	2	**4.55%**
70–79	1	2.27%	3	6.82%	4	**9.09%**
Grand Total	**13**	**29.55%**	**31**	**70.45%**	**44**	**100%**

Age-wise distribution of the victims revealed that two victims (4.54%) belonged to the 0–9 years group. Two victims (4.55%) were in the 10–19 years group, 10 (22.73%) in the 20–29 years group, and 14 (31.82%) in the 30–39 years group. Five victims (11.36%) were aged 40–49 years, five (11.36%) were in the 50–59 years group, two (4.55%) was between 60–69 years, and four (9.09%) were in the 70–79 years group. No victims were reported in the 80–89 or 90–99 years age groups.

Of the 44 victims, 31 (70.45%) were male and 13 (29.55%) were female. Regarding marital status, 31 victims (70%) were married, while 13 (30%) were unmarried. Five victims (11%) were under the influence of alcohol or other substances at the time of the incident, whereas 39 (89%) were not.

Profile of the Accused (Table 2)

Table 2. Age and gender wise distribution of male and female assailants

Age Group	Female (f)	Female %	Male (m)	Male %	Grand Total	Grand Total %
0–9	0	0%	0	0%	0	**0%**
10–19	0	0%	7	22.6%	7	**22.6%**
20–29	1	3.2%	11	35.5%	12	**38.7%**
30–39	1	3.2%	6	19.4%	7	**22.6%**
40–49	0	0%	3	9.7%	3	**9.7%**
50–59	1	3.2%	1	3.2%	2	**6.5%**
60–69	0	0%	0	0%	0	**0%**
70–79	0	0%	0	0%	0	**0%**
Grand Total	**3**	**9.7%**	**28**	**90.3%**	**31**	**100%**

Among the known accused (n=31), 7 individuals (22.6%) were aged 10–19 years, 12 (38.7%) were between 20–29 years, 7 (22.6%) were between 30–39 years, 3 (9.7%) were between 40–49 years, and 2 (6.5%) were aged 50 years or older. Four cases involved multiple accused, ranging from two to four individuals. The majority of the accused were male (28, 90.3%), with a few (3, 9.7%) females. Thirty accused (96.8%) had no prior criminal history, and only one individual (3.2%) had a known criminal background. Data regarding the influence of drugs or alcohol were available for only 20 accused individuals. Among them, 18 (90%) were not under the influence of any substance at the time of the incident, while 2 (10%) were found to be under the influence.

Occupational Profile of Victims

Among the victims, 6 (13.6%) were housewives, 5 (11.4%) were sales persons, 5 (11.4%) were farmers, 4 (9.1%) were drivers, and 3 (6.8%) each were construction workers, sanitary workers, or of unknown employment. Two victims (4.5%) each were coolies, unemployed, students, or clerks. One victim (2.3%) each was a cook, painter, maid, vegetable vendor, supervisor, carpenter, or engaged in real estate business, accounting for all 44 individuals (100%).

Weapons Used and Nature of Injuries

Various weapons were used in the commission of the homicides. Knives were the most commonly used weapon in most cases (10, 22.7%), followed by sticks (5, 11.4%), hands (6, 13.6%), sickles (4, 9.1%), iron rods (3, 6.8%), petrol (4, 9.1%), and stones (2, 4.5%). Other less frequent weapons included a rope (1, 2.3%), cricket bat (1, 2.3%), Saree (1, 2.3%), paint thinner (1, 2.3%), thick iron wire (1, 2.3%), water (1, 2.3%), and combinations such as stick and stone (1, 2.3%). Information on the weapon used was unavailable in 3 cases (6.8%).

Scene and Time of Incidents

Most deaths (32 cases, 72.73%) occurred outdoors, while 12 (27.27%) occurred inside residences. The majority of incidents took place at night (18 cases, 40.9%), followed by the evening (9 cases, 20.5%) and morning (8 cases, 18.2%). Fewer cases occurred in the afternoon (6 cases, 13.6%) and early morning (2 cases, 4.5%). One case (2.3%) had an unknown time of occurrence.

Victim–Accused Relationship

In most cases, the accused was known to the victim. Fourteen cases (31.82%) involved individuals from the same locality who were known neighbours. Other relationships included friends (5, 11.36%), unknown persons (5, 11.36%), brothers (3, 6.82%), husbands (3, 6.82%), colleagues (2, 4.55%), in-laws (2, 4.55%), uncles (2, 4.55%), and single instances (2.27% each) involving a brother-in-law, lover, mother, father, sister, niece, relative, and customer.

Motives and Precipitating Factors

A majority of homicides (27 cases, 61.36%) were allegedly premeditated, while 13 (29.55%) occurred during a heated argument, and 4 (9.09%) had unknown motives. Common precipitating events were identified in 40 out of 44 cases. These included revenge associated with old family and property disputes (16 cases, 36.36%), suspected or existing extra-marital affairs (13 cases, 29.55%), recent land disputes (4 cases, 9.09%), robbery (2 cases, 4.55%), and isolated incidents involving dowry, teasing/ragging, road rage, threatening, and mental illness (each 1 case, 2.27%). In 4 cases (9.09%), the motive remained unknown.

Causes of Death (Figure 1)

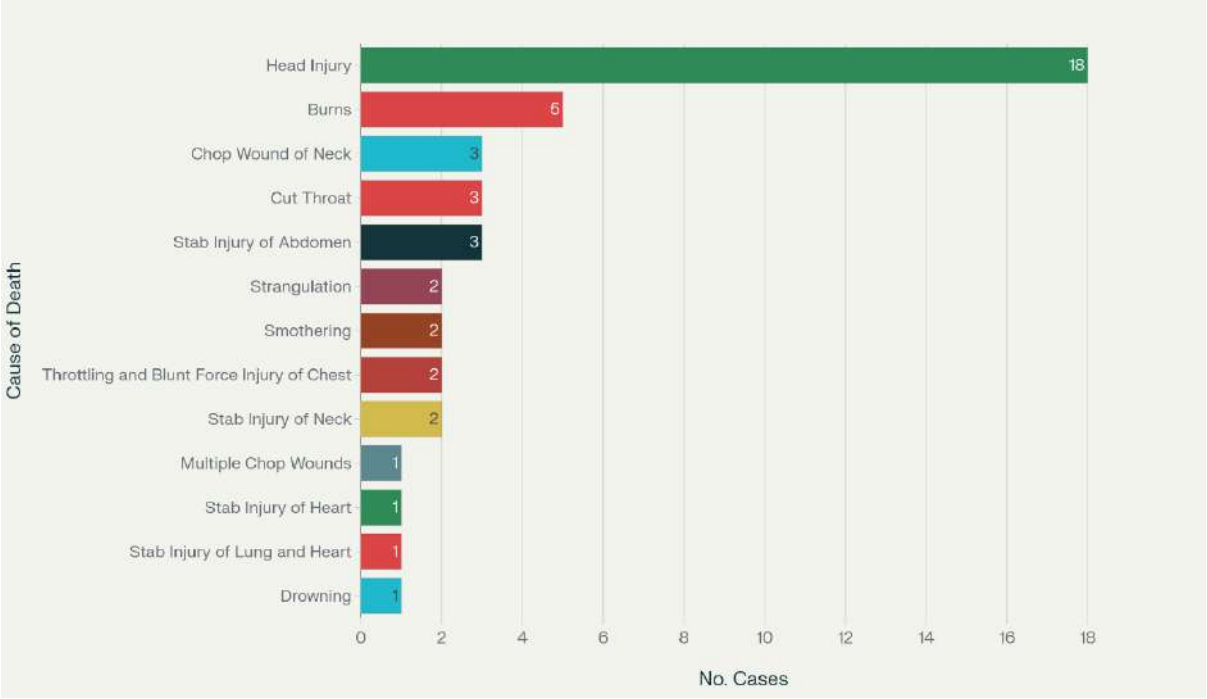

Figure 1. Distribution of cause of death among the victims

The predominant cause of death was head injury in 18 cases (40.9%). Other causes included burns (5, 11.4%), cut throat (3, 6.8%), chop wounds to the neck (3, 6.8%), stab injuries to the abdomen (3, 6.8%), strangulation (2, 4.5%), smothering (2, 4.5%), throttling with blunt chest injury (2, 4.5%), stab wounds to the neck (2, 4.5%), stab injury to the heart (1, 2.3%), stab injury involving lung and heart (1, 2.3%), drowning (1, 2.3%), and multiple chop wounds (1, 2.3%).

Survival Interval (Table 3)

Table 3. Survival period of victims

Survival Period	Count
Found dead	20
1 hour	1
6 hours	2
8 hours	1
1 day	5
2 days	1
3 days	3
4 days	3
5 days	4
7 days	1

10 days	1
15 days	1
18 days	1
Total	**44**

Of the 44 victims, 21 (47.7%) were found dead at the scene. Among the remaining victims, survival intervals varied: 1 hour in 1 case (2.3%), 6 hours in 2 cases (4.5%), 8 hours in 1 case (2.3%), 1 day in 5 cases (11.4%), 2 days in 1 case (2.3%), 3 days in 3 cases (6.8%), 4 days in 3 cases (6.8%), 5 days in 3 cases (6.8%), 7 days in 1 case (2.3%), 10 days in 1 case (2.3%), 15 days in 1 case (2.3%), and 18 days in 1 case (2.3%).

Discussion

Homicide rates vary globally, with some regions showing a decline due to targeted policing and community efforts. However, certain areas still experience high levels of violence, contributing to a significant portion of global homicides. Factors like socioeconomic status, education, and employment play a critical role in these trends as mentioned above. Effective homicide prevention requires a multipronged approach that combines law enforcement, community support, and policies aimed at addressing underlying social issues such as inequality and unemployment [5].

In a study conducted on homicide cases in Chennai during 2023 by Hariharan A et al., the victims were predominantly young males aged 18–30 years, with a male-to-female ratio of 2.2:1. Most victims were married, unemployed, illiterate, and belonged to low socioeconomic backgrounds. Personal vengeance and family disputes emerged as the leading motives, with incidents peaking during late evening hours. Sharp force trauma was identified as the leading cause of death. While our findings align with many aspects of this study, the key difference lies in the nature of injuries; whereas sharp force trauma predominated in their cases, blunt force trauma was more prevalent in ours [7]. According to a study conducted in the Oslo and Copenhagen regions, only 77 cases of blunt force homicides were recorded between 1985 and 1994, accounting for just 18% of all homicides during that decade. While blunt force trauma was relatively less common in that context, our study revealed a significantly higher incidence of such injuries [8]. These studies based in Chennai and Scandinavian capitals also highlight the fact that in the metropolitan areas and larger cities, means of homicide strongly vary from small cities.

The study conducted by Sweekriti et al. examined 2,379 medico-legal autopsies, of which 70 cases (2.94%) were homicides, involving 57 males and 13 females, with a male to female ratio of 4.38:1. The most common age group of victims was 21-30 years (50.87%), followed by 31-40 years (22.81%). Most victims (50.8%) were unmarried and came from nuclear families (68.42%). A higher number of male victims (68.42%) were from urban areas. The majority of male victims were brought dead (36.84%), followed by those who died at the spot (35.89%). Most victims were employed (50.88%), with a significant proportion being self-employed (28.81%) [9]. While most findings in our study align with those reported by Sweekriti et al., a

notable divergence was observed in the marital status of victims. In our cohort, the majority were married, contrasting with their study where this was not the case. This discrepancy underscores regional variations in demographic patterns of criminal victimization, suggesting that age and marital status may influence vulnerability to homicide differently across geographic contexts. Nevertheless, migration of citizens in search of employment to bigger cities is one factor that requires an in depth understanding in the context changing dynamics of not only homicides but different types of crime in our country which is under a demographic transition. The percentage of homicides in our case was about 1.16% which is less than Sweekriti et.al.

In a study conducted by Mopuri Venkateswarlu et al., 46 homicide cases were analysed, showing a male predominance among victims, with the highest incidence in the 21–30-year age group. Stab injuries (n = 18) and head injuries (n = 13) were the predominant causes of death. The most prevalent motive combinations were argument and revenge (39.13%), followed by argument-only (17.39%) and revenge-only (15.22%). Other motives, such as dowry harassment or property disputes, were less common, and in 17.39% of cases, the motive remained undetermined.

The findings of our study are largely concordant with those of Mopuri Venkateswarlu et al., except for a higher incidence of blunt-force trauma observed in our cohort. Similar to previous studies, a notable pattern was the predominance of homicides occurring during the evening and night hours. This temporal trend may reflect social and behavioural factors, including increased interpersonal interactions, alcohol consumption, and reduced public surveillance during these hours, which can escalate conflicts into fatal outcomes. Recognizing this pattern can help in targeted preventive measures and law enforcement resource allocation during high-risk periods [10].

The current command-and-control model employed by the police through CCTV surveillance appears inadequate to effectively prevent urban violence. Manual monitoring of such vast amounts of data is inherently prone to error. To improve responsiveness, surveillance systems should be equipped to automatically generate alerts for quick response teams using artificial intelligence and be integrated with public announcement systems at all identified homicide hotspots.

Common themes across these studies include a male predominance in homicide cases, with male victims consistently outnumbering female victims. The most common age group for victims is typically 21-30 years, followed by 31-40 years. The results of this study showed similarities with other studies conducted in India due to less difference in the beliefs of the people and the living conditions. Homicides often occur in urban areas, and a significant proportion of victims are employed or self-employed. Blunt force trauma and stabbing are the leading causes of death in many of these studies, with relationships between victims and perpetrators often being close, such as acquaintances, spouses, or family members. Moreover, many victims were found to have been brought dead or died at the scene of the incident indicating the extreme fatal nature of the injuries sustained during the attacks [11].

Intimate partner violence (IPV) is a growing concern in India, often escalating

to intimate partner homicides (IPH). Recent reports indicate a significant rise in such cases, with factors like financial conflicts, property disputes, extramarital affairs, revenge, and arguments being common motives. Additionally, substance abuse and mental health issues are identified as contributing factors, impairing judgment and increasing the risk of fatal outcomes. Experts emphasize the need for increased awareness, identification of warning signs, and a comprehensive approach involving both mental health and law enforcement to address this issue effectively [12,13].

Conclusion

Homicidal trends vary across regions, cultures, and time periods, influenced by social and demographic factors. In our study, the majority of victims were young, employed or self-employed males from urban areas, with most victims aged between 21 and 40 years. The majority of the homicides were allegedly premeditated and involved the use of both blunt and sharp weapons. In cases arising from heated arguments, easily accessible blunt force injury–causing weapons found in the surroundings were commonly used in spontaneous homicides. Blunt force injuries led to a higher number of deaths than sharp force injuries, with head injury being the most frequent cause of death.

To reduce homicide rates, it is important to understand these trends and implement measures such as improving social conditions, providing employment opportunities in the organized sector, and enhancing overall socioeconomic status of the population substantially. Strengthening the judicial system and conducting ongoing research into factors like weapon types, victim and offender characteristics, and mental health issues are essential. Furthermore, anger and stress management through counselling may help prevent such incidents.

Limitations

The present study did not include data on the educational or economic status of either the accused or the victims in homicide cases. Moreover, the data pertain to only a two-year period. This study relies mainly on the information based on the inquest and doesn't include information about the further investigations and judgments.

Recommendations

A comprehensive study covering at least five years of data from each medico-legal centre would be highly valuable for understanding the micro factors associated with homicide. Greater emphasis on the qualitative aspects of these cases, rather than solely relying on statistical data, would provide deeper insights into the underlying causes and patterns of such crimes. Also, associations between the variables can be better studied using inferential statistics on a bigger dataset for drawing meaningful conclusions.

Conflicts of interest

The authors declare that they do not have conflict of interest.

Funding

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Ethics committee approval

All ethical considerations were addressed by the authors, and the study was approved by the Institutional Ethics Committee, Andhra Medical College, Visakhapatnam.

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ORIGINAL ARTICLE

Demystifying Infection Prevention Strategy by Disposable Surgical Instruments

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Abstract

Background: Sepsis, a merciless curse and life-threatening silent storm caused by the body's response to an infection, remains a major complication following surgery. A wide range of infectious challenges can induce sepsis including surgical site infection. Moreover, during the surgery of patient suffering from infectious diseases, chances of cross infection are high. It is conceivable that three-dimensional (3D) printing technology has a significant role in limiting the chances of infection via development of advance surgical instrument. **Aim:** The objective of present study was to develop an effective preventive approach using 3D printing technology against nosocomial infection in a cost-effective manner which can be easily used in rural and urban areas as well. **Methodology:** Design of advance surgical instruments was created and functional prototype was developed by using PR 700 ABS equivalent material via 3D printing. **Result:** Six functional advance surgical instruments were developed, tested and feedback was taken from surgeon. These surgical instruments have enhanced functionality, efficiency, safety and cost effectiveness and can facilitate the surgeons in performing the surgeries with more accuracy and efficiency. **Conclusion:** Thus, the use of 3D printing technology in the development of advance surgical instruments has the potential to cause a paradigm shift in the management of sepsis, shifting away from supportive care and toward proactive and preventive measures to reestablish healthy and safe surgical conditions.

Keywords: Sepsis, nosocomial infection, Advanced Surgical Devices, pathophysiological tests

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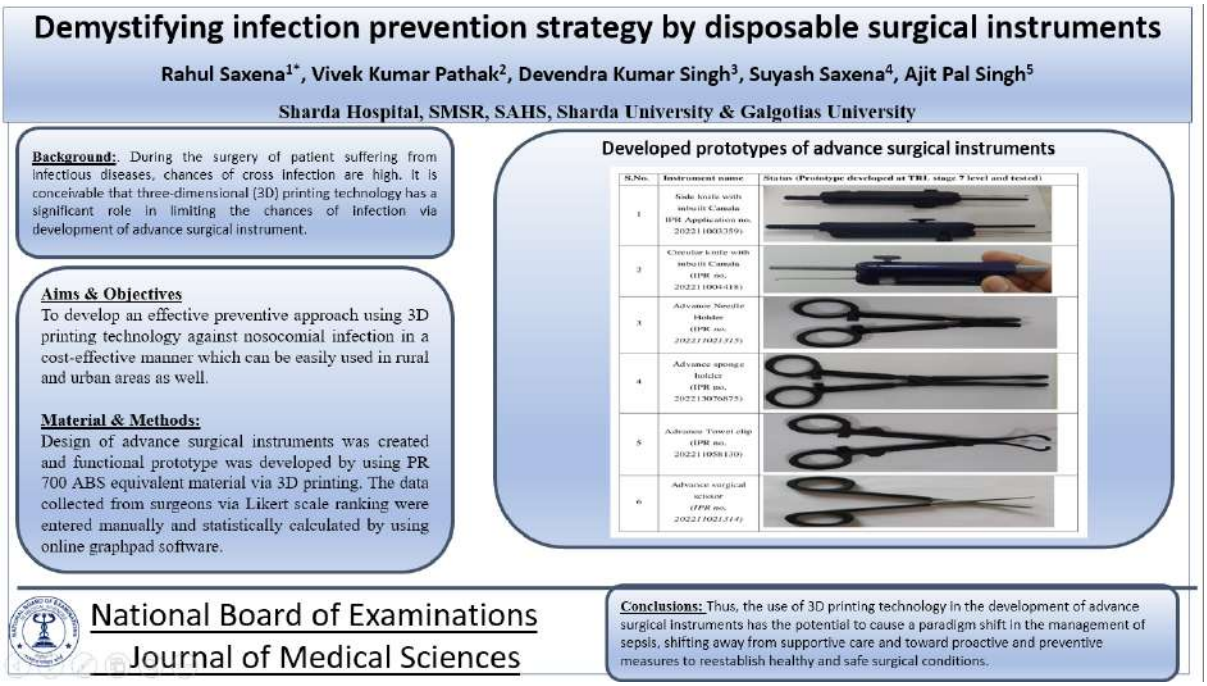
Graphical Abstract



Introduction

Sepsis, a well-defined condition, occurs when severe infections exceed the immune system's usual regulatory systems, leading to a dysregulated host response that manifests as new-onset organ failure [1]. Patients undergo surgery are at increased risk of developing surgical site infection (SSIs) and should receive antibiotic prophylaxis [2]. Despite use of antibiotic as preprocedural treatment, SSIs occurs and the patients have to bear the additional pain in terms of cost of various biochemical and pathological tests, antibiotic prophylaxis, hospitalizations and repeated nosocomial infection in Post-COVID era. Recently, it has been documented that excessive use of antibiotics is associated with increased mortality and morbidities [3]. In urban areas, hospitals are well equipped with sterilization procedures but in rural areas various basic facilities and proper sterilization procedures are lacking. Moreover, disposable version along with advance feature of surgical instruments are also not available to prevent infection while surgeries of patients with STDs and other infectious diseases like AIDS, COVID-19 etc. in urban and rural areas as well.

The use of surgical instruments in a clinical setting has been transformed by three-dimensional (3D) printing technology. Historically, all surgical procedures, including those involving patients with infectious diseases, have been performed by surgeons using traditional surgical instruments. Over the last few decades, advances in additive manufacturing technology have made it possible for medical science to progress to a more advanced level, leading to the development of innovative surgical instruments that can reduce the risk of nosocomial infections during surgery [4]. Therefore, the objective was to prepare the prototype of advanced disposable surgical

instruments kit by 3D printing technology which will be more economical, user friendly and can be tested in the real world of micro ear surgery.

Methodology

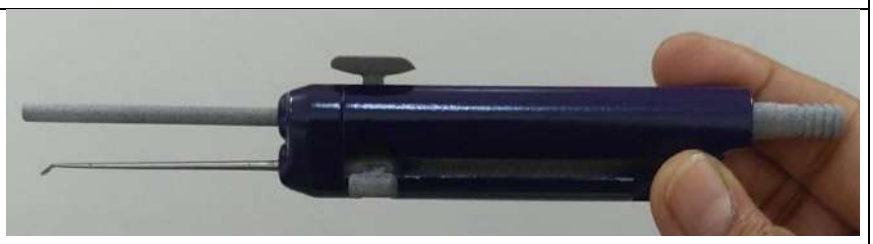
Design of the basic surgical instruments was conceptualized. PR 700 ABS equivalent material was used to prepare the instruments as per ASTM & ISO standards via 3D printing technology by vacuum casting [5]. Properties of material were tested in ISO certified laboratory with respect to Tensile strength, tensile modulus, shore hardness, elongation at yield and elongation at break. Developed sterilized prototype was clinically tested by surgeon after taking Ethical clearance (Ref. no. SU/SMSR/76-A/2024/28) from Institutional Ethical Committee of Sharda University. Data pertaining to various facts related to the developed prototypes of surgical instruments such as design and shape; size, user friendly, functionality, safety in surgery, compactness and time saving, were collected through feedback form from the surgeons (n=40) of various hospitals.

Statistical analysis

The data collected from surgeons via Likert scale ranking were entered separately in Microsoft Excel sheet of windows 2007 and values were expressed as Mean ± SD. In addition, correlation analysis between enhanced functionality and time saving feature was performed by using Pearson correlation test.

Results

Six advance surgical instruments were developed by using 3D printing technology and included these basic surgical instruments in a kit. These instruments were Side knife with inbuilt canula, Circular knife with canula, Advance surgical sponge holder, Advance surgical needle holder, Advance towel clip, and Advance surgical scissor. Information about developed prototypes of advance surgical instruments and their current status are illustrated in Figure 1. Feedback from surgeons were taken in relation to enhanced functionality, user friendly, effectiveness and time saving were observed. The result of feedback collected from various surgeons on numerous facts related to the developed prototypes of the surgical instruments was depicted in Figure 2. It was observed that these surgical instrument prototypes were excellent in design and shape; size, user friendly, functionality, safety in surgery, compactness and time saving.

S.No.	Instrument name	Status (Prototype developed at TRL stage 7 level and tested)
1	Side knife with inbuilt Canula IPR Application no. 202211003359)	
2	Circular knife with inbuilt Canula (IPR no. 202211004418)	
3	Advance Needle Holder (IPR *no. 202211021315*)	
4	Advance sponge holder (IPR no. 202213076875)	
5	Advance Towel clip (IPR no. 202211058130)	

6	Advance surgical scissor *(IPR no. 202211021314)*	

Figure 1. Developed prototypes of advance surgical instruments and their current status

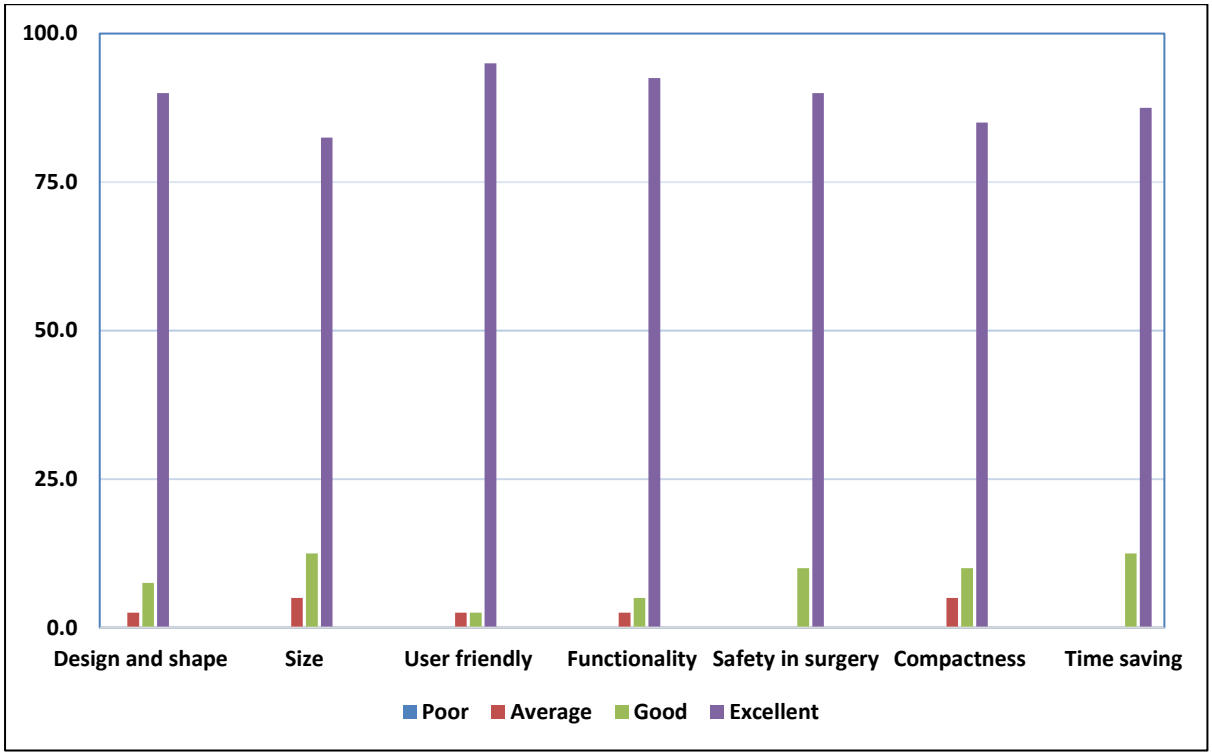


Figure 2. Feed back from various surgeons on various facts related to the developed prototypes

The material used in the preparation of these prototypes were tested in ISO certified laboratory and report was represented in Table 1. On applying correlation coefficient, it was observed that enhanced functionality and time saving feature were direct related to each other ($r=0.648$; $p<0.001$) as represented in Figure 3. In addition, patent of all the six instruments were granted (IPR Application no. 202211004418; 202211021314; 202211021315; 202211003359; 202213076875; 202211058130) [6]. Product of these prototypes in multiple copies can be developed and commercialized through surgical agencies. These advance surgical instruments are safe and cost effective which can be distributed to the rural areas under community services.

