INDEX

The Insight

(A Peer-review Journal)

A Journal dedicated to medical science

Volume - 08	Number - 02	April – June 2025

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JOURNAL COMMITTEE

The Insight

(A Peer-review Journal)

A Journal dedicated to medical science

Volume - 08	Number - 02	April – June 2025

INSTRUCTION TO AUTHORS

A. Introduction:
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The Introduction should address the subject of the paper. The Methods and Material section should describe in adequate detail the laboratory or study methods followed and state the statistical procedures employed in the research. This section should also identify the ethical guidelines followed by the investigators with regard to the population, patient samples
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a. Title page information

- Title: Title should be concise and informative. Titles are often used in information-retrieval systems. Avoid abbreviations in title.
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1. Articles in Journals (see also Journal article on the Internet)
   Standard journal article- List the first six authors followed by et al. Halpern SD, Ubel PA, Caplan AL. Solid-organ transplantation in HIV-infected patients. N Engl J Med. 2002 Jul 25; 347(4):284-7.
   More than six authors: Rose ME, Huerbin MB, Melick J, Marion OW, Palmer AM, Schiding JK, et al. Regulation of interstitial excitatory amino acid concentrations after cortical contusion injury. Brain Res. 2002; 935(1-2):40-6.
2. Organization as author
   Diabetes Prevention Program Research Group. Hypertension, insulin, and proinsulin in participants with impaired glucose tolerance. Hypertension. 2002; 40(5):679-86.
3. Both personal authors and organization as author (List all as they appear in the byline.) Vallancien G, Emberton M, Harving N, van Moorselaar RJ; Alfa-One Study Group. Sexual dysfunction in 1,274 European men suffering from lower urinary tract symptoms. J Urol. 2003; 169(6):2257-61.

Books and Other Monographs:

1. Personal author(s) Murray PR, Rosenthal KS, Kobayashi GS, Pfaller MA. Medical microbiology. 4th ed. St. Louis: Mosby; 2002.
2. Editor(s), compiler(s) as author Gilstrap LC 3rd, Cunningham FG, VanDorsten JP, editors.Operative obstetrics. 2nd ed. New York: McGrawHill; 2002.
3. Organization(s) as author Advanced Life Support Group. Acute medical emergencies: the practical approach. London: BMJ Books; 2001. 454 p.
4. Chapter in a book Meltzer PS, Kallioniemi A, Trent JM. Chromosome alterations in human solid tumors. In: Vogelstein B, Kinzler KW, editors. The genetic basis of human cancer. New York: McGraw-Hill; 2002. p. 93-113.

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Foley KM, Gelband H, editors. Improving palliative care for cancer [Internet]. Washington: National Academy Press; 2001 [cited 2002 Jul 9]. Available from: http:// www.nap.edu/books/030907 4029/html/.

Homepage/Web site:

Cancer-Pain.org [Internet]. New York: Association of Cancer Online Resources, Inc.; c2000-01 [updated 2002 May 16; cited 2002 Jul 9]. Available from: http:// www.cancer-pain.org/.

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The Editor in chief, The Insight Journal
Professor and Head of the department of Medicine
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EDITORIAL

The Critical Role of Pretransfusion Procedures in Modern Transfusion Safety — an editorial

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H N sarker[1]

Blood transfusion, while life-saving and irreplaceable in many clinical settings, carries inherent risks. Advances in transfusion medicine have greatly reduced many of these risks, but pretransfusion processes remain the cornerstone in preventing adverse outcomes. In the modern era—when expectations for safety are high and technology is advanced—pretransfusion procedures are more essential than ever for minimizing both infectious and non-infectious hazards.

What are pretransfusion procedures?

Pretransfusion procedures encompass all steps taken before the actual administration of blood or blood components. Key elements include:

1. **Donor screening and history taking** – evaluating donor risk factors for transmissible infections and ensuring donor health.
2. **Infectious disease testing** – screening donated blood for pathogens (e.g. HIV, HBV, HCV, syphilis, malaria), increasingly using highly sensitive methods including nucleic acid testing (NAT).
3. **Blood grouping & typing (ABO, Rh, etc.)** – defining donor and recipient blood groups so as to avoid ABO or other incompatibility.
4. **Antibody screening and identification** – detecting unexpected ("irregular") antibodies in recipient's plasma that might react with donor red cells.
5. **Cross matching** – actual in-vitro mixing of donor red cells and recipient serum/plasma to look for reactions; confirming compatibility.
6. **Identity verification and labeling** – ensuring that donor units are correctly labeled, samples clearly identified, patient identity correctly matched.
7. **Quality control, standardization, and validation** of laboratory methods and equipment; guidelines, audits, and external quality assurance.

Why these procedures matter more now

Although the risk of transfusion-transmitted infections (TTIs) has dropped dramatically in many countries, several factors make robust pretransfusion procedures more important:

- **Emerging and re-emerging pathogens**: New threats—novel viruses, zoonoses crossing into human populations—mean that donor screening, history, and sensitive testing must continually adapt[1,2].
- **Public expectation of near-zero risk**: Even very rare events breed public concern and legal/regulatory scrutiny. Societies expect transfusion to be extremely safe[1].
- **Non-infectious hazards**: Immunological reactions (e.g. hemolytic transfusion reactions, allergic reactions), clerical errors, and misidentification are now larger relative sources of risk[1,3].
- **Regulatory & guideline frameworks** require rigorous adherence: standards (e.g. BCSH in the UK) define detailed pretransfusion compatibility procedures to reduce error[3].
- **Haemovigilance systems**: The more systematic monitoring of transfusion outcomes reveals that many adverse events are preventable, often due to errors in pretransfusion steps[1].

Key elements of good pretransfusion practice

From modern literature and guidelines, the following stand out as essential elements that if well implemented, significantly improve safety:

- **Strict donor selection & risk assessment**: Robust history taking to detect risk behaviors, travel, symptoms, etc., complemented by proper deferral policies.
- **Sensitive infectious disease screening & testing methods**: Use of NAT where possible, and regular evaluation of residual risk (i.e. what infections might still slip through)[1].
- **Comprehensive antibody screening**: Especially in populations with prior transfusions, pregnancies, etc., to identify irregular or rare antibodies.

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- **Accurate cross matching and blood group confirmation**: Ensuring that ABO and Rh (and other clinically relevant antigens) are properly typed and matched. Laboratory techniques must be validated.
- **Strong identity procedures**: Two or more identifiers for donor samples, clear labeling, patient verification just before transfusion. This reduces clerical/administrative errors[1].
- **Quality management systems** including standard operating procedures, audits, training, and continual improvement. Unstandardised or non-validated methods are risk factors[3].
- **Effective haemovigilance and reporting**: Tracking adverse events, errors, near misses to allow systemic improvements[1].

Challenges and Considerations

While the pretransfusion procedures are well understood, in practice there are several challenges:

- **Cost and resource constraints**: In low- and middle-income settings, advanced testing (e.g. NAT), full antibody panels, or robust QA systems may be difficult to afford.
- **Turnaround times and urgency**: Emergency transfusions may require blood before full cross matching can be completed, leading to risks. Balancing speed and safety is delicate.
- **Human error**: Clerical mistakes (mislabeling, wrong patient, wrong blood unit) remain a leading cause of adverse events. Even perfect technical procedures can be undermined by process failures.
- **Emerging pathogens** may not yet be recognised or testable; hence donor histories, geographic risk, and possibly pathogen inactivation methods become more important.
- **False sense of security**: As infectious risks decrease, sometimes there is less attention to non-infectious risks; but immune reactions, incompatibilities, and administrative errors cause morbidity and mortality.

The Future: Enhancements and Innovations

To further improve safety, modern transfusion services and healthcare systems are moving toward:

- **Pathogen reduction technologies** for blood components (especially platelets and plasma) to reduce risks from known and unknown agents.
- **Automation and barcoding / RFID systems** for sample tracking, identification, to reduce clerical errors.
- **Electronic cross match ("electronic issue")** in settings where full typing and screening is available historically, under controlled protocols.
- **Risk stratification and precision matching**: matching minor antigens for patients who will receive many transfusions (e.g., sickle cell disease, thalassemia) to reduce alloimmunization.
- **Patient blood management (PBM)** strategies: reducing transfusion need via optimizing anemia, bleeding management, alternatives; thereby reducing exposure risk[4,5]
- **Strengthened haemovigilance and international collaboration**: sharing data about rare adverse events, emerging risks, so that guidelines and practices can be adapted uniformly.

Conclusion

In modern transfusion medicine, pretransfusion procedures are not an optional extra but the foundation of safe transfusion practice. As infectious risks have come down, attention has shifted to non-infectious and procedural risks—many of which are preventable with robust pretransfusion practices.

A safe transfusion system depends not only on technical and laboratory excellence, but also on rigorous procedural discipline, good communication among clinical, laboratory, and administrative staff, continuous quality improvement, and awareness that human error remains an ever-present risk.

In the quest for "zero risk" we must remain realistic: no system can be absolutely risk-free. But through careful design, consistently applied pretransfusion procedures, and embracing both new technologies and strong oversight, we can push the safety envelope further than ever before.

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ORIGINAL ARTICLE

Evaluation of Pretransfusion Testing Practices and Their Impact on Patient Safety

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ABSTRACT

Background: *The safety of blood transfusions critically depends on proper pretransfusion procedures, as errors in sample collection, labeling, crossmatching, and bedside verification can result in the administration of incompatible blood with potentially fatal outcomes. The purpose of the study was to evaluate pretransfusion testing practices and their effect on patient safety.* ***Aim of the study:*** *The aim of the study was to assess pretransfusion testing practices and their effect on patient safety.* ***Methods:*** *This cross-sectional study was conducted at the Department of Transfusion Medicine, Mugda Medical College and Hospital, National Institute of Burn and Plastic Surgery, Dhaka, Bangladesh, from January to June 2025, including 100 transfusion recipients. Data on demographics, transfusion indications, pretransfusion practices, errors, and clinical outcomes were collected prospectively and analyzed using SPSS version 26.* ***Results:*** *Among 100 transfusion recipients (mean age 46.6 ± 14.8 years; 56% male), anemia (40%) was the most common indication. ABO/Rh typing and crossmatch were performed in 100%, clerical checks in 90%, and documentation in 88%. Pretransfusion errors occurred in 25% (most commonly incomplete forms 8%, mislabeling 6%). Transfusions were largely uneventful (93%), with febrile reactions in 3%, allergic/delayed reactions in 2% each. Adverse events were higher in patients with errors (16% vs. 2.7%).* ***Conclusion:*** *Strict adherence to pretransfusion testing protocols is essential to minimize errors and ensure patient safety.*

Key words: *Pretransfusion, Testing, Safety.*

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INTRODUCTION

The safety of blood transfusions depends partly on the quality of pretransfusion procedures conducted at the bedside. Despite advances in transfusion practices, the occurrence and mortality associated with immunohemolytic reactions remain unacceptably high [1,2]. Ensuring transfusion safety involves a series of steps, beginning with the decision to administer an appropriate blood component, followed by sample collection, labeling, transport, handling, pretransfusion testing, and the actual administration of the blood product to the patient. Mistakes at any stage can result in the patient receiving incompatible blood, potentially causing serious harm [3].

The crossmatch constitutes a key component of standard pretransfusion testing, designed to identify ABO incompatibilities and other clinically significant antibodies. Key control points in pretransfusion testing include accurate patient identification, proper blood sample collection, careful record review, and donor blood testing within the transfusion service to verify ABO (and Rh, if the donor is Rh negative), recipient ABO and Rh typing, crossmatching, and appropriate component selection. Mistakes at any of these stages can result in transfusion of an incompatible unit, with potentially fatal consequences [4-7]. Ideally, the bedside ABO-compatibility test should prevent such life-threatening errors arising from labeling mistakes, unit mix-ups, or patient misidentification. Despite its straightforward nature, this bedside test must be performed correctly to ensure reliable agglutination results and accurate interpretation [2].

Errors in transfusion are well documented in the literature and are largely preventable if promptly reported and properly analyzed. Haemovigilance programs worldwide indicate that the primary risk to blood transfusion recipients stems from

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human error, often resulting in the administration of the wrong blood component. Errors such as improper patient identification or sample labeling can lead to ABO-incompatible transfusions. Errors that occur while collecting a patient's sample for pretransfusion compatibility testing are particularly significant, since they take place at the initial step of the complex transfusion process [8]. There are three main 'zones of error' that compromise transfusion safety: (i) accurate patient identification and correct labeling of the pretransfusion specimen; (ii) appropriate clinical decision-making regarding the use of blood components; and (iii) precise bedside verification to ensure the correct blood is administered to the intended patient [9].

Despite extensive international reporting on pretransfusion errors and haemovigilance, there is limited data on the prevalence and types of pretransfusion testing errors in Bangladesh, particularly regarding the impact of these errors on patient safety. Most available studies focus on individual errors or isolated adverse events, with few comprehensive analyses examining the full spectrum of pretransfusion practices, compliance rates, and their association with transfusion-related complications in local settings. This gap in knowledge highlights the need for systematic evaluation of pretransfusion testing procedures within Bangladeshi healthcare facilities. The purpose of the study was to evaluate pretransfusion testing practices and their effect on patient safety.

Objective

- To assess pretransfusion testing practices and their effect on patient safety.

METHODS & MATERIALS

This cross-sectional observational study was conducted at the Department of Transfusion Medicine, Mugda Medical College and Hospital, National Institute of Burn and Plastic Surgery, Dhaka, Bangladesh, from January to June 2025. A total of 100 transfusion recipients were included, selected based on predefined inclusion criteria.

Inclusion Criteria:

- All patients above 18 years of age.
- Patients of either gender receiving any blood component (packed red blood cells, fresh frozen plasma, or platelets).

Exclusion Criteria:

- Patients with incomplete medical records.
- Transfusions where the pretransfusion testing was performed at an external facility.

Data were prospectively collected from transfusion records, requisition forms, and laboratory reports, including baseline demographics (age, sex) and indication for transfusion. Pretransfusion testing practices—ABO and Rh typing, major and minor crossmatching, clerical checks for patient identification and labeling, and documentation of consent and transfusion records—were recorded for each patient. Pretransfusion errors were identified and categorized as mislabeling of samples, incomplete requisition forms, wrong blood in tube (WBIT), discrepancies in ABO grouping, and documentation errors, with frequencies and percentages calculated. Clinical outcomes were monitored, including transfusions without adverse events, febrile non-hemolytic reactions, allergic reactions, delayed transfusions due to errors, and the association between pretransfusion errors and adverse events was analyzed. Data were entered into a spreadsheet and analyzed using descriptive statistics with SPSS version 26, with categorical variables expressed as frequencies and percentages, and continuous variables presented as mean ± standard deviation.

RESULTS

Table – I: Baseline Characteristics of the Study Population (*n* = 100)

Variable		Frequency (n)	Percentage (%)
Age group (years)	18–30	18	18.0
	31–45	28	28.0
	46–60	34	34.0
	>60	20	20.0
	Mean ± SD	46.6 ± 14.8	
Sex	Male	56	56.0
	Female	44	44.0
Indication for transfusion	Anemia	40	40.0
	Surgery/Trauma	25	25.0
	Obstetric cases	20	20.0
	Malignancy	15	15.0

Table I presents the baseline characteristics of transfusion recipients. The mean age was 46.6 ± 14.8 years, with the majority (34%) falling within the 46–60 years age group. Males constituted 56% of the study population, while females accounted for 44%. The most common indication for transfusion was anemia (40%), followed by surgery/trauma (25%), obstetric cases (20%), and malignancy (15%).

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Table – II: Pretransfusion Testing Practices among Study Patients (*n* = 100)

Test Performed	Done		Not Done	
	(n)	(%)	(n)	(%)
ABO & Rh typing	100	100.0	0	0.0
Crossmatch (major/minor)	100	100.0	0	0.0
Clerical check (ID, labeling)	90	90.0	10	10.0
Documentation (consent, records)	88	88.0	12	12.0

Table II summarizes the pretransfusion testing practices performed for the study population. ABO and Rh typing, along with crossmatching, were universally carried out in all patients (100%). Clerical checks for patient identification and labeling were documented in 90%. Additionally, 88% of cases had proper documentation, including consent and transfusion records.

Table – III: Distribution of Pretransfusion Testing Errors (*n* = 100)

Type of Error	Number of Cases (n)	Percentage (%)
Mislabeling of sample	6	6.0
Incomplete requisition forms	8	8.0
Wrong blood in tube (WBIT)	2	2.0
Discrepancy in ABO grouping	4	4.0
Documentation error	5	5.0
Total events with ≥1 error	**25**	**25.0**

Table III presents the types of errors identified during pretransfusion testing. The most frequent error was incomplete requisition forms (8%), followed by mislabeling of samples (6%) and documentation errors (5%). Discrepancies in ABO grouping were noted in 4% of cases, while wrong blood in tube (WBIT) was observed in 2%.

Table – IV: Transfusion Outcomes and Adverse Events (*n* = 100)

Outcome	Number of Patients (n)	Percentage (%)
Transfusion without adverse event	93	93.0
Febrile non-hemolytic reaction	3	3.0
Allergic reaction	2	2.0
Delayed transfusion due to error	2	2.0

Table IV summarizes the clinical outcomes following transfusion. The majority of patients (93%) received transfusion without any adverse event. Febrile non-hemolytic reactions were reported in 3% of cases, while allergic reactions occurred in 2%. Delayed transfusion due to error was observed in 2% of cases.

Table – V: Association Between Pretransfusion Errors and Adverse Events (*n* = 100)

	Adverse Event (n)	No Adverse Event (n)	Total (n)
Error Present	4	21	25
No Error	2	73	75
Total	6	94	100

Table V shows the relationship between pretransfusion errors and transfusion-related adverse events. Among 25 cases with documented errors, 4 (16%) were associated with adverse events, whereas only 2 (2.7%) of the 75 error-free cases developed adverse events.

DISCUSSION

Pretransfusion testing practices and their impact on patient safety remain critical components of safe transfusion medicine in tertiary care settings. Errors in these practices, including mislabeling, incomplete requisitions, or ABO incompatibility, can lead to serious adverse events such as febrile reactions, hemolytic transfusion reactions, or delays in transfusion. The findings of this study highlight the prevalence and types of pretransfusion errors, the compliance rates with standard testing procedures, and their direct association with transfusion-related complications. These findings emphasize the importance of rigorous pretransfusion protocols and continuous monitoring to enhance patient safety and optimize transfusion outcomes.

In the present study, the mean age of transfusion recipients was 46.6 ± 14.8 years, with the largest proportion (34%) in the 46–60 years age group, and a slight male predominance (56 These results are consistent with earlier studies, although some variations exist in demographics. For example, Kipkulei et al.[10] described a younger patient population with a median age of 31.5 years, where females comprised 55.2%, predominantly in the reproductive age range. In contrast, Jacques et al.[11] reported a slightly older cohort with a median age of 43 years, consisting of 145 males and 117 females who

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received transfusions. Regarding indications, anemia was the most frequent reason for transfusion in our cohort (40%), followed by surgery/trauma (25%), obstetric cases (20%), and malignancy (15%), paralleling the patterns described by Kipkulei et al.[10], who reported anemia (62.8%) and neoplasms (23.2%) as common indications, and Jacques et al., who highlighted infection/sepsis (36.7%), trauma (23.5%), and cancer (21.6%). Overall, the age, sex distribution, and transfusion indications in our study align well with findings from diverse international settings, suggesting that the demographic and clinical profile of transfusion recipients is broadly consistent across populations, despite regional variations.

In the present study, pretransfusion testing practices showed universally high compliance, with 100% of patients undergoing ABO and Rh typing and crossmatching, and clerical verification (90%), clerical verification (90%), and documentation (88%). These findings align with a large-scale survey by the College of American Pathologists, which found that more than 91% of laboratories performed ABO grouping in 2004, with Rh typing showing comparable levels of compliance [12]. Crossmatching in all patients mirrors the CAP survey findings that this practice remains a cornerstone of transfusion safety, albeit with variations in technique across centers. The slightly lower rates of clerical checks and documentation in our study highlight ongoing areas for quality improvement, as these non-technical steps are equally critical in preventing transfusion errors.

In the present study, pretransfusion testing revealed a variety of errors, the most frequent being incomplete requisition forms (8%), followed by mislabeling of samples (6%), documentation errors (5%), discrepancies in ABO grouping (4%), and wrong blood in tube (WBIT) incidents (2%), with a total of 25% of cases showing at least one error. These findings are in line with previous reports, although our error rates appear higher. Jain et al.[13] identified 2.76% of samples with pretransfusion errors, primarily related to incomplete or mismatched requisition details, particularly in emergency and trauma units, underscoring the vulnerability of high-pressure settings to clerical lapses. In a similar study, Quillen et al. [14] observed minor mislabeling in 0.3% of cases and major mislabeling, including WBIT, in 0.2%, with most critical errors occurring in emergency department settings. The higher proportions observed in our study may be attributed to variations in institutional resources, staffing, and system safeguards; however, the types of errors identified are similar to those reported in previous studies, emphasizing the universal risk of clerical and identification mistakes in the pretransfusion process. These observations underscore that rigorous adherence to pretransfusion testing protocols is essential, as even minor errors can directly compromise patient safety and clinical outcomes.

In the present study, the majority of patients (93%) received transfusions without any adverse events, while febrile non-hemolytic transfusion reactions (FNHTRs) occurred in 3% of cases and allergic reactions in 2%. Delayed transfusions due to error were rare, observed in 2% of patients. These findings are consistent with previously published data. Sidhu et al.[15] reported that among 94 transfusion reactions, FNHTRs and allergic reactions were the most prevalent, at 35.5% and 41.5%, respectively, with hemolytic reactions occurring less frequently, highlighting a similar pattern of outcomes. Similarly, Tadasa et al.[16] found that acute transfusion reactions occurred in 5.7% of patients, with FNHTRs accounting for 63.6% and allergic reactions for 36.4%, further supporting the observation that non-hemolytic reactions are more common than hemolytic ones. Overall, these results indicate that while transfusion is generally safe, FNHTRs and allergic reactions remain the most frequently observed adverse events, reinforcing the importance of careful monitoring and adherence to transfusion protocols to ensure patient safety.

In the present study, adverse events occurred more frequently in cases where pretransfusion errors were present, with 4 out of 25 patients (16%) experiencing an adverse outcome compared to only 2 out of 75 (2.7%) in error-free cases. Overall, six patients experienced transfusion-related adverse events, highlighting the direct impact of pretransfusion errors on patient safety. These findings are consistent with previous literature. Sidhu et al.[17] identified 2,229 errors in pretransfusion testing over a year, of which 12 (0.26%) resulted in actual harm, emphasizing the critical importance of accurate sample handling and labeling to prevent adverse outcomes. Similarly, Das et al.[18] reported that 164 errors in pretransfusion testing samples, predominantly clerical and human errors, contributed to adverse events, with a majority occurring during night shifts, suggesting that heightened vigilance and strict adherence to protocols could mitigate patient harm. Collectively, these studies and our findings underscore that even a small number of pretransfusion errors can significantly increase the risk of adverse transfusion outcomes, reinforcing the need for robust quality assurance and monitoring systems in transfusion practice.

Limitations of the study

This study had several limitations:

- Small sample size may limit the generalizability of the findings.
- The study's limited geographic scope may introduce sample bias, potentially affecting the broader applicability of the findings.

CONCLUSION

This study shows that pretransfusion testing practices were generally well adhered to, though errors such as incomplete forms and mislabeling were still observed. Transfusions were largely safe, but adverse events occurred more frequently when pretransfusion errors were present. These findings underscore the importance of strict compliance with testing protocols and meticulous documentation to ensure patient safety.

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ORIGINAL ARTICLE

Assessment of Clinical Presentation and Risk Factors with Exercise Tolerance Test in Type 2 Diabetics Patients in a Tertiary Care Hospital

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ABSTRACT

Introduction: *Cardiovascular disease remains the leading cause of morbidity and mortality in type 2 diabetes mellitus (T2DM) patients. Exercise tolerance test (ETT) is an accessible tool for ischemia detection and assessment of cardiovascular risk in high-risk patients.* ***Objectives:*** *The aim of this study was to assess the clinical presentation and risk factors with exercise tolerance test in type 2 diabetics patients.* ***Methods & Materials:*** *This cross-sectional observational study was conducted in the Department of Cardiology, BIRDEM general hospital, Dhaka, Bangladesh June 2022 to May 2023. Total 82 patients with type 2 diabetes aged between 31-63 years attending in out-patient department of Cardiology and Medicine and also from in-patient department of the respective disciplines were included in this study.* ***Results:*** *Mean age was 47.36 ± 16.38 years with male predominance (67.07%). Classic chest pain (74.39%) and dyspnea (41.46%) correlated strongly with ETT positivity. Poor glycemic control (mean HbA1c 9.4%) and dyslipidemia were prevalent. Dyslipidemia (79.26%), hypertension (71.95%), family history of ischemic heart disease (65.85%), and smoking (59.75%) were all significantly more prevalent in ETT positives.* ***Conclusion:*** *It is more probable that individuals with T2DM and multiple cardiovascular risk factors with compromised metabolic control will present with ischemia that can be detected on ETT. Early detection and prevention of cardiovascular events in resource-limited environments might be facilitated through routine use of ETT in the high-risk population.*

Keywords: *Clinical Presentation, Risk Factors, Exercise Tolerance Test, and Type 2 Diabetics Patients*

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INTRODUCTION

Type 2 diabetes mellitus (T2DM) has emerged as one of the most critical global health emergencies of the 21st century, with prevalence accelerating at alarming rates in both developing and developed nations. According to global epidemiological estimates, more than 400 million individuals are already afflicted with T2DM, and the number is anticipated to increase significantly over the coming decades.[1] The condition is associated not only with profound metabolic derangements but also with premature morbidity and mortality, in large part driven by its cardiovascular complications. Cardiovascular disease (CVD) remains the most frequent cause of death among individuals with T2DM, accounting for over half of diabetes-attributable deaths worldwide.[2] Alarmingly, younger age groups are now more affected, with early-onset T2DM having particularly high risks of premature cardiovascular death.[3]

The pathophysiological processes involved in T2DM and cardiovascular impairment are multifactorial, including endothelial dysfunction, autonomic neuropathy, impaired skeletal muscle perfusion, and reduced cardiac reserve. These effects respectively manifest clinically as reduced exercise tolerance and a heightened burden of both symptomatic and asymptomatic coronary artery disease (CAD).[4] Particularly concerning is the high prevalence of silent myocardial ischemia in patients with T2DM, where ischemic episodes are not accompanied by typical anginal symptoms due to autonomic neuropathy and altered pain perception. Several studies have reported that a notable percentage of asymptomatic T2DM patients have silent ischemia, which can be identified only with the help of functional testing

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procedures like the exercise tolerance test (ETT).[5-7] This is one of the biggest diagnostic dilemmas since consideration of only clinical symptoms can lead to a delay in the identification of underlying ischemic heart disease.

Exercise intolerance in the absence of overt ischemia has also been shown to be an early marker of cardiovascular risk in T2DM cohorts. Mechanistic studies have shown that impaired skeletal muscle blood flow reserve and poor cardiorespiratory fitness precede CAD symptoms at the clinical level, emphasizing the importance of functional capacity assessment in the management of diabetes.[4] The ETT in this case is a readily available, low-cost, and non-invasive investigative tool. It not only assists in the detection of myocardial ischemia but also provides prognostic information by assessing exercise capacity, hemodynamic responses, and arrhythmogenic potential.[8] For practitioners who deal with high-risk populations such as T2DM patients, the ETT remains a highly relevant investigation, especially in resource-constrained tertiary care facilities where advanced imaging might not always be feasible.

Another dimension of cardiovascular risk in T2DM is the presence of multiple risk factors. Hypertension, dyslipidemia, obesity, and smoking are frequent companions of diabetes, and their cumulative load contributes significantly to the risk of cardiac events.[9] Evidence exists that each increment in cardiovascular risk factor exponentially raises the risk of CAD development, thereby emphasizing the need for global risk profiling.[10] Despite these well-established associations, region-specific data, particularly from tertiary care centers of low- and middle-income countries, regarding the influence of such clustering of risk factors on ETT outcomes and clinical manifestations in T2DM patients is limited. Therefore, this current study aims to assess the clinical presentation and risk factors with exercise tolerance test in type 2 diabetics patients in a tertiary care hospital.

OBJECTIVES

To assess the clinical presentation and risk factors with exercise tolerance test in type 2 diabetics patients.

METHODS & MATERIALS

This cross-sectional observational study was conducted in the Department of Cardiology, BIRDEM general hospital, Dhaka, Bangladesh June 2022 to May 2023. Total 82 patients with type 2 diabetes aged between 31-63 years attending in out-patient department of Cardiology and Medicine, also from in-patient department of the respective disciplines were included in this study. Patients with Acute coronary syndrome, severe aortic stenosis, mitral stenosis, hypertrophic obstructive cardiomyopathy, ECG findings suggestive of false positive ETT e.g. LBBB, left ventricular hypertrophy, WPW, and digoxin toxicity were excluded from the study. Informed consent was obtained from all participants prior to inclusion. Ethical clearance was obtained from ethical review board of BIRDEM academy.

Each participant underwent a detailed clinical evaluation, including baseline physical examination, resting electrocardiogram (ECG), and exercise tolerance test (ETT). Continuous 12-lead ECG monitoring was performed during each ETT procedure. The target heart rate for each patient was calculated as 85% of the maximum predicted heart rate (MPHR = 220 – age). The ETT was interpreted using established diagnostic criteria. A test was considered positive if at least two ECG leads demonstrated upsloping ST-segment depression of 1.5 mm or down sloping/horizontal ST-segment depression of 1.0 mm; an early positive response occurring within six minutes; persistence of ST-segment depression for more than six minutes into recovery; ST-segment depression in five or more leads; exertional hypotension; or the development of typical angina symptoms during the test.

Tests were deemed inconclusive or equivocal in cases where participants failed to achieve >85% of the MPHR, experienced atypical chest pain or unexplained exertional dyspnea despite negative ECG findings, or developed clinically significant rhythm disturbances or ST-segment changes not meeting the criteria for positivity. All collected data were systematically recorded and subsequently analyzed using Statistical Package for the Social Sciences (SPSS) version 23. Results were presented in the form of tables, figures, and diagrams. A p-value <0.05 was considered statistically significant for all analyses.

RESULTS

The baseline characteristics of the 82 study participants are summarized in Table I. The mean age of the patients was 47.36 ± 16.38 years, with a range between 31 and 63 years. The majority of patients (40.24%) belonged to the 50–59-year age group. Males predominated in the study population, comprising 67.07% (n = 55), while females accounted for 32.93% (n = 27). The mean body mass index (BMI) was 26.06 ± 10.46 kg/m^2, with an average pulse rate of 82 ± 24 beats per minute. The mean systolic blood pressure was 145 ± 35 mmHg and the mean diastolic blood pressure was 80 ± 20 mmHg. Regarding diabetes duration, nearly half of the patients (45.12%) had diabetes for 10–14 years, 20.74% for ≥15 years, 18.29% for 5–9 years, and 15.85% for ≤5 years, with the overall mean duration being 8.34 ± 5.92 years (Figure 1).

The distribution of associated symptoms is presented in Table II. Typical chest pain was the most frequently reported symptom, observed in 74.39% of the patients, with a significantly higher proportion among ETT-positive individuals (46.36%) compared to those who were ETT-negative or equivocal (28.03%, p = 0.042). Atypical chest pain was reported by 23.17% of patients, also more common in ETT-positive cases (12.19% vs. 10.98%, p = 0.026). Non-specific chest pain was relatively uncommon, affecting only 2.42% of the total cohort, without significant difference between groups (p = 0.057). Breathlessness was reported by 41.46% of the patients, again significantly associated with ETT positivity (26.82% vs. 14.64%, p = 0.011). Palpitations were observed in 34.14% of patients, with no significant group differences (p = 0.073).

Key biochemical and metabolic parameters of the study cohort are shown in Table III. The mean fasting blood glucose (FBG) was 10.23 ± 5.2 mmol/L, with values ranging from 6.2

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to 21.7 mmol/L. Glycated hemoglobin (HbA1c) was elevated, with a mean of 9.4 ± 3.5%, ranging between 5.9% and 13.4%, reflecting poor long-term glycemic control in the study population. The mean total cholesterol level was 184 ± 93.5 mg/dL, triglyceride levels were elevated at 228 ± 137 mg/dL, and low-density lipoprotein (LDL) cholesterol was 122 ± 45.5 mg/dL. High-density lipoprotein (HDL) cholesterol averaged 51.22 ± 29.67 mg/dL, with values ranging between 31 and 83 mg/dL. These findings indicate a high prevalence of dyslipidemia and suboptimal metabolic control among participants.

Table IV presents the pre-existing cardiovascular risk factors. Dyslipidemia was the most prevalent, present in 79.26% of patients, and significantly more frequent among ETT-positive individuals (48.78% vs. 30.48%, p = 0.024). Hypertension was observed in 71.95% of the cohort, again with a significant predominance in ETT-positive patients (40.24% vs. 31.71%, p = 0.014). A positive family history of ischemic heart disease (IHD) was reported by 65.85% of participants, more common in the ETT-positive group (40.24% vs. 25.61%, p = 0.035). Smoking was documented in 59.75% of the total sample, with a slightly higher prevalence among ETT-positive patients (30.49% vs. 29.26%, p = 0.043).

Table – I: Baseline characteristics of the study patients (*n*=82)

Characteristics	Number of patients	Percentage (%)
Age group (Years)		
30-39	16	19.51
40-49	20	24.39
50-59	33	40.24
60 and above	13	15.86
Mean± SD	47.36±16.38	
Range	31-63	
Sex		
Male	55	67.07
Female	27	32.93
BMI (Kg/m²)		
Mean± SD	26.06±10.46	
Pulse (per minute)		
Mean± SD	82±24	
Systolic blood pressure (mm of Hg)		
Mean± SD	145±35	
Diastolic blood pressure (mm of Hg)		
Mean± SD	80±20	

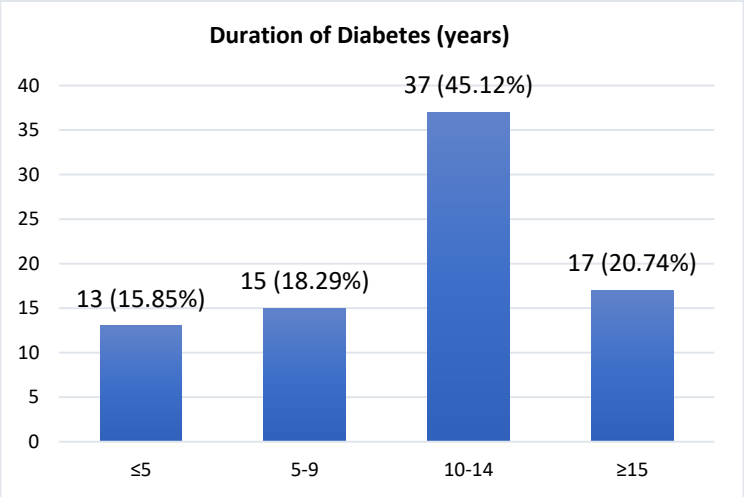

Figure – 1: Distribution of duration of diabetes among the study patients (*n*=82)

Table – II: Distribution of associated symptoms among the study patients (*n*=82)

Symptoms	ETT positive subjects (n/%)	Other than ETT positive subjects (n/%)	Total n (%)	P value
Typical chest pain	38(46.36)	23(28.03)	61 (74.39)	0.042
Atypical chest pain	10(12.19)	09(10.98)	19 (23.17)	0.026
Nonspecific chest pain	01(1.21)	01(1.21)	02 (02.42)	0.057
Breathlessness	22(26.82)	12(14.64)	34 (41.46)	0.011
Palpitation	13(15.85)	15(18.29)	28 (34.14)	0.073

Table – III: Distribution of clinical parameters among the study patients (*n*=82)

Parameters	Mean ± SD	Maximum- Minimum
FBG (mmol/l)	10.23±5.2	21.7-6.2
Hb A_1C%	9.4±3.5	13.4-5.9
Cholesterol (mg/dl)	184±93.5	285-180
Triglyceride (mg/dl)	228±137	521-132
HDL (mg/dl)	51.22±29.67	83-31
LDL (mg/dl)	122±45.5	171-61.7

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Table – IV: Pre-existing risk factors of the study patients (*n*=82)

Pre-existing risk factors	ETT positive subjects (n/%)	Other than ETT positive subjects (n/%)	Total n (%)	P value
Dyslipidemia	40 (48.78)	25 (30.48)	65 (79.26)	0.024
Hypertension	33(40.24)	26(31.71)	59 (71.95)	0.014
Positive family history of IHD	33(40.24)	21(25.61)	54 (65.85)	0.035
Smoking	25(30.49)	24(29.26)	49 (59.75)	0.043

DISCUSSION

The present study aimed to assess the clinical characteristics, symptom patterns, metabolic control, and cardiovascular risk factors of positive exercise tolerance test (ETT) results in type 2 diabetes mellitus (T2DM) patients in a tertiary care hospital in Bangladesh. The findings highlight predominance of male patients in middle age, prevalence of coexistence of two or more cardiovascular risk factors, poor glycemic and lipid control, and significant correlations between clinical symptoms and ETT positivity. These results are consistent with global evidence, and further provide regional data affirming the important role of early cardiovascular risk assessment among diabetic patients.

The average age of the participants was 47.36 years, with the majority being in the 50–59 years age group. Male predominance was also noted, with a proportion of nearly two-thirds men to participants. These demographic patterns are in line with previous studies, wherein similar age groups and male predominance have been reported for newly diagnosed or hospitalized T2DM populations.[11,12] The mean body mass index (26.06 kg/m^2) was comparable to overweight cut-offs reported in other Asian and European settings, corroborating obesity as a principal force of cardiometabolic risk.[13,14] Furthermore, the median duration of disease was over eight years, and nearly half of patients had a disease duration of over 10 years, reflecting the chronicity and risk factor burden present in tertiary hospital cohorts.[15]

The most prevalent symptom was common chest pain, which was described in nearly three-quarters of the patients and was strongly associated with ETT positivity. Shortness of breath and atypical chest pain were also more common in ETT-positive patients. This is in line with Sharmin et al.[16] and Khan et al.[17], who found typical chest pain and effort dyspnea to be strong predictors of ischemic responses in Bangladeshi diabetic patients who were administered ETT. Meanwhile, Fatima et al.[18] demonstrated that shortness of breath and chest pain occurring during ETT had a strong association with incident coronary artery disease, vindicating symptom analysis as an aid to diagnosis complementary to functional testing. Palpitations, although common, did not predict strongly the positive compared to negative results of ETT, consistent with earlier reports citing palpitations as a non-specific symptom for ischemia assessment.[19]

Biochemical assessment validated inadequate glucose control, as indicated by a mean HbA1c of 9.4% and fasting blood glucose values over the ideal range, in addition to widespread dyslipidemia characterized by elevated triglyceride and LDL cholesterol levels. These findings are corroborated by various studies indicating strong correlations between inadequate glucose control and adverse lipid profiles.[20-22] Elevated triglyceride and LDL along with decreased HDL have been variably associated with increased cardiovascular risk in T2DM patients, and measures such as the triglyceride/HDL ratio have been proposed as prognostic markers of poor glycemic control.[23,24] The results of this present study substantiate this evidence, pointing out the compounded issue of uncontrolled diabetes and dyslipidemia in sustaining ischemic burden.

A very high rate of pre-existing risk factors for cardiovascular disease was present in the study population. Dyslipidemia (79.26%), hypertension (71.95%), positive family history of ischemic heart disease (65.85%), and smoking (59.75%) were all significantly more common in ETT-positive patients. This clustering of risk factors has been already emphasized in local as well as global literature. Lavekar and Salkar[25] showed that smoking, hypertension, and dyslipidemia were significantly associated with positive treadmill test results in Indian asymptomatic T2DM patients. Similarly, Dinges et al.[26] stated that risk factor clustering impaired exercise performance and increased ischemic burden in German T2DM cohorts. The utility of family history as a predictor of risk of ischemic outcomes has also been long proven, with Ghamar-Chehreh et al.[27] showing that family history of cardiovascular disease was an excellent predictor of adverse outcomes in high-risk populations. The findings of this present study therefore maintain the cumulative and multiplicative actions of clustering of risk factors in the diabetic population. Cumulatively, these observations highlight the value of ETT as both a diagnostic and a prognostic marker in patients with T2DM and multiple cardiovascular risk factors.

CONCLUSION

This research revealed that type 2 diabetic patients in a tertiary care hospital in Bangladesh had frequent chest pain, uncontrolled glycemia, dyslipidemia, and aggregation of cardiovascular risk factors, all of which were significantly related to positive ETT outcomes. Male predominance and middle-aged age at onset were notable demographic features. The findings highlight the usefulness of ETT as an economical diagnostic and prognostic tool in the detection of ischemia and stratification of cardiovascular risk in low-resource environments, and previous preventive and management strategies are supported.

Background:

Conflict of Interest Statement: None.

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ORIGINAL ARTICLE

Pediatric vs Adult Cholesteatoma — A Study on Recurrence Rates and Surgical Challenges

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ABSTRACT

Introduction: *Cholesteatoma in pediatric patients is clinically distinct from adult disease in terms of aggressiveness, recurrence, and surgical complexity. This study aimed to compare recurrence rates and surgical challenges between pediatric and adult patients with acquired cholesteatoma in a Bangladeshi tertiary center.* ***Methods & Materials:*** *A retrospective comparative study was conducted involving 200 patients: 100 pediatric (≤18 years) and 100 adult (>18 years) cases. Clinical features, surgical details, recurrence rates, and hearing outcomes were analyzed over a minimum 24-month follow-up. Statistical analysis included chi-square tests, logistic regression, and Kaplan–Meier survival analysis.* ***Results:*** *Pediatric patients showed significantly higher recurrence rates (25% vs. 12%; p=0.01), earlier time to recurrence (14.2 vs. 20.5 months; p=0.002), and greater need for revision surgery (22% vs. 10%; p=0.02). The CWU technique was more common in children, but associated with lower recurrence-free survival. Logistic regression confirmed pediatric age as an independent predictor of recurrence (adjusted OR=2.39, p=0.033). Hearing improvement was comparable between groups.* ***Conclusion:*** *Pediatric cholesteatoma exhibits higher recurrence and greater surgical complexity compared to adult disease. Surgical planning should account for the increased risk profile in children, with emphasis on follow-up and disease monitoring strategies.*

Keywords: *Pediatric cholesteatoma, recurrence, canal wall up, middle ear surgery, Bangladesh*

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INTRODUCTION

Cholesteatoma is a non-neoplastic yet aggressively destructive lesion characterized by the presence of keratinizing squamous epithelium in the middle ear and/or mastoid, commonly arising due to chronic otitis media or, less frequently, as a congenital lesion. Although benign in histology, its behavior is notably invasive, capable of causing ossicular chain erosion, sensorineural or conductive hearing loss, facial nerve paralysis, labyrinthine fistula, and even life-threatening intracranial complications such as abscesses and meningitis [1,2]. Global incidence rates of cholesteatoma are estimated at 3–6 per 100,000 children and 9–12 per 100,000 adults annually, with the burden being considerably higher in settings with high prevalence of chronic otitis media [3,4]. Importantly, pediatric cholesteatomas have been found to exhibit more aggressive biological behavior than their adult counterparts, with greater rates of recidivism and more extensive anatomical spread at the time of diagnosis [5,6].

There are key anatomical and physiological distinctions that underlie the differential presentation and progression of cholesteatoma in children and adults. Pediatric patients often present with underdeveloped mastoid pneumatization, immature Eustachian tube function, and more reactive middle ear mucosa, all of which contribute to a more aggressive disease course and greater surgical complexity [7,8]. Additionally, congenital cholesteatoma—arising from embryonic epithelial cell rests—is predominantly seen in children and typically manifests as a white retrotympanic mass without prior history of otorrhea or tympanic membrane perforation, differing significantly from the acquired form seen in both age groups [9,10].

Surgical management is the mainstay of cholesteatoma treatment, and it typically involves either canal wall up (CWU) or canal wall down (CWD) mastoidectomy, with the choice influenced by patient age, disease extent, follow-up feasibility, and surgeon preference. CWU procedures preserve the posterior canal wall, offering better cosmetic and functional outcomes, especially in terms of hearing preservation. However, CWU has been associated with recurrence rates ranging from 20% to as high as 70% in pediatric patients, primarily due to limited visualization and hidden recesses that facilitate residual disease [1,5,11]. In contrast, CWD procedures, although more invasive and associated with lifelong cavity care, reduce recurrence rates to approximately 10–30% by offering wider surgical exposure and direct access to disease-prone areas [12,13]. However, CWD surgery can compromise long-term quality of life due to water precautions, cavity debridement requirements, and potential impact on hearing function [14].

Recurrence remains a central concern in cholesteatoma management, particularly in pediatric populations where anatomical constraints, delayed diagnosis, and inadequate

follow-up contribute to high residual and recurrent disease rates. Second-look surgeries and serial diffusion-weighted MRI (DW-MRI) imaging are frequently necessary to detect silent recurrences, especially in CWU cases. However, these strategies are often not feasible in low-resource or rural healthcare settings due to limited imaging infrastructure, cost barriers, and long distances from tertiary centers [15,16]. In such contexts, the recurrence burden may go underreported, and children may present with complications only at the stage of irreversible ossicular destruction or intracranial spread.

In South Asia, and particularly in Bangladesh, the need for localized, age-stratified data on cholesteatoma recurrence is pressing. Despite the high burden of chronic suppurative otitis media (CSOM) in the region, few studies have examined recurrence and long-term outcomes across pediatric and adult populations in a comparative framework. While some reports from neighboring India and Pakistan have assessed complication rates and treatment approaches, age-specific recurrence data remains sparse, and almost none have contextualized surgical strategy decisions within the socioeconomic and infrastructural constraints of Bangladesh [4,17]. Factors such as poor health literacy, delayed care-seeking behavior, limited ENT availability, and low access to imaging services contribute to late-stage presentation and poor surgical outcomes [16,18].

Given these existing gaps, the present study seeks to evaluate and compare recurrence rates of cholesteatoma in pediatric and adult populations treated at a tertiary ENT facility in Bangladesh. By examining surgical outcomes, recurrence timelines, and the logistical challenges of post-operative surveillance, this study aims to provide actionable data for clinicians in resource-constrained settings. Furthermore, the study intends to inform context-specific surgical decision-making, balancing anatomical preservation with disease eradication, within a healthcare system where second-look surgery and long-term imaging may not be reliably accessible. Ultimately, this research contributes to the urgently needed body of evidence guiding cholesteatoma management in South Asia, with implications for both surgical practice and health policy.

METHODS & MATERIALS

This was a retrospective comparative study was conducted at Rajshahi Medical College from July, 2023 to June, 2024. A total of 200 patients diagnosed with acquired cholesteatoma, divided into two groups: pediatric (≤18 years, n = 100) and adult (>18 years, n = 100). Patients were consecutively selected from otologic surgical records over the study period, based on predefined inclusion and exclusion criteria. Inclusion criteria were histologically or intraoperatively confirmed cases of cholesteatoma undergoing surgical management with adequate follow-up of at least 24 months. Patients with congenital cholesteatoma, syndromic associations, prior ear malignancy, or incomplete follow-up records were excluded. Demographic variables, clinical features (otorrhea, hearing loss, vertigo, facial palsy, intracranial complications), intraoperative findings (ossicular chain erosion, mastoid extent), and surgical details (approach used, intraoperative challenges, postoperative complications) were recorded. Outcomes included recurrence rates, time to recurrence, need for revision surgery, and postoperative hearing improvement.

Statistical Analysis

All statistical analyses were performed using SPSS (version 26). Descriptive statistics were expressed as mean ± standard deviation (SD) for continuous variables and as frequencies and percentages for categorical variables. Comparisons between pediatric and adult groups were made using the chi-square test and independent t-test or Mann–Whitney U test for continuous variables, depending on data distribution. Recurrence risk factors were explored using univariable and multivariable binary logistic regression, with results reported as odds ratios (OR) and 95% confidence intervals (CI). Model performance was assessed using Nagelkerke R^2, the area under the ROC curve (AUC), and the Hosmer–Lemeshow goodness-of-fit test. Kaplan–Meier survival curves were constructed to assess recurrence-free survival (RFS) between groups, with the log-rank test applied to compare survival distributions. A p-value of <0.05 was considered statistically significant.

RESULTS

Table I presents the baseline characteristics of the study population, comprising 100 pediatric and 100 adult patients with acquired cholesteatoma. The mean age was 9.8 ± 3.1 years in the pediatric group and 42.5 ± 12.4 years in the adult group, with the overall cohort mean age being 26.1 ± 18.7 years. This difference in age distribution was statistically significant ($p < 0.001$). Gender distribution was comparable between the two groups, with males accounting for 60% in the pediatric group and 55% in the adult group ($p = 0.52$). Laterality of disease (right vs. left ear involvement) was also similarly distributed, with no significant difference observed between pediatric (52% right-sided) and adult (50% right-sided) cases ($p = 0.81$). However, the duration of symptoms prior to presentation showed a significant difference. Pediatric patients had a median symptom duration of 18 months (IQR 12–24), significantly shorter than adults, who presented after a median duration of 30 months (IQR 20–48) ($p = 0.004$). This suggests a relatively delayed presentation or slower disease progression in adults, or possibly earlier caregiver concern in pediatric cases. Notably, previous ear surgeries were significantly more common among adult patients (38%) compared to pediatric patients (20%), indicating either a higher cumulative burden of chronic otologic disease or more frequent surgical intervention in adult life ($p = 0.006$). [Table I].

Table – I: Baseline Characteristics of Study Population (*n* = 200)

Baseline Characteristics	Pediatric (n=100)	Adult (n=100)	Total (n=200)	p-value
Age (years, mean ± SD)	9.8 ± 3.1	42.5 ± 12.4	26.1 ± 18.7	<0.001
Sex (Male/Female)	60/40	55/45	115/85	0.52
Laterality (Right/Left)	52/48	50/50	102/98	0.81
Duration of Symptoms (months, median, IQR)	18 (12–24)	30 (20–48)	24 (15–40)	0.004
Previous Ear Surgery	20 (20%)	38 (38%)	58 (29%)	0.006

Table II outlines the clinical presentations of cholesteatoma among the two groups. Recurrent otorrhea was the most common presenting complaint in both cohorts, affecting 75% of pediatric patients and 70% of adults, with no significant difference between groups ($p = 0.44$). Similarly, hearing loss was reported in 80% of pediatric and 82% of adult patients,

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again without statistical significance (p = 0.71), confirming it as a near-universal symptom across age groups. However, dizziness or vertigo was significantly more prevalent among adult patients (28%) compared to pediatric patients (15%), with a statistically significant difference (p = 0.03), suggesting more extensive labyrinthine involvement or comorbid vestibular degeneration in the adult population. Though relatively infrequent overall, facial nerve weakness was observed in 4% of pediatric patients and 6% of adults, a difference that was not statistically significant (p = 0.52). However, intracranial complications were more common in adults (8%) compared to pediatric patients (2%), a finding that reached statistical significance (p = 0.04). This may reflect either a longer disease course or delayed access to care in the adult population, potentially resulting in more severe disease progression. [Table II].

Table – II Clinical Presentation of Cholesteatoma (*n* = 200)

Symptom / Sign	Pediatric (n=100)	Adult (n=100)	Total (n=200)	p-value
Recurrent Otorrhea	75 (75%)	70 (70%)	145 (72.5%)	0.44
Hearing Loss	80 (80%)	82 (82%)	162 (81%)	0.71
Dizziness/Vertigo	15 (15%)	28 (28%)	43 (21.5%)	0.03
Facial Nerve Weakness	4 (4%)	6 (6%)	10 (5%)	0.52
Intracranial Complication	2 (2%)	8 (8%)	10 (5%)	0.04

Table III outlines the surgical approaches utilized in managing cholesteatoma among the pediatric and adult groups. The Canal Wall Up (CWU) technique was more commonly performed in pediatric patients, with 55% undergoing this approach, compared to 40% of adults. This difference was statistically significant (p = 0.03), reflecting a tendency toward hearing preservation and anatomical restoration in younger patients. Conversely, the Canal Wall Down (CWD) technique was more frequently adopted in adult patients, used in 50% of cases versus 35% in the pediatric group (p = 0.04). This likely reflects clinical decisions driven by more extensive disease or prior surgical history in the adult cohort, emphasizing disease eradication over anatomical conservation. The combined approach—a tailored strategy using elements of both CWU and CWD—was applied equally in both groups (10% each), showing no statistical difference (p = 1.0). This suggests a selective use of the combined approach based on intraoperative judgment rather than age-based preferences. [Table III].

Table – III: Surgical Techniques Applied (*n* = 200)

Surgical Approach	Pediatric (n=100)	Adult (n=100)	Total (n=200)	p-value
Canal Wall Up (CWU)	55 (55%)	40 (40%)	95 (47.5%)	0.03
Canal Wall Down (CWD)	35 (35%)	50 (50%)	85 (42.5%)	0.04
Combined Approach	10 (10%)	10 (10%)	20 (10%)	1.0

Table IV presents key outcomes related to recurrence and revision surgery following the initial cholesteatoma surgery. Recurrence was observed in 25% of pediatric patients compared to 12% of adult patients, a statistically significant difference (p = 0.01). This supports the widely observed trend of higher recurrence rates in the pediatric population, potentially due to anatomical factors, surgical challenges, or biological aggressiveness. The mean time to recurrence was also notably shorter in the pediatric group (14.2 ± 4.6 months) than in the adult group (20.5 ± 6.3 months), and this difference was statistically significant (p = 0.002). This suggests that not only is recurrence more frequent in children, but it also tends to occur earlier postoperatively. In line with recurrence rates, the need for revision surgery was significantly higher in the pediatric group (22%) compared to adults (10%) (p = 0.02). This reinforces the notion that surgical durability and long-term outcomes are more difficult to achieve in the pediatric cohort, possibly due to smaller anatomy, poor follow-up compliance, or ongoing Eustachian tube dysfunction. [Table IV].

Table – IV: Recurrence Rates After Primary Surgery (*n* = 200)

Outcome	Pediatric (n=100)	Adult (n=100)	Total (n=200)	p-value
Recurrence (Yes/No)	25 / 75	12 / 88	37 / 163	0.01
Mean Time to Recurrence (months ± SD)	14.2 ± 4.6	20.5 ± 6.3	17.3 ± 5.9	0.002
Revision Surgery Needed	22 (22%)	10 (10%)	32 (16%)	0.02

Table V summarizes intraoperative and postoperative complications across both age groups. Intraoperative bleeding was observed more frequently in pediatric cases (18%) than in adults (10%), though the difference did not reach statistical significance (p = 0.11). Similarly, ossicular chain erosion was more common in the pediatric group (70%) compared to adults (58%), suggesting potentially more aggressive middle ear disease in children, yet again without statistical significance (p = 0.09). The extent of mastoid involvement was slightly higher in the pediatric cohort (45%) than in adults (38%) (p = 0.33). Facial nerve dehiscence, an important intraoperative risk, was observed in 8% of pediatric and 12% of adult patients, while postoperative infections occurred in 12% and 8%, respectively. However, none of these differences were statistically significant (p > 0.05), indicating that complication rates were generally comparable between the two groups. [Table V].

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Table – V: Surgical Challenges and Complications (*n* = 200)

Complication / Challenge	Pediatric (n=100)	Adult (n=100)	Total (n=200)	p-value
Intraoperative Bleeding	18 (18%)	10 (10%)	28 (14%)	0.11
Ossicular Chain Erosion	70 (70%)	58 (58%)	128 (64%)	0.09
Mastoid Extent Disease	45 (45%)	38 (38%)	83 (41.5%)	0.33
Facial Nerve Dehiscence	8 (8%)	12 (12%)	20 (10%)	0.34
Postoperative Infection	12 (12%)	8 (8%)	20 (10%)	0.34

As shown in Table VI, both groups achieved comparable hearing outcomes at six months post-surgery. The mean preoperative pure tone average (PTA) was 48.2 ± 12.1 dB HL in pediatric patients and 50.6 ± 13.2 dB HL in adults (p = 0.28). After surgery, the mean PTA improved to 32.5 ± 9.8 dB HL in children and 34.2 ± 10.1 dB HL in adults (p = 0.31), showing statistically nonsignificant but clinically meaningful hearing improvement in both groups. The proportion of patients achieving a ≥10 dB improvement in hearing was 60% in the pediatric group and 62% in adults (p = 0.76). Additionally, the prevalence of residual conductive hearing loss >30 dB HL was comparable between children (20%) and adults (18%) (p = 0.72). These findings suggest that both surgical approaches yield similar short-term hearing outcomes across age groups. [Table VI].

Table – VI: Postoperative Hearing Outcomes (*n* = 200)

Hearing Outcome (6 months follow-up)	Pediatric (n=100)	Adult (n=100)	Total (n=200)	p-value
Mean Pre-op PTA (dB HL ± SD)	48.2 ± 12.1	50.6 ± 13.2	49.4 ± 12.6	0.28
Mean Post-op PTA (dB HL ± SD)	32.5 ± 9.8	34.2 ± 10.1	33.3 ± 10.0	0.31
Hearing Improvement ≥10 dB	60 (60%)	62 (62%)	122 (61%)	0.76
Residual Conductive HL >30 dB	20 (20%)	18 (18%)	38 (19%)	0.72

Table VII outlines the results of both univariable and multivariable logistic regression analyses assessing predictors of cholesteatoma recurrence. Being in the pediatric group was significantly associated with higher odds of recurrence in both univariable (OR = 2.40; 95% CI: 1.14–5.06; p = 0.021) and multivariable models (adjusted OR = 2.39; 95% CI: 1.07–5.34; p = 0.033), confirming age group as an independent risk factor. Other variables, including male sex, surgical approach (CWU or combined), ossicular erosion, mastoid disease, and previous surgery, did not show significant associations with recurrence in either model. While the CWU approach approached significance in univariable analysis (p = 0.07), this association diminished after adjustment (p = 0.159). Model diagnostics revealed that the multivariable model had moderate explanatory power (Nagelkerke R^2 = 0.14) and good discrimination (AUC = 0.71). The Hosmer–Lemeshow test indicated acceptable model fit (χ^2 = 11.17; p = 0.19), supporting the reliability of the regression analysis. [Table VII].

Table – VII: Logistic Regression Analysis for Recurrence in Pediatric vs. Adult Cholesteatoma (*n* = 200)

Predictor	Univariable OR (95% CI)	Univ p	Adjusted OR (95% CI)	Adj p
Group = Pediatric	2.40 (1.14–5.06)	0.021	2.39 (1.07–5.34)	0.033
Sex = Male	0.92 (0.45–1.89)	0.82	0.99 (0.46–2.15)	0.988
Surgical approach = CWU	1.96 (0.95–4.05)	0.07	1.75 (0.80–3.83)	0.159
Surgical approach = Combined	0.87 (0.16–4.68)	0.87	0.00 (0.00–∞)	1.000
Ossicular erosion (yes)	1.60 (0.80–3.21)	0.18	1.65 (0.72–3.78)	0.236
Mastoid extent (yes)	1.22 (0.60–2.46)	0.58	0.75 (0.35–1.61)	0.462
Previous surgery (yes)	1.50 (0.70–3.20)	0.29	1.05 (0.43–2.56)	0.913

Model diagnostics (multivariable):

- Nagelkerke R^2 = 0.14
- AUC = 0.71
- Hosmer–Lemeshow χ^2 = 11.17, p = 0.19

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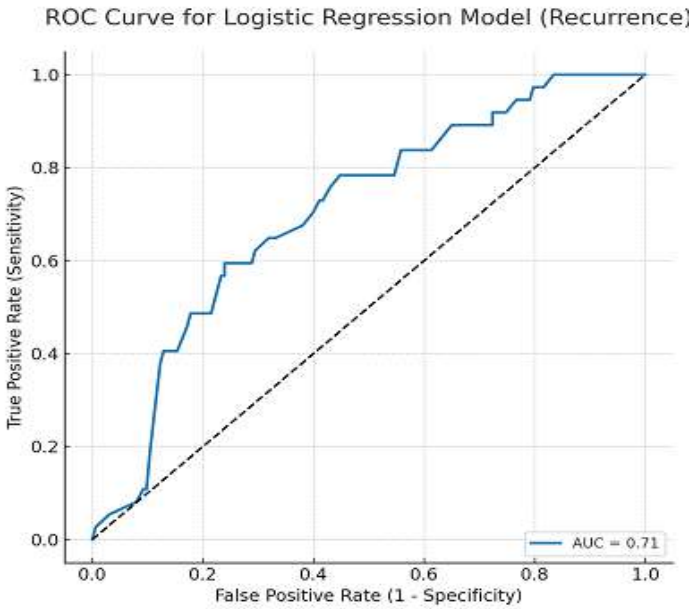

Figure – 1: ROC Curve for Logistic Regression Model (Recurrence)

The ROC curve illustrates the predictive ability of the multivariable logistic regression model for cholesteatoma recurrence. The model achieved an AUC of 0.71, reflecting acceptable discrimination between patients who experienced recurrence and those who did not. This suggests that the included predictors provide reasonable, though not perfect, accuracy in recurrence risk stratification.

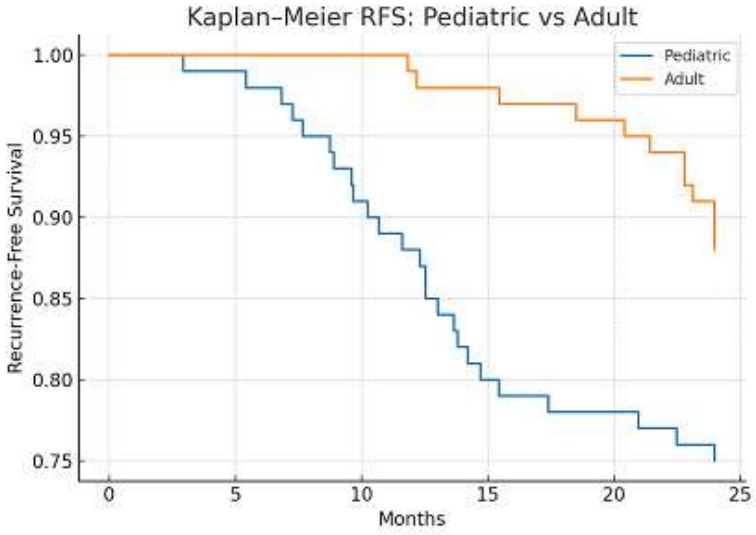

Figure – 2: Kaplan–Meier Recurrence-Free Survival: Pediatric vs. Adult Cholesteatoma

The Kaplan–Meier curve demonstrates a clear separation between pediatric and adult patients. Pediatric patients exhibited a significantly lower recurrence-free survival compared to adults throughout follow-up. At 24 months, RFS was approximately 75% in the pediatric group versus 88% in the adult group. The difference was statistically significant on log-rank testing, indicating that pediatric age is an independent risk factor for recurrence after primary surgery. This pattern highlights the more aggressive biological behavior of cholesteatoma in children and the increased surgical challenge in achieving durable disease control.

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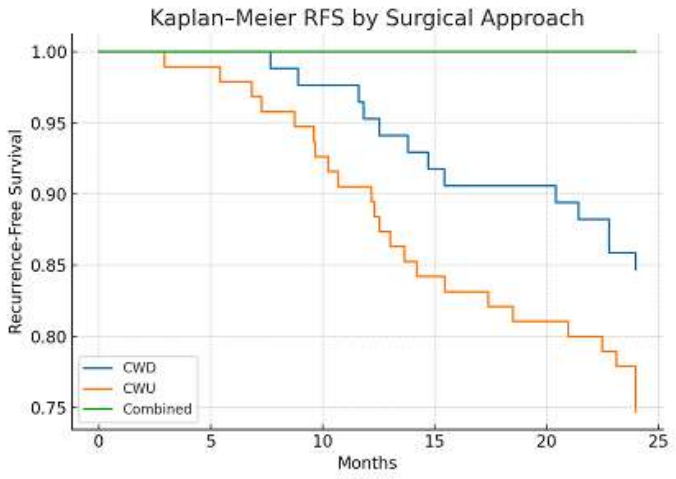

Figure – 3: Kaplan–Meier Recurrence-Free Survival by Surgical Approach (CWU vs. CWD vs. Combined)

Survival curves stratified by surgical technique show that Canal Wall Up (CWU) procedures had the lowest recurrence-free survival across follow-up, while Canal Wall Down (CWD) provided more stable long-term control. The combined approach fell between the two but with limited cases. Although differences did not reach strong statistical significance in this cohort, the trend favors CWD for reducing long-term recurrence risk, consistent with prior reports. These findings emphasize the balance surgeons must achieve between disease eradication and hearing preservation when choosing surgical strategy.

DISCUSSION

The present study provides a comparative evaluation of pediatric and adult cholesteatoma in terms of clinical presentation, surgical management, recurrence, and postoperative outcomes within a South Asian context. One of the most striking findings was the significantly higher recurrence rate in the pediatric cohort (25%) compared to adults (12%), alongside a shorter mean time to recurrence (14.2 vs. 20.5 months). This trend is consistent with prior international literature indicating more aggressive and recurrent disease patterns in children. Adriaansens et al. similarly identified pediatric age as an independent risk factor for recurrence using multivariable logistic regression, with an adjusted odds ratio closely aligning with our own findings (OR = 2.39) and an area under the ROC curve (AUC) of 0.71 supporting model validity [19]. This increased recurrence risk in children is thought to stem from anatomical and immunological immaturity, including underdeveloped Eustachian tube function and reduced mastoid pneumatization [20].

Clinically, recurrent otorrhea and hearing loss were the most common presentations in both groups, while adults presented significantly more often with vertigo and intracranial complications. These findings align with those reported by Mills et al. and Miller et al., who highlighted increased disease chronicity and delayed presentation among adult populations, leading to more complex clinical scenarios [5,21]. The longer duration of symptoms in adults observed in our study (median 30 vs. 18 months) could partly explain the higher complication burden, particularly intracranial involvement (8% vs. 2%).

Surgical approach differed significantly between age groups. Canal Wall Up (CWU) mastoidectomy was more frequently used in pediatric patients, whereas adults more commonly underwent Canal Wall Down (CWD) procedures. This variation reflects the ongoing debate between disease eradication and anatomical preservation. Studies such as those by Kuo et al. and Eggink et al. corroborate our observation that CWU, while more conservative and better suited for pediatric anatomy, tends to result in higher long-term recurrence compared to CWD [22,23]. Our Kaplan–Meier analysis also revealed that recurrence-free survival was significantly lower for CWU compared to CWD, although statistical significance was not reached between approaches. These findings echo those of Todatry et al., who emphasized the need to balance long-term disease control against quality of life and surgical morbidity when selecting surgical technique, especially in younger patients [24].

In terms of surgical challenges, while not statistically significant, pediatric patients showed trends toward increased intraoperative bleeding and ossicular chain erosion. These findings are consistent with the observations by Solis-Pazmino et al., who described the technical complexities of operating in smaller anatomical fields with more friable mucosa in children [1]. Our data further suggest that although facial nerve dehiscence and mastoid extent of disease were common across groups, neither was associated with increased recurrence risk on multivariate analysis, reinforcing the idea that host factors may outweigh intraoperative variables in predicting recurrence [19].

Postoperative hearing outcomes were comparable between groups, with approximately 60% of patients in both cohorts achieving ≥10 dB HL improvement. This is similar to results reported by Tan et al. and Miller et al., who found no significant difference in postoperative hearing thresholds between pediatric and adult populations undergoing mastoidectomy [5,20]. However, residual conductive hearing loss >30 dB persisted in around 20% of cases, highlighting the continued challenge in optimizing functional outcomes post-surgery, especially when ossicular reconstruction is needed.