Table 1. Lab report for material (PR 700 ABS Equivalent) used in the prototype development

S. No.	Parameter	Unit	Test method	Test Result
1	Average Tensile Strength	N/mm2	As Per UTM Machine	55.23.0
2	Tensile Modulus	Mpa	ISO :527-1	1670.0
3	Shore Hardness	Shore D	Hardness Taster	80.0
4	Elongation At Yield	%	As Per UTM Machine	2.20
5	Elongation At Break	%	As Per UTM Machine	7.34

UTM: Universal testing machine

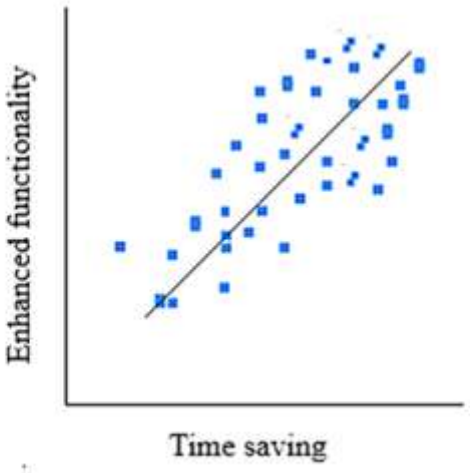


Figure 3. Enhanced functionality and time saving feature of the developed prototypes.

Discussion

There are various strategies to overcome the problem of sepsis. However, this curse of SSI still exists and have a wider room space to encourage the researchers to replenish the safe and healthy surgical procedures with some concrete solution. So, to solve the problem in the real world of micro-ear surgery in rural areas, there is a dire need to incorporate advance features to increase the functionality, safety, efficiency, and cost effectiveness of the instruments; and to help the surgeons in performing the surgeries with more accuracy and efficiency. In this context, the role of 3D printing technology paves a novel path in the field of medical sciences including surgery [7]. Interestingly, Parab et al. in their investigation also stressed that in order to reach the middle ear's nooks and corners without impairing vision and causing instrument cross-over, a modified circular knife is necessary [8]. Consequently, the prototype of six surgical instruments: Side knife with inbuilt canula, Circular knife with canula, Advance surgical sponge holder, Advance surgical needle holder, Advance towel clip, and Advance surgical scissor; have been prepared using 3D printing technology.

These advance surgical instruments can help in the following ways to the surgeons:

- More efficient and time saving instrument are available for the surgery.
- Multiple instruments can be used by surgeons in more flexible manner
- Different size number of suction cannula/ knife can be easily fitted in the sameinstrument so it can reduce the requirement of various separate instruments.
- The sliding feature in the handle of needle holder, sponge holder and towel clip can allow the surgeon to fix the shank of the surgical instrument as per need and **adjust the length** of these surgical instruments to reach deeper areas of nasopharyngeal region and decrease the height when front areas are to be reached.
- The multiple locking system along locking rachet provides the complete **stability** while working.
- The disposable feature helps the surgeon to use it only one time with patient suffering from sexually transmitted disease or infectious diseases. It can reduce the chances of infection effectively and economically.
- The present instruments allow the use of **same instrument** in different types of surgeries where different length of needle holders and sponge holders are required and thus, making the instrument **economically.**
- In addition, these advance and basic instruments (except side/circular knife) can be used in the surgery related to other field of medical sciences such as respiratory medicine, gynecology, general surgery and dental science also.

Conclusion

Thus, these 3D printed technology mediated developed surgical devices can contribute significantly in the reduction of nosocomial infection rates, improving patient outcomes, and reducing healthcare costs associated with sepsis treatment. Furthermore, the present study explores the future directions of advanced surgical devices, limited use of antibiotic &

pathophysiological tests and preventive-healthcare measures in the ongoing fight against sepsis mediated pain of the patient.

Limitation

The present surgical instruments were tested in Sharda Hospital only by ENT surgeon due to constraints of resources. We plan to do Multicentric study is needed to get more feedback in order to improve the efficiency of the instrument from patient and surgeon perspective.

Conflicts of interest

The authors declare that they do not have conflict of interest.

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ORIGINAL ARTICLE

Multicentric Analysis of Outcomes of Optical Internal Urethrotomy for Short Segment Bulbar Urethral Strictures

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Abstract

Background: Stricture urethra is a very common disease among men of all ages. It specially affects people of the productive age group (20–50yrs) thereby having both financial and health related implications. Hence there has been a long history of research in identifying the most optimal treatment modality of which optical internal urethrotomy offers a safe, easy and quick mode of treatment. This study aims to identify the best predictive markers for obtaining the optimal results in those patients. **Materials and Methods:** For this prospective observational analysis, 100 patients who had optical internal urethrotomy for small segment strictures between December 2023 and May 2025 are included. 50 patients from the A.C.S Medical College and Hospital, Chennai and 50 patients from the Aarupadai Veedu Medical College and Hospital, Puducherry were chosen for this study. These patients were followed up for a period of about 9 to 12 months with uroloflowmetry and symptomatology and the results are tabulated. **Results:** On analysing the follow up investigation results, it was found that stricture length of less than 1 cm, luminal narrowing of less than 40% and absence of lichen sclerosis were found to be the independent positive predictive factors for the success of optical internal urethrotomy. **Conclusion:** Optical internal urethrotomy is the most effective treatment for patients with short segment bulbar urethral strictures. Treatment outcomes are significantly influenced by the length of the stricture segment, the degree of luminal constriction, and the existence of related illnesses such as lichen sclerosis.

Keywords: Stricture Urethra, Optical internal urethrotomy, lichen sclerosis, Bulbar stricture

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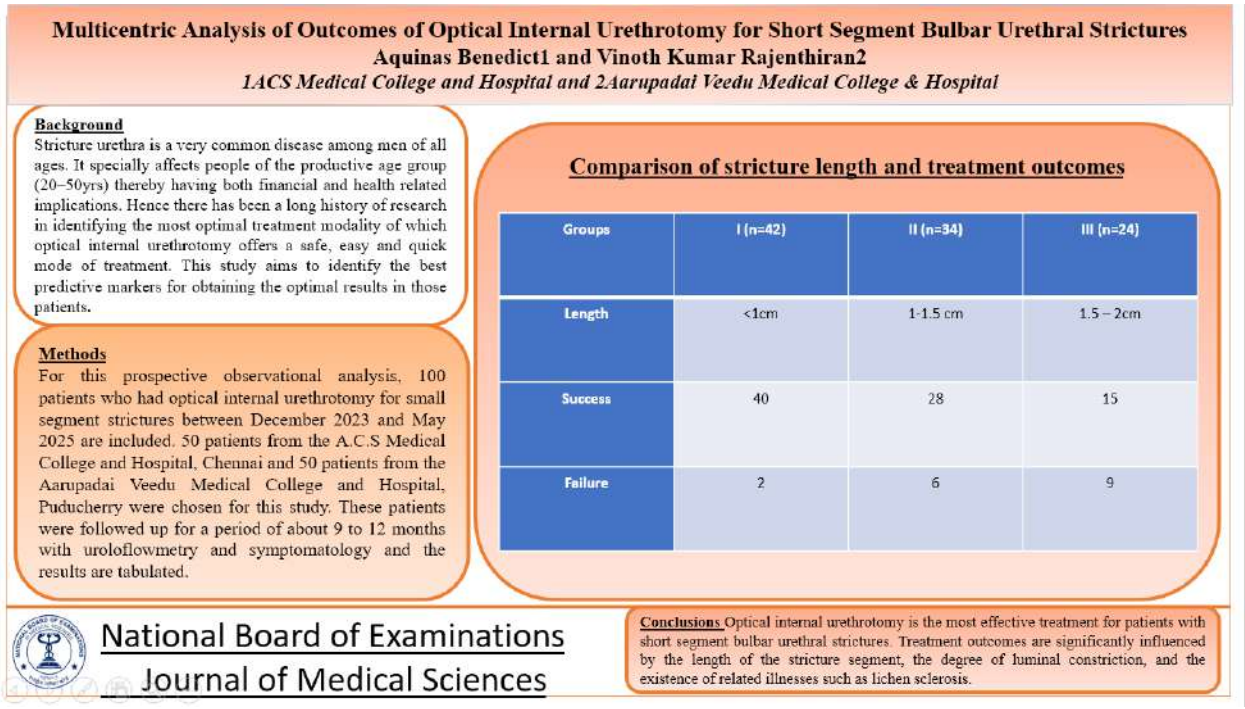
Graphical Abstract



Introduction

A stricture in the urethra can be defined as an abrupt narrowing in the urethra associated with some degree of fibrosis in the surrounding spongiosal fibres. It causes obstruction to the free flow of urine and causes all the classical voiding urinary symptoms. Most commonly, it forms following some sort of injury to the urethra. Eventhough less common in females, it can affect both sexes.

Usually the management of urethral stricture disease requires multiple office visits and admissions. In males, strictures are commonly seen in the Bulbar Urethra. The most common association with stricture urethra is Lichen sclerosis et atrophicus. It usually causes metal and submeatal stenosis which in turn causes increase in the intra urethral pressure. As a result, the urine effluxes into urethral glands causing urethral abscess which eventually leads to fibrosis and stricture formation.

Materials and Methods

Study Design

This was a prospective observational study.

Duration

Conducted from December 2023 to May 2025.

Study Subjects

The study included 100 patients attending the Urology outpatient departments, with 50 patients from A.C.S. Medical College and Hospital, Chennai, and 50 patients from Aarupadai Veedu Medical College and Hospital, Puducherry.

Study Population

The study focused on 100 male patients diagnosed with primary short-segment bulbar urethral strictures who underwent optical internal urethrotomy during the study period.

Inclusion criteria

Patients with primary Bulbar Urethral strictures.

Exclusion criteria

- Patients with history of prior surgical or endoscopic intervention.
- Complete obliteration of the urethral lumen.
- Strictures longer than 2 cms.

The study was conducted following all proper ethical considerations and proper written informed consent was obtained from all the patients. From December 2023 to May 2025, data from 100 patients with Bulbar stricture who underwent Optical internal urethrotomy were prospectively analysed.

Pre-operative evaluation: All patients with suspected stricture urethra from detailed history and clinical examination were subjected to investigations to establish the diagnosis and aid in surgery. Routine blood and urine investigations were performed. Uroflowmetry and Retrograde Urethrogram were done in all patients to determine the site and length of the stricture and calculate the percentage of narrowing.

Radiological Assessment: On RGU, the site of maximum narrowing is identified. The diameter of the normal distal urethra (x) and the stricture site (y) are measured on digital RGU images (Figure 1).

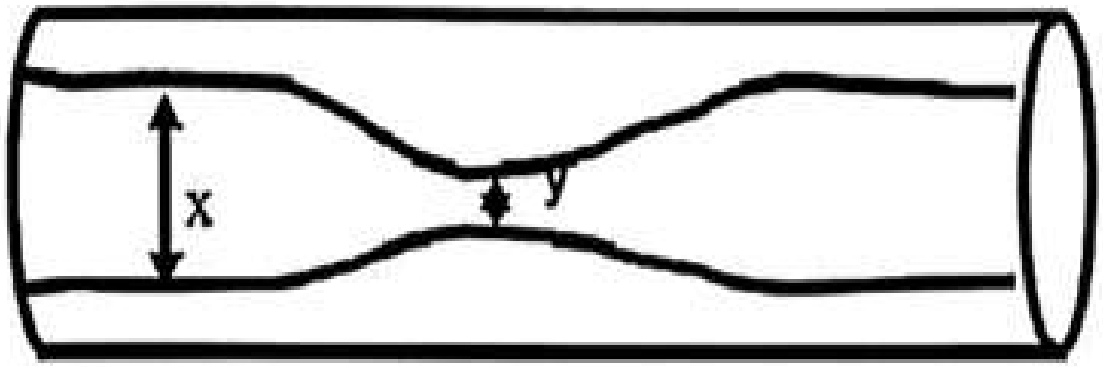


Figure 1. Estimation of luminal narrowing percentage

The percentage of narrowing can be identified using the following formula.

Percentage of narrowing = [(x-y)/x] * 100

Surgical procedure

All patients underwent Optical internal urethrotomy under regional or general anaesthesia. The procedure was performed using a standard 21Fr urethrotomy sheath and sacche's urethrotome. A 14 Fr silicone catheter was placed pre-operatively and retained for 5 to 7 days.

Post-operative Management: Patients were instructed to begin self-dilatation using a 14Fr Nelaton catheter 7 days after catheter removal. Self-dilatation is adviced once daily for the first month and then every third day for the following month and gradually spaced there after. Uroflowmetry is repeated 1 month, 3 months and 6 months of follow up.

Definition of outcomes:

- Success: No recurrence of symptoms and a Q-max of more than 15 ml/sec at

9 months without the need of repeat instrumentation.

- Failure: Recurrence of obstructive symptoms, Inability to pass the catheter or need for repeat OIU.

Results

Of the 100 patients, 42 patients had less than 1 cm stricture and 34 had strictures of size 1 to 1.5cm and 26 patients had 1.5 to 2 cm strictures. The success rate was maximum of 95% for the first group of patients and group 3 had the worst results of only 62% success rate (Table 1).

Table 1. Comparison of stricture length and treatment outcomes

Groups	I (n=42)	II (n=34)	III (n=24)
Length	<1cm	1-1.5 cm	1.5 – 2cm
Success	40	28	15
Failure	2	6	9

Similarly, patients with less than 40% of luminal narrowing had 91% success rate whereas patients with more than 60% luminal narrowing had 54% success rate only (Table 2).

Table 2. Comparison of degree of luminal narrowing and outcomes

Groups	A (n=42)	B (n=28)	C (n=26)
%of luminal narrowing	<40	40-60	>60
Success	42	22	14
Failure	4	12	6

The success rate also dramatically decreased when there is associated lichen sclerosis with 34% of the cases failing at 9 months of follow up.

Discussion

A urethral stricture is first suspected based on history, physical exam, urinalysis, symptoms, post-void residual volume, and peak flow rate. Persistent obstructive symptoms that do not improve with alpha-blockers point toward a urethral stricture or a weak detrusor muscle. Urethral strictures are confirmed using cystoscopy, retrograde urethrography, or voiding cystourethrography. Blood tests are not useful for diagnosis.

Uroflowmetry

Uroflowmetry is the preferred initial test because it offers a simple, noninvasive measure of peak urinary flow. Flow patterns help differentiate normal voiding from prostatic obstruction and urethral strictures. A Qmax below 12 mL/s suggests obstruction or a possible stricture.

Strictures typically create a sharp plateau on the flow curve. For accurate results, the voided volume should be at least 150 mL.

Post-Void Residual Urine Volume

Post-void residual urine is useful for assessing bladder emptying but is not very diagnostic. It should be interpreted along with urine flow studies.

Cystoscopy

Cystoscopy is a simple, quick procedure that provides a definitive diagnosis of urethral stricture and can be done under local anesthesia in the clinic. It confirms the stricture, allows immediate dilation, and identifies the distal extent. However, if the scope cannot pass the narrowing, it cannot assess stricture length, proximal urethral changes, or the prostate.

A small-caliber ureteroscope may pass through a stricture, giving extra diagnostic detail without trauma or dilation. Cystoscopy, while limited in evaluating surrounding fibrosis, provides a fast and reliable initial diagnosis.

Retrograde Urethrography

If the individual undergoing treatment is at ease, retrograde urethrography can display the urethra all the way to the bladder. The proximal urethra may not be entirely visible in cases of severe strictures. Voiding cystourethrography, which is carried out by having the patient void following bladder filling or using a suprapubic catheter, offers crucial extra information in these situations.

An excellent image of the whole urethra can be obtained by combining a retrograde urethrogram with a contemporaneous cystogram or voiding cystourethrography.

However, because these radiological methods, even when combined, only produce a two-dimensional image of a three-dimensional structure, there are certain limits when interpreting the images pertaining to the location of the stricture and the condition of the proximal urethra. According to certain research, sophisticated imaging methods like computed tomography (CT), voiding urethrography, or sonoelastography can offer precise pictures of the stricture and its features.

In complex urethral strictures, especially in women, videourodynamics is useful, combining bladder function assessment with urethral imaging. It helps distinguish true anatomical obstruction from functional urethral issues. High detrusor voiding pressure alongside radiographic narrowing strongly indicates obstruction, such as a stricture.

Significant variability exists among physicians, including radiologists, in interpreting retrograde urethrograms for stricture location, length, and width. A standardized interpretation method is recommended. Machine learning using convolutional neural networks is being developed to improve consistency, and surgeons are encouraged to perform their own urethrograms for best results.

Ultrasonography

Ultrasound is mainly used to evaluate the bladder and upper urinary tract. While it cannot directly show a urethral stricture, it can assess spongiofibrosis and post-void residual urine, indicating obstruction severity. Filling the urethra with fluid via a catheter may help visualize strictured areas. Some experts use urethral ultrasound to measure stricture length and

spongiofibrosis, though it is not widely adopted in routine practice.

Magnetic Resonance Imaging

The role of MRI in simple urethral strictures is limited. It is valuable when malignancy is suspected, as it shows tumor location and invasion.

Treatment

When there are no complications, treatment focuses on symptom relief. Decisions should consider symptom severity, stricture location and length, and patient preference. Asymptomatic or mild cases typically do not require intervention. Treatment is indicated for recurrent infections, acute retention, or other complications to relieve symptoms and prevent urinary tract damage. If infection is suspected, a course of antibiotics may be trialed, continuing if symptoms improve.

In healthy young men, normal peak urine flow exceeds 15 mL/s. Most stricture patients have a flow under 12 mL/s. Those with 10–15 mL/s are usually asymptomatic and typically do not need intervention if bladder emptying is complete and wall thickness is normal. Flow rates of 5–10 mL/s often cause obstructive symptoms, warranting treatment only if symptoms or bladder changes are significant, with active monitoring if untreated. Patients with flow below 5 mL/s face a higher risk of acute retention and should be offered treatment even if asymptomatic.

Urgent treatment

This is required when the patient has sudden painful distension of the urinary bladder. This can be either simple dilation, cystoscopy, DVIU, or suprapubic cystostomy. Suprapubic cystostomy prevents further urethral trauma and allows a 4–6 week “urethral rest” period for healing and accurate imaging before definitive treatment like urethroplasty. Any urinary infection should be treated with antibiotics, and once stabilized, definitive stricture management can proceed.

Urethral dilation

Urethral dilation with sounds or bougies has long been a standard initial treatment. Gradually increasing dilator size stretches and widens the stricture. Using a guide wire, especially for tight strictures, is recommended. Goodwin metal sounds, which taper gently and work over guide wires, help dilate strictures safely while minimizing urethral trauma, false passages, or bladder injury. Outcomes are similar to DVIU, with about 65% requiring retreatment within three years. Dilation is usually done under local anesthesia and may cause discomfort and bleeding. Balloon dilation may reduce frictional trauma and show lower recurrence rates than traditional techniques.

Direct vision internal urethrotomy:

DVIU involves a transurethral incision at the 12 o’clock position, allowing the stricture to heal by secondary intention and widening the urethral lumen. It is first-line for short (<2 cm) bulbar strictures with no prior treatment, but recurrence can reach 65% within three years. Complications occur in about 6.5%, including erectile dysfunction (5%), incontinence (4%), extravasation (3%), UTI (2%), and hematuria (2%).

There is debate on repeat DVIU versus moving directly to urethroplasty after recurrence. Some recommend one additional DVIU, while others prefer urethroplasty. Recurrences often involve longer strictures due to incision of adjacent healthy tissue. Prophylactic antibiotics are

advised, and the Foley catheter is typically removed after 72 hours.

The AUA recommends dilation, DVIU, or urethroplasty as initial treatment for short bulbar strictures. Experimental intralesional botulinum toxin during DVIU has shown improved outcomes in trials, suggesting it may be a useful adjunct.

Paclitaxel-coated urethral balloon dilation therapy

Combining paclitaxel-coated balloon dilation with DVIU significantly improves outcomes for recurrent bulbar urethral strictures <3 cm compared to DVIU alone. Paclitaxel, an anti-inflammatory and anti-proliferative agent, delivered uniformly via the balloon, reduces scar formation and recurrence. One-year urethral patency was 83.2% versus 21.7% for DVIU alone, and three-year functional success remained 67%. Overall, studies report over 90% success in small anterior strictures, with more than 70% of patients remaining intervention-free at 2–5 years. FDA-approved for anterior urethral strictures, its efficacy in penile strictures and repeat treatments is unclear. Men should use contraception for six months due to detectable paclitaxel in semen. Further research is needed to validate these results.

Intermittent self-catheterization:

Regular intermittent self-catheterization helps maintain urethral patency after treatment, typically using a 14- or 16-French catheter. Patients usually start with daily catheterization, gradually extending the interval to once or twice a month as tolerated. If passage is difficult, frequency is increased or a smaller catheter is used. Video training aids can improve technique. Longer self-catheterization (≥4 months) reduces recurrence compared to shorter durations, though the optimal length is unclear. Some experts suggest continuing once or twice monthly indefinitely for early detection of recurrence. Urethroplasty remains a safe, effective alternative for those reliant on self-catheterization.

Urethroplasty

Urethroplasty involves opening or removing the stricture, followed by either direct anastomosis for short (<2 cm) bulbar strictures, grafting with buccal mucosa or foreskin, or using a skin flap for longer strictures. Success rates exceed 85%, and complications—such as erectile dysfunction, UTIs, fistulas, incontinence, chordee, and neuropraxia—are uncommon. Recurrent strictures previously treated with dilation, meatotomy, or DVIU often fail with repeated procedures (>80% failure), making urethroplasty the preferred option, especially for blind-ending strictures, hypospadias repairs, or lichen sclerosus–related strictures.

Optimal duration of Foley catheterization after urethroplasty

The optimal duration of Foley catheterization after urethroplasty is debated, generally ranging from 3 to 21 days. Prolonged catheterization is uncomfortable and limits activity. Evidence suggests early removal at 7 days does not increase complications, extravasation, infection, or recurrence.

Pelvic fracture–related strictures are best managed with delayed urethroplasty, typically around 3 months after stabilization, with delays beyond 6 months not recommended. Selected patients may undergo repair in as little as 6 weeks to reduce suprapubic catheter time.

Bladder neck strictures can be managed with dilation, incision, or transurethral resection; recurrent or complex cases may require open or robotic reconstruction. Patients should be counseled about potential postoperative incontinence.

Anastomotic urethroplasty

Anastomotic urethroplasty, or stricture resection with end-to-end anastomosis, is ideal for short (<2 cm) bulbar strictures, often from traumatic straddle injuries. It is also suitable after failed dilation or DVIU, preferably in patients without prior instrumentation, which can reduce success.

Substitution or graft urethroplasty

Substitution urethroplasty involves mobilizing the urethra at the stricture, opening it lengthwise, and grafting tissue to widen the lumen. The procedure can be approached ventrally, dorsally, or laterally. Grafts are typically taken from oral mucosa, foreskin, or occasionally the upper inner thigh. Oral mucosa is preferred for its durability and resistance to urine, though donor-site discomfort, scarring, and numbness can occur. Lingual mucosa may reduce donor-site complications. Hair-bearing skin, allografts, xenografts, or synthetic materials are generally avoided outside clinical trials.

This approach is used for bulbar strictures too long for anastomotic urethroplasty or any penile urethral stricture. When local tissue is unsuitable, a skin flap is preferred. Complex cases, including prior hypospadias repair or lichen sclerosus, often require a two-stage procedure: first, stricturotomy with a grafted urethral plate; later, urethral closure over a catheter with a voiding trial after about three weeks. Various single- and two-stage techniques combining grafts and flaps are described depending on stricture complexity.

Perineal urethrostomy (Boutonnière)

Perineal urethrostomy is a palliative option for patients with multiple prior surgeries, complex strictures, or those unable or unwilling to undergo extensive procedures. It is also suitable for patients with significant comorbidities. The bulbar urethra is opened through a perineal incision, and the urethral edges are sutured to the skin to create a urethrostomy, preserving sphincter function and continence. Most patients report high satisfaction.

Recently, a single-stage preputial spiral graft using foreskin has been proposed as an alternative for extensive strictures in select patients. All stricture patients require regular follow-up to monitor for recurrence.

Conclusion

Optical internal urethrotomy offers a good outcome in select patients with short segment Bulbar Urethral strictures, particularly in those with idiopathic etiology, minimal narrowing and short stricture length. However, a particular subset of patients with more than 60 percentage luminal narrowing and those with lichen sclerosis demonstrate poor outcomes and benefit with alternative surgical strategies.