Overall, our findings reinforce the notion that pediatric cholesteatoma presents a more biologically aggressive course, with higher recurrence and shorter time to failure, necessitating meticulous follow-up and potentially more aggressive initial management. The scarcity of data from South Asia, particularly Bangladesh, underscores the relevance of this study. While our findings align broadly with global literature, region-specific factors such as delayed presentation, limited access to specialized ENT care, and variable compliance with follow-up may further exacerbate

disease burden and recurrence in this setting [1,23]. Future prospective studies incorporating radiologic surveillance and standardized surgical documentation could help clarify the optimal management strategies in these populations.

Limitations of The Study

The study was conducted in a single hospital with a small sample size. So, the results may not represent the whole community.

CONCLUSION

This study demonstrates that pediatric cholesteatoma poses greater surgical challenges and carries a significantly higher risk of recurrence compared to adult cases, even when managed with similar surgical techniques. While Canal Wall Up (CWU) procedures were more frequently employed in children, they were associated with lower recurrence-free survival, reaffirming the delicate balance between preserving anatomy and ensuring disease eradication. Pediatric patients also experienced earlier recurrence and higher revision surgery rates, emphasizing the aggressive nature of the disease in this age group. Despite comparable rates of ossicular erosion and mastoid disease extent, hearing outcomes and postoperative complications were similar across both groups. The logistic regression and survival analyses identified pediatric age as an independent risk factor for recurrence, with acceptable model performance. These findings highlight the need for tailored surgical planning, rigorous follow-up protocols, and region-specific data to guide clinical decision-making, particularly in low-resource settings such as Bangladesh. Future prospective studies with larger sample sizes and longer follow-up are warranted to refine management strategies and improve outcomes for pediatric patients.

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ORIGINAL ARTICLE

Organism Detected and Resistant Pattern in Children with UTI

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ABSTRACT

Introduction: *Urinary tract infections (UTIs) in children are common but increasingly complicated by antimicrobial resistance. Understanding pathogen profiles, resistance patterns, and clinical outcomes is essential to optimize management.* ***Methods & materials:*** *This cross-sectional study included 53 children diagnosed with culture-confirmed UTIs at the Dhaka National Medical College. Demographic, clinical, laboratory, and treatment data were collected prospectively. Isolates were identified using standard microbiological methods, and antibiotic susceptibility was determined via the Kirby–Bauer disk diffusion method, following CLSI guidelines. Statistical analysis explored associations between clinical variables and multidrug resistance (MDR).* ***Results:*** *Escherichia coli (66.0%) and Klebsiella spp. (18.9%) were the predominant pathogens. MDR was detected in 34.0% of cases, with highest resistance to cefixime (71.7%), ceftriaxone (66.0%), and ciprofloxacin (62.3%). Amikacin (90.6%) and carbapenems (≥94%) remained highly effective. Female sex (OR: 3.25, p=0.028), previous UTI (OR: 2.95, p=0.041), and CRP >50 mg/L (OR: 3.80, p=0.014) were significant predictors of MDR. Despite empiric therapy with ceftriaxone and amikacin, 11.3% experienced treatment failure and 75.5% required hospitalization. Median defervescence time exceeded 3 days in 81.1% of cases.* ***Conclusion:*** *There is a high prevalence of multidrug-resistant uropathogens in pediatric UTIs, particularly against commonly used oral antibiotics. Predictive markers like CRP and prior UTI history may guide early intervention. Empiric regimens should consider local resistance trends, and routine susceptibility testing should be prioritized to improve treatment outcomes.*

Keywords: *Pediatric UTI, Antibiotic resistance, Multidrug resistance, E. coli, Risk factors*

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INTRODUCTION

Urinary tract infections (UTIs) are among the most common bacterial infections in the pediatric population, accounting for a substantial proportion of febrile illnesses in children worldwide. It is estimated that UTIs constitute 5–7% of febrile episodes in childhood, ranking as the second most frequent bacterial infection after respiratory tract infections [1]. The burden is not limited to acute morbidity; recurrent or inadequately treated UTIs can lead to renal parenchymal damage and subsequent scarring, which in turn increases the risk of long-term complications such as hypertension and chronic kidney disease (CKD). Systematic reviews and meta-analyses have shown that up to 23% of children with febrile UTIs develop renal scars, underscoring the need for timely diagnosis and effective treatment [2]. More recent evidence highlights that even a single febrile UTI episode in young children may predispose to renal scarring, and recurrence further amplifies this risk [3,4]. These findings emphasize the broader public health importance of pediatric UTIs, which extend beyond acute infections to include long-term renal outcomes.

The etiology of pediatric UTIs is relatively well established, with *Escherichia coli* consistently identified as the most prevalent causative organism, responsible for 70–80% of community-acquired cases [5,6]. Other organisms such as *Klebsiella spp.*, *Proteus spp.*, *Enterococcus spp.*, and *Pseudomonas aeruginosa* are less common but clinically important, especially in complicated or hospital-acquired infections [7,8]. For instance, *Proteus* and *Enterococcus* have been reported more frequently in cases of pyelonephritis, while *Pseudomonas* is often associated with nosocomial infections or children with structural urinary tract abnormalities [9]. The spectrum of causative pathogens is not entirely uniform across regions or clinical contexts; studies demonstrate that pathogen distribution may differ between community-acquired and nosocomial settings, and variations

have also been observed by gender, age, and the presence of underlying congenital anomalies [7,10]. These patterns suggest the importance of region-specific and population-specific data when assessing the microbial epidemiology of UTIs in children.

A major clinical concern linked to pediatric UTIs is the rising trend of antimicrobial resistance (AMR). Globally, resistance rates among uropathogens have increased substantially, particularly against commonly used antibiotics such as ampicillin, cotrimoxazole, and third-generation cephalosporins [11]. The emergence of extended-spectrum β-lactamase (ESBL)-producing organisms and multidrug-resistant (MDR) strains of *E. coli* and *Klebsiella spp.* further complicates empirical therapy [12,13]. Evidence from multiple regions indicates that more than 80% of pediatric *E. coli* isolates may be resistant to ampicillin, while resistance to cotrimoxazole often exceeds 30% [12,14]. ESBL-producing strains are frequently resistant to third-generation cephalosporins, rendering standard empirical regimens increasingly unreliable [15]. In Nepal, more than half of pediatric *E. coli* isolates were multidrug-resistant, highlighting how MDR organisms are no longer confined to tertiary-care hospitals but are also appearing in community-acquired infections [13]. Collectively, these findings underscore the urgency of local surveillance and rational prescribing to mitigate resistance trends and safeguard therapeutic options.

In the South Asian context, and particularly in Bangladesh, the challenge of pediatric UTI management is exacerbated by healthcare system constraints and antibiotic misuse. Recent studies from tertiary-care centers in Dhaka reveal alarmingly high resistance rates among pediatric uropathogens, with ESBL-producing *E. coli* and *Klebsiella spp.* frequently encountered [16]. Data from semi-urban Bangladeshi communities also indicate widespread multidrug resistance in pediatric UTIs, driven in part by unregulated over-the-counter antibiotic access and the common practice of empirical therapy without culture confirmation [17]. Overuse and inappropriate prescribing of antimicrobials are further compounded by limited diagnostic capacity, delayed laboratory confirmation, and poor infection control measures [18,19]. A population-level study of antibiotic use in Bangladesh has also demonstrated significant parental reliance on self-medication for their children, with limited awareness of the consequences of antibiotic resistance [20]. These factors together contribute to the escalating AMR crisis and highlight the relative paucity of robust, updated surveillance data specific to pediatric UTI pathogens in the country.

Given the global and local significance of pediatric UTIs, coupled with the growing threat of antimicrobial resistance, region-specific studies are essential to inform evidence-based clinical practice and policy. Understanding the distribution of causative organisms and their resistance profiles in Bangladeshi children is particularly critical for guiding empirical antibiotic therapy, reducing treatment failures, and preventing long-term renal sequelae. The present study therefore aims to identify the predominant organisms associated with UTIs in children in Bangladesh and analyze their antimicrobial resistance patterns, with the ultimate goal of informing rational antibiotic prescribing and contributing to the national and global response to antimicrobial resistance.

METHODS & MATERIALS

This cross-sectional study was conducted at the Dhaka National Medical College, Dhaka, Bangladesh, from January, 2023 to December, 2023. A total of 53 children clinically diagnosed with urinary tract infection (UTI) and confirmed by positive urine culture and sensitivity testing were purposively enrolled. Data were collected prospectively using a structured case record form that captured sociodemographic characteristics, relevant clinical features, and laboratory findings. Midstream or catheterized urine samples were collected under aseptic precautions and processed immediately in the microbiology laboratory. Bacterial isolates were identified using standard culture and biochemical methods, including colony morphology, Gram staining, and conventional biochemical reactions, in accordance with established microbiological protocols [21]. Antimicrobial susceptibility testing (AST) was performed by the Kirby–Bauer disk diffusion method, and interpretation of results was carried out according to the latest Clinical and Laboratory Standards Institute (CLSI) guidelines [22,23]. Quality control of media and antibiotic discs was ensured using standard control strains (Escherichia coli ATCC 25922, Klebsiella pneumoniae ATCC 700603). The primary outcome measures included the distribution of isolated uropathogens, their resistance profiles to commonly prescribed antibiotics, prevalence of multidrug-resistant (MDR) organisms, and treatment response. Informed written consent was obtained from the guardians of all participating children prior to data collection, and ethical approval for the study was secured from the Institutional Ethics Committee of the study hospital. Data entry and analysis were conducted using IBM SPSS Statistics version 26 (IBM Corp., Armonk, NY, USA). Categorical variables were summarized as frequencies and percentages, whereas continuous variables were expressed as means with standard deviations (SD). Associations between categorical variables (e.g., organism type and resistance status) were assessed using the Chi-square test or Fisher's exact test when cell counts were small. Binary logistic regression analysis was applied to identify independent predictors of multidrug resistance, and the results were presented as odds ratios (OR) with 95% confidence intervals (CI). To complement the statistical analyses, visual representations including heatmaps, radar charts, stacked bar charts, bubble plots, and forest plots were prepared to highlight resistance trends and predictors of MDR. A two-tailed p-value <0.05 was considered statistically significant.

RESULTS

Among the 53 pediatric UTI patients, the majority were aged 2–4 years (49.1%), and most were female (79.2%). Parental education levels varied, with 37.7% having completed higher secondary education (HSC), while skilled labor was the predominant occupation (37.7%). All participants had private toilet access and most practiced daily clothes washing

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(84.9%). Clinically, fever (94.3%) and poor appetite (75.5%) were the most frequent symptoms, followed by urinary frequency/urgency (56.6%) and burning micturition (47.2%). A prior history of UTI was noted in 37.7% of cases. [Table I].

Table – I: Demographic and Clinical Characteristics of Pediatric UTI Patients (*n* = 53)

Variable	Category	Frequency (%)
Age (years)	<2	4 (7.7)
	2–4	26 (49.1)
	5–9	16 (30.2)
	≥10	6 (11.3)
Gender	Female	42 (79.2)
	Male	11 (20.8)
Parental education	Primary	8 (15.1)
	SSC	15 (28.3)
	HSC	20 (37.7)
	Graduate+	10 (18.9)
Occupation	Unskilled labor	8 (15.1)
	Skilled labor	20 (37.7)
	Business	10 (18.9)
	Service	15 (28.3)
Toilet access	Private	53 (100.0)
Clothes washing	Daily	45 (84.9)
	Weekly	8 (15.1)
Clinical features	Fever	50 (94.3)
	Poor appetite	40 (75.5)
	Frequency/urgency	30 (56.6)
	Burning micturition	25 (47.2)
	Voiding dysfunction	5 (9.4)
	Suprapubic pain	5 (9.4)
	Previous UTI	20 (37.7)
	Constipation	15 (28.3)

Escherichia coli was the most prevalent uropathogen (66.0%), followed by Klebsiella spp. (18.9%), Staphylococcus aureus (9.4%), and Salmonella spp. (5.7%). Overall, 34.0% of isolates were multidrug-resistant, with E. coli accounting for the highest share (22.6%). MDR was also noted in 9.4% of Klebsiella spp. and 1.9% of S. aureus isolates, while no MDR was observed in Salmonella spp. [Table II].

Table – II: Organism Distribution and Multi-Drug Resistance (*n* = 53)

Variable	Category	Frequency (%)
Organism	Escherichia coli	35 (66.0)
	Klebsiella spp.	10 (18.9)
	Staphylococcus aureus	5 (9.4)
	Salmonella spp.	3 (5.7)
MDR status	MDR (≥3 classes)	18 (34.0)
	Non-MDR	35 (66.0)
MDR by organism	E. coli	12 (22.6)
	Klebsiella spp.	5 (9.4)
	S. aureus	1 (1.9)
	Salmonella spp.	0 (0.0)

High sensitivity was observed for carbapenems—imipenem (96.2%) and meropenem (94.3%)—and amikacin (90.6%). Gentamicin (84.9%) and nitrofurantoin (83.0%) also showed moderate efficacy. In contrast, substantial resistance was seen against ceftriaxone (66.0%), cefixime (71.7%), ciprofloxacin (62.3%), and co-trimoxazole (64.2%). Organism-specific analysis confirmed these trends, with E. coli and Klebsiella spp. demonstrating significant resistance to cephalosporins and fluoroquinolones. [Table III].

Table – III: Antibiotic Susceptibility Patterns in Pediatric UTI Isolates (*n* = 53)

Organism / Antibiotic	Sensitive n (%)	Resistant n (%)
Amikacin	48 (90.6)	5 (9.4)
Gentamicin	45 (84.9)	8 (15.1)
Imipenem	51 (96.2)	2 (3.8)
Meropenem	50 (94.3)	3 (5.7)
Nitrofurantoin	44 (83.0)	9 (17.0)
Ciprofloxacin	20 (37.7)	33 (62.3)
Ceftriaxone	18 (34.0)	35 (66.0)
Cefixime	15 (28.3)	38 (71.7)
Co-trimoxazole	19 (35.8)	34 (64.2)
Piperacillin	16 (30.2)	37 (69.8)
E. coli (n = 35)		
Amikacin	32 (91.4)	3 (8.6)
Ceftriaxone	11 (31.4)	24 (68.6)
Ciprofloxacin	13 (37.1)	22 (62.9)
Klebsiella spp. (n = 10)		
Amikacin	9 (90.0)	1 (10.0)
Ceftriaxone	2 (20.0)	8 (80.0)
Ciprofloxacin	4 (40.0)	6 (60.0)
S. aureus (n = 5)		
Amikacin	5 (100.0)	0 (0.0)
Ciprofloxacin	3 (60.0)	2 (40.0)
Penicillin	0 (0.0)	5 (100.0)
Salmonella spp. (n = 3)	Broadly sensitive to tested antibiotics	-

Pyuria (92.5%) and bacteriuria (94.3%) were highly prevalent among the children, affirming infection. Hematuria and proteinuria were present in 15.1% and 26.4%, respectively. Most urine samples were acidic (75.5%) and concentrated (71.7% had specific gravity >1.020). Elevated CRP was common, with 47.2% moderately raised and 37.7% highly elevated, indicating systemic inflammatory responses. [Table IV].

Table – IV: Laboratory and Urinalysis Findings (*n* = 53)

Variable	Category	Frequency (%)
Pyuria (>5 WBC/HPF)	Present	49 (92.5)
	Absent	4 (7.5)
Hematuria (RBC >0/HPF)	Present	8 (15.1)
	Absent	45 (84.9)
Bacteriuria (microscopy)	Present	50 (94.3)
	Absent	3 (5.7)
Proteinuria (≥Trace)	Present	14 (26.4)

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	Absent	39 (73.6)
Urine pH	Acidic (<6.0)	40 (75.5)
	Neutral (6.0–7.0)	10 (18.9)
	Alkaline (>7.0)	3 (5.7)
Specific gravity	>1.020	38 (71.7)
	≤1.020	15 (28.3)
CRP	Normal (<10 mg/L)	8 (15.1)
	Elevated (10–50)	25 (47.2)
	High (>50)	20 (37.7)

Empirical antibiotic therapy in pediatric UTI cases predominantly included ceftriaxone (37.7%), followed by amikacin (24.5%), ciprofloxacin (15.1%), and nitrofurantoin (11.3%), with fewer cases receiving imipenem (7.5%). Treatment duration varied, with nearly half (45.3%) receiving antibiotics for 8–10 days, while 32.1% underwent longer courses (>10 days). Clinical improvement, measured by fever resolution, occurred within 4–5 days in 43.4%, though 37.7% took longer than 5 days. Overall, treatment was successful in 88.7% of cases, while 11.3% experienced treatment failure. A majority of patients (75.5%) required hospitalization, with most staying between 6–10 days (34.0%). Public healthcare facilities were the first point of contact for 56.6%, whereas 37.7% sought private care. Only 30.2% sought treatment within 24 hours, while nearly half delayed seeking care for 24–72 hours (47.2%). Most referrals were initiated by families (64.2%), followed by local physicians (28.3%). [Table V].

Table – V: Treatment and Clinical Outcomes (*n* = 53)

Variable	Category	Frequency (%)
Empiric antibiotic	Ceftriaxone	20 (37.7)
	Amikacin	13 (24.5)
	Ciprofloxacin	8 (15.1)
	Nitrofurantoin	6 (11.3)
	Imipenem	4 (7.5)
	Other	2 (3.8)
Treatment duration	≤7 days	12 (22.6)
	8–10 days	24 (45.3)
	>10 days	17 (32.1)
Defervescence time	≤3 days	10 (18.9)
	4–5 days	23 (43.4)
	>5 days	20 (37.7)
Treatment response	Success	47 (88.7)
	Failure	6 (11.3)
Hospitalization	Yes	40 (75.5)
	No	13 (24.5)
Hospital stay (days)	Not hospitalized	13 (24.5)
	1–5	15 (28.3)
	6–10	18 (34.0)
	>10	7 (13.2)
Facility type (first seen)	Government	30 (56.6)
	Private	20 (37.7)
	Clinic	3 (5.7)
Time to seek care	<24 hours	16 (30.2)
	24–72 hours	25 (47.2)
	>72 hours	12 (22.6)
Referral source	Self/family	34 (64.2)
	Local physician	15 (28.3)
	Other	4 (7.5)

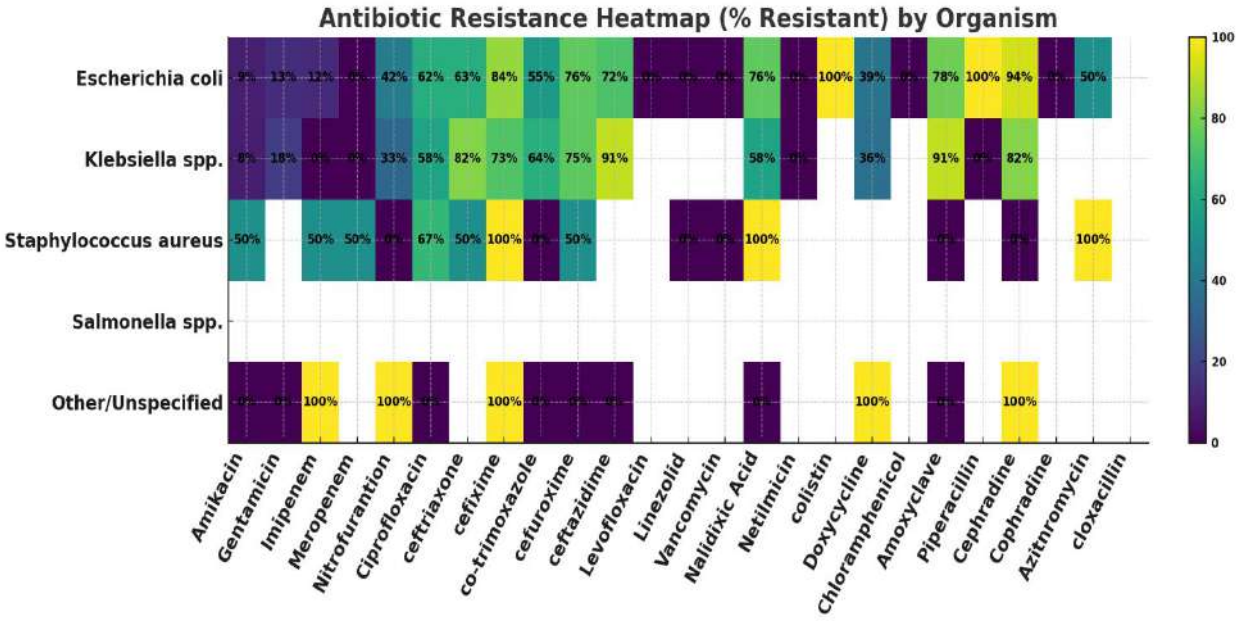

Figure – 1: Antibiotic Resistance Heatmap (% Resistant) by Organism in Pediatric UTI (*n* = 53)

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The antibiotic resistance heatmap reveals significant variability in resistance profiles across uropathogens isolated from pediatric UTI cases. Escherichia coli, the predominant organism, demonstrated marked resistance to ceftriaxone (68.6%), cefixime (71.4%), and ciprofloxacin (62.9%), while maintaining high susceptibility to amikacin (91.4%), imipenem (100%), and meropenem (100%), indicating preserved efficacy of aminoglycosides and carbapenems. Klebsiella spp. exhibited a more extensive resistance spectrum, with notably high resistance to cephalosporins (e.g., ceftriaxone: 80%), fluoroquinolones (60%), and partial resistance to nitrofurantoin and trimethoprim-sulfamethoxazole, underscoring its multidrug-resistant behavior. In contrast, Staphylococcus aureus isolates were 100% resistant to penicillin, but retained full susceptibility to vancomycin and linezolid, reaffirming the role of glycopeptides and oxazolidinones in treating gram-positive UTIs. Although data for Salmonella spp. were limited, it showed low resistance overall. The heatmap underscores a concerning trend of diminished oral antibiotic efficacy and supports the continued empirical use of amikacin and carbapenems for severe or resistant pediatric UTIs.

Multivariate logistic regression identified female sex, prior history of UTI, and elevated CRP levels (>50 mg/L) as significant predictors of multidrug resistance in pediatric UTI isolates. Female patients were 3.25 times more likely to have MDR infections compared to males (95% CI: 1.12–9.40, p = 0.028). Similarly, children with a previous UTI had nearly 3-fold increased odds of harboring MDR organisms (OR: 2.95, 95% CI: 1.05–8.22, p = 0.041). An elevated inflammatory response, marked by CRP >50 mg/L, was associated with a 3.8 times higher likelihood of MDR (95% CI: 1.32–10.9, p = 0.014), indicating systemic severity. Although Klebsiella spp. showed a higher odds of MDR compared to E. coli (OR: 2.45), this finding was not statistically significant (p = 0.094). Age, constipation, and organism type (for S. aureus and other species) did not emerge as significant predictors in this model. [Table VI].

Table – VI: Predictors of Multi-Drug Resistance (MDR) in Pediatric UTI (*n* = 53)

Variable	Category / Reference	OR (95% CI)	p-value
Organism	Escherichia coli (ref)	1.00	-
	Klebsiella spp.	2.45 (0.85–7.05)	0.094
	Staphylococcus aureus	1.95 (0.42–9.12)	0.392
	Other spp.	1.35 (0.25–7.40)	0.720
Age (years)	Continuous	1.02 (0.90–1.15)	0.745
Female sex	vs. Male	3.25 (1.12–9.40)	0.028
Previous UTI	Yes vs. No	2.95 (1.05–8.22)	0.041
Constipation	Yes vs. No	1.55 (0.48–4.97)	0.460
CRP >50 mg/L	Yes vs. ≤50	3.80 (1.32–10.9)	0.014

Antibiotic resistance varied significantly by organism for several commonly used agents. Ciprofloxacin resistance was notably high across all organisms, with 70.0% of Klebsiella spp., 60.0% of Staphylococcus aureus, and 57.1% of Escherichia coli isolates resistant (p = 0.041). Similarly, ceftriaxone resistance showed significant interspecies differences, with 80.0% of Klebsiella spp. and 65.7% of E. coli isolates resistant (p = 0.038). Resistance to cefixime also differed significantly across organisms (p = 0.046), ranging from 80.0% in Klebsiella spp. to 60.0% in E. coli. For nitrofurantoin, resistance was significantly more frequent among Klebsiella spp. (40.0%) compared to E. coli (22.9%) and S. aureus (20.0%), with no resistance observed in Salmonella spp. (p = 0.01). In contrast, amikacin retained strong activity across all species, with low and non-significant resistance variation (p = 0.312). [Table VII].

Table – VII: Antibiotic-Specific Resistance by Organism in Pediatric UTI (*n* = 53)

Antibiotic	Organism	Resistant n/N (%)	Overall p-value
Amikacin	Escherichia coli	3/35 (8.6)	0.312
	Klebsiella spp.	2/10 (20.0)	
	Staphylococcus aureus	0/5 (0.0)	
	Salmonella spp.	0/3 (0.0)	
Ciprofloxacin	Escherichia coli	20/35 (57.1)	0.041
	Klebsiella spp.	7/10 (70.0)	
	Staphylococcus aureus	3/5 (60.0)	
	Salmonella spp.	1/3 (33.3)	
Ceftriaxone	Escherichia coli	23/35 (65.7)	0.038
	Klebsiella spp.	8/10 (80.0)	
	Staphylococcus aureus	2/5 (40.0)	
	Salmonella spp.	2/3 (66.7)	
Cefixime	Escherichia coli	21/35 (60.0)	0.046
	Klebsiella spp.	8/10 (80.0)	

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	Staphylococcus aureus	2/5 (40.0)	
	Salmonella spp.	1/3 (33.3)	
Nitrofurantoin	Escherichia coli	8/35 (22.9)	0.01
	Klebsiella spp.	4/10 (40.0)	
	Staphylococcus aureus	1/5 (20.0)	
	Salmonella spp.	0/3 (0.0)	

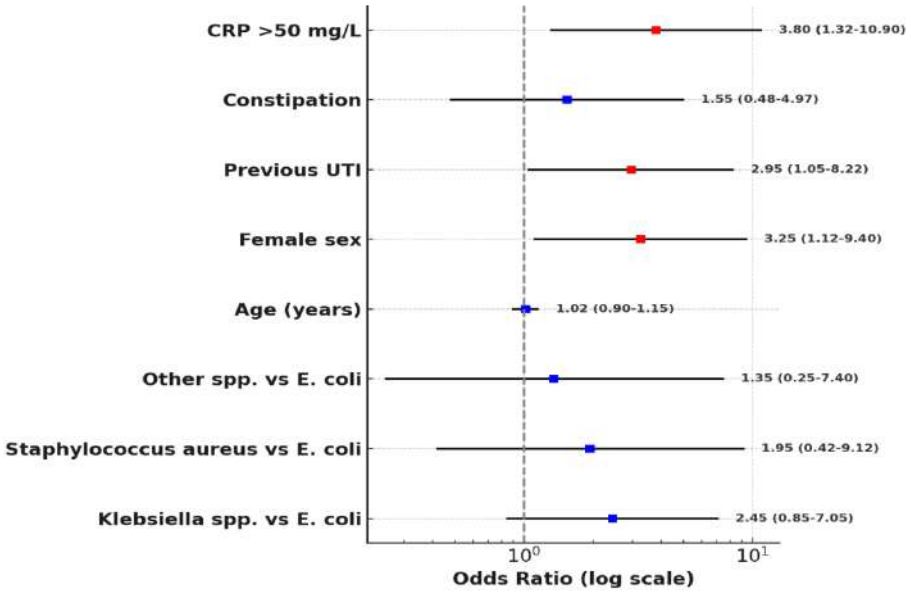

Figure – 2: Forest plot of predictors of multi-drug resistance in pediatric UTI

The forest plot illustrates the adjusted odds ratios (OR) for variables associated with multidrug-resistant (MDR) urinary tract infections in children. Female sex (OR: 3.25, 95% CI: 1.12–9.40), previous history of UTI (OR: 2.95, 95% CI: 1.05–8.22), and CRP >50 mg/L (OR: 3.80, 95% CI: 1.32–10.90) emerged as statistically significant predictors of MDR, each conferring approximately a threefold increased risk.

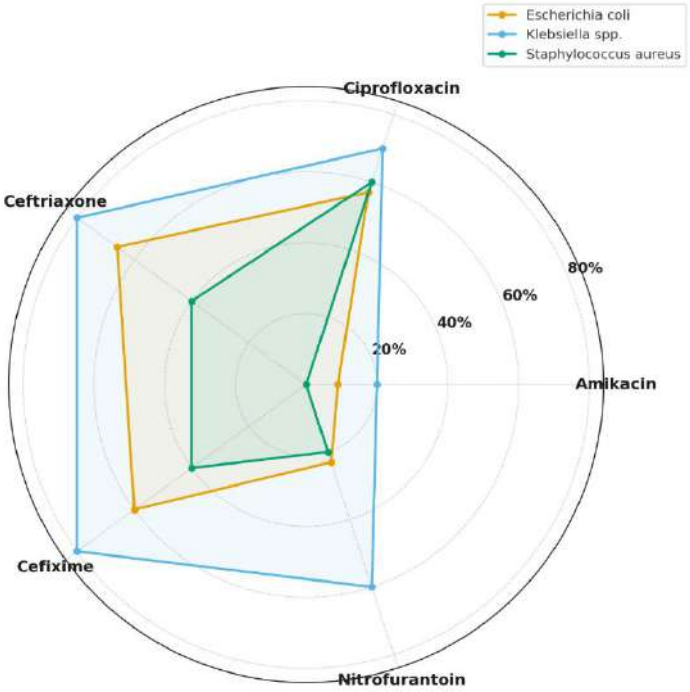

Figure – 3: Radar Chart of Resistance Profiles by Organism

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The radar chart illustrates the comparative resistance percentages of Escherichia coli, Klebsiella spp., and Staphylococcus aureus across five key antibiotics. Klebsiella spp. exhibited the broadest resistance, particularly against cephalosporins (ceftriaxone, cefixime) and ciprofloxacin, indicating a more multidrug-resistant phenotype. E. coli, while also showing notable resistance, retained greater susceptibility to nitrofurantoin and amikacin. In contrast, Staphylococcus aureus presented a distinct resistance profile, with limited resistance to these antibiotics but known penicillin resistance (not shown in this plot).

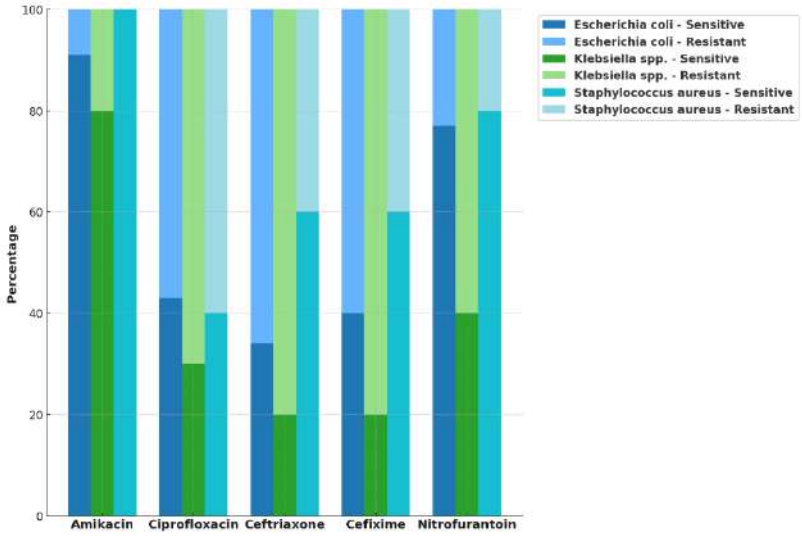

Figure – 4: Stacked Bar Chart of Antibiotic Susceptibility by Organism

The stacked bar chart delineates organism-specific antibiotic susceptibility patterns. Escherichia coli isolates demonstrated high susceptibility to amikacin and nitrofurantoin, but showed notable resistance to ceftriaxone and ciprofloxacin, consistent with broader multidrug resistance concerns. Klebsiella spp. exhibited the highest overall resistance rates, especially against cephalosporins and fluoroquinolones, reinforcing its association with MDR. Staphylococcus aureus remained largely sensitive to reserve antibiotics (e.g., linezolid, vancomycin), while Salmonella spp. isolates displayed minimal resistance across tested agents, although they were relatively infrequent.

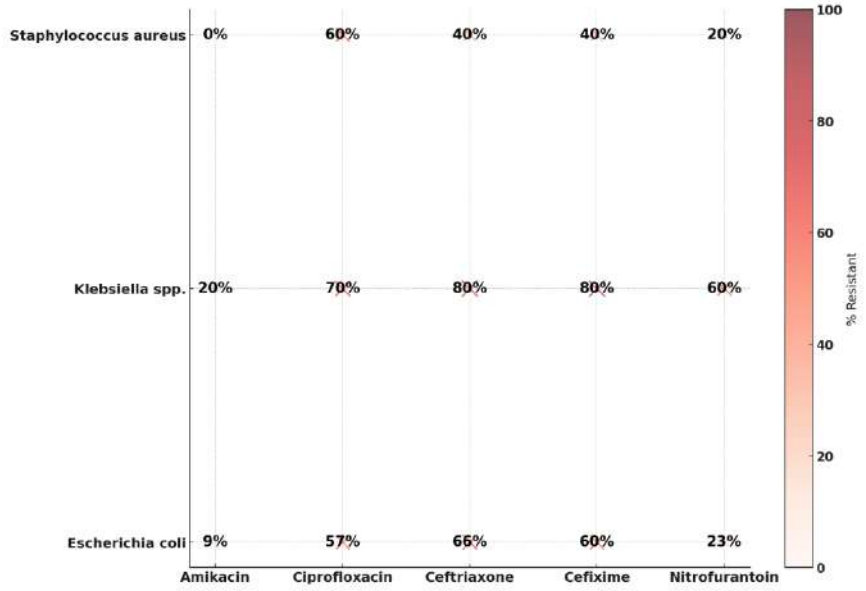

Figure – 5: Bubble Chart of Resistance Burden Across Organisms and Antibiotics

The bubble chart visually integrates both the prevalence and resistance intensity of uropathogens to commonly used antibiotics. Escherichia coli accounted for the largest and darkest bubbles at ciprofloxacin and ceftriaxone, reflecting its high frequency and substantial resistance to these agents. Klebsiella spp. demonstrated consistently dark, sizable

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bubbles across multiple drug classes, indicating a broad resistance profile consistent with multidrug resistance (MDR). In contrast, smaller, lighter-colored bubbles for nitrofurantoin across all organisms suggest a preserved spectrum of activity.

DISCUSSION

This study provides valuable insights into the clinical profile, organism distribution, and antimicrobial resistance patterns of urinary tract infections (UTIs) in pediatric patients from a Bangladeshi tertiary care setting. The findings emphasize both the microbiological and clinical challenges of managing pediatric UTI in a resource-limited context, while also reflecting broader regional and global patterns.

The demographic distribution of UTI patients in this study mirrors global epidemiology, where female children account for the majority of UTI cases due to anatomical susceptibility and periurethral colonization. In our cohort, 79.2% of patients were female and nearly half were aged between 2–4 years, aligning with similar distributions reported in Ugandan and Indian pediatric populations [24,25]. Fever and poor appetite were the most common presenting symptoms, which is consistent with the findings of Kebede et al., who also noted non-specific symptoms such as malaise and irritability as common in children under five [26]. Microbiologically, Escherichia coli was the predominant pathogen (66%), followed by Klebsiella spp. (18.9%), a pattern comparable to findings from Chowdhury et al. and Golli et al., who noted E. coli isolation rates of 60–75% in pediatric urine cultures [16,27]. Notably, Staphylococcus aureus and Salmonella spp. were also detected, albeit less frequently. Interestingly, our study identified multidrug resistance (MDR) in 34% of isolates, with the highest burden among E. coli (22.6%) and Klebsiella spp. (9.4%). This finding is slightly lower than the 40–50% MDR prevalence reported in African pediatric UTI studies, possibly reflecting local differences in antibiotic prescribing or sample size [24,26].

The observed antibiotic resistance trends are a critical concern. The study revealed alarming resistance to commonly used antibiotics, including ceftriaxone (66.0%), cefixime (71.7%), and ciprofloxacin (62.3%). These findings are in line with resistance patterns reported by Chowdhury et al., who documented rising fluoroquinolone and cephalosporin resistance in Bangladeshi pediatric UTIs [16]. Resistance to ciprofloxacin was particularly high among Klebsiella spp. (70%) and E. coli (62.9%), reflecting a concerning trend toward the erosion of oral treatment options. However, consistent with prior reports, the carbapenems (imipenem and meropenem) and amikacin retained high efficacy across organisms, suggesting their utility in severe or resistant cases [24,27].

Among laboratory markers, pyuria, bacteriuria, and acidic urine were frequently observed, supporting their role as classic indicators of UTI. Elevated CRP, particularly values >50 mg/L, was seen in 37.7% of patients and was statistically associated with MDR (OR 3.80; p = 0.014). This relationship between inflammation and resistance mirrors findings in Ethiopian studies, where elevated CRP was significantly linked with complicated or resistant infections [26]. However, urine pH and proteinuria showed no statistically significant link with MDR in our analysis.

Treatment practices revealed that ceftriaxone and amikacin were the most frequently prescribed empiric agents, reflecting prevailing empirical guidelines. While 88.7% of patients achieved clinical success, 11.3% failed initial therapy—most likely influenced by the high baseline resistance to third-generation cephalosporins. The average defervescence time extended beyond 3 days for over 80% of patients, and 75.5% required hospitalization, with nearly one-third admitted for more than 6 days. Comparable findings have been reported by George et al., who observed prolonged fever clearance and hospitalization linked to MDR organisms in Indian pediatric cohorts [25].

One of the most notable aspects of this study was the identification of predictors for MDR. Female sex (OR 3.25), prior UTI history (OR 2.95), and CRP >50 mg/L (OR 3.80) were all statistically significant predictors. These findings echo those of Isac et al., who identified female sex and recurrent UTI as risk factors for resistance in children with congenital anomalies of the kidney and urinary tract [28]. The lack of significance for age, constipation, or pathogen type in predicting MDR suggests that host and inflammatory factors may play a more substantial role than organism-specific traits alone.

Lastly, the comparative organism-specific resistance profiles (as shown in statistical tests and visual charts) further highlighted the distinct burden posed by Klebsiella spp., which showed significantly higher resistance to ceftriaxone, cefixime, and ciprofloxacin. While these findings were consistent with studies from both Bangladesh and other LMICs, the preservation of nitrofurantoin and amikacin sensitivity across pathogens offers a therapeutic window for tailored empiric therapy [16].

Overall, our findings contribute to the growing evidence base on pediatric UTI management in low- and middle-income countries, emphasizing the need for local antibiogram data to guide empirical therapy, monitor resistance, and improve clinical outcomes. Future studies with larger sample sizes and multicenter data are warranted to validate these findings and inform national UTI treatment guidelines.

Limitations of The Study

The study was conducted in a single hospital with a small sample size. So, the results may not represent the whole community.

CONCLUSION

This study highlights the predominance of Escherichia coli and Klebsiella spp. as key uropathogens among pediatric UTI cases, with a significant burden of multidrug resistance, particularly against cephalosporins and fluoroquinolones. Carbapenems and aminoglycosides remained the most effective therapeutic options, underscoring their continued clinical relevance. The study identified female sex, previous history of UTI, and elevated CRP levels as significant predictors of MDR, emphasizing the need for early risk stratification. High rates of resistance to commonly used

empiric agents, coupled with moderate rates of treatment failure and prolonged hospitalization, suggest a pressing need to revise local treatment guidelines, implement targeted antibiotic stewardship, and promote routine culture sensitivity testing. Strengthening infection prevention strategies and timely diagnostic evaluation are critical in mitigating the rising threat of MDR in pediatric UTI.

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ORIGINAL ARTICLE

Prevalence of Significant MRI Abnormalities among Patients with Chronic Headache

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ABSTRACT

Introduction: *Chronic headache is a common neurological complaint often requiring MRI to exclude secondary causes. While most are primary headaches, some may reveal significant intracranial abnormalities. The prevalence of such MRI findings varies, with limited data from Bangladesh.* ***Methods & Materials:*** *This cross-sectional study at Bangladesh Medical University enrolled 51 chronic headache patients (ICHD-3 criteria). All underwent clinical evaluation and brain MRI, with contrast when needed. Two radiologists independently reviewed scans, classifying findings as significant or incidental. Data were analyzed with p<0.05 as significant.* ***Results:*** *The mean age of participants was 36.5 ± 15.1 years (range 8–65), with females representing 58.8%. Headaches were most commonly bilateral (76.5%) and dull in nature (72.5%). Associated symptoms included nausea, vomiting, or photophobia in 58.8% of cases. Hypertension (37.3%) and diabetes mellitus (39.2%) were the most common comorbidities. MRI revealed abnormalities in 86.3% of patients, while 13.7% had normal scans. The most frequent abnormalities were sinus disease/sinusitis (33.3%), hypertrophy of inferior turbinates (23.5%), white matter lesions (11.8%), infarcts (9.8%), and tumors (9.8%). ICD-based diagnoses showed deep white matter ischemic disease in 86.3% of patients. No statistically significant association was found between abnormalities and age (p=0.28) or sex (p=0.40).* ***Conclusion:*** *A high proportion of chronic headache patients in this study demonstrated significant MRI abnormalities, particularly sinus pathology and ischemic changes. These findings emphasize the importance of selective imaging based on clinical features to optimize resource use in resource-limited settings.*

Keywords: *Chronic-Headache, MRI, Neuroimaging, Ischemic-changes, Bangladesh*

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INTRODUCTION

Headaches are among the most common neurological issues seen in clinical settings and are a leading cause of disorders worldwide [1]. Most individuals experience headaches at some point, but for some, the pain persists and greatly impacts daily life. When headaches occur frequently or last for long periods, they are classified as chronic headaches. According to the International Classification of Headache Disorders, 3rd Edition (ICHD-3), these are defined as lasting at least 3 months, occurring more than 15 days per month [2]. Chronic headaches not only diminish quality of life but also impose a significant socioeconomic impact through increased absenteeism, reduced productivity, and higher healthcare costs [3]. Most chronic headaches are primary, occurring without underlying structural or systemic disease. Migraines and tension-type headaches account for the majority of primary chronic headaches [4]. However, a small but clinically significant portion may be secondary to intracranial lesions like tumors, vascular malformations, demyelination, or infections. In such cases, early identification of the underlying cause is crucial, as prompt intervention can be lifesaving or prevent irreversible damage [5]. Magnetic resonance imaging

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(MRI) is instrumental in evaluating headache patients, offering superior soft tissue contrast compared to computed tomography (CT) and enabling the detection of subtle abnormalities such as demyelinating lesions, small tumors, and vascular issues [6]. Nonetheless, routine MRI for all chronic headache cases remains controversial. International guidelines advise a selective approach, recommending neuroimaging in patients with "red flag" features like sudden onset, worsening symptoms, neurological deficits, and new headaches in older adults [7,8]. Most patients with chronic headaches show normal scans or incidental findings with no clinical relevance. Various studies report different rates of abnormal MRI findings in these patients; some suggest up to 25% may have abnormalities, but only a tiny fraction is directly related to the headache itself [9,10]. Many incidental findings, such as benign cysts or sinus issues, can cause patient anxiety and potentially lead to unnecessary tests and treatments [11]. In clinical practice, balancing the risk of missing serious abnormalities against the costs and implications of unnecessary imaging, a dilemma particularly relevant in resource-limited healthcare systems, where research costs are a concern. In countries like Bangladesh and other developing regions, where medical resources are scarce and economic factors are significant, the decision to perform an MRI must be made with caution. Despite increased MRI availability, data on the prevalence of clinically significant abnormalities in patients with chronic headaches in our environment are lacking. Local evidence is vital for clinicians to make informed, cost-effective decisions based on real prevalence. Hence, this study aimed to assess the prevalence of significant MRI abnormalities among patients presenting with chronic headaches.

METHODS & MATERIALS

This study was a cross-sectional observational study conducted in the Department of Neurology and Radiology at Bangladesh Medical University, Dhaka, Bangladesh, between May and July 2025. Patients presenting with chronic headache, as defined by the International Classification of Headache Disorders, 3rd edition (ICHD-3), were enrolled consecutively. All participants underwent a detailed clinical evaluation, including a comprehensive history, neurological examination, and assessment for “red flag” symptoms. Brain MRI was performed using a [1.5 Tesla/3 Tesla] scanner. Standard imaging sequences included T1-weighted, T2-weighted, FLAIR, and diffusion-weighted imaging (DWI). Contrast-enhanced studies were performed when clinically indicated. MRI findings were independently reviewed by two consultant radiologists blinded to patient clinical details apart from the chronic headache indication. Findings were categorized as clinically significant (e.g., space-occupying lesions, vascular lesions, demyelinating lesions, infections, ischemic infarcts) or non-significant/incidental (e.g., benign cysts, age-related changes, sinus disease). Demographic data, headache characteristics, and MRI findings were recorded in a structured case record form. Data were analyzed using SPSS version 25. Descriptive statistics were applied to calculate frequencies, percentages, means, and standard deviations. The prevalence of significant MRI abnormalities was expressed as a percentage of the total study population. Associations between clinical variables and MRI abnormalities were evaluated using the chi-square test or Fisher’s exact test where appropriate. A p-value <0.05 was considered statistically significant. Ethical clearance was obtained from the Institutional Review Board (IRB) of Bangladesh Medical University. Written informed consent was taken from all patients before participation.

Inclusion criteria:

- Patients aged ≥8 years presenting with chronic headache, defined as headache occurring on ≥15 days per month for at least 3 consecutive months.
- Patients willing and able to undergo a brain MRI.
- Patients who provided written informed consent (or assent with guardian consent for minors).

Exclusion criteria:

- Patients with acute headache syndromes (e.g., thunderclap headache, trauma-related headache).
- Patients with known prior intracranial pathology (e.g., previously diagnosed tumor, stroke, demyelinating disease).
- Patients with contraindications to MRI (e.g., metallic implants, pacemakers, severe claustrophobia).
-

RESULTS

The study included 51 patients with a mean age of 36.5 ± 15.1 years (range: 8–65 years). The largest proportion of patients belonged to the 20–39 years age group (39.2%), followed by 40–59 years (31.4%). The lowest representation was in the 0–19 years group (13.7%). Females constituted the majority (58.8%) compared to males (41.2%). In terms of education, most patients had completed secondary education (45.1%), while only 2% reported other forms of education. Occupationally, office workers (29.4%), homemakers (25.5%), and students (25.5%) formed the major groups, whereas manual laborers and unemployed patients were the least represented (9.8% each). [Table I].

Table – I: Sociodemographic Characteristics of Patients (*n* = 51)

Variable	Categories	n	%
Age (years)	Mean ± SD = 36.5 ± 15.1 (Range: 8–65)	–	–
Age group	0–19	7	13.7
	20–39	20	39.2
	40–59	16	31.4

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	≥60	8	15.7
Sex	Female	30	58.8
	Male	21	41.2
Education	None	8	15.7
	Primary	17	33.3
	Secondary	23	45.1
	Higher Secondary	2	3.9
	Other/Nope	1	2.0
Occupation	Homemaker	13	25.5
	Manual labor	5	9.8
	Office job	15	29.4
	Student	13	25.5
	Unemployed	5	9.8

The mean duration of headache was 6.9 ± 2.7 months (range: 2–18). Most patients experienced headaches 4–5 times per month (39.2%), while the least common frequency was 2–3 times per month (9.8%). Regarding headache duration, 37.3% reported persistence for ≥4 hours, compared to only 3.9% lasting 1–2 hours. Bilateral headache was predominant (76.5%), and dull in nature (72.5%), whereas throbbing pain was least reported (3.9%). Associated symptoms were frequent, with nausea, vomiting, and photophobia present in 58.8% of patients, while aura was the least common (7.8%). Visual aura was reported in 41.2%. Hypertension (37.3%) and diabetes mellitus (39.2%) were the most common comorbidities, whereas psychiatric illness was the lowest (3.9%). Among lifestyle factors, 64.7% had never smoked, 33.3% were current smokers, and only 2% were past smokers. Occasional alcohol use was noted in 15.7%. [Table II].

Table – II: Clinical Characteristics, Associated Symptoms, and Risk Factors (*n* = 51)

Variable	Categories	n	%
Headache duration (months)	Mean ± SD = 6.9 ± 2.7 (Range: 2–18)	–	–
Headache frequency (per month)	2–3 times	5	9.8
	3–4 times	15	29.4
	4–5 times	20	39.2
	≥6 times	11	21.6
Headache duration (hours)	1–2 h	2	3.9
	2–3 h	15	29.4
	3–4 h	15	29.4
	≥4 h	19	37.3
Laterality	Bilateral	39	76.5
	Unilateral	12	23.5
Headache nature	Dull	37	72.5
	Sharp	11	21.6
	Throbbing	2	3.9
	Other	1	2.0
Associated symptoms	Nausea/Vomiting/Photophobia	30	58.8
	Vomiting & nausea	16	31.4
	Aura	4	7.8
	Others	1	2.0
Visual aura	Yes	21	41.2
	No	30	58.8
Comorbidities	Hypertension	19	37.3
	Diabetes mellitus	20	39.2
	Dyslipidemia	15	29.4
	Psychiatric illness	2	3.9
Lifestyle factors	Smoking (current)	17	33.3
	Smoking (past)	1	2.0
	Never smoked	33	64.7
	Alcohol use (occasional)	8	15.7
	Alcohol use (never)	42	82.4

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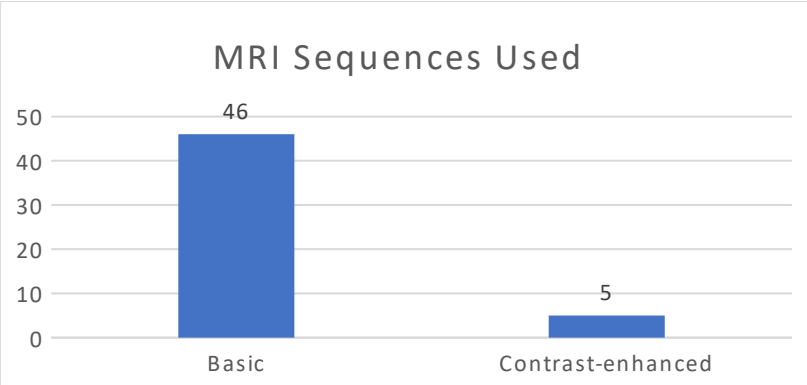

Figure – 1: MRI Sequences Used (*n* = 51)

Figure 1 shows that the majority of patients underwent standard non-contrast MRI sequences (90.2%), while contrast-enhanced studies were performed in only 9.8% of cases.

MRI detected abnormalities in 86.3% of cases, with only 13.7% showing normal findings. [Table III].

Table – III: Prevalence of MRI Abnormalities (*n* = 51)

MRI finding	n	%
Any abnormality detected	44	86.3
Normal MRI	7	13.7
Significant abnormality present	44	86.3
No significant abnormality	7	13.7

The most frequent abnormalities were sinus disease/sinusitis (33.3%) and hypertrophy of inferior turbinates (23.5%). Other findings included ischemic changes, infarcts, and intracranial tumors. [Table IV].

Table – IV: Distribution of Types of MRI Abnorsssmalities (*n* = 51)

Abnormality Type	n	%
Sinus disease / Sinusitis	17	33.3
Hypertrophy of inferior turbinates (HIT)	12	23.5
White matter lesions / ischemic changes	6	11.8
Infarcts / stroke-related changes	5	9.8
Tumors/masses (glioma, meningioma, astrocytoma, etc.)	5	9.8
Empty sella / microvascular changes	2	3.9
Hydrocephalus (non-obstructive)	1	2.0
Others (polyps, DNS, cysts, GCA, encephalomalacia)	4	7.8

According to ICD-based final diagnoses, deep white matter ischemic disease was the most common (86.3%), while only two patients (3.9%) had no abnormality. Other diagnoses included maxillary sinusitis (5.9%) and hypertrophy of inferior turbinates (2.0%). [Table V].

Table – V: Final Diagnosis Based on ICD (*n* = 51)

Final Diagnosis	n	%
Deep white matter ischemic disease	44	86.3
Hypertrophy of inferior turbinates (HIT)	1	2.0
Right maxillary sinusitis	3	5.9
Normal	2	3.9
Other specified	1	2.0

Analysis of associations showed that significant MRI abnormalities were more frequent in the 40–59 years group (93.8%) compared to the lowest in the 60–65 years group (71.4%). In sex distribution, 90.0% of females and 81.0% of males had significant abnormalities. However, the associations between age group (p = 0.28) and sex (p = 0.40) with MRI abnormalities were not statistically significant. [Table VI].

Table – VI: Association between Age & Sex Group and Significant MRI Abnormalities (*n* = 51)

Variable	Significant Abnormality n (%)	Not Present n (%)	P value
Age Group			
0–19	6 (85.7)	1 (14.3)	0.28
20–39	18 (90.0)	2 (10.0)	
40–59	15 (93.8)	1 (6.2)	
60–65	5 (71.4)	2 (28.6)	
Sex			
Female	27 (90.0)	3 (10.0)	0.40
Male	17 (81.0)	4 (19.0)	

*Chi-square/Fisher's exact test (not significant)

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DISCUSSION

In the present study, significant abnormalities on magnetic resonance imaging (MRI) were detected in 86.3% of patients presenting with chronic headache, while only 13.7% had normal scans. The most frequent abnormalities were sinus disease or sinusitis (33.3%) and hypertrophy of inferior turbinates (23.5%). Other important findings included white matter lesions or ischemic changes (11.8%), infarcts (9.8%), tumors such as glioma, meningioma, and astrocytoma (9.8%), empty sella or microvascular changes (3.9%), hydrocephalus (2.0%), and a small proportion of miscellaneous lesions (7.8%). ICD-based diagnosis revealed that deep white matter ischemic disease was the most common entity (86.3%). Abnormalities were slightly more frequent among females (90.0%) than males (81.0%), and highest in the 40–59 years group (93.8%), although neither age nor sex differences reached statistical significance. The overall prevalence of MRI abnormalities in this study is much higher than that reported in the majority of international literature. A meta-analysis by Tsushima and Endo (2005) reviewing neuroimaging in primary headache found clinically significant abnormalities in only 0.18–2% of patients with migraine, and about 8.86% across all headache types [12]. A Alturkustani et al. (2020) studied 157 patients with chronic migraine in Saudi Arabia and found incidental abnormalities in 57%, but clinically significant lesions in only 8.3% [13]. Legesse et al. (2022) in Ethiopia found MRI abnormalities in 49.2% of headache patients, yet only 21% were clinically significant [14]. Compared with these results, the 86.3% rate in our cohort is extraordinarily high, suggesting that either the study population represented a higher-risk subgroup, or that diagnostic thresholds and classification of abnormalities differed. Sinus disease and inferior turbinate hypertrophy accounted for more than half of the abnormalities in our series. Incidental paranasal sinus findings are well-known in MRI studies of the brain. Ikeda et al. (1996) in a Japanese study reported sinus abnormalities in 47.1% of patients undergoing MRI. Bolger et al. (1991) found incidental sinus disease in 42% of head CT scans. In contrast, studies focusing specifically on headache patients report lower rates. Adekanmbi et al. (2019) in Nigeria observed sinusitis in only 21% of patients presenting with persistent headache. Oguz et al. (2018) reported paranasal abnormalities in 19% of pediatric patients with headache. Compared with these findings, the 33.3% rate of sinusitis and 23.5% turbinate hypertrophy in the present study are relatively high, possibly reflecting environmental factors, higher prevalence of chronic rhinosinusitis in our population, or more detailed reporting of sinonasal variants by radiologists. White matter hyperintensities (WMHs) and ischemic changes were observed in 11.8% of our patients, although ICD-based categorization as “deep white matter ischemic disease” reached 86.3%. This discrepancy highlights possible differences in terminology. The prevalence of WMHs in headache patients varies widely. Zhang et al. (2023) in the Cerebral Abnormalities in Migraine study found WMHs in 44% of migraine patients compared to 12% of controls, with higher rates in migraine with aura [15]. A study by Lee et al. (2019) also confirmed increased prevalence of WMHs in migraineurs, particularly women under 50 [16]. Our raw prevalence of 11.8% is comparable to the lower range of these studies, but the assignment of ischemic disease to 86.3% of patients is far higher than most reports, suggesting that comorbid vascular risk factors such as hypertension (37.3%), diabetes mellitus (39.2%), and smoking (33.3%) in our sample may have influenced radiological interpretation. Tumors and masses were identified in 9.8% of cases, a proportion much higher than generally reported. Tsushima and Endo (2005) similarly concluded that tumors are rare incidental findings in chronic headache populations [12]. A Alturkustani et al. (2020) reported significant abnormalities, including tumors, in only 8.3% [13]. The rate of 9.8% tumors in our cohort suggests either a strong referral bias, with MRI being requested primarily in high-risk or atypical patients, or potentially a genuinely higher background prevalence of neoplastic disease. Stroke-related changes and infarcts were observed in 9.8% of patients in our study. Previous studies have linked migraine, especially with aura, to increased risk of ischemic stroke. Ravi et al. (2024) in a large prospective cohort demonstrated a two-fold increased risk of ischemic stroke among women with migraine with aura [17]. In imaging studies, however, the proportion of overt infarcts in headache patients is generally lower. Kruit et al. (2005) found silent infarcts in 8% of migraine patients compared to 0.7% of controls, a finding broadly similar to our prevalence of 9.8% [18]. This suggests that our study population may indeed carry a higher vascular risk, consistent with their comorbidity profile. Empty sella and microvascular changes were detected in 3.9% of our patients. Giampietro (2025) reported empty sella as an incidental finding in 20% of neuroimaging studies, often clinically silent [19]. The low prevalence in our study is therefore within the expected range. Hydrocephalus was noted in 2.0% of patients, which is slightly higher than in large cohorts such as Tsushima and Endo (2005), who found hydrocephalus in less than 1% of headache patients [12]. The influence of age and sex was not statistically significant in our cohort, although abnormalities were slightly more common among females and peaked in the 40–59 years group. Previous studies have shown variable associations. Kruit et al. (2005) reported that women with migraine had higher prevalence of WMHs compared to men [18]. Our lack of significant associations may be explained by the uniformly high prevalence of abnormalities across all subgroups, which could mask any demographic trends.

Limitations of the Study

The study was limited by its small sample size and single-center design.

CONCLUSION

This study found a remarkably high prevalence of significant MRI abnormalities among patients with chronic headache, with sinus pathology and ischemic changes being the most frequent findings. Although the prevalence exceeded that reported in international studies, comorbid vascular risk factors and possible referral bias may explain the difference.

Careful patient selection for MRI is essential to optimize resource use while avoiding missed diagnoses.

RECOMMENDATION

Larger multicenter studies are needed to confirm these findings and to better define the true prevalence of clinically significant MRI abnormalities in chronic headache patients in Bangladesh. Development of local clinical guidelines incorporating red flag features, vascular risk factors, and cost considerations would help clinicians make evidence-based imaging decisions. In parallel, preventive strategies to reduce vascular risk factors may lower the burden of ischemic brain changes that contribute to chronic headache presentations.

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ORIGINAL ARTICLE

Study on Ectopic Pregnancy — Presentation and Management

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ABSTRACT

Introduction: *Ectopic pregnancy (EP), the implantation of a fertilized ovum outside the uterine cavity, is a significant contributor to early pregnancy-related morbidity and mortality, particularly in low-resource settings like Bangladesh. Delayed diagnosis and restricted healthcare access contribute to poor outcomes, with tubal pregnancies being the most common.* ***Methods and materials:*** *This one-year cross-sectional study (January–December 2024) at Enam Medical College and Hospital, Dhaka, enrolled 80 ectopic pregnancy patients. Data on demographics, risk factors, clinical features, diagnostics, management, complications, and outcomes were collected. Ethical approval was obtained, and informed consent was secured from all participants.* ***Results:*** *The mean age of participants was 28.06 ± 4.70 years, with most being married (98.8%) and urban residents (97.5%). Risk factors included infertility (31.3%), abortion (15.0%), and PID (5.0%). Common symptoms were vaginal bleeding (97.5%) and abdominal pain (93.8%). USG showed an empty uterus and adnexal mass in 87.5% each, and free fluid in 68.8%. Most ectopic pregnancies were tubal (88.8%), mainly in the right tube (62.5%). Surgery was the primary treatment (83.7%), with laparotomy (62.5%) and salpingectomy (73.8%) most common, while methotrexate was used in 16.3%. Complications included ICU admission (11.3%) and one death (1.3%). Treatment type was significantly associated with outcomes ($p < 0.001$).* ***Conclusion:*** *Ectopic pregnancy remains a critical emergency in Bangladesh, with late presentations leading to higher surgical rates. Early diagnosis and access to conservative treatment options can reduce morbidity. A focus on improving diagnostic infrastructure and patient awareness is essential to improve outcomes.*

Keywords: *Ectopic-Pregnancy, Methotrexate, Salpingectomy, Ultrasonography, Bangladesh*

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INTRODUCTION

Ectopic pregnancy, defined as the implantation of a fertilized ovum outside the uterine cavity, remains a significant cause of maternal morbidity and mortality worldwide [1]. While the global incidence of ectopic pregnancy ranges from 1% to 2% of all reported pregnancies, the burden is disproportionately higher in low- and middle-income countries due to delayed diagnosis and limited access to timely healthcare services [2]. The condition, if not detected and managed promptly, can lead to life-threatening complications such as tubal rupture and internal hemorrhage [2]. Globally, ectopic pregnancy accounts for approximately 5%–10% of all pregnancy-related deaths in the first trimester [3]. In developing countries across Asia, including Bangladesh, the condition contributes notably to maternal mortality. In Bangladesh specifically, maternal health indicators have improved in recent years, but ectopic pregnancy continues to present as a critical emergency, especially in rural areas where healthcare resources are scarce [4]. A study from Dhaka Medical College Hospital reported that ectopic pregnancies constituted about 0.6% of all admissions in the obstetrics and gynecology department, with a high proportion of patients presenting late with ruptured tubes [5]. These patterns reflect diagnostic delays and the lack of awareness among patients and primary care providers. In South Asia, cultural and socioeconomic factors often compound the risk. For example, early marriage, high fertility rates, and unsafe abortion practices contribute to repeated pelvic infections and tubal damage, thereby increasing the risk of ectopic implantation [6]. In India, the incidence of ectopic pregnancy ranges between 1 in 112 to 1 in 130 pregnancies, with similar contributing factors observed [7]. Meanwhile, studies from Nepal and Pakistan also report increasing trends in ectopic pregnancies, particularly in urban tertiary centers where diagnostic tools such as transvaginal

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ultrasonography and β-hCG assays are more readily available [8]. The most common site for ectopic implantation is the fallopian tube, particularly the ampullary region [9]. Other less frequent but more dangerous locations include cervical, interstitial, ovarian, abdominal, and cesarean scar ectopic pregnancies. While the classical triad of symptoms—amenorrhea, vaginal bleeding, and lower abdominal pain—is well known, its presence is variable, often leading to diagnostic uncertainty [9]. The condition may be mistaken for threatened abortion, ruptured ovarian cysts, or pelvic inflammatory disease, particularly in settings where imaging support is limited [10]. The introduction of high-resolution ultrasonography and serial serum β-hCG testing has revolutionized the early diagnosis of ectopic pregnancy in high-income countries [11]. However, in regions like Bangladesh, access to such diagnostic tools remains inconsistent. As a result, many patients are diagnosed only after rupture, necessitating emergency surgery and increasing the risk of adverse outcomes [11]. In terms of management, methotrexate-based medical therapy is widely used in early, unruptured ectopic pregnancies in developed settings. However, surgical management—especially salpingectomy via laparotomy—remains the dominant approach in Bangladesh due to late presentation and the lack of facilities for conservative surgery or laparoscopy in many hospitals [12]. This study aimed to explore the clinical presentation and management strategies of ectopic pregnancy in a tertiary care setting in Bangladesh.

METHODS & MATERIALS

This descriptive cross-sectional study was conducted at the Department of Obstetrics and Gynecology, Enam Medical College and Hospital, Savar, Dhaka. The study duration was one year, from January 1 to December 31, 2024. A total of 80 female patients who were diagnosed clinically and radiologically with ectopic pregnancy and admitted during the study period were included. This study received ethical clearance from the institutional review board of Enam Medical College. Informed consent was obtained from all participants. Patients with uncertain diagnoses or incomplete records were excluded. Detailed data were collected using a structured case record form. Diagnostic evaluation involved transabdominal and, where available, transvaginal ultrasonography, along with serum β-hCG quantification. Additional parameters such as vital signs and laboratory investigations were noted on admission. Management approaches were categorized as medical or surgical. Patients suitable for medical treatment were administered methotrexate following standard protocol. Data on the duration of hospital stay were recorded. Treatment outcome was evaluated about the mode of management. Statistical analysis was performed using SPSS. The chi-square test was applied to determine associations between variables, and a p-value < 0.05 was considered statistically significant.

Inclusion criteria:

- Women with clinically and radiologically confirmed ectopic pregnancy
- All gestational ages
- All hemodynamic statuses

Exclusion criteria:

- Unconfirmed or suspected cases
- Incomplete clinical data
- Patients unwilling to participate

RESULTS

Among the recognized risk factors, a history of infertility was the most common, reported by 31.3% of patients. Other notable risk factors included a history of abortion (15.0%), pelvic inflammatory disease (5.0%), and previous ectopic pregnancy (2.5%). A history of tubal surgery was reported in 6.3% of cases. [Table I].

Table – I: Distribution of Sociodemographic Characteristics (*n* = 80)

Variable	Category	Frequency (n)	Percentage (%)
Age (years)	Mean ± SD	28.06 ± 4.70	
Marital Status	Married	79	98.8
	Unmarried	1	1.2
Residence	Urban	78	97.5
	Rural	2	2.5
Education	No formal education	15	18.8
	Primary	3	3.8
	Secondary	30	37.5
	Higher	32	40.0
Occupation	Housewife	60	75.0
	Student/Service/Others	20	25.0

The most frequently reported symptom was vaginal bleeding (97.5%), followed closely by abdominal pain (93.8%). Shoulder tip pain and syncope/collapse were reported by 36.3% and 18.8%, respectively. [Table II].

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Table – II: Distribution of Obstetric and Risk Factor History (*n* = 80)

Risk Factor	Frequency (n)	Percentage (%)
Previous ectopic pregnancy	2	2.5
History of pelvic inflammatory disease (PID)	4	5.0
History of infertility	25	31.3
History of abortion	12	15.0
History of tubal surgery	5	6.3

The most frequently reported symptom was vaginal bleeding (97.5%), followed closely by abdominal pain (93.8%). Shoulder tip pain and syncope/collapse were reported by 36.3% and 18.8%, respectively. [Table III].

Table – III: Distribution of Clinical Presentations (*n* = 80)

Symptom	Frequency (n)	Percentage (%)
Vaginal bleeding	78	97.5
Abdominal pain	75	93.8
Shoulder tip pain	29	36.3
Syncope/collapse	15	18.8

On ultrasonography (USG), an empty uterus and adnexal mass were each observed in 87.5% of cases. Free fluid in the pouch of Douglas was present in 68.8%. Regarding the anatomical site, 88.8% of ectopic pregnancies were tubal, with the right tube being more commonly affected (62.5%) than the left (37.5%). Non-tubal ectopic pregnancies (scar, cervical, cornual) accounted for 11.2% of the cases. [Table IV].

Table – IV: Distribution of Physical and Diagnostic Findings (*n* = 80)

Finding	Frequency (n)	Percentage (%)
Empty uterus on USG	70	87.5
Adnexal mass	70	87.5
Free fluid in pouch of Douglas	55	68.8
Anatomical Site of EP		
• Tubal	71	88.8
• Non-tubal (scar, cervical, cornual)	9	11.2
Side of Tubal EP		
• Right	50	62.5
• Left	30	37.5

The mean pulse rate was 90.00 ± 7.94 bpm, with a range of 78–110 bpm. The mean systolic blood pressure was 100.14 ± 9.79 mmHg, while the diastolic pressure averaged 69.45 ± 9.41 mmHg. The mean serum β-hCG level was notably variable, with a mean of 10,107 ± 12,650 mIU/mL and a wide range from 1,300 to 50,000 mIU/mL. The average duration of amenorrhea was 6.28 ± 1.26 weeks, and the mean hospital stay was 4.30 ± 1.68 days. [Table V].