A majority of treatment failures occur within first nine months following the procedure underlining the need for vigilant follow up during that period. This study establishes that the RGU based estimation of the percentage of luminal narrowing is a good predictor for the post operative

outcome after OIU and may serve aa a decision making tool in stricture management. Longitudinal studies with larger cohorts, standardized treatment outcomes and incorporation of novel imaging techniques are required to further refine the predictive factors of OIU outcomes.

Statements and Declarations

Conflicts of interest

The authors declare that they do not have conflict of interest.

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ORIGINAL ARTICLE

A Descriptive Study to Evaluate the Causes of Abnormal Vaginal Discharge by Clinical and Microbiological Examination in Reproductive and Post-Menopausal Women

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Abstract

Background: Abnormal vaginal discharge is one of the commonest gynaecological problems reported among women, specifically in the reproductive and post-menopausal age groups. Most of the time abnormal vaginal discharge is associated with multiple infectious and non-infectious aetiologies, and it significantly contributes to morbidity and impairs their quality of life. **Objectives**: To evaluate women presenting with abnormal vaginal discharge using clinical and microbiological methods and to identify the underlying etiological profile. **Methods**: This study was a hospital-based cross-sectional study that was conducted among women attending the gynaecology clinic as out-patients at Sri Muthukumaran Medical College and Research Institute between January–December 2023. A semi-structured questionnaire is used to collect necessary data, followed by clinical examination, and laboratory investigations such as vaginal pH, wet mount, KOH test, Gram stain, NAAT for gonorrhoea/chlamydia, Pap smear, and culture when indicated. Collected data were analysed using descriptive statistics and chi-square tests. **Results**: A total of 160 women were evaluated and their mean age was observed as 41.87 ± 9.5 years, with most of them 73.2% belonging to the 30–49-year age group. Among 50% of the study participants white discharge was the most common presentation, followed by profuse discharge was observed among 41.3%. Diagnosis in our study showed that bacterial vaginosis, vulvovaginal candidiasis, trichomoniasis, and other mixed infections as commonest causes. Sociodemographic and reproductive factors such as SES, education, marital status, sexual activity, and contraception practices were presented with distinguished patterns which helps us in arriving appropriate diagnosis. **Conclusion**: Abnormal vaginal discharge, a common conditions diagnostic accuracy can be improved with appropriate clinical evaluation with targeted microbiological assessment. Bacterial vaginosis and candidiasis remain the predominant causes.

Keywords: abnormal vaginal discharge, bacterial vaginosis, candidiasis, trichomoniasis, reproductive tract infections

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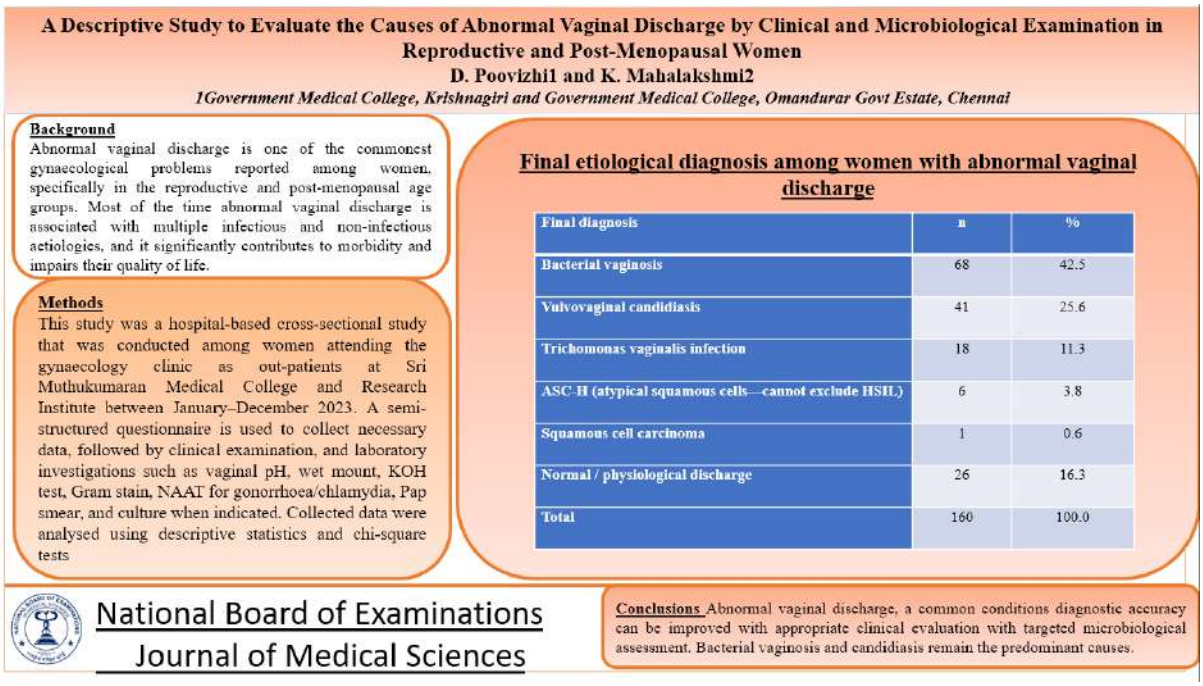
Graphical Abstract



Introduction

Vaginal discharge is considered as a normal physiological process that is essential for maintaining vaginal health through lubrication, epithelial turnover, and microbial homeostasis [1]. Abnormal vaginal discharge is a common condition seen in women is usually characterized with changes in colour, consistency, odour of the discharge and it may be associated with other symptoms such as pruritus, burning, or dyspareunia, usually indicating underlying pathology [2]. Globally, around 30% of the women were affected with bacterial vaginosis particularly in the reproductive-age [3], along with that most of the sexually transmitted infections occur among individuals aged between 15–49 years [4]. Candidiasis affects nearly 75% of women at least once in their lifetime [2]. In India, due to poor menstrual hygiene, sociocultural factors, early marriage, and poor access to healthcare system they contribute to a high prevalence of reproductive tract infections. In Tamil Nadu, the prevalence of symptomatic vaginal discharge is close to 30% [5], and gynaecology clinics reported that bacterial vaginosis as the predominant etiology in health care facilities [6]. National data (NFHS-5) show 12.1% prevalence of abnormal vaginal discharge in the preceding three months [7].

Abnormal vaginal discharge is commonly due to infectious causes include bacterial vaginosis, vulvovaginal candidiasis, and other sexually transmitted infections such as trichomoniasis, gonorrhoea, and chlamydial cervicitis [8]. In some articles they report that non-infectious etiologies like atrophic vaginitis, foreign bodies, and malignancy may also contribute [9–12]. Usually, it is associated with multiple behavioural and biological risk factors influence susceptibility, including sexual practices [13], antibiotic exposure [8], hormonal variations [10], and douching [9]. When such conditions go untreated, these infections can also result with either pelvic inflammatory disease,

infertility, ectopic pregnancy, chronic pelvic pain, and adverse pregnancy outcomes [12]. So, early recognition and microbiological diagnosis helps us to provide targeted therapy and prevents complications.

Given these clinical implications, the present study evaluates the causes of abnormal vaginal discharge through integrated clinical and microbiological approaches among women in a tertiary care setting.

Aims and Objectives

1. To evaluate women presenting with abnormal vaginal discharge using clinical and microbiological methods and to identify the underlying etiological profile

Materials and Methods

This was a hospital-based cross-sectional study conducted in the Department of Obstetrics and Gynaecology, Sri Muthukumaran Medical College and Research Institute, among women attending the gynaecology outpatient department with complaints of abnormal vaginal discharge. The study was carried out over one year, from January 2023 to December 2023, after obtaining approval from the Institutional Human Ethics Committee. The sample size was calculated using a prevalence of abnormal vaginal discharge of 11.8% [16], with a 95% confidence interval and 5% absolute error, yielding a sample size of 160; a consecutive sampling technique was then employed until this sample size was achieved.

Women with complaints or clinical signs of abnormal vaginal discharge who were willing to participate were included, while those on oral contraceptive pills, pregnant or menstruating women, those who had received antimicrobial or antifungal drugs in the preceding month, postpartum or post-abortal women within six weeks, post-hysterectomy patients, women below 19 years, unmarried or unconsummated females, and those unwilling to consent were excluded.

After informed written consent, data were collected using a semi-structured questionnaire capturing sociodemographic details, menstrual and sexual history, obstetric and medical history, and characteristics of the vaginal discharge. Each participant underwent general, systemic, pelvic, speculum and bimanual examination.

Microbiological evaluation included measurement of vaginal pH (pH <4.5 suggestive of candidiasis and >4.5 suggestive of bacterial vaginosis), wet mount in saline for Trichomonas vaginalis, 10% KOH mount for fungal elements, Gram staining for bacterial vaginosis and gonococci, nucleic acid amplification tests (NAAT) for Neisseria gonorrhoeae and Chlamydia trachomatis, Pap smear for abnormal cervical cytology and culture and sensitivity for Candida, Trichomonas and gonococci in selected cases.

Confidentiality was maintained and participation was voluntary. Data were entered in Microsoft Excel, analysed using SPSS version 17 and appropriate descriptive statistics were generated.

Results

The study included 160 women presenting with complaints of abnormal vaginal discharge to the gynaecology outpatient department. The mean age of the study population was 41.87 ± 9.5 years, with a clear predominance of women in the reproductive and perimenopausal age groups. Majority of the study participants

36.9 % of them belonged to the 40–49 years followed by 36.3% of them were in 30–39 years and 5.6% were in the 60–69-year group, which indicates that symptomatic discharge was most frequently reported in mid-reproductive and early menopausal age group (Table 1).

Table 1. Socio-demographic and reproductive characteristics of women presenting with abnormal vaginal discharge (n = 160)

Characteristic	**Category**	**n**	**%**
Age (years)	20–29	10	6.3
	30–39	58	36.3
	40–49	59	36.9
	50–59	24	15.0
	60–69	9	5.6
Educational status	Illiterate	18	11.3
	Primary education	19	11.9
	High school	37	23.1
	HSC / Diploma	37	23.1
	Undergraduate	37	23.1
	Postgraduate	12	7.5
Occupation	Employee	49	30.6
	Health-care worker	7	4.4
	Homemaker	83	51.9
	Self-employed	21	13.1
Residence	Urban	125	78.1
	Rural	35	21.9
Socio-economic class (Modified BG Prasad)	Lower	3	1.9
	Lower-middle	36	22.5
	Middle	33	20.6
	Upper-middle	46	28.8
	Upper	42	26.3
Menstrual status	Regular cycles	105	65.6
	Irregular cycles	37	23.1

	Post-menopausal	18	11.3
Marital status	Married	144	90.0
	Divorced/Separated/Widow	15	9.4
	Single / Never married	1	0.6
Sexual activity (current)	Sexually active	122	76.3
	Sexually not active	35	21.9
	Occasionally active	3	1.9
Contraception use (ever/current)	Tubectomy	117	73.1
	Condom	22	13.8
	IUCD	4	2.5
	Chaya pills	1	0.6
	None	16	10.0
Past history of similar discharge	Present	59	36.9
	Absent	101	63.1

In our study the educational status of the study participants were observed and one-tenth of the women in our study group were illiterate with 11.3%, 11.9% of them reported with primary education, and high school, higher secondary/diploma, and undergraduate education each contributed 23.1%, and 7.5% had postgraduate qualifications. This educational status distributions reflects that abnormal vaginal discharge affected women across all educational groups (Table 1).

In terms of occupation, approximately half of the women were homemakers, about one-third were employed, and a small proportion were healthcare workers, suggesting that both domestic and working women commonly sought care for this complaint (Table 1).

Clinically, patients presented with variable characteristics of discharge; the colour, consistency and quantity were documented systematically, with white discharge being the commonest type and profuse or moderate discharge reported in a large proportion of cases, underscoring its impact on daily comfort and quality of life. Microbiological work-up using pH testing, saline and KOH wet mounts, Gram stain, NAAT and culture identified a spectrum of etiologies including bacterial vaginosis, vulvovaginal candidiasis, trichomoniasis, cervicitis due to sexually transmitted pathogens and mixed infections (Tables 2 and 3). These etiological diagnoses, as detailed across the microbiology tables addresses the study objective of characterising both the clinical and microbiological profile of abnormal vaginal discharge in this cohort, and demonstrated that bacterial vaginosis and candidiasis were the leading infectious causes, with other STIs and non-infectious conditions contributing to a smaller but clinically relevant proportion of cases (Tables 4).

Table 2. Clinical profile of abnormal vaginal discharge (n = 160)

Clinical feature	Category	n	%
Colour of discharge	White	80	50.0
	Yellow	23	14.4
	Dirty white	24	15.0
	Colourless	13	8.1
	Grey	6	3.7
	Greyish white	8	5.0
	Curdy white	3	1.9
	Brownish white	1	0.6
	Milky white	1	0.6
Quantity	Profuse	66	41.3
	Moderate	61	38.1
	Scanty	33	20.6
Odour	Foul-smelling	52	32.5
	Odourless	108	67.5
Consistency	Mucoid	69	43.1
	Watery	57	35.6
	Curdy	28	17.5
	Thick	6	3.7
Associated itching	Present	67	41.9
	Absent	93	58.1
Blood-stained discharge	Present	6	3.8
	Absent	154	96.2
Urinary symptoms	Present	30	18.8
	Absent	130	81.3

Table 3. Microbiological investigation findings (n = 160)

Investigation	Finding	n	%
Wet mount preparation	Clue cells seen	37	23.1
	Fungal hyphae	35	21.9
	Motile organisms seen	18	11.3
	Few epithelial cells seen	12	7.5
	Normal / Not done	58	36.3
Gram stain	Clue cells seen	33	20.6
	Gram-negative rods seen	13	8.1
	Fungal hyphae seen	5	3.1
	Normal / Not done	109	68.1
Culture & sensitivity	Candida species	34	21.3
	Gardnerella vaginalis	31	19.6
	Trichomonas vaginalis	14	8.8
	Normal / Not done	81	50.6
Vaginal pH (by age group) [Mean ± SD]	20–29 years	5.61 ± 1.36	
	30–39 years	5.53 ± 1.23	
	40–49 years	5.40 ± 1.27	
	50–59 years	4.90 ± 1.19	
	60–69 years	5.18 ± 0.78	
	Overall	5.37 ± 1.23	

Table 4. Final etiological diagnosis among women with abnormal vaginal discharge (n = 160)

Final diagnosis	n	%
Bacterial vaginosis	68	42.5
Vulvovaginal candidiasis	41	25.6
Trichomonas vaginalis infection	18	11.3

ASC-H (atypical squamous cells—cannot exclude HSIL)	6	3.8
Squamous cell carcinoma	1	0.6
Normal / physiological discharge	26	16.3
Total	160	100.0

Discussion

In the present study, the mean age of the participants was 41.87 years, and the majority belonged to the 30–49 year age group. This pattern closely aligns with the findings of Guntoory et al. [13], who also reported that 74% of their participants were between 25–44 years. Similar age clustering was seen in studies by Patil et al. [14], who identified 25–29 years as the most affected age group, and Nigerian research [15], where the highest prevalence of vaginal discharge was observed between 26–30 years. Das et al. [16] in their article reported that 26–35 years as the commonest group whereas, Usharani et al. [5] in their article they observed that 74% of their study population were in 25–44-year age group. Collectively all these observations suggests that reproductive-aged women are the most vulnerable group for symptomatic vaginal discharge, as they have active sexual life, hormonal influences, and higher exposure to risk factors.

Educational status observed in our study showed that 23.1% of them had high-school education, 23.1% had higher secondary/diploma, 23.1% were undergraduates, whereas 11.3% were illiterate. Patil et al. [14], in their article reported that 43% of them had only primary education, and from Guntoory et al. [13] and Das et al. [16], both authors observed illiteracy rates around 42–56% in their observation. Usharani et al. [5] also reported high illiteracy among participants. These observations contrast our study finding and highlights that abnormal vaginal discharge affects women irrespective of their educational background.

In our study 51.9% of the women were homemakers, followed by 30.6% of them were employed and 4.4% of them work as healthcare workers. Das et al. [16] in their study they have observed similar proportions, with 45.6% being homemakers. This might be due to limited access to health information and lack of independence in seeking care and it might be a reason for the higher burden of symptomatic vaginal discharge in this group.

The socio-religious distribution in our study shows that 81.3% of women were Hindus, followed by 11.9% Muslims and the remaining Christians. Patil et al. [14] reported contrasting findings, with a majority of participants being Muslims, whereas Das et al. [16] observed higher prevalence among Hindus, similar to the present study. These patterns may be due to the local population demographics rather than any causal religious association.

Socioeconomic status was also considered as an important determinant in our study as 28.3% belonged to the upper middle class and 26.3% to the upper class,

with only 3.6% being from the lower class as per Modified BG Prasad's classification. In contrast, Guntoory et al. [13] and Usharani et al. [5] reported that 70% of their participants belonged to either middle or lower-middle socioeconomic groups. These differences show the epidemiological difference between various geographical and social populations, and it also highlights that vaginal discharge is not restricted to low-income groups.

Microbiological profiles reported that 42.5% of them had bacterial vaginosis and 25.6% of them had vulvovaginal candidiasis, followed by 11.3% with trichomonas vaginalis, it is also observed that 16.3% of them had normal physiological discharge, similar observations were made by Konadu et al. [17] from Ghana, where the observed prevalence rates of vulvovaginal candidiasis with 36.5%, bacterial vaginosis in 30.9%, and trichomoniasis among 1.4%, which is slightly similar to our etiologic distribution. Other large retrospective analyses [18] have confirmed that bacterial vaginosis and trichomoniasis as significant contributors to symptomatic discharge. Usharani et al. [5] also identified Bacterial vaginosis among 21%, candidiasis in 10%, and trichomoniasis among 3% of their study population as the major etiologies. Studies from East Africa have similarly reported bacterial vaginosis as the most common isolate, along with concerning levels of antimicrobial resistance, reinforcing the need for laboratory confirmation and susceptibility testing in symptomatic women.

The observations state that abnormal vaginal discharge is a complex condition which may be influenced by age, education, occupation, socioeconomic status, and sexual behaviour. The consistent higher prevalence of bacterial vaginosis and candidiasis across multiple regional and international studies highlights the significance of integrating clinical assessment with microbiological testing for accurate diagnosis and effective management.

Conclusion

Abnormal vaginal discharge remains a complex and yet common condition with clinically significant complaint. Our study demonstrated that by combining clinical evaluation with microbiological confirmation it drastically improves diagnostic precision. Bacterial vaginosis and vulvovaginal candidiasis are the commonest etiologies observed among women attending tertiary health care. Systematic assessment, timely treatment, and preventive counselling are essential to reduce reproductive morbidity.

Limitations

This was a single-center, hospital-based descriptive study, and the findings may not be generalizable to the wider community and the results are specific to women attending this tertiary care institute and may differ in community settings. The cross-sectional design also precludes the assessment of causal relationships.

Author Contributions

Author 1 has contributed to the conceptualization and definition of the intellectual content of the manuscript, design of the study, data analysis, and statistical analysis, Author 2 contributed to the literature search, data acquisition, manuscript editing, and manuscript review. Author 1 will serve as the corresponding author / guarantor of the manuscript

Data availability statement

The datasets generated and analysed in this study are available from the corresponding author on reasonable request. They are not publicly shared because they contain sensitive information that could indirectly identify participants.

Ethical committee approval

This study has been approved by the Institution Ethics Committee – Sri Muthukumaran Medical College Hospital and Research Institute carrying approval number 28/03/IEC/2022 dated 02.09.2022.

Consent from

Written informed consent was obtained from all participants after explaining the study procedures, potential risks and benefits. Consent covered both participation and publication of anonymised findings, with assurance of confidentiality and data privacy.

Conflicts of interest

The authors declare that they do not have conflict of interest.

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ORIGINAL ARTICLE

Estimating Prevalence and Prognostic Impact of Sick Euthyroid Syndrome in Patients with Acute Heart Failure

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Abstract

Background: Non-thyroidal illness (NTI), also termed sick euthyroid syndrome (SES), represents transient alterations in thyroid hormone levels that occur during acute or critical illness. Typically, serum thyroid-stimulating hormone (TSH) remains within the normal range, while triiodothyronine (T3), thyroxine (T4), and reverse T3 (rT3) show characteristic fluctuations. Thyroid hormones play a crucial role in maintaining myocardial contractility, hence affecting cardiac function and overall prognosis of the patient. **Aim:** To estimate prevalence of sick euthyroid syndrome in patients admitted with acute heart failure and to assess its prognostic significance. **Discussion:** Morbidity of heart failure was assessed as a need for prolonged hospital stay and re-hospitalization as previous literature review showed that it was increased among low T3 subjects. However, such an association was not seen in our study. **Conclusion:** The prevalence of Sick euthyroid syndrome was found to be 22.3%. The mortality rate as well as re-hospitalization rate among our study subjects was very low, however statistical data showed a slightly more prolonged hospital stay among sick euthyroid subjects. Thyroid function assessment and its treatment whenever indicated is of paramount importance especially among heart failure subjects.

Keywords: Sick Euthyroid, Reverse T3, non-thyroidal illness, Ejection Fraction

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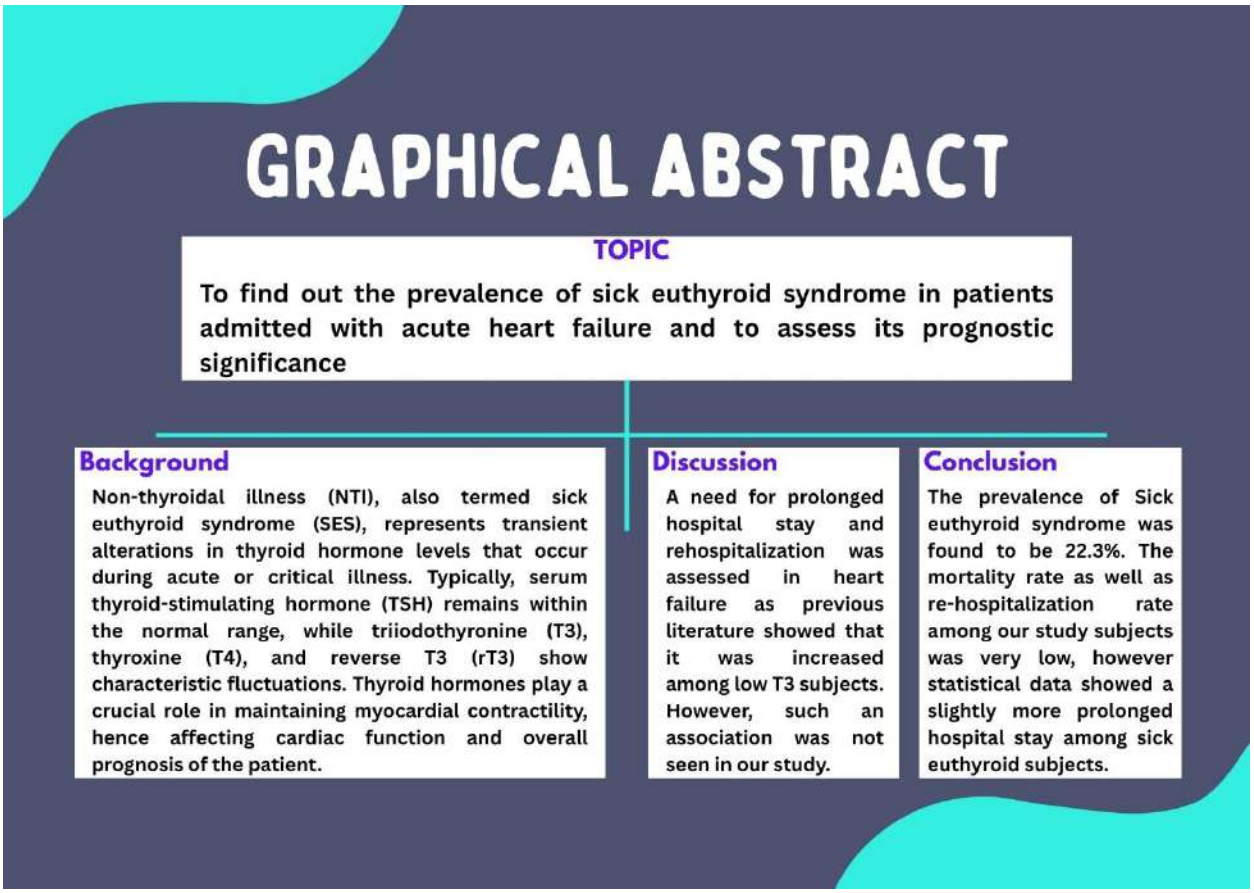
Abbreviations

SES	:	Sick Euthyroid Syndrome
rT3	:	reverse Triiodothyronine
LVD	:	Left Ventricular Dysfunction
HFpEF	:	Heart Failure with preserved Ejection Fraction
FT3	:	Free Triiodothyronine
TSH	:	Thyroid Stimulating Hormone
NTI	:	Non-Thyroidal Illness
T3	:	Total Triiodothyronine
ICU	:	Intensive Care Unit
FTI	:	Free Thyroxine Index
T4	:	Total Thyroxine or Tetraiodothyronine
FT4	:	Free Tetraiodothyronine
TBG	:	Thyroid Binding Globulin



Introduction

Non-thyroidal illness (NTI), also termed sick euthyroid syndrome (SES), represents transient alterations in thyroid hormone levels that occur during acute or critical illness. It is not a primary thyroid disorder but rather a reflection of temporary dysregulation in the hypothalamic–pituitary–thyroid axis in individuals without prior thyroid disease. Such abnormalities are reported in nearly three-quarters of critically ill patients [1]. Typically, serum thyroid-stimulating hormone (TSH) remains within the normal range, while triiodothyronine (T3), thyroxine (T4), and reverse T3 (rT3) show characteristic fluctuations. A decline in T3 concentration has been identified as an independent predictor of mortality in heart failure. Given the crucial role of thyroid hormones in maintaining myocardial contractility and hemodynamic stability, the presence of SES in acute heart failure merits further research to elucidate its prognostic relevance [2].