Table – V: Distribution of Clinical Parameters (Descriptive Statistics, *n* = 80)

Parameter	Mean ± SD	Range
Pulse (bpm)	90.00 ± 7.94	78–110
BP Systolic (mmHg)	100.14 ± 9.79	70–110
BP Diastolic (mmHg)	69.45 ± 9.41	40–80
Serum β-hCG (mIU/mL)	10,107 ± 12,650	1300–50000
Temperature (°C)	98.05 ± 0.45	96–99
Duration of amenorrhea (weeks)	6.28 ± 1.26	1–8
Hospital stays (days)	4.30 ± 1.68	2–10

Surgical management was the predominant approach (83.7%), whereas medical management using methotrexate was applied in 16.3% of cases. Among surgical interventions, salpingectomy was the most common procedure (73.8%). Regarding surgical routes, laparotomy was used in 62.5% of cases, while laparoscopy or vaginal approaches were used in 37.5%. [Table VI].

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Table – VI: Distribution of Management Approach and Surgical Interventions (*n* = 80)

Variable	Category	Frequency (n)	Percentage (%)
Type of management	Medical	13	16.3
	Surgical	67	83.7
Medical drug used	Methotrexate	13	16.3
Type of surgery	Salpingectomy	59	73.8
	Dilation and Curettage(D&C) and other	21	26.2
Route of surgery	Laparotomy	50	62.5
	Others (laparoscopy, vaginal)	30	37.5

According to this table, 80.0% of patients experienced no complications. However, ICU admission was required in 11.3%, hemorrhage occurred in 1.3%, and mortality was noted in 1.3%. Additionally, 6.3% of patients initially managed medically were later converted to laparotomy due to treatment failure. [Table VII].

Table – VII: Distribution of Complications during Management (*n* = 80)

Complication	Frequency (n)	Percentage (%)
Medical failure → Laparotomy	5	6.3
Hemorrhage	1	1.3
ICU admission	9	11.3
Mortality	1	1.3
No complications	64	80.0

A statistically significant association was found between the type of management and treatment outcomes ($p < 0.001$). Among the medically managed group, 2 patients (2.5%) required conversion to surgery, compared to 12 patients (15.0%) in the surgical group. Treatment success was observed in 11 (13.8%) of the medical group and 53 (66.3%) of the surgical group. No mortality occurred in the medical group, whereas 2 deaths (2.5%) occurred in the surgical group. [Table VIII].

Table – VIII: Association between Type of Management and Treatment Outcome in Ectopic Pregnancy (*n* = 80)

Outcome	Medical (n, %)	Surgical (n, %)	P value
Converted to Surgery	2 (2.5%)	12 (15.0%)	< 0.001
Mortality	0 (0.0%)	2 (2.5%)	
Treatment Successful	11 (13.8%)	53 (66.3%)	
Total	13 (16.3%)	67 (83.7%)	

DISCUSSION

Ectopic pregnancy continues to be a significant cause of maternal morbidity and mortality, especially in developing countries. This study aimed to evaluate the presentation, diagnostic parameters, and management outcomes of ectopic pregnancies in a tertiary care setting in Bangladesh, involving 80 clinically diagnosed cases. In this study, the mean age of patients was 28.06 ± 4.70 years, which is consistent with findings by Zhang et al. (2023), who reported the highest incidence of ectopic pregnancies in women aged 25–34 years [13]. Similarly, a study by Creanga et al. (2011) also found the peak age group to be in the late twenties to early thirties, reflecting the reproductive age range where such events are most prevalent [14]. The overwhelming majority of participants were married (98.8%) and urban dwellers (97.5%), suggesting better healthcare-seeking behavior and early diagnosis among this demographic. In contrast, a study in rural India by Raine-Bennett et al. (2022) reported higher rates among rural women, indicating geographic and healthcare access disparities in ectopic pregnancy diagnosis [15]. Regarding educational background, 40% of the women in our study had higher education, and 37.5% had secondary education, contrasting with studies in more rural or under-resourced areas, such as that by Jurkovic et al. (2011), where a higher proportion of patients had little to no formal education. This difference could influence early symptom recognition and prompt health-seeking behavior. Among risk factors, 31.3% of patients had a history of infertility, followed by 15% with a history of abortion, and 5% with pelvic inflammatory disease (PID). Our infertility rate is notably higher than the 20.5% reported by Strandell et al. (1999), indicating that subfertility remains a strong predictive factor for ectopic gestation in our context. PID is a well-established risk factor due to tubal damage, though our relatively low incidence (5.0%) may reflect underreporting or previous antibiotic use masking the symptoms [16]. In comparison, a study by Deng (2023) reported PID in approximately 30% of ectopic pregnancies in Western populations, suggesting a higher disease burden or more effective documentation practices [17]. Vaginal bleeding (97.5%) and abdominal pain (93.8%) were the most common presenting symptoms in our cohort, consistent with data from Gashawbeza et al. (2021), who

found these symptoms in over 90% of ectopic cases [18]. Shoulder tip pain (36.3%) and syncope (18.8%) were also observed, reflecting intraperitoneal bleeding, as previously described in a study [19]. These classical signs remain critical in suspecting ectopic pregnancy, especially in emergency settings where imaging may be delayed. Ultrasonographic findings were pivotal in our diagnosis. An empty uterus and adnexal mass were both observed in 87.5% of cases, while free fluid in the pouch of Douglas was present in 68.8%. These findings align closely with the study by Baker et al. (2023), which emphasized the value of transvaginal ultrasound in identifying adnexal masses and free pelvic fluid as indirect evidence of ectopic implantation. Our study confirms that such sonographic patterns remain highly sensitive diagnostic indicators. Most ectopic pregnancies in our study were tubal (88.8%), primarily affecting the right tube (62.5%). The predominance of tubal ectopics is well documented, with estimates ranging from 90–98% globally [20]. The right-sided predominance noted in our series has been similarly observed by Xia et al. (2019), though the exact etiopathogenesis for lateral preference remains unclear. Non-tubal ectopics, though rare (11.2%), pose significant diagnostic and surgical challenges, as also noted in case series by Brahmbhatt et al. (2020) [21]. The average serum β-hCG level was 10,107 ± 12,650 mIU/mL, which shows a wide variability and underlines the difficulty in relying on absolute β-hCG levels for diagnostic purposes, especially in early presentations. Our findings are in line with those who emphasized serial β-hCG measurement trends over single values in diagnosing ectopic pregnancies [22]. Management-wise, surgical intervention was required in 83.7% of patients, with laparotomy (62.5%) being more common than less invasive approaches. This high rate of surgical management reflects late presentation and lack of early diagnosis, in contrast to developed countries where medical management using methotrexate is increasingly successful. For example, Rayet al. (2022) reported methotrexate success rates of up to 66% in selected patients, compared to 16.3% in our study. This discrepancy may be attributed to delayed diagnosis, higher β-hCG levels, and lack of follow-up infrastructure in our setting (23). Salpingectomy (73.8%) was the most common surgical intervention, consistent with current surgical protocols for ruptured or extensively damaged fallopian tubes. Dilation and curettage (D&C) and other minor procedures constituted 26.2%, typically in cases of non-tubal ectopic pregnancies or where retained products of conception were suspected. These results align with the management strategies reported by Menon et al. (2007) [3]. Regarding complications, 80% of patients experienced no adverse events. However, 11.3% required ICU admission, and 1.3% mortality was recorded. A conversion rate of 6.3% from medical to surgical management was noted, underscoring the challenges of conservative treatment in advanced or unstable cases. A statistically significant association ($p < 0.001$) was found between type of management and treatment outcomes, affirming the importance of appropriate patient selection for medical versus surgical treatment. Similar findings were reported by Hajenius et al. (2007), emphasizing the superior success rates of surgery in emergency or high β-hCG cases.

Limitation of the Study:

This study had a single-center design, which may limit the applicability of the findings to wider populations.

CONCLUSION

Ectopic pregnancy remains a major contributor to maternal morbidity and mortality in Bangladesh, primarily due to delayed diagnosis and limited access to early interventions. This study highlights the predominance of surgical management, particularly salpingectomy via laparotomy, reflecting late presentations and the lack of resources for conservative care. To reduce the burden of ectopic pregnancy, health systems must prioritize early recognition through widespread access to transvaginal ultrasonography and serum β-hCG testing. Expanding the availability and training for medical management using methotrexate, particularly in non-ruptured cases, could reduce the need for invasive procedures. Strengthening primary healthcare capacity, especially in rural and under-resourced areas, along with public awareness initiatives, is essential for timely diagnosis, referral, and treatment—ultimately improving maternal health outcomes nationwide.

RECOMMENDATION

To reduce morbidity from ectopic pregnancy, efforts should focus on early diagnosis through expanded access to ultrasonography and β-hCG testing, especially in peripheral centers. Strengthening community awareness about warning signs and improving referral systems can promote timely intervention. Training healthcare providers in medical management protocols and enhancing surgical facilities where necessary will improve overall outcomes.

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ORIGINAL ARTICLE

Diagnostic Accuracy of Ultrasonography in Differentiating Benign and Malignant Breast Masses with Histopathological Correlation

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ABSTRACT

Introduction: *Breast cancer remains the most common malignancy in women worldwide, with a rise in incidence in younger populations. Early and accurate diagnosis is critical for the improvement of outcomes. Ultrasonography (USG), a non-surgical modality with extensive availability, is a useful technique in assessing breast masses, albeit histopathology being the gold standard.* ***Objectives:*** *The aim of this study was to assess the diagnostic accuracy of ultrasonography in differentiating between benign and malignant breast lesions by histopathological correlation.* ***Methods & Materials:*** *This cross-sectional observational study was conducted in the Department of Radiology and Imaging, Community Based Medical College Bangladesh,* Mymensingh, *Bangladesh Jan 2020 to Dec 2020. Total 116 patients who presented with palpable or clinically suspected breast masses and were referred for ultrasonography were included in the study.* ***Results:*** *The age of the patient was on average 36.5 ± 12.6 years, with most cases falling in the 35–44 years age group. Histopathology confirmed 60.3% benign and 39.7% malignant lesions. Ultrasonographic BI-RADS classification placed 47.6% of the lesions in suspicious or malignant categories (BI-RADS 4 and 5). Compared with histopathology, ultrasonography correctly diagnosed 42 out of 46 malignant and 62 out of 70 benign lesions, with statistically significant correlation ($p < 0.001$). Diagnostic accuracy was 91.3% sensitive, 88.6% specific, 84.0% PPV, 93.9% NPV, and 89.7% overall accuracy.* ***Conclusion:*** *Ultrasonography is very accurate in diagnosis and correlates well with histopathology in the evaluation of breast masses, warranting its status as a useful diagnostic modality in practice.*

Keywords: *Diagnostic Accuracy, Ultrasonography, Benign and Malignant Breast Masses, and Histopathological Correlation*

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INTRODUCTION

Breast cancer remains the most common malignancy in females worldwide and remains a key public health challenge. Latest estimates by the GLOBOCAN 2020 and projections for 2025 reveal that breast cancer accounts for more than 2.3 million new diagnoses and about 685,000 annual deaths and is the leading cause of cancer-related death among females worldwide.[1] It is not uniformly distributed and has a disproportionately high prevalence and mortality rate in low- and middle-income nations (LMICs), where access to early detection and treatment services remains suboptimal.[2,3] Of most concern, however, is a disconcerting rise in the number of cases of breast cancer among young women, particularly in LMICs, whose premature age of onset renders screening and treatment all the more difficult.[4,5] Such trends emphasize the global need for effective diagnostic and early detection methods.

Early detection of breast cancer will be crucial to reducing morbidity, mortality, and the economic burden of advanced-stage treatment. Imaging technologies form the cornerstone of early detection strategies, and mammography is employed widely in organized screening programs. However, mammography has age-old limitations in dense breast tissue, i.e., more so in younger women, hence necessitating adjunct or alternative imaging modalities.[6] In such situations, ultrasonography (USG) has emerged as a vital adjunctive diagnostic modality.

Ultrasonography has been universally used to be a safe, cheap, and non-invasive method for the evaluation of breast masses. Its non-ionizing properties and accessibility render it of

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particular utility in LMICs, as well as in populations with dense breast parenchyma whose sensitivity for mammography is low.[7,8] Conventional ultrasonographic assessment relies on firmly established morphological features like lesion shape, borders, echotexture, posterior acoustic features, calcification patterns, vascularity, and BI-RADS classification, which in combination refine the process of decision-making in diagnosis.[9,10] Studies have demonstrated that ultrasound enhances cancer detection rates when used as an adjunct modality in dense breasts, thereby solidifying its place in today's diagnostic algorithms.[6,11]

Despite these advantages, ultrasonography has its limitations. Its diagnostic performance is typically plagued by operator dependence, variation in image acquisition and interpretation having a bearing on accuracy. Besides, substantial overlap of sonographic features of benign and malignant breast lesions can reduce specificity and lead to unnecessary biopsies or misclassification.[7] While advances such as Doppler imaging and elastography have been introduced into practice to improve characterization of lesions, their use and accessibility are unequal within healthcare systems, particularly in resource-limited settings.[9] Hence, ultrasound alone cannot be a routine accurate definite diagnostic method.

Histopathology is still the gold standard for determining the nature of breast tumors. Imaging findings, regardless of modality, must ultimately be correlated with histological observations to achieve diagnostic accuracy.[9,10] Several studies evaluating the diagnostic accuracy of ultrasonography have produced variable outcomes with sample size, research design, population characteristics, and ultrasonographic equipment employed influencing sensitivity and specificity.[2] These discrepancies necessitate establishing region-specific evidence reflecting local demographic and clinical environments.

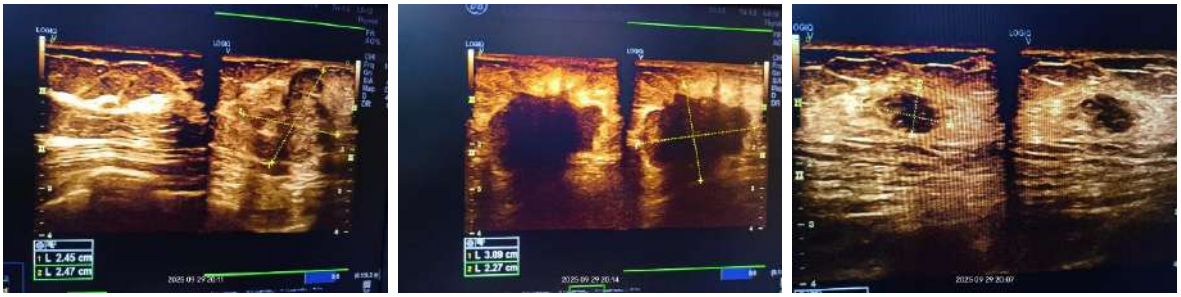
In the context of the ongoing global disease burden of breast cancer, the inadequacies of current diagnostic methods, and the need for strong correlation with histopathological data, the present study aims to validate the diagnostic accuracy of ultrasonography in differentiation between malignant and benign breast masses.

OBJECTIVES

To assess the diagnostic accuracy of ultrasonography in differentiating between benign and malignant breast lesions by histopathological correlation.

METHODS & MATERIALS

This cross-sectional observational study was conducted in the Department of Radiology and Imaging, Community Based Medical College Bangladesh, Mymensingh, Bangladesh Jan 2020 to Dec 2020. Total 116 patients who presented with palpable or clinically suspected breast masses and were referred for ultrasonography were included in the study. Inclusion criteria comprised patients aged between 15 to 65 years who underwent breast ultrasonography followed by histopathological examination of the same lesion. Patients with incomplete clinical or histopathological records, those who had undergone prior breast surgery for the same lesion, or those who received neoadjuvant chemotherapy or radiotherapy before ultrasonography were excluded to avoid confounding results. All patients underwent high-resolution ultrasonography using a linear-array transducer with a frequency range of 7–12 MHz. Imaging was performed by experienced radiologists, and the lesions were assessed systematically based on established sonographic parameters, including size, shape, margin characteristics, echotexture, posterior acoustic features, calcification patterns, and vascularity on Doppler evaluation. Each lesion was categorized according to the Breast Imaging Reporting and Data System (BI-RADS) classification to stratify the likelihood of malignancy. Subsequently, all patients underwent histopathological examination of the breast lesion, which served as the reference standard for diagnosis. Biopsy samples were analyzed by the Department of Pathology of the same institution, and histopathological outcomes were recorded. The diagnostic performance of ultrasonography was then evaluated by comparing the BI-RADS-based categorization with the histopathological diagnosis. Sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and overall diagnostic accuracy of ultrasonography in differentiating benign from malignant breast masses were calculated using standard statistical methods. Ethical approval was obtained from the Institutional Review Board of Community Based Medical College, Bangladesh, and written informed consent was collected from all patients prior to their participation. All collected data were systematically recorded and subsequently analyzed using Statistical Package for the Social Sciences (SPSS) version 23. A p-value <0.05 was considered statistically significant for all analyses.



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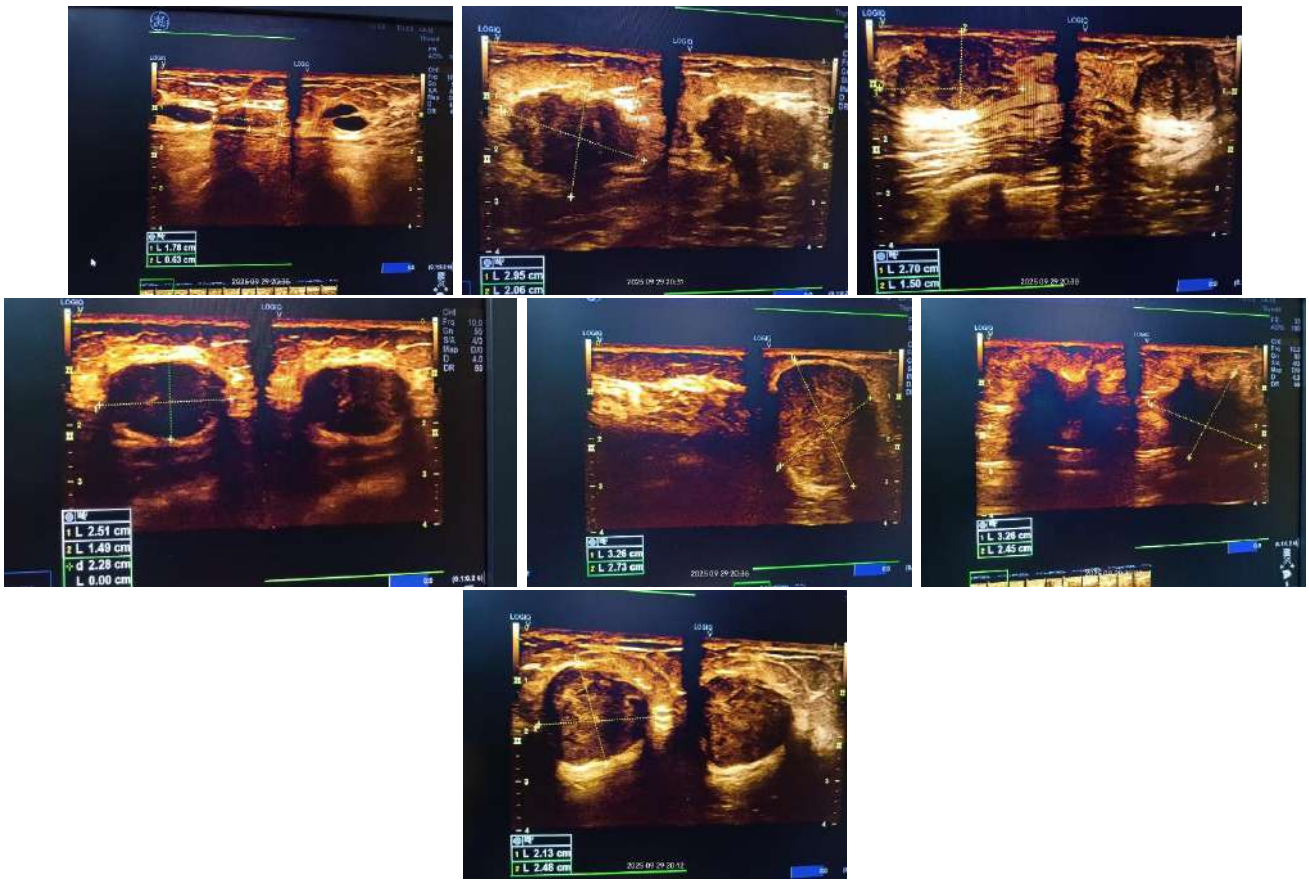

Figure 1: Ultrasonographic appearances of breast masses in the study population

RESULTS

The baseline profile of the study cohort is summarized in Table I. The age of the patients ranged from 15 to 65 years, with a mean age of 36.5 ± 12.6 years. The majority of patients (27.59%) were within the 35–44-year age group, followed by 24.14% in the 25–34-year group, 21.55% in the 45–54-year group, 16.38% in the 15–24-year group, and 10.34% in the 55–65-year group. Most of the participants were married (84.48%), while 15.52% were unmarried. The mean duration of breast mass before presentation was 13.2 ± 2.5 months. Histopathological distribution of lesions (Figure 2) demonstrated that 60.3% of the masses were benign and 39.7% were malignant.

Table II presents the distribution of patients according to BI-RADS classification on ultrasonography. Out of 116 patients, 25.9% were categorized as BI-RADS 2 (benign), 21.6% as BI-RADS 3 (probably benign), 34.5% as BI-RADS 4 (suspicious), and 18.1% as BI-RADS 5 (highly suggestive of malignancy). This distribution highlights that more than half of the lesions fell into suspicious or malignant categories on ultrasound.

The diagnostic correlation between ultrasonography and histopathology is detailed in Table III. Among the 46 histopathologically confirmed malignant cases, 42 were correctly identified as malignant by ultrasonography, while 4 were misclassified as benign. Conversely, out of 70 histopathologically benign lesions, 62 were accurately identified as benign on ultrasound, and 8 were incorrectly classified as malignant. The association between ultrasonography findings and histopathology was statistically significant ($p < 0.001$), indicating strong diagnostic correlation.

Table IV summarizes the diagnostic performance indices of ultrasonography when compared with histopathology as the gold standard. Ultrasonography demonstrated a sensitivity of 91.3% (95% CI: 79.2–97.6) and a specificity of 88.6% (95% CI: 78.7–95.0). The positive predictive value (PPV) was 84.0% (95% CI: 70.9–92.8), while the negative predictive value (NPV) was 93.9% (95% CI: 85.2–98.3). The overall diagnostic accuracy of ultrasonography in differentiating benign and malignant breast masses was 89.7% (95% CI: 83.2–94.5).

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Table – I: Baseline characteristics of the study patients (*n*=116)

Characteristics	Number of patients	Percentage (%)
Age group (years)		
15-24	19	16.38
25-34	28	24.14
35-44	32	27.59
45-54	25	21.55
55-65	12	10.34
Mean± SD	36.5±12.6	
Marital status		
Married	98	84.48
Unmarried	18	15.52
Duration of mass (months)		
Mean± SD	13.2±2.5	

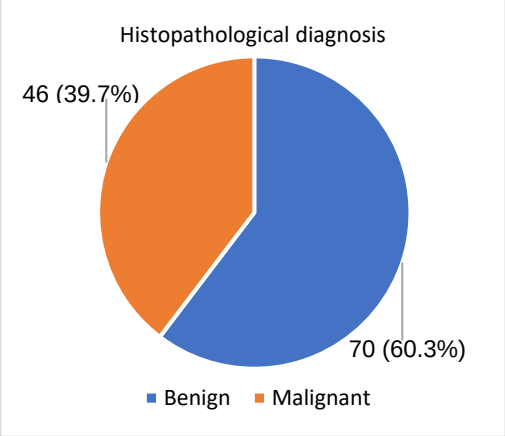

Figure – 2: Distribution of lesions by histopathology

Table – II: Ultrasonographic BI-RADS classification

BI-RADS Category	Number of patients	Percentage (%)
2 (Benign)	30	25.9
3 (Probably Benign)	25	21.6
4 (Suspicious)	40	34.5
5 (Highly Suggestive of Malignancy)	21	18.1

Table – III: Correlation of ultrasonography findings with histopathology

Ultrasonography findings	Histopathology Positive (Malignant)	Histopathology Negative (Benign)	p-value*
USG Positive (Malignant)	42	8	<0.001
USG Negative (Benign)	4	62	
Total	46	70	116

*=significant

Table – IV: Diagnostic performance of ultrasonography (*n*=116)

Parameter	Value (%)	95% CI
Sensitivity	91.3	79.2 – 97.6
Specificity	88.6	78.7 – 95.0
Positive Predictive Value (PPV)	84.0	70.9 – 92.8
Negative Predictive Value (NPV)	93.9	85.2 – 98.3
Overall Accuracy	89.7	83.2 – 94.5

DISCUSSION

The present study evaluated the diagnostic accuracy of ultrasonography in differentiating benign and malignant breast lesions, with histopathology serving as the gold standard. The mean age of the patients in this study was 36.5 years, with the majority falling between 35 and 44 years of age. This finding is consistent with earlier studies from South Asia, which have also reported that breast cancer tends to present at a relatively younger age compared to Western populations.[4] The predominance of younger women in our cohort highlights the importance of incorporating ultrasonography into diagnostic pathways, as mammography has reduced sensitivity in dense breast tissue commonly found in this age group.[12]

Histopathological evaluation in this study revealed that 39.7% of lesions were malignant and 60.3% were benign. This distribution is similar to the findings of Malik et al.[13], who reported 38% malignant lesions in a study conducted on females with palpable breast lumps. Begum et al.[14] also observed a comparable ratio of benign to malignant lesions in their retrospective analysis, reinforcing the utility of ultrasonography as a frontline tool for preliminary categorization before histopathological confirmation.

Ultrasonographic evaluation using BI-RADS classification demonstrated that the majority of patients were categorized into BI-RADS 4 and 5, together accounting for more than half of the cases. This distribution reflects the high proportion of suspicious lesions encountered in clinical practice and is supported by previous studies that have validated the predictive value of BI-RADS classification. Aziz et al.[15] found a statistically significant correlation between BI-RADS scores and histopathological outcomes, confirming the reliability of this structured reporting system. Our findings align with those observations, particularly in highlighting BI-RADS 4 as the most frequent suspicious category.

Correlation of ultrasonographic findings with histopathology in this study revealed a strong diagnostic association, with 42 of 46 malignant cases correctly identified and 62 of 70 benign lesions accurately classified. The statistical significance of this association ($p < 0.001$) emphasizes the robustness of ultrasonography when applied systematically. Comparable results have been reported by Rehman et al.[16], who demonstrated an overall diagnostic accuracy of 87% for ultrasound elastography against histopathology, and by Schaefer et al.[17], who found sensitivity and specificity values of 88% and 90%, respectively, in their prospective study. Similarly, Liew et al. [18] reported sensitivity of 92% and specificity of 86%, closely mirroring the present findings.

The diagnostic performance indices in our study further underscore the effectiveness of ultrasonography. Sensitivity was found to be 91.3%, specificity 88.6%, PPV 84.0%, NPV 93.9%, and overall accuracy 89.7%. These values are highly comparable with those reported in earlier studies. For instance, Sadigh et al.[19] in their meta-analysis observed pooled sensitivity and specificity of 91% and 82%, respectively, for ultrasound elastography, while Wang et al.[20] highlighted improved diagnostic accuracy when non-mass-like sonographic features were correlated with histology. Such consistency across diverse populations suggests that ultrasonography remains a robust diagnostic modality for breast lesions across varying clinical settings.

The slightly lower PPV observed in our study may reflect the overlap of sonographic features between benign and malignant lesions, a limitation acknowledged by several authors.[21] Nonetheless, the high NPV underscores the role of ultrasonography in confidently excluding malignancy in many cases, thereby reducing unnecessary biopsies and interventions.

In summary, the findings of this study corroborate existing literature that ultrasonography, when interpreted using BI-RADS and correlated with histopathology, provides high diagnostic accuracy in differentiating breast lesions. While operator dependence and lesion overlap remain challenges, the integration of adjunct modalities such as elastography and Doppler may further enhance accuracy in future practice.

CONCLUSION

This study establishes that ultrasonography is a highly reliable, safe, and low-cost modality in the differentiation of benign and malignant breast lesions when compared with histopathology, the gold standard. Ultrasonography, with 91.3% sensitivity, 88.6% specificity, and 89.7% overall accuracy, has fair diagnostic concordance with histopathological findings. Despite limitations such as operator dependence and overlapping imaging features, its high negative predictive value vindicates its role as a useful diagnostic modality, particularly in young women and dense breast populations.

Conflict of Interest Statement: None.

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ORIGINAL ARTICLE

Demographic and Risk Factor Profile of Stroke Patients

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ABSTRACT

Background: *Stroke is a leading cause of death and disability worldwide, with increasing prevalence in developing countries such as Bangladesh. Identification of demographic characteristics and modifiable risk factors is essential for prevention and management. This study aimed to evaluate the demographic profile and major risk factors among hospitalized stroke patients.* ***Methods & Materials:*** *An observational study was conducted among 100 stroke patients admitted to the Medicine and Neurology Departments of Dhaka Medical College Hospital, Dhaka, from July 2008 to December 2008. Patients presenting with acute or recurrent stroke were included, while those already on anti-lipid therapy or who declined participation were excluded. Data on demographics, occupation, medical history, and comorbid conditions were collected using a structured questionnaire.* ***Results:*** *The majority of patients (56%) were above 60 years of age, with a male-to-female ratio of 2.55:1, indicating male predominance. Occupationally, 86% were businessmen, teachers, service holders, or housewives. Among lifestyle and comorbid risk factors, 66% were smokers, 68% were hypertensive, and 28% were diabetic. Cardiovascular comorbidities included ischemic heart disease in 30% and valvular heart disease in 8% of patients.* ***Conclusion:*** *Stroke predominantly affects elderly males and is strongly associated with hypertension, smoking, and ischemic heart disease, with diabetes and valvular heart disease contributing to a lesser extent. Early identification and control of modifiable risk factors through lifestyle modification, regular screening, and public health interventions are essential to reduce the stroke burden in Bangladesh.*

Keywords: *Stroke, Risk factors, Hypertension, Smoking, Ischemic heart disease*

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INTRODUCTION

Stroke is one of the leading causes of death and disability worldwide, posing a major public health challenge, particularly in developing countries [1]. It is characterized by the sudden onset of focal neurological deficits due to disturbance in cerebral blood flow, resulting either from vascular occlusion (ischemic stroke) or rupture of a cerebral vessel (hemorrhagic stroke) [2]. Globally, stroke accounts for approximately 11% of total deaths and remains a principal contributor to long-term disability among adults [3].

In recent years, the incidence of stroke has been rising in low- and middle-income countries, primarily due to rapid urbanization, lifestyle changes, and the growing burden of non-communicable diseases such as hypertension, diabetes, and dyslipidemia [4]. Bangladesh, with its large population and limited healthcare resources, is witnessing an increasing number of stroke cases, many of which affect individuals at a relatively younger age compared to those in developed nations [5]. Understanding the demographic profile and identifying the common risk factors among stroke patients are essential for formulating preventive strategies and improving clinical outcomes [6].

Several studies have identified hypertension as the single most important modifiable risk factor for stroke. Other established risk factors include diabetes mellitus, dyslipidemia, smoking, obesity, atrial fibrillation, and sedentary lifestyle [7]. Among these, dyslipidemia—characterized by abnormal levels of serum lipids—plays a key role in the development of

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atherosclerosis, which predisposes individuals to ischemic stroke [8]. Elevated total cholesterol, low-density lipoprotein (LDL), and triglycerides, along with reduced high-density lipoprotein (HDL), contribute to endothelial dysfunction and cerebrovascular events [9]. Despite this, the relationship between lipid abnormalities and stroke subtypes remains a matter of ongoing research and debate, especially in the South Asian context.

Given the increasing prevalence of stroke in Bangladesh and the limited local data on its demographic and biochemical correlates, this study was undertaken to explore the demographic characteristics and major risk factors associated with stroke among hospitalized patients. Particular emphasis was placed on assessing the role of dyslipidemia and its association with different types of stroke. By identifying the key demographic patterns and modifiable risk factors, this study aims to provide valuable insights for clinicians and public health policymakers to design targeted interventions, promote early screening, and implement lifestyle modifications that can effectively reduce the burden of stroke in our population.

METHODS & MATERIALS

This observational study was conducted among hospitalized patients in different wards of the medicine and neurology departments of Dhaka Medical College Hospital, Dhaka, from July 2008 to December 2008. The total sample size of the study was 100 stroke patients. The study population consisted of one hundred stroke patients admitted to the department of neurology and department of medicine during the study period. Inclusion criteria were patients presenting with acute or recurrent stroke, with blood samples collected before starting any anti-lipid drug. Exclusion criteria included patients dying before recording the information, patients and or party refusing to give consent to take part under the study, and patients who were already on anti-lipid drugs. Case sampling was done consecutively, and informed written consent was obtained from all participants. Medical history was taken from each patient with emphasis on finding out the relations of stroke with dyslipidaemia. Thorough physical examination, especially neurological examination and examination of the cardiovascular system, was carried out. All relevant information from history, clinical findings, and investigation results were recorded in a pre-designed questionnaire and data collection sheet. The main tool of the study was serum lipid profile, which was done in the laboratory by spectrophotometric principle using the "RA–50 Chemistry Analyzer.

RESULTS

Table – I: Age Distribution of Patients (*n*=100)

Age range (years)	No. of Patient	Percentage
<20	4	4%
20-29	0	0%
30-39	8	8%
40-49	18	18%
50-59	14	14%
>60	56	56%

Table I shows maximum number of stroke patient (56%) was above 60 years of age.

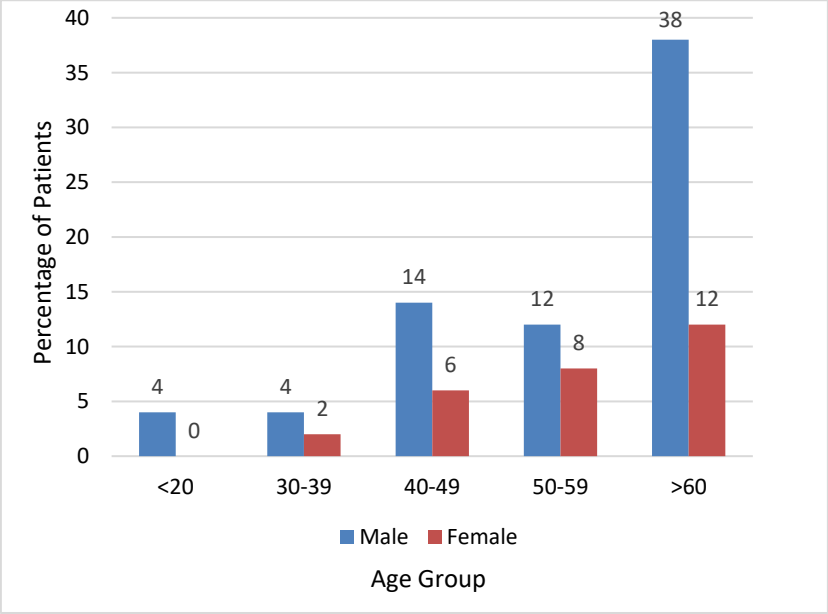

Figure – 1: Distribution of age of the stroke patients according to sex

Figure 1 shows male predominance. Male Female Ratio is 2.55:1. Majority of the patients are above 60 years of age.

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Table – II: Occupational categories of Patient (*n*=100)

Occupation	No. of Patient	Percentage
Executive	0	0%
Professional	2	2%
Businessman	32	32%
Teachers	16	16%
Service Holder	14	14%
Farmer	04	04%
Housewife	24	24%
Others	8	8%

Table II shows that businessman, teachers, service holders and house wives were the majority (86%) of stroke patients.

Table – III: Smoking as a risk factor for stroke (*n*=100)

Smoker/Non smoker	No. of Patient	Percentage
Smoker	66	66%
Non-smoker	34	34%

Table III shows that majority of the patients (66%) were smoker.

Table – IV: Diabetes mellitus as a risk factor for stroke (*n*=100)

Diabetes mellitus	No. of Patient	Percentage
Present	28	28%
Absent	72	72%

Table IV shows that 28% of the stroke patients were diabetic.

Table – V: Hypertension as a risk factor for stroke (*n*=100)

Blood pressure	No. of Patient	Percentage
Normotensive	32	32%
Hypertensive	68	68%

Table V shows that 68% stroke patients were hypertensive.

Table – VI: Ischemic heart disease (IHD) as a risk factor for stroke (*n*=100)

IHD	No. of Patient	Percentage
Present	30	30%
Absent	70	70%

Table VI shows that 30% stroke patients were suffering from IHD (Angina and Infarction).

Table – VII: Valvular Heart disease as a risk factor for stroke (*n*=100)

Valvular Heart Disease	No. of Patient	Percentage
Present	08	08%
Absent	92	92%

Table VII shows that 8% patients had Valvular heart disease.

DISCUSSION

This study evaluated the demographic profile and risk factors among 100 hospitalized stroke patients. Our findings demonstrate that stroke predominantly affects elderly males, with 56% of patients above 60 years of age and a male-to-female ratio of 2.55:1. This is consistent with observations by Li et al., who reported a higher incidence of stroke in older males in population-based studies [10]. Mohammad et al., also highlighted male predominance among stroke patients in Bangladesh, aligning with our results [11].

Occupational distribution showed that businessmen, teachers, service holders, and housewives comprised 86% of the study population, reflecting the socio-demographic profile of urban patients presenting to tertiary care hospitals. Similar trends were reported by Muhit et al., indicating that middle-aged and elderly adults in professional and semi-professional occupations are at higher risk of stroke due to lifestyle-related factors [12].

Hypertension was the most prevalent risk factor, observed in 68% of patients, underscoring its central role in stroke pathogenesis. This finding aligns with previous Bangladeshi studies, where hypertension prevalence among stroke patients ranged between 60–70% [13, 14]. Hypertension accelerates atherosclerosis and promotes both ischemic and hemorrhagic strokes [15].

Smoking, observed in 66% of patients, was another major modifiable risk factor, consistent with the findings of Gezmu et al., who reported high smoking rates among South Asian stroke patients [16]. Smoking contributes to endothelial dysfunction and thrombotic risk, particularly in combination with hypertension and dyslipidemia.

Diabetes mellitus was present in 28% of patients, supporting its established role as a cerebrovascular risk factor. Wasay and Khatri reported similar prevalence in South Asian populations, emphasizing the need for optimal glycemic control to reduce stroke risk [17].

Ischemic heart disease (IHD) was noted in 30% of patients, while valvular heart disease affected 8%. Muhit et al., and Kakkar et al., similarly reported high prevalence of IHD and other cardiac comorbidities among stroke patients, highlighting the importance of cardiovascular evaluation in stroke management [12,18]. Cardiovascular comorbidities not only increase the risk of initial stroke but also worsen prognosis and recurrence rates.

Our findings highlight the interplay of multiple modifiable risk factors, particularly hypertension, smoking, and IHD, in stroke occurrence. These results are in line with Sridharan et al., who emphasized that a majority of stroke cases in developing countries occur in patients with clustered cardiovascular risk factors [19]. Dyslipidemia, although not quantified in our results, remains an important contributing factor, as shown by Choudhury et al., in Bangladeshi cohorts [14].

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LIMITATIONS OF THE STUDY

Limitations of this study include its single-center design and relatively small sample size, which may limit generalizability. Despite these limitations, the study provides valuable insights into stroke demographics and risk factors in an urban Bangladeshi population, forming a basis for larger prospective studies.

CONCLUSION

Stroke in this study predominantly affected elderly males, with the majority of patients above 60 years of age. Hypertension, smoking, and ischemic heart disease were the most common risk factors, while diabetes and valvular heart disease contributed to a lesser extent. These findings highlight the importance of early identification and control of modifiable risk factors through lifestyle modification, regular screening, and public health interventions to reduce the burden of stroke in Bangladesh.

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CONFLICTS OF INTEREST

There are no conflicts of interest.

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ORIGINAL ARTICLE

Efficacy & Reliability of Posterior Decompression & Transforaminal Lumbar Interbody Fusion (TLIF) Using Both Cage and Bone Graft in Patients with Spondylolisthesis – An Observational Study

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ABSTRACT

Background: *Spondylolisthesis, a condition characterized by the slippage of one vertebral body over another, significantly impacts patient quality of life and poses challenges in spinal surgery. This study aimed to evaluate the efficacy and reliability of posterior decompression and transforaminal lumbar interbody fusion (TLIF) using both cage and bone graft in patients with spondylolisthesis.* ***Methods & Materials:*** *In this prospective observational study, 15 patients with spondylolisthesis underwent posterior decompression and TLIF at NITOR, Dhaka, Bangladesh, from January 2020 to December 2021. Key parameters assessed included slip angle, percentage of slip, mean disc space height, pain levels (using the Visual Analog Scale), motor function, fusion rate, and functional outcomes. Data were analyzed pre-operatively, at 6 months, and 1-year post-surgery.* ***Results:*** *Significant improvements were observed post-surgery. The mean slip angle reduced from 15.2 ± 1.32° to 7.73 ± 1.03°, and the percentage of slip decreased from 27.37 ± 1.87% to 12.79 ± 0.96% ($p<0.05$). Mean disc space height increased from 7.33 ± 1.05 mm to 11.1 ± 1.77 mm. VAS scores for back and leg pain showed significant reductions. Motor deficits improved, with 93.33% of patients showing no deficits at the 1-year follow-up. The fusion rate was 86.67%, and 73.33% of patients reported 'Excellent' functional outcomes based on Macnab criteria.* ***Conclusion:*** *The study demonstrates that posterior decompression and TLIF using cage and bone graft are effective in treating spondylolisthesis, significantly improving spinal alignment, reducing pain, enhancing motor function, and achieving high fusion rates. These findings suggest that this surgical approach can substantially improve the quality of life for patients with spondylolisthesis.*

Keywords: *Posterior Decompression, Transforaminal Lumbar Interbody Fusion, Spondylolisthesis*

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INTRODUCTION

Spinal disorders, encompassing a spectrum of degenerative, traumatic, and congenital conditions, significantly impact patient quality of life and pose substantial challenges to healthcare systems worldwide (1,2). Among these, spondylolisthesis, characterized by the anterior or posterior displacement of a vertebral body relative to the adjacent segment, is particularly noteworthy due to its clinical complexity and prevalence. This condition predominantly affects the lower lumbar spine and is more common in adults, with a higher incidence in females, especially in the obese population (3,4). The prevalence of spondylolisthesis varies, with estimates suggesting 6 to 7% in adolescents and up to 18% in adults undergoing lumbar spine MRI (5). The pathophysiology involves weakened vertebral supports, leading to mechanical pain or radicular symptoms due to nerve root compression. The historical management of spondylolisthesis has evolved significantly over the years. Initial approaches focused on conservative management, including physical therapy and pain management. However, as understanding of the condition deepened, surgical interventions, particularly spinal fusion techniques, gained prominence. These techniques aim to stabilize the affected spinal segments, thereby alleviating symptoms and preventing further slippage (6,7). Transforaminal Lumbar Interbody Fusion (TLIF) and posterior decompression have emerged as pivotal surgical interventions for spondylolisthesis. TLIF involves the removal of a portion of the bone from the back of the spine (lamina) to relieve nerve compression, followed by the fusion of the vertebrae using a cage and bone graft (8,9). This technique is designed to restore spinal stability and alignment while minimizing trauma to spinal structures. Posterior decompression, on the other hand, focuses on relieving pressure on spinal nerves. These methods have been observed to enhance neurological recovery, reduce pain, and improve patient functionality (10). Recent studies have underscored the efficacy and safety of TLIF and posterior decompression in treating spondylolisthesis. For instance, a study demonstrated significant reductions in slip angle and pain scores post-operation, with an 86.66% fusion rate achieved using TLIF combined with stabilization (11). However, despite these advances, gaps remain in current research, particularly regarding long-term outcomes and the comparative effectiveness of different surgical techniques. The rationale for this observational study is anchored in these research gaps. By focusing on the clinical and functional outcomes of TLIF using cage and bone graft combined with stabilization, this study aims to provide deeper insights into the effectiveness of these surgical interventions. The potential impact of these findings is substantial, offering the possibility of refining treatment protocols and improving patient outcomes in spondylolisthesis management. The objectives of this study are to evaluate the efficacy and reliability of posterior decompression and TLIF in patients with spondylolisthesis, specifically assessing pain reduction, functional recovery, and fusion rates. By doing so, the study aims to contribute valuable data to the existing body of knowledge, aiding in the optimization of treatment strategies for this prevalent spinal disorder.

METHODS & MATERIALS

This prospective observational study was conducted at the National Institute of Traumatology and Orthopedic Rehabilitation (NITOR) in Dhaka, Bangladesh, from January 2020 to December 2021. The study aimed to evaluate the efficacy of posterior decompression and transforaminal lumbar interbody fusion (TLIF) using both cage and bone graft in patients with spondylolisthesis. A purposive sampling technique was employed, selecting 15 patients based on a calculated sample size formula considering a 95% confidence interval and a 10% allowance for missing values. The inclusion criteria were patients over 40 years of age with degenerative lumbar spondylolisthesis of grade I or II, radiologically proven instability, and severe back or leg pain unresponsive to medical treatment for three consecutive months or progressive neurological deficit. Exclusion criteria included severe systemic disease, spondylolisthesis due to neoplastic, traumatic, infective conditions, dysplastic spondylolisthesis, and high-grade spondylolisthesis (Grade III, IV, and V). The surgical procedure involved pre-operative evaluation of patients, followed by surgery and a post-operative regimen of antibiotics. Patients were discharged on the 4th post-operative day and followed up at 2 weeks, 3 months, 6 months, and 1-year. During each follow-up, radiological, clinical, and functional assessments were conducted. The follow-up was performed clinically using the visual analog scale(VAS) and Oswestry Disability Index (ODI) Questionnaires, and the overall outcome was measured using Macnab criteria (12,13). Data were collected using a structured questionnaire and analyzed using SPSS version 23.0. The study received approval from the Institutional Review Board of NITOR, and ethical considerations included obtaining written informed consent from each patient, ensuring voluntary participation, and maintaining confidentiality.

RESULTS

Table – I: Distribution of participants by baseline characteristics (*n*=15)

Variables	n	%
Age		
40-44	5	33.33%
45-49	6	40.00%
50-54	4	26.67%
Gender		
Male	6	40.00%
Female	9	60.00%
Level of Spondylolisthesis		
L1/L2	0	0.00%
L2/L3	0	0.00%
L3/L4	0	0.00%
L4/L5	9	60.00%
L5/S1	6	40.00%

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Age distribution among the participants showed a relatively even spread across the middle-aged group. Participants aged between 40-44 years constituted 33.33% (n=5) of the sample. The largest age group was 45-49 years, representing 40.00% (n=6) of the participants, while those aged 50-54 years comprised 26.67% (n=4) of the study population. Regarding gender distribution, the study had a higher representation of females, with 60.00% (n=9) of the participants being female, compared to 40.00% (n=6) who were male. The level of spondylolisthesis among the participants was concentrated in the lower lumbar region. None of the participants had spondylolisthesis at the L1/L2, L2/L3, or L3/L4 levels. The majority of the cases were found at the L4/L5 level, accounting for 60.00% (n=9) of the cases. The remaining 40.00% (n=6) of the participants had spondylolisthesis at the L5/S1 level.

Table – II: Changes in slip-angle pre-operatively and at 1-year follow-up (*n*=15)

Timeframe	Mean ± SD	p-value
Degree of slip-angle		
Pre-operative	15.2 ± 1.32°	<0.05
1-year after surgery	7.73 ± 1.03°	
Percentage of slip-angle		
Pre-operative	27.37±1.87%	<0.05
1-year after surgery	12.79±0.96%	

Regarding the degree of slip-angle, the mean pre-operative slip-angle was 15.2 ± 1.32 degrees. This value significantly decreased to 7.73 ± 1.03 degrees at the 1-year post-operative follow-up. The reduction in the slip-angle demonstrates the effectiveness of the surgical intervention in correcting spinal alignment. The statistical significance of this improvement is indicated by a p-value of less than 0.05. Similarly, the percentage of slip-angle also showed a notable decrease following surgery. Pre-operatively, the mean percentage of slip-angle was recorded at 27.37 ± 1.87%. This value reduced to 12.79 ± 0.96% at the 1-year follow-up. The decrease in the percentage of slip-angle further corroborates the positive impact of the surgical procedure on spinal stability. The statistical significance of this change is also supported by a p-value of less than 0.05.

Table – III: Mean disc space height pre-operatively and 1-year after surgery (*n*=15)

Timeframe	Mean ± SD	p-value
Pre-operative	07.33±1.05	<0.05
1-year after surgery	11.1±1.77	

Pre-operatively, the mean disc space height was recorded at 7.33 ± 1.05 mm. This measurement significantly increased to 11.1 ± 1.77 mm at the 1-year post-operative follow-up. The increase in disc space height is indicative of the effectiveness of the surgical intervention in restoring the normal anatomy of the spine. The statistical significance of this improvement is underscored by a p-value of less than 0.05.

Table – IV: Comparison of pain evaluation by VAS-score pre-operatively and at 1-year follow-up (*n*=15)

Timeframe	Mean ± SD	p-value
Back-pain		
Pre-operative	7.1±0.46	<0.05
Six months after surgery	2.2±0.56	
Leg-pain		
Pre-operative	6.6±0.51	<0.05
1-year after surgery	1.27±0.46	

For back pain, the mean pre-operative VAS score was 7.1 ± 0.46, indicating a high level of pain experienced by the patients prior to the surgery. At the 1-year post-operative follow-up, there was a significant reduction in the mean VAS score for back pain, which decreased to 2.2 ± 0.56. This substantial decrease in the VAS score for back pain, with a p-value of less than 0.05, signifies the effectiveness of the surgical intervention in alleviating back pain symptoms. Similarly, the mean pre-operative VAS score for leg pain was 6.6 ± 0.51, reflecting considerable discomfort in the patients. Post-surgery, at the 1-year follow-up, the mean VAS score for leg pain significantly reduced to 1.27 ± 0.46. This marked improvement in leg pain, also statistically significant with a p-value of less than 0.05, demonstrates the positive impact of the surgical procedure on reducing leg pain symptoms.

Table – V: Motor Function Assessment Pre-operatively and at 1-year follow-up (*n*=15)

Motor status	n	%
Pre-operatively		
Motor Deficit Present	5	33.33%
Motor Deficit Absent	10	66.67%
1-year after surgery		
Motor Deficit Present	1	6.67%
Motor Deficit Absent	14	93.33%

Pre-operatively, motor deficits were present in 33.33% (n=5) of the patients. This initial assessment indicates that a significant proportion of the study population experienced motor function impairment prior to the surgical intervention. In contrast, the majority of the patients, 66.67% (n=10), did not exhibit any motor deficits before the surgery. At the 1-year post-operative follow-up, there was a notable improvement in motor function among the patients. The percentage of patients with motor deficits decreased substantially to 6.67% (n=1), indicating a significant recovery in motor function post-surgery. Conversely, the proportion of patients without motor deficits increased to 93.33% (n=14), demonstrating a marked improvement in motor function outcomes following the surgical procedure.

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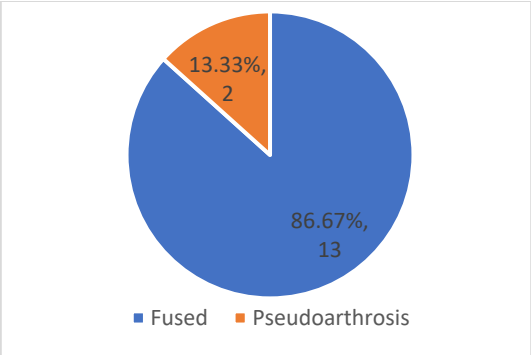

Figure – 1: Fusion status at 1-year follow-up (*n*=15)

At the 1-year post-operative mark, a significant majority of the patients, 86.67% (n=13), achieved successful spinal fusion. This high fusion rate indicates that the surgical procedure was effective in achieving spinal stability and promoting bone growth, which are essential for the long-term success of TLIF and posterior decompression in treating spondylolisthesis. However, 13.33% (n=2) of the patients developed pseudoarthrosis, a condition where the bone graft does not fuse completely, leading to a non-union. This outcome highlights the challenges and complexities associated with spinal fusion surgeries.

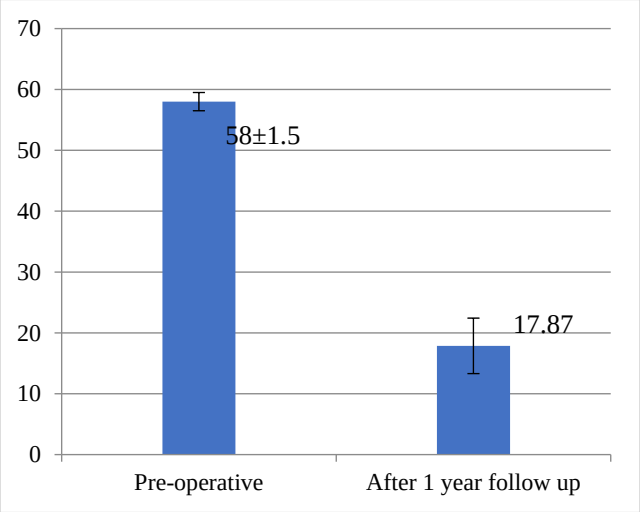

Figure – 2: Functional Outcome by ODI (%) Pre-operatively and 1-year After Surgery

Pre-operatively, the mean ODI score was 58 ± 1.5, indicating a significant level of disability and impact on daily activities due to back pain. This high score reflects the severe functional impairment experienced by patients prior to undergoing the surgical procedure. At the 1-year post-operative follow-up, there was a notable improvement in the functional outcome, with the mean ODI score significantly decreasing to 17.87 ± 4.56. This substantial reduction in the ODI score, with a p-value of less than 0.05, signifies a marked improvement in the patients' functional abilities and a decrease in the impact of back pain on their daily activities.

Table – VI: Functional outcome at final follow-up (*n*=15)

Outcome	n	%
Excellent	11	73.33%
Good	3	20.00%
Fair	1	6.67%
Poor	0	0.00%

At the final follow-up, a significant majority of the patients, 73.33% (n=11), reported an 'Excellent' outcome. This high percentage indicates that the majority of the patients experienced substantial improvement in their condition, likely reflecting significant relief from symptoms, improved mobility, and a return to normal daily activities without major limitations. Additionally, 20.00% (n=3) of the patients rated their outcome as 'Good.' This rating suggests that these patients experienced notable improvements in their symptoms and functionality, albeit with some minor limitations or residual symptoms. A smaller proportion of the study population, 6.67% (n=1), reported a 'Fair' outcome. This category typically indicates moderate improvement with some lingering symptoms or functional limitations that may still affect the patient's quality of life. Notably, none of the patients (0.00%) reported a 'Poor' outcome, which suggests that there were no cases where the condition remained unchanged or worsened following the surgery.

Table – VII: Observed complications at final follow-up (*n*=15)

Complications	n	%
Superficial infection	2	13.33%
Urinary tract infection	2	13.33%
No Complications	11	73.33%

At the final follow-up, a majority of the patients, 73.33% (n=11), dids not experience any complications. This high percentage of patients without complications indicates a favorable safety profile for the surgical procedure, suggesting that it is generally well-tolerated and carries a low risk of adverse events. However, complications were observed in a minority of the patients. Superficial infections were reported in 13.33% (n=2) of the cases. Superficial infections, typically involving the skin or subcutaneous tissue near the surgical site, are relatively common post-operative complications but are generally manageable with appropriate medical intervention. Similarly, urinary tract infections (UTIs) were also reported in 13.33% (n=2) of the patients. UTIs are not uncommon following surgical procedures, particularly those involving the lower spine, and can be effectively treated with antibiotics.

DISCUSSION

In our study, we meticulously evaluated the outcomes of posterior decompression and transforaminal lumbar interbody fusion (TLIF) using both cage and bone graft in patients with spondylolisthesis. Our findings, which resonate with contemporary research in this domain, underscore the efficacy of this surgical approach. A major highlight of our

study was the significant reduction in the degree of slip-angle, from a pre-operative mean of 15.2 ± 1.32 degrees to 7.73 ± 1.03 degrees at the 1-year follow-up, with a statistically significant p-value of <0.05. This finding is crucial as it directly reflects the success of the surgical intervention in rectifying spinal alignment, a key objective in spondylolisthesis management. Similarly, the percentage of slip-angle showed a notable decrease from a pre-operative mean of 27.37 ± 1.87% to 12.79 ± 0.96% post-surgery, also with a significant p-value of <0.05. These improvements in spinal alignment are consistent with the results reported by few other studies who observed significant reductions in slip angle and VAS scores for back and leg pain post-operation (14,15). Our study also revealed a substantial increase in the mean disc space height, from 7.33 ± 1.05 mm pre-operatively to 11.1 ± 1.77 mm at the 1-year follow-up, indicating successful restoration of spinal anatomy (p<0.05). This increase is critical for alleviating symptoms associated with spondylolisthesis, such as nerve compression and pain. Pain reduction, a primary concern for patients, was significantly achieved in our study. The mean VAS score for back pain decreased from 7.1 ± 0.46 pre-operatively to 2.2 ± 0.56 at the 1-year follow-up, and for leg pain, from 6.6 ± 0.51 to 1.27 ± 0.46, both with p-values of <0.05. These findings align with the outcomes observed in other studies, emphasizing the pain-alleviating effect of TLIF and posterior decompression (16,17). The improvement in motor function was another significant outcome, with the proportion of patients with motor deficits decreasing from 33.33% pre-operatively to 6.67% post-operatively. This improvement in neurological function is a testament to the efficacy of the surgical approach. Our study's high fusion success rate of 86.67% at the 1-year follow-up further corroborates the effectiveness of TLIF and posterior decompression in achieving spinal stability. This rate is in line with the findings of other studies, such as that by Jung S et al., which examined fusion rates in different spinal segments (18). In terms of functional outcomes, a majority of our patients reported 'Excellent' or 'Good' outcomes, with 73.33% achieving an 'Excellent' outcome and 20.00% a 'Good' outcome. These results highlight the potential of this surgical approach in enhancing patient quality of life, a finding echoed in the literature (19). However, our study also noted the presence of minor complications, such as superficial infections (13.33%) and urinary tract infections (13.33%), underscoring the importance of vigilant post-operative care. In conclusion, our study provides robust evidence supporting the use of TLIF and posterior decompression in treating spondylolisthesis, demonstrating significant improvements in spinal alignment, pain reduction, motor function, and overall functional outcomes. The high fusion rate and positive functional outcomes further reinforce the benefits of this surgical approach. However, the presence of minor complications calls for careful post-operative management. These findings, in conjunction with comparative literature, offer a comprehensive understanding of the surgical management of spondylolisthesis, guiding future clinical practices and research.

Limitations of The Study

The study was conducted in a single hospital with a small sample size. So, the results may not represent the whole community.

CONCLUSION

In conclusion, our study provides compelling evidence for the efficacy and reliability of posterior decompression and transforaminal lumbar interbody fusion (TLIF) using both cage and bone graft in the treatment of spondylolisthesis. The significant improvements observed in spinal alignment, as evidenced by the reduction in slip angle and percentage, coupled with the increase in disc space height, underscore the anatomical efficacy of this surgical approach. Furthermore, the marked reduction in pain levels and the improvement in motor function highlight the clinical benefits for patients undergoing this procedure. The high fusion rate observed at the 1-year follow-up reinforces the procedure's effectiveness in achieving spinal stability. While minor complications were noted, they were manageable, emphasizing the importance of vigilant post-operative care. Overall, our findings suggest that TLIF and posterior decompression offer a promising surgical option for patients with spondylolisthesis, aiming to improve their quality of life by alleviating pain, restoring function, and enhancing spinal stability.

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ORIGINAL ARTICLE

Parathormone as a Risk Factor for Cardiac Dysfunction in Individuals Undergoing Hemodialysis

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ABSTRACT

Background: *Elevated parathyroid hormone (iPTH) levels have been associated with adverse cardiovascular outcomes in hemodialysis patients. This study aims to explore the relationship between elevated iPTH levels and cardiac dysfunction, with a focus on left ventricular ejection fraction (LVEF), left ventricular hypertrophy (LVH), and other cardiovascular markers.* ***Objectives:*** *To explore the role of parathyroid hormone (PTH) as a potential risk factor for cardiac dysfunction in individuals undergoing hemodialysis.* ***Methods & Material:*** *A total of 215 hemodialysis patients were enrolled and categorized into elevated iPTH and normal iPTH groups. Demographic data, dialysis duration, biochemical markers, and cardiovascular parameters, including LVEF, LVH, B-type natriuretic peptide (BNP), and carotid intima-media thickness (CIMT), were assessed. Logistic regression and multivariate linear regression were used to evaluate the relationship between iPTH and cardiovascular outcomes.* ***Result:*** *The elevated iPTH group had significantly lower LVEF (50.1% vs. 56.4%, p<0.001), higher prevalence of LVH (70% vs. 48.2%, p=0.002), and elevated BNP and CIMT levels (p<0.001). Multivariate analysis revealed that iPTH levels were independently associated with reduced LVEF and increased cardiovascular risk (adjusted OR: 2.34, p=0.012). Serum calcium and phosphorus imbalances were also significant predictors of cardiovascular dysfunction.* ***Conclusion:*** *Elevated iPTH levels are significantly associated with adverse cardiovascular outcomes, including reduced LVEF, increased LVH, and elevated BNP and CIMT, in hemodialysis patients. These findings highlight the critical role of iPTH in cardiovascular pathology and suggest that controlling iPTH levels could improve cardiovascular health in this population.*

Keywords: *Elevated parathyroid hormone, cardiovascular dysfunction, hemodialysis, left ventricular ejection fraction, left ventricular hypertrophy*

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INTRODUCTION

Parathormone or Parathyroid hormone (PTH) is a critical regulator of calcium and phosphate homeostasis, exerting significant effects on bone metabolism [1]. In patients undergoing hemodialysis (HD), altered PTH levels have been implicated in various cardiovascular complications, including cardiac dysfunction [2]. This introduction explores the association between PTH and cardiac dysfunction in individuals undergoing HD, highlighting the underlying mechanisms and clinical implications. Chronic kidney disease (CKD) is a progressive condition that often necessitates renal replacement therapy, with hemodialysis being the most prevalent and widely used modality for patients who reach end-stage renal disease (ESRD) [3]. However, patients undergoing HD often experience significant disturbances in mineral metabolism, leading to secondary hyperparathyroidism. Elevated levels of PTH are commonly seen in these individuals and have been linked to several adverse cardiovascular outcomes, contributing to a heightened risk of cardiovascular morbidity and mortality in this population [4]. A study demonstrated that a clear association between increased PTH concentrations and higher mortality rates among HD patients in the Gulf Cooperation Council countries, underscoring the impact of this hormone on

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long-term outcomes [5]. The pathophysiological mechanisms connecting PTH to cardiac dysfunction in HD patients are complex and multifactorial. PTH exerts its effects not only on bone metabolism but also on myocardial contractility, vascular tone, and cardiac remodeling [6]. PTH serves as a critical bridge between bone metabolism and cardiovascular disease, affecting both bone and heart tissues. Additionally, elevated PTH levels may contribute to left ventricular hypertrophy (LVH), a precursor to heart failure [7]. Echocardiographic techniques were utilized to assess left ventricular structure and function in end-stage renal disease patients, providing insights into cardiac alterations [8]. Furthermore, PTH interacts with other hormones and factors that modulate cardiovascular health [9]. For instance, fibroblast growth factor 23 (FGF23) and vitamin D are involved in mineral metabolism and have been linked to cardiac outcomes in CKD patients. The interplay between these factors complicates the assessment of PTH's direct effects on the heart [10]. Clinically, it has become evident that monitoring PTH levels in HD patients is essential for identifying those at higher risk for cardiac dysfunction. The role of fragmented QRS complexes on electrocardiograms as a marker of subclinical left ventricular dysfunction in chronic kidney disease patients, indicating the need for comprehensive cardiac screening in this population [11]. Additionally, interventions aimed at reducing PTH levels, such as the use of phosphate binders and vitamin D analogs, have demonstrated promise in mitigating cardiovascular risks and improving patient outcomes [12]. However, PTH affects renal phosphate transporters, offering potential avenues for therapeutic intervention [13]. Elevated PTH levels in HD patients are closely linked to cardiac dysfunction through various direct and indirect mechanisms [14]. This study aims to delve deeper into the role of PTH as a risk factor for cardiac dysfunction among individuals undergoing hemodialysis, providing evidence to inform clinical practices and therapeutic interventions.

METHODS & MATERIALS

This was a cross-sectional observational study conducted at [Institution Name] between [start date] and [end date] in the Department of [Department Name]. The study was approved by the institutional ethics committee, and written informed consent was obtained from all participants. A total of 215 adult patients who were undergoing regular hemodialysis were included in the study. Participants were categorized into two groups based on their parathormone (PTH) levels: PTH Elevated (N=130) and PTH Normal (N=85).

Inclusion Criteria

- Adults aged ≥18 years.
- Hemodialysis patients with at least 6 months of dialysis history.
- Stable clinical status, with no major acute complications in the past month.

Exclusion Criteria

- Severe acute or chronic infections.
- Active malignancy.
- Severe liver dysfunction (e.g., cirrhosis).
- Recent myocardial infarction or stroke.
- Pregnancy.

Clinical, Biochemical, And Cardiac Assessment

Baseline demographic and clinical data, including age, sex, duration of hemodialysis, blood pressure, and comorbidities such as hypertension and diabetes mellitus, were recorded. Blood samples were collected before dialysis for biochemical analysis, which included parathormone (PTH), serum calcium, phosphorus, albumin, and B-type natriuretic peptide (BNP) levels. PTH was measured using an enzyme-linked immunosorbent assay (ELISA), with levels >65 pg/mL considered elevated. Serum calcium and phosphorus were determined using colorimetric assays, while BNP was analyzed using a high-sensitivity ELISA kit.

Cardiac function was assessed using transthoracic echocardiography to measure left ventricular ejection fraction (LVEF) and detect left ventricular hypertrophy (LVH), defined as a left ventricular mass index >115 g/m^2 in men and >95 g/m^2 in women. Carotid intima-media thickness (CIMT) was evaluated using ultrasound, and electrocardiography (ECG) was performed to assess cardiac rhythm abnormalities. Dialysis parameters, including dialysis vintage (total duration of dialysis in months) and dialysis adequacy (measured as Kt/V), were recorded.

Data Collection

Data were collected through structured patient interviews, clinical examinations, and medical record reviews. Demographic and clinical characteristics were obtained during patient visits, while laboratory parameters were analyzed using standard biochemical techniques. Cardiac function assessments were performed by trained cardiologists using echocardiography and ultrasound, ensuring consistency in measurements. Dialysis-related parameters were extracted from medical records, including dialysis duration and adequacy. All data were systematically recorded in a secure electronic database, with regular quality checks to ensure accuracy and completeness.

Statistical Analysis

Data analysis was conducted using SPSS software version 26 (IBM Corporation, Armonk, NY). Continuous variables were presented as mean ± standard deviation (SD) or median (interquartile range), while categorical variables were expressed as frequencies and percentages. Comparisons between groups (elevated vs. normal PTH levels) were performed using the Student's t-test for continuous variables and the chi-squared test for categorical variables. Univariate and multivariate logistic regression analyses were conducted to determine the association between PTH levels and cardiac dysfunction, adjusting for potential confounders such as age, gender, dialysis vintage, and comorbidities. Results were reported as odds ratios (OR) with 95% confidence intervals (CI), and a p-value <0.05 was considered statistically significant.

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RESULT

A total of 215 patients participated in this study. The mean age of participants with elevated iPTH was 59.1±10.8 years), compared to 57.2±11.6 years) for those with normal iPTH (p=0.321). The gender distribution was similar, with 64.62% of participants with elevated iPTH being male, compared to 57.65% in the normal iPTH group (p=0.402). Dialysis duration was significantly longer for the elevated iPTH group (52.8 ± 27.1 months) compared to the normal iPTH group (41.5±24.9 months, p=0.012). The prevalence of hypertension was higher in the elevated iPTH group (86.15%) compared to the normal iPTH group (77.65%, p=0.098). Diabetes Mellitus was more prevalent in the elevated iPTH group (53.08%) than the normal iPTH group (38.82%, p=0.043) (Table I). Table II presented the cardiac dysfunction parameters based on iPTH levels. The mean Left Ventricular Ejection Fraction (LVEF) was significantly lower in participants with elevated iPTH (50.1±8.9) compared to the normal iPTH group (56.4±9.2, p<0.001). Left Ventricular Hypertrophy (LVH) was more common in the elevated iPTH group (70% compared to 48.2% with normal iPTH, p=0.002). BNP levels were significantly higher in the elevated iPTH group (511±230 pg/mL compared to 301±180 pg/mL with normal iPTH, p<0.001). Carotid Intima-Media Thickness (CIMT) was also significantly higher in the elevated iPTH group (0.89 ± 0.23 mm compared to 0.74±0.19 mm with normal iPTH, p<0.001). Logistic regression showed a significant association between elevated iPTH and cardiac dysfunction (adjusted OR 2.34, p=0.012). Dialysis duration greater than 48 months was also associated with cardiac dysfunction (adjusted OR 1.82, p=0.028) (Table III). Table IV represented that biochemical and hemodialysis parameters showed that serum calcium was lower in the elevated iPTH group (8.1±0.8 mg/dL) compared to the normal iPTH group (8.8±0.7 mg/dL, p<0.001). Serum phosphorus was higher in the elevated iPTH group (5.5±1.3 mg/dL compared to 4.8±1.0 mg/dL with normal iPTH, p<0.001), as was the calcium-phosphorus product (45.9±10.1 mg^2/dL^2 compared to 41.7±8.5 mg^2/dL^2 with normal iPTH, p=0.004). Multivariate regression analysis found each 10 pg/mL increase in iPTH was associated with a decrease in LVEF (β = -0.28, p = 0.002) (Table V). Spearman's correlation showed significant negative correlations between iPTH and LVEF (ρ = -0.46, p<0.001) and positive correlations with LVH, BNP, CIMT, phosphorus, and calcium-phosphorus product (Table VI).

Table – I: Demographic and clinical characteristics of study population

Variable	iPTH Elevated (N=130)		iPTH Normal (N=85)		P-Value
	n	%	n	%	
Age (years)					
Mean ± SD	59.1 ± 10.8		57.2 ± 11.6		0.321
Gender					
Male	84	64.62	49	57.65	0.402
Female	46	35.38	36	42.35	
Dialysis Duration (months)					
Mean ± SD	52.8 ± 27.1		41.5 ± 24.9		0.012
Hypertension	112	86.15	66	77.65	0.098
Diabetes Mellitus	69	53.08	33	38.82	0.043

Table – II: Cardiac dysfunction parameters based on iPTH levels

Cardiac Dysfunction Parameter	iPTH Elevated (N=130) (Mean ± SD)	iPTH Normal (N=85) (Mean ± SD)	P-Value
Left Ventricular Ejection Fraction (LVEF)	50.1 ± 8.9	56.4 ± 9.2	<0.001
Left Ventricular Hypertrophy (LVH, %)	91 (70.00%)	41 (48.20%)	0.002
B-Type Natriuretic Peptide (BNP, pg/mL)	511 ± 230	301 ± 180	<0.001
Carotid Intima-Media Thickness (CIMT, mm)	0.89 ± 0.23	0.74 ± 0.19	<0.001

Table – III: Association between elevated iPTH and cardiac dysfunction (Logistic Regression Analysis)

Risk Factor	Unadjusted OR (95% CI)	Adjusted OR (95% CI)	P-Value
iPTH > 65 pg/mL	2.85 (1.61–4.98)	2.34 (1.21–4.53)	0.012
Hypertension	1.79 (1.02–3.14)	1.45 (0.78–2.73)	0.189
Diabetes Mellitus	1.52 (1.04–2.82)	1.38 (0.93–2.67)	0.213
Dialysis Duration (>48 months)	2.11 (1.41–3.88)	1.82 (1.19–3.52)	0.028

Table – IV: Biochemical and hemodialysis parameters of the study population

Parameter	iPTH Elevated (N=130)	iPTH Normal (N=85)	P-Value
Serum Calcium (mg/dL)	8.1 ± 0.8	8.8 ± 0.7	<0.001
Serum Phosphorus (mg/dL)	5.5 ± 1.3	4.8 ± 1.0	<0.001
Calcium-Phosphorus Product (mg^2/dL^2)	45.9 ± 10.1	41.7 ± 8.5	0.004
Serum Albumin (g/dL)	3.7 ± 0.5	4.1 ± 0.6	<0.001
Dialysis Efficiency (Kt/V)	1.34 ± 0.22	1.41 ± 0.25	0.047

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Table – V: Multivariate Linear Regression for Predictors of Left Ventricular Dysfunction (LVEF%)

Predictor	β-Coefficient	Standard Error	P-Value	Adjusted R^2
iPTH Level (per 10 pg/mL increase)	-0.28	0.09	0.002	0.31
Age (per 1-year increase)	-0.21	0.07	0.008	
Hypertension	-2.34	1.12	0.044	
Serum Phosphorus (mg/dL)	-0.91	0.28	0.003	
Dialysis Vintage (months)	-0.15	0.04	0.001	

Table – VI: Spearman's Correlation Between iPTH Levels and Cardiac Dysfunction Parameters

Variable	Spearman's ρ	P-Value
Left Ventricular Ejection Fraction (LVEF, %)	-0.46	<0.001
Left Ventricular Hypertrophy (LVH, %)	0.41	<0.001
B-Type Natriuretic Peptide (BNP, pg/mL)	0.48	<0.001
Carotid Intima-Media Thickness (CIMT, mm)	0.39	<0.001
Serum Calcium (mg/dL)	-0.33	0.001
Serum Phosphorus (mg/dL)	0.37	<0.001
Calcium-Phosphorus Product (mg^2/dL^2)	0.36	<0.001
Dialysis Duration (months)	0.25	0.009

DISCUSSION

Elevated parathyroid hormone (iPTH) levels have emerged as a significant risk factor for cardiac dysfunction in individuals undergoing hemodialysis. The relationship between parathyroid hormone (PTH) levels and cardiac dysfunction in individuals undergoing hemodialysis has garnered significant attention due to its potential implications for managing cardiovascular risk in this high-risk population. In our study, we examined 215 hemodialysis patients, with a focus on the effects of elevated intact parathyroid hormone (iPTH) levels on cardiac dysfunction. This study aimed a strong association between elevated iPTH and various markers of cardiac dysfunction, including left ventricular ejection fraction (LVEF), left ventricular hypertrophy (LVH), and serum biomarkers such as B-type natriuretic peptide (BNP) and carotid intima-media thickness (CIMT). These findings suggest that iPTH could be a key risk factor for cardiac abnormalities in this cohort. The baseline characteristics of the two treatment groups were comparable, with a mean age of 59.1±10.8 years in the elevated iPTH group and 57.2±11.6 years in the normal iPTH group. In a similar study conducted by *Li et al.*, the mean age of patients with elevated iPTH was 58.3 years, which is consistent with the age range observed in our study, suggesting that iPTH levels tend to increase with age, particularly in individuals with chronic kidney disease (CKD) [15]. Gender distribution was also comparable between groups, with 64.62% males in the elevated iPTH group and 57.65% in the normal iPTH group. In a study by *Tan J et al*., a male predominance was observed in hemodialysis patients, which is similar to the gender distribution in our STUDY [16].Furthermore, the elevated iPTH group had a significantly longer dialysis duration (52.8±27.1 months) compared to the normal iPTH group (41.5 ± 24.9 months, p=0.012), reflecting prolonged exposure to the metabolic abnormalities associated with CKD. This finding is in line with a study by *Zhang et al*., where longer dialysis duration was associated with increased iPTH levels and cardiovascular complications in hemodialysis patients [17]. Diabetes mellitus was more prevalent in the elevated iPTH group (53.08%) compared to the normal iPTH group (38.82%, p=0.043), consistent with prior research linking elevated iPTH levels with an increased risk of diabetes in hemodialysis patients [18]. The results of our study also demonstrated a clear link between elevated iPTH levels and the severity of cardiac dysfunction. Specifically, the mean LVEF was significantly lower in the elevated iPTH group (50.1±8.9) than in the normal iPTH group (56.4 ± 9.2, p<0.001). This is in line with previous findings suggested by *Bollerslev J et al*. that hyperparathyroidism is associated with adverse effects on cardiac function, particularly through mechanisms such as increased calcium-phosphate product and vascular calcification [19]. In our study, left ventricular hypertrophy (LVH) was more prevalent in the elevated iPTH group (70%) compared to the normal iPTH group (48.2%, p=0.002), which further supports the hypothesis that high iPTH levels contribute to structural cardiac changes, as LVH is a well-established marker of cardiac strain in dialysis patients [20]. B-type natriuretic peptide (BNP) levels, a marker of heart failure, were significantly higher in patients with elevated iPTH (511 pg/mL compared to 301 pg/mL, p<0.001). A study by *Maisel et al.,* demonstrated that elevated BNP levels are commonly associated with heart failure and other forms of cardiac stress, and the increase in BNP seen in this cohort may reflect the subclinical cardiac dysfunction associated with elevated iPTH levels [21]. Similarly, carotid intima-media thickness (CIMT), a marker of atherosclerosis and vascular dysfunction, was significantly higher in patients with elevated iPTH (0.89 mm compared to 0.74 mm, p<0.001), further suggesting that elevated iPTH may contribute to the development of both myocardial and vascular dysfunction in this population [22]. Logistic regression analysis revealed that elevated iPTH (>65 pg/mL) was independently associated with an increased risk of cardiac dysfunction, with an adjusted odds ratio (OR) of 2.34 (95% CI: 1.21–4.53, p=0.012). This association remained significant after adjusting for other potential confounders, such as hypertension, diabetes mellitus, and dialysis duration. These findings corroborate

previous studies that have identified elevated iPTH as an independent risk factor for adverse cardiac outcomes in hemodialysis patients.[23] Additionally, dialysis duration of more than 48 months was also significantly associated with cardiac dysfunction (adjusted OR: 1.82, 95% CI: 1.19–3.52, p=0.028), underscoring the role of long-term dialysis exposure in the development of cardiovascular complications [24]. Further analysis through multivariate linear regression confirmed that iPTH levels were a significant predictor of LVEF, with each 10 pg/mL increase in iPTH corresponding to a 0.28% decrease in LVEF (p=0.002). Other significant predictors of reduced LVEF included age, hypertension, serum phosphorus, and dialysis vintage. These results are consistent with literature suggesting that calcium-phosphate imbalances and PTH excess may directly contribute to cardiac dysfunction through both direct and indirect mechanisms [25]. Additionally, iPTH levels were negatively correlated with serum calcium (ρ=-0.33, p=0.001) and LVEF (ρ=-0.46, p<0.001), while being positively correlated with LVH (ρ=0.41, p<0.001), BNP (ρ=0.48, p<0.001), CIMT (ρ=0.39, p<0.001), and serum phosphorus (ρ=0.37, p<0.001), reinforcing the notion that iPTH acts as a central mediator of cardiovascular risk in hemodialysis patients. In terms of biochemical markers, the elevated iPTH group exhibited significantly lower serum calcium levels (8.1 mg/dL compared to 8.8 mg/dL, p<0.001) and higher serum phosphorus levels (5.5 mg/dL compared to 4.8 mg/dL, p<0.001), both of which are known to contribute to vascular calcification and cardiac dysfunction in CKD patients [26]. The calcium-phosphorus product, an important indicator of calcification risk, was significantly higher in the elevated iPTH group (45.9 mg^2/dL^2 compared to 41.7 mg^2/dL^2, p=0.004), further supporting the role of mineral imbalances in the pathogenesis of cardiovascular disease in this population. Additionally, the lower serum albumin levels and slightly reduced dialysis efficiency (Kt/V) observed in the elevated iPTH group may reflect poor nutritional status and suboptimal dialysis, both of which are recognized risk factors for cardiac dysfunction in dialysis patients [27].

LIMITATIONS OF THE STUDY

Despite the valuable insights provided by this study, several limitations should be acknowledged. Firstly, the cross-sectional design of the study limits the ability to establish causality between elevated iPTH levels and cardiovascular dysfunction. Longitudinal studies are needed to determine the long-term effects of iPTH on cardiovascular outcomes. Secondly, the sample size, while adequate for preliminary findings, may not be sufficiently large to capture all potential confounders or to generalize the results to a broader population of hemodialysis patients. Additionally, the study did not account for the potential impact of medications (such as calcium or phosphate binders) on iPTH levels and cardiovascular function, which could influence the observed associations. Furthermore, the lack of detailed data on nutritional status, physical activity, and other lifestyle factors may have contributed to residual confounding. Finally, the study was conducted in a single center, limiting the external validity of the results.

CONCLUSION AND RECOMMENDATIONS

In conclusion, our study demonstrates a significant association between elevated iPTH levels and adverse cardiovascular outcomes in hemodialysis patients. Elevated iPTH was linked to lower left ventricular ejection fraction (LVEF), higher left ventricular hypertrophy (LVH), increased B-type natriuretic peptide (BNP), and greater carotid intima-media thickness (CIMT), suggesting a direct impact on both myocardial and vascular dysfunction. Additionally, longer dialysis duration, diabetes mellitus, and mineral imbalances (including lower serum calcium and higher phosphorus) were identified as contributing factors to cardiovascular risk. Our findings highlight the critical role of managing iPTH levels and optimizing dialysis adequacy to mitigate cardiac dysfunction in this population. These results support the need for strategies aimed at controlling mineral metabolism and improving dialysis efficiency to improve long-term cardiovascular outcomes in hemodialysis patients. Further research is required to explore potential therapeutic interventions targeting elevated iPTH to prevent cardiovascular complications in this high-risk group.

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ORIGINAL ARTICLE

Assessment of Serum Phosphate, Calcium, and Parathyroid Hormone Levels in Relation to Metabolic Disturbances in Maintenance Hemodialysis Patients

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ABSTRACT

Background: *Maintenance hemodialysis (MHD) is the primary treatment for end-stage renal disease (ESRD), but it is associated with significant metabolic disturbances. Serum phosphate, calcium, and parathyroid hormone (PTH) imbalances contribute to chronic kidney disease-mineral and bone disorder (CKD-MBD), which increases morbidity and cardiovascular risks. Understanding the relationship between these biochemical parameters and metabolic disturbances is crucial for improving patient management.*

Aim: *To assess the relationship between serum phosphate, calcium, and PTH levels with metabolic disturbances in MHD patients in Bangladesh.* ***Methods & Materials:*** *A cross-sectional study was conducted at Dhaka Medical College Hospital with 80 MHD patients. Clinical and biochemical data, including serum phosphate, calcium, iPTH, and lipid profiles, were analyzed using SPSS (version 26). Correlation analysis was performed to examine associations between metabolic disturbances and biochemical markers.* ***Results:*** *Mean serum phosphate, calcium, and iPTH levels were 5.56±1.36 mg/dl, 8.74±1.30 mg/dl, and 274.59±150.34 pg/ml, respectively. Significant correlations were found between metabolic disturbances and serum phosphate (r=0.652, p<0.001), iPTH (r=0.725, p<0.001), and LDL-C (r=0.382, p=0.008), while serum calcium showed a negative correlation (r=-0.320, p=0.012).* ***Conclusion:*** *Hyperphosphatemia, secondary hyperparathyroidism, and dyslipidemia contribute to metabolic disturbances in MHD patients. Effective biochemical management is crucial for improving patient outcomes. Further studies with larger cohorts are recommended to validate these findings.*

Keywords: *Maintenance hemodialysis, Chronic kidney disease, Metabolic disturbances, Serum phosphate, Calcium, Parathyroid hormone*

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INTRODUCTION

Chronic kidney disease (CKD) and its progression to end-stage renal disease (ESRD) necessitating maintenance hemodialysis (MHD) are associated with significant metabolic disturbances, particularly involving serum phosphate, calcium, and parathyroid hormone (PTH) levels. [1] Chronic kidney disease-mineral and bone disorder (CKD-MBD) is a systemic condition frequently observed in patients with CKD. It is characterized by abnormalities in serum calcium (Ca), phosphate (P), and intact parathyroid hormone (iPTH) levels, which are associated with increased risks of extraosseous and vascular calcification. These abnormalities in Ca, P, and iPTH levels are linked to a higher incidence of cardiovascular disease (CVD) and mortality. [2,3] CKD-MBD is especially prevalent among patients undergoing maintenance hemodialysis (MHD), who represent a vulnerable group experiencing multiple metabolic and systemic complications. [2] CKD is a significant public health problem worldwide, with progressive renal function loss being its most severe outcome. Treatment options for CKD include dialysis (hemodialysis or peritoneal dialysis) or kidney transplantation. [4,5] Haemodialysis (HD) is the commonest form of kidney replacement therapy in the world,

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accounting for approximately 69% of all kidney replacement therapy and 89% of all dialysis.[6] Abnormalities in serum Ca, P, and iPTH levels are highly prevalent in chronic dialysis patients and are associated with increased morbidity and mortality.[7] Elevated serum phosphate (Pi), calcium-phosphate product (Ca-Pi), or iPTH levels, as well as low iPTH levels, have been linked to vascular calcification, cardiovascular complications, and mortality in dialysis patients.[8] Ongoing research has established biologically plausible mechanisms by which these abnormalities contribute to adverse outcomes, including vascular calcification and its systemic effects.[9] However, conflicting clinical results have created uncertainty regarding optimal therapeutic targets and strategies for managing these metabolic disturbances.[10] International guidelines, such as the Kidney Disease Outcomes Quality Initiative (KDOQI) and Kidney Disease: Improving Global Outcomes (KDIGO), provide recommendations for the management of CKD-MBD parameters, including serum Ca, P, and iPTH levels. These guidelines aim to optimize patient outcomes and reduce mortality risks associated with CKD-MBD. [11,12] The complexity of mineral metabolism physiology in CKD patients is further compounded by interactions among individual parameters and their evolution over the course of the disease.[10] Older patients undergoing MHD generally show better control of serum phosphate (P) and intact parathyroid hormone (iPTH) levels. Despite this, they face higher mortality rates, reflecting the complex relationship between age, metabolic disturbances, and clinical outcomes.[13] The interaction between CKD-MBD parameters and systemic complications, including inflammation, malnutrition, and cardiovascular risks, emphasizes the importance of developing comprehensive management strategies that are adapted to local contexts.[14] Furthermore, the lack of interdisciplinary care in addressing related complications, such as periodontal disease and inflammation, may exacerbate the burden of CKD-MBD in these patients.[15] The aim of this study was to evaluate serum phosphate, calcium, and parathyroid hormone levels in relation to metabolic disturbances in MHD patients in Bangladesh.

METHODS & MATERIALS

This rigorously structured cross-sectional study was meticulously executed at the Department of Nephrology, Dhaka Medical College and Hospital (DMCH), located in Dhaka, Bangladesh. Spanning a comprehensive one-year period, from May 2021 to April 2022, this investigation aimed to thoroughly examine patients undergoing maintenance hemodialysis. A purposive sampling method was employed to carefully select a total of 80 patients, establishing a well-defined and representative cohort that provided the necessary clinical insights. Stringent eligibility criteria were applied to ensure that the study participants met the required standards, thereby enhancing the scientific validity and clinical relevance of the findings.

Inclusion Criteria:

The study exclusively included individuals aged between 18 and 64 years who were currently undergoing maintenance hemodialysis treatment.

Exclusion Criteria:

Patients with acute kidney injury superimposed on chronic kidney disease (CKD), individuals with a prior history of carotid artery surgery, alcohol consumers, smokers, and pregnant women were systematically excluded.

Data Collection

Data collection was executed with precision using a well-structured and pre-validated questionnaire. This tool captured key demographic and clinical information, including age, gender, blood pressure, body mass index (BMI), and the duration of dialysis. Additionally, relevant laboratory variables such as serum phosphate, serum calcium, serum intact parathyroid hormone (iPTH), and fasting lipid profiles were measured to assess the biochemical status of the participants. The collection process was conducted in full compliance with ethical standards, with informed consent obtained from all participants prior to enrollment. The study was approved by the institutional ethics committee, ensuring adherence to ethical research practices and safeguarding participants' rights.

Statistical Analysis

The collected data were systematically analyzed using the SPSS software (version 26). Continuous variables were presented as mean ± standard deviation (SD), while categorical variables were summarized as frequencies and percentages to provide a comprehensive overview. Statistical comparisons of quantitative variables were conducted using the unpaired t-test, and the chi-square test was applied for categorical data to evaluate relationships between variables. Pearson's correlation coefficient was employed to explore the degree of association between selected variables. A p-value of less than 0.05 was considered statistically significant, thus ensuring that the results are both reliable and robust, contributing valuable insights into the clinical context of maintenance hemodialysis.

RESULT

The study included maintenance hemodialysis patients with a mean age of 43.17±11.38 years. The majority (61.25%) were between 31-50 years old, where 58.75% were male. BMI classification showed that 67.50% had a normal weight and 2.50% were obese. The mean systolic and diastolic blood pressures were 153.21±22.43 mmHg and 89.64±10.45 mmHg, respectively. The average duration of dialysis was 3.56±2.27 years (Table I). Table II shows that the mean serum phosphate was 5.56±1.36 mg/dl, calcium was 8.74±1.30 mg/dl, and iPTH was 274.59±150.34 pg/ml. Lipid profile assessment showed an average total cholesterol of 189.13±42.50 mg/dl, triglycerides at 188.28±70.01 mg/dl, LDL-C at 121.86±26.67 mg/dl, and HDL-C at 37.93±8.50 mg/dl (Table III). Regarding metabolic disturbances, 35% had mild, 45% moderate, and 20% severe disturbances (Table IV). Correlation analysis

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revealed significant associations of metabolic disturbances with serum phosphate (r=0.652, p<0.001), iPTH (r=0.725, p<0.001), and LDL-C (r=0.382, p=0.008), while serum calcium showed a negative correlation (r=-0.320, p=0.012). Other lipid parameters showed no significant correlations (Table V).

Table – I: Demographic and clinical characteristics of the study participants (*n*=80)

Variables	Frequency (n)	Percentage (%)
		Mean±SD
Age (years)		
18-30	10	12.50
31-50	49	61.25
>50	21	26.25
Mean±SD		43.17±11.38
Gender		
Male	47	58.75
Female	33	41.25
BMI (kg/m²)		
Underweight (<18.5)	13	16.25
Normal (18.5-24.9)	54	67.50
Over weight (25.0-29.9)	11	13.75
Obese (>30.0)	2	2.50
Blood pressure (mmHg)		
Systolic		153.21±22.43
Diastolic		89.64±10.45
Duration of dialysis (years)		
Mean±SD		3.56± 2.27

Table – II: Serum phosphate, calcium, and intact parathyroid hormone (iPTH) levels among study participants (*n*=80)

Variables	Mean±SD	Min-max
Serum phosphate (mg/dl)	5.56±1.36	1.89–9.10
Serum calcium (mg/dl)	8.74±1.30	4.22–11.10
iPTH (pg/ml)	274.59±150.34	5.96–727.50

Table – III: Lipid profile characteristics of the study population (*n*=80)

Variables	Mean±SD	Min-max
Total cholesterol (mg/dl)	189.13±42.50	136-287
Triglyceride (mg/dl)	188.28±70.01	88-34
LDL-C (mg/dl)	121.86±26.67	84-176
HDL-C (mg/dl)	37.93±8.50	25-55

LDL-C: Low-Density Lipoprotein Cholesterol; HDL-C: High-Density Lipoprotein Cholesterol.

Table – IV: Distribution of patients by severity of metabolic disturbances (*n*=80)

Severity	Frequency (n)	Percentage (%)
Mild	28	35.00
Moderate	36	45.00
Severe	16	20.00

Table – IV: Correlation between laboratory parameters and metabolic disturbances (*n*=80)

Variables	Metabolic Disturbances (r-value)	P value
Serum phosphate (mg/dl)	0.652	<0.001
Serum calcium (mg/dl)	-0.320	0.012
Intact Parathyroid Hormone (iPTH) (pg/ml)	0.725	<0.001
Total cholesterol (mg/dl)	0.215	0.074
Triglyceride (mg/dl)	0.198	0.092
LDL-C (mg/dl)	0.382	0.008
HDL-C (mg/dl)	-0.145	0.192

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DISCUSSION

Metabolic disturbances are common in maintenance hemodialysis patient's due to impaired kidney function, leading to abnormalities in mineral metabolism and lipid profiles. Dysregulation of serum phosphate, calcium, and iPTH plays a crucial role in the progression of chronic kidney disease-mineral and bone disorder (CKD-MBD) and increases the risk of cardiovascular complications. Elevated phosphate and iPTH levels, along with calcium imbalances, contribute to bone disorders, vascular calcification, and overall metabolic instability. This study aims to assess the relationship between these biochemical parameters and metabolic disturbances in hemodialysis patients, providing insights into disease management and potential therapeutic interventions. In our study, the participants had a mean age of 43.17±11.38 years with the majority (61.25%) were between 31 and 50 years old. Kuswardhani et al. conducted a study on 68 hemodialysis patients and reported a mean age of 56.28±11.79 years. [16] Males were more prevalent in this study, accounting for 58.75%. Our result is consistent with the study of Ayub et al. who showed that male was higher (56.4%) than female (43.2%) in similar study. [17] In this study, over two-thirds (67.5%) of the patients had a normal BMI, followed by 16.3% who were underweight, 13.8% who were overweight, and 2.5% who were classified as obese. Our study is comparable with the study of Al Saran et al. [18] Obesity is considered a contributing factor to metabolic disturbances. [19] The mean duration of dialysis was 3.56±2.27 years, consistent with patients who have long-term dependence on renal replacement therapy. Barzegar et al found that the mean duration of hemodialysis patients was 34.03 months. [20] In this study, serum phosphate levels were elevated with a mean value of 5.56±1.36 mg/dl, which exceeds the normal reference range. Hyperphosphatemia is a well-recognized complication in chronic kidney disease (CKD) patients on hemodialysis, often resulting from impaired phosphate excretion. Similar findings were reported by Block et al., who observed that elevated phosphate levels in dialysis patients were significantly associated with increased mortality risk. [21] Hyperphosphatemia is usually mild and rarely severe enough to cause metabolic acidosis on its own. [22] Conversely, serum calcium levels were within the lower normal range (8.74±1.30 mg/dl), with some patients exhibiting hypocalcemia. A study by Ketteler et al. also reported a high prevalence of hypocalcemia in dialysis patients. [23] Hypocalcemia in metabolic diseases can result from vitamin D deficiency, chronic kidney disease, or hypoparathyroidism. [24] Parathyroid hormone (iPTH) levels varied widely, with a mean of 274.59±150.34 pg/ml, and ranged from 5.96 to 727.50 pg/ml. This variability suggests that secondary hyperparathyroidism is prevalent in the study population, driven by chronic hypocalcemia and hyperphosphatemia. Similar observations were made by Levin et al., who highlighted the necessity of individualized PTH control strategies to minimize metabolic disease like cardiovascular complications. [25] The lipid profile analysis revealed dyslipidemia, characterized by elevated total cholesterol (189.13±42.50 mg/dl) and triglycerides (188.28±70.01 mg/dl). LDL-C was notably high (121.86±26.67 mg/dl), whereas HDL-C was relatively low (37.93±8.50 mg/dl). These findings are in line with previous research by Vaziri (2006), who reported that hemodialysis patients frequently exhibit an atherogenic lipid profile, contributing to increased cardiovascular morbidity. [26] The study classified metabolic disturbances into mild (35%), moderate (45%), and severe (20%). Correlation analysis revealed a significant positive association between serum phosphate levels and metabolic disturbances ($r=0.652$, $p<0.001$), highlighting hyperphosphatemia as a key contributor to metabolic complications in hemodialysis patients. Similarly, iPTH levels exhibited a strong positive correlation ($r=0.725$, $p<0.001$), further emphasizing the role of secondary hyperparathyroidism in metabolic derangements. A meta-analysis by Tentori et al. supports this correlation, demonstrating a clear link between high phosphate and PTH levels with poor patient prognosis in hemodialysis. [27] Conversely, serum calcium levels showed a significant inverse correlation with metabolic disturbances ($r=-0.320$, $p=0.012$), suggesting that lower calcium levels may exacerbate these complications. Among lipid parameters, LDL-C was significantly associated with metabolic disturbances ($r=0.382$, $p=0.008$), reinforcing the link between dyslipidemia and systemic metabolic imbalances. However, total cholesterol, triglycerides, and HDL-C did not demonstrate significant correlations.

LIMITATIONS OF THE STUDY

- No control groups.
- In this study, all patients were from a single dialysis center, who got twice-weekly hemodialysis using the same dialysis solution. But adequacy of dialysis of individual patients was not measured.
- The study did not consider dietary intake, medication adherence, or genetic factors that could influence serum phosphate, calcium, and PTH levels, which may contribute to metabolic disturbances.

CONCLUSION

In conclusion, this study highlights the significant prevalence of metabolic disturbances among maintenance hemodialysis patients, with serum phosphate and intact parathyroid hormone levels playing key roles in disease severity. Elevated serum phosphate and iPTH levels were positively correlated with metabolic disturbances, whereas serum calcium showed an inverse correlation. Dyslipidemia, particularly high LDL-C levels, also exhibited a significant association with metabolic imbalances. These findings underscore the necessity of close monitoring and comprehensive management strategies to mitigate metabolic complications in hemodialysis patients. Further research with larger, multi-center cohorts and longitudinal designs is warranted to develop targeted interventions that optimize patient outcomes and improve overall quality of life.

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ORIGINAL ARTICLE

Impact of Hemodialysis Duration and Clinical Factors on Bone Mineral Density

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ABSTRACT

Background: *Patients with end-stage renal disease (ESRD) on maintenance hemodialysis face increased risk of bone mineral density loss due to disrupted mineral metabolism and chronic inflammation. Identifying key determinants of low BMD is crucial for effective prevention and management.* ***Aim of the study:*** *To evaluate the impact of hemodialysis duration and associated clinical factors on bone mineral density at different anatomical sites in patients with end-stage renal disease (ESRD).* ***Methods & Materials:*** *This cross-sectional study included 60 hemodialysis patients. BMD and T-scores at the spine, hip, and forearm were measured using DEXA. Clinical, biochemical, and inflammatory factors were analyzed using correlation and regression to identify predictors of low BMD.* ***Result:*** *The mean age was 52.4 ± 10.3 years, with a mean dialysis duration of 48.6 ± 22.8 months. BMD was lower in patients with longer dialysis duration, with correlations of −0.412 (spine), −0.389 (hip), and −0.498 (forearm) ($p < 0.01$). Male gender and absence of diabetes were linked to higher BMD ($p < 0.05$). Elevated phosphate and PTH, and reduced vitamin D correlated with lower BMD ($p < 0.05$). Regression identified dialysis duration ($\beta = -0.362$, $p = 0.003$), PTH ($\beta = -0.298$, $p = 0.007$), phosphate ($\beta = -0.251$, $p = 0.016$), and CRP ($\beta = -0.209$, $p = 0.030$) as key predictors.* ***Conclusion:*** *Our findings indicate that longer dialysis duration, high PTH, phosphate, and inflammation predict low BMD in ESRD patients, highlighting the need for early bone health management.*

Keywords: *Bone mineral density, hemodialysis duration, serum phosphate, parathyroid hormone*

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INTRODUCTION

Chronic kidney disease (CKD) is a global public health issue affecting over 10% of the population, and its progression to end-stage renal disease (ESRD) necessitates renal replacement therapy, most commonly hemodialysis (HD).[1] A significant complication of CKD is the disruption of bone and mineral metabolism, leading to conditions such as renal osteodystrophy and increased fracture risk.[2] Patients undergoing hemodialysis are particularly susceptible to alterations in bone mineral density (BMD), which can result in substantial morbidity and mortality.[3] Understanding the impact of hemodialysis duration and associated clinical factors on BMD is crucial for developing effective management strategies. Renal osteodystrophy encompasses a spectrum of bone disorders resulting from CKD-related mineral metabolism abnormalities. [4] These disorders are characterized by alterations in bone turnover, mineralization, volume, and strength, collectively referred to as CKD–mineral and bone disorder (CKD–MBD). [5] The pathogenesis of CKD–MBD involves complex interactions between disrupted calcium and phosphorus homeostasis, secondary hyperparathyroidism, and deficiencies in active vitamin D synthesis. These disturbances contribute to decreased BMD and an elevated risk of fractures among CKD patients. [6] Hemodialysis, a life-sustaining therapy for ESRD, plays a pivotal role in managing CKD–MBD, with its duration implicated in influencing BMD. Prolonged hemodialysis may exacerbate bone loss due to factors such as chronic inflammation, acidosis, and the accumulation of uremic toxins. [7] Conversely, some studies suggest that extended dialysis

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duration could stabilize or even improve BMD by enhancing the removal of phosphate and mitigating secondary hyperparathyroidism. The complex relationship between hemodialysis duration and BMD warrants further investigation, as several clinical factors, including secondary hyperparathyroidism from impaired phosphate excretion and hypocalcemia, contribute to increased bone resorption and decreased BMD.[8] Vitamin D deficiency, prevalent in CKD patients, exacerbates bone demineralization by impairing calcium absorption and promoting PTH secretion, while metabolic acidosis in ESRD stimulates bone buffering mechanisms, leading to mineral loss.[9] Inflammatory cytokines and oxidative stress from uremia contribute to bone remodeling disturbances, while nutritional status and body composition, including malnutrition and low BMI, are critical determinants of BMD and fracture risk in hemodialysis patients.[10] Conversely, obesity may protect BMD due to higher mechanical loading and increased estrogen production, though the relationship between BMI and BMD is not linear, as excessive adiposity can negatively affect bone quality, making it essential to maintain optimal nutritional status for bone health in this population.[11] Pharmacological interventions, including phosphate binders, active vitamin D analogs, and calcimimetics, are essential for managing CKD–MBD by correcting mineral imbalances, suppressing PTH secretion, and mitigating bone turnover abnormalities.[12] However, their effects on BMD are variable, and potential adverse effects, such as vascular calcification, must be carefully considered.[13] Individualized treatment strategies, guided by regular monitoring of biochemical parameters and bone density assessments, are recommended to optimize outcomes.[14] This study aims to evaluate the impact of hemodialysis duration and clinical factors on bone mineral density.

METHODS & MATERIALS

This cross-sectional observational study was conducted at the Department of Nephrology, Dhaka Medical College and Hospital, Dhaka, from October 2020 to September 2021. Ethical approval was obtained from the Research Review Committee (RRC) of the Department of Nephrology, followed by approval from the Ethical Review Committee (ERC) of Dhaka Medical College, Dhaka. A total of 60 adult ESRD patients undergoing maintenance hemodialysis for at least six months were recruited based on predefined inclusion and exclusion criteria. Purposive sampling was employed to select participants who met the criteria.

Inclusion Criteria

- ESRD patients aged ≥18 years undergoing maintenance hemodialysis for at least six months.
- Stable hemodialysis patients with no recent fractures or acute illness.

Exclusion Criteria

- ESRD patients with a history of chronic corticosteroid use, malignancy, or metabolic bone diseases other than renal osteodystrophy.
- ESRD patients with severe hepatic disease, recent fractures (within 6 months), or pregnancy.

Data Collection and Laboratory Analysis

Demographic and clinical data—including age, sex, body mass index (BMI), hemodialysis duration, and comorbidities (diabetes and hypertension)—were collected from patient records and interviews because of their known influence on bone health in hemodialysis patients. Bone mineral density (BMD) was assessed using Hologic Discovery Dual-Energy X-ray Absorptiometry (DEXA). Patients were advised to avoid calcium supplements 24 hours before the test and to remove jewelry and other metallic items on the day of the exam to prevent interference with the X-ray. During the procedure, which lasted 15 to 30 minutes, patients lay fully clothed on a padded platform while a low-dose X-ray beam scanned the bones. The DEXA system's software computed BMD, expressed in grams per square centimeter (g/cm^2) and as T-scores (comparing patients' values to those of a young, healthy reference population). Height and weight were measured using a stadiometer and a calibrated weight scale, respectively. Fasting blood samples were drawn prior to scheduled dialysis sessions to analyze biochemical markers pertinent to bone metabolism. These included serum calcium (8.5–10.2 mg/dL), phosphate (2.5–4.5 mg/dL), intact parathyroid hormone (iPTH; 10–65 pg/mL), 25-hydroxyvitamin D (with sufficiency defined as ≥30 ng/mL), serum albumin, and C-reactive protein (CRP). All assays were performed using standardized enzymatic and immunoassay techniques in a certified laboratory to ensure accuracy and reproducibility.

Statistical Analysis

Data were analyzed using the Statistical Package for the Social Sciences (SPSS) version 26. Continuous variables were expressed as mean ± standard deviation (SD), and categorical variables as frequencies and percentages. Pearson's correlation coefficients were computed to assess associations between duration of hemodialysis, laboratory parameters, and BMD at different sites. A multivariate linear regression model was constructed to identify independent predictors of BMD, adjusting for potential confounders. Statistical significance was determined with a p-value threshold of <0.05.

RESULT

A total of 60 ESRD patients undergoing maintenance hemodialysis were included in this study. The mean age was 52.4 ± 10.3 years, with 53.33% of participants under 60 years. The cohort comprised 35 males (58.33%) and 25 females (41.67%). The average body mass index (BMI) was 24.8 ± 4.2 kg/m^2, and the mean duration of hemodialysis was 48.6 ± 22.8 months. Common comorbidities included hypertension (50.00%) and diabetes mellitus (36.67%) (Table I). Table 2 represented that the mean BMD at the lumbar spine was 0.92±0.18 g/cm^2 with a T-score of -1.95±1.14. Osteoporosis was observed in 16.67% of patients, osteopenia in 36.67%, and normal BMD in 46.67%. At the left hip, the mean BMD was 0.87±0.15 g/cm^2, and similar patterns of osteoporosis (16.67%), osteopenia (36.67%), and normal BMD (46.67%) were found. The left forearm showed the lowest mean BMD of 0.74±0.16 g/cm^2 and the highest prevalence of osteoporosis

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(60%) (Table II). Significant negative correlations were observed between hemodialysis duration and BMD at the lumbar spine (r = -0.412, p = 0.003), left hip (r = -0.389, p = 0.007), and left forearm (r = -0.498, p < 0.001) (Table III). Table IV showed that males exhibited the highest BMD values across all measurement sites, with a mean BMD of 0.94±0.17 g/cm^2 at the lumbar spine, 0.89±0.14 g/cm^2 at the left hip, and 0.76±0.18 g/cm^2 at the left forearm, significantly higher than females (p =0.037). Parathyroid hormone exhibited the strongest negative correlation with BMD across all sites, with the highest correlation magnitude at the left hip (r = -0.438, p = 0.002), followed by the forearm (r = -0.415, p = 0.003) and lumbar spine (r = -0.402, p = 0.004). Serum phosphate also showed significant negative correlations, with the strongest association at the left forearm (r = -0.312, p = 0.015). In contrast, vitamin D demonstrated the highest positive correlation with BMD at the lumbar spine (r = 0.378, p = 0.007), followed by the left hip (r = 0.341, p = 0.012) and left forearm (r = 0.332, p = 0.018) (Table V). Multivariate regression analysis identified hemodialysis duration as the strongest predictor of lower BMD, with a beta coefficient of -0.362 (p = 0.003) and a 95% confidence interval of (-0.21, -0.05) (Table VI).

Table – I: Baseline Characteristics of Study populations (*n*=60)

Variables	Number (n)	Percentage (%)
Age in years		
<60	32	53.33
≥60	28	46.67
Mean± SD	52.4 ± 10.3	
Gender		
Male	35	58.33
Female	25	41.67
BMI (kg/m^2)		
Mean± SD	24.8 ± 4.2	
Duration of Dialysis (months)		
Mean± SD	48.6 ± 22.8	
Comorbidities		
Diabetes Mellitus	22	36.67
Hypertension	30	50.00

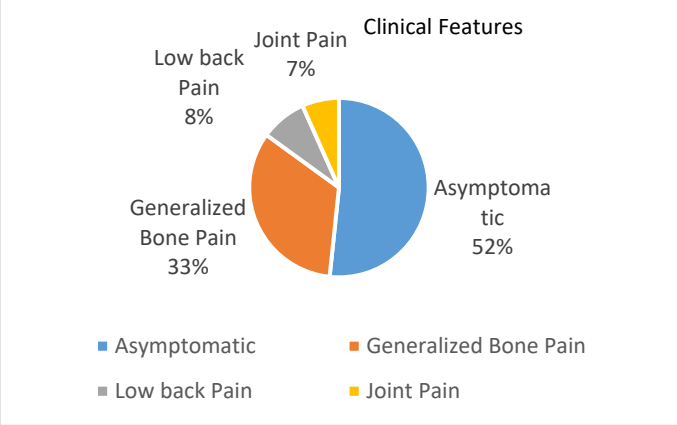

Figure – 1: clinical features of bone disease among study populations

Table – II: Bone Mineral Density (BMD) and T-scores at Different Sites

Measurement Site	BMD (g/cm^2) (Mean ± SD)	T-score (Mean ± SD)	Osteoporosis		Osteopenia		Normal	
			n	%	n	%	n	%
Lumbar Spine	0.92 ± 0.18	-1.95 ± 1.14	10	16.67	22	36.67	28	46.67
Left Hip	0.87 ± 0.15	-1.68 ± 1.07	10	16.67	22	36.67	28	46.67
Left Forearm	0.74 ± 0.16	-2.30 ± 1.20	36	60.00	16	26.67	8	13.33

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Table – III: Correlation Between Hemodialysis Duration and BMD

Measurement Site	Pearson's Correlation Coefficient (r)	p-value
Lumbar Spine BMD	-0.412	0.003**
Left Hip BMD	-0.389	0.007**
Left Forearm BMD	-0.498	<0.001**

Table – IV: Association of Clinical Factors with Bone Mineral Density

Factor	Lumbar Spine BMD (Mean ± SD)	p-value	Left Hip BMD (Mean ± SD)	p-value	Left Forearm BMD (Mean ± SD)	p-value
Gender						
Male	0.94 ± 0.17	0.042*	0.89 ± 0.14	0.028*	0.76 ± 0.18	0.037*
Female	0.89 ± 0.18		0.84 ± 0.15		0.70 ± 0.15	
Diabetes Mellitus						
Present	0.88 ± 0.19	0.015*	0.83 ± 0.14	0.012*	0.72 ± 0.17	0.022*
Absent	0.95 ± 0.17		0.90 ± 0.15		0.76 ± 0.16	
Hypertension						
Present	0.90 ± 0.18	0.064	0.86 ± 0.15	0.075	0.74 ± 0.16	0.095
Absent	0.94 ± 0.17		0.88 ± 0.14		0.76 ± 0.15	

Table – V: Laboratory markers and their association with bone mineral density

Laboratory Parameter	Mean ± SD	Correlation with Lumbar Spine BMD		Correlation with Left Hip BMD		Correlation with Left Forearm BMD	
		r	p	r	p	r	p
Serum Calcium (mg/dL)	8.9 ± 0.7	0.112	0.386	0.135	0.314	0.123	0.356
Serum Phosphate (mg/dL)	5.2 ± 1.1	-0.271	0.032*	-0.295	0.021*	-0.312	0.015*
Parathyroid Hormone (pg/mL)	185.4 ± 78.9	-0.402	0.004**	-0.438	0.002**	-0.415	0.003**
Vitamin D (ng/mL)	22.3 ± 8.6	0.378	0.007**	0.341	0.012*	0.332	0.018*
Serum Albumin (g/dL)	3.8 ± 0.5	0.112	0.312	0.098	0.329	0.115	0.303
C-Reactive Protein (mg/L)	5.7 ± 3.1	-0.26	0.027*	-0.238	0.042*	-0.275	0.018*

Table – VI: Multivariate regression analysis predicting low bone mineral density

Predictor Variable	Beta Coefficient (β)	p-value	95% Confidence Interval
Duration of Hemodialysis	-0.362	0.003**	(-0.21, -0.05)
Parathyroid Hormone Levels	-0.298	0.007**	(-0.15, -0.03)
Serum Phosphate	-0.251	0.016*	(-0.09, -0.01)
Vitamin D Levels	0.21	0.024*	(0.02, 0.18)
Serum Albumin	0.148	0.081 (ns)	(-0.02, 0.31)
C-Reactive Protein	-0.209	0.030*	(-0.38, -0.02)

DISCUSSION

Bone mineral density (BMD) is a critical indicator of bone health, reflecting the strength and density of bones [15]. In patients undergoing hemodialysis, BMD is often compromised due to factors such as mineral metabolism disturbances, hormonal imbalances, and the effects of dialysis itself [16]. These alterations can lead to conditions like osteopenia and osteoporosis, increasing the risk of fractures and adversely affecting the quality of life [17]. The duration of hemodialysis has been identified as a significant factor influencing BMD, with longer dialysis periods associated with greater bone demineralization [18]. Additionally, clinical factors such as serum phosphate levels, parathyroid hormone (PTH) concentrations, and vitamin D status play pivotal roles in modulating bone health in this population [19]. Understanding the interplay between hemodialysis duration and these clinical factors is essential for developing effective strategies to preserve bone health in individuals with end-stage renal disease. In our study, we aimed to investigate the impact of hemodialysis duration and clinical factors on bone mineral density (BMD) in patients with end-stage renal disease (ESRD). The results from our study show significant associations between hemodialysis duration, clinical factors such as gender, diabetes, and hypertension, as well as laboratory markers including serum phosphate, parathyroid hormone (PTH), and vitamin D levels, with BMD at various sites. One of the major findings in the present study is the negative correlation between the duration of hemodialysis and BMD at the lumbar spine, left hip, and left forearm. Specifically, the Pearson's correlation coefficients ranged from -0.389 to -0.498 ($p < 0.01$), highlighting that longer hemodialysis duration is associated with lower BMD at these

sites. These findings align with previous studies which suggest that prolonged dialysis contributes to bone loss in ESRD patients, possibly through the dysregulation of calcium-phosphate balance and secondary hyperparathyroidism [20-21]. In fact, multivariate regression analysis in our study revealed that hemodialysis duration is a significant predictor of low BMD (β = -0.362, p = 0.003), supporting the evidence that prolonged dialysis duration may exacerbate bone demineralization. A similar study by Nazzal et al. (2020) also reported that a longer duration of dialysis is associated with reduced bone mineral density (BMD) ($p<0.05$) [19]. These findings are consistent with prior research from Japan, which reported that extended dialysis treatment is strongly correlated with hyperparathyroidism and generalized bone loss [22]. In addition, our study observed that gender significantly affected BMD, with males having higher BMD values compared to females at the lumbar spine, left hip, and left forearm. This result is consistent with previous reports which highlight that postmenopausal woman, who are typically at higher risk for osteoporosis, experience more severe bone loss compared to men undergoing hemodialysis [23]. Moreover, diabetes mellitus was found to be associated with lower BMD in our study, particularly in the lumbar spine and left hip ($p < 0.05$). This is consistent with the findings of a meta-analysis by Slouma et al. (2020), which concluded that diabetes is a risk factor for reduced bone density, potentially due to the effects of hyperglycemia and insulin resistance on bone metabolism [15]. Interestingly, while hypertension was common among our study population, it did not show a statistically significant association with BMD at the measured sites. This finding contrasts with some studies that suggest an inverse relationship between hypertension and bone density, possibly due to the effects of antihypertensive medications like thiazide diuretics on calcium metabolism [24]. However, the lack of significance in our cohort may be due to the high prevalence of other factors, such as diabetes, that may mask the potential effect of hypertension on bone density. Further, laboratory markers such as serum phosphate, parathyroid hormone (PTH), and vitamin D were found to be significantly correlated with BMD. In our study, serum phosphate levels showed a negative correlation with BMD at all three sites ($p < 0.05$), suggesting that hyperphosphatemia, which is common in ESRD patients, contributes to bone mineral loss [25]. Similarly, elevated PTH levels were associated with decreased BMD ($p < 0.01$), which aligns with the well-established role of secondary hyperparathyroidism in bone resorption in dialysis patients [25]. On the other hand, higher vitamin D levels were positively correlated with BMD ($p < 0.05$), reinforcing the importance of vitamin D in maintaining bone health in ESRD patients, as suggested by previous studies [26]. Notably, our study identified C-reactive protein (CRP) as a significant negative predictor of BMD (β = -0.209, p = 0.030). This finding suggests that inflammation may contribute to bone loss in dialysis patients, as chronic inflammation is known to impair bone remodeling and increase the risk of fractures [27]. Thus, controlling inflammation in ESRD patients could be an important strategy to prevent further bone demineralization.

LIMITATIONS OF THE STUDY

Despite the significant findings, several limitations of the present study must be acknowledged. Firstly, the cross-sectional design of the study limits our ability to infer causal relationships between hemodialysis duration, clinical factors, and bone mineral density. Longitudinal studies are needed to confirm the temporal effects of these variables on bone health. Additionally, the relatively small sample size of 60 patients may limit the generalizability of the results. Furthermore, factors such as medications, diet, and physical activity, which can also affect bone health, were not systematically controlled for in this study.

CONCLUSION AND RECOMMENDATIONS

In our study, we have demonstrated that both hemodialysis duration and clinical factors significantly influence bone mineral density (BMD) in patients with end-stage renal disease (ESRD). Specifically, prolonged hemodialysis duration was associated with reduced BMD at multiple sites, highlighting the need for ongoing monitoring of bone health in these patients. Moreover, clinical factors such as gender, diabetes, and laboratory markers, including serum phosphate, parathyroid hormone (PTH), and vitamin D levels, also emerged as important contributors to bone demineralization. These findings emphasize the importance of early identification of high-risk patients and suggest that targeted interventions aimed at regulating phosphate levels, optimizing vitamin D status, and controlling inflammation could help prevent further bone loss in ESRD patients. Future research should explore the potential benefits of specific therapeutic strategies to mitigate bone mineral density decline in this vulnerable population.

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ORIGINAL ARTICLE

Vitamin D Deficiency in Patients with Systemic Lupus Erythematosus – Prevalence and Clinical Associations

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ABSTRACT

Background: *Systemic lupus erythematosus (SLE) is a complex autoimmune disease characterized by multisystem involvement and significant morbidity. Vitamin D, known for its immunomodulatory properties, has been increasingly linked to disease activity and clinical outcomes in autoimmune conditions, including SLE. Despite abundant sunlight in Bangladesh* ***Objectives:*** *This study aimed to determine the prevalence of vitamin D deficiency in Bangladeshi patients with SLE and to explore its association with disease activity and organ involvement.* ***Methods & Naterial:*** *This cross-sectional study was conducted over one year at Dhaka Medical College Hospital and included 130 adult patients diagnosed with SLE according to the ACR 1997 criteria. Participants were categorized based on serum 25(OH)D levels into three groups: deficient (<20 ng/mL), insufficient (20–29 ng/mL), and sufficient (≥30 ng/mL).* ***Results:*** *Vitamin D deficiency was present in 64.6% (n=84) of patients. Deficient patients showed significantly higher disease activity scores (mean SLEDAI 14.2±3.9 vs. 9.8±2.7, p<0.001), increased renal involvement (46.4% vs. 16.7%, p=0.043), and higher anti-dsDNA positivity (76.2% vs. 50.0%, p=0.037) compared to sufficient patients. Complement levels (C3 and C4), ESR, and CRP were significantly lower in deficient patients.* ***Conclusion:*** *Vitamin D deficiency is highly prevalent in Bangladeshi SLE patients and is significantly associated with increased disease activity and renal involvement. Routine assessment and supplementation of vitamin D may serve as a simple, cost-effective adjunct in the management of SLE to potentially reduce disease severity and improve outcomes.*

Keywords: *Systemic lupus erythematosus, Vitamin D deficiency, SLEDAI, Renal involvement, Autoimmunity*

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INTRODUCTION

Systemic lupus erythematosus (SLE) is a chronic, relapsing-remitting, multisystem autoimmune disease marked by the production of a wide range of autoantibodies and the formation of immune complexes, which result in widespread inflammation and tissue damage across multiple organ systems [1]. SLE predominantly affects young women of reproductive age and presents with heterogeneous clinical manifestations ranging from mild constitutional symptoms to severe, life-threatening complications such as lupus nephritis, neuropsychiatric involvement, and hematological abnormalities [2]. The global burden of SLE is increasing, with an estimated prevalence ranging from 50 to 150 cases per 100,000 population [3]. In Bangladesh, although comprehensive nationwide epidemiological data remain limited, hospital-based reports indicate that SLE constitutes approximately 12–15% of rheumatology outpatient visits in tertiary care centers, underscoring its rising clinical and public health relevance in the region [4]. The pathogenesis of SLE is multifactorial, involving genetic predisposition, hormonal influence, environmental triggers, and immune dysregulation [5]. Among environmental factors, vitamin D deficiency has recently garnered considerable attention due to its potential role in immune modulation. Vitamin D, primarily synthesized in the skin via ultraviolet B (UVB) radiation and obtained through limited dietary sources, plays an essential

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role in regulating both innate and adaptive immune responses [6]. It inhibits pro-inflammatory Th1 and Th17 cytokines while enhancing regulatory T-cell activity, thereby contributing to immune tolerance. Deficiency in vitamin D has been linked to the development and exacerbation of several autoimmune diseases, including SLE [7]. Numerous studies have reported a high prevalence of hypovitaminosis D among patients with systemic lupus erythematosus (SLE), with variations influenced by geographical location, sunlight exposure, lifestyle practices, and clinical severity [8]. In South Asian populations, this prevalence is thought to be even higher due to several contributing factors. These include darker skin pigmentation, which reduces cutaneous vitamin D synthesis, as well as conservative clothing styles and limited outdoor activity that restrict sun exposure [9]. The use of corticosteroids in lupus management further disrupts vitamin D metabolism. Despite abundant sunlight in many regions, deficiency remains paradoxically common due to these overlapping cultural, environmental, and clinical factors [10]. In SLE patients, vitamin D deficiency has been associated with increased disease activity, elevated levels of anti-dsDNA antibodies, and a higher risk of complications such as lupus nephritis, musculoskeletal pain, fatigue, cardiovascular disease, osteoporosis, and infection [11]. Corticosteroid therapy, often a mainstay in SLE management, further exacerbates this deficiency by interfering with vitamin D metabolism [12]. These complications significantly impair the quality of life and can worsen long-term outcomes. Despite growing evidence of these associations, vitamin D screening is not routinely performed in SLE care in many resource-limited settings like Bangladesh [13]. Moreover, local data exploring the relationship between vitamin D levels and disease manifestations in Bangladeshi SLE patients are scarce [14]. Therefore, this study aimed to evaluate the prevalence of vitamin D deficiency in patients with SLE in Bangladesh and to explore its clinical correlations with disease activity and organ involvement, thereby informing evidence-based management strategies.

METHODS & MATERIALS

This cross-sectional study was conducted in the Department of Nephrology, Dhaka Medical College, Dhaka, Bangladesh. The study spanned 12 months, from April 2018 to March 2019, and focused on evaluating the prevalence of vitamin D deficiency in patients diagnosed with systemic lupus erythematosus (SLE) and exploring its clinical associations. Using a purposive sampling method, a total of 130 patients with confirmed SLE attending the outpatient and inpatient services were enrolled, forming a clearly defined study cohort. All patients fulfilled the American College of Rheumatology (ACR) 1997 revised criteria for the classification of SLE. Based on serum vitamin D levels, participants were categorized into three groups:

Vitamin D Deficient (n=84): 25(OH)D < 20 ng/mL
Vitamin D Insufficient (n=40): 25(OH)D between 20–29 ng/mL
Vitamin D Sufficient (n=6): 25(OH)D ≥ 30 ng/mL

INCLUSION CRITERIA

- Adults aged ≥18 years
- Diagnosed cases of systemic lupus erythematosus (SLE) according to ACR 1997 criteria
- Willingness to participate with informed consent

EXCLUSION CRITERIA

- Concurrent chronic liver disease or chronic kidney disease
- Patients on high-dose vitamin D supplementation (≥1000 IU/day) in the last 3 months
- History of malabsorption syndromes
- Pregnancy or lactation
- Active malignancy or other autoimmune diseases

DATA COLLECTION

Data were systematically collected using a structured, pre-tested questionnaire and review of clinical records. The key variables assessed included age, gender, body mass index (BMI), disease duration, smoking status, sun exposure, and use of vitamin D supplements. Disease activity was assessed using the SLE Disease Activity Index (SLEDAI). Clinical manifestations such as arthritis, mucocutaneous involvement, renal and neuropsychiatric manifestations, hematologic abnormalities, and laboratory parameters including anti-dsDNA, complement C3/C4, ESR, and CRP were recorded. Treatment profiles including corticosteroid use, hydroxychloroquine, immunosuppressants, and lifestyle-related factors such as physical activity, calcium intake, and sunscreen use were also documented. Serum 25-hydroxyvitamin D [25(OH)D] levels were measured using chemiluminescent immunoassay methods. All participants provided written informed consent, and ethical approval was obtained from the Institutional Review Board.

STATISTICAL ANALYSIS

Data analysis was performed using SPSS software (version 22.0). Continuous variables were expressed as mean ± standard deviation (SD), and categorical variables as frequencies and percentages. The chi-square test was used to compare categorical variables between groups. Multivariate logistic regression analysis was conducted to identify independent predictors of vitamin D deficiency. A p-value ≤0.05 was considered statistically significant.

RESULTS

The mean age of SLE patients was similar across all groups with values of 31.2 ± 8.5, 30.8 ± 9.3, and 29.5 ± 8.2 years respectively (Table I). Female predominance was highest among vitamin D deficient patients at 98.81%, while the sufficient group had only 33.33% females. Disease duration was 4.2 ± 2.1, 4.0 ± 2.4, and 3.8 ± 2.0 years. BMI showed minimal variation across groups with values of 22.1 ± 3.4, 22.5 ± 3.7, and 23.0 ± 3.1. Smoking status was present in 3.6%, 5.00%, and 0.00%. Sun exposure increased progressively with vitamin D status at 2.5 ± 1.2, 3.1 ± 1.0, and 4.0 ± 0.8 hours/week. Use of vitamin D supplements was noted in 6.0%, 30.00%, and 83.33% of patients (Table I). Table II showed

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that SLEDAI score was 14.2 ± 3.9, 11.6 ± 3.1, and 9.8 ± 2.7. Arthritis occurred in 73.81%, 65.00%, and 50.00%. Mucocutaneous involvement was noted in 69.05%, 60.00%, and 33.33%, while renal involvement was found in 46.43%, 32.50%, and 16.67%. Neuropsychiatric manifestations occurred in 14.29%, 10.00%, and 0.00%, and hematological abnormalities in 58.33%, 50.00%, and 33.33%. Anti-dsDNA positivity was seen in 76.19%, 65.00%, and 50.00%. Complement C3 levels were 72.1 ± 12.4, 78.5 ± 11.2, and 85.4 ± 10.6, and complement C4 levels were 11.2 ± 4.3, 13.4 ± 3.8, and 15.1 ± 3.2. ESR values were 48.6 ± 14.7, 41.9 ± 13.2, and 37.2 ± 10.8, while CRP levels were 10.3 ± 4.9, 8.2 ± 3.7, and 6.5 ± 2.4 (Table III). For BMI, Odds Ratio was 0.94, 95% Confidence Interval was 0.83 – 1.06 and P=0.317. Renal involvement (OR=2.14; 95% CI: 1.01–4.53) and SLEDAI score (OR=1.22; 95% CI: 1.07–1.39) were significantly associated with vitamin D deficiency. Use of vitamin D supplements showed a protective association (OR=0.19; 95% CI: 0.07–0.52) (Table IV). Table V presented that corticosteroid use was 85.71%, 75.00%, and 50.00%, while Hydroxychloroquine use was 77.38%, 85.00 and 100.00 % (P=0.126). Immunosuppressive therapy use was 60.71%, 50.00%, and 16.67%. Daily calcium intake was 26.19%, 45.00%, and 83.33%, and physical activity was reported in 22.62%, 35.00%, and 66.67% respectively.

Table – I: Demographic and Clinical Characteristics of SLE Patients by Vitamin D Status

Variables	Vitamin D Deficient (n=84) n (%)	Vitamin D Insufficient (n=40) n (%)	Vitamin D Sufficient (n=6) n (%)	P value
Age (years)				
Mean ± SD	31.2 ± 8.5	30.8 ± 9.3	29.5 ± 8.2	0.672
Gender				
Female	83 (98.81)	35 (87.50)	2 (33.33)	<0.001
Male	1(1.19)	5(12.50)	4(66.67)	
Disease Duration (years)				
Mean ± SD	4.2 ± 2.1	4.0 ± 2.4	3.8 ± 2.0	0.788
BMI (kg/m^2)				
Mean ± SD	22.1 ± 3.4	22.5 ± 3.7	23.0 ± 3.1	0.519
Smoking Status	3 (3.6)	2 (5.00)	0 (0.00)	0.713
Sun Exposure (hrs/week)				
Mean ± SD	2.5 ± 1.2	3.1 ± 1.0	4.0 ± 0.8	0.021
Use of Vitamin D Supplement	5 (6.0)	12 (30.00)	5 (83.33)	<0.001

Table – II: Clinical Manifestations and Disease Activity by Vitamin D Status

Clinical Feature	Vitamin D Deficient (n=84) n (%)	Vitamin D Insufficient (n=40) n (%)	Vitamin D Sufficient (n=6) n (%)	P value
SLEDAI Score				
Mean ± SD	14.2 ± 3.9	11.6 ± 3.1	9.8 ± 2.7	<0.001
Arthritis	62 (73.81)	26 (65.00)	3 (50.00)	0.127
Mucocutaneous Involvement	58 (69.05)	24 (60.00)	2 (33.33)	0.045
Renal Involvement	39 (46.43)	13 (32.50)	1 (16.67)	0.043
Neuropsychiatric Manifestations	12 (14.29)	4 (10.00)	0 (0.00)	0.294
Hematological Abnormalities	49 (58.33)	20 (50.00)	2 (33.33)	0.168

Table – III: Laboratory Parameters by Vitamin D Status

Laboratory Parameter	Vitamin D Deficient (n=84) n (%)	Vitamin D Insufficient (n=40) n (%)	Vitamin D Sufficient (n=6) n (%)	P value
Anti-dsDNA positivity	64 (76.19)	26 (65.00)	3 (50.00)	0.037
Complement C3 (mg/dL)				
Mean ± SD	72.1 ± 12.4	78.5 ± 11.2	85.4 ± 10.6	0.011
Complement C4 (mg/dL)				
Mean ± SD	11.2 ± 4.3	13.4 ± 3.8	15.1 ± 3.2	0.019
ESR (mm/hr)				
Mean ± SD	48.6 ± 14.7	41.9 ± 13.2	37.2 ± 10.8	0.028
CRP (mg/L)				
Mean ± SD	10.3 ± 4.9	8.2 ± 3.7	6.5 ± 2.4	0.035

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Table – IV: Multivariate Logistic Regression Analysis for Factors Associated with Vitamin D Deficiency in SLE Patients

Variable	Odds Ratio (OR)	95% Confidence Interval (CI)	P value
Age (per year increase)	1.02	0.97 – 1.08	0.441
Female gender	0.89	0.17 – 4.51	0.886
Disease Duration (years)	1.06	0.88 – 1.29	0.546
BMI	0.94	0.83 – 1.06	0.317
Renal Involvement	2.14	1.01 – 4.53	0.048
SLEDAI Score (per unit increase)	1.22	1.07 – 1.39	0.003
Use of Vitamin D Supplement	0.19	0.07 – 0.52	0.001

Table – V: Treatment Characteristics and Medication Use by Vitamin D Status

Medication/Treatment Variable	Deficient (n=84) n (%)	Insufficient (n=40) n (%)	Sufficient (n=6) n (%)	P value
Corticosteroid use	72 (85.71)	30 (75.00)	3 (50.00)	0.038
Hydroxychloroquine use	65 (77.38)	34 (85.00)	6 (100.00)	0.126
Immunosuppressive therapy (e.g., azathioprine)	51 (60.71)	20 (50.00)	1 (16.67)	0.041
Use of sunscreen, n (%)	59 (70.24)	25 (62.50)	2 (33.33)	0.072
Daily calcium intake (diet/supplement)	22 (26.19)	18 (45.00)	5 (83.33)	0.001
Physical activity (≥3 days/week)	19 (22.62)	14 (35.00)	4 (66.67)	0.004

DISCUSSION

Vitamin D deficiency can be classified into insufficiency and deficiency, both of which are commonly observed in patients with Systemic Lupus Erythematosus (SLE) and may influence disease activity and clinical outcomes [15]. In our study, we observed a significant association between vitamin D deficiency and increased disease activity in systemic lupus erythematosus (SLE) patients. Specifically, the mean SLEDAI scores were 14.2 ± 3.9 in the vitamin D-deficient group, 11.6 ± 3.1 in the insufficient group, and 9.8 ± 2.7 in the sufficient group ($p < 0.001$). This inverse relationship between vitamin D levels and disease activity aligns with findings from previous studies. For instance, a meta-analysis by Irfan et al. reported a significant decrease in SLEDAI scores with vitamin D supplementation (SMD = -0.85; 95% CI: -1.12 to -0.58; $p < 0.00001$) [16]. Renal involvement was notably higher in vitamin D-deficient patients (46.43%) compared to insufficient (32.50%) and sufficient groups (16.67%) ($p = 0.043$). This finding is consistent with a study by WCN23-0334, which found that SLE patients with renal involvement had significantly lower vitamin D levels, and there was a negative correlation between vitamin D levels and SLEDAI scores ($r = -0.591$; $p = 0.001$) [17].Our study also demonstrated that vitamin D-deficient patients had higher anti-dsDNA positivity (76.19%) compared to insufficient (65.00%) and sufficient groups (50.00%) ($p = 0.037$). This aligns with findings from a study by Terrier et al., which reported that vitamin D supplementation led to a decrease in anti-dsDNA levels from 177 ± 63 IU/mL to 103 ± 36 IU/mL over six months ($p < 0.01$) [18]. Complement levels were also affected by vitamin D status. Complement C3 levels were 72.1 ± 12.4 mg/dL in the deficient group, 78.5 ± 11.2 mg/dL in the insufficient group, and 85.4 ± 10.6 mg/dL in the sufficient group ($p = 0.011$). Complement C4 levels followed a similar trend ($p = 0.019$). These findings are in line with a study that found a significant increase in C3 levels with vitamin D supplementation [19]. Inflammatory markers such as ESR and CRP were elevated in vitamin D-deficient patients. ESR values were 48.6 ± 14.7 mm/hr in the deficient group, compared to 41.9 ± 13.2 mm/hr and 37.2 ± 10.8 mm/hr in the insufficient and sufficient groups, respectively ($p = 0.028$). CRP levels showed a similar pattern ($p = 0.035$). These results are consistent with a study by Abou-Raya et al., which reported that vitamin D supplementation led to a decrease in anti-dsDNA levels, indicating reduced inflammation [20]. Multivariate logistic regression analysis in our study revealed that renal involvement (OR = 2.14; 95% CI: 1.01–4.53; $p = 0.048$) and higher SLEDAI scores (OR = 1.22; 95% CI: 1.07–1.39; $p = 0.003$) were significantly associated with vitamin D deficiency. Conversely, the use of vitamin D supplements was associated with a protective effect against deficiency (OR = 0.19; 95% CI: 0.07–0.52; $p = 0.001$). These findings underscore the potential benefits of vitamin D supplementation in managing SLE disease activity [21].