Thyroid abnormalities in critical illnesses

Several abnormalities in thyroid function tests have been documented among patients with NTIs. A common finding is a reduction in serum T3 accompanied by an increase in rT3, a pattern often referred to as the “low T3 syndrome.” Alterations in TSH, T4, FT4, and the free thyroxine index (FTI) have also been observed, with the degree of change varying according to the severity and duration of the illness as shown in Figure 1 [3] It has been well established that as the severity of the non-thyroidal illness increases, serum T3 and T4 concentrations tend to decline progressively, returning to normal once the acute condition resolves [4].

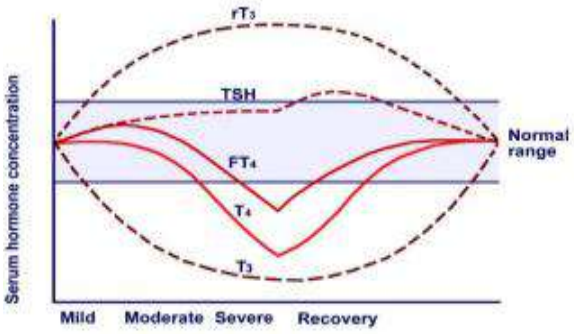


Figure 1. Relationship between serum thyroid hormone concentrations and severity of NTI [5]

Thyroid abnormalities in SES

SICK EUTHYROID	LOW T3	NORMAL	LOW	NORMAL
	HIGH T4	NORMAL	NORMAL	HIGH
	LOW T3 LOW T4	NORMAL	LOW	LOW
	LOW T4	NORMAL	NORMAL	LOW

Figure 2. Types of thyroid abnormalities in SES [6]

Low T3 Syndrome

In low T3 syndrome, serum TSH, T4, and free thyroxine (FT4) levels generally remain within the normal range, while T3 levels are decreased as shown in Figure 2. Free T3 concentrations may be normal or reduced, whereas rT3 levels are typically elevated, except in patients with renal impairment.

A progressive daily decline in T3 production has also been observed during acute illness. Among hospitalized patients with severe systemic conditions, more than 70% exhibit reduced total T3 levels. This

pattern is particularly common in individuals with heart failure, affecting nearly half of those who are otherwise euthyroid and has been identified as an independent predictor of adverse outcomes in patients with cardiac failure [7].

Low T3 and Low T4 Syndrome

Studies have shown that serum T3 and T4 levels are reduced in approximately 30% to 50% of patients admitted to medical ICUs. In critically ill or moribund individuals, daily production of T4 may be normal or slightly diminished as shown in Figure 2. Reduced serum T4 is linked to increased mortality in systemic illnesses. Moreover, among patients with low T4, the coexistence of low T3 levels was associated with the worst prognosis [8].

High T4 Syndrome

In certain patient groups, particularly those with hepatic dysfunction or patients on amiodarone or radiocontrast agents, an isolated elevation in total serum T4 has been observed. This increase is primarily attributed to elevated levels of thyroxine-binding globulin (TBG), reduced hepatic metabolism of T4, or a combination of both mechanisms as shown in Figure 2. Despite the rise in total T4, the concentration of free T4 in these patients typically remains within the normal range [9].

Increased Serum Reverse T3

Another notable thyroid function abnormality observed in non-thyroidal illness is an elevation in serum reverse triiodothyronine (rT3) levels, which occurs in the majority of systemic disorders. An exception to this pattern is seen in renal impairment, where rT3 concentrations typically remain within the normal range as shown in Figure 2. Elevated serum rT3 levels, as well as a reduced T3/rT3 ratio have been identified as independent predictors of mortality in patients with congestive heart failure [10].

Acute Cardiac Failure and Heart failure with preserved ejection fraction

Cardiovascular disease is recognized as the foremost cause of death worldwide and encompasses a range of disorders affecting the heart and blood vessels. These include coronary artery disease, cerebrovascular disease, rheumatic heart disease, and various other related conditions. Heart failure represents the final stage of most cardiac disorders, contributing to its significant prevalence. Despite advancements in medical management, heart failure continues to be associated with high mortality rates [11].

Heart failure with preserved ejection fraction (HFpEF) is a condition in which patients exhibit the typical signs and symptoms of heart failure due to elevated left ventricular filling pressures, despite having normal left ventricular systolic function. The exact prevalence of HFpEF remains uncertain; however, recent studies estimate it to range between 40% and 70%. Currently, there is no established effective treatment for HFpEF [12].

Mechanisms of cardiac function affect by thyroid hormone abnormalities

T3 influences cardiovascular function through multiple mechanisms.

1. First, T3 binds to nuclear receptors within cardiac myocytes, thereby regulating gene expression and directly affecting myocardial structure and performance.
2. Second, it modulates cardiac responsiveness to the sympathetic nervous system, enhancing the heart's sensitivity to catecholamines.
3. Third, T3 induces peripheral hemodynamic changes that increase venous return and cardiac filling, while also influencing the force and efficiency of myocardial contraction [13].

Mechanisms contributing to low T3 and T4 levels

1. Compromised nutritional status and alterations in selenium status.
2. Increased generation of free radicals in tissues and cytokines.
3. Circulating inhibitors of the activity of iodothyronine 5′-monodeiodinase in tissues.
4. Increased cortisol in circulation.
5. Decreased uptakes of T4 by tissues.
6. Decrease in TSH or its effect on the thyroid.
7. Circulating inhibitors of binding of T4 to serum proteins.
8. Increased reverse T3
9. Decreased serum binding of T3 and T4
10. Abnormalities in T4-binding globulin (14)

Methodology

It was a prospective cohort study undertaken for 2 years at Little Flower Hospital, Angamaly, Kerala for prevalence estimation of the sick euthyroid syndrome in heart failure patients. 121 patients were admitted in medicine and cardiology departments with acute heart failure.

Inclusion Criteria:

- Age > 18 years
- No history or clinical evidence of structural heart disease
- No history of intake of medications altering thyroid function.

Exclusion Criteria:

- Age < 18 years
- are not willing to participate
- Non-cardiac acute illness including sepsis along with acute cardiac dysfunction.

Thyroid Function tests

Venous blood samples were obtained at the time of study entry and thyroid function test was done using Cobas e 411 instruments for thyroid profile analysis in the hospital laboratory. The values mentioned in Table 1 were considered for normal thyroid values as well as for the sick euthyroid syndrome diagnosis.

Table 1. Reference Range of Thyroid Function Test [15]

TSH	0.27 - 4.2 µIU/ml
T3	80-200 ng/dL
T4	4.5-12 µg/dL

Severity of heart failure was assessed as a token of ejection fraction which was noted by performing a 2D-echocardiography at our heart care center at admission.

Other methods for acute heart failure quantification like NT-ProBNP and pulmonary edema on chest xray were not taken in this study as the parameters for heart failure assessment.

Ejection fraction was classified in different categories as follows (16):

- Preserved Ejection Fraction >50%
- Mild LVD: 41-49%
- Moderate LVD: 31-40%
- Severe LVD: <30%

Thyroid samples were repeated only if the samples were found defective via lab parameters otherwise it was no resampling done. No thyroid replacement therapy or drugs for myocardial remodeling prevention were initiated unless patient was already on such drugs which were commenced promptly as it was an observational study and not an interventional study [17,18].

Patients were followed up for 6 months from the date of discharge for life events like re-hospitalization mortality [19].

Data collected were coded and entered in Microsoft Excel sheet which was checked and analyzed using SPSS statistical software version 22.

Quantitative variables were summarized using mean and standard deviation. Categorical variables were represented using frequency and percentage. Pearson Chi-square test and Fisher's exact test were used for comparing categorical variables between groups. A P value of <0.05 was considered statistically significant.

Results

The age of the participants ranged from 41 to 88 years. Maximum number of study subjects were in the age group of 71-80 years. Age distribution of the patients is shown in Table 2 and Figure 3.

Mean age of the study population was 68.3 years. Standard deviation was 10.85. Median age was 70 years.

Table 2. Age distribution

Age Group	No. of patients	%age
40-50 years	7	5.8
51-60 years	24	19.8
61-70 years	30	24.8
71-80 years	45	37.2
81-90 years	15	12.4

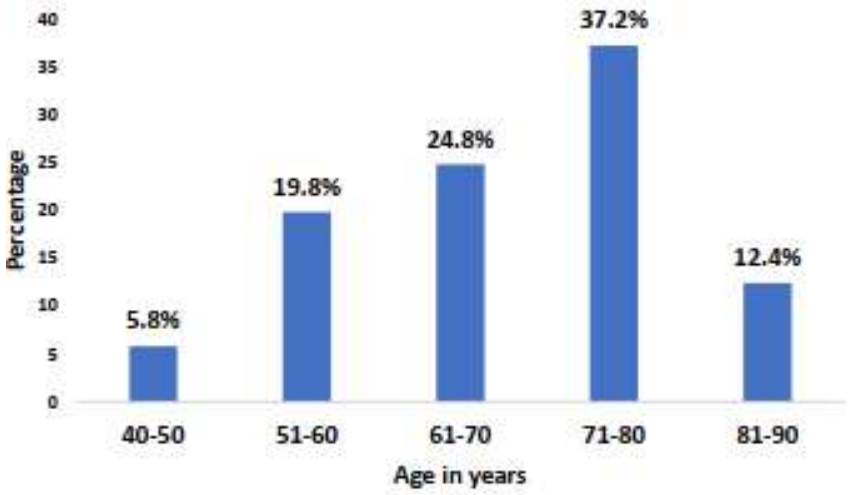


Figure 3. Graphical representation of age distribution of the study participants

Table 3. Distribution of participants as per their ejection fraction

EJECTION FRACTION	NO. OF SUBJECTS (%AGE)
Preserved EF (>50%)	23(19%)
Mild LVD (41%-49%)	19(15.7%)
Moderate LVD (31%-40%)	39(32.2%)
Severe LVD (<30%)	40(33.1%)

40 had severe LVD, 39 had moderate LVD, 23 had preserved ejection fraction and 19 had mild LVD which was diagnosed on Echocardiography as shown in Table 3.

Table 4. Distribution of SES in Study population

SICK EUTHYROID SYNDROME	NO. OF SUBJECTS (%AGE)
Present	27(22.3%)
Absent	94(77.7%)

Out of 121 subjects, 27 subjects (22.3%) had sick euthyroid syndrome and rest of 94 patients didn't fit into the diagnosis of sick euthyroid syndrome as shown in Table and Figure 4.

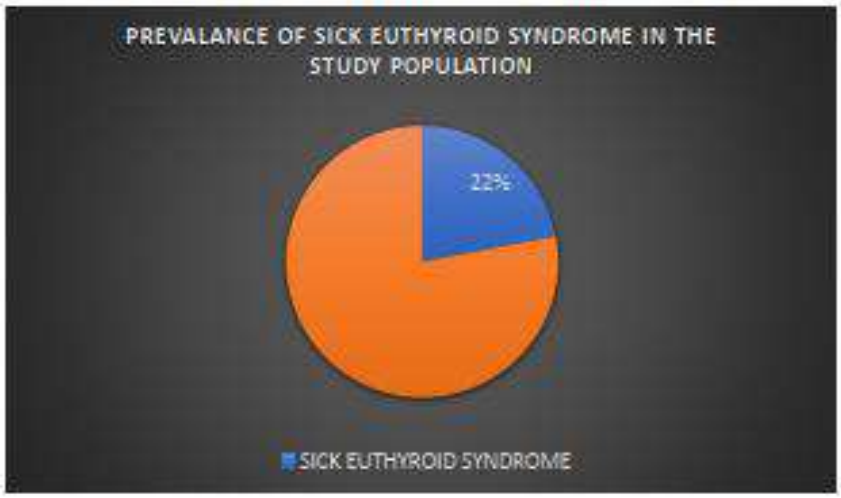


Figure 4. Pie chart showing prevalence of SES in Study population

Table 5. Distribution of SES components in Study population

SICK EUTHYROID SYNDROME	NO. OF SUBJECTS (%AGE)
LOW T3	20(16.5%)
HIGH T4	3(2.5%)
LOW T3 LOW T4	2(1.7%)
LOW T4	2(1.7%)

Among the 27 subjects with sick euthyroid syndrome, 20 subjects had low T3 syndrome: 3 had high T4 levels, 2 had low T3 low T4 levels and 2 had low T4 levels as shown in table 5.

Table 6. Duration of In-patient care required in the Study population

DURATION OF IN-PATIENT CARE	NO. OF SUBJECTS (%age)
≤5 days	65(53.7%)
>5 days	56(46.3%)

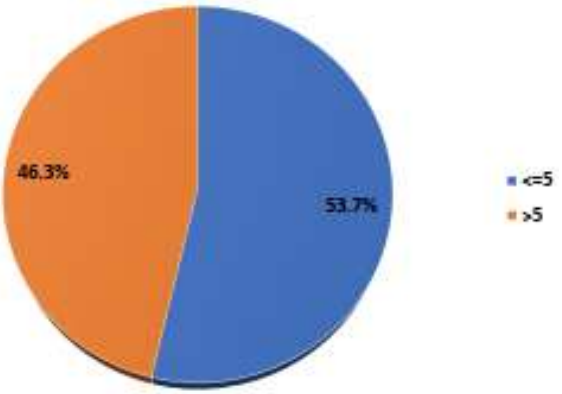


Figure 5. Pie chart showing duration of In-patient care

The mean days of hospitalization were 5.71 days. Standard deviation was 3.49. 53.7% of study subjects required only less than 5 days of hospitalization whereas 46.3% required more than 5 days of hospitalization as shown in Table 6 and Figure 5.

Table 7: Readmission required in the Study population

READMISSION STATUS	**NO. OF SUBJECTS (%AGE)**
Readmission	19(15.7%)
No readmission	102(84.3%)

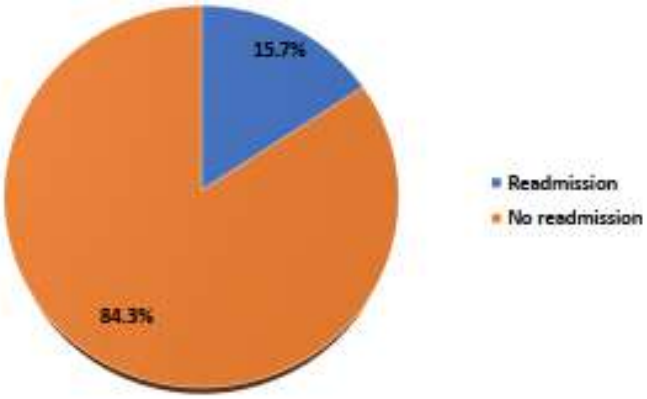


Figure 6. Pie chart showing Readmission percentage in Study Population

15.7% (19 out of 121) required re-hospitalization within 6 months of index inpatient care as shown in Table 7 and Figure 6.

Table 8. Hospital mortality in the Study population

HOSPITAL MORTALITY	NO. OF SUBJECTS (%AGE)
Yes	1(0.8%)
No	120(99.2%

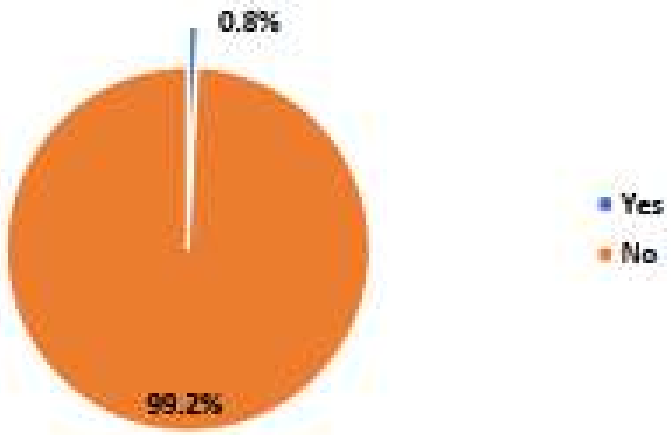


Figure 7. Pie chart showing mortality percentage in Study Population

Mortality within six months of index inpatient care was only 0.8%. Only 1 patient died out of 121 as shown in table 8 and figure 7.

Table 9. Association of SES with age

Age	Sick euthyroid syndrome		P-Value
	No. & %age	No. & %age	
40-50 years	0	7(7.4%)	0.354
51-60 years	8(29.6%)	16(17%)	
61-70 years	5(18.5%)	25(26.6%)	
71-80 years	11(40.7%)	34(36.2%)	
81-90 years	3(11.1%)	12(12.8%)	
Total	27 (22.3%)	94(77.7%)	

Out of 27 subjects with sick euthyroid syndrome, 11(40.7%) were in the age group of 71-80 years; 8 (29.6%) belonged to age group of 51-60 years; 5 (18.5%) belonged to age group of 61-70years and 3(11.1%) belonged to the age group of 81-90 years. Whereas in the non-sick euthyroid category, 34 (36.2%) were in the age group of 71-80 years; 25 (26.6%) were in the age group of 61-70 years; 16 (17%) were in the age group of 51-60 years; 12 (12.8%) were in the age group of 81-90 years and 7 (7.4%) belonged to 40-50 years as shown in table 9. Correlation between incidence of sick euthyroid syndrome in acute heart failure and age at admission was inconclusive in our study because P-value could not establish a statistical association.

Table 10. Association of SES with ejection fraction

Ejection Fraction	Sick euthyroid syndrome		P-Value
	Present No. & %age	Absent No. & %age	
Preserved EF	7(25.9%)	16(17%)	0.724
Mild LVD	4(14.8%)	15(16%)	
Moderate LVD	7(25.9%)	32(34%)	
Severe LVD	9(33.3%)	31(33%)	

Out of 27 subjects with sick euthyroid syndrome, 9(33.3%) had severe LVD; 7(25.9%) had heart failure with preserved ejection fraction; 7(25.9%) had moderate LVD; 4(14.8%) had mild LVD. Whereas in non-sick euthyroid subjects 31 (33%) had severe LVD; 32 (34%) had moderate LVD; 15 (16%) had mild LVD and 16 (17%) had preserved EF as shown in Table 10.

Correlation between severity of heart failure and incidence of sick euthyroid syndrome in acute heart failure was inconclusive in our study because P-value could not establish a statistical association.

Table 11. Association of SES with duration of inpatient care

Duration of inpatient care	Sick euthyroid syndrome		P-Value
	Present No. & %age	Absent No. & %age	
≤5 DAYS	13(48.1%)	52(55.3%)	0.510
>5 DAYS	14(51.9%)	42(44.7%)	

Out of 27 subjects with sick euthyroid syndrome, 14(51.9%) needed a longer hospital stay of more than 5 days whereas 13(48.1%) required hospital stay less than 5 days. In the non sick euthyroid category 52 (55.3%) required hospital stay less than 5 days whereas 42 (44.7%) required hospital stay more than 5 days as shown in Table 11. Correlation between duration of in-patient care and incidence of acute heart failure was inconclusive in our study because P-value could not establish a statistical association.

Table 12. Association of SES with readmission

Status of readmission	Sick euthyroid syndrome		P-Value
	Present No. & %age	Absent No. & %age	
Readmission	2(7.4%)	17(18.1%)	0.238
No readmission	25(92.6%)	77(81.9%)	

Out of 27 patients with sick euthyroid syndrome, only 2 out of 27 (7.4%) subjects got re admitted within six months of index admission. Among the sick euthyroid

subjects 17 out of 94 (18.1%) got readmitted within six months of index admission as shown in table 12.

Correlation between incidence of sick euthyroid syndrome in acute heart failure and the risk of re-admission within 6 months of index admission was inconclusive in our study because P-value could not establish a statistical association.

Table 13. Association of SES with in-hospital mortality

In hospital Mortality	Sick euthyroid syndrome		P-Value
	Present No. & %age	Absent No. & %age	
Yes	0(0)	1(1.3%)	1.000
No	46(100%)	74(98.7%)	

Mortality was zero percentage among subjects with sick euthyroid syndrome. Only single mortality was documented among study subjects during the six months of follow-up as shown in table 13. Correlation between incidence of sick euthyroid syndrome and in-hospital mortality was inconclusive in our study because P-value could not establish a statistical association.

Discussion

Morbidity of heart failure was assessed as a token of need for prolonged hospital stay and the need for re hospitalization within six months of index admission. Previous literature review showed need for prolonged hospital stay and readmission was increased among low T3 subjects. However, such an association was inconclusive in our study, probably limited by low sample size.

Conclusion

The prevalence of Sick euthyroid syndrome was found to be 22.3% More than half the subjects (62%) admitted with acute heart failure had some form of thyroid abnormality. 33.6% were euthyroid. The duration of in-patient care required among the sick euthyroid and non-sick euthyroid category was found to be almost equal, however statistical data showed a slightly more prolonged hospital stay among sick euthyroid subjects. The mortality rate as well as re-hospitalization rate among our study subjects was very low. Thyroid function assessment and its treatment whenever indicated is of paramount importance especially among heart failure subjects.

Strengths and limitations

It is one of the few studies to be done on this topic in India especially in Kerala. Data collection using structured questionnaires was done by the clinician at the time of admission which improves the validity of the data as well as its study findings. Thyroid function tests were done using standardized instruments and standard procedures were followed while collecting samples. The mortality and morbidity within six months of enrolment is alone included in the study as the study was time bound. As our study is an observational one, no definite conclusion can be made regarding the

influence of thyroid hormone abnormalities on the outcome of acute heart failure. As the thyroid function is only one among the many factors both modifiable and non-modifiable influencing the outcome of acute heart failure, the mortality morbidity assessment may not be solemnly dependent on thyroid function. Being a single institutional study, the data might not be representative of the entire picture of the study settings and thus limiting its generalizability.

Future Scope

The prevalence of SES in heart failure varies widely across studies depending on the severity of cardiac illness and underlying comorbidities. This hormonal disturbance is believed to be an adaptive metabolic response to stress, yet persistent or severe changes have been associated with poor clinical outcomes. Although our study was not much conclusive about its role, but several studies have demonstrated that the presence of SES in heart failure correlates with higher in-hospital mortality, prolonged hospital stay, and increased risk of rehospitalization. Thus, recognizing SES in acute heart failure holds prognostic significance and may serve as an indicator of disease severity and adverse outcomes.

Statements and Declarations

Conflicts of interest

The authors declare that they do not have conflict of interest.

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ORIGINAL ARTICLE

Prevalence and Predictors of Burnout Among Medical Students in a Private Medical College: A Cross-Sectional Study

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Abstract

Background: Medical students are consistently subjected to psychosocial stresses during their training, which can result in burnout, a condition characterised by emotional, mental, and physical weariness due to severe and protracted stress. **Objectives**: To evaluate the prevalence and associated factors of burnout among medical students at a tertiary medical college. **Methodology**: A descriptive study was conducted in a tertiary Medical college after obtaining institutional ethical approval and informed consent. The Copenhagen Burnout Inventory Scale was used to determine the prevalence and correlates of burnout related to patients, work, and personal life. After being imported into Excel, the data was sent to SPSS version 25 for analysis. Chi-square was employed as a test of hypothesis, and frequencies for demographic variables were computed using proportions. **Results:** The study found a high prevalence of burnout among medical students, especially first-year students, with personal burnout at 33.33% and work-related burnout at 48.48%. Female students, those living away from family, and students lacking regular exercise showed higher burnout levels. Patient-related burnout was generally lower but increased with academic year, peaking in final-year students due to clinical exposure. Exercise showed a protective effect across all burnout types, while smoking and alcohol use had a modest impact. The findings align with global studies, indicating burnout is multifactorial and influenced by lifestyle, support systems, and academic demands. **Conclusion:** The study concludes that burnout is highly prevalent among medical students, particularly among females, first-year students, and those lacking familial or physical support. Regular exercise and living with family appear to be protective factors. Institutional reforms and targeted interventions are essential to reduce burnout and support student well-being.

Keywords: Burnout, medical students, emotional, mental, physical stress

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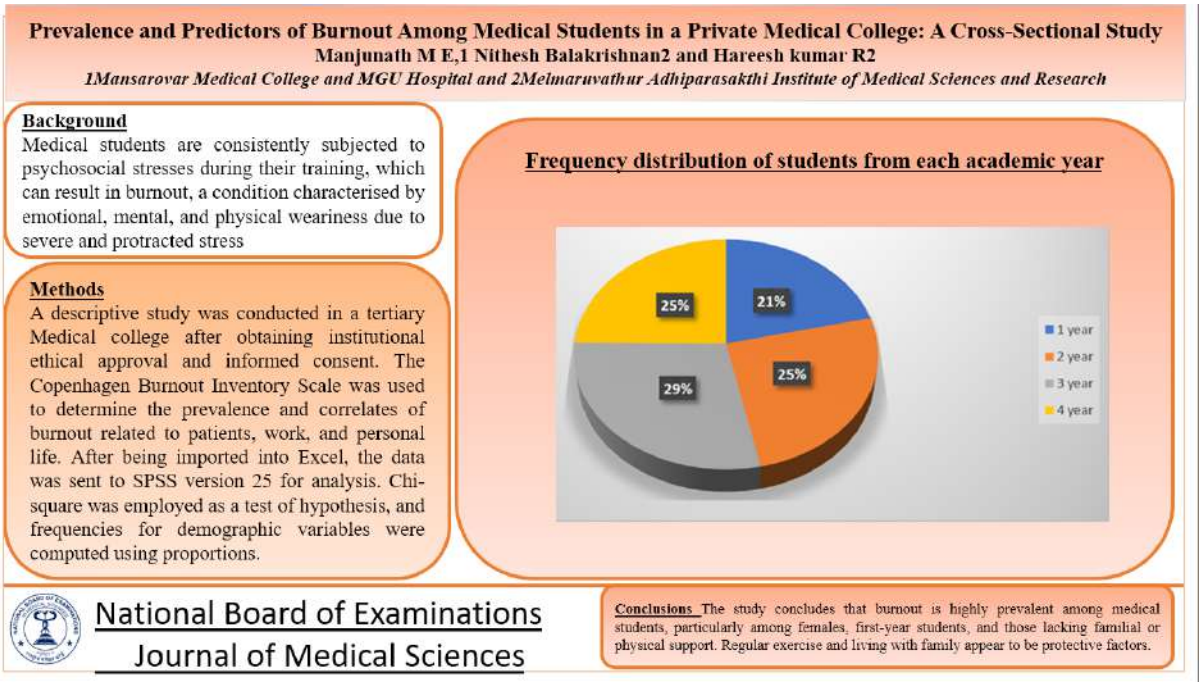
Graphical Abstract



Introduction

Infectious disease, non-communicable diseases (including mental health conditions), and other trends directly linked to globalisation, such trauma, contribute to the triple burden of disease that developing nations currently face. Similar to infectious diseases, our health is compromised by the combination of environmental pollutants and our biological vulnerabilities [1]. However, modern poisons are the result of toxic stress & trauma rather than microbes. Stress is the body's general reaction to any demands placed on it. Most individuals have fallen under its grip as it evolved like an unseen illness [2].