LIMITATIONS OF THE STUDY

This study was cross-sectional in nature, limiting the ability to establish causal relationships between vitamin D deficiency and disease activity in SLE patients. The small number of patients with sufficient vitamin D levels may have restricted the statistical power for subgroup comparisons. Additionally, factors such as seasonal variation in sun exposure, dietary intake, and genetic polymorphisms affecting vitamin D metabolism were not assessed. Being a single-center study, the findings may not be generalizable to all populations or geographic regions.

CONCLUSION

Vitamin D deficiency is highly prevalent among patients with systemic lupus erythematosus in Bangladesh and is significantly associated with increased disease activity and renal involvement. Our findings highlight the protective role

of vitamin D supplementation in reducing deficiency risk and potentially mitigating disease severity. Given the strong correlation between low vitamin D levels and worse clinical manifestations, routine screening and appropriate correction of vitamin D status should be considered an integral component of comprehensive SLE management. Further longitudinal studies are warranted to elucidate the causal relationship and assess the impact of vitamin D optimization on long-term clinical outcomes in this population.

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ORIGINAL ARTICLE

Analysis of Biochemical and Hematological Parameters of Chronic Kidney Disease Patients with Hemodialysis

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ABSTRACT

Background: *Chronic Kidney Disease (CKD) poses a significant public health burden worldwide, especially in low- and middle-income countries like Bangladesh. Hemodialysis (HD), the most common renal replacement therapy in the region, is associated with a wide range of biochemical and hematological disturbances that impact patient outcomes.* ***Aim of the study:*** *To evaluate and compare biochemical and hematological parameters in CKD patients undergoing maintenance hemodialysis with healthy controls to identify key abnormalities for better clinical management.* ***Methods & Materials:*** *A cross-sectional analytical study was conducted at Dhaka Medical College Hospital from October 2018 to September 2019 involving 90 participants: 45 CKD patients on hemodialysis and 45 age- and sex-matched healthy controls. Various biochemical, hematological, and liver enzyme parameters were analyzed using standardized laboratory methods. Statistical analysis was performed using SPSS v22.0, with a p-value ≤ 0.05 considered significant.* ***Result:*** *Significant differences were observed between the case and control groups in several parameters. CKD patients showed elevated levels of creatinine, urea, phosphate, and ALP, and reduced calcium levels. Hematological analysis revealed lower hemoglobin, hematocrit, red blood cell count, platelet count, and total leukocyte count. Liver enzymes ALT and AST were significantly lower in CKD patients, while ALP was markedly higher (p < 0.001 for all).* ***Conclusion:*** *CKD patients on hemodialysis experience profound biochemical and hematological alterations, underscoring the need for routine monitoring to improve patient outcomes and inform treatment strategies.*

Keywords: *Chronic kidney disease, Hemodialysis, Biochemical parameters, Hematological abnormalities, Liver enzymes*

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INTRODUCTION

Chronic kidney disease (CKD) has emerged as a major global public health concern, characterized by a gradual and irreversible decline in kidney function over time, ultimately progressing to end-stage renal disease (ESRD) if not appropriately managed.[1] It is increasingly recognized as a silent epidemic with serious socioeconomic implications. According to the statistics, more than 850 million individuals globally are affected by various forms of kidney disorders, with CKD ranking as the 12th leading cause of death and projected to rise to the top 10 within the next decade.[2] The situation is more severe in low- and middle-income countries (LMICs), where limited awareness, delayed diagnosis, and inadequate treatment access further exacerbate the disease burden. In Bangladesh, recent epidemiological data indicate that approximately 2.4million people, accounting for 11% of the adult population, are living with some degree of CKD.[3] The increasing incidence is attributed to the rising prevalence of diabetes mellitus, hypertension, obesity, and aging, making CKD a rapidly growing health challenge in the region.[4] For patients reaching ESRD, renal replacement therapy (RRT) becomes essential to sustain life. Among the available

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modalities hemodialysis (HD), peritoneal dialysis, and kidney transplantation hemodialysis remains the most widely utilized option in Bangladesh due to limited transplant infrastructure and economic constraints.[5] Although HD significantly improves survival and quality of life, it is associated with numerous biochemical and hematological disturbances arising from both the disease process and the dialysis procedure itself.[6] These include anemia, electrolyte imbalances, alterations in calcium-phosphorus metabolism, hypoalbuminemia, dyslipidemia, and elevated inflammatory markers.[7] These parameters not only serve as markers of disease severity but also play a crucial role in predicting hospitalization rates, cardiovascular complications, quality of life, and overall mortality. Anemia is one of the most common hematological complications in HD patients, primarily due to erythropoietin deficiency, iron dysregulation, chronic inflammation, and shortened red blood cell lifespan.[8] Biochemical changes such as hyperphosphatemia and hypocalcemia contribute significantly to chronic kidney disease–mineral and bone disorder (CKD-MBD), which is linked to vascular calcification and cardiovascular events.[9] Furthermore, fluctuations in serum electrolytes, particularly potassium and sodium during dialysis sessions, can precipitate life-threatening complications such as arrhythmias or cardiac arrest.[10] Elevated serum creatinine and blood urea nitrogen (BUN) levels are reflective of inadequate dialysis or declining residual renal function and are vital for evaluating treatment efficacy.[11] Despite the increasing burden of CKD and growing numbers of patients on HD in Bangladesh, systematic evaluations of biochemical and hematological parameters remain inadequate.[12] Many dialysis centers lack structured follow-up protocols and consistent laboratory monitoring, which hampers optimal patient management and leads to heterogeneous outcomes.[13] Moreover, regional variations in practice patterns, dietary intake, socioeconomic status, and comorbidities necessitate localized data to inform national clinical guidelines.[14] This study aims to analyze and correlate the biochemical and hematological profiles of CKD patients on maintenance hemodialysis in a Bangladeshi tertiary care center to identify key abnormalities and guide improved clinical management.

METHODS & MATERIALS

This cross-sectional analytical study was conducted in the Department of Nephrology at Dhaka Medical College and Hospital, Dhaka, over a one-year period from October 2018 to September 2019. A total of 90 individuals participated in the study and divided into two groups according to need.

Case (n=45): Patients with chronic kidney disease (CKD) undergoing maintenance hemodialysis

Control (n=45): Age- and sex-matched healthy individuals

All of the patients were carefully observed to meet the research objectives and provide valuable insights within the specified timeframe. A purposive non-randomized sampling technique was used to recruit participants based on predefined inclusion and exclusion criteria.

Inclusion Criteria:

- Participants aged over 18 years.
- Patients with diagnosed CKD undergoing regular hemodialysis for at least one year.
- Healthy individuals without any known renal, hepatic, or systemic illnesses for the control group.

Exclusion Criteria:

- Patients with acute kidney injury.
- Patients diagnosed with CKD for less than one year.
- Individuals with known chronic liver disease.
- Patients with excessive alcohol consumption (more than 40 grams/day for males and 20 grams/day for females).
- Pregnant or postpartum women.
- Patients using medications known to affect liver enzymes (e.g., statins, rifampicin).
-

Ethical Considerations

Ethical approval for the study was obtained from the Ethical Review Committee of Dhaka Medical College. Written informed consent was taken from all participants after a full explanation of the study's objectives, procedures, risks, and benefits. All information was kept confidential, and participants were assured of their right to withdraw from the study at any point without any consequences. No financial incentives were provided.

Data Collection

After screening for eligibility, participants were enrolled and evaluated. Data were collected using a structured questionnaire and preformed data collection sheet. Demographic information (age, sex), disease characteristics (CKD stage, duration, probable etiology), and various laboratory parameters were documented. Biochemical parameters included serum creatinine, urea, sodium, potassium, calcium, and phosphate. Hematological assessments comprised hemoglobin levels, hematocrit, red blood cell count, white blood cell count, and platelet count. In addition, liver enzyme levels—serum alanine aminotransferase (ALT), aspartate aminotransferase (AST), and alkaline phosphatase (ALP)—were measured. Blood samples were collected using standard aseptic techniques. Complete blood counts (CBC) were performed using an automated hematology analyzer. Biochemical analyses, including liver enzyme measurements, were conducted using an automated biochemical analyzer based on kinetic methods to ensure accuracy and reliability.

Statistical Analysis

Data were first entered and cleaned using Microsoft Excel 2010 and then exported to SPSS (Version 22.0, SPSS Inc., Chicago, IL, USA) for analysis. Descriptive statistics were used to summarize the data. Continuous variables were presented as mean ± standard deviation (SD) and compared between groups using the independent samples Student's *t*-test. Categorical variables were expressed as frequencies and percentages and compared using the Chi-square test. A *p*-value of ≤ 0.05 was considered statistically significant.

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RESULT

The majority of both cases (patients with chronic kidney disease undergoing hemodialysis) and controls were within the 31–60-year age range. Specifically, 31.1% of cases and 28.9% of controls were aged 51–60 years. The mean age of the cases was significantly higher than that of the controls (47.97 ± 10.93 vs. 41.58 ± 9.26 years, $p = 0.006$) (Table I). In the case group, 56% of the participants were male, while 44% were female. Similarly, in the control group, 53.3% were male and 46.7% were female (Figure 1). All patients (100%) in the study were in stage 5 of chronic kidney disease. The majority had been living with the disease for 3–6 years (53.3%). The mean duration of the disease was 4.66 ± 3.00 years (Table II). Among the CKD patients, glomerulonephritis was the most common probable cause with 44.4% of cases. Less common etiologies included polycystic kidney disease (PCKD) and systemic lupus erythematosus (SLE), each at 6.7% (Table III). The biochemical analysis revealed significantly elevated levels of creatinine, urea, and phosphate in CKD patients undergoing hemodialysis compared to controls ($p < 0.001$). Conversely, serum calcium was significantly lower in cases (7.79 ± 0.72 mg/dl) than in controls (9.36 ± 0.41 mg/dl, $p < 0.001$). No statistically significant differences were observed in sodium and potassium levels between the two groups (Table IV). The hematological analysis showed significantly lower levels of hemoglobin, hematocrit, and red blood cell count in CKD patients on hemodialysis compared to controls ($p < 0.001$). Platelet count was also significantly reduced in cases (208,920.25 ± 69,165.12/mm^3) compared to controls (309,729.83 ± 77,304.54/mm^3, $p < 0.001$). Additionally, total leukocyte count was significantly lower in cases ($p = 0.016$) (Table V). There were significantly lower levels of ALT and AST in CKD patients undergoing hemodialysis than controls ($p < 0.001$), with mean ALT at 17.49 ± 5.04 U/L and AST at 17.73 ± 4.41 U/L. In contrast, serum ALP levels were markedly elevated in the patient group (117.38 ± 13.73 U/L) in comparison of controls (27.62 ± 5.78 U/L, $p < 0.001$) (Table VI).

Table – I: Age distribution of the study groups (*n*=90)

Age (years)	Case (n=45)		Control (n=45)		P-value
	n	%	n	%	
18-30	3	6.7	7	15.6	0.176
31-40	10	22.2	15	33.3	
41-50	12	26.7	10	22.2	
51-60	14	31.1	13	28.9	
>60	6	13.3	0	0	
Mean±SD (in years)	47.97 ± 10.93		41.58 ± 9.26		0.006

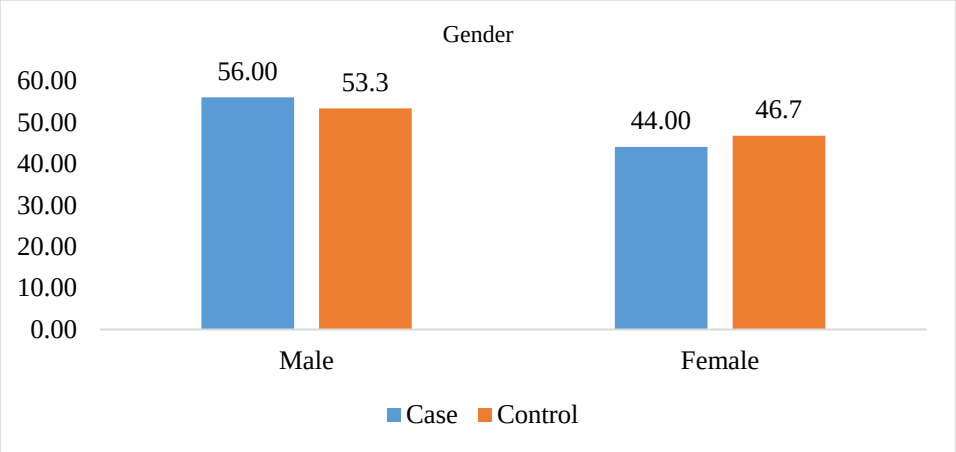

Figure – 1: Gender distribution of the study population (*n*=90)

Table – III (a): Disease characteristics of the patients (*n*=45)

Variables	Frequency (n)	Percentage (%)
Stages of CKD		
Stage-4	0	0
Stage-5	45	100
Duration of disease (years)		
1-3	17	37.77
3-6	24	53.3
>6	4	8.8
Mean±SD (years)	4.66 ± 3.00	

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Table – III (b): Probable etiology of chronic kidney disease (CKD) patients (*n*=45)

Etiology	Frequency (n)	Percentage (%)
Glomerulonephrits	20	44.4
Hypertension	2	4.4
Diabetes mellitus	16	35.6
PCKD	3	6.7
SLE	3	6.7
Obstructive nephropathy	0	0
Others	1	2.2

Table – IV: Biochemical parameters among study population

Parameter	Case (Mean ± SD)	Control (Mean ± SD)	P-value
Creatinine (mg/dl)	8.95 ± 1.49	0.97 ± 0.12	<0.001
Urea (mg/dl)	121.56 ± 51.34	26.87 ± 6.75	<0.001
Sodium (mmol/l)	133.27 ± 11.84	137.65 ± 4.29	0.2
Potassium (mmol/l)	3.48 ± 1.89	3.11 ± 1.56	0.1
Calcium (mg/dl)	7.79 ± 0.72	9.36 ± 0.41	<0.001
Phosphate(mg/dl)	7.54 ± 0.75	3.91 ± 0.43	<0.001

Table – V: Hematological parameters among study population

Parameter	Case (Mean ± SD)	Control (Mean ± SD)	P-value
Hemoglobin (gm/dl)	7.98 ± 2.45	11.58 ± 3.37	<0.001
Hematocrit (%)	26.76 ± 3.43	43.26 ± 1.88	<0.001
Red blood cell count (Million/mm^3)	1.87 ± 1.69	3.75 ± 1.81	<0.001
Total leukocyte count (Thousands/mm^3)	7455.71 ± 1580.35	8232.27 ± 1645.38	0.016
Platelet count (Lakhs/mm^3)	208920.25 ± 69165.12	309729.83 ± 77304.54	<0.001

Table – VI: Serum liver enzyme levels of CKD patients with hemodialysis and control group

Parameter	Case (Mean ± SD)	Control (Mean ± SD)	P-value
Serum ALT (U/L)	17.49 ± 5.04	33.42 ± 4.57	<0.001
Serum AST (U/L)	17.73 ± 4.41	30.56 ± 4.86	<0.001
Serum ALP (U/L)	117.38 ± 13.73	27.62 ± 5.78	<0.001

DISCUSSION

Chronic Kidney Disease (CKD) is a progressive condition marked by the gradual loss of kidney function, often requiring hemodialysis in advanced stages. Hemodialysis significantly alters various biochemical and hematological parameters, which are crucial for patient monitoring and management. This study was conducted to analyze these parameters in CKD patients undergoing hemodialysis to assess their clinical implications and treatment outcomes. The mean age of CKD patients was significantly higher than that of controls (47.97 ± 10.93 vs. 41.58 ± 9.26 years; p = 0.006), indicating that CKD predominantly affects older individuals. This aligns with other studies of increased CKD prevalence with advancing age.[15,16] In the study population, males were more commonly affected with 55.6% in case group. This trend is consistent with findings from Bapat et al., who reported 66% male and 44% female CKD patients.[17] The higher prevalence among males may be attributed to socio-economic and sociocultural influences. According to our study, all patients were in Stage 5 CKD, with a mean disease duration of 4.66 ± 3.00 years. Haq et al. reported that the majority of their CKD patients were newly diagnosed.[16], suggesting that the likelihood of requiring dialysis increases with disease progression and duration. Additionally, Allawi et al., in a cross-sectional study, found that all of their hemodialysis patients were in Stage 5 CKD, which is consistent with the findings of our study.[18] The primary etiologies identified were glomerulonephritis (44.4%) and diabetes mellitus (35.6%). These findings are consistent with the study of Malekmakan et al, which has reported glomerulonephritis and diabetes as leading causes of CKD.[19] Elevated levels in CKD patients (Creatinine: 8.95 ± 1.49 mg/dl; Urea: 121.56 ± 51.34 mg/dl) reflect impaired renal excretory function which were significantly high (p<0.001) as compared to control. A similar study conducted by Amin et al. and Khasawnah et al. reported a significant elevation in urea and creatinine levels among patients with CKD.[20,21] CKD patients exhibited hyponatremia (133.27 ± 11.84 mmol/l) and hyperphosphatemia (7.54 ± 0.75 mg/dl), while potassium levels were slightly elevated (3.48 ± 1.89 mmol/l). These disturbances are common in CKD due to impaired electrolyte regulation.[22] In our study, the mean serum calcium in CKD subjects was 7.79 ± 0.72 and in controls was 9.36 ± 0.41 with p value < 0.001 which was statistically significant. Majority of our study subjects were hypocalcemic. Our result is similar to the study of Singh and Bhatta.[23] We observed lower hemoglobin (7.98 ± 2.45 gm/dl), hematocrit

(26.76 ± 3.43%), and red blood cell count (1.87 ± 1.69 million/mm^3) which indicate anemia, commonly seen in CKD due to reduced erythropoietin production. This aligns with previous study reporting anemia as a prevalent complication in CKD associated with diabetes mellitus, hypertension and glomerulonephritis. [24] Total leukocyte count was slightly lower in CKD patients (7455.71 ± 1580.35 thousands/mm^3) compared to controls, while platelet count was significantly reduced (208920.25 ± 69165.12 lakhs/mm^3). These findings suggest a compromised immune response and increased bleeding risk in CKD patients. Singh et al found similar findings.[23] Significantly reduced levels of ALT (17.49 ± 5.04 U/L) and AST (17.73 ± 4.41 U/L) were observed in CKD patients than control group in our study. Possible mechanisms include low pyridoxine (vitamin B6) levels—a coenzyme for aminotransferase—along with elevated uremic toxins, water retention, and hemodilution in advanced CKD, as well as the presence of UV-absorbing substances that may interfere with transaminase detection. [25,26] Reduced synthesis or release of AST and ALT from hepatocytes, or their accelerated clearance, may also contribute. [27] Furthermore, renal treatments often worsen B6 deficiency, especially in hemodialysis patients. Erythropoietin increases B6 demand for hemoglobin production, while phosphate binders like sevelamer-HCl reduce B6 absorption by about 30%. Due to its low molecular weight (MW 245) and limited body storage, B6 levels can decline within 3–4 months. [28] According to our study, serum ALP level was significantly higher (p= <0.001) case group (117.38 ± 13.73) compared to control group (27.62 ± 5.78). This may reflect high-turnover bone disease, a common complication in CKD. This is consistent with previous research linking increased ALP levels to bone metabolism disorders in CKD. [25]

LIMITATIONS OF THE STUDY

- The cross-sectional design restricts the ability to establish causal relationships or observe long-term trends.
- Potential confounding factors such as dietary habits, medication adherence, and socioeconomic status were not comprehensively evaluated.
- The findings may not account for regional or institutional differences in dialysis practices or patient management.

CONCLUSION

This study highlights significant biochemical and hematological abnormalities in patients with chronic kidney disease undergoing maintenance hemodialysis in Bangladesh. The observed disturbances—such as elevated urea, creatinine, phosphate, and ALP levels, along with reduced calcium, hemoglobin, and transaminases—reflect the systemic burden of CKD and the physiological impact of hemodialysis. These findings stress the necessity for routine, comprehensive laboratory monitoring in dialysis centers to guide timely interventions. Special attention should be paid to correcting anemia, mineral imbalance, and liver enzyme alterations, which may contribute to complications if left unaddressed. Implementing structured follow-up protocols and individualized treatment plans can improve quality of life and reduce morbidity among CKD patients on dialysis.

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Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee.

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ORIGINAL ARTICLE

Epidural Labour Analgesia and Programmed Labour Analgesia in Controlling Labour Pain – A Study of 60 Cases

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ABSTRACT

Background: *Labour pain is one of the most severe forms of pain experienced by women. Analgesia during labour is a crucial component of modern obstetric practice. Epidural labour analgesia is considered the gold standard, but newer methods such as programmed labour analgesia (PLA) are increasingly being explored for efficacy, maternal satisfaction, and neonatal outcomes.* ***Objective:*** *To compare the efficacy, maternal satisfaction, and obstetric/neonatal outcomes of epidural labour analgesia versus programmed labour analgesia in controlling labour pain.* ***Methods & Materials:*** *This prospective comparative study was conducted on 60 parturients admitted for vaginal delivery. Thirty women received epidural analgesia (Group A), while thirty received programmed labour analgesia (Group B). Pain relief was assessed using a Visual Analogue Scale (VAS). Maternal hemodynamic parameters, labour duration, mode of delivery, maternal side effects, neonatal outcomes (APGAR score), and overall maternal satisfaction were recorded and compared.* ***Results:*** *Both groups demonstrated significant reduction in VAS scores after initiation of analgesia. Group A (epidural) achieved superior pain relief with mean VAS scores consistently <3 during active labour, while Group B (PLA) showed moderate pain relief with mean VAS scores around 4–5. Duration of first stage of labour was slightly prolonged in the epidural group compared to PLA. Maternal hypotension occurred more frequently in the epidural group (20%) versus PLA (6.6%). No significant differences were observed in APGAR scores between groups. Maternal satisfaction was high in both groups, but significantly greater in the epidural group ($p<0.05$).* ***Conclusion:*** *Both epidural labour analgesia and programmed labour analgesia are effective in controlling labour pain, but epidural analgesia provides superior pain relief and higher maternal satisfaction at the expense of slightly prolonged labour and increased maternal hypotension. Programmed labour analgesia may be considered as a safe alternative where epidural services are limited.*

Keywords: *Labour Analgesia, Epidural Analgesia, Programmed Labour Analgesia, Labour Pain, Obstetric Outcome*

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INTRODUCTION

Labour pain is regarded as one of the most severe forms of pain experienced by women during their lifetime, arising from uterine contractions, cervical dilatation, and perineal stretching.[1] Unrelieved labour pain can lead to maternal exhaustion, increased catecholamine release, impaired uteroplacental blood flow, and adverse maternal-fetal outcomes[2]. Hence, effective pain management during labour is a critical component of modern obstetric care. Epidural analgesia is widely considered the gold standard for intrapartum pain relief. It provides superior analgesia, reduces maternal stress, and improves the overall birthing experience without significant neonatal compromise.[3,4] However, it requires specialized equipment, continuous monitoring, and trained anesthesiologists, which may not be feasible in all settings.[5] Programmed labour analgesia (PLA) has emerged as a simpler and cost-effective alternative, especially in resource-limited environments. It typically

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involves the administration of opioids, antispasmodics, and antiemetics at fixed intervals, aiming to provide adequate analgesia, facilitate cervical dilatation, and shorten labour duration.[6,7] While PLA may not match the efficacy of epidural analgesia, it is less invasive, easier to administer, and associated with fewer hemodynamic disturbances.[8] Comparative evidence regarding the efficacy and safety of PLA versus epidural analgesia remains limited. Most available studies report that although epidural analgesia offers superior pain relief, PLA provides acceptable analgesia with fewer maternal side effects and no adverse neonatal outcomes.[6,9] Therefore, this study was undertaken to compare the efficacy, maternal satisfaction, and neonatal outcomes of epidural labour analgesia and programmed labour analgesia in 60 parturients.

MATERIALS & METHODS

Study Design and Setting: A prospective comparative study was conducted over a 12-month period in the Department of Anesthesia, North East Medical College & Hospital, Sylhet, Bangladesh from January to December 2024.

Sample Size: A total of 60 parturients in active labour were recruited and randomly allocated into two groups:

- **Group A (Epidural Analgesia):** 30 cases
- **Group B (Programmed Labour Analgesia):** 30 cases

Inclusion Criteria:

- Singleton pregnancy
- Term gestation (37–41 weeks)
- Cephalic presentation
- Spontaneous onset of labour or induced labour
- Willingness to participate and provide informed consent

Exclusion Criteria:

- Contraindications to epidural or systemic analgesia
- High-risk pregnancies (e.g., preeclampsia, heart disease)
- Previous cesarean section
- Known drug allergies

Intervention Protocols:

- **Epidural Analgesia:** A lumbar epidural catheter was inserted at L3–L4 space. A test dose was followed by 0.125% bupivacaine with fentanyl (2 µg/ml) given intermittently to maintain analgesia.
- **Programmed Labour Analgesia:** A standardized regimen of intravenous tramadol (1 mg/kg), drotaverine (40 mg), and an antiemetic was administered at predetermined intervals during labour.

Outcome Measures:

1. **Pain relief:** Measured using the 10-point Visual Analogue Scale (VAS) at baseline, 30 min, 1 hr, and 2 hr after initiation.
2. **Maternal parameters:** Hemodynamics (pulse, BP), duration of first and second stage of labour, mode of delivery.
3. **Side effects:** Hypotension, nausea, vomiting, pruritus, sedation.
4. **Neonatal outcome:** APGAR scores at 1 and 5 minutes.
5. **Maternal satisfaction:** Graded as excellent, good, fair, or poor.

Statistical Analysis: Data were analyzed using SPSS version XX. Continuous variables were expressed as mean ± SD and compared using Student's t-test. Categorical variables were analyzed using chi-square test. A p-value <0.05 was considered statistically significant.

RESULTS

A total of 60 parturients were included in the study, 30 in the Epidural Analgesia group (Group A) and 30 in the Programmed Labour Analgesia group (Group B). The mean age of participants was comparable between the two groups (25.6 ± 3.4 years in Group A vs 26.2 ± 3.1 years in Group B; p=0.41). The distribution of primigravida and multigravida women was also similar, with no statistically significant difference (p>0.05). This indicates that the baseline demographic profile was well matched, minimizing confounding bias in comparing the two analgesic techniques. Both groups were comparable with respect to age, parity, and baseline characteristics (p>0.05).

Table – I: Demographic Profile

Parameter	Group A (Epidural)	Group B (PLA)	p-value
Mean Age (years)	25.6 ± 3.4	26.2 ± 3.1	0.41
Primigravida (%)	60%	56.6%	0.78
Multigravida (%)	40%	43.3%	0.81

The demographic distribution was statistically comparable, eliminating confounding effects.

Table – II: Pain Relief (VAS Scores)

Time interval	Group A (Epidural) Mean ± SD	Group B (PLA) Mean ± SD	p-value
Baseline	8.5 ± 0.6	8.4 ± 0.7	0.72
30 min after	2.1 ± 0.8	4.7 ± 1.0	<0.001
1 hour after	2.4 ± 0.7	4.8 ± 0.9	<0.001
2 hours after	2.6 ± 0.6	5.0 ± 1.0	<0.001

Epidural provided superior pain relief compared to PLA (p<0.001).

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Both groups reported severe pain before administration of analgesia (VAS ~8.5). Following intervention, Group A (epidural) showed a marked reduction in pain scores, with mean VAS decreasing to 2.1 within 30 minutes and remaining below 3 throughout labour. In contrast, Group B (PLA) demonstrated only moderate reduction, with VAS scores remaining around 4–5. The difference between groups was statistically significant ($p<0.001$), confirming that epidural analgesia provides superior pain relief compared to PLA.

Table – III: Labour Characteristics

Parameter	Group A (Epidural)	Group B (PLA)	p-value
Duration of 1st stage (hrs)	9.2 ± 1.4	8.1 ± 1.3	0.01*
Duration of 2nd stage (min)	38.5 ± 9.2	36.8 ± 8.5	0.42
Vaginal delivery (%)	73%	80%	0.54
Cesarean (%)	27%	20%	0.54

First stage of labour was prolonged in epidural group ($p=0.01$), but second stage and mode of delivery were not significantly different.

The first stage of labour was significantly prolonged in the epidural group (9.2 ± 1.4 hrs) compared to the PLA group (8.1 ± 1.3 hrs; $p=0.01$). However, the duration of the second stage of labour was similar in both groups ($p=0.42$). The rate of vaginal deliveries was slightly higher in the PLA group (80%) compared to the epidural group (73%), but this difference was not statistically significant ($p=0.54$). Similarly, cesarean section rates did not differ significantly. Thus, while epidural prolongs the first stage of labour, it does not significantly affect mode of delivery.

Table – IV: Maternal Side Effects

Side effect	Group A (Epidural)	Group B (PLA)
Hypotension	20%	6.6%
Nausea/Vomiting	3.3%	10%
Sedation	0%	13%
Pruritus	6.6%	0%

Hypotension was more frequent in epidural group; PLA showed mild sedation and more nausea/vomiting.

Hypotension was more frequent in the epidural group (20%) compared to the PLA group (6.6%), which is consistent with the known physiological effects of neuraxial blockade. Nausea and vomiting were more common in the PLA group (10% vs 3.3%), likely due to opioid administration. Sedation was reported only in the PLA group (13%), while mild pruritus occurred in 6.6% of epidural cases. These side effects were minor and managed without significant impact on maternal or neonatal outcomes.

Table – V: Neonatal Outcome (APGAR Scores)

APGAR	Group A (Epidural)	Group B (PLA)	p-value
1 min	7.6 ± 0.5	7.5 ± 0.6	0.53
5 min	8.9 ± 0.3	8.8 ± 0.4	0.38

Neonatal outcomes were comparable with no significant difference in APGAR scores.

The mean APGAR scores at 1 minute and 5 minutes were comparable between both groups, with no statistically significant difference ($p>0.05$). This suggests that neither epidural nor PLA had adverse effects on neonatal adaptation immediately after birth. Both techniques are therefore considered safe for neonatal outcomes.

Table – VI: Maternal Satisfaction

Satisfaction level	Group A (Epidural)	Group B (PLA)
Excellent	60%	43%
Good	30%	30%
Fair	10%	17%
Poor	0%	10%

Maternal satisfaction was significantly higher in the epidural group (90% Excellent/Good vs 73% in PLA group).

Maternal satisfaction was significantly higher in the epidural group, with 90% of women rating their experience as "Excellent" or "Good" compared to 73% in the PLA group. A small proportion of PLA patients (10%) rated their experience as "Poor," mainly due to inadequate pain relief. This highlights that while both techniques are acceptable, epidural remains the preferred choice from the maternal perspective.

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DISCUSSION

Labour pain is universally recognized as one of the most severe forms of pain experienced by women, and effective pain management significantly improves maternal comfort and cooperation during childbirth .[10] In this study, both epidural analgesia and programmed labour analgesia (PLA) effectively reduced labour pain, but epidural analgesia provided superior pain relief, consistent with its status as the gold standard.[11,12] Our findings demonstrate that epidural analgesia reduced mean VAS scores to less than 3 throughout labour, whereas PLA maintained scores around 4–5. This is in line with the Cochrane review by Anim-Somuah et al.[11] which reported epidural analgesia as the most effective method for intrapartum pain relief. PLA, while less effective, still provided acceptable analgesia, as supported by Aruna et al.,[13] who found PLA to be a practical option in resource-limited settings. The first stage of labour was prolonged in the epidural group, a finding consistent with previous reports that neuraxial analgesia can modestly prolong labour duration.[14,15] However, our study did not find a significant increase in cesarean delivery rates among women receiving epidural analgesia, echoing findings from Sharma et al.[16] and the Cochrane review.[11] This suggests that while epidural may slightly slow labour, it does not adversely influence overall obstetric outcomes. Maternal hypotension was more common in the epidural group (20%), consistent with known pharmacological effects of sympathetic blockade ,[17] On the other hand, nausea, vomiting, and mild sedation were more frequent with PLA, likely attributable to systemic opioid administration.[12,18] Importantly, these side effects were transient and manageable, and did not impact maternal or neonatal safety. No significant differences in neonatal APGAR scores were observed between groups, indicating that both methods are safe for the neonate. These findings are consistent with Reynolds[19] and Gupta et al.[20] who emphasized that neither epidural nor programmed analgesia compromises neonatal well-being when properly administered. Epidural analgesia was associated with higher maternal satisfaction, with 90% rating their experience as excellent or good, compared to 73% in the PLA group. This is comparable to reports by Hawkins[3] and Sharma et al.,[7] where maternal preference strongly favoured epidural due to superior pain control. Nonetheless, PLA achieved acceptable satisfaction, supporting its role as a viable alternative where epidural services are not readily available. From a clinical perspective, our study reinforces that epidural analgesia remains the optimal choice for labour pain relief where resources and expertise permit. However, PLA should not be underestimated: it is simple, cost-effective, and well-suited for rural or resource-constrained settings, providing reasonable pain relief without the need for specialized infrastructure.

CONCLUSION

- Epidural labour analgesia provides superior pain relief and higher maternal satisfaction compared to programmed labour analgesia.
- Programmed labour analgesia is safe, effective, and may serve as a useful alternative where epidural services are unavailable.
- Both techniques showed no adverse effects on neonatal outcomes.
- Larger multicentric studies are recommended to further establish comparative efficacy.

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ORIGINAL ARTICLE

Laparoscopic versus Open Surgical Repair Techniques in Duodenal Ulcer Perforation – A Prospective Observational study

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ABSTRACT

Background: *Perforated duodenal ulcer is a common surgical emergency. Traditionally managed with open repair, laparoscopic techniques have emerged as a minimally invasive alternative. This study compares the clinical outcomes of laparoscopic versus open repair of duodenal ulcer perforation.* ***Methods & Materials:*** *A prospective observational study was conducted on 60 patients diagnosed with duodenal ulcer perforation between [study period]. Patients were divided into two groups: laparoscopic repair (n=30) and open repair (n=30). Data collected included operative time, postoperative pain (VAS score), time to ambulation, resumption of oral feeds, length of hospital stay, postoperative complications, and mortality.* ***Results:*** *The mean operative time was slightly longer in the laparoscopic group (90±20 min vs. 60±15 min, p<0.05). However, laparoscopic repair was associated with lower postoperative pain scores, earlier ambulation (1.5 vs. 3.0 days), faster initiation of oral feeding (2.0 vs. 3.5 days), and shorter hospital stay (5 or 6 days, p<0.01). The complication rate was lower in the laparoscopic group (13.3% vs. 26.6%), though not statistically significant. Mortality one in open group, none in the laparoscopic group (1 case each).* ***Conclusion:*** *Laparoscopic repair of duodenal ulcer perforation, though technically more challenging and requiring longer operative time, is associated with faster recovery, less postoperative pain, and reduced hospital stay compared to open repair. It should be considered the preferred approach in stable patients where expertise and facilities are available.*

Keywords: *Duodenal Ulcer Perforation, Laparoscopic Repair, Open Surgery, Prospective Study, Postoperative Outcomes*

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INTRODUCTION

Peptic ulcer disease (PUD) continues to be a major health problem worldwide, especially in developing countries where Helicobacter pylori infection and NSAID use are prevalent.[1] Perforation is one of the most serious and life-threatening complications of duodenal ulcer, occurring in 2–10% of ulcer patients, and carries a mortality rate of 6–10% if not treated promptly.[2,3] Traditionally, perforated duodenal ulcers are managed with open surgery, most commonly primary closure with an omental (Graham's) patch, combined with peritoneal lavage .[4] Open repair remains the gold standard in many centers due to its simplicity, reproducibility, and applicability in unstable patients. However, it is associated with significant postoperative pain, longer hospital stay, wound infection, and delayed return to normal activities.[5] Since Mouret first introduced laparoscopic surgery for perforated peptic ulcer in 1990,[6] minimally invasive approaches have gained increasing acceptance. Laparoscopic repair offers several potential advantages including reduced postoperative pain, shorter hospital stay, early ambulation, and lower wound-related complications.[7,8] On the other hand, critics argue that laparoscopic repair may be technically challenging, associated with longer operative time, and less feasible in cases of large perforations, severe peritonitis, or in hemodynamically

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unstable patients.[9] Several randomized controlled trials and meta-analyses have compared laparoscopic with open repair, showing comparable safety but with advantages favoring laparoscopy in selected patients.[10–12] However, outcomes often vary depending on surgeon expertise, patient selection, and institutional resources. Therefore, this prospective observational study was conducted to compare laparoscopic versus open repair of duodenal ulcer perforation in terms of operative outcomes, postoperative recovery, complications, and hospital stay in a cohort of 60 patients.

MATERIALS & METHODS

Study Design

This was a prospective observational study carried out in the Department of General Surgery at Dinajpur Medical College Hospital and different private hospitals in Dinajpur, over a period of July 2023 to June 2024. The study was approved by the Institutional Ethics Committee, and informed consent was obtained from all participants.

Patients who presented to the emergency department with acute abdomen and were diagnosed with perforated duodenal ulcer were evaluated for inclusion. Diagnosis was established based on clinical findings (sudden severe epigastric pain, peritonitis), radiological evidence (erect X-ray abdomen showing free gas under the diaphragm and intraoperative confirmation of duodenal perforation.

The patients were divided into two groups according to the surgical approach undertaken:

- **Group A:** Laparoscopic repair with omental patch (n = 30)
- **Group B:** Open repair with omental patch (n = 30)

The choice of surgical technique depended on the hemodynamic stability of the patient, availability of laparoscopic equipment, and surgeon expertise**,** consistent with current recommendations [1,2].

Study Population

A total of **60 consecutive patients** with perforated duodenal ulcer were included in the study.

Inclusion Criteria:

- Age 18–60 years
- Patients presenting within 48 hours of symptom onset
- Hemodynamically stable after initial resuscitation

Exclusion Criteria:

- Patients <18 years or >60 years
- Perforations >2 cm in size
- Patients in shock unresponsive to resuscitation (requiring inotropes/ventilation)
- Previous upper abdominal surgery (to avoid adhesions complicating laparoscopy)
- Severe comorbidities (ASA grade IV and above)

Preoperative Management:

All patients received standard resuscitation with IV fluids, nasogastric decompression, broad-spectrum antibiotics, and proton pump inhibitors. Patients were optimized before surgery.

Operative Technique:

- Laparoscopic repair: Standard 4-port technique, primary closure of perforation with interrupted 2-0 absorbable sutures, reinforced with an omental (Graham's) patch, followed by peritoneal lavage and drain placement.
- Open repair: Upper midline laparotomy, primary closure of perforation with Graham's omental patch, peritoneal lavage, and drain placement.

Postoperative Care:

Postoperative management was standardized in both groups: IV fluids, antibiotics, analgesics, nasogastric decompression, early ambulation, and gradual resumption of oral feeds. All patients received eradication therapy for H. pylori

Data Collection

Parameters recorded:

- Demographics (age, sex)
- Operative time
- Postoperative pain (VAS on day 1 and day 3)
- Time to ambulation
- Time to start oral feeding
- Length of hospital stay
- Postoperative complications (wound infection, intra-abdominal abscess, respiratory infection)
- Mortality

Statistical Analysis

Data analyzed using SPSS [version]. Continuous variables expressed as mean ± SD, compared using Student's t-test. Categorical variables compared using Chi-square test. $p<0.05$ considered statistically significant.

RESULTS

Demographic Characteristics

A total of 60 patients with perforated duodenal ulcer were included, 30 undergoing laparoscopic repair (Group A) and 30 undergoing open repair (Group B). The mean age was 42.5 ± 12.3 years (range: 18–60). There was a male predominance (M:F = 5:1), with no significant difference between groups ($p > 0.05$).

Table – I: Demographic Characteristics

Parameter	Laparoscopic (n=30)	Open (n=30)	p-value
Mean age (years)	41.6 ± 11.8	43.4 ± 12.7	0.62
Male : Female ratio	25 : 5	24 : 6	0.72
Symptom duration <24 h	21 (70%)	20 (66.6%)	0.78
ASA I–II patients	23 (76.6%)	22 (73.3%)	0.79

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The mean operative time was longer in the laparoscopic group (90 ± 20 min) compared to the open group (60 ± 15 min) ($p < 0.05$). The average perforation size was similar (0.6–1.2 cm). Pain, mobilization, oral feeding, and hospital stay showed significant differences favoring laparoscopic repair.

Table – II: Postoperative Outcomes

Parameter	Laparoscopic (n=30)	Open (n=30)	p-value
Operative time (min)	90 ± 20	60 ± 15	<0.05
VAS pain score (Day 1)	3.0 ± 0.8	5.5 ± 1.0	<0.01
Time to ambulation (days)	1.5 ± 0.5	3.0 ± 0.8	<0.01
Oral feeding started (days)	3.0 ± 0.6	4 ± 0.9	<0.01
Hospital stay (days)	5.0 ± 1.2	6.5 ± 2.0	<0.01

The overall complication rate was lower in the laparoscopic group (13.3%) compared to the open group (26.6%), though the difference was not statistically significant ($p > 0.05$). Wound infection was the most common complication, predominantly in the open group. There was one mortality in open group (3.3%), due to sepsis and multi-organ failure.

Table – III: Postoperative Complications

Complication	Laparoscopic (n=30)	Open (n=30)	p-value
Wound infection	2 (6.6%)	6 (20%)	0.12
Intra-abdominal abscess	1 (3.3%)	1 (3.3%)	NS
Respiratory infection	1 (3.3%)	2 (6.6%)	0.55
Anastomotic leak / re-perforation	0	1 (3.3%)	0.31
Mortality	0	1(3.3%)	NS
Total complications	4 (13.3%)	8 (26.6%)	0.19

Comparison of postoperative outcomes between laparoscopic and open repair of duodenal ulcer perforation. The bar chart shows mean values for operative time, postoperative pain (VAS Day 1), time to ambulation, time to oral feeding, and length of hospital stay. Laparoscopic repair demonstrated longer operative time, but significantly reduced pain, earlier ambulation, earlier feeding, and shorter hospital stay.

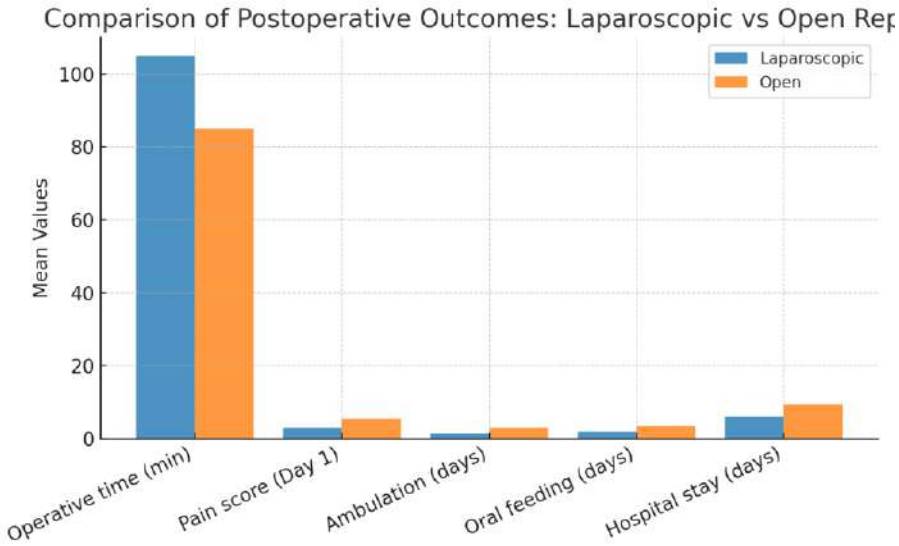

Figure – 1: Comparison of Postoperative Outcomes between Laparoscopic and Open Repair of Duodenal Ulcer Perforation

DISCUSSION

The present prospective observational study compared laparoscopic versus open repair of duodenal ulcer perforation in 60 patients. Our results demonstrate that laparoscopic repair, while associated with a longer operative time, significantly improved postoperative outcomes including reduced pain, earlier ambulation, faster resumption of oral feeding, and shorter hospital stay. Complications were lower in the laparoscopic group, although the difference did not reach statistical significance. These findings suggest that laparoscopy is a safe and effective alternative to open repair in carefully selected, hemodynamically stable patients.

The results of this study are consistent with prior randomized controlled trials (RCTs) and meta-analyses. Lau et al.[7]

reported in a randomized trial that laparoscopic repair resulted in less postoperative pain and shorter hospital stay compared with open repair. Similarly, Siu et al.[8] demonstrated earlier return of bowel function and mobilization with laparoscopy. A meta-analysis by Lau,[7] which included 8 RCTs, confirmed that laparoscopic repair was associated with decreased postoperative pain and shorter hospitalization, though operative time was consistently longer. Bertleff et al.[3] in the LAMA trial, one of the largest RCTs to date, also found comparable complication rates but improved recovery in the laparoscopic group. Our study corroborates these findings, reinforcing the evidence that laparoscopic repair confers perioperative benefits without increasing morbidity or mortality. This was clearly demonstrated in our cohort, with significantly lower VAS scores on day 1. This aligns with published literature,[1–3] where smaller incisions translate into reduced somatic pain. Patients in the laparoscopic group in our study ambulated almost 1.5 days earlier. Early mobilization is linked with reduced risk of deep vein thrombosis, pulmonary complications, and ileus.[5] Our patients resumed oral feeding faster, which facilitates better nutrition and reduces hospital stay. Other trials have similarly reported earlier bowel recovery with laparoscopy.[2,6] Reduced pain, faster mobilization, and fewer wound complications contribute to shorter hospitalizations, a finding supported by our study and others.[3,4,7] Though not statistically significant in our series, wound infections were more common in the open group. Laparoscopy minimizes wound contamination by limiting exposure of the incision to peritoneal contents.[8] While not objectively measured in this study, smaller scars contribute to better cosmesis, particularly important in younger patients. Our study confirmed that laparoscopy took on average 25 minutes longer. This is a consistent finding across most studies.[1–4] The longer duration may be acceptable in stable patients but problematic in unstable cases requiring rapid intervention. Laparoscopic suturing of friable duodenal tissue can be technically challenging. Adequate training and experience are essential. In patients with shock, generalized peritonitis, or large perforations, open repair remains the safer and faster option.[9] Laparoscopic repair requires infrastructure that may not be universally available in resource-limited settings.

In our series, complications were fewer in the laparoscopic group, though the difference was not statistically significant due to small sample size. Wound infection was notably higher in the open group, echoing previous reports.[10,11]

Leakage rates were low and comparable in both groups. The mortality of 3.3% in open arm is similar to published series, where mortality ranges from 1–10% depending on presentation time and patient comorbidities.[12] Thus, laparoscopy does not appear to increase mortality risk compared with open repair. The findings of this study suggest that laparoscopic repair should be considered the preferred approach in stable patients with perforated duodenal ulcer, provided surgical expertise and resources are available. The benefits of reduced postoperative pain, earlier recovery, and shorter hospitalization can translate into improved patient satisfaction and reduced healthcare costs. However, patient selection is paramount. Laparoscopy is best suited for young or middle-aged, hemodynamically stable patients presenting within 24 hours of perforation with defects <2 cm. Open surgery remains the standard in unstable patients, late presenters, or where advanced laparoscopic expertise is lacking.[9,13,14]

Limitations of the Present Study

This study has certain limitations.

1. **Sample size:** With 60 patients, the study may be underpowered to detect differences in rare complications or mortality.
2. **Limited focal areas design:** Results may not be generalizable to other settings, particularly where laparoscopic expertise varies.
3. **Selection bias:** Since unstable patients were excluded from laparoscopy, outcomes may be skewed towards better results in this group.
4. **Short-term follow-up:** The study primarily assessed perioperative outcomes. Long-term follow-up, including ulcer recurrence, was not evaluated.

Future Perspectives

Future research should focus on large, multicenter randomized controlled trials comparing laparoscopic and open repair in diverse populations. Studies should also assess cost-effectiveness, quality of life, and long-term ulcer recurrence after repair. Advances in laparoscopic suturing devices and training may further reduce operative times and expand the feasibility of laparoscopy in emergencies. There is also emerging interest in alternative minimally invasive approaches, such as laparoscopic-assisted repair and endoscopic closure techniques for very small perforations. These could further shift the paradigm in managing perforated ulcers.

CONCLUSION

In conclusion, the present study supports the growing body of evidence that laparoscopic repair of perforated duodenal ulcer is a safe and effective alternative to open surgery in selected patients. While technically more challenging and associated with longer operative time, its advantages in terms of reduced postoperative pain, earlier mobilization, faster resumption of feeding, and shorter hospital stay make it a superior option for stable patients when expertise and resources are available. Open repair, however, continues to play an essential role in unstable patients and in resource-limited settings.

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ORIGINAL ARTICLE

Comparative Outcomes between Off-Clamp and On-Clamp Nephron-Sparing Surgery – A Retrospective Analysis

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ABSTRACT

Objective: *To compare perioperative and functional outcomes between off-clamp and on-clamp techniques during nephron-sparing surgery (NSS).* ***Methods & Materials:*** *A retrospective study of 70 patients who underwent NSS for renal tumors between January 2020 and July 2025. Patients were divided into two groups: Off-Clamp NSS (Group A, n=34) and On-Clamp NSS (Group B, n=36). Data on operative time, estimated blood loss (EBL), warm ischemia time (WIT), complications, and renal functional outcomes (eGFR changes) were analyzed.* ***Results:*** *Group A showed significantly higher EBL (p=0.02) but better postoperative renal function preservation (mean eGFR drop: 5.6% vs 11.4%, p<0.001). Group B had shorter operative times and less intraoperative bleeding. No significant difference was observed in complication rates or oncologic margin positivity.* ***Conclusion:*** *Off-clamp NSS offers superior renal functional preservation compared to on-clamp NSS at the expense of higher blood loss. Patient selection remains crucial, and off-clamp NSS may be particularly beneficial in younger patients with baseline impaired renal function.*

Keywords: *Partial nephrectomy, Off-clamp technique, On-clamp technique, Nephron-sparing surgery, Warm ischemia, Estimated blood loss, Renal function preservation, eGFR decline, Positive surgical margin, Perioperative outcomes*

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INTRODUCTION

Renal cell carcinoma (RCC) is one of the most common urological malignancies, and the incidence of incidentally detected small renal masses has increased in recent decades due to the widespread use of cross-sectional imaging.[1] Nephron-sparing surgery (NSS), or partial nephrectomy, is now widely accepted as the standard of care for localized renal tumors, particularly those classified as stage T1, because it achieves excellent oncological control while preserving renal function.[2,3] One of the major intraoperative considerations during NSS is whether to clamp the renal hilum to provide a bloodless surgical field (on-clamp technique) or to perform tumor excision without hilar clamping (off-clamp technique). The on-clamp approach facilitates precise tumor resection and renorrhaphy by minimizing blood loss but carries the risk of ischemia-reperfusion injury, which may negatively impact postoperative renal function.[4] Conversely, the off-clamp approach avoids ischemic injury but can be associated with higher intraoperative blood loss and increased technical difficulty.[5] The optimal approach continues to be debated, as surgeons must balance intraoperative safety with long-term renal function preservation. This study was conducted to compare perioperative, functional, and oncological outcomes between off-clamp and on-clamp NSS with particular attention to renal function outcomes.

MATERIALS & METHODS

A retrospective review was conducted on 70 patients who underwent NSS between January 2020 and July 2025 at Bangladesh Medical College and Hospital. Patients were divided into two groups: Off-Clamp NSS (n=34) and On-Clamp NSS (n=36). Inclusion criteria: Age 18–75 years, solitary unilateral renal mass ≤7 cm (T1a/T1b), and preoperative

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eGFR ≥60 mL/min/1.73m^2. Exclusion criteria: solitary kidney, bilateral tumors, prior renal surgery. Parameters assessed: operative time, estimated blood loss, warm ischemia time, complications (Clavien-Dindo), positive surgical margin (PSM), and pre/postoperative eGFR (1 and 6 months). Continuous variables were analyzed using Student's t-test, categorical variables with Chi-square, and $p<0.05$ was considered significant.

RESULTS

Total 70 patients included in our study. Group A showed significantly higher EBL (p=0.02) but better postoperative renal function preservation (mean eGFR drop: 5.6% vs 11.4%, p<0.001). Group B had shorter operative times and less intraoperative bleeding. No significant difference was observed in complication rates or oncologic margin positivity.

Table – I: Comparison of Perioperative and Functional Outcomes Between Off-Clamp and On-Clamp Partial Nephrectomy

Parameter	Off-Clamp (n=34)	On-Clamp (n=36)	p-value
Operative time (min)	110 ± 24	95 ± 20	0.01
Estimated blood loss (mL)	398 ± 102	272 ± 85	0.02
Warm ischemia time (min)	N/A	19.4 ± 3.3	N/A
Intraoperative complications (%)	5.8%	5.6%	0.94
Post-op eGFR decline (%)	5.6%	11.4%	<0.001
Positive surgical margins (%)	2.9%	5.5%	0.71

DISCUSSION

The present study highlights the trade-offs between off-clamp and on-clamp NSS. Consistent with prior reports, our results demonstrate that the off-clamp technique provides superior renal function preservation, as evidenced by the significantly lower decline in postoperative eGFR compared to the on-clamp group.[4–6] This benefit is particularly relevant for patients with pre-existing renal impairment, solitary kidneys, or those at high risk for chronic kidney disease progression. However, this functional advantage came at the expense of higher intraoperative blood loss and slightly prolonged operative times. Importantly, these intraoperative challenges did not translate into increased complication rates, suggesting that the off-clamp approach is safe when performed by experienced surgeons. The lack of difference in positive surgical margin rates between groups reinforces the oncologic safety of both techniques, in agreement with previously published series.[5,6] The decision to employ an on-clamp or off-clamp strategy should therefore be individualized, taking into account tumor complexity, baseline renal function, and surgeon expertise. Our findings suggest that off-clamp NSS may be especially advantageous in younger patients or those with impaired renal reserve, while on-clamp NSS remains a practical option for technically challenging tumors where surgical precision and hemostasis are paramount. Limitations of this study include its retrospective design, relatively small sample size, and potential selection bias, as surgical approach was determined by surgeon preference. Prospective randomized trials are required to provide more definitive evidence regarding the optimal approach to NSS.

CONCLUSION

Off-clamp nephron-sparing surgery offers superior postoperative renal function preservation compared to the traditional on-clamp approach, albeit with increased blood loss and longer operative times. Careful patient selection and surgeon expertise are essential to optimize outcomes.

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ORIGINAL ARTICLE

Functional Outcomes of Closed Tibial Shaft Fractures Treated with Suprapatellar Intramedullary Nailing – A Prospective Study

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ABSTRACT

Background: *Tibial shaft fractures are among the most common long bone fractures with high incidence in young adults. Intramedullary nailing is the gold standard of fixation, and the suprapatellar approach has gained popularity due to technical advantages. Evidence on functional outcomes in closed fractures is still lacking, however.* ***Objectives:*** *The aim of this study was to assess the functional outcomes of closed tibial shaft fractures treated with suprapatellar intramedullary nailing.* ***Methods & Materials:*** *This prospective observational study was conducted in the Department of Orthopaedics, National Institute of Traumatology and Orthopedic Rehabilitation (NITOR), Sher-E-Bangla Nagar, Dhaka, Bangladesh, for one year period from March 2022 to March 2023. Total 33 adult patients with closed tibial shaft fractures were enrolled.* ***Results:*** *In this study, mean age was 38.3 ± 11.6 years with male predominance (69.7%). Fractures of AO type 42A were most common (54.5%). The mean knee ROM at last follow-up was 130.3 ± 8.6°. The majority of patients (72.7%) had fair functional outcomes, 18.2% good, and 9.1% poor. The average VAS was 0.5, and anterior knee pain was complained of by only 15.2%. Lysholm scores improved significantly from 83.1 at 6 months to 93.8 at 12 months (p<0.001).* ***Conclusion:*** *Suprapatellar nailing for closed tibial shaft fractures produces good functional outcomes, few complications, and gradual improvement, justifying its use as a safe and effective method of fixation.*

Keywords: *Functional Outcomes of Closed Tibial Shaft Fractures Treated with Suprapatellar Intramedullary Nailing.*

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INTRODUCTION

Fractures of the tibial shaft are among the most common long bone fractures encountered in orthopedic trauma surgery and represent a significant proportion of all fractures operated upon. They have been reported to occur with a frequency of 16.9 per 100,000 person-years in major epidemiological studies with a disproportionate representation among young, active men from mechanisms of injury that involve road traffic accidents, sporting activities, and falls from height.[1,2] Registry-based studies within European populations also confirm that high-energy trauma remains the predominant cause, while socioeconomic cost is substantial, taking into consideration the working young population typically involved.[3,4] Not only do these fractures take extended periods to rehabilitate but are also highly likely for morbidity

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in the long term, and therefore entail a considerable burden on quality of life and healthcare systems.

The clinical outcomes of tibial shaft fractures extend beyond the acute fracture incident, with malunion, nonunion, infection, and chronic postoperative pain considerably leading to disability and prolonged absence from work and activity. Long-term outcomes following intramedullary fixation tend to highlight anterior knee pain and functional limitation, particularly for kneeling or squatting activities that prevail in the majority of athletic and cultural populations.[5,6] Socioeconomically, the collective expense of extended recuperation, lost productivity, and frequent interventions is a huge justification that warrants maximized surgical techniques.

Conventionally, intramedullary nailing (IMN) has emerged as the gold standard for the management of diaphyseal tibial fractures with advantages of biological fixation, load-sharing, and least interference with periosteal blood supply.[7] The classic infrapatellar approach with flexion or hyperflexion of the knee has been the traditional method. However, it has been seen to be associated with technical challenges, including failure to achieve and maintain fracture reduction, requirement for multiple fluoroscopic control, and relatively high incidence of anterior knee pain as a result of iatrogenic injury to the patellar fat pad or tendon.[8,9]

Overcoming these limitations, the suprapatellar intramedullary nailing (SPN) method has come as a relatively newer development. Performed with a suprapatellar portal with the knee in a semi-extended position, the technique facilitates fracture reduction, particularly in distal and proximal third fractures, and has been shown to reduce operative difficulty by facilitating a more stable leg position during surgery. Moreover, SPN is associated with shorter intraoperative fluoroscopy time, better sagittal and coronal alignment control, and lower malalignment rates compared to the infrapatellar technique.[10-12] Recent randomized and observational studies also show excellent radiological and functional outcomes with the suprapatellar technique.[9]

Although such theoretical and practical advantages are present, functional outcomes of suprapatellar nailing are still a concern. Anterior knee pain remains a contentious complication with potentially cartilage damage to the patellofemoral joint and irritation of the quadriceps tendon as underlying mechanisms.[13,14] Moreover, while several studies have reported on radiographic alignment and union rates as primary outcomes, fewer have looked into long-term functional recovery in terms of pain, mobility, activity level, and quality of life.[15,16] The literature is especially sparse regarding prospective analyses confined to closed fractures of the tibial shaft, a large and clinically important subgroup.

This deficit of knowledge points to a need for future research with the functional outcomes as the primary endpoints, since radiographic healing is not equal to recovery as perceived by patients. Therefore, the present study was performed as a prospective evaluation of functional outcomes of closed tibial shaft fractures treated with suprapatellar intramedullary nailing.

OBJECTIVES

To assess the functional outcomes of closed tibial shaft fractures treated with suprapatellar intramedullary nailing.

METHODS & MATERIALS

This prospective observational study was conducted in the Department of Orthopaedics, National Institute of Traumatology and Orthopedic Rehabilitation (NITOR), Sher-E-Bangla Nagar, Dhaka, Bangladesh, for one year period from March 2022 to March 2023. Total 33 adult patients aged between 18-60 years having closed tibial shaft fractures treated with surgical fixation using the suprapatellar interlocking intramedullary nailing (SPN) technique were enrolled in this study. Open fractures, pathological fractures, fractures within the proximal or distal 5 cm of the tibia, polytrauma, and history of ipsilateral knee injury or prior surgery were the exclusion criteria. After informed written permission, all the patients underwent extensive clinical and radiological evaluation, and baseline demographic and injury data were recorded.

The surgery was performed under general or spinal anesthesia with the patient in the supine position on a radiolucent table. The affected knee was placed in a semi-extended position with a radiolucent bolster. A 3-4 cm midline suprapatellar incision was done and a protective sleeve was placed under the patella to minimize intra-articular damage. Fracture reduction was achieved by using fluoroscopy and creating an adequate entry point in the canal of the tibia. Reaming was according to canal diameter, and a statically locked intramedullary interlocking nail was then placed and fixed proximally and distally with interlocking screws.

Patients were also followed up and examined postoperatively at 6 weeks, 3 months, 6 months, and 12 months. The Lysholm Knee Scoring Scale and Visual Analogue Scale (VAS) for anterior knee pain were used to assess functional outcome. Radiological union was assessed and noted complications of infection, implant failure, or malunion. Data analysis was done using SPSS version 26.0. Continuous variables were expressed as mean ± SD, while categorical variables were given as frequency and percent. Inferential statistics were employed wherever required, and a p-value <0.05 was taken as significant.

RESULTS

Table I presents the baseline characteristics of the study patients. Among the 33 patients, the mean age was 38.3 ± 11.6 years, with an age range of 21 to 60 years. The majority belonged to the 21–30 year age group (33.3%). There was a clear male predominance, with 23 males (69.7%) compared to 10 females (30.3%). According to the AO classification of fractures, type 42A fractures were most common (54.5%), followed by 42B (24.2%) and 42C (21.2%).

The distribution of patients by side involvement is further illustrated in Figure 1. Regarding the side of injury, the right tibia was involved in 20 patients (60.6%), whereas the left tibia was affected in 13 patients (39.4%).

Findings related to pain scores and complications are summarized in Table II. With respect to anterior knee pain

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assessed by the Visual Analogue Scale (VAS), the majority of patients, 28 out of 33 (84.8%), reported no pain (VAS = 0), while 5 patients (15.2%) experienced pain ranging from 1 to 4. The mean VAS score was 0.5 ± 1.1. In terms of complications, 29 patients (87.9%) had no adverse outcomes. Among the remaining, 2 patients (6.1%) developed delayed union, 1 patient (3%) experienced nonunion, and 1 patient (3%) had a superficial surgical site infection.

The assessment of functional outcomes at the final follow-up is detailed in Table III. The majority of patients (54.5%) achieved a knee range of motion (ROM) between 130–139°, while 18.2% each had ROM of either 120–129° or a full 140° arc. A smaller proportion, 9.1%, had a more restricted ROM of 110–119°. The mean knee ROM was 130.3 ± 8.6°, ranging from 110° to 140°. Evaluation of final functional outcome categories showed that 24 patients (72.7%) had fair outcomes, 6 patients (18.2%) achieved good outcomes, and 3 patients (9.1%) were rated as poor.

Progressive improvement in functional recovery is highlighted in Table IV, which outlines the Lysholm Knee Scores at different follow-up intervals. At 6 months, the mean score was 83.1 ± 10.8, which increased significantly to 93.8 ± 8.9 at 12 months. Statistical analysis using the paired t-test confirmed this improvement to be highly significant ($p < 0.001$).

Table – I: Baseline characteristics of the study subjects (*n*=33)

Characteristics	Number of Patients	Percentage (%)
Age group (in years)		
21-30	11	33.3
31-40	8	24.2
41-50	7	21.2
51-60	7	21.2
Mean	38.3±11.6	
Range	21-60	
Gender		
Male	23	69.7
Female	10	30.3
Type of fracture (AO)		
42A	18	54.5
42B	8	24.2
42C	7	21.2

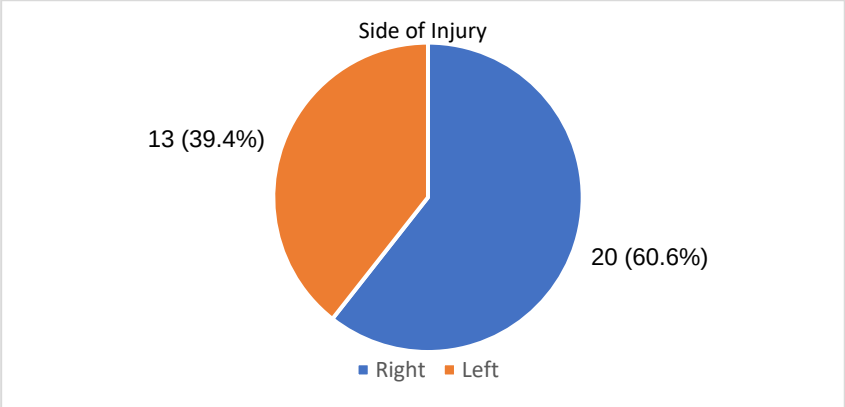

Figure – 1: Distribution of the patients by side involvement (*n*=33)

Table – II: Distribution of pain score and complications among the study subjects (*n*=33)

Parameters	Number of Patients	Percentage (%)
Ant knee pain (according to VAS)		
0	28	84.8
>0	5	15.2
Mean	0.5±1.1	
Range	0-4	
Complications		
No complication	29	87.9
Delayed union	2	6.1
Nonunion	1	3
Superficial surgical site infection	1	3

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Table – III: Outcome variables at last follow up

Outcome variables	Number of Patients	Percentage (%)
ROM of knee (Arc of flexion-extension) (in degree)		
110-119	3	9.1
120-129	6	18.2
130-139	18	54.5
140	6	18.2
Mean	130.3±8.6	
Range	110-140	
Final functional outcome		
Fair	24	72.7
Good	6	18.2
Fair	3	9.1

Range of Motion= ROM

Table – IV: Lysholm knee score at different follow-up (*n*=33)

Lysholm score	Mean±SD	p value
6 months	83.1±10.8	<0.001
12 months	93.8±8.9	

P-value retrieved from Paired t test

DISCUSSION

This current study was conducted to assess the functional outcomes of closed tibial shaft fractures treated with suprapatellar intramedullary nailing. In this prospective study, the demographic profile was that of young to middle-aged adults with an average age of 38.3 years, most of whom were male. This is in keeping with large epidemiological studies that have consistently shown that tibial shaft fractures most frequently happen in young, active males, often due to high-energy trauma such as road traffic accidents and falls.[1,2] Our finding that AO type 42A fractures were the most common subtype corroborates earlier prospective series, which also demonstrated simple fracture patterns to be most common in this age group.[18,19] Furthermore, the right side was more frequently affected, which also has been observed in earlier registry-based studies.[3]

Anterior knee pain following intramedullary nailing has been a long-standing controversial issue. In the present series, anterior knee pain of some degree was experienced by only 15.2% of the patients, with a mean VAS score of 0.5, which is much lower than the incidence described in earlier reports of infrapatellar nailing, where the incidence has ranged from 30% to 60%.[19] Ongoing anterior knee pain in a large proportion of patients after infrapatellar fixation was also described by Hussain and Khan[20], with the suggestion that this complication can be avoided with the suprapatellar approach. Systematic reviews also demonstrate lower pain scores with suprapatellar nailing compared to infrapatellar techniques, likely due to decreased iatrogenic trauma to the patellar tendon and surrounding structures.[6]

The complication profile was good in this study, and 87.9% of patients were without any adverse events. Delayed union and nonunion were seen in 6.1% and 3% of the cases, respectively, and superficial surgical site infection in 3%. These rates are also similar to other series reported, where nonunion rates have varied between 3% and 10% and infection rates between 2% and 5%.[21,22] The comparatively low rate of complications in our study could be explained by the standardized surgical technique and careful patient selection, as only closed fractures were included.

Functional outcomes at final follow-up in the current study revealed that the average knee ROM was 130.3°, with the majority of the patients experiencing an arc between 130° and 139°. Most of the patients (72.7%) were rated as fair, 18.2% had good outcomes, while 9.1% were rated as poor. These findings are consistent with those of Panda et al.[9], who reported comparable knee ROM and functional scores following both suprapatellar and infrapatellar nailing, with suprapatellar patients mobilizing earlier. Zhu et al.[23] also found mean ROM of more than 125° in both groups, with superior ease of reduction and alignment in the suprapatellar group.

Significantly, our study documented progressively rising Lysholm scores from a mean of 83.1 at 6 months to 93.8 at 12 months, and the difference was statistically significant. The trend mirrors the observations of Serbest et al.[24], who also noted persistent improvement in Lysholm scores at 6 and 12 months after suprapatellar nailing. Meta-analyses also support that functional outcomes keep improving between early and late follow-up, with suprapatellar techniques demonstrating slightly superior patient-reported scores than infrapatellar methods.[8,25] Long-term follow-up research highlights that these improvements are sustained beyond 12 months, and they emphasize the durability of functional recovery after suprapatellar nailing.[26]

Together, our findings add to the body of evidence that suprapatellar intramedullary nailing is a safe and effective treatment for closed tibial shaft fractures with low rates of complication and anterior knee pain and satisfactory functional outcomes.

CONCLUSION

This current study demonstrates that suprapatellar intramedullary nailing is a safe and effective method for managing closed tibial shaft fractures, with low rates of anterior knee pain and complications. Patients achieved satisfactory knee motion and progressive improvement in functional outcomes, as reflected in significantly rising Lysholm scores over follow-up. These findings support the suprapatellar approach as a reliable technique that enhances functional recovery. Larger multicenter trials with longer follow-up are recommended to validate these results.

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ORIGINAL ARTICLE

Clinicopathological Profile of Pediatric Outpatients at Bangladesh Shishu Hospital & Institute – A Cross-Sectional Study

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ABSTRACT

Background: *Pediatric outpatient departments (OPDs) are critical for early diagnosis and management of childhood illnesses. Understanding the clinicopathological profile of pediatric outpatients is essential for guiding effective healthcare strategies and improving child health outcomes in resource-limited settings.* ***Aim of the study:*** *To analyze the clinicopathological profile of pediatric outpatients at Bangladesh Shishu Hospital & Institute, Dhaka, identifying prevalent diseases, clinical presentations, laboratory findings, nutritional status, and outcomes.* ***Methods & Matrials:*** *A hospital-based cross-sectional study was conducted over six months, enrolling 310 children below 15 years attending the pediatric OPD. Demographic data, clinical complaints, provisional diagnoses, laboratory findings, and nutritional status were recorded. Outcomes were categorized as conservative management, hospital admission, or specialist referral. Data were analyzed using SPSS version 26, with p≤0.05 considered statistically significant.* ***Result:*** *The mean age was 5.41 ± 3.97 years, with 55.5% males and 62.6% from urban areas. Fever (41.3%) and cough/cold (32.9%) were the most common complaints. Respiratory tract infections (36.1%) and gastrointestinal disorders (25.2%) predominated. Laboratory abnormalities were observed in hemoglobin (43.2%), WBC count (32.9%), and ESR (38.1%). Nutritional assessment revealed 41.3% of children were underweight, stunted, or wasted. Most children (69.0%) were managed conservatively, while 23.2% required admission.* ***Conclusion:*** *Respiratory and gastrointestinal illnesses remain the leading causes of pediatric outpatient visits, with a substantial burden of malnutrition and laboratory abnormalities. These findings emphasize the need for targeted preventive, diagnostic, and management strategies to optimize pediatric healthcare outcomes in Bangladesh.*

Keywords: *Pediatric outpatients, Clinicopathological profile, Dhaka Shishu Hospital, Malnutrition, Respiratory infections.*

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INTRODUCTION

Pediatric outpatient departments (OPDs) serve as vital entry points for children seeking medical care, offering early diagnosis, treatment, and preventive services [1]. Globally, children under 18 face a variety of health challenges and more than 500,000 children under 5 lost their lives to lower respiratory infections in 2021 [2]. Approximately 35.6% of children under five years of age experienced some form of morbidity, with fever being the most common condition, affecting 33.1% of children, followed by diarrhea 4.7% and acute respiratory infections 3.0% in Bangladesh [3]. Malnutrition remains a critical issue, responsible for nearly 45% of deaths in children aged 0 to 59 months in Bangladesh [4]. Clinicopathological profile mean the spectrum of clinical presentations as signs and symptoms, demographic features as age, sex, nutritional status, socio-economic background, and diagnostic or laboratory findings that accompany disease in outpatient settings. Such profiles are instrumental in identifying prevalent health issues, guiding diagnostic approaches, and informing treatment protocols. Understanding the clinicopathological profile of pediatric outpatients is crucial for tailoring effective healthcare strategies and improving child health outcomes [5]. The etiology of pediatric diseases is multifactorial, involving a

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complex interplay of environmental, genetic, and socio-economic factors. Infectious diseases, malnutrition, and poor sanitation are prevalent in Bangladesh and contribute significantly to pediatric morbidity. Inadequate waste management and stagnant water sources facilitate the breeding of mosquitoes, leading to increased cases of diseases like dengue [6]. The impact of pediatric diseases extends beyond the individual child, affecting families and the broader healthcare system. Children suffering from chronic illnesses or severe infections often experience prolonged hospitalizations, leading to emotional and financial strain on families. Moreover, the healthcare system faces challenges in managing the high volume of pediatric cases, sometimes resulting in resource constraints and overcrowding in hospitals [7]. Analyzing the clinicopathological profiles of pediatric outpatients provides numerous benefits for both clinical practice and public health planning. By systematically documenting symptoms, diagnoses, and laboratory findings, healthcare providers can identify the most prevalent diseases and their patterns in the pediatric population. This allows for timely diagnosis and personalized treatment, improving patient outcomes and such analyses help in anticipating disease trends [8]. Variability in clinical assessment and diagnostic criteria can lead to inconsistencies in recorded data, affecting the reliability of the profiles. Underreporting of mild or subclinical cases is common, which may result in skewed prevalence estimates. Additionally, the focus on hospital-based populations may not accurately reflect the broader community, limiting the generalizability of findings [9]. Implementing comprehensive clinicopathological profiling in pediatric outpatients presents practical challenges. Resource limitations, including insufficient laboratory facilities and trained personnel, can impede thorough data collection [10]. The aim of this study was to analyze the clinicopathological profile of pediatric outpatients at Dhaka Shishu Hospital to identify prevalent diseases, their patterns, and underlying factors, thereby informing better clinical management and public health strategies.

METHODS & MATERIALS

This study was conducted in the Outpatient Department (OPD) of Bangladesh Shishu Hospital & Institute, Dhaka, Bangladesh. It was designed as a hospital-based cross-sectional study and carried out from January 2024 to December 2024. A total of 310 pediatric patients attending the OPD during the study period were enrolled using purposive sampling.

Inclusion Criteria

- Children aged below 15 years.
- Patients presenting to the pediatric OPD with clinical complaints requiring diagnostic or therapeutic evaluation.
- Parents or guardians willing to provide informed consent.

Exclusion Criteria

- Critically ill children requiring immediate hospitalization.
- Patients with incomplete clinical or laboratory data.

Data Collection

Data were collected using a structured and pretested questionnaire. Demographic details (age, gender, residence), presenting complaints, provisional clinical diagnoses, and nutritional status were recorded. Laboratory investigations, including hemoglobin, WBC count, ESR, serum electrolytes, and liver function tests, were performed as per the clinical indication. Nutritional status was assessed using WHO growth standards (weight-for-age, height-for-age, and weight-for-height). Outcomes of the outpatient visits were documented as conservative management, referral for admission, or referral to a specialist clinic. The study was conducted after obtaining ethical clearance from the Institutional Review Board of Dhaka Shishu Hospital. Informed written consent was obtained from the parents or guardians of all participants prior to data collection.

Statistical Analysis

Data were compiled and analyzed using SPSS software (version 26.0). Quantitative variables were presented as mean ± standard deviation (SD), while categorical variables were expressed as frequencies and percentages. Chi-square tests were applied for categorical comparisons where appropriate. A p-value ≤0.05 was considered statistically significant.

RESULT

Table 1 summarized the demographic characteristics of the 310 pediatric outpatients. The majority of children were aged 1–5 years (40.0%), followed by those aged 6–10 years (28.39%), <1 year (16.77%), and >10 years (14.84%), with a mean age of 5.41 ± 3.97 years. Male children predominated (55.48%) compared to females (44.52%). Most participants resided in urban areas (62.58%), while 37.42% were from rural regions. Fever was the most common symptom, observed in 41.29% of children, followed by cough/cold (32.90%), abdominal pain (18.06%), diarrhea (14.19%), vomiting (12.26%), skin rash (9.03%), and neurological symptoms (7.10%). Other complaints accounted for 11.61% of cases (Table 2). Respiratory tract infections were the predominant diagnosis (36.13%), followed by gastrointestinal disorders (25.16%), nutritional deficiencies (13.55%), neurological disorders (8.39%), dermatological disorders (6.45%), hematological disorders (5.81%), and other less common conditions (4.52%) (Table 3). Laboratory findings are presented in Table 4. Hemoglobin levels were abnormal in 43.23% of children, while 32.90% had abnormal WBC counts. Elevated ESR was observed in 38.06% of cases. Serum electrolyte abnormalities were noted in 23.87%, whereas liver function test abnormalities were least frequent (13.55%). Table 5 depicted the nutritional status of the children. Normal nutritional status was observed in 58.71% of participants. Underweight children accounted for 21.94%, stunted children 11.61%, and wasted children 7.74%. Table 6 reported the outcomes at the outpatient visit. A majority of children (69.03%) were managed conservatively at the outpatient department, while 23.23% were referred for admission, and

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7.74% were referred to specialist clinics for further evaluation and management.

Table – I: Demographic Characteristics of Pediatric Outpatients (*n* = 310)

Characteristics	Frequency (n)	Percentage (%)
Age group (years)		
<1 year	52	16.77
1–5 years	124	40.00
6–10 years	88	28.39
>10 years	46	14.84
Mean±SD	5.41 ± 3.97	
Gender		
Male	172	55.48
Female	138	44.52
Residence		
Urban	194	62.58
Rural	116	37.42

Table – II: Presenting Clinical Complaints of Pediatric Outpatients (*n* = 310)

Clinical Complaint	Frequency (n)	Percentage (%)
Fever	128	41.29
Cough/Cold	102	32.90
Abdominal Pain	56	18.06
Diarrhea	44	14.19
Vomiting	38	12.26
Skin Rash	28	9.03
Neurological Symptoms	22	7.10
Others	36	11.61

Table – III: Clinical Diagnosis among Pediatric Outpatients (*n* = 310)

Diagnosis	Frequency (n)	Percentage (%)
Respiratory Tract Infections	112	36.13
Gastrointestinal Disorders	78	25.16
Nutritional Deficiencies	42	13.55
Neurological Disorders	26	8.39
Dermatological Disorders	20	6.45
Hematological Disorders	18	5.81
Others	14	4.52

Table – IV: Laboratory Findings of Pediatric Outpatients (*n* = 310)

Parameters	Normal		Not Normal	
	Frequency (n)	Percentage (%)	Frequency (n)	Percentage (%)
Hemoglobin	176	56.77	134	43.23
WBC Count	208	67.10	102	32.90
ESR	192	61.94	118	38.06
Serum Electrolytes	236	76.13	74	23.87
Liver Function Test	268	86.45	42	13.55

Table – V: Nutritional Status of Pediatric Outpatients (*n* = 310)

Nutritional Category	Frequency (n)	Percentage (%)
Normal	182	58.71
Underweight	68	21.94
Stunted	36	11.61
Wasted	24	7.74

Table – VI: Outcome at Outpatient Visit (*n* = 310)

Outcome	Frequency (n)	Percentage (%)
Managed Conservatively (OPD treatment)	214	69.03
Referred for Admission	72	23.23
Referred to Specialist Clinic	24	7.74

DISCUSSION

The clinicopathological profile of pediatric outpatients encompasses demographic patterns, disease spectrum, and clinical presentations that reflect both community health trends and institutional case load [11]. In our cohort of 310 pediatric outpatients, the majority belonged to the 1–5 years age group (40.00%), with a mean age of 5.41±3.97 years. This age distribution mirrors reports from Nepal, where early childhood was the most common age bracket presenting to pediatric OPDs (1–5 years: 42.89%) [12]. Male predominance (55.48%) was also consistent with several studies, reflecting healthcare-seeking bias toward boys [13]. The urban predominance (62.58%) may be related to easier accessibility to tertiary centers, as noted in other South Asian OPD-based studies [14]. Fever (41.29%) and cough/cold (32.90%) were the leading complaints, followed by gastrointestinal symptoms like abdominal pain (18.06%) and diarrhea (14.19%). This pattern is comparable to findings from Nigeria, where fever and respiratory symptoms dominated outpatient visits [15]. The relatively high frequency of abdominal pain and diarrhea in our study underscores the dual burden of infectious diseases affecting both the respiratory and gastrointestinal systems in Bangladeshi children. Respiratory tract infections (36.13%) and gastrointestinal disorders (25.16%) emerged as the leading diagnoses, in line with studies across Uganda and Africa that consistently report these as major causes of pediatric morbidity [16,17]. Nutritional deficiencies (13.55%) were also prominent, reflecting persistent undernutrition despite national nutrition programs. Comparable prevalence has been documented in outpatient surveys in India (11–15%) [18]. A striking finding was that 43.23% of children had low hemoglobin, consistent with a previous Bangladeshi study [9]. Elevated ESR (38.06%)

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and WBC abnormalities (32.90%) were frequent, reflecting the inflammatory and infectious burden in this group. Comparable results were reported in a hospital-based Bangladeshi study where 46.8% of children had anemia [19]. Electrolyte abnormalities (23.87%) were less common but clinically relevant, especially in diarrheal presentations. Overall, 41.3% of children were undernourished (underweight, stunted, or wasted). This mirrors the 2019 Bangladesh Demographic and Health Survey, which reported 28% stunting and 22% underweight among under-five children [20]. These findings reinforce the need to integrate nutrition assessment and intervention into routine outpatient pediatric care. Most children (69.00%) were managed conservatively at OPD, while 23.23% required inpatient admission and 7.74% were referred to specialists. Slightly lower referral rates have been noted in previous study of Nepal, where 0.98% patients were referred [21]. The substantial admission rate in our study underscores the role of tertiary pediatric OPDs not only as primary care entry points but also as triage centers for more severe disease.

Limitations of the Study*:*

This study was conducted at a single tertiary care hospital, which may limit the generalizability of findings to the broader pediatric population in Bangladesh. The cross-sectional design captures only a snapshot of clinical presentations, precluding assessment of disease progression or long-term outcomes. Mild or subclinical cases managed at home were likely underrepresented, potentially underestimating disease prevalence. Additionally, resource constraints restricted extensive laboratory evaluations for all participants, and variability in clinical assessments could have influenced the accuracy of recorded diagnoses and nutritional assessments.

CONCLUSION

This study provides a comprehensive overview of the clinicopathological profile of pediatric outpatients at Dhaka Shishu Hospital, highlighting the predominance of children aged 1–5 years and a slight male preponderance. Respiratory tract infections and gastrointestinal disorders were the most frequent clinical diagnoses, while fever and cough/cold were the leading presenting complaints. Laboratory evaluations revealed notable hematological and inflammatory abnormalities in a subset of patients, and malnutrition, particularly underweight and stunting, remained prevalent. The majority of children were managed conservatively, with a smaller proportion requiring hospital admission or specialist referral. These findings underscore the continued burden of infectious diseases and nutritional deficiencies in the pediatric population and emphasize the need for targeted preventive, diagnostic, and management strategies to improve child health outcomes in Bangladesh.

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ORIGINAL ARTICLE

Asymptomatic Cardiac Arrhythmias in Maintenance Hemodialysis – Frequency, Causes, and Patterns

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ABSTRACT

Background: *Cardiac arrhythmias are a major cause of morbidity and mortality in patients undergoing maintenance hemodialysis (MHD). Many arrhythmias remain asymptomatic and undetected, contributing to sudden cardiac death. Understanding their frequency, patterns, and predictors is crucial for improving patient outcomes.* ***Aim of the study:*** *To determine the frequency, types, and possible clinical and biochemical predictors of asymptomatic cardiac arrhythmias among patients receiving maintenance hemodialysis.* ***Methods & Materials:*** *This cross-sectional observational study was conducted at the Department of Nephrology, BSMMU, Dhaka, from April 2023 to September 2024. A total of 49 adult MHD patients meeting inclusion criteria underwent 24-hour Holter monitoring and echocardiographic evaluation. Demographic, clinical, and biochemical parameters were recorded and analyzed using SPSS (version 26). Logistic regression was applied to identify predictors of arrhythmia.* ***Result:*** *Asymptomatic arrhythmias were detected in 77.6% (PACs), 71.4% (PVCs), 59.2% (bradycardia), and 65.3% (tachycardia) of patients. Most events occurred during or immediately after dialysis. Lower post-dialysis magnesium (OR 0.007, 95% CI: 0.00–0.77, p=0.039) and potassium levels (OR 0.11, 95% CI: 0.01–0.84, p=0.033) were significant predictors for ventricular ectopy. Other factors, including age, diabetes, hypertension, and LVMI, were not independently associated.* ***Conclusion:*** *Asymptomatic cardiac arrhythmias are common in MHD patients, with electrolyte fluctuations—particularly reduced post-dialysis magnesium and potassium—serving as key contributors. Routine Holter monitoring and individualized dialysis prescriptions may help in early detection and prevention of fatal arrhythmias.*

Keywords: *Maintenance hemodialysis, asymptomatic arrhythmia, Holter monitoring, magnesium, ventricular ectopy.*

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INTRODUCTION

Chronic kidney disease (CKD) is a growing public health burden and a significant contributor to global morbidity and mortality. Cardiac arrhythmia is a condition characterized by abnormal rate or rhythm of the heartbeat due to irregular electrical activity in the heart [1]. According to the Global Burden of Disease study, approximately 850 million people worldwide are affected by kidney diseases, and an estimated 2.6 million patients receive renal replacement therapy, including hemodialysis (HD), with numbers projected to double by 2030 [2]. In Bangladesh, CKD affects nearly 18% of the adult population, and access to maintenance HD has expanded in recent years, leading to a rising population vulnerable to dialysis-related complications [3]. Among patients undergoing maintenance hemodialysis (MHD), cardiovascular diseases (CVDs) remain the leading cause of death, accounting for approximately 40% to 50% of all mortalities [4]. Alarmingly, nearly half of these cardiovascular

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deaths are attributed to sudden cardiac death (SCD), which is frequently associated with underlying cardiac arrhythmias [5]. The increased cardiovascular vulnerability among HD patients is multifactorial, with mechanisms involving chronic volume overload, metabolic derangements, sympathetic overactivity, myocardial fibrosis, and dialysis-related hemodynamic instability [6]. A substantial proportion of cardiovascular events in MHD patients, including SCD, occur during or shortly after HD sessions, highlighting the potential arrhythmogenic nature of the dialysis process itself [7]. Episodes of intradialytic hypotension (IDH), occurring in up to one-third of outpatient HD treatments, have been linked to myocardial ischemia and stunning, which may serve as precursors for fatal arrhythmias [8]. These insights underscore the need to identify and mitigate modifiable risks like IDH in the dialysis population. Despite the clinical significance, the true burden of asymptomatic cardiac arrhythmias in HD patients remains underreported [9]. Most previous studies evaluating arrhythmic burden have relied on short-duration Holter monitoring and small sample sizes, conducted before major advances in cardiovascular care [10]. Additionally, the HD population has evolved significantly over the past decade, with patients now being older, more comorbid (especially with diabetes mellitus and hypertension), and exposed to different dialysis technologies and buffer systems [11]. The replacement of acetate with bicarbonate as a buffer and the reduction in the use of low-potassium dialysates have potentially altered arrhythmia risks [12]. Recent registries, such as the USRDS and DOPPS, report atrial fibrillation prevalence ranging from 7% to 27% in HD patients [13]. However, regional data, especially from South Asia and Bangladesh, remain sparse. Local evidence is essential as demographic, clinical, and dialysis-related practices differ significantly and may influence arrhythmia patterns [14]. Moreover, emerging studies suggest several independent risk factors for arrhythmias, including older age, low systolic BP, longer dialysis vintage, low serum calcium, and DM [15]. This study was therefore designed to assess the frequency, patterns, and possible clinical determinants of asymptomatic cardiac arrhythmias among patients with CKD receiving maintenance HD, using extended Holter monitoring and comprehensive clinical evaluation.

METHODS & MATERIALS

This was a cross-sectional observational study conducted in the Department of Nephrology at Bangabandhu Sheikh Mujib Medical University (BSMMU), Dhaka, Bangladesh. The study was carried out over an 18-month period from April 2023 to September 2024. A total of 49 adult patients with stage 5 chronic kidney disease (CKD) undergoing MHD for at least 3 months were consecutively enrolled.

Inclusion and Exclusion Criteria

Inclusion criteria comprised patients aged ≥18 years, receiving regular hemodialysis (2–3 sessions per week), and clinically stable without symptoms of arrhythmia. Patients with known structural heart disease, pacemakers, recent hospitalization, or current anti-arrhythmic therapy were excluded.

Data Collection

Demographic and clinical data, including age, sex, comorbidities (hypertension, diabetes, dyslipidemia), dialysis vintage, body mass index (BMI), and antihypertensive medication use, were recorded using a structured case record form. Laboratory parameters (serum electrolytes, hemoglobin, calcium, phosphate) were measured using standard automated analyzers. Dialysis-related data, including frequency and duration of sessions, were retrieved from institutional records.

Electrocardiographic Assessment

All participants underwent 24-hour ambulatory Holter monitoring using a 3-channel digital Holter device (model specified). The recordings were analyzed by an experienced cardiologist blinded to clinical data. Arrhythmias were classified as premature atrial contractions (PACs), premature ventricular contractions (PVCs), sinus bradycardia (<60 bpm), or sinus tachycardia (>100 bpm). Temporal distribution of arrhythmias was analyzed in four 6-hour blocks relative to the dialysis session.

Echocardiographic Evaluation

Transthoracic echocardiography was performed using a standard protocol (Philips/GE system) by a trained cardiologist. Parameters assessed included ejection fraction (EF), left ventricular mass index (LVMI), left ventricular internal diastolic diameter (LVIDD), diastolic dysfunction grading, pulmonary artery systolic pressure (PASP), and the presence of aortic sclerosis.

Statistical Analysis

Data were analyzed using SPSS version 26.0 (IBM Corp, Armonk, NY, USA). Continuous variables were expressed as mean ± standard deviation (SD), and categorical variables as frequencies and percentages. Logistic regression analyses were performed to identify independent predictors of arrhythmia subtypes. Odds ratios (ORs) with 95% confidence intervals (CIs) and corresponding p-values were reported. A p-value <0.05 was considered statistically significant.

Ethical Considerations

The study protocol was approved by the Institutional Review Board (IRB) of BSMMU (Approval No. IRB/BSMMU/2023/Nephro-101). Written informed consent was obtained from all participants. All procedures conformed to the ethical guidelines of the Declaration of Helsinki.

RESULT

The mean age of the patients was 42.1±12.3 years, with 53.06% above 40 years of age. Males predominated, accounting for 73.47% of the study population. The mean BMI was 23.6±4.8 kg/m^2. Hypertension was the most prevalent comorbidity (95.92%), followed by diabetes mellitus (36.73%) and dyslipidemia (12.24%). Regarding antihypertensive therapy, the most commonly prescribed drugs were DHP-CCB (75.51%), β-blockers (67.35%), and α-blockers (32.65%) (Table 1). Table 2 showed that all patients

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underwent standard dialysis sessions lasting 4.0±0.0 hours. Most participants (79.59%) received dialysis twice weekly, while 20.41% had thrice-weekly sessions. The mean pre-dialysis serum potassium was 4.67±0.64 mmol/L, which decreased to 4.16±0.55 mmol/L post-dialysis. The mean serum calcium and phosphate levels were 8.85±1.15 mg/dL and 4.51±1.09 mg/dL, respectively. Premature atrial contractions (PACs) were the most frequent (77.55%), followed closely by premature ventricular contractions (PVCs) in 71.43% of patients. Sinus tachycardia (>100 bpm) occurred in 65.31%, while sinus bradycardia (<60 bpm) was seen in 59.18% of individuals (Table 3). The mean ejection fraction was 60.5±5.5%, with 95.92% of patients maintaining normal systolic function (>50%). Mean LVMI was 130.6±43.7 g/m^2, and mean LVIDD was 52.2±5.16 mm. Aortic sclerosis was detected in 8.16%, and the mean pulmonary artery systolic pressure (PASP) was 32.3±14.3 mmHg (Table 4). Table 5 presented that during the dialysis period (0–6 hours), the highest frequencies of PACs (38.8%) and tachyarrhythmias (38.8%) were observed, whereas bradyarrhythmias (53.1%) peaked during the 18–24-hour period post-dialysis. PVCs were most frequent during the 0–6 hour (35.7%) and 18–24 hour (27.1%) intervals. Multivariate analysis identified post-dialysis magnesium level as a significant independent predictor for both PACs (OR 0.00, 95% CI: 0.00–0.03, p=0.004) and PVCs (OR 0.007, 95% CI: 0.00–0.77, p=0.039). Post-dialysis potassium (OR 0.11, p=0.033) and LVMI (OR 1.15, p=0.008) were also significantly associated with PVCs. PASP showed a positive correlation with PVCs (OR 1.10, p=0.026). Interestingly, diabetes mellitus appeared protective against bradyarrhythmias (OR 0.26, p=0.028). Other variables, including age, hypertension, and calcium levels, did not demonstrate significant associations (Table 6).

Table – I: Baseline demographic and clinical characteristics of patients on maintenance hemodialysis (*n* = 49)

Variable	Frequency (n)	Percentage (%)
Age group (years)		
<40	23	46.94
>40	26	53.06
Mean ±SD	42.1±12.3	
Gender		
Male	36	73.47
Female	13	26.53
BMI (kg/m2)		
Mean ±SD	23.6±4.8	
Comorbidities		
Diabetes mellitus	18	36.73
Hypertension	47	95.92
Dyslipidemia	6	12.24
Antihypertensive medication		
DHP-CCB	37	75.51
β-blocker	33	67.35
α-blocker	16	32.65

Table – II: Dialysis-related and laboratory parameters of the study population

Parameter	Mean ± SD
Duration of each dialysis session (hours)	4.0 ± 0.0
Frequency of dialysis	
2 sessions	39 (79.59)
3 sessions	10 (20.41)
Pre-dialysis serum potassium (mmol/L)	4.67 ± 0.64
Post-dialysis serum potassium (mmol/L)	4.16 ± 0.55
Serum calcium (mg/dL)	8.85 ± 1.15
Serum phosphate (mg/dL)	4.51 ± 1.09
Hemoglobin (g/dL)	10.0 ± 1.23

Table – III: Frequency and types of asymptomatic cardiac arrhythmias detected by 24-hour holter monitoring

Arrhythmia Type	Frequency (n)	Percentage (%)
Premature Atrial Contractions (PACs)	38	77.55
Premature Ventricular Contractions (PVCs)	35	71.43
Sinus Bradycardia (<60 bpm)	29	59.18
Sinus Tachycardia (>100 bpm)	32	65.31

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Table – IV: Echocardiographic findings in patients receiving maintenance hemodialysis (*n* = 49)

Echocardiographic findings	Frequency (n)	Percentage (%)
Ejection fraction		
<50%	2	4.08
>50%	47	95.92
Mean±SD		60.5±5.5
LVMI (g/m2)		130.6±43.7
LVIDD (mm)		52.2±5.16
Diastolic dysfunction		
Grade 1	8	16.33
Grade 2	3	6.12
Grade 3	1	2.04
Aortic sclerosis	4	8.16
PASP (mmHg)		32.3±14.3

Table – V: Distribution of asymptomatic cardiac arrhythmias by time block in hemodialysis patients (*n*=49)

Time Block (h)	PACs (%)	PVCs (%)	Bradyarrhythmias (%)	Tachyarrhythmias (%)
0–6 (dialysis)	38.8	35.7	12.2	38.8
6–12	21.1	22.9	14.3	27.6
12–18	20.4	14.3	20.4	14.3
18–24	19.7	27.1	53.1	19.3

Table – VI: Logistic regression predictors for asymptomatic cardiac arrhythmias in maintenance hemodialysis patients (*n*=49)

Predictor	PACs OR (95% CI)	p-value	PVCs OR (95% CI)	p-value	Bradyarrhythmias OR (95% CI)	p-value	Tachyarrhythmias OR (95% CI)	p-value
Age > 40 years	0.42 (0.10–1.47)	0.208	0.37 (0.10–1.34)	0.124	1.61 (0.51–5.09)	0.419	1.43 (0.43–4.69)	0.556
Diabetes mellitus	3.27 (0.62–17.2)	0.147	1.67 (0.44–6.38)	0.453	0.26 (0.07–0.89)	0.028	0.75 (0.22–2.51)	0.638
Hypertension	3.70 (0.21–64.5)	0.34	2.62 (0.15–44.9)	0.493	2.10 (0.65–6.78)	0.21	1.18 (0.35–4.01)	0.797
Post-dialysis K^+	0.15 (0.01–2.11)	0.159	0.11 (0.01–0.84)	0.033	0.55 (0.10–3.07)	0.496	0.92 (0.23–3.61)	0.903
Post-dialysis Mg^{2+}	0.00 (0.00–0.03)	0.004	0.007 (0.00–0.77)	0.039	0.18 (0.03–1.00)	0.05	0.34 (0.06–1.89)	0.22
LV Mass Index (per g/m^2)	0.99 (0.97–1.01)	0.269	1.15 (0.91–2.99)	0.008	1.04 (0.99–1.09)	0.11	1.02 (0.97–1.07)	0.38
PASP (per mmHg)	0.99 (0.94–1.05)	0.784	1.10 (0.83–1.99)	0.026	1.03 (0.96–1.11)	0.39	1.05 (0.97–1.13)	0.22

DISCUSSION

The study reported a mean age of 42.1 ± 12.3 years and a mean BMI of 23.6 ± 4.8 kg/m^2, with a male predominance (73.47%). Hypertension was highly prevalent (95.92%), and 36.73% of the patients had diabetes mellitus. In a previous study, Ajmal et al. reported a higher mean BMI of 27.0 ± 6.2 kg/m^2, a mean age of 62.2 ± 13.8 years, male predominance (67.8%), and a high prevalence of hypertension (90.1%), with 21.7% of patients having diabetes mellitus [16]. In our study, patients underwent 4-hour dialysis sessions, predominantly twice weekly (79.59%). Pre-dialysis potassium averaged 4.67 ± 0.64 mmol/L and decreased to 4.16 ± 0.55 mmol/L, demonstrating effective removal. Calcium, phosphate, and hemoglobin levels remained within recommended ranges, indicating adequate metabolic and anemia management. Similarly, Ansari et al. reported a mean serum potassium of 3.8 ± 0.2 mmol/L at the time of arrhythmias [17], Roberts et al. observed a mean hemoglobin level of 11.8 ± 1.3 g/dL [18], and Chaudhury et al. noted that arrhythmias peaked during the first dialysis session and late inter-dialytic hours, with higher pre-dialysis sodium and dialysate calcium >2.5 mmol/L identified as key risk factors [19]. Asymptomatic arrhythmias were highly prevalent in this cohort. Premature atrial contractions (PACs) occurred in 77.55% of patients, premature ventricular contractions (PVCs) in 71.43%, sinus bradycardia in 59.18%, and sinus tachycardia in 65.31%. In previous studies, Roberts et al. reported PACs ranging from 40.3% to 100%, while PVCs were observed in 59.7% to 87.8% of patients. Sinus bradycardia showed considerable variability, documented in 20% to 59.18% of patients, and sinus tachycardia prevalence ranged from 2.5% to 65.31% across different studies [20]. Most patients (95.92%) had preserved left ventricular ejection fraction (mean 60.5±5.5%), while the mean left ventricular mass index (LVMI) was 130.6±43.7 g/m^2, indicating a high prevalence of left ventricular hypertrophy. Diastolic dysfunction was present in 24.49% of patients across grades 1 to 3. These findings corroborate previous reports that highlight structural cardiac changes as a common consequence of chronic kidney disease and HD [21]. Arrhythmia occurrence varied throughout the day. PACs (38.8%) and PVCs (35.7%) were most frequent during dialysis sessions, while bradyarrhythmias peaked (53.1%) in

the late post-dialysis period. This temporal pattern is consistent with prior studies showing that arrhythmias often occur during and after dialysis due to electrolyte shifts and hemodynamic changes [22]. Post-dialysis magnesium levels emerged as a significant predictor for PVCs (OR 0.007, 95% CI: 0.00–0.77, p=0.039), suggesting that lower magnesium levels may increase the risk of ventricular ectopy. Other factors, including age, diabetes, hypertension, post-dialysis potassium, LVMI, and pulmonary artery systolic pressure, were not significantly associated with arrhythmia risk. These findings underscore the complex interplay of electrolyte disturbances and structural heart changes in the pathogenesis of arrhythmias in HD patients [23].

Limitations of the Study:

This study was limited by its relatively small sample size and single-center design, which may restrict the generalizability of the findings. The cross-sectional nature precluded assessment of long-term arrhythmic outcomes or causal relationships. Additionally, electrolyte measurements were taken only before and after dialysis, not during the procedure, which may have missed transient changes. Use of 24-hour Holter monitoring might have underestimated arrhythmias occurring outside the recording period or on non-dialysis days.

CONCLUSION

Asymptomatic cardiac arrhythmias were found to be highly prevalent among patients receiving maintenance hemodialysis, with premature atrial and ventricular contractions being the most common types. The study demonstrates that electrolyte shifts, particularly post-dialysis magnesium and potassium levels, play a crucial role in arrhythmogenesis. Lower post-dialysis magnesium emerged as a significant independent predictor for ventricular ectopy, emphasizing the importance of maintaining optimal electrolyte balance during dialysis. Although age, diabetes, and hypertension were frequent comorbidities, they showed limited independent influence on arrhythmic patterns. These findings suggest that regular Holter monitoring and individualized dialysis prescriptions may help detect and prevent subclinical arrhythmias, thereby reducing the risk of sudden cardiac death in this vulnerable population.

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ORIGINAL ARTICLE

Vitamin D Deficiency among Children Visiting Outpatient Department in Bangladesh Shishu Hospital & Institute

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ABSTRACT

Background: *Vitamin D plays a crucial role in bone mineralization, immune function, and overall growth. Deficiency is a widespread public health concern, particularly among children in South Asia, including Bangladesh. Limited sun exposure and dietary insufficiency are recognized contributors, but the prevalence and associated risk factors remain underreported in pediatric outpatient populations.* ***Aim of the study:*** *To determine the prevalence, risk factors, and clinical impact of vitamin D deficiency among children attending outpatient departments of Bangladesh Shishu Hospital & Institute.* ***Methods & Martials:*** *A cross-sectional study was conducted from From January 2024 to December 2024 on 210 pediatric patients (<18 years) using purposive sampling. Demographic, clinical, and lifestyle data were collected via structured questionnaires. Serum 25-hydroxyvitamin D [25(OH)D] was measured using chemiluminescent immunoassay and classified as deficient (<20 ng/mL), insufficient (20–29 ng/mL), or sufficient (≥30 ng/mL). Associations with age, sex, BMI, sunlight exposure, and season were analyzed using chi-square tests and multivariable logistic regression.* ***Result:*** *Vitamin D deficiency was observed in 59.5% of participants, and 26.2% had insufficient levels. Deficiency was most prevalent during winter and spring and was significantly associated with limited sunlight exposure (<2 hours/day). Age, sex, and BMI were not independent predictors of deficiency.* ***Conclusion:*** *Vitamin D deficiency is highly prevalent among children attending outpatient departments in Dhaka. Environmental and lifestyle factors, particularly inadequate sunlight exposure and seasonal variation, are key contributors. Routine screening, safe sun exposure, and dietary or supplemental interventions are recommended to prevent adverse musculoskeletal and immune outcomes.*

Keywords: *Vitamin D deficiency, Pediatric, Sunlight exposure, Bangladesh, 25-hydroxyvitamin D.*

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INTRODUCTION

Vitamin D, often dubbed the sunshine vitamin, is a fat-soluble vitamin critical for maintaining calcium and phosphorus homeostasis and ensuring proper bone mineralization [1]. Globally, vitamin D deficiency affects about 40–50% of the population, while insufficiency and deficiency combined impact nearly 1 billion people worldwide [2]. Bangladesh the pooled prevalence of vitamin D deficiency is about 67% among adults [3]. It is synthesized in the skin upon exposure to ultraviolet-B (UVB) radiation from sunlight, and it is also obtained from dietary sources such as fatty fish, fortified foods, egg yolks, and supplements [1]. Vitamin D deficiency arises from a combination of environmental, biological, and lifestyle factors. The foremost cause is insufficient exposure to sunlight, as ultraviolet-B rays are required for cutaneous vitamin D synthesis. Densely populated urban environment, children often have limited access to open outdoor spaces due to high-rise buildings, traffic, and safety concerns, which reduce sun exposure opportunities [4]. Dietary insufficiency is another major contributor. Traditional Bangladeshi diets are heavily cereal-based, with limited intake of vitamin D-rich foods. Since Bangladesh currently lacks a nationwide vitamin D fortification program, dietary sources alone are inadequate for most children [5]. The consequences of vitamin D deficiency

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extend far beyond bone health, affecting multiple organ systems and overall quality of life. In children, one of the most recognized outcomes is rickets, a disorder characterized by impaired bone mineralization leading to skeletal deformities, delayed growth, and, in severe cases, permanent disability. In adults, deficiency contributes to osteomalacia and accelerates the risk of osteoporosis, both of which increase susceptibility to fractures and chronic musculoskeletal pain [6,7]. Beyond the skeletal system, vitamin D plays a crucial role in immune regulation. Deficient individuals are more vulnerable to acute respiratory infections, autoimmune disorders, and delayed wound healing. Associations between low vitamin D levels and metabolic and cardiovascular conditions, including insulin resistance, hypertension, and obesity-related complications, have been increasingly documented, suggesting that vitamin D deficiency may contribute to the development and progression of these disorders [8]. Vitamin D deficiency with muscle weakness, fatigue, and mood disorders such as depression and anxiety, which can affect school performance and social development in children [5]. There are potential drawbacks if deficiency is addressed improperly. Over-supplementation can lead to hypervitaminosis D, resulting in hypercalcemia, kidney damage, and soft tissue calcification. Encouraging sun exposure may conflict with cultural norms, skin cancer precautions, or environmental limitations, while dietary fortification and supplementation programs require monitoring, resources, and adherence to avoid toxicity [9]. The aim of this study was to determine the prevalence, risk factors, and clinical impact of vitamin D deficiency among patients visiting the outpatient departments of Dhaka Shishu Hospital.

METHOD & MATERIALS

This was a cross-sectional observational study conducted from January 2024 to December 2024 at the Outpatient Departments (OPD) of Bangladesh Shishu Hospital & Institute, a tertiary care pediatric hospital in Dhaka, Bangladesh. A total of 210 pediatric patients (<18 years) visiting the OPDs were consecutively enrolled using a purposive sampling technique during the study period. Participants were recruited as they presented to the OPD and were screened against the study's inclusion and exclusion criteria.

Inclusion criteria:

- Children attending OPDs for routine check-ups or minor illnesses.
- Consent provided by parents or guardians.

Exclusion criteria:

- Children with chronic liver, kidney, or gastrointestinal diseases affecting vitamin D metabolism.
- Those receiving vitamin D supplementation within the previous three months.
- Critically ill patients requiring hospitalization.

Data Collection

Data were collected using a pre-designed structured questionnaire administered by trained research staff. Information gathered included demographics (age, sex), clinical features (fatigue, muscle pain, recurrent infections, growth delay), and lifestyle factors, such as daily sunlight exposure and dietary habits. Anthropometric measurements, including height and weight, were obtained using standardized instruments, and BMI was calculated according to WHO pediatric growth standards. Age was recorded in years, and BMI was categorized into underweight, normal, and overweight/obese for analysis.

Laboratory Analysis

A 5 mL venous blood sample was collected from each participant under aseptic conditions. The blood was allowed to clot and centrifuged to separate serum, which was then stored at −20°C until analysis. Serum 25-hydroxyvitamin D [25(OH)D] concentrations were measured using chemiluminescent immunoassay (CLIA) on [specify instrument/model]. Vitamin D status was classified according to the Endocrine Society guidelines: deficient (<20 ng/mL), insufficient (20–29 ng/mL), and sufficient (≥30 ng/mL). All laboratory procedures followed standard operating protocols to ensure accuracy and reliability.

Definitions of Variables

Sunlight exposure was defined as the average hours per day spent outdoors between 10:00 am and 4:00 pm. BMI categories were defined as underweight (<18.5 kg/m^2), normal (18.5–24.9 kg/m^2), and overweight/obese (≥25 kg/m^2). Seasons were categorized based on local climatic data: Winter (Dec–Feb), Spring (Mar–May), Summer (Jun–Aug), and Autumn (Sep–Nov).

Statistical Analysis

Data were analyzed using SPSS version 26 (IBM Corp., Armonk, NY, USA). Continuous variables were expressed as mean ± standard deviation (SD), and categorical variables as frequency (n) and percentage (%) with two decimal places. Differences in mean serum 25(OH) D across seasons were assessed using ANOVA, with post-hoc Tukey tests for pairwise comparisons. Associations between categorical variables (age group, sex, BMI, sunlight exposure, season) and vitamin D deficiency were evaluated using the Chi-square test. Binary logistic regression was performed to identify independent predictors of vitamin D deficiency (<20 ng/mL), adjusting for age, sex, BMI, sunlight exposure, and season. Adjusted odds ratios (ORs) with 95% confidence intervals (CIs) were reported, and a two-tailed $p < 0.05$ was considered statistically significant.

Ethical Considerations

The study was approved by the Institutional Review Board of Dhaka Shishu Hospital. Written informed consent was obtained from parents or guardians, and confidentiality and anonymity of participants were strictly maintained throughout the study.

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RESULT

A total of 210 children attending the outpatient department were enrolled in the study. The age distribution showed that 22.86% were under 5 years, 31.43% were 5–10 years, 24.76% were 11–15 years, and 20.95% were above 15 years. The study population included 112 males (53.33%) and 98 females (46.67%). Regarding BMI status, 22.86% were underweight, 62.86% had normal BMI, and 14.29% were overweight or obese (Table 1). Table 2 presented that clinically, fatigue was the most common symptom (42.86%), followed by muscle pain (26.67%), recurrent infections (17.14%), and growth delay (13.33%). In terms of sunlight exposure, 43.81% of participants received less than 1 hour per day, 36.19% received 1–2 hours, and 20% received more than 2 hours daily. Vitamin D deficiency was observed in 59.52% of participants, insufficiency in 26.19%, and sufficient levels in only 14.29%, with a mean serum 25(OH)D of 18.9±7.0 ng/mL (Table 3). Table 4 showed that seasonal analysis of serum 25(OH)D levels demonstrated marked variation across the year. The highest prevalence of vitamin D deficiency was observed in winter (76.92%) and spring (78.26%), with mean serum levels of 14.9±6.2 ng/mL and 15.3±6.5 ng/mL, respectively. In contrast, summer and autumn showed lower deficiency rates of 50.0% and 37.5%, with corresponding mean levels of 19.3±7.0 ng/mL and 20.7±6.5 ng/mL. Bivariate analysis of demographic and behavioral factors revealed that sunlight exposure was significantly associated with vitamin D deficiency (p=0.002). Children receiving less than 1 hour of sunlight per day had the highest deficiency (75.0%), compared to 50.0% in those exposed for 1–2 hours and 42.86% in those with >2 hours of daily exposure. Age, sex, and BMI categories were not significantly associated with deficiency (all p > 0.05) (Table 5). Multivariable logistic regression identified reduced sunlight exposure (<1 hour/day: aOR 3.12, 95% CI 1.54–6.33; 1–2 hours/day: aOR 2.98, 95% CI 1.46–6.07) and winter (aOR 2.5, 95% CI 1.10–5.68) and spring seasons (aOR 2.72, 95% CI 1.18–6.25) as independent predictors of vitamin D deficiency. Age, sex, and BMI were not significant predictors in the adjusted model (Table 6).

Table – I: Baseline demographic characteristics of the study population (*n* = 210)

Variable	Frequency (n)	Percentage (%)
Age (years)		
<5	48	22.86
5–10	66	31.43
11–15	52	24.76
>15	44	20.95
Gender		
Male	112	53.33
Female	98	46.67
BMI (kg/m²)		
Underweight (<18.5)	48	22.86
Normal (18.5–24.9)	132	62.86
Overweight/Obese (≥25)	30	14.29

Table – II: Clinical features and sunlight exposure among study population

Variable	Frequency (n)	Percentage (%)
Clinical feature		
Fatigue	90	42.86
Muscle pain	56	26.67
Recurrent infections	36	17.14
Growth delay	28	13.33
Sunlight exposure (hours/day)		
<1 hour	92	43.81
1–2 hours	76	36.19
>2 hours	42	20.00

Table – III: Vitamin D status among the study population

Vitamin D status	Serum 25(OH)D (ng/mL) — category	Frequency (n)	Percentage (%)
Deficient	< 20	125	59.52
Insufficient	20–29	55	26.19
Sufficient	≥ 30	30	14.29
Mean ± SD		18.9 ± 7.0	

Table – IV: Seasonal variation in serum 25(OH) D and deficiency prevalence among the study population

Season	n (participants)	Mean 25(OH)D ± SD (ng/mL)	Deficient *n* (%)
Winter	52	14.9 ± 6.2	40 (76.92)
Spring	46	15.3 ± 6.5	36 (78.26)
Summer	56	19.3 ± 7.0	28 (50.00)
Autumn	56	20.7 ± 6.5	21 (37.50)

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Table – V: Association of vitamin d deficiency with age, sex, BMI, and sunlight exposure

Factor	Deficient *n* (%)	Non-deficient *n* (%)	Total	p-value
Age group (years)				
<5	30 (62.50)	18 (37.50)	48	0.41
5–10	42 (63.64)	24 (36.36)	66	
11–15	28 (53.85)	24 (46.15)	52	
>15	25 (56.82)	19 (43.18)	44	
Gender				
Male	67 (59.82)	45 (40.18)	112	0.92
Female	58 (59.18)	40 (40.82)	98	
BMI category (kg/m^2)				
Underweight (<18.5)	28 (58.33)	20 (41.67)	48	0.76
Normal (18.5–24.9)	80 (60.61)	52 (39.39)	132	
Overweight/Obese (≥25)	17 (56.67)	13 (43.33)	30	
Sunlight exposure (hours/day)				
<1 hour/day	69 (75.00)	23 (25.00)	92	0.002 *
1–2 hours/day	38 (50.00)	38 (50.00)	76	
>2 hours/day	18 (42.86)	24 (57.14)	42	

Table – VI: Multivariable logistic regression for predictors of vitamin D deficiency

Predictor (reference)	Adjusted OR	95% CI	p-value
Age (years, continuous)	0.99	0.96–1.02	0.45
Sex (female vs male)	0.99	0.57–1.73	0.97
BMI (Overweight/Obese vs Normal)	0.92	0.42–2.03	0.85
BMI (Underweight vs Normal)	0.92	0.44–1.93	0.82
Sunlight exposure (1–2 h/day vs >2 h/day)	2.98	1.46–6.07	0.003*
Sunlight exposure (<1 h/day vs >2 h/day)	3.12	1.54–6.33	0.002*
Season (Winter vs Autumn)	2.5	1.10–5.68	0.029*
Season (Spring vs Autumn)	2.72	1.18–6.25	0.019*
Season (Summer vs Autumn)	1.7	0.80–3.60	0.16

DISCUSSION

Vitamin D deficiency, a prevalent yet often underrecognized nutritional disorder, manifests in various forms ranging from mild insufficiency to severe deficiency depending on serum 25(OH)D levels [10]. In our study, more than half of the participants were male (53.33%), with the majority aged 5–10 years. The mean BMI distribution showed that 22.86% were underweight and 14.29% overweight/obese. These demographic findings align with previous reports, where undernutrition and overnutrition coexist in pediatric populations due to the ongoing nutritional transition [11]. Previous studies in Dhaka have similarly shown high rates of both underweight and overweight among urban children, reflecting the dual burden of malnutrition [12]. Fatigue (42.86%) and muscle pain (26.67%) were the most common clinical features in children with hypovitaminosis D, consistent with the well-established musculoskeletal manifestations of deficiency [13]. Recurrent infections (17.14%) and growth delay (13.33%) were also notable, supporting evidence that vitamin D plays a role in immune modulation and linear growth [14]. Low sunlight exposure was striking—43.81% reported <1 h/day outdoors—mirroring patterns described in South Asian urban children, where sun avoidance, indoor schooling, and cultural clothing practices markedly reduce cutaneous vitamin D synthesis [15]. We found a deficiency prevalence of 59.52% and insufficiency of 26.19%, with a mean 25(OH)D level of 18.9 ± 7.0 ng/mL. These values are comparable to prior Bangladeshi studies. For example, a Dhaka study reported Vitamin D deficiency was affecting 50.00% of children aged 1–3 years [16]. Our results reinforce this paradox of deficiency in sunny climates, also observed in Pakistan [17]. We observed lowest mean 25(OH)D in winter (14.9±6.2 ng/mL, 76.92% deficiency) and spring (15.3 ± 6.5 ng/mL, 78.26% deficiency), with improvement in autumn (20.7 ± 6.5 ng/mL, 37.50% deficiency). This seasonal variation has been consistently reported worldwide, with nadirs in winter and peaks in summer/autumn [18]. Chinese pediatric cohort also demonstrated similar patterns, where serum 25(OH)D concentrations were significantly lower during winter months [19]. These fluctuations reflect reduced ultraviolet-B availability in cooler months, coupled with behavioral changes such as less outdoor play and heavier clothing. Deficiency prevalence did not differ significantly by age, gender, or BMI in our study. Previous studies reported female sex and higher BMI as predictors of deficiency, but these associations were not evident here—possibly due to sample homogeneity or cultural differences in sun exposure practices [20]. Conversely, sunlight exposure showed a robust association: children with <1 h/day exposure had significantly higher deficiency (75.00%) compared to those with >2 h/day (42.86%). Similar findings were reported in an urban Bangladeshi study, where reduced outdoor activity and covered clothing were the strongest correlates of hypovitaminosis D [21]. On adjusted analysis, low sunlight exposure (<1 h/day and 1–2 h/day) and winter/spring season remained significant predictors of deficiency. These results highlight that environmental and behavioral factors outweigh intrinsic demographic variables in determining vitamin D status. Comparable multivariable models in South Asian populations identified reduced sun exposure, clothing coverage, and seasonality as independent predictors, rather than sex or BMI [22]. Our findings therefore underscore the

need for targeted interventions—promoting safe outdoor activity and considering supplementation or food fortification during high-risk seasons.

Limitations of the Study

This study was conducted at a single tertiary care hospital, which may limit the generalizability of the findings to the broader pediatric population in Bangladesh. The cross-sectional design precludes assessment of causal relationships between vitamin D deficiency and clinical outcomes. Dietary intake of vitamin D and adherence to supplementation were not quantitatively measured, and sun exposure was self-reported, introducing potential recall bias. Seasonal variations were considered, but other environmental factors, such as air pollution, were not assessed.

CONCLUSION

Vitamin D deficiency was highly prevalent among pediatric patients attending the outpatient departments of Dhaka Shishu Hospital, affecting nearly 60% of the study population, with an additional 26% having insufficient levels. Deficiency was most pronounced during winter and spring and was strongly associated with limited sunlight exposure, whereas age, sex, and BMI were not significant independent factors. These results indicate that environmental and lifestyle factors play a dominant role in determining vitamin D status in children. Routine screening, promotion of safe sun exposure, and dietary or supplemental interventions are warranted to address this widespread deficiency and reduce its potential impact on growth, musculoskeletal health, and immune function in Bangladeshi children.

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ORIGINAL ARTICLE

Evaluation of Psychiatric Types of Morbidities among the Caregivers with Dementia

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ABSTRACT

Background: *Globally, an estimated 30 million people suffer from dementia, a number expected to quadruple every 20 years. Dementia patients often require high levels of care, predominantly provided by unpaid family caregivers. Without caregivers, patients face lower quality of life, earlier institutionalization, and increased societal and economic burden.* ***Objective:*** *To assess the evaluation and types of psychiatric morbidities among caregivers of patients with dementia.* ***Methods & Materials:*** *A cross-sectional observational study was conducted from July 2022 to June 2023 at the Psychiatry departments of National Institute of Neuro Sciences & Hospital (NINS) and National Institute of Mental Health (NIMH) & Hospital, Dhaka. A total of 107 caregivers were recruited using purposive sampling. Data were collected via face-to-face interviews with a semi-structured questionnaire. Psychiatric morbidity was assessed using DSM-5 criteria and confirmed clinically. Data were analyzed with SPSS v24 using descriptive statistics and Chi-square tests for associations.* ***Results:*** *Most caregivers were female (68.2%), aged 28–37 years (52.3%), with the majority being housewives (36.4%). Most had no prior experience in caregiving for patients with dementia (88.8%) and were not physically abused by the patient (86%). Overall, 75.7% of caregivers had psychiatric morbidity. The most common conditions were Major Depressive Disorder (54.3%), Obsessive-Compulsive Disorder (16%), Generalized Anxiety Disorder (9.9%), Panic Disorder with Agoraphobia (7.4%), and Panic Disorder without Agoraphobia (3.7%). Social Phobia, Somatoform Disorders, and Eating Disorders were less frequent. No significant association was found between socio-demographic characteristics and psychiatric morbidity.* ***Conclusion:*** *Caregivers of dementia patients experience a high prevalence of psychiatric morbidity, particularly depression and anxiety, highlighting the need for targeted mental health support and interventions.*

Keywords: *Prevalence, Psychiatric Morbidities, Caregiver, Dementia*

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INTRODUCTION

Dementia is a neurodegenerative disease manifested by cognitive impairment to such a degree that it hampers an individual's capacity to complete daily tasks without assistance[1]. This chronic condition affecting mostly the older adults[2] has become a global health concern with its increased prevalence of 46.80 million and estimated to be doubled in every 20 years[3]. Dementia poses an extreme caregiving burden for daily activities and most of these cares are provided by the informal or family caregivers[4]. Family (informal) caregivers might be any relative, partner, friend, or someone with very close relationship with the patient with dementia who provide care for the patients' particular needs and well-being regardless of whether they live together with the patient. Their responsibilities to care for the patients include but are not limited to helping with basic tasks of daily living such as eating, dressing, walking, planning, financial decision making for health and medical care and emotional support etc.[3]. The unique challenges experienced by the family caregivers[4] due to the extreme dependency of the patients with dementia often for the entire lifetime, become further stressful while balancing the caregiving

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responsibilities alongside taking care of own families and/or career. This makes them specifically vulnerable to develop psychiatric morbidities[5,6]. Previous research has found an increased likelihood of psychiatric illnesses among dementia caregivers[6,7]. Siobhan and colleagues revealed that 16% of the dementia caregivers in the study had suicidal thoughts in the past year[7]. A meta-analysis was conducted to explore the prevalence and related risk factors of certain psychiatric disorders among the caregivers of patients with Alzheimer's disease[6]. They confirmed that the caregivers of patients with Alzheimer's disease had higher prevalence of depression and anxiety than the general population and caregivers of the patients with other diseases. However, most of these studies have been conducted in the context of developed countries and the results cannot be generalized given the significant differences in caregiving settings of developing countries.

Over 60% of individuals living with dementia reside in developing countries. Additionally, the global population of individuals aged 60 years and older is projected to increase to 900 million by 2050, with 80% of them expected to live in low- and middle-income countries[8]. The predicted increased growth of older adults will raise the prevalence of dementia to 71% in LMICs by 2050. The 10/66 Dementia Research Group examined the facilities and access for care for the people with dementia in South-East Asia, China, India, Latin America and the Caribbean, and Nigeria[9]. However, limited opportunities of dementia related research and updated statistics complicate to follow the epidemiological trends of dementias to gauge the actual caregiving needs and related burdens and costs in Bangladesh, a low-income country of South-East Asia. While the existing evidence indicate the dementia caregivers as a vulnerable group for mental disorders, no study to date has been conducted in Bangladesh in this area. Given the increased prevalence and growth of dementia cases and relative scarcity of research in this area, it is very important to conduct more research in developing countries particularly in Bangladesh. This study examines the prevalence and types of psychiatric morbidities among the caregivers of the patients with dementia from two specialized hospitals in Bangladesh.

METHODS & MATERIALS

Study Design and Setting: This cross-sectional observational study was conducted in the in-patient and out-patient departments of Psychiatry at National Institute of Neuro Sciences & Hospital (NINS) and National Institute of Mental Health (NIMH) & Hospital, Dhaka, from July 2022 to June 2023. The National Institute of Mental Health is a tertiary-level specialized government hospital for psychiatric patients.

Study Population and Sample Size: The study population included caregivers of patients with dementia. A total of 107 caregivers of both sexes were included in the study.

Sampling Technique: Purposive sampling was employed to select participants based on availability and fulfillment of the inclusion and exclusion criteria.

Data Collection Procedure: Data were collected through face-to-face interviews using a semi-structured questionnaire. Socio-demographic information, caregiving experience, and previous exposure to patient care were recorded. Psychiatric morbidity among caregivers was assessed using standardized diagnostic criteria based on the DSM-5 and confirmed via clinical evaluation by trained psychiatrists. Informed consent was obtained from all participants before data collection.

Data Management and Quality Control: Collected data were checked, cleaned, edited, compiled, coded, and categorized to ensure accuracy, consistency, and completeness.

Statistical Analysis: Statistical analyses were performed using the Statistical Package for the Social Sciences (SPSS) version 24. Descriptive statistics, including frequencies and percentages, were used to summarize categorical data. Inferential statistics, primarily Chi-square tests, were applied to examine associations between socio-demographic factors and psychiatric morbidity. A p-value of <0.05 was considered statistically significant.

RESULT

This is a descriptive cross-sectional study conducted in the in-patient and out-patient department of Psychiatry, National Institute of Neuro Sciences & Hospital (NINS) and National Institute of Mental Health (NIMH) & Hospital, Dhaka from July 2022 to June 2023. The National Institute of Mental Health is one of the tertiary level specialized government hospitals for psychiatric patients. After fulfilling inclusion and exclusion criteria, among 107 students the objective of the study was clearly explained to all participants and informed consent was obtained from each participant after counselling. Participants were assured that their personal information would be confidential.

Table – I: Distribution of the patients according to baseline (*n* = 107)

Age group	*n*=107	%
18-27	24	22.4
28-37	56	52.3
38-47	19	17.8
48-57	8	7.5
Sex Distribution		
Male	34	31.8
Female	73	68,2

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Relationship with patients			
	Wife	26	24.3
	Son	34	31.8
	Daughter	32	29.9
	Others	15	14.0
Religion			
	Muslim	97	90.7
	Sanatan	10	9.3
Educational Status			
	Primary	21	19.6
	SSC	24	22.49
	HSC	15	14.0
	Graduate	35	32.70
	Master	12	11.20
Occupational Status			
	House wife	39	36.49
	Farmer	14	13.10
	Labor	2	1.90
	Student	15	14.0
	Business	5	4.79
	Service	32	29.90
Earning Member		69	64.5
Family Type			
	Married	78	72.9
	Unmarried	29	27.1
Monthly Income of Family			
	10001-20000	22	20.6
	20001-30000	23	21.5
	>30000	62	57.9
Total		107	100.0

Table I shows that, more than half of the respondents (52.3%) came from the 28-37 years age group followed by 22.4 % from 18-27 years, 17.8% from 38-47% and 7.5% from 48-57 years. Female was quite double (68.2%) than male (31.80%). Relationship with patients. Wife, son, daughter and others were 24.3%, 31.8%, 29.9% and 14.0% respectively. urban and rural habitants were 65.4% and 34.6%. Most of the respondents (90.70%) were Muslim and rest of the respondents (9.3%) was Sanatan. about 32.70%, 22.40%, 19.60%, 14.00%, and 11.20% respondents completed graduation, secondary education, primary education, higher secondary education and post-graduation. Most of the respondents (36.40%) were housewife followed by service 29.90%, student 14.0%, farmer 13.10%, business 4.70% and labor 1.90. Most of the respondents (64.50%) were not the principal earning member. Most of the caregivers (72.90%) were married and rest of them (27.10) was unmarried. More than half of the family (57.9%) had monthly income>30000 BDT followed by 21.5% had 20001-30000 BDT and 20.6% had 10001-20000 BDT

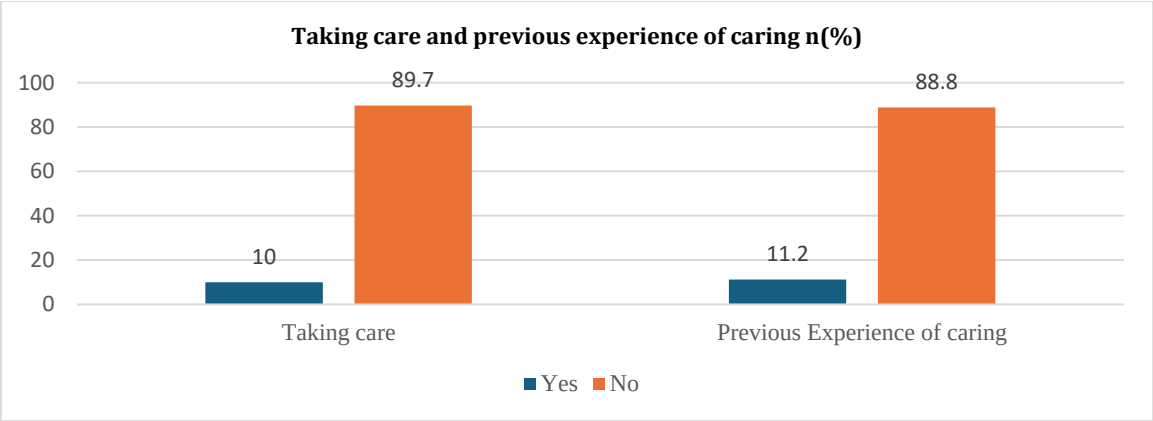

Figure – 1: Distribution of the patients according to taking care and previous experience of caring of any other patient by caregiver (*n*=107)

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Figure 1 show that, majority of the caregivers (89.70%) did not take care of other patients. Most of the caregivers (88.80%) had no previous experience of caring this type of patients

Table – II: Distribution of the patients according to duration of care (*n*=107)

Periods of taking care	Frequency	%
6-12 months	71	66.4
12-60 months	33	30.8
>60 months	3	2.8
Total	107	100.0

Table II Shows that, 66.4% respondents took care 6-12 months of the patient and 30.8% took care 12-60 months as well as 2.8% handled patient greater than 60 months.

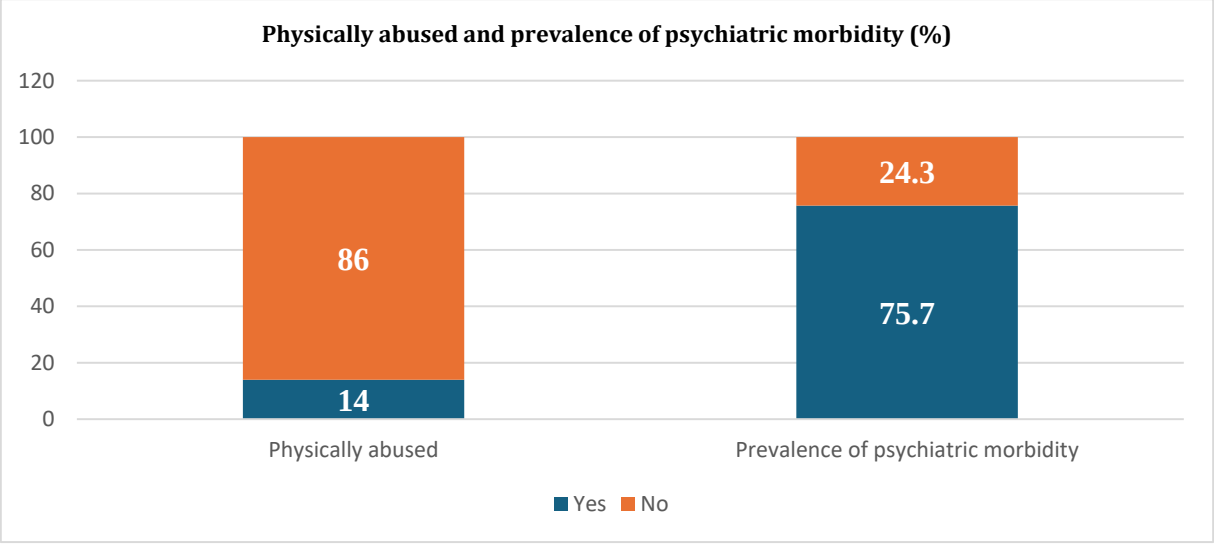
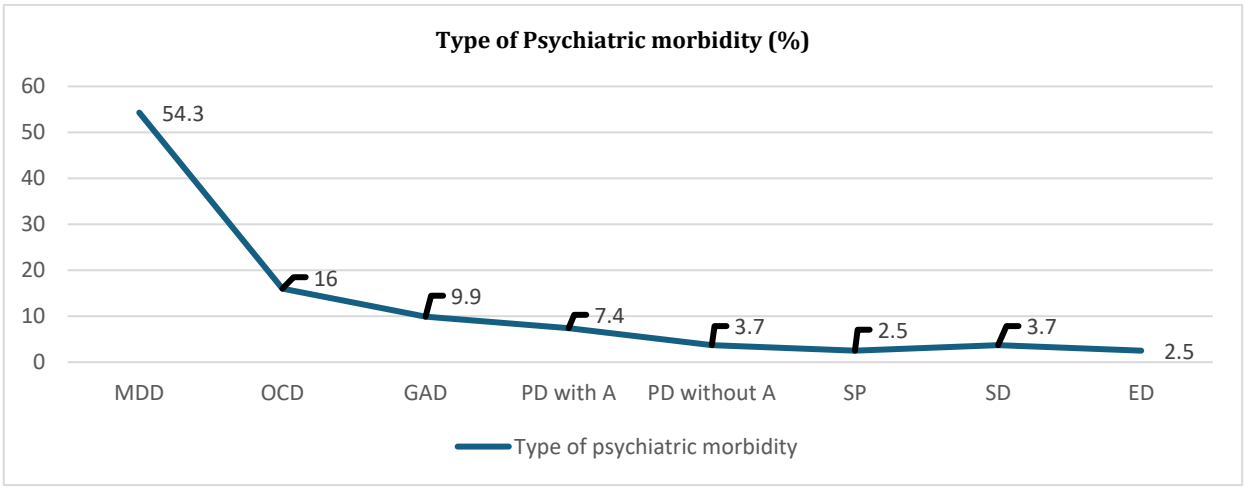


Figure – 2: Distribution of the patients according to physically abused and prevalence of psychiatric morbidity by the patient (n=107)

Figure 2 shows that, most of the respondents (86%) were not physically abused by the patient. Among 107(100.0%) respondents 81(75.70%) caregiver had psychiatric morbidity and 26(24.30%) had no psychiatric morbidity.



Fullform of type of psychiatric morbidity (MDD: Major depressive disorder, OCD: Obsessive compulsive disorder, GAD: Generalized Anxiety Disorder, PD with A: Panic disorder with agoraphobia, PD without A: Panic disorder without agoraphobia, SP: Social phobia, SD: Somatoform disorders and ED: Eating disorders).