Burnout is a condition of extreme and persistent stress that results in physical, mental, and emotional depletion. It happens when you're too overloaded to meet continuous demands. You start to lose interest in or motivation for your task or commitment as the stress gets worse. The reason is rather insignificant and arises from the disruptions we encounter in our daily lives. There isn't a single, obvious reason to identify the true cause. A lack of leisure, family, and friend time, as well as an overwhelming workload and educational responsibilities, all add to their stress levels [3].

The three aspects of student burnout syndrome are as follows: 1) cynicism (apathy or indifference towards academic activities), 2) emotional tiredness (caused by the demands of education), and 3) low professional performance (feeling of inefficiency as a student) [4]. The National Institute for Occupational Health in Denmark created the publicly available Copenhagen Burnout Inventory (CBI). The CBI's fundamental characteristic is that it distinguishes between three types of burnout, each of which is characterised by the area of life.

Student burnout includes three components: cynicism toward academic work, emotional exhaustion from study demands, and reduced academic efficacy,

or feeling ineffective as a student. The Copenhagen Burnout Inventory (CBI), developed by Denmark's National Institute for Occupational Health, measures burnout across three domains: personal burnout (general physical and mental exhaustion), work-related burnout (exhaustion linked to one's job), and client-related burnout (exhaustion tied to working with clients). Scale scores are calculated by averaging the item responses [5].

As aspiring medical professionals, medicos must examine themselves and their goals in order to know what they are pursuing and what they are actually attempting to do in a useful way. The main query is if they truly choose to stay on their current unstructured route or manage stress. Before it's too late to undo the harm, they are doing to themselves, this has to be seriously considered. Work performance, psychological well-being, and self-esteem are all impacted by burnout syndrome, which can lead to other mental illnesses. Therefore, this study is a modest attempt to highlight the necessity to promote the adoption of preventative measures for medicos in a tertiary care hospital and to enable early diagnosis of burnout syndrome.

Methodology

The study aimed to assess the prevalence of burnout and its contributing factors among students at a tertiary medical college. After obtaining institutional ethics approval, a descriptive study was conducted over three months. MBBS students from first to final year who provided informed consent were included through convenience sampling, while those who declined participation were excluded. Using the formula $4pq/d^2$, with a prevalence (p) of 12.8% from a previous study and an absolute error (d) of 5%, the required sample size was 202. After accounting for a 10% non-response rate, the final sample size was set at 225.

Burnout was assessed using the 19-item Copenhagen Burnout Inventory (CBI), which evaluates personal burnout (6 items), work-related burnout (7 items), and patient-related burnout (6 items). Responses were scored as Always (100), Often (75), Sometimes (50), Seldom (25), and Never/Almost Never (0). The mean of item scores provided the overall score, with values below 50 considered low or absent burnout and scores above 50 classified as high. Data were entered into Excel and analyzed using SPSS version 25 (Table 1 and Figure 1)).

Results:

Table 1. Frequency distribution of medicos from each academic year (n=225)

Year of study	No of persons	%
1 year	48	21.33
2 years	57	25.33
3 years	64	28.44
4 years	56	24.89
Total	225	100.00

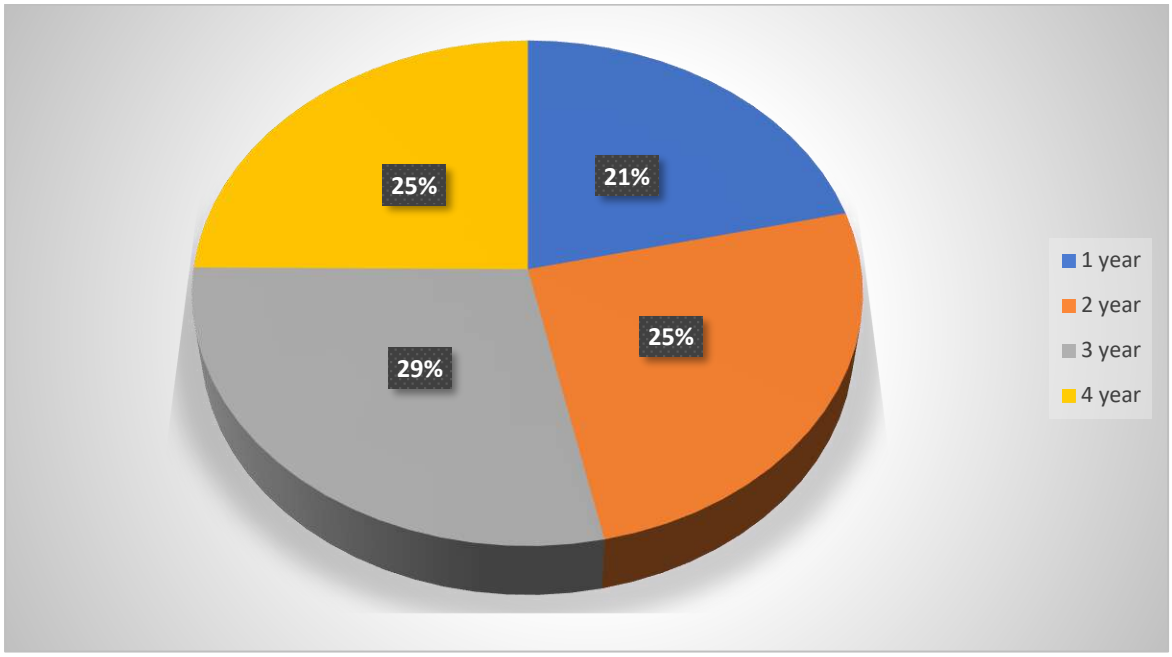


Figure 1. Frequency distribution of students from each academic year

This Table 1 illustrates the distribution of medical students across four academic years out of a total of 225 participants. The third-year students represent the highest proportion at 28.44% (64 students), followed by second-year students at 25.33% (57 students), fourth-year students at 24.89% (56 students), and first-year students at 21.33% (48 students). This distribution indicates a relatively balanced representation across all academic years, which strengthens the generalizability of the subsequent findings on burnout. The near-uniform spread ensures that no single academic group dominates the sample, thereby minimizing bias due to overrepresentation.

Moreover, the increasing percentage up to the third year and a slight drop in the fourth year might reflect cohort-specific enrollment patterns or retention factors. These could include challenges such as academic stress, clinical exposure, or shifting interests, which often intensify in later years and might influence dropout or deferral rates. Overall, this foundational demographic table sets the stage for understanding how burnout symptoms may vary depending on academic level.

Table 2. Prevalence of students with personal burnout as per Copenhagen burnout inventory

Variables	Total no of students	%	No of students with personal burnout	%	P value
Academic Year					
1 year	48	21.33	11	33.33	0.0023
2 years	57	25.33	6	18.18	0.0041
3 years	64	28.44	9	27.27	0.0061
4 years	56	24.89	7	21.21	
Gender					
Males	96	42.67	9	27.27	
Females	129	57.33	24	72.73	
Stay					
Stay with family	32	14.22	4	12.12	
Stay away from family	193	85.78	29	87.88	
exercise					
No exercise	78	34.67	14	42.42	
Some exercise	93	41.33	11	33.33	
Regular exercise	54	24.00	8	24.24	
Smoking status					
Smoking	27	12.00	6	18.18	
Non Smoking	198	88.00	27	81.82	
Alcohol Intake					
History of alcohol intake	18	8.00	4	12.12	
No history of alcohol intake	207	92.00	29	87.88	

The Table 2 explores the prevalence of personal burnout among students using the Copenhagen Burnout Inventory. It is segmented by academic year, gender, living situation, exercise habits, smoking status, and alcohol consumption. The highest

prevalence of personal burnout is seen in first-year students (33.33%), which is statistically significant with a p-value of 0.0023. This suggests that transitioning into medical education may be associated with significant psychological stress, perhaps due to academic pressure, adjustment challenges, and social isolation.

Interestingly, females report a significantly higher prevalence of personal burnout (72.73%) compared to males (27.27%), highlighting possible gender-based differences in stress perception or coping mechanisms. Students staying away from family are more affected (87.88%) than those living with family (12.12%), suggesting the emotional buffering role of familial support.

Exercise appears to play a protective role: only 24.24% of students who exercised regularly experienced personal burnout, compared to 42.42% in those who did not exercise. Similarly, smoking and alcohol intake are associated with slightly higher levels of burnout, although these variables show relatively modest differences. Overall, the table underscores that lifestyle and support systems are critical determinants of personal burnout in medical students.

Table 3. Prevalence of students with work burnout as per Copenhagen burnout inventory

Variables	Total no of students	%	**No of students with work burnout**	%	P value
Academic Year					
1 year	48	21.33	16	48.48	0.0013
2 years	57	25.33	3	9.09	0.0022
3 years	64	28.44	6	18.18	0.0031
4 years	56	24.89	8	24.24	
Gender					
Males	96	42.67	14	42.42	
Females	129	57.33	19	57.58	
Stay					
Stay with family	32	14.22	3	9.09	
Stay away from family	193	85.78	30	90.91	
exercise					
No exercise	78	34.67	16	48.48	
Some exercise	93	41.33	11	33.33	

Regular exercise	54	24.00	6	18.18	
Smoking status					
Smoking	27	12.00	4	12.12	
Non Smoking	198	88.00	29	87.88	
Alcohol Intake					
History of alcohol intake	18	8.00	2	6.06	
No history of alcohol intake	207	92.00	31	93.94	

Table 3 presents the prevalence of work-related burnout, again using the Copenhagen Burnout Inventory. The most striking finding is that first-year students report the highest rate of work burnout at 48.48%, with statistical significance ($p = 0.0013$). This is quite concerning, especially considering that first-year students are usually not involved in intensive clinical work. The likely explanation is academic overload and the stress of adjusting to the rigorous demands of medical school.

Gender does not show much variation in work burnout: males (42.42%) and females (57.58%) are relatively balanced. However, a larger difference appears when comparing students living away from family (90.91%) versus those staying with family (9.09%). This trend again suggests that family presence may act as a buffer against stress.

Exercise habits show a clear inverse relationship with work burnout: 48.48% of students who do not exercise suffer from work burnout compared to only 18.18% of those who exercise regularly. These findings advocate for physical activity as a stress-relieving measure. Smoking and alcohol consumption do not show significant variation in this table, indicating that their role in work-related burnout might be less prominent than in personal burnout. Overall, this table provides essential insights into the environmental and behavioral factors contributing to work-related exhaustion.

Table 4. Prevalence of students with patient burnout as per Copenhagen burnout inventory

Variables	Total no of students	%	No of students with patient burnout	%	P value
Academic Year					
1 year	48	21.33	1	3.03	0.0052
2 years	57	25.33	5	15.15	0.0042

3 years	64	28.44	4	12.12	0.0011
4 years	56	24.89	8	24.24	
Gender					
Males	96	42.67	11	33.33	
Females	129	57.33	7	21.21	
Stay					
Stay with family	32	14.22	4	12.12	
Stay away from family	193	85.78	14	42.42	
exercise					
No exercise	78	34.67	3	9.09	
Some exercise	93	41.33	6	18.18	
Regular exercise	54	24.00	9	27.27	
Smoking status					
Smoking	27	12.00	1	3.03	
Non Smoking	198	88.00	17	51.52	
Alcohol Intake					
History of alcohol intake	18	8.00	0	-	
No history of alcohol intake	207	92.00	18	54.55	

Table 4 analyzes the burnout experienced by students in relation to patient interactions. Unlike personal and work burnout, patient burnout appears to be significantly lower across all groups. The highest percentage is seen among fourth-year students (24.24%), likely due to increased clinical exposure and responsibilities. Interestingly, first-year students report a minimal patient burnout rate of just 3.03%, which aligns with their limited or non-existent patient contact.

Gender trends are reversed here: males report higher patient burnout (33.33%) compared to females (21.21%), which might reflect different approaches to patient care or stress perception in clinical settings. As with the previous tables, students staying away from family report more burnout (42.42%) than those living with family (12.12%), indicating a recurring theme of the impact of living arrangements.

Regular exercise again appears beneficial, with 27.27% of regular exercisers reporting patient burnout, which is slightly higher than in other categories but still lower than those who do not exercise. Smoking and alcohol consumption are associated with minimal to no increase in patient burnout. Notably, none of the students with a history of alcohol intake reported patient burnout,

though this finding should be interpreted cautiously due to the small sample size (n=18).

Overall, this table highlights that patient-related burnout is generally less prevalent than other forms but still warrants attention, especially in later academic years. The trend indicates that burnout increases with clinical responsibilities and suggests the importance of early resilience-building interventions.

Discussion

The study's findings regarding the prevalence of personal burnout, particularly among first-year students (33.33%), are consistent with worldwide patterns. According to a comprehensive review and meta-analysis by Almutairi et al.7, medical students had an overall burnout rate of 37.23%, with depersonalization at 35.07% and emotional exhaustion at 38.08%. In a similar vein, a study by Adesola et al.8 discovered that 81.1% of medical students had burnout, which they attributed to a heavy workload and insufficient breaks.

The study's greater burnout rates among first-year students are in line with research conducted in Indonesia by Daryanto et al. [9], which found that preclinical students had far higher levels of depersonalization and emotional weariness than their clinical peers. This pattern highlights the difficulties students encounter when adjusting to the rigorous setting of medical school.

Almutairi et al. [7] found that female gender was a strong predictor of burnout, supporting the study's result that female students reported greater levels of personal burnout (72.73%). The Nigerian study Adesola et al. similarly shows same tendency, with 91.7% of female students reporting burnout. These results imply that female medical students may be more prone to burnout, possibly as a result of a mix of social expectations and academic stress.

The association between staying away from family and increased burnout levels observed in the study aligns with the Nigerian research, which highlighted the role of social support in mitigating burnout. Students living away from familial support systems may lack the emotional buffering needed to cope with academic stressors.

The study highlights the protective role of regular exercise against burnout, consistent with research showing that physical activity helps reduce stress. Similarly, Ilic et al. reported that smoking and alcohol use contribute to burnout, a finding supported by Serbian research linking frequent alcohol consumption and sedative use to higher burnout risk. Despite elevated burnout levels, counseling services were underused, revealing a gap in institutional support. This underscores the importance of medical colleges not only offering mental health resources but also encouraging their use and reducing associated stigma.

Conclusion

The study's findings are consistent with global research on medical student burnout, highlighting the multifaceted nature of the issue. Addressing burnout requires a comprehensive approach that includes curricular reforms, enhanced support systems, promotion of healthy lifestyles, and targeted interventions for vulnerable groups. Future research should focus on longitudinal studies to assess the effectiveness of such interventions in reducing burnout among medical students.

Statements and Declarations

Conflicts of interest

The authors declare that they do not have conflict of interest.

Funding

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ORIGINAL ARTICLE

A Cross Sectional Study on Knowledge, Attitude, Practices of Menstrual Hygiene and College Absenteeism During Menstruation Among Medical Students

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Abstract

Background: Menstruation is a normal body process. However, poor awareness, social restrictions, and symptoms like pain can affect female students' daily activities and college attendance. Medical students, as future doctors, should have good knowledge and safe practices regarding menstrual hygiene. **Methods:** A facility-based cross-sectional study was conducted among 245 female medical students at Government Karur Medical College using a semi-structured questionnaire. Data were summarized using descriptive statistics and tested using Chi-square test and odds ratio. A p-value <0.05 was taken as statistically significant. **Results:** The mean age of participants was 20.4 ± 1.1 years. About 69.4% had some knowledge about menstruation before menarche, mainly from their mothers. College absenteeism during menstruation was reported by 36.7% of students, mostly due to pain (93.3%). Painful menstruation had a significant association with absenteeism ($p < 0.001$), and students with pain had higher odds of taking leave (OR 14.72; 95% CI: 5.13–42.17). PMS was present in 64.9% of participants. Sanitary napkins were used by 97.1%, and most students followed proper disposal and hand hygiene. **Conclusion:** Even though most students had good awareness and hygiene practices, menstrual pain and PMS still led to college absenteeism. Early identification, counselling, and supportive steps at the college level can help reduce absence during menstruation.

Keywords: Menstrual hygiene, college absenteeism, premenstrual syndrome, medical students, dysmenorrhea

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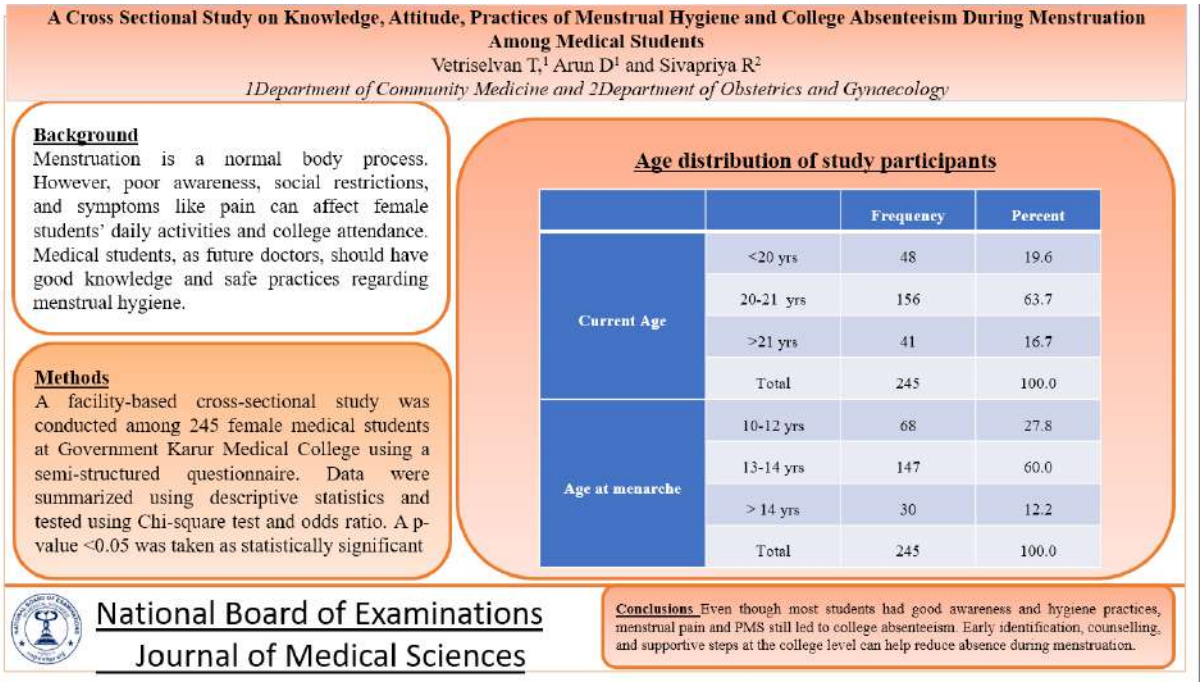
Graphical Abstract



Introduction

Menstruation is a normal body process, but it is still affected by myths, shame, and restrictions, which can influence menstrual hygiene practices and college attendance [1]. Public health guidance highlights that good menstrual hygiene management (MHM) is important for the health, dignity, and education of adolescent girls and young women [2]. Evidence from low- and middle-income countries shows that problems during menstruation are often linked to factors such as social norms, lack of proper toilets and facilities, and limited support that can reduce participation in studies and also affect their well-being [3,4].

Studies among Indian medical and health-professional students show that missing college during menstruation is common and the most common reason is dysmenorrhea and discomfort [5,6]. Medical students usually have better awareness and practices compared to the general population but still gaps exist in understanding the biological process and in proper management of the symptoms [7,8]. Dysmenorrhea is common symptom among university students worldwide which can reduce quality of life and daily functioning among them [9,10]. Proper assessment and appropriate management of primary dysmenorrhea is recommended to reduce symptoms and to improve their routine activity [11].

Premenstrual syndrome (PMS) is also common in young women which can affect their mood, physical comfort, and also their academic performance [12]. Evidence from meta-analysis noted that prevalence of this PMS differs among various studies because of different criteria and populations. PMS also remains as a significant problem [13]. In India, myths and restrictions in menstrual practices continue to be common problem that is even seen among educated groups [14]. Safe disposal of menstrual waste is another important problem and studies have shown

that there are various challenges in disposal methods and can vary widely [15].

Therefore, this study was conducted among female medical students in Karur, Tamil Nadu, to assess knowledge, attitude and practices (KAP) related to menstrual hygiene, measure the prevalence of college absenteeism during menstruation, and identify associated factors.

Objectives

1. To assess the knowledge, attitude, and practices related to menstrual hygiene among female medical students.
2. To determine the prevalence of college absenteeism during menstruation and associated factors.
3. To assess the prevalence of premenstrual syndrome (PMS).

Materials and Methods

A cross-sectional study was conducted among 245 female medical students at Government Karur Medical College, Tamil Nadu. Simple random sampling was used for selecting the students. A pre-validated semi-structured questionnaire was used to collect the data regarding sociodemographic details like their age, age at menarche, prior knowledge about menstruation, menstrual pattern, menstrual pain (dysmenorrhea), symptoms regarding PMS, hygiene practices, restrictions during menstruation, and college absenteeism.

Data were entered in Microsoft Excel and summarized using descriptive statistics. The Chi-square test was utilised to find the association between these menstrual factors and college absenteeism. Odds ratios (OR) with 95% confidence intervals (CI) were calculated. A p-value <0.05 was considered statistically significant.

Results

A total of 245 female medical students participated in the study. The mean age of the participants was 20.4 ± 1.1 years. All participants had attained menarche, and the mean age at menarche was 13.1 ± 1.2 years. About 69.4% of students had some knowledge about menstruation before menarche. The most common source of information was mother (56.47%), followed by friends (21.76%), teachers (8.82%), books (5.29%), and other sources (7.67%). However, despite this prior knowledge, more than half of the students (55.1%) were unaware of the source of menstrual blood, and only 40.4% correctly identified the uterus as its origin. Nearly 47.3% of students reported feeling anxious during their first menstrual experience.

Menstrual absenteeism was reported by 90 students (36.7%). Among them, 28.2% missed college for one day, 7.8% for two days, and 0.8% for three days. The main reasons for absenteeism were menstrual pain (93.33%), need for rest (26.67%), fear of staining clothes (8.89%), and lack of toilet privacy (4.44%).

The mean duration of menstruation was 4.98 ± 1.52 days, ranging from 2 to 20 days. Most students (85.7%) reported having a regular menstrual cycle, while 14.3% had irregular cycles. Among those with irregular cycles, only 57.14% had sought medical consultation. The remaining students did not seek care mainly because they believed the irregularity was normal (73.3%). Most students with irregular cycles (65.71%) felt that poor lifestyle habits were the cause.

Menstrual pain was experienced by 72.7% of participants, commonly on the

first (34.27%) and second day (42.70%) of menstruation. For pain relief, the majority preferred rest (83.15%), while 10.11% used home remedies and only 6.74% took medications. Vaginal discharge was reported by 67.8% of students, most commonly white discharge (65.66%), followed by curdy white discharge (31.93%). Only 10.24% reported foul-smelling discharge. Other symptoms experienced during menstruation included fatigue (49.4%), nausea (18%), diarrhoea (17.1%), dizziness (13.1%), headache (11.8%), and vomiting (9.8%).

Regarding menstrual products, 90.2% of students were aware of menstrual cups, but only 47.51% knew how to use them properly. Sanitary napkins were used by 97.1% of participants, while very few used tampons (0.4%) or menstrual cups (0.4%). About 2% used a combination of products. The average number of pads used per cycle was 4 ± 6.16, with a range of 1 to 7 pads. Most students (95.5%) disposed used pads by wrapping them and throwing them in dustbins, while 3.7% used incineration. Almost all participants (99.6%) practiced proper handwashing after changing absorbents.

Most students (94.3%) discussed menstruation with their family members. However, 76.7% reported facing at least one restriction during menstruation. These included avoidance of religious places (75.1%), restriction from entering the kitchen (6.1%), avoidance of family functions (8.2%), being made to sleep or sit separately (4.9%), and restriction from sports activities (0.4%).

More than half of the students (64.9%) experienced premenstrual syndrome (PMS). Common PMS symptoms included irritability (60%), fatigue (47.8%), anxiety (31.8%), depression (30.6%), crying spells (28.2%), increased appetite (22.9%), confusion (20%), headache (20%), bloating (20%), dizziness (15.9%), breast tenderness (11%), insomnia (9%), palpitations (5.3%), and forgetfulness (5.3%).

On statistical analysis, a significant association was found between menstrual pain and college absenteeism, with 95.6% of students who experienced pain taking leave during menstruation ($p < 0.001$). The association between absenteeism and irregular menstrual cycles (45.7%) or PMS (38.4%) was not statistically significant. Students with menstrual pain had 14.72 times higher odds of availing leave (95% CI: 5.13–42.17), whereas the odds of absenteeism among those with PMS were 1.223 (95% CI: 0.70–2.12) (Tables 1-3 and Figure 1 to 2).

Table 1. Age distribution of study participants and age at menarche among female medical students (n = 245)

		Frequency	Percent
Current Age	<20 yrs	48	19.6
	20-21 yrs	156	63.7
	>21 yrs	41	16.7
	Total	245	100.0
Age at menarche	10-12 yrs	68	27.8
	13-14 yrs	147	60.0
	> 14 yrs	30	12.2
	Total	245	100.0

Table 2. Association between menstrual-related factors and college absenteeism during menstruation among female medical students

	LEAVE ON MENSTRUATION		Total	p value
	Yes	No		
Painful Menstruation	86	92	178	<0.001*
	48.3%	51.7%	100.0%	
Irregular Menstrual Cycle	16	19	35	0.234
	45.7%	54.3%	100.0%	
PMS	61	98	159	0.472
	38.4%	61.6%	100.0%	

* Statistically Significant

Table 3. Distribution of menstrual knowledge, symptoms, health-seeking behaviour, and menstruation-related absenteeism among female medical students (n = 245)

	Yes	No	Total
Knowledge about menarche	170 (69.4%)	75 (30.6%)	245 (100.0%)
Discuss Menstruation with Family members	231 (94.3%)	14 (5.7%)	245 (100.0%)
Painful menstruation	178 (72.7%)	67 (27.3%)	245 (100.0%)
Visited Gynaecologist during painful/Irregular menstruation	20 (57.1%)	15 (42.9%)	245 (100.0%)
Vaginal discharge	160 (65.3%)	85 (34.7%)	245 (100.0%)
PMS	159 (64.9%)	86 (35.1%)	245 (100.0%)
Leave on Menstruation	90 (36.7%)	155 (63.33%)	245 (100.0%)

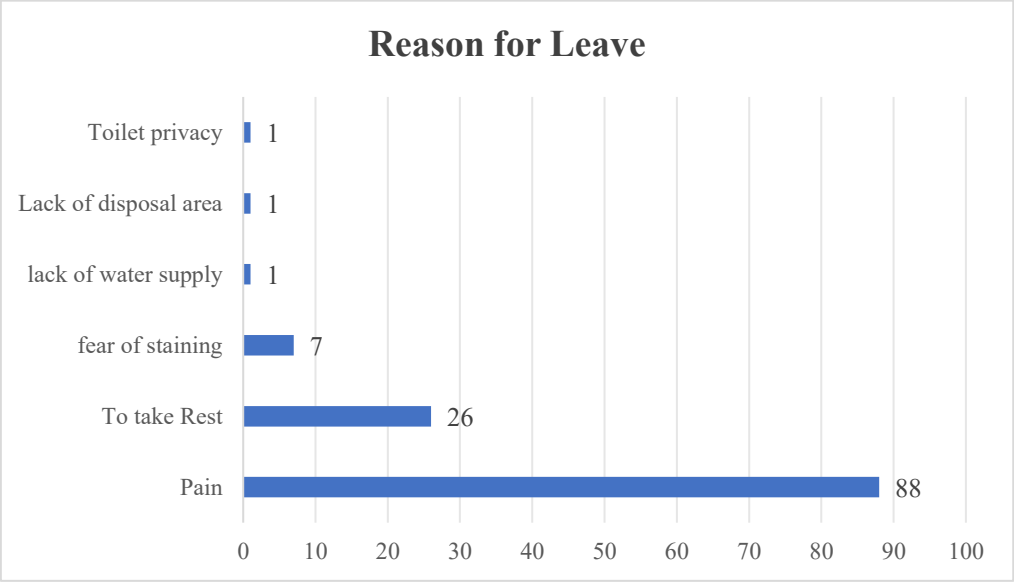


Figure 1. Reasons for college absenteeism

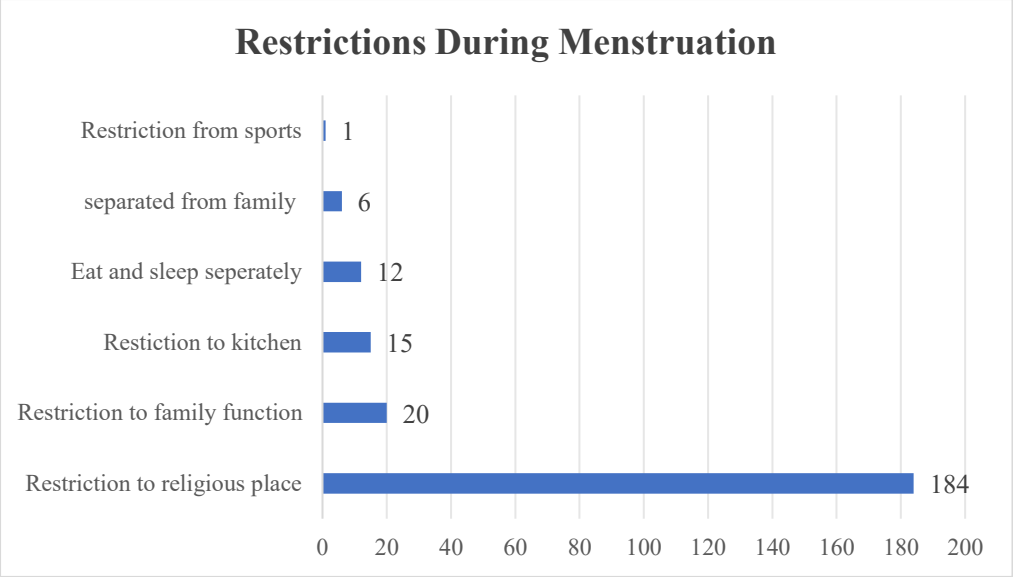


Figure 2. Restrictions during Menstruation

Discussion

The menstrual absenteeism rate in the present study was 36.7% which is similar to reports from medical and dental students in India, where absence during menstruation is mainly due to menstrual pain (dysmenorrhea) and discomfort [5,6]. The strong link between dysmenorrhea and absenteeism found in our study also matches international evidence showing that dysmenorrhea commonly causes difficulty in daily activities and lowers quality of life among university students [9,10]. This highlights the need to follow standard, guideline-based methods for assessment and management of primary dysmenorrhea while providing student health services (11).

The prevalence of PMS in this study was 64.9% which is also like findings from other study in young women and college student populations. Even though PMS was not significantly linked with absenteeism in our study, it still indicates a high burden [12,13]. Menstrual restrictions were frequently reported, showing that cultural taboos and social restrictions still persist, which is similar to findings from some Indian studies and also from qualitative studies done in low- and middle-income countries [3,14].

Although most of the students used sanitary napkins and also practiced good hand hygiene, the type of menstrual product used and the method of its disposal are still important in menstrual hygiene management. The product preference and disposal practices observed in our study are comparable to earlier studies showing wide variation in menstrual hygiene behaviors and disposal methods [7,15]. The high awareness but low use of menstrual cups suggests that knowledge alone may not be enough; practical guidance and supportive environments are also needed to improve their acceptance and regular use of these menstural cups [8].

Conclusion

Menstrual absenteeism was common among the students mainly due to dysmenorrhea. Although most students followed good hygiene practices, many still had gaps in understanding the process in

menstruation. Restrictions because of social and cultural beliefs were common in this study. Menstrual health education in the college, easy access to counselling, and proper treatment for menstrual pain may help in reducing absenteeism and improve students' well-being.

Strengths

This study included an adequate number of female medical students and used simple random sampling, which reduced selection bias within the study setting. It assessed many important aspects of menstrual health, including knowledge before menarche, understanding of menstruation process, hygiene practices, dysmenorrhea, premenstrual syndrome, sociocultural restrictions, and college absenteeism thus providing us a comprehensive picture. The use of statistical analysis to assess associations and report odds ratios with confidence intervals strengthened the identification of dysmenorrhea as an important factor contributing to absenteeism. The findings are particularly relevant because medical students are future healthcare providers, and the results from this study can help in planning effective college-based menstrual health interventions.

Limitations

As the study had a cross-sectional design, it can identify associations but cannot establish cause-and-effect relationships. This is a single-centre study conducted in one medical college so the findings may not be generalizable to all medical students or other educational settings. The data was collected using a self-reported questionnaire that may cause recall bias and also may have underreporting of some sensitive issues. Premenstrual syndrome was identified based on reported symptoms alone since there is no standardized diagnostic tool, which may also influence the accuracy in determination of prevalence. Some factors that could affect menstrual symptoms and absenteeism like anemia, stress, nutritional status, or underlying gynecological conditions, were not assessed in this study.

Author Contributions

Author 1 contributed to the conceptualization and definition of the intellectual content of the manuscript and design of the study. Author 2 was responsible for the design of the study, data acquisition, data analysis, and statistical analysis, and contributed to the definition of intellectual content. Author 3 played a key role in literature search, manuscript editing, and manuscript review. Author 1 will serve as the corresponding author / guarantor of the manuscript

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Conflicts of interest

The authors declare that they do not have conflict of interest.

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ORIGINAL ARTICLE

Obstructive Sleep Apnea in Chronic Obstructive Pulmonary Disease: A Prospective Observational Study

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Abstract

Background: Chronic obstructive pulmonary disease (COPD) and obstructive sleep apnea (OSA) frequently coexist as overlap syndrome a condition associated with severe nocturnal hypoxemia, increased exacerbations, higher cardiopulmonary morbidity and mortality. Despite its clinical impact, overlap syndrome remains underrecognized due to overlapping symptoms and limited routine screening. **Objectives:** To determine the prevalence of OSA in COPD patients and assess its association with disease severity, exacerbations, hospitalizations and cardiopulmonary outcomes. **Methodology:** This prospective observational study was conducted in a tertiary care hospital from September to November 2025. A total of 160 stable COPD patients were enrolled and classified into obese (BMI ≥30 kg/m²; n=80) and non-obese (BMI ≤29.9 kg/m²; n=80) groups. All participants underwent clinical evaluation, spirometry, validated questionnaires, echocardiography and overnight polysomnography. OSA was diagnosed using the apnea–hypopnea index. Statistical analysis included nonparametric tests, correlation, and multivariate regression. **Results:** OSA was identified in 61.9% of patients with moderate-to-severe OSA in 33.7%. Obese patients had significantly higher neck circumference, sleepiness scores and apnea -hypopnea index ($p<0.001$). OSA was associated with increased exacerbations, hospitalizations, pulmonary hypertension and right ventricular dysfunction. Apnea - hypopnea index correlated positively with body mass index and daytime sleepiness and negatively with FEV_1. Obesity, increased neck circumference, excessive daytime sleepiness and reduced lung function independently predicted moderate-to-severe OSA. **Conclusion:** OSA is highly prevalent in COPD, particularly among obese patients and is associated with adverse clinical outcomes. Early screening may improve diagnosis and management of overlap syndrome.

Keywords: Chronic obstructive pulmonary disease, Obstructive sleep apnea, Overlap syndrome, Polysomnography, Obesity

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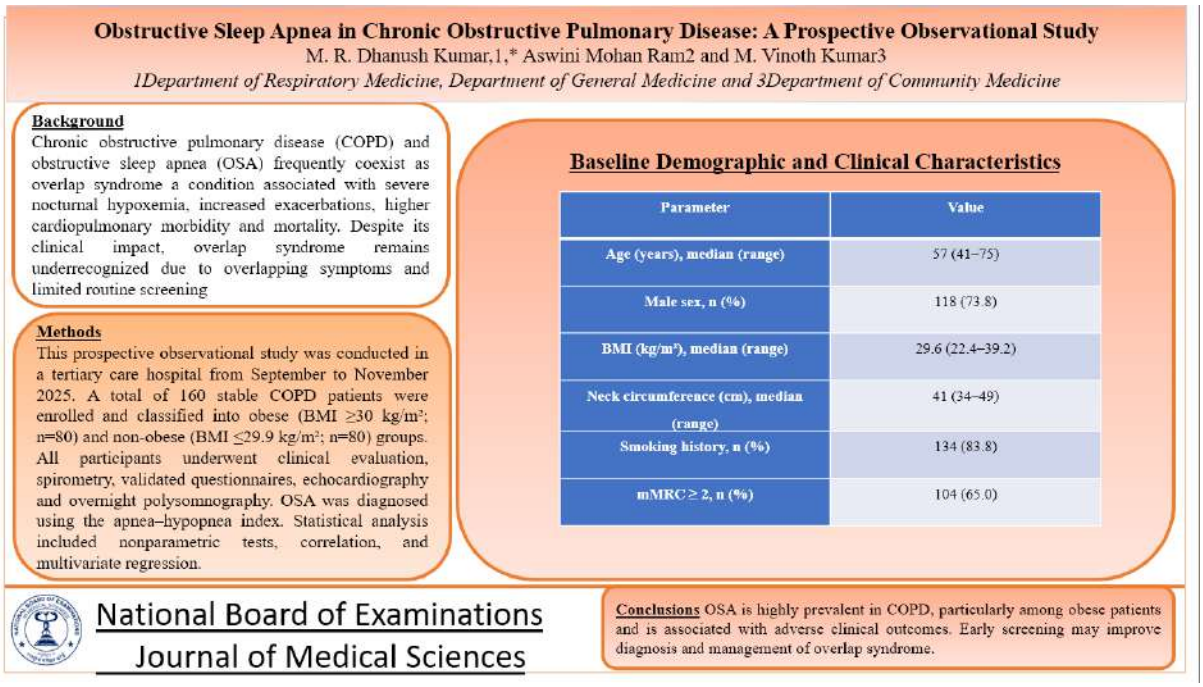
Graphical Abstract



Introduction

A common, preventable and treatable condition chronic obstructive pulmonary disease (COPD) is characterized by persistent respiratory symptoms and airflow limitation due to airway and additional alveolar abnormalities that are typically caused by critical exposure to hazardous particles or gases [1]. The sleep disease known as obstructive sleep apnea (OSA) causes arousals from sleep and hypoxemia at night by discontinuing or significantly reducing airflow in the midst of breathing exertion [2]. David Flenley first described the coexistence of COPD and OSA known as overlap syndrome (OS) thirty years ago. He noted that in order to identify the presence of associated OSA a sleep study should be taken into consideration in obese COPD patients those who snore or who report headaches after nocturnal oxygen therapy [3]. According to the Global Burden Disease Study, COPD which was the sixth leading cause of death in 1990 is expected to become the third leading cause of death globally in 2020. According to a more recent forecast COPD would rank as the fourth leading cause of death by 2030 [4]. Despite the fact that both OSA and COPD are extremely common illnesses, it is unknown if each condition predisposes patients to a higher prevalence of the other [5] but they can have an impact on one another's pathogenesis. [6] Significant morbidity and mortality are linked to these disorders which are marked by severe clinical symptoms [7,8] especially when they occur [9]. Compared to patients with either condition alone patients with COPD and OSA have a significantly higher risk of morbidity and mortality. The prevalence of overlap syndrome is 11% in patients with OSA and 14% in patients with mild COPD [10]. The concomitance of chronic obstructive pulmonary disease (COPD) and obstructive sleep apnea also known as overlap syndrome is a condition of notable yet overlooked importance due to the serious implications it holds for affected patients.

Sufferers with overlap syndrome experience more severe nocturnal hypoxemia more acute exacerbations of the disease, higher cardiovascular morbidity and a higher rate of mortality than in persons with only one of these conditions in other words the combined effects are even more severe when taking both conditions together. Notwithstanding the serious effects the combined condition holds it goes largely unseen because of the overlapping symptoms of the condition and the fact that sleeping disorders are not screened for in people with COPD. The purpose of this study was to assess the effect of obstructive sleep apnea in people with COPD with regard to the incidence of exacerbations of the condition, the rate of hospitalization and the severity of the disease.

Materials and Methods

This is a prospective observational study that was carried out in the single Centre multi-specialty hospital in Chest Department outpatient clinic of KL Multi specialty hospital over a period of 3 months extending from September 2025 to November 2025.

The sample size was calculated using a single population proportion formula with finite population correction. Assuming a confidence level of 95% ($Z = 1.96$), a margin of error of 5% and a population proportion (p) of 50%. Considering the total available population size of 270 patients the final sample size was adjusted using finite population correction. Based on the formula $n = [Z^2 \times p \times (1 - p) / e^2] / [1 + (Z^2 \times p \times (1 - p) / (e^2 \times N))]$ the calculated sample size was 159 participants. This sample size was considered adequate to ensure sufficient statistical power and representativeness of the study population.

The study initially enrolled a total of 200 patients who attended a chest out-patient clinic for a check-up. From these 160 patients who were stable chronic obstructive pulmonary disease (COPD) sufferers were selected based on their medical history, physical examination and pulmonary function test. Written consent has been sought prior to the involvement of all research participants.

Patients with COPD were divided into two groups based on their BMI:

Group A: Obese COPD patients (BMI ≥ 30 kg/m^2; n = 80)

Group B: Non-obese COPD patients (BMI ≤ 29.9 kg/m^2; n = 80)

Inclusion Criteria

Patients were diagnosed as having COPD based on the 2017 guidelines of the Global Initiative for Chronic Obstructive Pulmonary Disease. The inclusion criteria included presentation of cough, sputum production, difficulty in breathing and / or a history of exposure to risk factors along with spirometry-proven airflow limitation, ascertained by a post-bronchodilator FEV1/FVC fixed > 70%.

Exclusion Criteria

Patients were excluded if there was an acute COPD exacerbation, extreme COPD (post-BD FEV1 < 30% predicted or < 50% predicted in the presence of chronic respiratory insufficiency), decompensated heart failure, thyroid disturbances, ENT conditions as the cause of OSA of an obstructive type or evidence of liver and/or kidney dysfunction.

Evaluation of the Severity of COPD

The severity of COPD was determined according to the post-bronchodilator FEV_1 values

Mild FEV1 ≥ 80% predicted
Moderate (50% ≤ FEV_1 < 80% predicted)
Severe (30% ≤ FEV_1 < 50% predicted

Clinical Evaluation

All the candidates were assessed thoroughly which included the history and physical examination. General examination consisted of BMI and Neck circumference measurement while the Systemic examination included Chest, Oral and Ear, Nose and Throat examination.

Survey Assessment

Patients were surveyed using validated questionnaires:

Epworth Sleepiness Scale (ESS), Arabic version

STOP Bang Questionnaire SBQ

mMRC dyspnoea score, English version – modified version

Pulmonary & Laboratory Investigations

Spirometry tests were carried out by using a JAEGER CareFusion spirometer, when patients were stable. Other investigations included echocardiograms as well as blood tests like liver and renal function tests and thyroid function tests (T3, T4, and TSH).

All the patients underwent an overnight polysomnography using the SOMNO Screen Plus recording device (SOMNO Medics GmbH). Besides the following channels were studied during the polysomnography. Electroencephalogram, electrooculogram, electrocardiogram, electromyogram, pulse oximetry, thoracic and abdominal effort belts, body position sensors, nasal thermistor, nasal pressure cannula and limb movement channels.

Apnea was considered the halt of airflow for at least 10 seconds and hypopnea was considered a 30% reduction in airflow duration 10 seconds associated with 4% oxygen desaturation. The apnea-hypopnea index (AHI) was calculated by determining the total apnea and hypopnea events per hour of sleep. Severe obstructive sleep apnea was categorized into mild (AHI 5–14 events/hour), moderate (AHI 15–29 events/hour) and severe (AHI ⩾30 events/hour).

Analysis of the data was done using IBM SPSS Statistics for Windows version 24.0. The data is presented as frequencies and percentages for the qualitative variables and as median and range for the quantitative data because of the violation of the normality of distribution. Comparison between the groups is done by Chi-square or Fishers exact test for the qualitative data and the use of the Mann-Whitney U test for the quantitative data. Correlation between the data was done using the Spearman correlation coefficient. Multiple regression analysis was used to determine the predictors of the Apnea Hypopnea Index (AHI). P-value of <0.05 was taken as significance.

Results

A total of 160 patients with stable chronic obstructive pulmonary disease were included in the study. The median age of the study population was 57 years ranging from 41 to 75 years with males comprising 118 patients accounting for 73.8% of the population. The median body mass index was 29.6 kg/m² ranging from 22.4 to 39.2 kg/m² while the median neck circumference was 41 cm ranging from 34 to 49 cm. A history of smoking was present in 134 patients accounting for 83.8% while moderate-to-severe dyspnea (mMRC ≥ 2) was observed in 104 patients accounting for 65.0% of all patients (Table 1).

Table 1. Baseline Demographic and Clinical Characteristics (n = 160)

Parameter	Value
Age (years), median (range)	57 (41–75)
Male sex, n (%)	118 (73.8)
BMI (kg/m²), median (range)	29.6 (22.4–39.2)
Neck circumference (cm), median (range)	41 (34–49)
Smoking history, n (%)	134 (83.8)
mMRC ≥ 2, n (%)	104 (65.0)

According to post-bronchodilator FEV_1 values, the severity of COPD was classified as mild in 44 patients (27.5%) as moderate in 72 patients (45.0%) and as severe in 44 patients (27.5%) (Table 2). When comparing obese and non-obese COPD patients obese patients had a significantly higher median neck circumference (44 cm vs 38 cm) higher ESS scores (11 vs 7), a greater proportion of STOP-Bang scores ≥ 3 (77.5% vs 35.0%) and higher median AHI values (22 vs 9 events/hour) (Table 3).

Table 2. COPD Severity Distribution

Parameter	Value
Mild	44 (27.5%)
Moderate	72 (45.0%)
Severe	44 (27.5%)

Table 3. Comparison Between Obese and Non-Obese COPD Patients

Parameter	Value
Neck circumference (cm)	44 vs 38 ($p<0.001$)
ESS score	11 vs 7 ($p<0.001$)
STOP-Bang ≥3	77.5% vs 35.0% ($p<0.001$)
AHI (events/hr)	22 vs 9 ($p<0.001$)

It identified 99 patients with obstructive sleep apnea or 61.9% of the patients included. Of these 45 or 28.1% had mild disease while 33 or 20.6% had a moderate degree of the disease. Severe OSA was found in 21 or 13.1% of the patients. Sixty-one patients, 38.1% were without the disease as shown in Table 4. Increased severity of COPD was found to have a statistically significant correlation with worsening severity of OSA as seen in Table 5.

Table 4. OSA Severity Distribution

Parameter	Value
No OSA	61 (38.1%)
Mild OSA	45 (28.1%)
Moderate OSA	33 (20.6%)
Severe OSA	21 (13.1%)

Table 5. Association Between OSA Severity and COPD Severity

Parameter	Value
p-value	0.004

Among patients with OSA rates of adverse clinical outcomes were higher. Frequent exacerbations (≥2 per year) occurred in 55.6% of those with OSA and in 31.1% of those without OSA. The median number of hospitalizations per year was greater in patients with OSA than in those without it (2 vs 1) and pulmonary hypertension was more common in the OSA group than in the non-OSA group (40.4% vs 16.4%) (Table 6).

Table 6. Clinical Outcomes in COPD With and Without OSA

Parameter	Value
≥2 Exacerbations/year	55.6% vs 31.1% (p=0.003)
Hospitalizations/year	2 vs 1 (p=0.001)
Pulmonary hypertension	40.4% vs 16.4% (p=0.002)

By correlation analysis AHI was positively related to body mass index (r = 0.52), neck circumference (r = 0.58) and ESS score (r = 0.49) but negatively with FEV_1 (% predicted) (r = −0.41) (Table 7). Neck circumference (β = 0.38), body mass index (β = 0.34) and ESS score (β = 0.27) were positively related to AHI while FEV_1 (% predicted) was negatively related (β = −0.29) by multiple linear regression analysis (Table 8).

Table 7. Correlation of AHI With Clinical Variables

Parameter	Value
BMI	r=0.52
Neck circumference	r=0.58
ESS score	r=0.49
FEV_1 % predicted	r=-0.41

Table 8. Multiple Linear Regression Predicting AHI

Parameter	Value
Neck circumference	β=0.38
BMI	β=0.34
ESS score	β=0.27
FEV_1 % predicted	β=-0.29

Questionnaire-based comparisons revealed higher median ESS scores (11 vs 7), higher STOP-Bang scores (5 vs 2) and a greater proportion of mMRC scores ≥ 2 among obese patients versus non-obese patients (72.5% vs 57.5%; Table 9). Moderate-to-severe OSA was identified in 45.0% of obese patients compared to 22.4% of non-obese patients (Table 10).

Table 9. Questionnaire Score Comparison

Parameter	Value
ESS median	11 vs 7
STOP-Bang median	5 vs 2
mMRC ≥2	72.5% vs 57.5%

Table 10. OSA Severity by BMI

Parameter	Value
Moderate–Severe OSA	45.0% vs 22.4% (p<0.001)

Nocturnal oxygenation parameters were lower for mean nocturnal oxygen saturation (87% vs 91%), lower for minimum oxygen saturation (78% vs 84%) and longer in duration of oxygen saturation below 90% (32% vs 18%) in obese patients when compared with non-obese patients (Table 11). A STOP-Bang score ≥ 3 was found in 78.8% of the patients with OSA as compared with 34.4% of the patients without OSA (Table 12). The majority of the patients with ESS scores ≥ 10 had moderate-to-severe OSA (Table 13).

Table 11. Nocturnal Oxygenation Parameters

Parameter	Value
Mean SpO_2 (%)	87 vs 91
Minimum SpO_2 (%)	78 vs 84
Time <90% SpO_2	32% vs 18%

Table 12. STOP-Bang Score and OSA Diagnosis

Parameter	Value
STOP-Bang ≥3	78.8% OSA vs 34.4% non-OSA

Table 13. ESS Score and OSA Severity

Parameter	Value
ESS ≥10	Moderate–Severe OSA predominant

Of these patients with severe COPD 70.5% had frequent exacerbations (Table 14). Pulmonary hypertension as assessed by echocardiography was present in 40.4% of patients with OSA compared with 16.4% of patients without OSA and right ventricular dysfunction in 28.3% versus 13.1%, respectively (Table 15).

Table 14. COPD Severity and Exacerbations

Parameter	Value
Severe COPD with ≥2 exacerbations	70.5%

Table 15. Echocardiographic Findings

Parameter	Value
Pulmonary hypertension	40.4% vs 16.4%
RV dysfunction	28.3% vs 13.1%

In logistic regression analysis significant predictors of moderate-to-severe OSA included body mass index ≥30 kg/m², neck circumference ≥40 cm, ESS score ≥10 and FEV_1 < 50% predicted (Table 16).