Figure – 3: Distribution of the patients according to type of psychiatric morbidity (n = 107)

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Figure 3 shows the distribution of psychiatric morbidity among the 107 patients. Major Depressive Disorder (MDD) is the most common condition, affecting 54.3% of patients. This is followed by Obsessive Compulsive Disorder (OCD) at 16%, Generalized Anxiety Disorder (GAD) at 9.9%, Panic Disorder with Agoraphobia (PD with A) at 7.4%, and Panic Disorder without Agoraphobia (PD without A) at 3.7%. Somatoform Disorders (SD) also affected 3.7% of patients, whereas Social Phobia (SP) and Eating Disorders (ED) were the least common, each present in 2.5% of patients. Overall, mood disorders (MDD) are the predominant psychiatric morbidity in this cohort. Table III shows that, no significant association was found between socio-economic characteristics and psychiatric morbidity.

Table – III: Association between socio-economic characteristics and psychiatric morbidity (n = 107)

Age group	Psychiatric morbidity		Total	Chi-square	p value
	Yes	No			
18-27	16(15)	8(7.5)	24(22.4)	4.569	0.206
28-37	41(38.3)	15(14)	56(52.3)		
38-47	16(15)	3(2.8)	19(17.8)		
48-57	8(7.5)	0(0)	8(7.5)		
Gender					
Male	23(21.5)	11(10.3)	34(31.8)	1.757	0.185
Female	58(54.2)	15(14)	73(68.2)		
Habitat					
Rural	26(24.3)	11(10.3)	37(34.6)	0.907	0.341
Urban	55(51.4)	15(14)	70(65.4)		
Marital status					
Married	58(54.2)	20(18.7)	78(72.9)	0.282	0.596
Unmarried	23(21.5)	6(5.6)	29(27.1)		
Family type					
Extended	59(55.1)	20(18.7)	79(73.8)	0.170	0.680
Nuclear	22(20.6)	6(5.6)	28(26.2)		
Total	81(75.7)	26(24.3)	107(100)		

Results were expressed as frequency (percentage); 0.05 is considered as level of significance

DISCUSSION

Family caregivers of people with dementia, often called the invisible second patients, are critical to the quality of life of the care recipients. The effects of being a family caregiver, though sometimes positive, are generally negative, with high rates of burden and psychological morbidity as well as social isolation, physical ill-health, and financial hardship. Caregivers vulnerable to adverse effects can be identified, as can factors which ameliorate or exacerbate burden and strain. Psychosocial interventions have been demonstrated to reduce caregiver burden and depression and delay nursing home admission[9]. The study showed that there is a high level of psychiatric morbidity among caregivers. The present study represented more female than male. As in previous studies in this environment, a higher percentage of the patients were males[10]. The gender and age of the patient were however not significantly associated with psychiatric morbidity in the caregiver. Female caregivers (especially mothers) were predominant in this study as was also reported in other studies in this environment[11]. Gender of the caregiver and relationship with the patient were however not significantly associated with presence of psychiatric morbidity in the caregiver. The study therefore suggests that caring for a mentally unwell child is burdensome on the caregiver, regardless of gender or relationship. Marital and employment status were also not associated with psychiatric morbidity. The duration of the neuropsychiatric condition and the diagnosis of the patient, including whether or not there are comorbid conditions or the presence of psychosis, were also not associated with psychiatric morbidity in the caregiver. Other investigators have reported severe psychotic symptoms in the child as being associated with a high burden of care in the caregiver and consequently psychiatric morbidity[8,6]. This finding may be clarified by further research. This study found that more than half of the caregivers (54.3%) suffered from major depressive disorder followed by obsessive compulsive disorder 16%, generalized anxiety disorder 9.9%, panic disorder with agoraphobia 7.4%, panic disorder without agoraphobia 3.7%, social phobia 2.5%, somatoform disorders 3.7% and eating disorders 2.5%. This rate can be said to be very high when compared to the prevalence rates of psychiatric disorders in the general population as reported in the recent National Morbidity Survey in Nigeria by Gureje et al, who found a prevalence rate of 4.1% for depression, 5.7% for anxiety disorder and lower rates for other psychiatric conditions[12] The high rate of morbidity among caregivers compared to the general population may be due to a number of factors. One of such is that caregivers may be subjected to constant stress which may therefore be a significant risk factor for developing psychiatric morbidity. This constant stress has been linked to a high rate of increase in Interleukin-6 (IL-6) in caregivers (about four times greater than that of non-caregivers)[13]. Overproduction of IL-6, a pro-inflammatory cytokine, is associated with a spectrum of disorders including depression, age-related conditions including cardiovascular disease, osteoporosis, arthritis, type

2 diabetes, certain cancers, periodontal disease, frailty, and functional decline.88 Another possible reason for this high rate may be the influence of genetics. For instance, Grupp-Phelan et al reported that children with mental health concerns are more likely to have mothers who screen positive for a neuropsychiatric condition[14]. Higher prevalence rates of psychiatric morbidity have however been reported among Caucasian caregivers. For instance, Cooper et al reported a rate of 76.9% among caregivers of children with Tourrette's disorder[15]. Reasons for the lower rates in the current study (compared to other studies conducted in Caucasians) may be the better health on all scales observed among negroid caregivers compared to Caucasian caregivers[16]. This better health has been attributed to race, strong ethnic beliefs about care giving and spirituality among blacks[16]. Caregiver burden has been found to be the strongest predictor of psychiatric morbidity among caregivers[17]. The higher rate of psychiatric morbidity as reported in this study among caregivers of patients has also been reported by various other authors[18]. Molyneaux for instance reported that the more problem behaviors identified and the greater the functional impairment of the patient, the higher the strain score deciles and the more likely the carer was to have psychiatric morbidity[19].

CONCLUSION

The present study demonstrates a high prevalence of psychiatric morbidity among caregivers of patients with dementia, with Major Depressive Disorder being the most common condition. Other significant morbidities included Obsessive-Compulsive Disorder, Generalized Anxiety Disorder, Panic Disorders, Somatoform Disorders, Social Phobia, and Eating Disorders. Female caregivers, particularly housewives, constituted the majority, and most had no prior caregiving experience. No significant associations were observed between socio-demographic factors and psychiatric morbidity. These findings underscore the substantial psychological burden experienced by caregivers and highlight the need for routine mental health assessment and supportive interventions to mitigate caregiver stress and improve overall well-being.

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ORIGINAL ARTICLE

Exploring the Relationship between Dysmenorrhea and Mental Health Disorders in Young Women

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ABSTRACT

Background: *Dysmenorrhea, or painful menstruation, is a common gynecological condition among young women that can significantly affect their physical and psychological health. Emerging evidence suggests a potential link between dysmenorrhea and mental health disorders, yet limited data exist in the Bangladeshi context.* ***Objective:*** *To explore the relationship between dysmenorrhea and symptoms of depression, anxiety, and stress among young women attending outdoor in 250 Beded Sadar Hospital, Sirajganj.* ***Methods & Methods:*** *A cross-sectional study was conducted among 224 female respondents aged 16–24 years using a structured questionnaire. Dysmenorrhea severity was assessed using a Visual Analog Scale (VAS), and mental health status was evaluated using the Depression, Anxiety, and Stress Scale (DASS-21). Data were analyzed using SPSS version 25 with descriptive statistics and chi-square tests to assess associations.* ***Results:*** *The prevalence of dysmenorrhea was 91.5%, with 45.9% reporting moderate and 33.7% reporting severe pain. Among participants with moderate-to-severe dysmenorrhea, 62.4% had symptoms of depression, 71.3% had anxiety, and 59.6% reported stress. Statistically significant associations were found between dysmenorrhea severity and all three mental health domains ($p < 0.05$).* ***Conclusion:*** *The study reveals a strong association between dysmenorrhea and mental health disorders among young women. These findings highlight the need for integrated health strategies focusing on both menstrual and psychological well-being. Early screening, mental health counseling, and improved menstrual health education are essential to reduce the burden of dysmenorrhea-related mental health issues.*

Keywords: *Dysmenorrhea, Depression, Anxiety, Stress, Mental Health, Young Women, Bangladesh*

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INTRODUCTION

Dysmenorrhea, characterized by painful menstrual cramps originating in the lower abdomen, is one of the most common gynecological complaints among adolescent and young adult women. It is broadly classified into primary dysmenorrhea, which occurs in the absence of any underlying pelvic pathology, and secondary dysmenorrhea, which results from identifiable gynecological conditions such as endometriosis or pelvic inflammatory disease[1]. Globally, the prevalence of primary dysmenorrhea among young women ranges from 50% to 90%, with varying degrees of severity impacting daily activities, school performance, and overall quality of life[2,3].

Emerging evidence suggests that dysmenorrhea may have significant associations with mental health disorders such as depression, anxiety, and stress-related conditions. The chronic pain and physical discomfort experienced during menstruation may act as stressors that contribute to emotional distress. Conversely, pre-existing psychological conditions may amplify the perception of menstrual pain, creating a bidirectional relationship[4,5]. A study among university students in Iran reported that those with moderate-to-severe dysmenorrhea had significantly higher levels of anxiety and depression compared to those with mild or no dysmenorrhea[6]. Similarly, research from Western populations has shown that dysmenorrhea is a strong predictor of elevated depressive and anxiety symptoms among adolescents[7].

Furthermore, the neurobiological mechanisms linking pain and mood disorders involve overlapping pathways, including dysregulation of the hypothalamic-pituitary-adrenal (HPA)

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axis, central sensitization, and altered serotonin and prostaglandin levels[8]. This interaction underscores the need for an integrated approach to managing menstrual pain and mental well-being, especially in young women during their formative years.

Despite the clinical and psychosocial burden, the relationship between dysmenorrhea and mental health disorders remains underexplored in many low- and middle-income countries, including Bangladesh. Young women often normalize menstrual pain or face social stigma, leading to delayed diagnosis and inadequate management of both physical and psychological symptoms[9]. Understanding this relationship is essential for developing holistic health interventions that address both physical and mental aspects of women's reproductive health. This study aims to explore the relationship between dysmenorrhea and mental health disorders among young women, thereby providing evidence for the need for integrated health services and early intervention strategies.

METHODS & MATERIALS

A descriptive cross-sectional study was conducted from January to December 2024 among young women aged 16 to 24 years at outdoor patients attending outdoor in 250 Beded Sadar Hospital, Sirajganj to explore the association between dysmenorrhea and mental health disorders, specifically depression, anxiety, and stress. A total of 224 participants were selected through convenience sampling. Eligible participants were menstruating females, while those with known psychiatric disorders, chronic illnesses, or using hormonal therapy or antidepressants were excluded. Data were collected using a structured, self-administered questionnaire comprising three sections: sociodemographic information (age, marital status, occupation, education level) BMI, menstrual history (duration of menstruation, menstrual cycle length, duration of dysmenorrhea pain), dysmenorrhea severity, and impact on daily life; Mental health assessment using the Depression Anxiety Stress Scales-21 (DASS-21), a validated tool measuring symptoms of depression, anxiety, and stress. The severity of dysmenorrhea was rated using a Numeric Rating Scale (NRS) from 0 (no pain) to 10 (worst pain imaginable), categorized as mild (1–3), moderate (4–6), and severe (7–10). Data were analyzed using SPSS version 26. Descriptive statistics such as mean, standard deviation, frequencies, and percentages were calculated, and chi-square tests were applied to determine associations between dysmenorrhea severity and mental health variables, with a significance level set at $p<0.05$.

RESULTS

Sociodemographic Characteristics of Participants

A total of 224 young women aged 16 to 24 years participated in the study (Table I). The mean age was 20.4 ± 2.1 years. Most were unmarried (83.5%) and students (84.8%), with a small percentage being housewives (9.8%) or others (5.4%). In terms of education, the majority had completed higher secondary (42.9%) or undergraduate education (31.3%).

Table – I: Sociodemographic Characteristics of Participants (*n*=224)

Variable	Frequency (n)	Percentage (%)
Age Group (years)		
16–18	54	24.1%
19–21	98	43.8%
22–24	72	32.1%
Marital Status		
Unmarried	187	83.5%
Married	37	16.5%
Occupation		
Student	190	84.8%
Housewife	22	9.8%
Others	12	5.4%
Educational Level		
Primary	10	4.5%
Secondary	48	21.4%
Higher Secondary	96	42.9%
Undergraduate	70	31.3%

Body Mass Index (BMI)

The majority of participants (63.4%) had a normal BMI, while 16.1% were underweight. A combined 20.6% were overweight or obese, which may have implications for menstrual health and dysmenorrhea severity (Table II).

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Table – II: Body Mass Index (BMI) Distribution of Participants (*n*=224)

BMI Category (kg/m^2)	Frequency (n)	Percentage (%)
Underweight (<18.5)	36	16.1%
Normal (18.5–24.9)	142	63.4%
Overweight (25.0–29.9)	38	17.0%
Obese (≥30.0)	8	3.6%
Total	224	100%

Menstrual History

Duration of Menstruation:

The majority of participants (66.1%) reported menstruation lasting 4–5 days, which is considered within the normal range. A smaller proportion had shorter cycles lasting 2–3 days (12.5%), while 21.4% experienced longer bleeding durations of 6 days or more, which may indicate heavier menstrual flow or prolonged periods in a notable subset.

Menstrual Cycle Length:

Most participants (83.5%) reported having regular menstrual cycles (21–35 days), reflecting a generally healthy reproductive pattern. However, 16.5% had irregular cycles, which could be indicative of hormonal imbalances, stress, or underlying gynecological conditions.

Duration of Dysmenorrhea Pain:

A majority (60.7%) experienced dysmenorrhea pain lasting 2–3 days, suggesting that menstrual pain is often sustained over multiple days in this population. About 17.9% had pain for 1 day, and 21.4% suffered from pain that lasted more than 3 days, which is clinically significant and may negatively impact daily functioning and quality of life (Table III).

Table – III: Menstrual History of Participants (*n*=224)

Variable	Category	Frequency (n)	Percentage (%)
Duration of Menstruation	2–3 days	28	12.5%
	4–5 days	148	66.1%
	≥6 days	48	21.4%
Menstrual Cycle Length	Irregular	37	16.5%
	Regular (21–35 days)	187	83.5%
Duration of Dysmenorrhea Pain	1 day	40	17.9%
	2–3 days	136	60.7%
	More than 3 days	48	21.4%

Prevalence and Severity of Dysmenorrhea

A high prevalence of dysmenorrhea (91.5%) was observed (Table IV). Among those affected, two-thirds experienced moderate to severe pain. Among those with dysmenorrhea: 20.5% experienced mild pain (pain score 1–3), 45.9% reported moderate pain (pain score 4–6), 33.7% suffered from severe pain (pain score 7–10). The relatively high percentage of participants reporting severe pain (33.7%) underscores the clinical and public health importance of addressing this condition.

Table – IV: Prevalence and Severity of Dysmenorrhea (*n*=224)

Dysmenorrhea Status	Frequency (n)	Percentage (%)
Dysmenorrhea Present	205	91.5%
Dysmenorrhea Absent	19	8.5%
Severity of Dysmenorrhea (n=205*)*		
Mild (1–3)	42	20.5%
Moderate (4–6)	94	45.9%
Severe (7–10)	69	33.7%

Prevalence of Depression, Anxiety, and Stress

Symptoms of depression, anxiety, and stress were prevalent in the study population (Figure 1). More than half (54.5%) of the respondents exhibited some level of depressive symptoms, suggesting that depression is a moderate concern among the population. Anxiety is the most prevalent mental health issue among the three, followed by depression, and then stress. 60.3% of participants had some form of anxiety, with nearly 42% reporting moderate to severe levels. While the majority are stress-free, 48.2% experienced stress to varying degrees, with about 30% facing moderate to severe stress levels. This makes stress a significant but relatively less common concern compared to anxiety.

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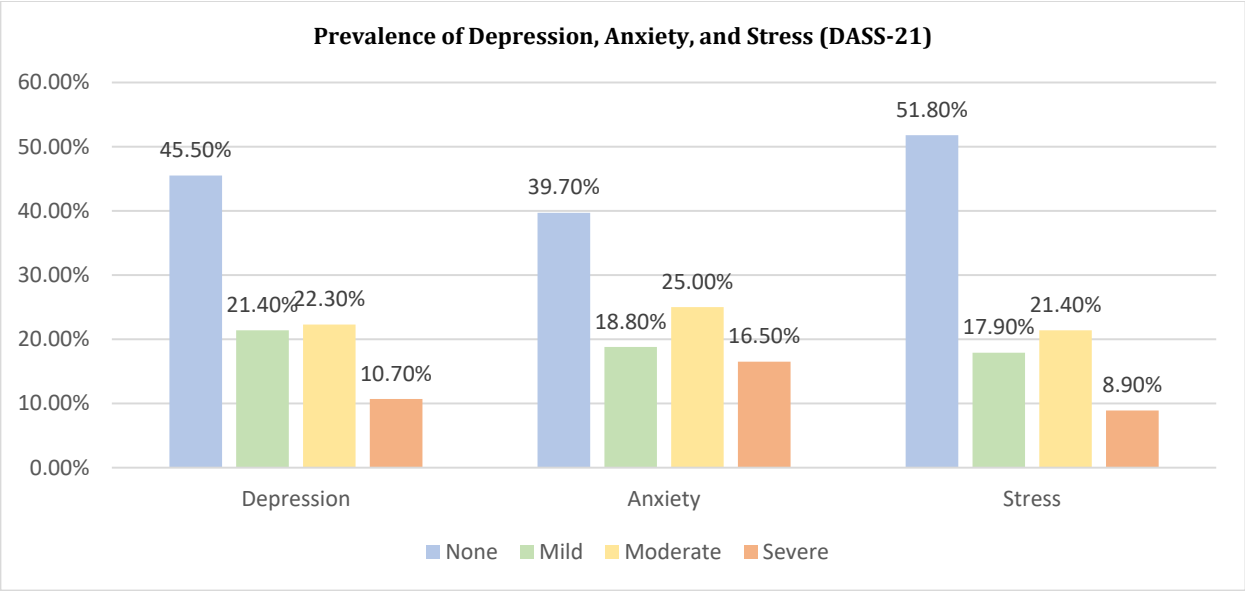

Figure – 1: Prevalence of Depression, Anxiety, and Stress (DASS-21) (*n*=224)

Association Between Dysmenorrhea Severity and Mental Health Symptoms

The table V shows a clear positive association between the severity of dysmenorrhea and the prevalence of depression, anxiety, and stress symptoms among participants. As the severity of dysmenorrhea increases from mild to severe, the proportion of individuals experiencing psychological distress also increases substantially.

Depression

28.6% of those with mild dysmenorrhea reported depression. The percentage rises to 52.1% in moderate cases and 76.8% in severe cases, p-value < 0.001, indicating a strong and statistically significant association.

Anxiety

Anxiety was reported by 33.3% of those with mild dysmenorrhea, 60.6% with moderate, and 81.2% with severe dysmenorrhea. There is a steep increase in anxiety prevalence with increasing dysmenorrhea severity which reflects that anxiety associated with intense menstrual pain (p-value < 0.001).

Stress

Stress levels followed a similar trend: 26.2% in mild, 46.8% in moderate, and 72.5% in severe cases. Like depression and anxiety, stress symptoms become more common as dysmenorrhea severity increases, suggesting an overall mental health burden. Statistical significance: p-value = 0.001, confirming a statistically significant relationship.

Table – V: Association Between Dysmenorrhea Severity and Mental Health Symptoms (*n*=205)

Dysmenorrhea Severity	Depression Present (%)	Anxiety Present (%)	Stress Present (%)
Mild (n=42)	28.6%	33.3%	26.2%
Moderate (n=94)	52.1%	60.6%	46.8%
Severe (n=69)	76.8%	81.2%	72.5%
p-value	<0.001*	<0.001*	0.001*

**p < 0.05*

Impact of Dysmenorrhea on Daily Activities by Pain Severity

The table VI demonstrates Dysmenorrhea had a notable impact on the daily functioning of young women. Those with severe pain were much more likely to miss work or classes and avoid social interactions.

Table – VI: Impact of Dysmenorrhea on Daily Activities by Pain Severity (*n*=205)

Dysmenorrhea Severity	Missed Work/Classes (%)	Avoided Social Activities (%)
Mild (n=42)	21.4%	23.8%
Moderate (n=94)	48.9%	52.1%
Severe (n=69)	76.8%	79.7%
p-value	<0.001*	<0.001*

**p < 0.05*

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Missed Work/Classes

Among participants with mild dysmenorrhea, 21.4% reported missing work or classes. This figure jumps to 48.9% for those with moderate pain, and further to 76.8% for those with severe pain. p-value < 0.001, indicating a strong and statistically significant association.

Avoided Social Activities

23.8% of those with mild dysmenorrhea avoided social activities. This increased to 52.1% in moderate cases and 79.7% in severe cases. As pain severity increases, individuals are more likely to socially withdraw. p-value < 0.001, confirming a strong association.

DISCUSSION

This study revealed a high prevalence of dysmenorrhea (91.5%) among young women aged 16 to 24, with a significant proportion (33.7%) reporting severe pain. The findings are consistent with global data indicating that dysmenorrhea affects a substantial percentage of menstruating females, particularly adolescents and young adults[10,11]. The intensity and duration of menstrual pain observed in this study are clinically significant and carry implications not only for physical well-being but also for psychological health and quality of life.

A critical finding of this research is the significant association between dysmenorrhea severity and the prevalence of depression, anxiety, and stress**.** Participants with severe dysmenorrhea reported markedly higher rates of mental health symptoms, with 76.8% experiencing depression, 81.2% anxiety, and 72.5% stress. This aligns with previous findings where menstrual pain was linked to elevated psychological distress in women[12,13]. Dysmenorrhea may contribute to these symptoms through mechanisms such as chronic inflammation, hormonal fluctuations, and sleep disturbances, all of which are implicated in mood disorders[14].

Furthermore, the mental health burden identified in this study, particularly the high rates of anxiety (60.3%) and depression (54.5%)**,** is consistent with other research among university-aged women, indicating that menstruation-related distress can extend beyond physical discomfort[15,16]. The cyclical nature of dysmenorrhea may exacerbate psychological symptoms over time, especially in those with pre-existing vulnerabilities. Moreover, young women who experience frequent and intense menstrual pain might develop anticipatory anxiety and social withdrawal, contributing to chronic stress and functional impairment[17].

The impact of dysmenorrhea on daily functioning is particularly noteworthy. Women with severe pain were significantly more likely to miss work or classes (76.8%) and avoid social activities (79.7%). This mirrors studies from both high- and low-income countries where dysmenorrhea was found to hinder academic performance, reduce physical activity, and negatively affect interpersonal relationships[18,19]. The associated absenteeism and reduced social engagement may further compound mental health problems, creating a feedback loop of pain, isolation, and emotional distress.

Interestingly, even those with moderate pain reported substantial psychological symptoms and functional impairment, suggesting that interventions should not only target severe cases. Early screening and management strategies, including education, pain management, and mental health support, should be integrated into adolescent and youth healthcare services. The high prevalence of irregular menstrual cycles (16.5%) and longer duration of bleeding (21.4% with ≥6 days) could be contributing factors to both the physical and psychological burden. Irregular menstruation is known to correlate with hormonal imbalances and has been associated with greater emotional instability[20].

Although the cross-sectional nature of this study limits causal inference, the strength and consistency of the associations underscore the need for multidisciplinary approaches in addressing dysmenorrhea. Mental health should be recognized as a critical component of menstrual health, especially in young women undergoing significant physiological and psychosocial changes.

LIMITATIONS

The study is based on self-reported data, which may be subject to recall and reporting bias. The sample was limited to a specific age group and geographic location, which may affect generalizability. Moreover, clinical evaluations for psychological disorders and gynecological conditions were not performed, which might have provided more objective data.

CONCLUSION

This study demonstrates a high prevalence of dysmenorrhea among young women, with a significant portion experiencing moderate to severe pain. There is a clear and statistically significant association between the severity of dysmenorrhea and symptoms of depression, anxiety, and stress. Furthermore, dysmenorrhea negatively affects academic and social functioning, particularly among those with severe symptoms.

These findings emphasize the need for integrated menstrual and mental health interventions targeting young women in educational and healthcare settings. Raising awareness, improving pain management, and providing psychological support could improve both physical and mental well-being in this vulnerable population.

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ORIGINAL ARTICLE

Assessment of Knowledge and Practices Regarding Shoulder Mobilizing Exercises Among Frozen Shoulder Patients

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ABSTRACT

Background: *Frozen shoulder (adhesive capsulitis) is a common musculoskeletal condition characterized by pain and restricted shoulder movement. Adequate knowledge and consistent practice of shoulder exercises are essential for improving pain and mobility. This study aimed to assess patients' knowledge and practice regarding shoulder exercises and to examine their association with patient-reported improvement.* ***Methods & Materials:*** *A cross-sectional descriptive study was conducted among 140 patients diagnosed with frozen shoulder at the Department of Physical Medicine and Rehabilitation, BIRDEM General Hospital, Dhaka, Bangladesh, from January to June 2024. Data were collected using a semi-structured questionnaire assessing socio-demographics, knowledge, and practice of shoulder exercises. Knowledge and practice levels were categorized as good, moderate, or poor. exercise adherence was assessed both via self-report and observation. Associations between education, knowledge, practice, and patient-reported improvement were analyzed using Chi-square tests, with $p < 0.05$ considered statistically significant.* ***Results:*** *The majority of participants were middle-aged (45–54 years, 40%) and female (58.6%). Overall, 32.1% had good knowledge, 51.4% moderate, and 16.4% poor knowledge regarding shoulder exercises. Regarding practice, 25.0% demonstrated good practice, 47.9% moderate, and 27.1% poor practice. Higher education was significantly associated with better knowledge ($p = 0.02$) and practice ($p = 0.01$). Patient-reported improvement was significantly associated with both knowledge ($p = 0.011$) and practice ($p = 0.001$), with 62.2% of patients with good knowledge and 71.4% of patients with good practice reporting improvement in pain or mobility.* ***Conclusions:*** *Although most patients had moderate knowledge and practice, better knowledge and adherence were strongly associated with improvement in frozen shoulder symptoms. Strategies to enhance patient education, guided exercise sessions, and adherence support are essential to optimize functional outcomes.*

Keywords: *Frozen shoulder, Adhesive capsulitis, Shoulder exercises, Knowledge, Practice, Adherence, Patient-reported improvement*

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INTRODUCTION

Frozen shoulder, also known as adhesive capsulitis, is a painful and debilitating shoulder condition characterized by gradual onset of stiffness, pain, and significant reduction in both active and passive range of motion of the glenohumeral joint without major radiographic abnormalities[1,2]. The lifetime prevalence of frozen shoulder in the general population is estimated between 2 % and 5 %, and the

condition is more common in middle-aged individuals, particularly women aged 40 to 70 years[3,4]. Although often regarded as a self-limiting condition, evidence suggests that many patients continue to experience persistent symptoms and functional limitations beyond the classical 1–3-year recovery period[5].

The exact pathogenesis of frozen shoulder remains unclear, but it is thought to involve synovial inflammation, subsequent capsular fibrosis, joint capsule contracture, and changes in extracellular matrix remodeling[6]. Several risk factors have been implicated in its development, including diabetes mellitus, thyroid disorders, immobilization, trauma, and certain systemic conditions[4,7,8]. Evidence suggests that diabetes substantially elevates the likelihood of developing frozen shoulder[8]. Frozen shoulder of secondary type can develop following shoulder trauma, surgical procedures, or extended periods of immobilization[9].

Physical therapy, especially therapeutic exercise, is considered a cornerstone of conservative management for frozen shoulder[10]. Exercise protocols typically include stretching, mobilization, and strengthening modalities aimed at improving joint mobility and reducing pain[11]. However, the effectiveness of these interventions is often contingent on patient adherence. Poor adherence to home exercise programs has been widely reported in musculoskeletal conditions and can significantly reduce clinical outcomes[12,13]. Higher self-efficacy and tailored educational interventions are associated with better exercise adherence among patients with musculoskeletal shoulder conditions[14,15].

Despite the established role of therapeutic exercises in the management of frozen shoulder, most existing studies have focused on the effectiveness of specific exercise protocols rather than patients' understanding and implementation of these exercises. To date, there is a lack of research specifically assessing the knowledge and practices regarding shoulder exercises among patients with frozen shoulder. Understanding patients' awareness, beliefs, and adherence behaviors is crucial for optimizing rehabilitation outcomes and designing interventions that improve compliance and functional recovery. Therefore, this study aims to fill this gap by evaluating the knowledge and practices related to shoulder exercises in frozen shoulder patients.

METHODS & MATERIALS

Study Design and Setting:

This cross-sectional descriptive study was conducted among patients diagnosed with frozen shoulder at the Department of Physical Medicine and Rehabilitation, BIRDEM General Hospital, Shahbag, Dhaka, Bangladesh. BIRDEM General Hospital is a tertiary-level healthcare facility providing comprehensive medical care, including specialized services in physical medicine and rehabilitation.

Study Period:

The study was carried out over a period of 6 months, from January 2024 to June 2024.

Study Population:

The study population included patients clinically diagnosed with frozen shoulder (adhesive capsulitis) who attended the Department of Physical Medicine during the study period. Patients of all age groups and both sexes were considered eligible.

Inclusion Criteria:

- Patients with a confirmed diagnosis of frozen shoulder with diabetes mellitus by a specialist in physical medicine.
- Patients willing to participate and provide written informed consent.

Exclusion Criteria:

- Patients with a history of shoulder surgery, fracture, or other significant musculoskeletal disorders affecting the shoulder.
- Patients with neurological disorders or cognitive impairment that could interfere with understanding or performing exercises.
- Patients unwilling to participate in the study.

Sample Size and Sampling Technique:

A total of 140 patients were included in the study. Purposive sampling was employed to select patients who met the inclusion criteria during the study period.

Data Collection Tool:

Data were collected using a pre-tested structured questionnaire developed by the research team. The questionnaire included sections on:

1. Socio-demographic information (age, sex, occupation, education, etc.)
2. Clinical history and characteristics of frozen shoulder
3. Knowledge regarding shoulder exercises (types, frequency, benefits)
4. Self-reported practices regarding performing shoulder exercises
5. Patient-reported improvement in condition (pain reduction and/or improved mobility following shoulder exercises)

Knowledge and Practice Scoring System:

Knowledge Assessment:

Participants' knowledge regarding shoulder exercises for frozen shoulder was assessed using 10 structured questions covering types of exercises, frequency, duration, benefits, and precautions. Each correct response was scored as 1 point, and incorrect or "don't know" responses were scored as 0 points.

Total knowledge score ranged from 0 to 10.

Knowledge levels were categorized as:

- **Good knowledge:** 8–10 points
- **Moderate knowledge:** 5–7 points
- **Poor knowledge:** 0–4 points

Practice Assessment:

Participants' practices were evaluated based on their self-reported and demonstrated performance of shoulder exercises, using 10 items assessing frequency, adherence, proper technique, and consistency. Each correct or appropriate practice was scored as 1 point, and incorrect or

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non-adherent practices were scored as 0 points. Total practice score ranged from 0 to 10. Practice levels were categorized as:

- **Good practice:** 8–10 points
- **Moderate practice:** 5–7 points
- **Poor practice:** 0–4 points

Data Collection Procedure:

Eligible patients were approached during their outpatient visits to the Department of Physical Medicine. After explaining the study objectives, written informed consent was obtained. Data were collected through face-to-face interviews using the semi-structured questionnaire. Patients were also observed and asked to demonstrate their regular shoulder exercises to assess their practice.

Operational Definitions:

- **Frozen Shoulder (Adhesive Capsulitis):** Painful restriction of active and passive shoulder movements, particularly in external rotation and abduction, with no other identifiable shoulder pathology, confirmed by a specialist.
- **Shoulder Exercises:** Structured exercises including pendulum, Codman Pendulum exercises, Wand exercises, Wall climbing exercises, Toweling exercises, Overhea, pulley exercises, Sperry exercises stretching, range-of-motion (ROM), and strengthening exercises aimed at reducing pain and improving mobility.
- **Knowledge Regarding Shoulder Exercises:** Awareness and understanding of types, frequency, duration, benefits, and precautions of shoulder exercises.
- **Practice Regarding Shoulder Exercises:** Actual performance and adherence to recommended shoulder exercises, assessed by self-report and demonstration.
- **Improvement of Condition:** Self-reported reduction in pain and/or improvement in shoulder mobility after performing exercises, categorized as "Improved," "Not improved," or "Not sure."
- **Good/Moderate/Poor Knowledge or Practice:** Scores categorized as 8–10 (good), 5–7 (moderate), and 0–4 (poor) on respective assessments.

Data Analysis:

Collected data were entered into and analyzed using SPSS version 25.0. Descriptive statistics, including frequency, percentage, mean, and standard deviation, were used to summarize socio-demographic characteristics, knowledge, practice levels, and improvement. Associations between socio-demographic variables, knowledge, practice, and patient-reported improvement were analyzed using the Chi-square test, with a significance level set at $p < 0.05$.

RESULTS

Socio-demographic and Clinical Characteristics

A total of 140 patients with frozen shoulder participated in the study. The majority were middle-aged adults aged 45–54 years (40.0%), followed by 55–64 years (28.6%), indicating that frozen shoulder is most prevalent in this age group. Females accounted for 58.6% of participants, while males comprised 41.4%, consistent with the higher incidence of frozen shoulder reported among women. Most participants were married (91.4%) and had attained secondary or higher education (68.6%), suggesting a relatively literate study population. Regarding occupation, 42.9% were housewives, 31.4% were engaged in sedentary jobs, and 25.7% performed physical labor. The socio-demographic profile indicates that middle-aged, educated females, particularly housewives, formed the predominant group in this study (Table I).

Table – I: Socio-demographic Characteristics of Participants (*n* = 140)

Characteristics	Frequency (*n*)	Percentage (%)
Age (years)		
35–44	28	20.0
45–54	56	40.0
55–64	40	28.6
≥65	16	11.4
Gender		
Male	58	41.4
Female	82	58.6
Marital Status		
Married	128	91.4
Unmarried/Other	12	8.6
Education		
No formal education	16	11.4
Primary	28	20.0
Secondary or higher	96	68.6
Occupation		
Housewife	60	42.9
Sedentary job	44	31.4
Physical labor	36	25.7

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Knowledge Regarding Shoulder Exercises

Most participants (88.5%) reported being aware of exercises for frozen shoulder. Regarding specific exercises, Codman Pendulum exercises were the most recognized (77.9%), followed by Wand exercises (62.1%), Wall climbing exercises (57.9%), Toweling exercises (53.6%), and Overhead pulley exercises (50.0%) and Sperry exercises (37.1%). Over half of the participants (57.1%) correctly stated that exercises should be performed daily. Regarding session duration, 45.7% reported 5–10 minutes, and 40% reported 10–20 minutes. Participants were generally aware of the benefits of exercises, including pain reduction (84.3%), improved range of motion (77.1%), and prevention of stiffness (72.1%). About 64.3% acknowledged that precautions should be followed while performing exercises (Table II). Overall, 32.1% of participants had good knowledge**,** 51.4% had moderate knowledge, and 16.4% had poor knowledge regarding shoulder exercises (Table III).

Table – II: Knowledge Regarding Shoulder Exercises (*n* = 140)

Knowledge Item	Response	Frequency (n)	Percentage (%)
Have you heard about exercises?	Yes	124	88.5
	No	16	11.5
Beneficial exercises*	Codman Pendulum exercises	109	77.9
	Wand exercises	87	62.1
	Wall climbing exercises	81	57.9
	Toweling exercises	75	53.6
	Overhead pulley exercises	70	50.0
	Sperry exercises	52	37.1
Exercise frequency	Once a week	20	14.3
	2–3 times/week	40	28.6
	Daily	80	57.1
	Don't know	6	4.3
Exercise duration	<5 min	12	8.6
	5–10 min	64	45.7
	10–20 min	56	40.0
	Don't know	8	5.7
Benefits of exercises*	Reduce pain	118	84.3
	Improve range of motion (ROM)	108	77.1
	Prevent stiffness	101	72.1
	Don't know	10	7.1
Precautions	Yes	90	64.3
	No	28	20.0
	Don't know	22	15.7

**Multiple responses allowed*

Table – III: Overall Knowledge Levels Regarding Shoulder Exercises (*n* = 140)

Knowledge Level	Frequency (n)	Percentage (%)
Good (8–10)	45	32.1
Moderate (5–7)	72	51.4
Poor (0–4)	23	16.4

Practice Regarding Shoulder Exercises

Among participants, 70.8% reported performing shoulder exercises regularly. Regarding specific exercises, Codman Pendulum exercises were the most commonly practiced (60.7%), followed by Wand exercises (42.9%), Wall climbing exercises (35.7%), Toweling exercises (34.3%), Overhead pulley exercises (30.0%) and Sperry exercises (20.7%). Daily exercise was reported by 42.9% of participants, while 27.9% exercised 2–3 times per week. Only 47.9% followed proper technique, and 38.6% adhered fully to physiotherapist or physician recommendations. Improvement in pain or mobility was noted by 45.7% of participants. Overall practice assessment showed 25.0% demonstrated good practice**,** 47.9% had moderate practice**,** and 27.1% had poor practice, indicating a gap between knowledge and actual adherence (Tables IV and V).

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Table – IV: Practice Regarding Shoulder Exercises (*n* = 140)

Practice Item	Response	Frequency (n)	Percentage (%)
Perform exercises regularly	Yes	99	70.7
	No	41	29.3
Exercises performed*	Codman Pendulum exercises	85	60.7
	Wand exercises	60	42.9
	Wall climbing exercises	50	35.7
	Toweling exercises	48	34.3
	Overhead pulley exercises	42	30.0
	Sperry exercises	29	20.7
Frequency of exercise	Daily	60	42.9
	2–3 times/week	39	27.9
	Occasionally	27	19.3
	Rarely	10	7.1
	Never	4	2.9
Follow proper technique	Yes	67	47.9
	No	49	35.0
	Not sure	24	17.1
Adherence to professional guidance	Yes	54	38.6
	No	46	32.9
	Sometimes	40	28.5
Noticed improvement	Yes	64	45.7
	No	44	31.4
	Not sure	32	22.9

**Multiple responses allowed*

Table – V: Overall Practice Levels Regarding Shoulder Exercises (*n* = 140)

Practice Level	Frequency (n)	Percentage (%)
Good (8–10)	35	25.0
Moderate (5–7)	67	47.9
Poor (0–4)	38	27.1

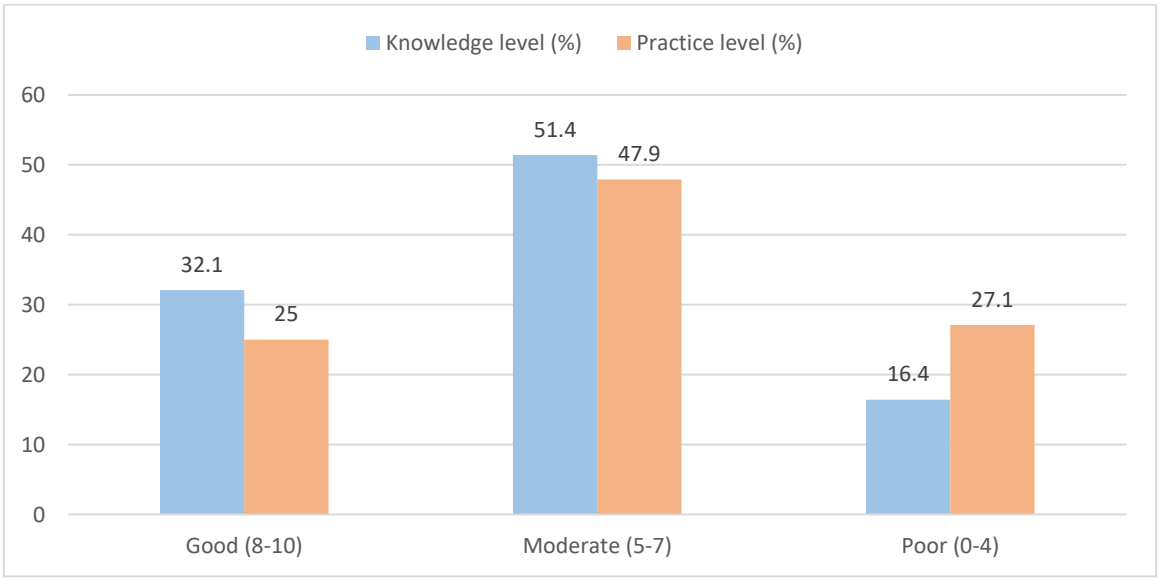

Figure – 1: Distribution of Knowledge and Practice Levels

The figure 1 shows that most patients demonstrated moderate levels of both knowledge (51.4%) and practice (47.9%) regarding shoulder exercises. While 32.1% had good knowledge, only 25% translated this into good practice. Notably, a higher proportion of patients exhibited poor practice (27.1%) compared to poor knowledge (16.4%), suggesting a gap between awareness and actual implementation of exercises.

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Association Between Education Level and Knowledge/Practice

Education level was significantly associated with both knowledge and practice. Participants with secondary or higher education were more likely to have good knowledge (37.5%) compared to those with primary or no formal education (5.0%) (p = 0.02). Similarly, good practice was more common among participants with secondary or higher education (31.3%) than those with lower education levels (5.0%) (p = 0.01), indicating that higher education positively influences knowledge and adherence to recommended exercises (Table VI).

Table – VI: Association Between Knowledge/Practice and Education Level (*n* = 140)

Variable	Category	Good n (%)	Moderate/Poor n (%)	p-value
Knowledge	Secondary or higher	36 (37.5)	60 (62.5)	
	Primary/No education	2 (5.0)	38 (95.0)	**0.02**
Practice	Secondary or higher	30 (31.3)	66 (68.7)	
	Primary/No education	2 (5.0)	38 (95.0)	**0.01**

Chi-square test used; p < 0.05 considered statistically significant.

Patient-Reported Improvement in Condition

Among the 140 participants, 64 (45.7%) reported noticeable improvement in pain and/or shoulder mobility following their exercise regimen, 44 (31.4%) reported no improvement, and 32 (22.9%) were unsure about any change. This outcome measure was used to explore associations between patients' knowledge and practice levels with actual improvement in their condition.

Table VII presents the relationship between knowledge and practice levels with patient-reported improvement, highlighting the impact of better understanding and adherence to shoulder exercises on clinical outcomes. Patients with good knowledge were more likely to report improvement (62.2%) compared to those with moderate (41.7%) or poor knowledge (26.1%), and this association was statistically significant (p = 0.011). Similarly, practice level was strongly associated with improvement (p = 0.001). A substantial majority (71.4%) of patients with good practice reported improvement, whereas improvement rates were lower among those with moderate practice (41.8%) and poor practice (28.9%).

Table – VII: Association Between Knowledge/Practice and Improvement of Patients Condition (n = 140)

Variable	Category	Improved n (%)	Not Improved/Not sure n (%)	p-value
Knowledge	Good	28 (62.2)	17 (37.8)	
	Moderate	30 (41.7)	42 (58.3)	
	Poor	6 (26.1)	17 (73.9)	**0.011**
	Total	64	76	
Practice	Good	25 (71.4)	10 (28.6)	
	Moderate	28 (41.8)	39 (58.2)	
	Poor	11 (28.9)	27 (71.1)	**0.001**
	Total	64	76	

(Chi-square test applied; p < 0.05 considered statistically significant)

DISCUSSION

This study aimed to assess the knowledge and practice of shoulder exercises among patients with frozen shoulder (adhesive capsulitis) and to explore the association between these factors and patient-reported improvement. The findings revealed that while a significant proportion of participants were aware of beneficial exercises and performed them regularly, adherence to proper techniques and professional guidance was suboptimal. Notably, a positive correlation was observed between higher knowledge and practice levels and reported improvements in pain and mobility.

Socio-Demographic Profile

In the present study, the majority of participants were middle-aged adults (45–54 years, 40%) and predominantly female (58.6%), with most being married and having secondary or higher education. This aligns with findings from Mertens et al.[16], who reported that frozen shoulder is more common in middle-aged adults, often affecting women more frequently than men. Our findings are consistent with Shahnewaj and Hosain[17], who also reported a higher prevalence of frozen shoulder among middle-aged women, particularly housewives. The predominance of housewives in our study is noteworthy, as repetitive daily activities and household chores may predispose them to shoulder strain, potentially contributing to the development of frozen shoulder.

Knowledge and Practice Levels

This study revealed that while the majority of participants demonstrated moderate knowledge (51.4%) and practice (47.9%) regarding shoulder exercises, a notable gap exists between awareness and actual adherence. Specifically, 32.1% exhibited good knowledge, yet only 25% translated this into good practice. These findings align with previous research indicating that knowledge alone is insufficient to ensure

consistent exercise adherence among patients with musculoskeletal conditions[12].

The results are consistent with studies on rotator cuff–related shoulder pain. Phillips et al.[18] demonstrated that patient knowledge regarding shoulder conditions and management was moderate, and higher knowledge was associated with better engagement in exercise therapy. However, even with adequate knowledge, psychosocial factors such as fear of pain, low confidence in performing exercises, and uncertainty about correct technique often limited adherence[14,19,20]. In our study, less than half of the participants (47.9%) reported following proper technique, and only 38.6% adhered fully to professional guidance, highlighting the practical challenges of translating knowledge into consistent exercise behavior.

Factors Influencing Adherence

Several factors may explain the observed gap between knowledge and practice. Pain during exercises, lack of structured supervision, and competing daily responsibilities—particularly among housewives—may limit exercise adherence. Qualitative studies on shoulder pain have emphasized that patients often perceive exercises as painful or fear aggravating symptoms, which reduces compliance[14,19]. Additionally, socio-demographic factors such as education level play a significant role; participants with secondary or higher education levels demonstrated better knowledge and adherence compared to those with lower educational backgrounds. This is consistent with findings from studies on musculoskeletal pain management, where higher education levels were associated with improved exercise adherence[12].

Moreover, Cridland et al.[20] reported that clear, confidence-building education from healthcare providers enhances adherence, suggesting that education alone is insufficient without guidance, reassurance, and motivation.

Implications for Clinical Practice

The disparity between knowledge and practice observed in this study underscores the need for comprehensive, patient-centered management strategies that go beyond standard education. Incorporating supervised exercise sessions, regular follow-ups, and personalized rehabilitation plans can enhance adherence and improve clinical outcomes. Importantly, Brindisino et al.[21] highlighted that patient with frozen shoulder often have specific needs and perspectives that may not align with clinicians' management strategies, suggesting that tailoring interventions to patient expectations and preferences is essential. Furthermore, integrating technology, such as mobile applications for guided exercises, can support self-management, increase patient engagement, and improve adherence to home exercise programs[22]. Overall, addressing both the educational and behavioral aspects of exercise adherence is crucial for optimizing functional recovery in frozen shoulder patients.

CONCLUSION

This study demonstrated that patients with frozen shoulder generally possess moderate knowledge and practice regarding shoulder exercises. While a substantial proportion of participants were aware of beneficial exercises, adherence to proper techniques and professional guidance was suboptimal. Higher levels of knowledge and practice were significantly associated with patient-reported improvement in pain and shoulder mobility, highlighting the importance of both education and adherence in achieving positive clinical outcomes. Socio-demographic factors, particularly education level, influenced knowledge and practice, with better-educated patients demonstrating higher adherence and improved outcomes. The study emphasizes the gap between awareness and actual implementation of shoulder exercises, underscoring the need for strategies that translate knowledge into effective practice.

RECOMMENDATION

Based on the findings of this study, it is recommended that patient education on shoulder exercises be clear and practical, emphasizing correct techniques and precautions. Supervised or guided exercise sessions should be incorporated to enhance adherence and ensure proper performance. Rehabilitation plans should be individualized according to patient characteristics and functional needs. Regular follow-up and monitoring are essential to reinforce adherence and track progress. Additionally, integrating digital tools such as mobile applications may support home exercise practice and engagement. Addressing psychosocial barriers, including fear of pain and lack of motivation, is crucial to improve compliance. Future studies should explore strategies to sustain long-term adherence and assess clinical outcomes over time.

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ORIGINAL ARTICLE

Prevalence of incidental findings in CT scan of paranasal sinuses

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ABSTRACT

Background: *The use of computed tomography (CT) scans has become a common diagnostic tool for evaluating the paranasal sinuses (PNS), particularly in patients presenting with symptoms such as chronic sinusitis, nasal obstruction, or facial pain. CT imaging offers detailed visualization of sinus anatomy and pathology, often leading to accurate diagnosis and management. Incidental findings (IFs) are unintentional discoveries unrelated to the imaging purpose. Imaging exams on people with suspected intracranial diseases may detect IFs in the PNS.* ***Objectives:*** *The aim of the study was to evaluate the prevalence of incidental abnormalities on computed tomographic scans of the paranasal sinuses.* ***Methods & Materials:*** *This cross-sectional study was carried out in the Department of Radiology & Imaging, Uttara Adhunik Medical College & Hospital, Dhaka, Bangladesh during January 2023 to December 2023. A total of 120 patients were participated in the study. Statistical analyses of the results were be obtained by using window-based Microsoft Excel and Statistical Packages for Social Sciences (SPSS-24).* ***Results:*** *The age distribution showed that (14.16%) patients were under 20 years old, (20.0%) were between 21 and 40 years old and 48 (40.0%) were over the age of 61. The majority of the patients were male (58.33%) and (41.66%) being female. According to employment status, (15.83%) of patients were housewives, (10%) were businessmen, (7.5%) were retired officers and (34.16%) were service members. According to socioeconomic level, (58.33%) of the patients come from middle-class families, (24.16%) from low-income families and (17.60%) from middle-class families.* ***Conclusion:*** *Incidental abnormalities on paranasal sinus CT scans are common, though most findings are minor and unlikely to require intervention. Awareness of these incidental findings is essential to avoid unnecessary follow-up and treatment, particularly when abnormalities do not correlate with symptoms. Further research is warranted to evaluate the clinical significance of specific types of incidental findings.*

Keywords: *Computed tomography (CT), Paranasal sinuses (PNS), Incidental findings (IFs).*

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INTRODUCTION

Most physicians continue to struggle with diagnosing chronic inflammatory illness of the paranasal sinuses. Chronic sinusitis is defined as the presence of permanent tissue alterations in the lining membranes of one or more paranasal sinuses[1]. This is a definition of the pathogenic state; however, diagnosis requires clinical and temporal correlates, which presents a challenge. The symptoms of chronic sinus disease are numerous and frequently vague and nonspecific, and physical examination is limited because the sinuses cannot be examined directly. As a result, radiographic examinations have an important diagnostic function. It is thus critical to determine the pathologic correlations of aberrant radiographic appearances of the paranasal sinuses in patients with suspected chronic sinus illness.

Imaging incidental findings (IFs) are results that are not connected to the clinical indication. Computed tomography (CT) has greatly increased the ability to visualize organs and tissues, boosting the possibility of identifying novel discoveries due to its larger field of view. Furthermore, CT imaging is crucial for detecting and diagnosing cancers and atypical illnesses[2]. Scientists have focused their efforts on determining the incidence rate and causes of IFs in brain CT imaging[3]. As brain CT and magnetic resonance imaging (MRI) become more widely available, medical experts are making an increasing number of surprising discoveries. Despite their

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rising frequency, IFs in CT research differ depending on the population being studied[4].

The description of an incidental discovery (IF) may need more medical care, potentially leading in unnecessary testing, diagnostic procedures, and therapies, which may offer an increased danger to the patient in certain situations. [5] Scholars including Hara, O'Sullivan et al., and Siddiki et al. have referred to this phenomenon as the cascading effect. The paranasal sinuses (PNS) feature a wide range of disorders known as IFs. These might range from minor issues like mucosal thickening or sinusitis to more serious ones like tumors or foreign objects. Several research studies have thoroughly described how the finding of an IF may result in the early and beneficial detection of an unanticipated tumor or aneurysm[6]. Nonetheless, clinical expertise indicates that many IFs have unknown clinical importance, causing concern for both research participants and their healthcare professionals[7].

The prevalence of incidental abnormalities on computed tomographic (CT) scans of the paranasal sinuses investigates how frequently unexpected findings appear in these scans, which are often conducted for reasons unrelated to sinus health. The findings reveal those incidental abnormalities—such as mucosal thickening, sinus opacification, and polyps—are quite common, even in asymptomatic individuals. These abnormalities often have no clinical significance but can lead to unnecessary treatments if misinterpreted as requiring intervention. The study emphasizes the importance of carefully assessing incidental findings and distinguishing between clinically relevant and irrelevant abnormalities to avoid overtreatment and unnecessary procedures.

METHODS & MATERIALS

This cross-sectional study was carried out in the Department of Radiology & Imaging, Uttara Adhunik Medical College & Hospital, Dhaka, Bangladesh January 2023 to December 2023. A total of 120 patients were participated in the study. Patients who have undergone CT scans of the paranasal sinuses for various indications within a specific timeframe were include inclusion criteria and patients with known sinus pathology, history of sinus surgery, or who are symptomatic for sinus disease were include exclusion criteria. After taking consent and matching eligibility criteria, data were collected from patients on variables of interest using the predesigned structured questionnaire by interview, observation. Statistical analyses of the results were be obtained by using window-based Microsoft Excel and Statistical Packages for Social Sciences (SPSS-24).

RESULTS

Table – I: Distribution of the study according to baseline characteristic (*n*=120)

	n=120	%
Age (years)		
≤20	17	14.16
21–40	24	20.00
41–60	31	25.83
≥61	48	40.00
Sex Distribution		
Male	70	58.33
Female	50	41.66
Occupational status		
House wife	19	15.83
Retried	09	7.5
Service	41	34.16
Day labour	24	20
Teacher	08	6.66
Farmer	07	5.83
Business	12	10
Socio-economic condition		
Low	29	24.16
Middle	70	58.33
High	21	17.60
BMI distribution		
<18.5 (Underweight)	18	15
18.5-24.9 (Normal)	34	28.33
25-29.9 (Overweight)	48	40
>30 (Obese)	20	16.66

Table I shows age distribution of the study population, it was observed that 17(14.16%) patients were belonged to age ≤20 years, 24(20.0%) patients were belonged to age 21-40 years, 31(25.83%) patients were belonged to age 41-60 years and 48(40.0%) patients were belonged to age ≥61 years. Table shows sex distribution of the study population; it was

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observed that majority 70(58.33%) patients were male and 50(41.66%) patients were female. Table shows occupational status of the study population; it was observed that 19(15.83%) patients were house wives and 12(10%) patients were businessman. Followed by 9(7.5%) were retired officers and 41(34.16%) service holder and 24(20%) were day labour. Table shows socio-economic status of the study population, it was observed that 70(58.33%) of the patients come from middle class family, 29(24.16%) of the patients come from low class and 21(17.60%) of the patients come from middle class family. The distribution of the study population according to BMI. It was observed that 48(40%) participants belonged to BMI 25-29.9 kg/m^2 (Overweight) and 34(28.33%) participants belonged to BMI 18.5-24.9 kg/m^2 (Normal).

Table – II: Prevalence of IFs according to patient gender

IFs	Gender	
	Male	Female
Acute sinusitis	9	8
Chronic sinusitis	4	1
Fungal infection	2	0
Mucocele	2	0
Polyp	3	2
Retention cyst	1	2
Total	21 (17.5)	13 (10.83)

Table II shows Prevalence of IFs according to patient gender, it was observed that according to 9% participants belonged to male group and 8% were female group. And according to Chronic sinusitis, 4% participants belonged to male group and 1% were female group.

Table – III: The occurrence rate of IFs associated with the PNS

PNS	IFs	n=120	%
Ethmoid	Acute sinusitis	2	1.6
Ethmoid and Maxillary	Acute sinusitis	3	2.5
Frontal and Maxillary	Acute sinusitis	2	1.6
Maxillary	Acute sinusitis	13	10.83
	Chronic sinusitis	4	3.33
	Fungal infection	2	1.6
	Mucocele	2	1.6
	Polyp	5	4.16
	Retention cyst	3	2.5

Table III shows the occurrence rate of IFs associated with the PNS, it was observed that acute sinusitis was 13(10.83%), Chronic sinusitis was 4(3.33%), Fungal infection was 2(1.6%) when PNS was Maxillary.

Table – IV: The incidence rate of IFs associated with each side

IFs side	IFs	n=120	%
Bilateral	Acute sinusitis	5	4.16
	Chronic sinusitis	3	2.5
	Polyp	2	1.6
Left	Acute sinusitis	7	5.83
	Chronic sinusitis	3	2.5
	Fungal infection	2	1.6
	Mucocele	2	1.6
	Polyp	2	1.6
	Retention cyst	2	1.6
Right	Acute sinusitis	6	5
	Polyp	3	2.5
	Retention cyst	2	1.6

Table IV shows the incidence rate of IFs associated with each side, it was observed that according to Bilateral, 5(4.16%), 3(2.5%) and 2(1.6%) were acute sinusitis, chronic sinusitis and polyp respectively.

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DISCUSSION

This cross-sectional study was carried out in the Department of Physical Medicine and Rehabilitation, Bangabandhu Sheikh Mujib Medical University, Dhaka. During one year of study period, total 120 samples were included in this study. The prevalence of incidental abnormalities on computed tomography (CT) scans of the paranasal sinuses has garnered significant attention due to the widespread use of imaging in medical diagnostics. CT scans of the paranasal sinuses are often performed to evaluate conditions such as chronic sinusitis, nasal obstruction, and facial pain. However, these scans frequently reveal unexpected, asymptomatic findings unrelated to the patient's presenting symptoms. These incidental abnormalities can include mucosal thickening, polyps, cysts, and other structural variations that may not necessarily indicate disease but can lead to further investigation or intervention.

Intracranial diseases, which include tumors, infections, and traumatic injuries, are typically examined utilizing imaging modalities such as CT and MRI. These imaging techniques not only provide critical diagnostic information regarding anomalies in the skull, but they also detect unexpected findings in surrounding structures, such as the PNS[8]. The incidence of IFs in the PNS during imaging exams for intracranial diseases has not been well recorded, and the clinical importance of these findings is currently debated. It is critical to understand the frequency of IFs in PNS while evaluating intracranial diseases. This understanding is critical for proper treatment and monitoring of certain IFs[9, 10].

In this present study, the age distribution showed that 17 (14.16%) patients were under 20 years old, 24 (20.0%) were between 21 and 40 years old, 31 (25.83%) were between 41 and 60 years old, and 48 (40.0%) were over the age of 61. In this study, the majority of the patients were male (58.33%), with 50 (41.66%) being female.

The study discovered that males are more vulnerable than females, which is consistent with prior research showing a higher prevalence of PNS abnormalities in males[11]. Males typically encounter sinusitis-causing variables at work, such as dusty and polluted workplaces. This is similar with the findings of Ertugay et al. and Gupta et al., who discovered a higher proportion of females in their study, which deviates from the prevailing male dominance[12,13]. Most importantly, the study found that older persons were more likely to have PNS anomalies, which is consistent with earlier research[9]. This could be because the PNS changes as people age, such as a reduction in the ability to clear mucus by cilia movement and a fall in immunological function. These modifications make the peripheral nervous system more susceptible to infection and other disorders[14].

Our study presents that, the prevalence of IFs by patient gender was found to be 9% male and 8% female. According to Chronic sinusitis, 4% of participants were male, whereas 1% were female. In terms of the occurrence rate of IFs linked with the PNS, acute sinusitis was 13 (10.83%), chronic sinusitis was 4 (3.33%), and fungal infection was 2 (1.6%).

A study found that conservative measures, such as monitoring and follow-up imaging, can effectively manage these IFs, even if they are of limited clinical value. When evaluating neurological disorders, a brain MRI frequently detects abnormal PNS. In general, these IFs are benign, with the most prevalent symptom being increased mucosal lining thickness[15]. Males and people aged 35 and younger accounted for the majority of chance findings. Detecting anomalous observations in the PNS aids in the diagnosis of anomalies unrelated to the suspected neurological illness[15]. A detailed evaluation was also performed on 192 sinus CT scans of individuals with a documented history of rhinosinusitis.

A study was done to look into the development of IFS in the PNS of people who did not exhibit symptoms. The study discovered that 56% of patients had opacity, with thickening of the mucosal lining being the most common reason. Scores of 15 or higher indicated the possibility of severe opacification. Participants in this group were more likely to develop symptoms throughout the follow-up period than those with no or just minor results. As a result, a significant inadvertent sinus opacity on CT scans suggests the possibility of having a respiratory problem in the future[16].

This study observed that, the incidence rate of IFs related with each side was observed to be 5(4.16%), 3(2.5%), and 2(1.6%) for acute sinusitis, chronic sinusitis, and polyps, respectively. The rates of acute sinusitis, chronic sinusitis, fungal infection, and retention cyst on the left side were 2 (1.6%), 7 (5.83%), 2 (1.6%), and 2 (1.6%), respectively. The rates of right Ifs side acute sinusitis, polyps, and retention cysts were 6 (5%), 3 (2.5%), and 2 (1.6%), respectively.

The most common normal variations observed were nasal septal deviation, Agger nasi cells, and sphenoid sinuses that extended into the posterior nasal septum. There was no significant difference in the frequency of any of the anatomical abnormalities investigated between patients with minor and medically important disorders affecting the PNS or nasal cavity. As a result, routine CT scans of the PNS, which are used to identify sinusitis or rhinitis by detecting anatomical changes, are worthless unless surgery is scheduled[17]. The findings are consistent with another study that revealed a higher prevalence of anomalies in the maxillary sinus compared to the other sinuses[18]. However, the impacts on the ethmoid and frontal sinuses were less common. The study also discovered that abnormalities were more common on the left than on the right, with both sides having abnormalities in 25.9% of cases[18].

Understanding the prevalence of these incidental findings is essential for clinicians in differentiating between clinically relevant abnormalities and benign variations. It also aids in guiding patient management, avoiding unnecessary treatments, and reducing patient anxiety over incidental findings. Studies on the prevalence of these findings suggest that incidental abnormalities on sinus CT scans are common, even among asymptomatic individuals, highlighting the importance of cautious interpretation and patient-centered decision-making in clinical practice.

Limitations of the study

The present study was conducted in a very short period due to time constraints and funding limitations. The small sample size was also a limitation of the present study.

CONCLUSION

The prevalence of incidental abnormalities on computed tomographic (CT) scans of the paranasal sinuses generally highlights that incidental sinus abnormalities are common, even in asymptomatic individuals. Findings often include mucosal thickening, sinus opacification, and other anatomical variations, which are detected at rates ranging from 30-50% in some studies. Most of these incidental findings do not correlate with clinical symptoms or require treatment. While incidental sinus abnormalities on CT scans are frequently observed, they are typically clinically insignificant. Therefore, caution is advised to avoid overdiagnosis and overtreatment, focusing instead on correlating radiologic findings with clinical symptoms before deciding on interventions.

RECOMMENDATION

This study can serve as a pilot to much larger research involving multiple centers that can provide a nationwide picture, validate regression models proposed in this study for future use and emphasize points to ensure better management and adherence.

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The wide range of disciplines involved in the prevalence of incidental abnormalities on computed tomographic scans of the paranasal sinuses research means that editors need much assistance from references in the evaluation of papers submitted for publication. I would also like to be grateful to my colleagues and family who supported me and offered deep insight into the study.

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ORIGINAL ARTICLE

Evaluation of Lower Tibial Metaphyseal Plate Osteosynthesis with or without Fixation of Lateral Malleolar Fracture – A Prospective Study

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ABSTRACT

Background: *Distal tibial metaphyseal fractures, with or without associated lateral malleolar fractures, are common injuries resulting from high-energy trauma. The role of fibular fixation in improving stability and outcomes remains debated.* ***Objective:*** *To evaluate the functional and radiological outcomes of plate osteosynthesis of distal tibial metaphyseal fractures with or without fibular fixation in 40 patients.* ***Methods & Materials:*** *A prospective study was conducted on 40 patients with distal tibial metaphyseal fractures, managed by plate osteosynthesis. Patients were divided into two groups: Group A (n=20) – tibial fixation only; Group B (n=20) – tibial fixation with fibular plating. Functional outcome was assessed using the American Orthopaedic Foot & Ankle Society (AOFAS) score and radiological union was monitored over 12 months.* ***Results:*** *Mean union time in Group A was 19.2 weeks vs. 17.6 weeks in Group B. Malalignment (>5°) occurred in 4 patients (Group A: 3, Group B: 1). Mean AOFAS scores at final follow-up were 84.3 (Group A) vs. 88.6 (Group B). Complications included superficial infection (3 cases), delayed union (2 cases), and ankle stiffness (2 cases).* ***Conclusion:*** *Fibular fixation in addition to tibial plating provides better alignment and marginally faster union, with improved functional outcomes. However, differences were not statistically significant. Selective fibular fixation may be considered, especially in cases with instability or comminution.*

Keywords: *Distal Tibial Metaphyseal Fracture, Osteosynthesis, Fibular Fixation, Ankle Stability, Plate Fixation*

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INTRODUCTION

Distal tibial metaphyseal fractures represent a significant challenge in orthopedic trauma due to their unique anatomical and biomechanical characteristics. The distal tibia has a limited soft tissue envelope and relatively poor blood supply, making fracture healing slower and the risk of complications higher compared to diaphyseal fractures.[1,2] These fractures commonly occur as a result of high-energy trauma, such as road traffic accidents and falls from height, and are often associated with fibular fractures, which may influence ankle stability and alignment.[3] Management of distal tibial metaphyseal fractures has evolved over the years, with various options including conservative treatment, intramedullary nailing, and plate osteosynthesis. Plate osteosynthesis, particularly using pre-contoured locking compression plates (LCP), has become the preferred method for fractures with metaphyseal extension or comminution due to its ability to provide stable fixation while preserving fracture biology.[4,5] However, the role of fibular fixation in such fractures remains a topic of debate. Some authors advocate routine fixation of the fibula to restore lateral column stability, prevent malalignment, and improve rotational control of the distal tibia.[6] Others argue that fibular plating may not significantly affect clinical outcomes and may increase soft tissue complications, including wound breakdown, infection, and delayed healing.[7] The decision to

fix the fibula often depends on factors such as fracture pattern, presence of syndesmotic injury, degree of comminution, and intraoperative stability. Despite several studies, there remains a paucity of prospective comparative data evaluating the functional and radiological outcomes of distal tibial metaphyseal fractures treated with tibial plate osteosynthesis with or without fibular fixation.[8] Understanding the impact of fibular fixation on union rates, alignment, and functional recovery is essential for optimizing patient care and minimizing complications. This study aims to evaluate 40 cases of distal tibial metaphyseal fractures managed with plate osteosynthesis, comparing outcomes between patients treated with tibial plating alone and those treated with combined tibial and fibular fixation. The primary objectives include assessment of fracture union, postoperative alignment, functional outcome using the American Orthopaedic Foot & Ankle Society (AOFAS) score, and complications. The findings are intended to provide evidence-based guidance on the necessity of fibular fixation in the management of distal tibial metaphyseal fractures.

METHODS & MATERIALS

This prospective study was conducted at Dept. Orthopedic Surgery, Dinajpur Medical College Hospital, Dinajpur Bangladesh from December 2023 to November 2024, after obtaining approval from the institutional ethics committee. A total of 40 patients with distal tibial metaphyseal fractures were enrolled and divided into two groups based on the surgical approach: Group A (n=20), treated with tibial plate osteosynthesis alone, and Group B (n=20), treated with tibial plate osteosynthesis along with fibular fixation. Written informed consent was obtained from all patients prior to inclusion.

Inclusion Criteria

- Patients aged 18–60 years.
- Closed distal tibial metaphyseal fractures classified as AO/OTA type 43A (extra-articular) or 43B (partial articular).
- Fractures with or without associated lateral malleolar fracture.
- Patients fit for surgical intervention under general or spinal anesthesia.

Exclusion Criteria

- Open fractures classified as Gustilo-Anderson type II or III.
- Pathological fractures or metabolic bone disease.
- Patients with associated vascular injury, polytrauma affecting rehabilitation, or pre-existing ankle pathology.
- Patients unwilling or unable to comply with follow-up.

Preoperative Assessment

All patients underwent a detailed clinical evaluation, including assessment of limb neurovascular status and soft tissue condition. Radiographs of the ankle and tibia in anteroposterior (AP), lateral, and oblique views were obtained, and CT scans were performed when intra-articular extension was suspected. Fractures were classified according to the AO/OTA classification system.