Table 16. Predictors of Moderate–Severe OSA (Logistic Regression)

Parameter	Value
BMI ≥30	OR 3.4
Neck circumference ≥40 cm	OR 4.1
ESS ≥10	OR 2.8
FEV_1 <50%	OR 2.2

Discussion

Obstructive sleep apnea (OSA) was found in 61.9% of chronic obstructive pulmonary disease (COPD) patients with moderate-to-severe OSA seen in 33.7%. Prevalence rates for this condition appear higher than for the general population but as seen in other research studies can range from 40% to over 60% depending upon the criteria chosen for diagnosis as documented

in healthcare studies [11–13]. The "overlap syndrome" as a co-existing condition for both COPD and OSA was aptly identified for the first time by Flenley who further delineated the significance of this condition [1]. The overlap syndrome remains a condition that is otherwise underdiagnosed especially in obese chronic obstructive pulmonary disease individuals as documented in other studies [12,13].

Obesity as well as an increased neck circumference were found to be strongly linked to higher apnea-hypopnea indexes as well as to moderate to severe OSA. These findings have also been observed in previous studies where anthropometric parameters particularly an increased neck size have been recognized as valid predictors for the severity of OSA [14–16]. The observed increase in the STOP-Bang scores among obese patients with COPD in the current analysis also reconfirms the role of this scoring system in identifying susceptible patients for moderate to severe OSA [17].

The daytime sleepiness measured by the Epworth Sleepiness Scale (ESS) was found to be significantly increased in both obese patients and OSA patients and ESS ≥10 was found to be an independent predictor for moderate to severe OSA. Previous studies have already found a positive correlation between AHI and ESS but this correlation may not be significant in patients with COPD due to the chronic symptoms and disrupted sleep [17,18]. The current study supports other studies which found daytime sleepiness to remain a significant clinical predictor for OSA in overlap syndrome.

Patients with overlap syndrome in this study had a significantly lower level of nocturnal oxygenation as reflected by mean and minimal values of nocturnal SaO2 and time spent below 90% SaO2. This finding is attuned with previous physiological studies that showed that co-existing conditions of COPD and sleep apnea cause more severe degrees of nocturnal hypoxemia than when either condition is present [19,20]. Hypoxia intermittently imposed upon chronic airflow obstruction is postulated to cause pulmonary vascular changes and cardiovascular events [20].

Patients with OSA experienced poorer clinical outcomes in our cohort represented by higher rates of frequent exacerbations, hospitalizations, pulmonary hypertension and right ventricular dysfunction. These results are consistent with long-term outcome studies that document higher morbidity and mortality in patients with untreated overlap syndrome [12,21]. Marin et al. demonstrated that overlap syndrome is a predictor of hospitalization for and mortality by COPD and that its treatment by continuous positive airway pressure (CPAP) improves survival outcome [12]. Subsequent outcome studies of larger series have confirmed overlap patients higher rates of healthcare utilization and requirement for ventilatory support during hospitalizations due to acute exacerbation of COPD [22,23].

Pulmonary hypertension as well as the dysfunction of the right ventricle proved more common among the overlap population in our study. This has been confirmed by other investigations which found that the prevalence of pulmonary hypertension in overlap syndrome proved higher when compared to those patients suffering from COPD alone even if the pulmonary function proved relatively preserved [19,20]. Intermittent hypoxia activation of the sympathetic nerve system, as well as endothelial dysfunction can be considered crucial factors for the

development of pulmonary hypertension among these patients.

The independent predictors for moderate to severe OSA in the multivariate analysis in the current study were weight status (BMI) ≥30 kg/m², increased neck circumference ≥40 cm, preexisting daytime sleepiness (ESS-10) and FEV_1 < 50% predicted. These predictors confirm those previously published in the medical literature for the same patient group attending the respiratory outpatient clinics [14–17,24].

The results of this study are in keeping with the current literature in that overlap syndrome is recognized as being prevalent among sufferers of COPD and is linked to poor nocturnal oxygenation, higher exacerbation rates, more cardiac morbidity and increased healthcare utilization. Early identification and directed treatment of concomitant OSA in the presence of COPD may well offer an area where outcomes can be improved as supported by previous intervention and observational studies [12,21–23].

Statements and Declarations

Conflicts of interest

The authors declare that they do not have conflict of interest.

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ORIGINAL ARTICLE

A Study to Assess Gender Differences in Lifestyle Factors: A Logistic Regression Analysis

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Abstract

Background: Lifestyle factors such as sleep patterns, physical activity, caffeine intake, and screen time play a significant role in determining physical and mental health outcomes. Gender-based differences in these behaviors have been reported; however, evidence from contemporary Indian populations remains inconsistent. **Objectives:** To assess gender differences in selected lifestyle factors among adults using logistic regression analysis. **Methods:** A cross-sectional analytical study was conducted using secondary data from 150 adults. Gender (male/female) was considered the primary independent variable, while lifestyle factors—including sleep duration, physical activity, employment status, caffeine intake, and screen time—were analyzed as outcome variables where appropriate. Binary logistic regression analysis was performed using IBM SPSS Statistics version 26 to examine gender-related differences. Adjusted odds ratios (AORs) with 95% confidence intervals were calculated, and statistical significance was set at $p < 0.05$. **Results:** The study included 71 males (47.3%) and 79 females (52.7%). Logistic regression analysis revealed no statistically significant gender differences across the selected lifestyle factors. None of the examined behaviors demonstrated a significant association with gender after adjustment for relevant covariates. The overall models showed limited explanatory power. **Conclusion:** The findings indicate no significant gender-based differences in the selected lifestyle factors among the study population. These results suggest convergence in lifestyle behaviors across genders and highlight the need for larger, longitudinal studies incorporating objective measures to further explore gender-specific lifestyle patterns.

Keywords: Lifestyle factors; Gender differences; Logistic regression; Physical activity; Sleep behavior; Public health

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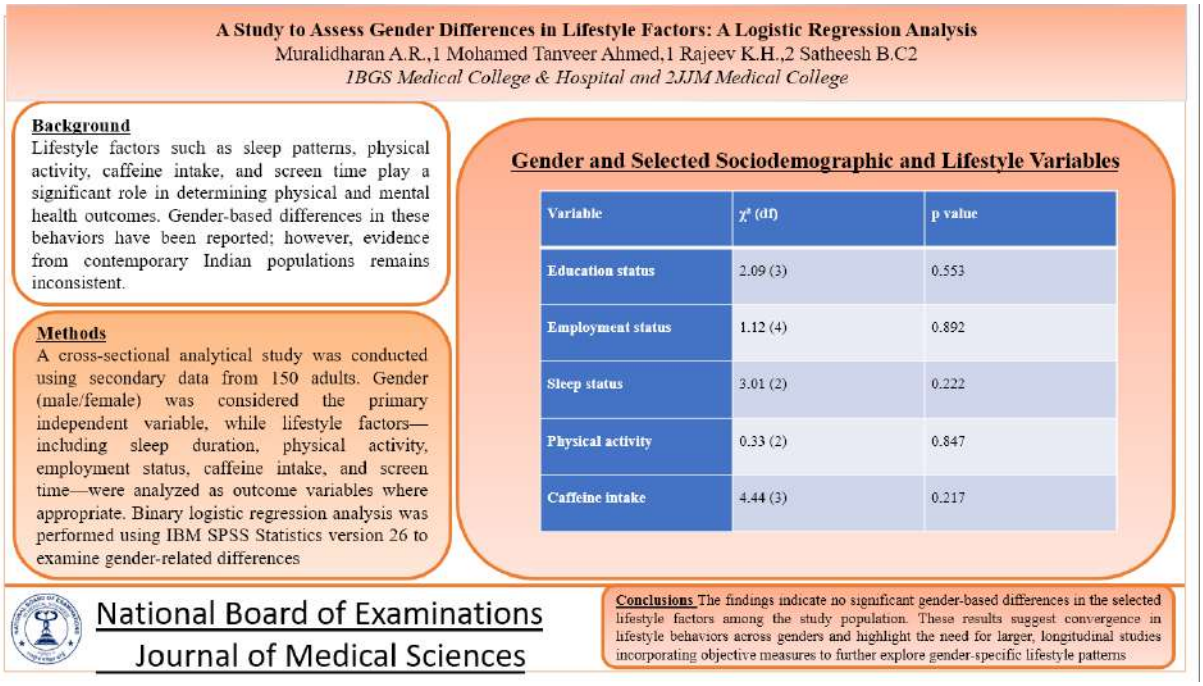
Graphical Abstract



Introduction

Stress is a complex psychophysiological response to perceived environmental and psychological demands and plays a critical role in the development of both mental and physical disorders [1,2]. Chronic stress has been associated with cardiovascular diseases, metabolic disorders, depression, and impaired quality of life [3].

Gender has traditionally been regarded as an important determinant of stress perception and coping mechanisms. Biological differences, gender-specific social roles, and cultural expectations have been suggested to influence how men and women experience stress [4,5]. Several studies have reported higher perceived stress among women, often attributed to caregiving responsibilities and occupational strain [6].

Lifestyle behaviors such as sleep duration, physical activity, caffeine intake, and screen exposure interact closely with stress pathways and influence health outcomes [7–9]. However, recent studies suggest that modernization, changing work environments, and increased digital exposure may have narrowed traditional gender differences in stress-related behaviors [10,11].

Given the inconsistent evidence and limited community-based data from India, the present study aimed to assess gender differences in stress levels and examine the association of selected lifestyle factors with stress using logistic regression analysis.

Objectives

1. To examine the association between selected lifestyle factors and stress after adjusting for gender.

Materials and Methods

Study Design and Setting

A cross-sectional analytical study was conducted using secondary data from *150 adults* residing in rural and semi-urban areas surrounding *Bangalore, Karnataka, India*.

Study Variables

- **Dependent variable:** Gender (Male = 0, Female = 1)
- **Independent variables:** Education level, employment status, sleep duration, physical activity, caffeine intake, screen time, and stress level.

All categorical variables were **dummy coded** prior to analysis.

Statistical Analysis

Binary logistic regression analysis was performed using *IBM SPSS Statistics version 26.0***,** employing the *Enter method.* Model adequacy was assessed using the *Omnibus Test of Model Coefficients***,** *−2 Log Likelihood***,** *Cox & Snell* R^2, and *Nagelkerke* R^2. Adjusted odds ratios (Exp[B]) with corresponding significance levels were reported. A p-value < 0.05 was considered statistically significant.

Results

Descriptive and Bivariate Analysis

All *150 participants (100%)* were included in the analysis, with *no missing data.*

Sample Distribution by Gender:

The study included a total of 150 participants, of whom 71 (47.3%) were males and 79 (52.7%) were females. This relatively balanced gender distribution ensures adequate representation of both sexes and minimizes potential gender-related sampling bias in the analysis (Table 1).

Table 1. Association between Gender and Selected Sociodemographic and Lifestyle Variables

Variable	**χ^2 (df)**	***p* value**
Education status	2.09 (3)	0.553
Employment status	1.12 (4)	0.892
Sleep status	3.01 (2)	0.222
Physical activity	0.33 (2)	0.847
Caffeine intake	4.44 (3)	0.217

Note: Chi-square test applied; $p < 0.05$ considered statistically significant.

Chi-square analysis demonstrated *no statistically significant association* between gender and education level (p = 0.553), employment status (p = 0.892), sleep status (p = 0.222), physical activity (p = 0.847), or caffeine intake (p = 0.217)

Logistic Regression Analysis (Table 2)

Table 2. Case Processing Summary

Unweighted Cases[a]		N	Percent
Selected Cases	Included in Analysis	150	100.0
	Missing Cases	0	.0
	Total	150	100.0
Unselected Cases		0	.0
Total		150	100.0

a. If weight is in effect, see classification table for the total number of cases.

All *150 study participants (100%)* were successfully included in the binary logistic regression analysis, with *no missing or excluded cases*. This indicates that the dataset was *complete and suitable for multivariable analysis*, eliminating the need for imputation or case-wise deletion. It can be inferred that the inclusion of all observations strengthens the *internal validity* of the analysis and ensures that the estimated regression coefficients and odds ratios are *not biased by missing data.* Consequently, the results derived from the logistic regression model can be interpreted with greater confidence, as they reflect the *entire study sample* (Table 3).

Table 3. Dependent variable Encoding

Original Value	Internal Value
1	0
2	1

The dependent variable *Gender* was dichotomized and coded for binary logistic regression analysis as follows:

- *Original value 1 → Internal value 0 (reference category)*
- *Original value 2 → Internal value 1 (comparison category)*

In the logistic regression model, the estimated coefficients (B) and odds ratios [Exp(B)] represent the *log odds and odds of being in Gender category 2 relative to Gender category 1.* A positive regression coefficient indicates an increased likelihood of belonging to *Gender category 2*, whereas a negative coefficient indicates a decreased likelihood compared to the reference group (Gender category 1). This coding framework allows for clear interpretation of the direction and magnitude of associations between the independent variables and gender.

Block 0: Beginning Block (Table 4)

Table 4: Classification Table[a,b]

Observed			Predicted		
			Gender		Percentage Correct
			1	2	
Step 0	Gender	1	0	71	.0
		2	0	79	100.0
	Overall Percentage				52.7

a. Constant is included in the model. b. The cut value is .500

The Block 0 model represents the *null (constant-only) model,* in which no independent variables are included and predictions are made solely based on the most frequent outcome category.

- All participants were predicted to belong to *Gender category 2.*
- *Correct classification:*
  - Gender 1: *0.0%*
  - Gender 2: *100.0%*
- *Overall classification accuracy: 52.7%*

The overall accuracy of 52.7% reflects the *proportional distribution of the dominant gender category* in the sample rather than true predictive ability. The null model *fails to discriminate between gender categories*, serving only as a baseline for comparison. Any improvement in classification accuracy in subsequent models (Block 1) would indicate the *added explanatory value of the predictor variables* (Table 5).

Table 5. Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 0	Constant	.107	.164	.426	1	.514	1.113

In the null model (Step 0), only the *constant (intercept)* was included in the logistic regression equation.

- The regression coefficient for the constant was *B = 0.107* with an *odds ratio [Exp(B)] of 1.113.*
- The Wald statistic was *0.426* with a *p-value of 0.514*, indicating that the constant was *not statistically significant.*

The non-significant intercept suggests that, in the absence of predictor variables, the log odds of belonging to *Gender category 2* (relative to Gender category 1) do not differ significantly from zero. This confirms that the *baseline model has limited explanatory power* and underscores the need to introduce independent variables to assess whether lifestyle and sociodemographic factors improve the prediction of gender differences (Table 6).

Table 6. Variables not in the Equation

Step 0			Score	df	Sig.
	Variables	Education Status	.010	1	.919
		Employment Status	.003	1	.959
		Sleep	1.213	1	.271
		Exercise	.318	1	.573
		Caffine	1.776	1	.183
	Overall Statistics		3.372	5	.643

At Step 0, none of the independent variables were included in the model. The *Score statistics* indicate the potential contribution of each predictor if entered individually into the logistic regression model.

- Education: Score = 0.010, $p = 0.919$
- Employment status Score = 0.003, $p = 0.959$
- Sleep duration Score = 1.213, $p = 0.271$
- Exercise habits Score = 0.318, $p = 0.573$
- Caffeine intake Score = 1.776, $p = 0.183$

The *overall score statistic* was *3.372* ***with*** *5 degrees of freedom* ($p = 0.643$).

None of the predictors showed a statistically significant score test ($p > 0.05$), indicating that *no single variable demonstrated sufficient predictive strength* to warrant inclusion at this stage. The non-significant overall statistic further suggests that, collectively, the variables *do not substantially improve the model* over the constant-only baseline. This preliminary finding foreshadows the limited explanatory power observed in the full model and indicates weak associations between the selected lifestyle variables and gender.

Block 1: Method = Enter (Table 7)

Table 7. Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	3.411	5	.637
	Block	3.411	5	.637
	Model	3.411	5	.637

The Omnibus Tests of Model Coefficients assess whether the inclusion of the independent variables in Block 1 significantly improves the model compared with the null (Block 0) model.

- *Model Chi-square:* $\chi^2(5) = 3.411$
- *p-value: 0.637* (Table 8)

Table 8: Model Summary

Step	-2Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	204.106[a]	.022	.030

a. Estimation terminated at iteration number 3 because parameter estimates changed by less than .001.

The non-significant omnibus test ($p > 0.05$) indicates that the inclusion of education, employment status, sleep duration, exercise habits, and caffeine intake did not result in a statistically meaningful improvement over the constant-only model. This finding suggests that, when considered collectively, the selected sociodemographic and lifestyle variables do not adequately explain gender-related differences in the outcome. Consequently, the overall logistic regression model demonstrates limited model fit and weak predictive capability.

Evaluation of model fit showed a −2 Log Likelihood (−2LL) value of 204.106, with Cox and Snell R^2 and Nagelkerke R^2 values of 0.022 and 0.030, respectively. These pseudo R^2 estimates indicate that the model explains only 2.2% to 3.0% of the variance, reflecting minimal explanatory power. Although the model achieved early convergence, indicating numerical stability, the low pseudo-R^2 values highlight the limited practical significance of the predictors in distinguishing gender differences in stress-related outcomes (Table 9).

Table 9: Classification Table[a]

Observed		Predicted		
		Gender		Percentage Correct
		1	2	
Step 1	Gender 1	29	42	40.8
	Gender 2	27	52	65.8
	Overall Percentage			54.0

a. The cut value is .500

The classification table for Block 1 evaluates the predictive accuracy of the logistic regression model after inclusion of the independent variables.

- *Correct classification rates:*
  - Gender category 1: *40.8%* (29 correctly classified out of 71)
  - Gender category 2: *65.8%* (52 correctly classified out of 79)

- *Overall classification accuracy: 54.0%*
- *Cut-off value:* 0.500

This means that the overall classification accuracy increased marginally from *52.7% (null model)* ***to*** *54.0% (full model)*, indicating only a *minimal improvement* in predictive performance. The model demonstrates better accuracy in predicting *Gender category 2* compared to category 1, suggesting an imbalance in classification performance. However, the modest gain in accuracy reinforces the conclusion that the included lifestyle variables *do not substantially enhance the model's ability to predict gender*, and the practical utility of the model remains limited (Table 10).

Table 10: Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	Education Status	-.210	.260	.656	1	.418	.810
	Employment Status	.004	.117	.001	1	.969	1.004
	Sleep	-.196	.205	.913	1	.339	.822
	Exercise	-.146	.279	.272	1	.602	.864
	Caffine	.257	.205	1.568	1	.210	1.293
	Constant	.484	1.234	.154	1	.695	1.623

a. Variable(s) entered on step 1: Education Status, Employment Status, sleep, exercise, Caffine.

The binary logistic regression model included education, employment status, sleep duration, exercise habits, and caffeine intake as predictors of gender.

Predictor-wise Interpretation

- ***Education:*** The regression coefficient was negative (B = −0.210) with an odds ratio of *0.81****,*** indicating a lower likelihood of belonging to Gender category 2 with higher educational status. However, this association was *not statistically significant* (*p* = 0.418).
- ***Employment status:*** Employment status showed a negligible effect (B = 0.004; OR = *1.004****)*** and was *not significant* (*p* = 0.969), suggesting no meaningful association with gender.
- *Sleep duration:* Sleep duration was negatively associated with gender (B = −0.196; OR = *0.822*), implying reduced odds of being in Gender category 2 with increased sleep duration. This effect was *not statistically significant* (*p* = 0.339).
- *Exercise habits:* Exercise habits showed a weak negative association (B

= −0.146; OR = *0.864*), but the relationship was *not significant* (p = 0.602).

- *Caffeine intake:* Caffeine intake demonstrated a positive coefficient (B = 0.257; OR = ***1.293***), suggesting higher odds of belonging to Gender category 2 with increased caffeine consumption; however, this association was *not statistically significant* (p = 0.210).
- *Constant:*

The intercept was not significant (p = 0.695), indicating no meaningful baseline difference in gender classification in the absence of predictors.

None of the selected lifestyle or sociodemographic variables were statistically significant predictors of gender (p > 0.05). The odds ratios were close to unity, reflecting *minimal effect sizes.* Collectively, these findings indicate that *education, employment, sleep duration, exercise habits, and caffeine intake do not significantly differentiate gender* in the study population. The results support the conclusion that observed stress-related lifestyle behaviors are *largely comparable across genders***,** and that other psychosocial or contextual factors may be required to explain potential gender differences.

Discussion

The present study found *no statistically significant gender differences* in stress or associated lifestyle behaviors. These findings contrast with earlier literature reporting higher stress levels among women [5,11], but align with more recent studies suggesting convergence of stress-related behaviors across genders [9,12].

The absence of significant associations may reflect evolving social roles, increased workforce participation among women, and shared exposure to digital technologies and occupational stressors. Similar patterns have been observed in contemporary population-based studies across Asia and Europe [10,13].

The weak explanatory power of the model may be attributable to the modest sample size, categorical measurement of lifestyle behaviors, and exclusion of psychosocial determinants such as coping strategies, social support, and personality traits. Longitudinal studies incorporating multidimensional stress frameworks are warranted.

Limitations

Despite its strengths, this study has certain limitations that should be considered while interpreting the findings. The cross-sectional design precludes establishing temporal or causal relationships between stress and lifestyle factors. Information on stress and lifestyle behaviors was obtained through self-reported measures, which may be subject to recall and social desirability bias. The relatively modest sample size may have limited the statistical power to detect subtle gender-specific differences. Additionally, as the study was conducted within a specific sociocultural setting, the generalizability of the findings to other populations may be limited. Important psychosocial variables such as coping strategies, social support, and comorbid mental health conditions were not assessed and may have influenced the results. Future studies employing longitudinal designs, larger and more diverse samples, and comprehensive psychosocial assessments are recommended.

Conclusion

This study indicates that stress and associated lifestyle behaviors, including sleep duration, physical activity, caffeine intake, and screen time, do not differ significantly by gender in the studied adult population. These results suggest an attenuation of traditional gender-based disparities in stress-related behaviors and underscore the importance of integrating broader psychosocial frameworks in future stress research.

Conflicts of interest

The authors declare that they do not have conflict of interest.

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ORIGINAL ARTICLE

Peer-Assisted Learning vs Expert-Assisted Learning in Osteology: A Comparative Crossover Study in Medical Education

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Abstract

Background: Anatomy forms the structural foundation of medical education, and osteology is a core component of first-year MBBS training. Despite its importance, osteology—particularly of the axial skeleton—is frequently perceived as difficult by students due to the volume of factual information, three-dimensional orientation, and limited instructional time. Expert-Assisted Learning (EAL) has traditionally been employed to teach osteology; however, increasing student numbers, reduced curriculum duration, and faculty constraints have encouraged exploration of alternative strategies such as Peer-Assisted Learning (PAL). **Objectives:** The primary objective of this study was to compare academic performance of undergraduate medical students taught axial skeleton osteology using Peer-Assisted Learning versus Expert-Assisted Learning. Secondary objectives were to assess student perceptions of PAL and to evaluate its feasibility as a sustainable supplementary teaching-learning strategy in osteology. **Methods:** A comparative crossover study was conducted among 50 first-year MBBS students. Participants were randomly allocated into two groups. Group A received Expert-Assisted Learning and Group B received Peer-Assisted Learning in small groups guided by academically forward peer tutors. Following assessment, the teaching methods were crossed over for a comparable osteology topic. **Results:** Students taught using Expert-Assisted Learning achieved significantly higher scores than those taught through Peer-Assisted Learning. The mean score for EAL was 18.72 ± 6.18, compared to 16.34 ± 6.21 for PAL ($p = 0.0088$). Despite lower objective scores, students reported positive perceptions of PAL, highlighting better interaction, comfort, and peer support. **Conclusion:** Expert-Assisted Learning remains superior for achieving higher academic performance in osteology. However, Peer-Assisted Learning is well accepted and promotes active engagement. PAL can be effectively integrated as a supplementary strategy to reinforce learning and optimise faculty resources in undergraduate anatomy education.

Keywords: Peer-Assisted Learning, Expert-Assisted Learning, Osteology, Axial Skeleton, Medical Education

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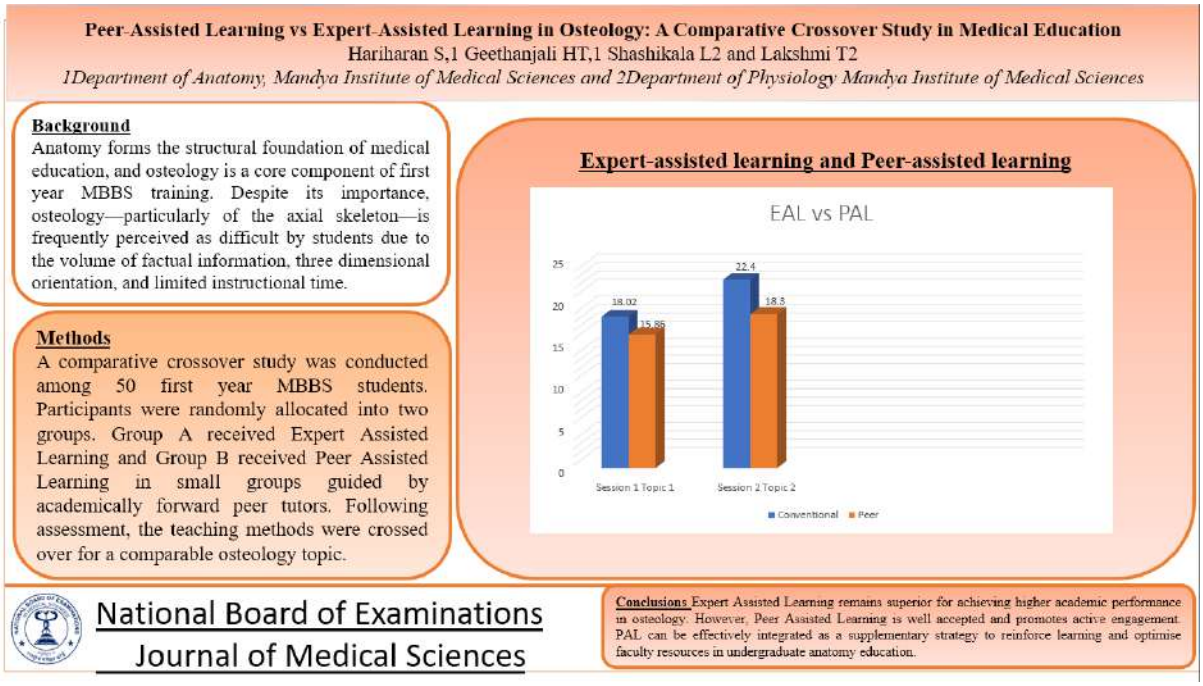
Graphical Abstract



Introduction

Anatomy is universally recognised as a cornerstone of undergraduate medical education, providing the structural and spatial basis required for clinical reasoning, diagnostic accuracy, and procedural competence [1,2]. Among the various subdivisions of anatomy, osteology occupies a central role during the first year of the MBBS curriculum, as it introduces students to skeletal framework, joint mechanics, and muscle attachments that underpin later learning in gross anatomy, radiology, orthopaedics, and surgery [3]. Despite its importance, osteology is often regarded as one of the most challenging components of anatomy due to the extensive factual content, three-dimensional complexity, and requirement for repeated visual-tactile exposure to bone specimens [4,5].

The axial skeleton, comprising the skull, vertebral column, ribs, and sternum, presents additional difficulties for novice learners. These bones possess multiple landmarks, foramina, and articulations that demand precise identification and spatial orientation. For first-year students transitioning from pre-university education, mastering these details within a compressed academic schedule can be overwhelming [5,6]. In India, revisions in the undergraduate medical curriculum and reduction of the First MBBS duration have further intensified academic pressure, often limiting the time available for small-group teaching and individual clarification [7].

Traditionally, anatomy teaching has relied on Expert-Assisted Learning (EAL), wherein experienced faculty members deliver structured instruction through lectures, demonstrations, and tutorials. EAL ensures content accuracy, uniformity of instruction, and integration of clinical relevance, making it particularly effective for complex and detail-oriented subjects such as osteology [6,8]. However, the increasing intake of medical students, limited faculty strength, and growing administrative responsibilities of teachers

have strained the feasibility of exclusively relying on expert-led teaching [7]. Additionally, some students may hesitate to actively participate or ask questions in faculty-led settings due to fear of judgement or lack of confidence.

Peer-Assisted Learning (PAL) has emerged as a learner-centred educational strategy aimed at addressing these challenges. Topping defined PAL as an instructional method in which individuals from similar social and educational backgrounds help each other learn while simultaneously reinforcing their own knowledge through teaching [1]. Educational theory suggests that PAL is supported by the concepts of cognitive congruence and social congruence, wherein peer tutors, having recently learned the same material, are better able to explain concepts at an appropriate level and create a less intimidating learning environment [9]. This may encourage active questioning, discussion, and collaborative problem-solving among learners.

Several studies in medical education have reported that PAL improves student motivation, engagement, communication skills, and self-confidence [2,10,11]. In anatomy education, PAL has been applied to dissection sessions, surface anatomy teaching, and revision tutorials, with many studies demonstrating comparable or equivalent outcomes to traditional teaching [12-14]. However, evidence regarding its effectiveness in producing superior objective academic performance remains inconsistent. While some authors have reported equivalence between PAL and EAL, others have demonstrated that faculty-led instruction yields better examination scores, particularly for foundational and content-heavy subjects [3,6,15].

Notably, there is limited literature specifically evaluating PAL in osteology of the axial skeleton using a crossover study design, which allows direct comparison of teaching methods within the same cohort and reduces inter-group variability [16]. Given the contextual challenges of medical education in India—such as large class sizes, limited access to specimens, and faculty shortages—there is a need to critically evaluate whether PAL can serve as an effective supplementary strategy without compromising academic standards [7].

The present study was therefore undertaken to compare Peer-Assisted Learning and Expert-Assisted Learning in teaching axial skeleton osteology to first-year MBBS students. By employing a crossover design, the study aimed to assess academic performance, explore student perceptions, and evaluate the feasibility of integrating PAL as a sustainable adjunct to traditional anatomy teaching.

Objectives

Primary Objective

- To compare the academic performance of undergraduate medical students learning axial skeleton osteology through Peer-Assisted Learning versus Expert-Assisted Learning.

Secondary Objective

- To assess students' perceptions of Peer-Assisted Learning as a teaching-learning method in osteology.
- To evaluate the feasibility of implementing Peer-Assisted Learning as a sustainable supplementary teaching strategy in undergraduate osteology.

Methodology

This comparative crossover study was conducted in the Department of

Anatomy at Mandya Institute of Medical Sciences, Karnataka, India, during routine tutorial sessions for first-year MBBS students. Ethical clearance was obtained from the institutional ethics committee, and informed consent was obtained from all participants. Fifty first-year MBBS students were enrolled in the study. Inclusion criteria comprised willingness to participate and regular attendance in tutorial sessions. Five academically forward students were selected as peer tutors based on previous internal assessment performance and voluntary participation.

Participants were randomly divided into two equal groups (Group A and Group B).

Session 1: Group A received Expert-Assisted Learning through faculty-led small-group tutorials, while Group B underwent Peer-Assisted Learning in groups of five students guided by peer tutors.

Session 2 (Crossover): The teaching methods were interchanged. Group A received PAL and Group B received EAL for a comparable topic from axial skeleton osteology.

The duration of teaching sessions, learning objectives, bone specimens, and topics were standardised across both groups to minimise instructional bias.

Peer tutors were oriented regarding the scope of the syllabus, learning objectives, and expectations prior to teaching sessions. They were provided access to bone specimens and recommended textbooks for preparation. After each teaching session, students were given 1–2 days for self-study and clarification of doubts from faculty or peers. Academic performance was assessed using a 30-mark spotter test conducted by an independent faculty member who was not involved in teaching. Answer scripts were evaluated by the paper setter to minimise observer bias.

Student perceptions regarding both teaching methods were collected using a structured Likert-scale questionnaire. The questionnaire assessed aspects such as clarity of concepts, engagement, comfort in asking questions, perceived effectiveness, and overall satisfaction. Data were analysed using paired sample t-tests to compare mean scores between EAL and PAL. Perception data were analysed using descriptive statistics and expressed as percentages. A p-value of less than 0.05 was considered statistically significant.

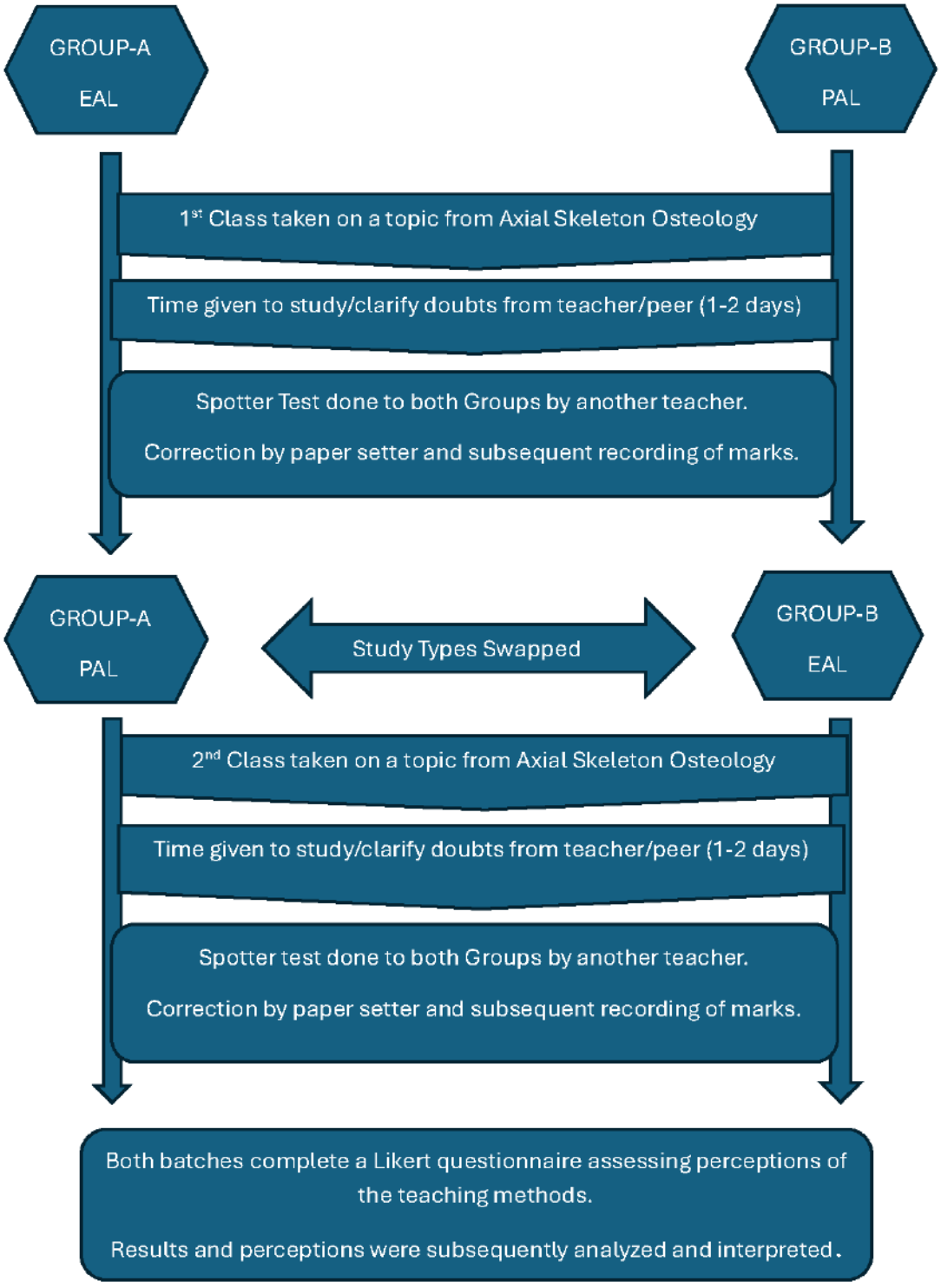


Figure 1. Study flowchart depicting Expert-Assisted Learning (EAL) and Peer-Assisted Learning (PAL) intervention design.

Results

Expert-Assisted Learning consistently resulted in higher academic scores compared to Peer-Assisted Learning across both sessions of the crossover study. The overall mean score achieved through EAL was 18.72 ± 6.18, whereas PAL yielded a mean score of 16.34 ± 6.21. This difference was statistically significant ($p = 0.0088$), indicating superior academic performance with faculty-led instruction.

Session-wise analysis also demonstrated higher mean scores for EAL in both teaching cycles, suggesting that the observed difference was not topic-specific but related to the teaching method itself. Despite this, analysis of student feedback revealed that a substantial proportion of students perceived PAL as an engaging and supportive learning method. Many students reported increased comfort in interacting with peers, better opportunities for discussion, and reduced hesitation in asking questions during PAL sessions.

Academic Performance

Expert-Assisted Learning consistently resulted in higher academic scores compared to Peer-Assisted Learning across both sessions of the crossover study. The overall mean score achieved through EAL was 18.72 ± 6.18, whereas PAL yielded a mean score of 16.34 ± 6.21. This difference was statistically significant ($p = 0.0088$), indicating superior academic performance with faculty-led instruction.

Session-wise analysis also demonstrated higher mean scores for EAL in both teaching cycles, suggesting that the observed difference was not topic-specific but related to the teaching method itself. These findings indicate that for complex and detail-intensive topics such as axial skeleton osteology, expert guidance plays a critical role in enhancing immediate academic outcomes.

Student Perceptions

Student perceptions regarding both teaching-learning methods were assessed using a structured Likert-scale questionnaire (Fig. 3) administered after completion of both sessions. The questionnaire explored multiple domains including clarity of concepts, ease of understanding, level of interaction, comfort in asking questions, motivation to learn, perceived effectiveness, and overall satisfaction.

Analysis of perception data revealed that a majority of students expressed favourable opinions toward Peer-Assisted Learning despite its comparatively lower objective scores. A substantial proportion of students agreed or strongly agreed that PAL sessions were more interactive and promoted active participation. Students reported feeling more comfortable asking questions and expressing doubts during peer-led sessions, attributing this to reduced fear of judgement and a more informal learning environment.

Many students perceived that explanations provided by peer tutors were easier to understand, as peers used simpler language and relatable examples. PAL was also viewed as encouraging collaborative learning, discussion among group members, and mutual support. These aspects contributed to increased learner engagement and motivation, particularly among students who were hesitant to participate actively during faculty-led tutorials.

In contrast, Expert-Assisted Learning was rated higher for clarity, organisation of content, and confidence in the accuracy of information delivered.

Students acknowledged that faculty-led sessions were more structured, examination-oriented, and effective in highlighting important osteological landmarks and clinically relevant details. Consequently, EAL was perceived as more beneficial for examination preparation and acquisition of precise anatomical knowledge.

Overall satisfaction ratings indicated that while students recognised EAL as superior for academic performance, they valued PAL as a supportive and engaging learning experience. A majority of respondents expressed that an integrated approach combining expert-led teaching with peer-assisted sessions would be the most effective strategy for learning osteology.

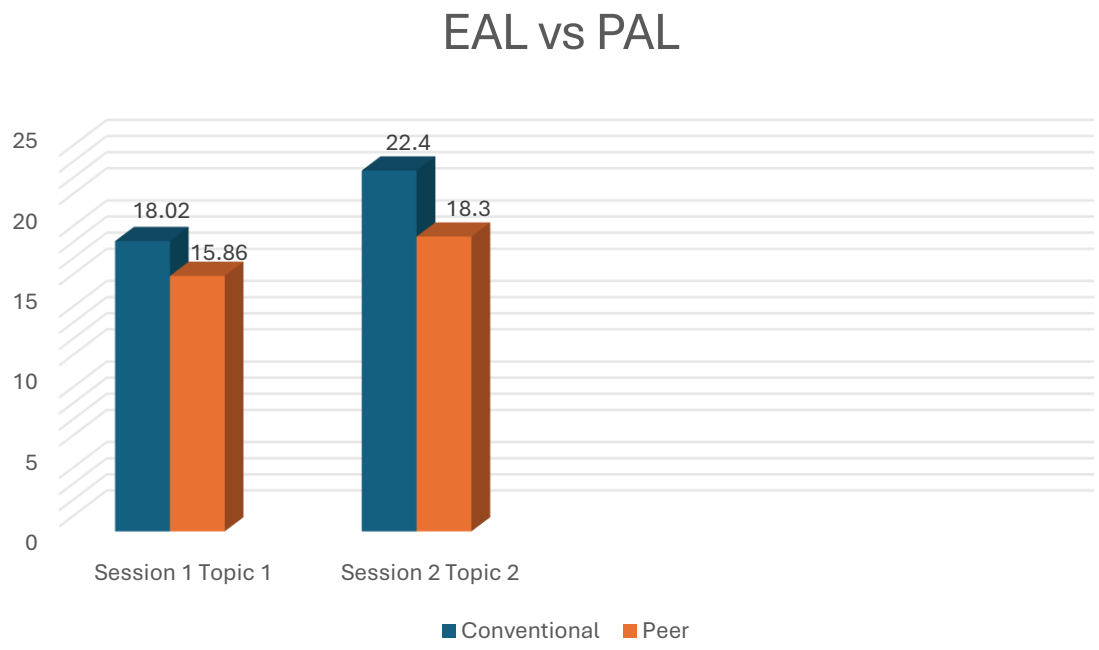


Figure 2. Comparison graph of Expert-assisted learning and Peer-assisted learning.

Table 1. Mean scores of Expert-assisted learning and Peer-assisted learning across two sessions.

	Session 1 Topic 1	Session 2 Topic 2
Conventional	18.02	22.4
Peer	15.86	18.3

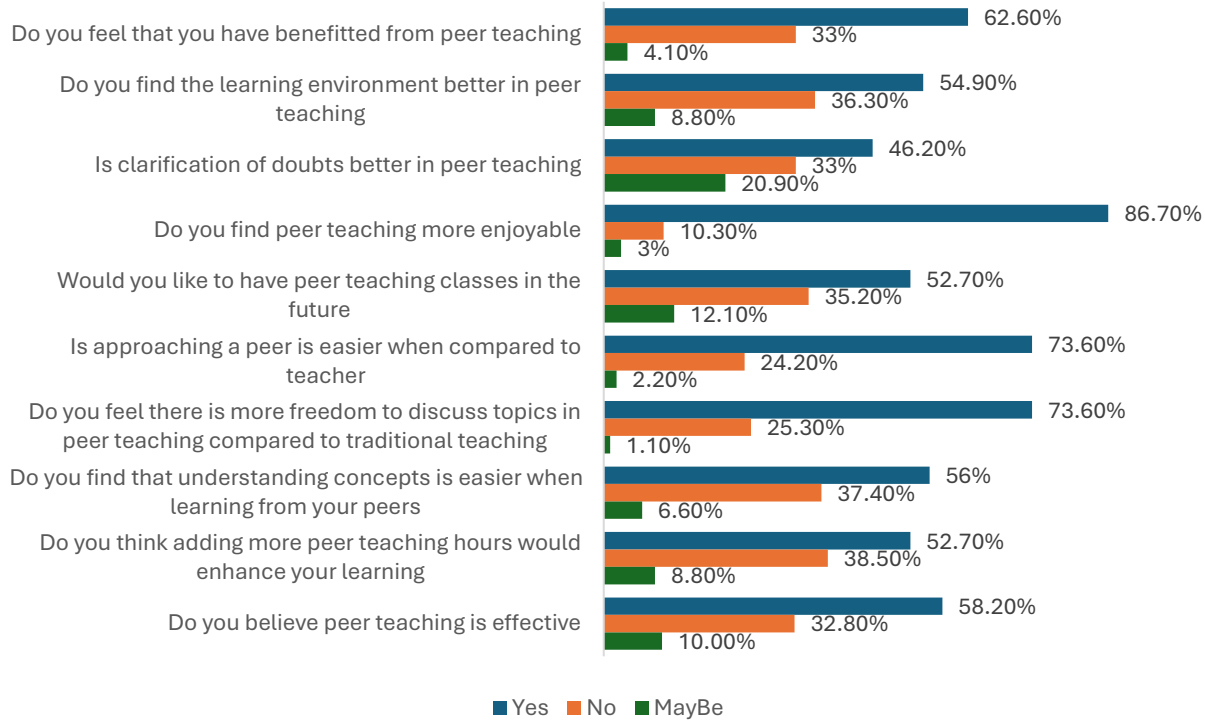


Figure 3. Likert-Scale based Questionnaire.

Discussion:

The present study evaluated the effectiveness of Peer-Assisted Learning compared to Expert-Assisted Learning in teaching axial skeleton osteology using a crossover design. The findings demonstrate that students taught through Expert-Assisted Learning achieved significantly higher scores in objective assessments. This underscores the continued importance of faculty-led instruction for complex and detail-oriented subjects such as osteology.

The superior performance associated with EAL is consistent with earlier studies that emphasised the role of faculty expertise, structured delivery, and emphasis on examination-relevant details [3,6,15]. Experienced teachers are able to contextualise osteological features clinically, clarify subtle anatomical variations, and correct misconceptions promptly—advantages that are particularly relevant for first-year students who are still developing foundational understanding.

Although Peer-Assisted Learning resulted in lower mean scores, student perceptions toward PAL were largely positive. These findings align with previous literature reporting improved engagement, motivation, and learner satisfaction with peer-led teaching [2,10,11]. Hermann-Werner et al. highlighted that PAL fosters a supportive and less hierarchical learning environment, which may enhance participation even if objective performance does not surpass traditional methods [4]. Cognitive congruence between peer tutors and learners may facilitate understanding by enabling explanations at an appropriate level and encouraging open discussion [9].

Several authors have suggested that PAL is particularly effective as a

reinforcement or revision strategy rather than as a primary mode of instruction [12–14]. In the present study, the absence of formal pedagogical training for peer tutors and the inherent complexity of axial skeleton osteology may have contributed to the comparatively lower scores observed with PAL. Similar observations were reported by Geethanjali et al. and Mussarat et al., who found that while PAL was well accepted, faculty-assisted teaching resulted in better academic outcomes [3,6].

The crossover design employed in this study enhances internal validity by allowing each student to experience both teaching methods, thereby reducing confounding due to inter-individual differences [16]. However, the assessment was limited to short-term objective performance using spotter tests and did not evaluate long-term retention or higher-order cognitive outcomes such as clinical application.

From an educational standpoint, the findings suggest that Peer-Assisted Learning should be integrated as a supplementary strategy rather than a replacement for Expert-Assisted Learning. PAL can be effectively utilised for small-group discussions, revision sessions, and alleviating faculty workload, particularly in resource-constrained settings [7,10]. Such a blended approach may optimise learning outcomes while fostering collaborative skills and professional development among medical students.

Limitations

The study has certain limitations, including a relatively small sample size, single-institution setting, short duration of intervention, and lack of assessment of long-term knowledge retention. Peer tutors did not receive formal training in teaching methodology. Future research involving multicentric studies with larger cohorts, structured peer-tutor training, and longitudinal follow-up are recommended to further explore the role of PAL in anatomy education.

Conclusion

Expert-Assisted Learning remains superior in achieving higher academic performance in axial skeleton osteology among first-year MBBS students. Nevertheless, Peer-Assisted Learning is positively perceived and promotes engagement, comfort, and collaborative learning. PAL should be adopted as a supplementary teaching-learning strategy to reinforce osteology instruction and optimise faculty resources, rather than as a substitute for traditional expert-led teaching.

Statements and Declarations

Conflicts of interest

The authors declare that they do not have conflict of interest.

Funding

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IMAGES IN SURGERY

Laparoscopic View of Gallbladder Calculi with Multiple Liver Cysts

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Abstract

Liver cyst discovered during incidental laparoscopic cholecystectomy causes concern for the operating surgeon as it hampers the post placement and may cause the operating field to be messy if it gets ruptured inadvertently during the procedure. A careful dissection is required in such a case.

Keywords: Liver cyst, Laparoscopic Cholecystectomy, Cyst rupture

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A 34-year-old lady patient undergoing elective laparoscopic cholecystectomy was found to have multiple cysts in the Segment 4b and Segment 6 of the liver, which were not diagnosed before in the preoperative ultrasound (Figure 1 and 2). Cyst makes the surgery slow as the surgeon has to negotiate the gallbladder and perform laparoscopic cholecystectomy preferably without accidental rupture of the cyst either during the port placement or during gall bladder removal, as the operating field may become messy if the cyst ruptures. Though the cyst can be excised or laparoscopic fenestration (unroofing) can be done, the hepatic cyst causes an impediment and a mental barrier for the operating surgeon. The usual incidence is **3% and 18%**, but no correlation with laparoscopic cholecystectomy has been seen [1]. Literature recommends that any intraoperative intervention of liver cyst should have a mortality below 1%, overall morbidity less than 10% and recurrence rate below 10%. Liver cysts > 10 cm in diameter are more likely to cause compression-related symptoms. The only exception is polycystic liver disease, which has a higher recurrence rate after marsupialization than simple cysts [2].

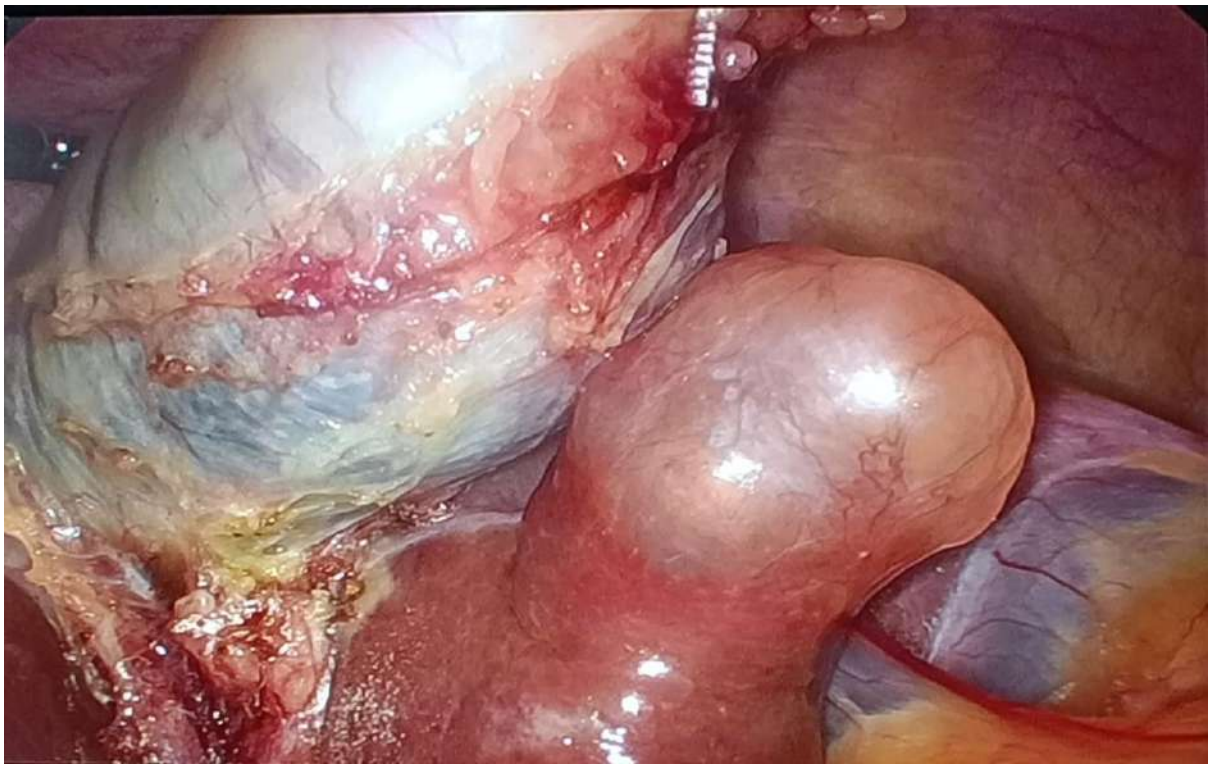

Figure 1. Liver cyst obscuring Calot's triangle during Laparoscopic cholecystectomy

Figure 2. Liver cyst hampering axillary port placement

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