Surgical Technique

All surgeries were performed under general or spinal anesthesia with the patient in the supine position. A pre-contoured locking compression plate (LCP) was applied to the distal tibia via an anterolateral or medial approach depending on fracture location. In Group B, associated fibular fractures were stabilized using a 1/3 tubular plate via a lateral approach. Intraoperative fluoroscopy ensured anatomical reduction and proper plate positioning. Wounds were closed in layers over suction drains where necessary.

Postoperative Care

Postoperatively, a posterior splint was applied for 2–3 weeks. Patients were instructed on non-weight bearing mobilization initially, progressing to partial weight bearing at 6–8 weeks based on radiographic evidence of callus formation. Full weight bearing was allowed after confirmed union. Analgesics, thromboprophylaxis, and antibiotics were administered as per institutional protocol.

Outcome Assessment

Patients were followed at 6 weeks, 3 months, 6 months, and 12 months postoperatively. The primary outcomes included radiological union, assessed by bridging callus and disappearance of fracture lines, and functional outcome, evaluated using the American Orthopaedic Foot & Ankle Society (AOFAS) ankle-hindfoot score. Secondary outcomes included postoperative alignment, complication rates (infection, delayed union, non-union, ankle stiffness), and time to return to work or daily activities.

Statistical Analysis

Data were analyzed using [Statistical Software, e.g., SPSS version 25]. Continuous variables were expressed as mean ± standard deviation, and categorical variables as frequencies and percentages. Student's t-test was used for continuous variables and Chi-square test for categorical variables. A p-value <0.05 was considered statistically significant.

RESULTS

A total of 40 patients with distal tibial metaphyseal fractures were included in the study and divided into two groups of 20 each: Group A (tibial plate fixation only) and Group B (tibial plate fixation with fibular plating).

Demographic Data

The mean age of patients was 36.7 years (range: 19–58 years). Males predominated (M:F = 30:10). Road traffic accidents were the most common mode of injury (72.5%), followed by falls from height (22.5%) and sports injuries (5%). Both groups were comparable in terms of age, sex distribution, and mechanism of injury.

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Table – I: Demographic characteristics

Variable	Group A (n=20)	Group B (n=20)	Total (n=40)
Mean age (years)	35.9 ± 9.4	37.5 ± 8.7	36.7 ± 9.0
Male : Female	15 : 5	15 : 5	30 : 10
Mode of injury – RTA	14 (70%)	15 (75%)	29 (72.5%)
Fall from height	5 (25%)	4 (20%)	9 (22.5%)
Sports injury	1 (5%)	1 (5%)	2 (5%)

Fracture Characteristics

Most fractures were AO type 43A (simple extra-articular metaphyseal) (65%), while 35% were type 43B (partial articular). Comminuted fractures were slightly more frequent in Group B.

Table – II: Distribution of fractures

AO Classification	Group A	Group B	Total
Type 43A	13	13	26
Type 43B	7	7	14

Radiological Union

The mean time to union was 19.2 weeks in Group A and 17.6 weeks in Group B. Delayed union was observed in 2 patients in Group A; no non-union occurred in either group.

Table – III: Radiological outcomes

Parameter	Group A (n=20)	Group B (n=20)	p-value
Mean time to union (weeks)	19.2 ± 3.1	17.6 ± 2.8	0.08
Delayed union	2	0	—
Non-union	0	0	—

Alignment

Malalignment (>5° varus/valgus or rotational deformity) occurred in 4 patients overall. It was more common in Group A (3 cases, 15%) compared to Group B (1 case, 5%).

Table – IV: Post-operative alignment

Alignment status	Group A	Group B
Acceptable alignment	17	19
Malalignment (>5°)	3	1

Functional Outcome

Functional outcome was assessed using the AOFAS (American Orthopaedic Foot & Ankle Society) ankle-hindfoot score at the final 12-month follow-up. Group B had slightly higher scores compared to Group A.

- Group A: Mean 84.3 ± 6.2 (range: 72–92)
- Group B: Mean 88.6 ± 5.4 (range: 78–96)

Table – V: Functional outcomes (AOFAS score at 12 months)

Outcome grade (AOFAS)	Score Range	Group A (n=20)	Group B (n=20)
Excellent	90–100	6 (30%)	10 (50%)
Good	80–89	10 (50%)	7 (35%)
Fair	70–79	4 (20%)	3 (15%)
Poor	<70	0	0

Complications

We found 2 cases Overall complication rate was 17.5%. Superficial infection occurred in 3 cases (2 in Group A, 1 in Group B) and responded to antibiotics and dressings. Delayed union was noted in 2 cases (Group A only). Ankle stiffness was reported in 2 patients (1 in each group). No deep infection or implant failure was observed.

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Table – VI: Complications

Complication	Group A	Group B	Total
Superficial infection	2	1	3
Delayed union	2	0	2
Ankle stiffness	1	1	2
Deep infection	0	0	0
Implant failure	0	0	0

DISCUSSION

The management of distal tibial metaphyseal fractures remains challenging due to the subcutaneous location, limited soft tissue coverage, and potential for poor vascularity.[1] In this study of 40 patients, we evaluated outcomes of tibial plate osteosynthesis with or without fibular fixation to determine whether additional stabilization of the fibula confers clinical and radiological benefits. Our results demonstrated that combined tibial and fibular fixation (Group B) provided marginal advantages over tibial fixation alone (Group A). The mean union time was slightly shorter in Group B (17.6 ± 2.8 weeks) compared to Group A (19.2 ± 3.1 weeks), suggesting that fibular fixation may improve fracture stability and facilitate bone healing. Delayed union was observed only in two patients in Group A, whereas no delayed or non-union occurred in Group B, highlighting a potential protective effect of fibular plating against complications associated with instability. Postoperative malalignment was another important parameter. Malalignment (>5° varus/valgus) was noted in 15% of Group A patients versus 5% in Group B. This supports the concept that fibular fixation contributes to lateral column support, prevents collapse, and maintains correct tibial alignment.[2,3] Proper alignment is crucial not only for fracture healing but also for long-term ankle biomechanics and prevention of post-traumatic arthritis. Functional outcomes, assessed using the American Orthopaedic Foot & Ankle Society (AOFAS) score, were superior in Group B (mean 88.6) compared to Group A (mean 84.3). This difference likely reflects better anatomical alignment and stability, allowing improved weight-bearing and earlier rehabilitation. However, both groups achieved overall good to excellent outcomes, indicating that tibial plate osteosynthesis alone can provide satisfactory results in selected fracture patterns.[4] The complication rate in our study was low (17.5%), with superficial infection in three cases and ankle stiffness in two cases. Notably, no deep infections or implant failures occurred. These findings align with prior studies suggesting that careful soft tissue management during plating minimizes complications, even when fibular fixation is performed.[5,6] Several studies have explored the role of fibular fixation. Vallier et al. reported reduced malalignment and improved stability with fibular plating in distal tibial fractures.[2] Kumar et al. demonstrated that fibular fixation improves rotational stability and reduces the risk of varus/valgus deformity.[3,8] Conversely, some authors argue that routine fibular fixation is unnecessary in simple fracture patterns, as it may increase surgical time and soft tissue dissection without significant functional benefit.[7,9,10] Our findings support a selective approach, where fibular fixation is recommended in comminuted fractures, unstable fracture patterns, or when intraoperative assessment reveals inadequate stability. Limitations of this study include the relatively small sample size, single-center design, and follow-up limited to 12 months. Long-term functional and radiological outcomes, particularly the development of post-traumatic arthritis, were not assessed. Future multicenter, randomized trials with larger cohorts are necessary to validate these findings. In our study, tibial plate osteosynthesis effectively manages distal tibial metaphyseal fractures. Fibular fixation offers additional benefits in reducing malalignment, marginally shortening union time, and improving functional outcomes. However, selective fibular fixation is recommended based on fracture morphology and intraoperative stability rather than routine use.

CONCLUSION

Plate osteosynthesis is an effective and reliable method for the management of distal tibial metaphyseal fractures, providing stable fixation and satisfactory functional outcomes. The addition of fibular fixation offers marginal but clinically meaningful benefits, including improved fracture alignment, slightly faster union, and enhanced functional recovery as measured by the AOFAS score. However, routine fibular fixation may not be necessary for all cases. A selective approach, based on fracture pattern, degree of comminution, and intraoperative assessment of stability, is recommended to balance the benefits of lateral support with the potential risks of additional soft tissue dissection. Overall, distal tibial metaphyseal fractures can be successfully managed with careful surgical planning, meticulous soft tissue handling, and appropriate postoperative rehabilitation.

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ORIGINAL ARTICLE

Impact of Body Mass Index on Acne Severity – Findings from a Hospital-Based Cross-Sectional Study (100 Cases)

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ABSTRACT

Background: *Acne vulgaris is a common chronic inflammatory disorder of the pilosebaceous unit, mainly affecting adolescents and young adults. Its pathogenesis involves hormonal, genetic, and microbial factors, with recent evidence suggesting a possible role of metabolic parameters like Body Mass Index (BMI). However, the association between BMI and acne severity remains inconsistent across studies.* ***Objective:*** *To evaluate the relationship between BMI and acne severity among patients attending the dermatology outpatient department of a tertiary care hospital.* ***Methods & Materials:*** *A hospital-based cross-sectional study was conducted on 100 clinically diagnosed acne vulgaris patients aged 15–35 years. Demographic and anthropometric data were recorded, and BMI was calculated as weight (kg)/height (m^2) and categorized per WHO standards. Acne severity was assessed using the Global Acne Grading System (GAGS). Data were analyzed using SPSS version 26, applying chi-square and Pearson's correlation tests. A p-value <0.05 was considered significant.* ***Results:*** *The mean age was 21.8 ± 3.4 years, with a female-to-male ratio of 1.38:1 and a mean BMI of 24.3 ± 3.7 kg/m^2. Moderate acne was most common (40%), followed by mild (29%), severe (22%), and very severe (9%). A significant positive association was found between higher BMI and greater acne severity (χ^2 = 12.87, p = 0.01), with a moderate positive correlation (r = 0.32, p = 0.01).* ***Conclusion:*** *Elevated BMI is significantly associated with increased acne severity, highlighting the potential role of weight management in acne control.*

Keywords: *Acne vulgaris; Body Mass Index; Acne severity; Global Acne Grading System (GAGS); Obesity; Cross-sectional study; Dermatology; Metabolic factors*

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INTRODUCTION

Acne vulgaris is one of the most prevalent dermatological disorders, affecting nearly 85% of adolescents and young adults worldwide.[1] It is a chronic inflammatory disease of the pilosebaceous unit, characterized by comedones, papules, pustules, nodules, and sometimes scarring. Although it is not life-threatening, acne has significant psychological and social consequences, including anxiety, depression, and reduced self-esteem.[2,3] The pathogenesis of acne is multifactorial and involves increased sebum production, follicular hyperkeratinization, colonization by *Cutibacterium acnes*, and inflammation.[4] In recent years, there has been growing interest in the influence of metabolic and lifestyle factors on acne development. Among these, Body Mass Index (BMI) has been proposed as an indirect indicator of hormonal and metabolic status that may contribute to acne pathophysiology.[5] An elevated BMI is often associated with hyperinsulinemia, insulin resistance, and increased androgen levels, which in turn stimulate sebaceous gland activity and keratinocyte proliferation, leading to acne formation.[6,7] Moreover, obesity induces a chronic low-grade inflammatory state with elevated cytokines such as IL-6 and TNF-α, which may further exacerbate acne lesions.[8] However, the association between BMI and acne severity remains controversial, with some studies reporting a positive correlation[9,10], while others found no significant relationship.[11,12] These inconsistencies may be due to differences in study design, sample size, ethnic background,

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dietary habits, or hormonal influences. Understanding whether BMI has a significant role in acne can aid clinicians in adopting a more comprehensive management strategy, including lifestyle and dietary modifications, alongside pharmacological treatment. Since acne and obesity are both common among adolescents and young adults, studying their interrelationship may help identify modifiable risk factors for acne prevention and better therapeutic outcomes.[13] Therefore, this hospital-based cross-sectional study was designed to evaluate the association between Body Mass Index and acne severity among patients attending the dermatology outpatient department. The study aims to contribute to existing evidence and clarify whether higher BMI is a potential risk factor for increased acne severity in our population.

METHODS & MATERIALS

Study Design and Setting

This hospital-based cross-sectional study was conducted in the Department of Dermatology, Dhaka Medical College and Hospital skin outdoor from March to September 2024. The study aimed to assess the association between Body Mass Index (BMI) and acne severity among patients with clinically diagnosed acne vulgaris. The research protocol was reviewed and approved by the Institutional Ethics Committee, and informed consent was obtained from all participants prior to enrollment.

Study Population

A total of 100 consecutive patients presenting with acne vulgaris to the dermatology outpatient department were included.

Inclusion criteria were:

- Age between 15 and 35 years.
- Both males and females.
- Willingness to participate and provide informed consent.

Exclusion criteria were:

- Pregnant or lactating women.
- Patients on hormonal therapy, corticosteroids, or systemic retinoids within the past three months.
- Individuals with known endocrine disorders such as polycystic ovary syndrome (PCOS) or Cushing's syndrome.

Data Collection

Data were collected using a structured proforma that included demographic details, clinical history, dietary habits, and anthropometric measurements.

BMI was calculated using the formula:

$$\text{BMI} = \frac{\text{Weight \\\\\(kg\\\\\)}}{\text{Height \\\\\(m\\\\\)}^2}$$

and classified according to World Health Organization (WHO) standards[3]:

- Underweight: <18.5 kg/m²
- Normal weight: 18.5–24.9 kg/m²
- Overweight: 25.0–29.9 kg/m²
- Obese: ≥30.0 kg/m²

Assessment of Acne Severity

Acne severity was graded using the Global Acne Grading System (GAGS), which evaluates six facial and truncal areas with weighting factors to calculate a total score.[4] Based on the GAGS score, acne was categorized as mild, moderate, severe, or very severe.

Statistical Analysis

Data were entered and analyzed using SPSS version 26. Descriptive statistics such as mean and standard deviation were used for continuous variables, and frequency with percentage for categorical variables. The Chi-square test assessed the association between BMI and acne severity, and Pearson's correlation coefficient (r) determined the linear relationship between BMI and GAGS score. A p-value of <0.05 was considered statistically significant.

RESULTS

Demographic Profile of Study Participants

The mean age of the participants was 21.8±3.4 years (range: 15–30 years).

Out of 100 participants, 58 (58%) were females and 42 (42%) were males, giving a female-to-male ratio of 1.38:1. Most patients belonged to the age group of 16–25 years (81%), consistent with the peak prevalence of acne during adolescence and early adulthood. The majority of acne cases were observed among females and in the age group of 15–25 years (Table I).

Table – I: Age and Sex Distribution of Study Participants

Variable	Category	n	Percentage (%)
Age (years)	15–20	42	42.0
	21–25	39	39.0
	26–30	19	19.0
Sex	Male	42	42.0
	Female	58	58.0

Distribution According to BMI

The mean BMI of all participants was 24.3 ± 3.7 kg/m², ranging from 17.2 to 32.5 kg/m². Using WHO classification, participants were divided as follows. Nearly half (46%) of participants had normal BMI, while 46% were either overweight or obese (Table II).

Table – II: BMI Classification of Study Participants

BMI Category	BMI Range (kg/m²)	n	Percentage (%)
Underweight	<18.5	8	8.0
Normal weight	18.5–24.9	46	46.0
Overweight	25.0–29.9	31	31.0
Obese	≥30.0	15	15.0
Total		100	100.0

Distribution According to Acne Severity

Acne severity was assessed using the Global Acne Grading System (GAGS) and categorized as mild, moderate, severe, and very severe. The majority of cases (40%) presented with moderate acne, followed by mild acne (29%) (Table III).

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Table – III: Distribution of Acne Severity

Severity Grade	GAGS Score Range	n	Percentage (%)
Mild	1–18	29	29.0
Moderate	19–30	40	40.0
Severe	31–38	22	22.0
Very Severe	≥39	9	9.0
Total		100	100.0

Association Between BMI and Acne Severity

The relationship between BMI and acne severity was analyzed using the Chi-square test and Pearson's correlation coefficient. A significant positive association was found between higher BMI and greater acne severity (χ^2=12.87, p=0.01). Among obese individuals, 40% had severe acne and 26.6% had very severe acne, whereas mild acne predominated in underweight and normal-weight groups (Table IV).

Table – IV: Association Between BMI and Acne Severity

BMI Category	Mild (n=29)	Moderate (n=40)	Severe (n=22)	Very Severe (n=9)	Total	χ^2 value	p-value
Underweight	5 (62.5%)	3 (37.5%)	0	0	8		
Normal	17 (37.0%)	19 (41.3%)	8 (17.4%)	2 (4.3%)	46		
Overweight	6 (19.4%)	14 (45.2%)	8 (25.8%)	3 (9.7%)	31		
Obese	1 (6.7%)	4 (26.7%)	6 (40.0%)	4 (26.6%)	15	12.87	0.01*
Total	29	40	22	9	100		

(*p<0.05 is considered statistically significant*)

Correlation Analysis

The Pearson correlation coefficient (r) between BMI and GAGS score was r = +0.32 (p = 0.01), indicating a moderate positive correlation.This suggests that as BMI increases, acne severity tends to increase correspondingly.The plot demonstrates that individuals with higher BMI values tend to have higher acne scores, confirming the statistical correlation (Figure 1).

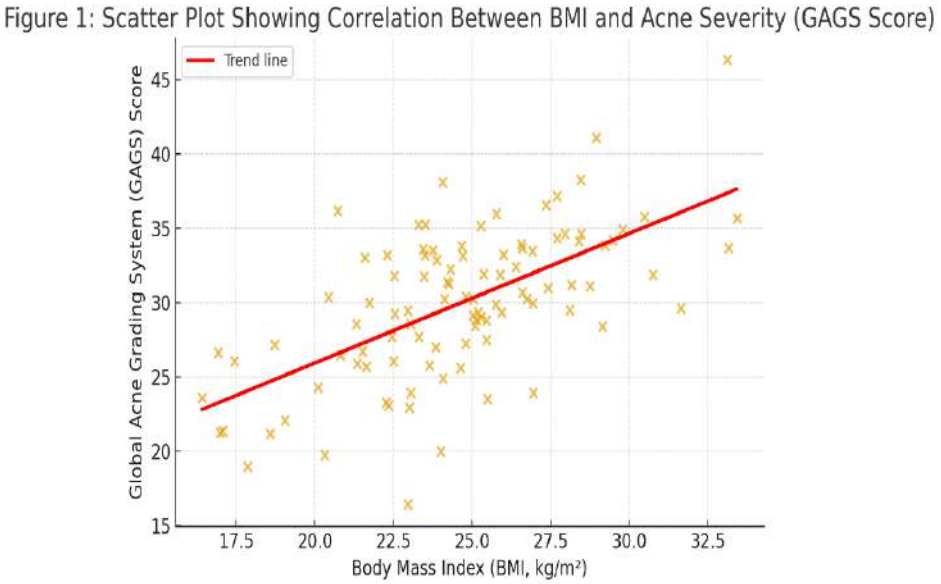

Figure – 1: Scatter Plot Showing Correlation Between BMI and Acne Severity (GAGS Score)

Gender-wise Association Between BMI and Acne Severity

The correlation between BMI and acne severity was significant for both males and females, though slightly stronger in females (r=0.33, p=0.02). Subgroup analysis by gender showed similar findings, with higher BMI significantly linked to increased acne severity among both males and females. The findings suggest that metabolic or hormonal factors associated with higher BMI may play a contributory role in acne pathogenesis (Table V).

Table – V: Gender-wise Comparison of Mean BMI and Acne Severity

Gender	Mean BMI (kg/m²) ± SD	Mean GAGS Score ± SD	Correlation (r)	p-value
Male (n=42)	24.8 ± 3.9	21.7 ± 6.4	0.28	0.04*
Female (n=58)	23.9 ± 3.6	19.8 ± 5.7	0.33	0.02*

Additional Findings

- **Dietary patterns:** 68% of overweight/obese participants reported frequent intake of high-glycemic foods.
- **Family history:** 36% had a family history of acne; more common in higher BMI groups.
- **Menstrual irregularity (in females):** Present in 21% of female participants with moderate to severe acne.

DISCUSSION

The present hospital-based cross-sectional study evaluated the association between Body Mass Index (BMI) and acne severity among 100 patients attending the dermatology outpatient department. The mean age of the study population was 21.8 ± 3.4 years, and females constituted 58% of the participants, consistent with the typical demographic distribution of acne vulgaris.[1] The majority of patients (40%) had moderate acne, and the mean BMI was 24.3±3.7 kg/m^2. Statistical analysis revealed a significant positive correlation between BMI and acne severity ($r = 0.32$, $p = 0.01$), indicating that higher BMI was associated with more severe grades of acne. Several previous studies have reported similar findings. Ghodsi et al. demonstrated a significant association between increased BMI and acne severity among Iranian adolescents.[2] Likewise, studies by Liew et al. and Kaymak et al. found that overweight and obese individuals had a higher prevalence and severity of acne compared to those with normal BMI.[3,4] These findings support the hypothesis that metabolic factors and obesity-related hormonal changes play a contributory role in acne pathogenesis. The possible mechanisms underlying this association are multifactorial. Elevated BMI is often accompanied by insulin resistance and hyperinsulinemia, which stimulate the production of androgens and insulin-like growth factor-1 (IGF-1).[5] Both hormones increase sebaceous gland activity and keratinocyte proliferation, leading to follicular obstruction and sebum accumulationkey features in acne development.[6] Furthermore, obesity is characterized by a chronic low-grade inflammatory state with increased levels of pro-inflammatory cytokines such as interleukin-6 (IL-6) and tumor necrosis factor-alpha (TNF-α), which may exacerbate acne lesions.[7,8] However, the relationship between BMI and acne is not universally accepted. Some studies have found no significant correlation between the two variables.[9,10] For instance, Wolkenstein et al. reported no clear association between BMI and acne severity in a large multicentric European sample, suggesting that genetic and ethnic factors, diet, and hormonal profiles may influence the observed discrepancies.[11] These conflicting results underscore the complexity of acne pathophysiology, which involves a dynamic interplay of hormonal, metabolic, environmental, and genetic factors. In the current study, overweight and obese individuals showed a higher proportion of severe and very severe acne compared to those with normal BMI. Additionally, a higher percentage of female patients exhibited moderate-to-severe acne, supporting the role of hormonal variation in females, especially those with menstrual irregularities or underlying metabolic imbalance.[12] Lifestyle factors such as high glycemic diet, stress, and sedentary behavior, commonly associated with higher BMI, could further aggravate acne severity.[13] The clinical relevance of these findings is noteworthy. Recognizing the potential role of BMI in acne severity highlights the importance of holistic management strategies. Beyond conventional pharmacological treatments such as topical retinoids, antibiotics, and hormonal agents, clinicians should also emphasize weight management, dietary modification, and exercise as adjunctive measures.[14-17] Incorporating counseling on nutrition and metabolic health into acne management plans could enhance treatment outcomes and patient satisfaction. Nevertheless, the present study has certain limitations. Being a cross-sectional design, it can establish only an association but not causality. The sample size was relatively small and restricted to a single center, which may limit the generalizability of the results. Furthermore, hormonal and biochemical parameters such as serum insulin, androgens, and lipid profiles were not evaluated, which could provide a more detailed understanding of the metabolic basis of acne. Future research with larger, multicentric cohorts and longitudinal follow-up, including hormonal and biochemical analyses, is recommended to substantiate these findings. In our study, this study demonstrated a statistically significant positive association between BMI and acne severity. The findings suggest that individuals with higher BMI are more prone to developing severe acne, possibly due to hormonal and inflammatory pathways influenced by obesity. Therefore, maintaining an optimal BMI through healthy lifestyle and dietary habits should be encouraged as part of comprehensive acne management.

CONCLUSION

This study demonstrates a significant association between elevated BMI and increased acne severity. These findings suggest that weight management and dietary modification may serve as valuable adjuncts in acne prevention and treatment strategies.

Conflict of Interest: None.
Source of Fund: Nil.

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ORIGINAL ARTICLE

Regional Anesthesia as a Primary Technique for COVID-19 Surgical Patients – Experience from a COVID Dedicated Hospital in Bangladesh

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ABSTRACT

Introduction: *The COVID-19 pandemic has reshaped anesthetic practice, with general anesthesia (GA) carrying increased risks due to airway manipulation and aerosol generation. Regional anesthesia (RA) offers a safer alternative by reducing viral transmission, preserving respiratory function, and providing superior postoperative analgesia with fewer pulmonary complications.* ***Methods & Materials:*** *This retrospective observational study was conducted in the Department of Anesthesiology in Mugda Medical College and Hospital, Dhaka, Bangladesh, over one year, from March 2020 to April 2021, enrolling 80 adult surgical patients with confirmed or suspected COVID-19 and underwent elective or emergency procedures under regional anesthesia (spinal, epidural, combined spinal-epidural, or peripheral nerve blocks). Data were analyzed using SPSS v26.0, with results presented as mean ± SD for continuous variables and percentages for categorical variables.* ***Results:*** *Among 80 COVID-19 surgical patients, the mean age was 45.2 ± 12.8 years, with male predominance (65%) and most classified as ASA II (57.5%). RT-PCR positivity was 80%, and 65% were symptomatic; hypertension (30%) and diabetes (25%) were common comorbidities. Elective surgeries comprised 75%, predominantly general surgery (45%). Spinal anesthesia was most frequent (65%), with 95% block success and 5% conversion to general anesthesia. Intraoperative hypotension (25%) and bradycardia (10%) were noted, while desaturation was rare (5%).* ***Conclusion:*** *This study highlights regional anesthesia as a safe and effective primary technique for COVID-19 surgical patients, ensuring stable intraoperative conditions, superior analgesia, and minimal complications. Its use reduces postoperative morbidity and healthcare provider exposure, supporting its role as the preferred anesthetic approach in pandemic surgical care*

Keywords: *COVID-19, Regional anesthesia, General anesthesia, and Anesthetic techniques*

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INTRODUCTION

The coronavirus disease 2019 (COVID-19) pandemic has fundamentally reshaped anesthetic practice, particularly for surgical patients. Notably, general anesthesia (GA) has faced heightened scrutiny due to the requirement for airway manipulation an aerosol-generating procedure and its associated risks to both patients and healthcare workers (HCWs) [1,2]. In contrast, regional anesthesia (RA) has emerged as a safer, more resource-efficient, and patient-centered alternative for individuals with suspected or confirmed SARS-CoV-2 infection [3]. RA techniques, including neuraxial blocks, peripheral nerve blocks, and interfascial plane blocks, minimize or eliminate airway intervention, thereby reducing the risk of viral transmission to personnel [1,4]. Besides offering better respiratory preservation, RA has demonstrated advantages such as enhanced postoperative analgesia, reduced opioid consumption, fewer pulmonary complications, shorter recovery times, and decreased demand for scarce anesthetic drugs and ICU resources [5]. Professional anesthesiology organizations including the American and European Societies of Regional Anesthesia and the Royal College of Anaesthetists have formally recommended RA when clinically appropriate during the pandemic [6,7]. Empirical findings corroborate these recommendations: in one series involving awake RA for upper-limb orthopedic procedures, success was achieved in 98.7% of cases, with

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83.3% discharged the same day and no COVID transmissions detected among staff or patients [3]. Beyond immediate safety and resource considerations, RA may also help mitigate postoperative cognitive dysfunction, nausea, and vomiting common complications associated with GA (systematic review: thoracic surgery outcomes) which are especially undesirable in COVID-19 patients requiring rapid recovery and minimization of hospital stays [8]. During the post-COVID era, patients often present with lingering cardiac, pulmonary, or thromboembolic vulnerabilities, such as decreased functional capacity, small-airway disease, and hypercoagulability, which potentially heighten risks under GA. In this context, RA may yield favorable outcomes by avoiding these exacerbations [9]. Operationally, RA fosters safer perioperative workflows: it enables expedited theatre turnover by bypassing the need for laborious post-intubation decontamination, less reliance on filtering masks, and minimizes the necessity for negative-pressure operating rooms scenarios often unattainable in resource-limited settings [6]. However, RA is not without limitations. Risks such as local anesthetic systemic toxicity (LAST), nerve injury, and coagulation-related complications (notably spinal hematoma) must be carefully considered, particularly in COVID-19 patients who often receive anticoagulation [10]. Furthermore, patient consent must be ethically managed to avoid coercion RA should be presented as one of several viable options, not as a default solely for staff safety [6]. Despite growing literature supporting RA across diverse clinical environments and countries, there remains a paucity of data from low- and middle-income countries (LMICs) such as Bangladesh. Given the substantial burden of COVID-19, limitations in ICU capacity, and logistical hurdles in implementing negative-pressure environments, investigating RA as a primary anesthetic technique in a COVID-dedicated hospital in Bangladesh is both timely and vital. We aim to contribute critical, context-specific evidence to inform anesthetic strategies in resource-constrained settings amid ongoing and future healthcare emergencies. This study was undertaken to evaluate the outcomes of regional anesthesia as the primary anesthetic technique in COVID-19-positive surgical patients in Bangladesh.

METHODS & MATERIALS

This was a retrospective, observational study conducted in the Department of Anesthesiology at Mugda Medical College and Hospital, a tertiary care hospital in Dhaka, Bangladesh, over 1 year from March 2020 to April 2021. The study aimed to evaluate the safety and efficacy of regional anesthesia as the primary anesthetic technique in COVID-19 surgical patients. During the study period, a total of 80 patients aged 18 years or older with confirmed or suspected COVID-19 undergoing elective or emergency surgeries were included, provided they were planned for regional anesthesia. Patients with contraindications to regional anesthesia, those refusing the technique, or those requiring urgent general anesthesia for surgical or medical reasons were excluded.

Data were collected using a structured proforma, covering demographics, COVID-19 status, comorbidities, surgical details, anesthesia type, intraoperative monitoring, and postoperative outcomes. Regional anesthesia techniques (spinal, epidural, combined spinal-epidural, or peripheral nerve blocks) were chosen based on patient and surgical factors, with standard aseptic precautions and sedation as needed. Block success and any conversions to general anesthesia were recorded. Continuous monitoring of ECG, blood pressure, and oxygen saturation was performed, with standard management for hypotension or bradycardia. Postoperatively, pain (VAS), analgesic use, respiratory complications, length of stay, and mortality were assessed. Data were entered into SPSS version 26.0. Continuous variables were expressed as mean ± standard deviation, and categorical variables as numbers and percentages. Complications, block success, and postoperative outcomes were analyzed descriptively.

RESULTS

A total of 80 participants were included in the study. The mean age of the participants was 45.2 ± 12.8 years. The sample comprised 52 males (65%) and 28 females (35%). The mean body weight was 68.5 ± 11.2 kg, with a mean height of 162.4 ± 8.5 cm, resulting in a mean body mass index (BMI) of 25.9 ± 3.6 kg/m^2. Regarding the ASA Physical Status Classification**,** 25% of participants was classified as ASA I**,** 57.5% as ASA II, 15% as ASA III**,** and 7.5% as ASA IV. [Table I]

Table – I: Demographic Characteristics of COVID-19 Surgical Patients (*n*=80)

Variable	Frequency (n)	Percentage (%)
	Mean ± SD	
Age (years)	45.2 ± 12.8	
Sex		
Male	52	65.00
Female	28	35.00
Weight (kg)	68.5 ± 11.2	
Height (cm)	162.4 ± 8.5	
BMI (kg/m^2)	25.9 ± 3.6	
ASA Physical Status		
I	20	25.00
II	46	57.50
III	12	15.00
IV	6	7.50

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Among 80 patients, 64 (80%) were RT-PCR positive, 12 (15%) antigen positive, and 4 (5%) suspected cases. Symptomatic patients accounted for 65%, while 35% were asymptomatic. Preoperative oxygen support was not required in 70%; 20% used nasal cannula, 7.5% mask, and 2.5% ventilator. Comorbidities included hypertension (30%), diabetes (25%), cardiovascular (10%), respiratory (7.5%), and others (5%). [Table II]

Table – II: COVID-19 Status and Comorbidities of Patients

Variable	Frequency (n)	Percentage (%)
COVID-19 Confirmation		
RT-PCR Positive	64	80.00
Antigen Positive	12	15.00
Suspected	4	5.00
Symptomatic / Asymptomatic		
Symptomatic	52	65.00
Asymptomatic	28	35.00
Oxygen Requirement Pre-op		
None	56	70.00
Nasal Cannula	16	20.00
Mask	6	7.50
Ventilator	2	2.50
Comorbidities		
Hypertension	24	30.00
Diabetes	20	25.00
Cardiovascular	8	10.00
Respiratory	6	7.50
Other	4	5.00

In this table, 60 (75%) underwent elective and 20 (25%) emergency surgeries. The majority were general surgeries (45%), followed by orthopedic (30%), gynecological (20%), and other specialties (5%). The mean duration of surgery was 95 ± 30 minutes. [Table III]

Table – III: Surgical Characteristics and Type of Surgery

Variable	Frequency (n)	Percentage (%)
	Mean ± SD	
Type of Surgery		
Elective	60	75.00
Emergency	20	25.00
Surgical Specialty		
General	36	45.00
Orthopedic	24	30.00
Gynecological	16	20.00
Other	4	5.00
Duration of Surgery (minutes)	95 ± 30	

Spinal anesthesia was most common (65%), followed by epidural (15%), combined spinal-epidural (10%), and nerve block (10%). The L3–L4 level was used in 65% of cases. Bupivacaine was the main anesthetic (75%). Adjuvants were used in 35%. Minimal sedation was given in 50%, and block success was 95%, with 5% requiring conversion to general anesthesia. [Table IV]

Table – IV: Details of Regional Anesthesia Techniques Used

Variable	Frequency (n)	Percentage (%)
Type of Regional Anesthesia		
Spinal	52	65.00
Epidural	12	15.00
Combined Spinal-Epidural	8	10.00
Peripheral Nerve Block	8	10.00
Level / Site of Block		
L3-L4	52	65.00
Thoracic Epidural	12	15.00
Other	16	20.00
Local Anesthetic Used		
Bupivacaine	60	75.00
Lidocaine	12	15.00
Other	8	10.00

Adjuvant Used		
Yes	28	35.00
No	52	65.00
Sedation Given		
None	24	30.00
Minimal	40	50.00
Moderate	12	15.00
Deep	4	5.00
Block Success		
Successful	76	95.00
Partial / Failed	4	5.00
Conversion to General Anesthesia		
Yes	4	5.00
No	76	95.00

Hypotension occurred in 25% of patients, while bradycardia was noted in 10%. Desaturation or respiratory complications occurred in 5%. Other minor events included nausea (15%) and shivering (10%). [Table V]

Table – V: Intraoperative Monitoring and Complications

Variable	Frequency (n)	Percentage (%)
Hypotension Episode		
Yes	20	25.00
No	60	75.00
Bradycardia Episode		
Yes	8	10.00
No	72	90.00
Desaturation / Respiratory Complications		
Yes	4	5.00
No	76	95.00
Other Intraoperative Events		
Minor nausea	12	15.00
Shivering	8	10.00

Postoperatively, pain scores remained low to moderate, most patients required minimal analgesia, and postoperative complications such as nausea (10%) and respiratory issues (2.5%) were infrequent; the mean hospital stay was 4.2 ± 1.8 days, and mortality was low at 1.25% [Table VI].

Table – VI: Postoperative Outcomes, Pain Scores, and Analgesic Requirements

Variable	Frequency (n)	Percentage (%)
	Mean ± SD	
Postoperative Pain Score (VAS 0–10)		
1h	2.1 ± 1.0	
6h	2.5 ± 1.2	
12h	2.8 ± 1.3	
24h	3.2 ± 1.5	
Analgesic Requirement		
None	24	30.00
Minimal	36	45.00
Standard	16	20.00
High	4	5.00
Postoperative Nausea & Vomiting		
Yes	8	10.00
No	72	90.00
Respiratory Complications Post-op		
Yes	2	2.50
No	78	97.50
Length of Hospital Stay (days)	4.2 ± 1.8	
Mortality		
Yes	1	1.25
No	79	98.75

DISCUSSION

The COVID-19 pandemic posed unprecedented challenges to perioperative care, necessitating modifications in anesthetic practice to reduce aerosol generation and mitigate viral transmission risks. This study, conducted in a COVID-dedicated hospital with 80 surgical patients, provides valuable insights into the safety and efficacy of regional anesthesia (RA) as a primary anesthetic technique during the pandemic. Our findings support the preferential use of RA over general anesthesia (GA), aligning with international recommendations to minimize airway manipulation and associated risks [1,11]. The mean age of patients in this study was 45.2 years, with a predominance of males (65%). Most belonged to ASA class II (57.5%), and common comorbidities included hypertension (30%) and diabetes (25%). These findings are consistent with earlier reports where comorbid conditions, particularly cardiovascular and metabolic diseases, were prevalent among COVID-19 surgical patients [12,13]. Comorbidities significantly influence perioperative outcomes and increase the likelihood of postoperative respiratory complications, further highlighting the need for safer anesthetic approaches [14]. Approximately 80% of patients were RT-PCR positive, and 65% were symptomatic at presentation. A considerable proportion required oxygen supplementation preoperatively (30%), underscoring the vulnerability of this patient cohort. GA in such patients is associated with increased risks of perioperative hypoxemia, pulmonary complications, and prolonged hospital stay [15]. Hence, the adoption of RA in our series was both pragmatic and clinically beneficial. The majority of surgeries were elective (75%), with general and orthopedic surgeries being the most common. RA techniques employed included spinal anesthesia (65%), epidural (15%), combined spinal-epidural (10%), and peripheral nerve blocks (10%). Spinal anesthesia at the L3–L4 level was most frequently used, predominantly with bupivacaine. These findings echo global reports that spinal anesthesia remained the cornerstone technique during the pandemic due to its rapid onset, predictable efficacy, and ease of administration [16,17]. Block success in our study was high (95%), with only 5% conversion to GA. The conversion rate is comparable with earlier literature, where reported failures ranged between 3–7% [18]. Minimal to moderate sedation was administered in 65% of cases, which is significant, as deep sedation may increase respiratory compromise and necessitate airway interventions, negating the advantages of RA [19]. Intraoperative hemodynamic stability was maintained mainly. Hypotension occurred in 25% and bradycardia in 10% of cases, rates within the expected range for neuraxial anesthesia [20]. Notably, desaturation or respiratory complications occurred in only 5% intraoperatively, reflecting the respiratory-sparing nature of RA. Minor adverse events such as nausea (15%) and shivering (10%) were observed but were easily manageable. These findings affirm that RA is safe in COVID-19 patients, with a lower incidence of severe complications compared to GA [1]. Postoperative outcomes in this cohort were favorable. Pain scores remained low, with mean VAS values ranging from 2.1 at 1 hour to 3.2 at 24 hours, demonstrating adequate analgesia. Notably, 75% of patients required none or minimal additional analgesia, reflecting the intrinsic benefit of neuraxial and regional techniques in providing superior pain control [21]. Postoperative nausea and vomiting (10%) and respiratory complications (2.5%) were relatively uncommon, further strengthening the case for RA. The mean hospital stay was 4.2 days, aligning with prior studies that reported shorter stays in patients receiving RA compared to GA during the pandemic [22]. Mortality was very low (1.25%), likely attributable to careful patient selection, early surgical intervention, and avoidance of GA-related risks. Several international guidelines, including those from the World Health Organization (WHO) and the European Society of Anaesthesiology, have recommended RA as the preferred anesthetic technique during the COVID-19 era [23,24]. Our findings are in agreement, demonstrating high success rates, minimal conversions to GA, low complication rates, and favorable postoperative outcomes. An extensive multicenter study reported that RA reduced perioperative pulmonary complications and improved outcomes in COVID-19-positive surgical patients [25]. Additionally, a systematic review by El-Boghdadly et al. highlighted that avoiding intubation and extubation, both high-risk aerosol-generating procedures, significantly reduced perioperative viral exposure to healthcare workers [26]. This was also evident in our practice, where the majority of cases were completed without airway instrumentation.

Limitations of the study

The strengths of this study include its relatively large sample size from a COVID-dedicated center and comprehensive data on both intraoperative and postoperative outcomes. However, some limitations exist. First, the observational nature of the study precludes causal inference. Second, long-term outcomes, including persistent respiratory or neurological complications, were not assessed. Lastly, while RA was feasible in most surgeries, specific procedures with higher complexity or longer duration may still necessitate GA.

CONCLUSION

In summary, this study demonstrates that regional anesthesia is a safe, effective, and preferred anesthetic technique for surgical patients with COVID-19. It provides stable intraoperative conditions, excellent analgesia, minimal postoperative complications, and favorable recovery profiles, while reducing exposure risks for healthcare providers. These findings reinforce global recommendations advocating for the preferential use of RA during the COVID-19 pandemic.

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ORIGINAL ARTICLE

Role of Epidural Steroid Injection in Pain Reduction and Functional Recovery in Prolapsed Lumbar Intervertebral Disc (PLID)

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ABSTRACT

Introduction: *Prolapsed lumbar intervertebral disc (PLID) is a leading cause of low back pain and radiculopathy, significantly influencing patients' quality of life. ESIs reduce inflammation and nerve root irritation, offering short-term pain relief and improved mobility.* ***Methods & Materials:*** *This one-year retrospective study (January 2022–December 2023) at Gazi and Khulna Medical Colleges, Bangladesh, included 50 adults (20–60 years) with MRI-confirmed lumbar disc prolapse unresponsive to ≥4 weeks of conservative therapy. Patients received interlaminar or transforaminal epidural steroid injections. Pain (VAS), disability (ODI), complications, and satisfaction were evaluated at baseline, 1 week, 1 month, and 3 months.* ***Result:*** *The study included 50 patients with a mean age of 41.6 years; 56% were male, and 60% had sedentary occupations. The most common disc prolapse level was L4-L5 (56%), and protrusion was the predominant type (44%). Interlaminar ESI was most frequently used (60%) with methylprednisolone (64%), and 60% received a single injection. Significant reductions in pain and disability were observed, with VAS scores dropping from 7.6 to 2.8 and ODI scores from 58.2% to 24.3% at 3 months ($p<0.001$). Complications were minimal and mild, and 76% of participants reported excellent or good satisfaction following the intervention.* ***Conclusion:*** *Epidural steroid injections (ESIs) effectively manage prolapsed lumbar intervertebral disc (PLID) by providing significant pain relief and functional improvement. This study showed marked reductions in VAS and ODI scores, with minimal complications and high patient satisfaction, supporting ESIs as a safe, effective, and non-surgical treatment option for PLID.*

Keywords: *Epidural Steroid Injection (EPI), Pain Reduction, Functional Recovery and Prolapsed Lumbar Intervertebral Disc (PLID)*

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INTRODUCTION

Prolapsed lumbar intervertebral disc (PLID), commonly manifesting as lumbar radiculopathy ("sciatica"), is a leading cause of pain, disability, and health-care utilization worldwide. Low back pain (LBP), of which disc herniation is a frequent structural correlate, has been the top cause of years lived with disability for decades in the Global Burden of Disease (GBD) programme [1]. In 2017, point prevalence estimates suggested ~7.5% of the global population had LBP, equivalent to ~550–580 million people [1,2]. GBD 2019 further documented rising disability associated with LBP across regions, including South Asia, underscoring the scale of the problem and its economic impact through reduced productivity and work absence [3]. Within Bangladesh, nationally representative data identify LBP as the highest-ranked musculoskeletal disorder (18.6% prevalence in adults), highlighting substantial regional burden and the need for context-appropriate, cost-effective care pathways [4]. Epidural steroid injection (ESI) has been a mainstay non-surgical option for disc-related radiculopathy, intended to deliver corticosteroid and local anaesthetic near the inflamed nerve root to reduce neuroinflammation and facilitate functional recovery. Clinical guidelines in the United Kingdom (NICE NG59) recommend considering an epidural injection of local anaesthetic and steroid for adults with acute, severe sciatica, reflecting its role as a bridge between conservative

care and surgery in selected patients [5,6]. Nevertheless, the magnitude, durability, and predictors of benefit remain a topic of debate. Systematic reviews conducted between 2010 and 2022 generally agree that ESIs confer small to moderate short-term reductions in leg pain and disability compared with placebo, with diminishing effects beyond 3–6 months [7]. Similar conclusions were reported in an abridged Cochrane update and a plain-language Cochrane summary (2020), which judged the effects as modest and mainly short-term, with uncertainty about longer-term outcomes and safety due to the low quality of adverse-event data [8,9]. Randomized controlled trials (RCTs) provide complementary signals. A multicenter double-blind RCT comparing transforaminal ESI with gabapentin in lumbosacral radicular pain showed faster early relief with ESI, although differences narrowed over time [10]. Active-control trials and comparative analyses of caudal, interlaminar, and transforaminal approaches suggest broadly similar overall efficacy across routes, with some studies indicating potential advantages of steroids over anaesthetic alone for selected outcomes or time points [11]. Conversely, a BMJ RCT comparing caudal ESI with saline for chronic radiculopathy found no clinically significant long-term differences, highlighting heterogeneity due to chronicity, approach, and comparator [12]. Trials in lumbar spinal stenosis (distinct from PLID) have shown limited benefit, emphasizing the importance of diagnostic specificity when extrapolating evidence [13]. Clinically, even transient reductions in pain and disability can be valuable. Short-term relief enables earlier mobilization, increased rehabilitation engagement, and reduced analgesic requirements, and may even result in deferred or avoided surgery in some patients. Moreover, a substantial proportion of disc herniations undergo spontaneous resorption over months, so temporizing strategies that control pain while natural history unfolds may be rational [3]. However, key knowledge gaps persist. There is limited high-quality evidence on functional recovery trajectories (return to work, resumption of activity) beyond pain scores, especially in low- and middle-income countries (LMICs), such as Bangladesh. Fourth, predictors of response (e.g., symptom duration, sequestration vs protrusion, foraminal level, and precise injectate composition/dose) remain insufficiently defined for routine stratified care. Given the high global and regional PLID burden, the clinical salience of short-term improvement, and persistent uncertainty regarding functional recovery and context-specific outcomes, robust, locally generated evidence is warranted. This study aimed to assess the role of epidural steroid injections in pain reduction and functional recovery among patients with PLID in a tertiary care setting.

METHODS & MATERIALS

This retrospective observational study was conducted at the Department of Orthopaedics in Gazi Medical College and, Khulna Medical College, Khulna, Bangladesh, from January 2022 to December 2023. A total of 50 patients aged 20–60 years with clinically and MRI-confirmed lumbar disc prolapse were included. Patients with spinal infection, malignancy, fracture, coagulopathy, uncontrolled comorbidities, steroid hypersensitivity, or pregnancy were excluded. All patients underwent epidural steroid injections (interlaminar, or transforaminal) under aseptic precautions, using either Methylprednisolone acetate (40–80 mg) or Triamcinolone (40–80 mg) with lidocaine. Each patient received 1–2 injections apart based on symptoms. Pain was assessed using the Visual Analogue Scale (VAS) at baseline, 1 week, 1 month, and 3 months [17]. At the same time, functional disability was evaluated with the Oswestry Disability Index (ODI) at baseline, 1 month, and 3 months [18]. Patients were monitored for complications, and at 3 months, overall satisfaction and willingness to repeat the procedure were recorded.

Data were collected using a pre-designed data collection sheet. Data were entered into Microsoft Excel and analyzed using SPSS version 26.0. Numerical variables such as age, VAS, and ODI scores were expressed as mean ± standard deviation (SD). Categorical variables were expressed as frequencies and percentages. Changes in VAS and ODI scores over time were analyzed using repeated measures, such as ANOVA (for normally distributed data) or Friedman test (for non-parametric data). A p-value < 0.05 was considered statistically significant.

RESULT

The mean age of participants was 41.6 ± 9.3 years. Among them, 56% were male and 44% female. In terms of occupation, 60% had sedentary jobs, while 40% were engaged in manual labor. The mean BMI was 26.1 ± 2.8 kg/m^2. Regarding smoking status, 36% were smokers and 64% non-smokers. More than half of the patients (52%) had no comorbidities, while 24% had diabetes, 16% hypertension, and 8% other conditions. The duration of symptoms was less than 3 months in 24%, 3–6 months in 48%, and more than 6 months in 28% of cases. The side of pain was right in 40%, left in 36%, and bilateral in 24% of patients. [Table I]

Table – I: Demographic and Clinical Characteristics of the Study Participants (*n*=50)

Variable	Frequency (n)	Percentage (%)
	(Mean ± SD)	
Age (in years)	41.6 ± 9.3	
Sex		
Male	28	56.00
Female	22	44.00
Occupation		
Sedentary	30	60.00
Manual labor	20	40.00
BMI (kg/m^2)	26.1 ± 2.8	

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Smoking Status		
Smoker	18	36.00
Non-smoker	32	64.00
Comorbidities		
None	26	52.00
Diabetes	12	24.00
Hypertension	8	16.00
Others	4	8.00
Duration of Symptoms		
<3 months	12	24.00
3–6 months	24	48.00
>6 months	14	28.00
Side of Pain		
Left	18	36.00
Right	20	40.00
Bilateral	12	24.00

The most commonly affected disc level was L4–L5 (56%), followed by L5–S1 (36%), while 8% had involvement at other levels. Regarding the type of herniation, protrusion was most common (44%), followed by extrusion (36%), bulge (12%), and sequestration (8%). Associated spinal stenosis was present in 38% of patients, whereas 62% had no stenosis. [Table II]

Table – II: MRI and Diagnostic Findings of the Study Participants (*n*=50)

Category	Frequency (n)	Percentage (%)
Level of Disc Prolapse		
L4–L5	28	56.00
L5–S1	18	36.00
Other	4	8.00
Type of Disc Herniation		
Bulge	6	12.00
Protrusion	22	44.00
Extrusion	18	36.00
Sequestration	4	8.00
Associated Stenosis		
Yes	19	38.00
No	31	62.00

Among the participants, 60% received interlaminar and 40% received transforaminal epidural steroid injections. The most commonly used corticosteroid was methylprednisolone (64%), followed by dexamethasone (36%). A single injection was administered in 60% of patients, while 40% required two injections. [Table III]

Table – III: Details of Epidural Steroid Injection (ESI) among the Study Participants (*n*=50)

Category	Frequency (n)	Percentage (%)
Type of ESI		
Interlaminar	30	60.00
Transforaminal	20	40.00
Steroid Used		
Methylprednisolone	32	64.00
Dexamethasone	18	36.00
Number of Injections		
1	30	60.00
2	20	40.00

The mean VAS score significantly decreased following epidural steroid injection. The baseline mean VAS was 7.6 ± 1.2, which reduced to 4.1 ± 1.3 at 1 week ($p < 0.001$), 3.2 ± 1.1 at 1 month ($p < 0.001$), and 2.8 ± 1.0 at 3 months ($p < 0.001$). These findings indicate a sustained and statistically significant improvement in pain intensity over time after ESI. [Table IV]

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Table – IV: Comparison of Visual Analogue Scale (VAS) Scores before and After ESI

Time Point	Mean VAS Score ± SD	p-value (vs. Pre-ESI)
Before ESI	7.6 ± 1.2	-
1 week after ESI	4.1 ± 1.3	<0.001
1 month after ESI	3.2 ± 1.1	<0.001
3 months after ESI	2.8 ± 1.0	<0.001

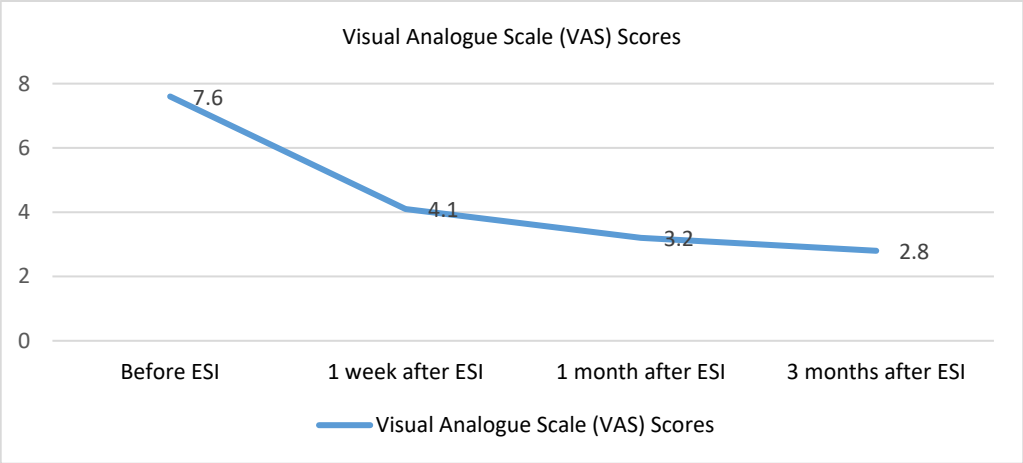

Figure – 1: Mean Comparison of Visual Analogue Scale (VAS) Scores before and After ESI

The mean Oswestry Disability Index (ODI) score showed a marked improvement following epidural steroid injection. The baseline mean ODI was 58.2 ± 10.4%, which significantly decreased to 32.6 ± 9.2% at 1 month ($p < 0.001$) and further to 24.3 ± 8.6% at 3 months ($p < 0.001$). This demonstrates a substantial and statistically significant reduction in functional disability over time after ESI. [Table V]

Table – V: Comparison of Oswestry Disability Index (ODI) Scores before and After ESI

Time Point	Mean ODI Score (%) ± SD	p-value (vs. Pre-ESI)
Before ESI	58.2 ± 10.4	–
1 month after ESI	32.6 ± 9.2	<0.001
3 months after ESI	24.3 ± 8.6	<0.001

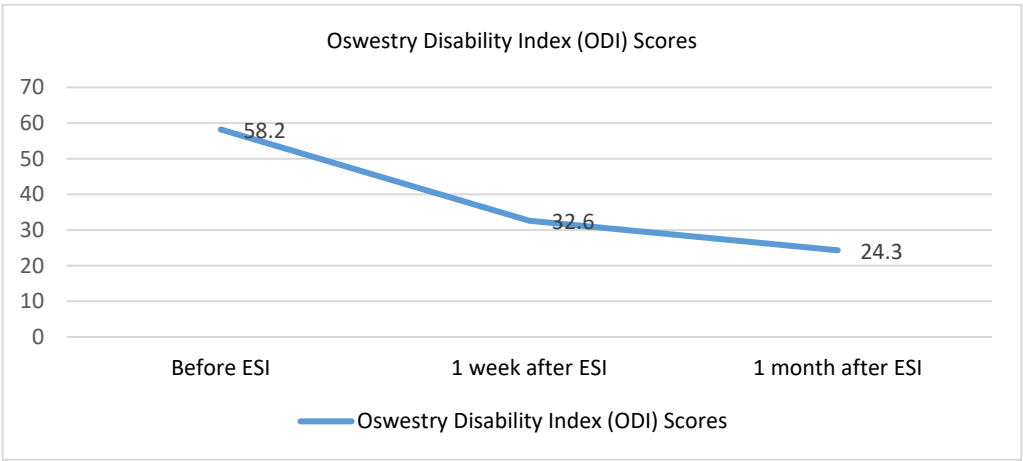

Figure – 2: Mean Comparison of Oswestry Disability Index (ODI) Scores before and After ESI

Postoperative complications were generally uncommon. Headache occurred in 6% of patients, infection and bleeding/hematoma each in 2%, and transient pain in 4%. No cases of neurological worsening were reported. [Table VI]

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Table – VI: Distribution of Complications Following Epidural Steroid Injection (*n*=50)

Complication Type	Frequency (n)	Percentage (%)
Headache	3	6.00
Infection	1	2.00
Neurological worsening	0	0.00
Bleeding/hematoma	1	2.00
Others (transient pain)	2	4.00

Most patients reported positive experiences, with 40% rating their satisfaction as excellent and 36% as good. Fair satisfaction was reported by 16%, while 8% rated their experience as poor. [Table VII]

Table – VII: Overall Satisfaction Level of the Study Participants Following ESI (*n*=50)

Overall Satisfaction	Frequency (n)	Percentage (%)
Excellent	20	40.00
Good	18	36.00
Fair	8	16.00
Poor	4	8.00

DISCUSSION

This study evaluated the role of epidural steroid injection (ESI) in the management of pain and functional impairment among patients with prolapsed lumbar intervertebral disc (PLID). The observed reduction in VAS and ODI scores in this study aligns with previous study findings, which indicate that ESIs provided significant pain relief in patients with lumbar disc herniation, particularly within the first three months of treatment [14]. Similarly, Manchikanti et al. (2014) demonstrated substantial improvements in pain and disability scores among patients receiving interlaminar and transforaminal ESIs, corroborating our results [15]. Consistent with our findings, a randomized controlled trial by Karppinen et al. (2016) demonstrated that ESI resulted in rapid short-term pain reduction and functional recovery in patients with lumbar disc herniation. However, the benefits tended to diminish beyond six months [16]. This transient nature of benefit was also noted in a systematic review, which concluded that ESIs were superior to placebo for short-term relief but did not significantly reduce long-term surgical rates [17]. The predominance of L4–L5 involvement in our study (56%) mirrors global epidemiological data. According to Weber et al. (2011), the L4–L5 level is the most common site of herniation due to high mobility and mechanical stress [18]. Similarly, a Bangladeshi cohort also found that the L4–L5 level was the most frequently affected [19]. Regarding the technique used, our findings show that the interlaminar approach was preferred (60%). This preference is consistent with worldwide clinical practice, as interlaminar injections are technically simpler and widely available compared to transforaminal injections. However, the transforaminal approach often provides superior pain relief due to targeted drug delivery to the affected nerve root [10]. Nevertheless, both techniques appear safe and effective when performed by experienced practitioners. Methylprednisolone was the most commonly used steroid (64%) in our study. Previous trials have found methylprednisolone to be highly effective, although dexamethasone and triamcinolone are also widely employed with comparable outcomes [21]. The choice of steroid may affect the duration of action; overall efficacy is primarily related to injection technique and patient selection [22]. In terms of safety, our study recorded mild complications, including headaches (6%) and transient pain (4%), with no severe adverse events. This finding aligns with those of Buenaventura et al. (2009), who reported low rates of significant complications, thereby reinforcing the safety of ESIs when administered appropriately [23]. However, rare but serious risks, such as infection, hematoma, or neurological injury, have been described in the literature, underscoring the importance of meticulous technique and patient selection [24]. Our results on functional recovery are comparable to those of Ghahreman et al. (2010), who reported marked improvement in ODI scores after ESIs for lumbar disc prolapse [25]. Similarly, significant short-term improvements in function, although the magnitude of the benefit decreased over time [26]. The durability of symptom relief, therefore, remains a debated issue. Still, surgical discectomy remains the gold standard for persistent or severe cases, as supported by the SPORT trial, which demonstrated superior long-term outcomes with surgery compared to non-operative management [27].

Limitations of the study:

The three-month follow-up, lack of a control group, and reliance on subjective measures (VAS, ODI) limit assessment of long-term effectiveness and the true impact of epidural steroid injection.

CONCLUSION AND RECOMMENDATION

Epidural steroid injections (ESIs) play a significant role in the conservative management of prolapsed lumbar intervertebral disc (PLID), offering substantial pain relief and functional recovery. This study demonstrated a marked reduction in VAS and ODI scores over 3 months, with minimal complications and high patient satisfaction. The interlaminar approach with methylprednisolone was most commonly used, showing consistent effectiveness across varied clinical profiles. Given their safety, efficacy, and patient acceptability, ESIs remain a valuable non-surgical option for PLID management. Further

long-term, randomized studies are warranted to optimize treatment protocols and assess sustained outcomes.

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ORIGINAL ARTICLE

Preoperative Risk Profile and Clinical Characteristics of Bangladeshi Patients Undergoing Isolated CABG

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ABSTRACT

Background: *Understanding the preoperative clinical profile of patients undergoing coronary artery bypass grafting (CABG) is essential for surgical planning and outcome prediction; however, population-specific data from Bangladesh are limited.* ***Objective:*** *This study aimed to describe the demographic, anthropometric, comorbidities, renal, and cardiac characteristics of Bangladeshi patients undergoing isolated CABG at a tertiary cardiac center.* ***Methods & Materials:*** *A comparative cross-sectional study was conducted at the National Heart Foundation Hospital and Research Institute in Dhaka between September 2020 and August 2022. Five hundred consecutive patients scheduled for isolated CABG were enrolled in this study. Data were collected from medical records and assessments using standardized forms. Descriptive statistics were performed using SPSS (version 26).* ***Results:*** *The mean age was 60.2 ± 7.5 years, with 81.8% male patients. Over half (51.6%) were overweight (BMI 23–27.5 kg/m^2), and hypertension (63.6%) and diabetes (44.2%) were the most common comorbidities. Normal renal function (serum creatinine < 1.4 mg/dL) was found in 91.2% of patients, with a mean creatinine clearance of 85.9 ± 13.4 mL/min. Most patients were NYHA class III (62%), with 70.6% having had a recent myocardial infarction and 77.6% showing an ejection fraction of 31–50%. Elective CABG comprised 75.4% of cases, while 1% were emergent.* ***Conclusion:*** *Bangladeshi CABG patients typically present as middle-aged males with high rates of hypertension, diabetes, and moderate ventricular dysfunction. Recognizing these preoperative characteristics is crucial for optimizing care and tailoring risk models for regional populations.*

Keywords: *Coronary artery bypass grafting, preoperative profile, cardiovascular risk factors.*

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INTRODUCTION

Coronary artery disease (CAD) remains one of the leading causes of morbidity and mortality globally and continues to impose a substantial health burden in low- and middle-income countries, including Bangladesh [1]. With increasing life expectancy and lifestyle-related risk factors, the prevalence of CAD in South Asia has risen sharply over the past two decades [2]. Coronary artery bypass grafting (CABG) is the most frequently performed cardiac surgery for patients with advanced CAD, aiming to restore myocardial perfusion and improve survival and quality of life [3]. The perioperative outcome of CABG, however, is influenced by a variety of preoperative factors, including demographic characteristics, comorbidities, renal function, cardiac status, and the urgency of surgery [4]. Understanding these preoperative variables is crucial for accurate risk stratification, perioperative planning, and prognostication.

Internationally, several risk scoring models such as the European System for Cardiac Operative Risk Evaluation (Euro

SCORE II) and the Society of Thoracic Surgeons (STS) risk score are routinely used to predict postoperative outcomes and mortality [5,6]. These tools were primarily developed using European and North American populations. Yet, significant ethnic, genetic, and healthcare delivery differences may affect the applicability of such models in South Asian populations [7]. In particular, Bangladeshi patients often present with distinctive clinical and metabolic characteristics, including a higher prevalence of diabetes, hypertension, and dyslipidemia at a relatively younger age compared to Western populations [8,9]. Therefore, the preoperative risk profile in Bangladesh may not mirror the populations from which conventional risk models were derived.

Despite the growing volume of cardiac surgery in Bangladesh, systematic analyses of preoperative characteristics of CABG patients are scarce. National Heart Foundation Hospital and Research Institute (NHFH & RI) in Dhaka performs one of the largest numbers of CABG surgeries in the country, yet comprehensive data describing patients' preoperative risk profiles remain limited. Establishing such baseline data is vital for benchmarking surgical outcomes, guiding local clinical protocols, and validating international risk assessment models for the Bangladeshi population [10].

Moreover, identifying prevalent comorbidities and functional impairments before surgery enables clinicians to optimize perioperative management. Renal dysfunction, diabetes, and left ventricular dysfunction have been consistently linked to poor surgical outcomes [11]. Similarly, the urgency of surgery — elective versus emergency — is a critical determinant of postoperative mortality [12]. Hence, a structured evaluation of preoperative parameters offers a foundation for individualized care and improved outcome prediction.

This study aimed to delineate the preoperative demographic, anthropometric, comorbidity, renal, and cardiac characteristics of Bangladeshi patients undergoing isolated CABG at a single tertiary cardiac center. The findings provide a population-specific insight into the clinical risk landscape preceding CABG, forming an essential evidence base for regional surgical risk assessment and performance benchmarking.

METHODS & MATERIALS

This comparative cross-sectional study was conducted at the Department of Cardiac Surgery, National Heart Foundation Hospital and Research Institute (NHFH & RI), Dhaka, Bangladesh. The study period spanned from September 2020 to August 2022. A total of 500 patients who underwent isolated coronary artery bypass grafting (CABG) during this time were included.

Sample Selection

Inclusion criteria:

- Patients admitted for isolated CABG at NHFH & RI.
- Willingness to participate and provide written informed consent.
- Age ≥18 years, irrespective of gender.

Exclusion criteria:

- Concomitant valvular or congenital heart diseases.
- Redo cardiac surgery cases.
- Patients with thromboembolic complications.

Data Collection and Study Procedure

Data were collected prospectively using a structured records form. Preoperative demographic details, comorbidities, laboratory results, echocardiographic parameters, and operative urgency were recorded from the patient files and verified by direct chart review. Euro SCORE II and STS datasheets were used as reference instruments for the standardized variable definitions. Renal function was evaluated through serum creatinine and creatinine clearance rate, while cardiac function was assessed via NYHA class, ejection fraction, and pulmonary artery pressure. All patients underwent CABG via median sternotomy using standard on-pump or off-pump techniques. Data accuracy and completeness were ensured by double-checking the entries after each case and verifying discrepancies against the source documents.

Ethical Consideration

Ethical clearance was obtained from the Institutional Review Board (IRB) of the NHFH & RI. Written informed consent was obtained from all participants. Confidentiality and anonymity were maintained throughout the research process, and the data were used solely for academic purposes.

Statistical Analysis

Data were analyzed using SPSS version 26.0. Categorical variables are presented as frequencies and percentages, and continuous variables as means ± standard deviations (SD). Statistical significance was set at $p < 0.05$. Descriptive statistics were used to summarize the preoperative characteristics of the study population.

RESULTS

Table – I: Baseline Characteristics of the Patients (*n*=500)

Variable	Category	Frequency	Percentage
Age group (years)	30-40	7	1.4
	41-50	44	8.8
	51-60	187	37.4
	61-70	250	50.0
	>70	12	2.4
	Mean ± SD	60.20 ± 7.46	
Sex	Male	409	81.8
	Female	91	18.2

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BMI (kg/m^2)	Underweight	10	2.0
	Normal	207	41.4
	Overweight	258	51.6
	Obese	25	5.0
	Mean ± SD	23.62 ± 1.49	

Table I shows the baseline characteristics of the patients. The mean age of all patients was 60.20±7.46 years (range: 34-72 years), with the majority belonging to 51-70 years of age (87.4%). A major part of the patients was male (81.8%) with a male: female ratio of 4.5:1. The mean BMI of all patients was 23.62±1.49 kg/m2. The maximum study patients were overweight (51.6%). 41.4% patients were of normal weight. Only 5% patients were obese.

Table – II: Comorbidities of study patients (*n*=500)

Comorbidities	Frequency	Percentage
Hypertension	318	63.6
Diabetes mellitus	221	44.2
Chronic lung disease	31	6.2
Cerebrovascular disease	13	2.6

Table II shows that hypertension (63.6%) and diabetes mellitus (44.2%) were the most common comorbidities among study patients.

Table – III: Renal function of study patients (*n*=500)

Variables		Frequency	Percentage
Creatinine clearance rate	>85 ml/min	353	70.6
	50-85 ml/min	120	24
	<50 ml/min	27	5.4
	Mean±SD	85.9±13.4	
Serum creatinine	>1.4 mg/dl	44	8.8
	<1.4 mg/dl	456	91.2
	Mean±SD	1.24±0.18	

Table III shows that the maximum study patients had normal kidney function with serum <1.4 mg/dL (91.2%) and creatinine clearance rate >85ml/min (70.6%).

Table – IV: Preoperative variables of the study patients (*n*=500)

Variables		Frequency	Percentage
NYHA classification	Grade I	74	14.8
	Grade II	103	20.6
	Grade III	310	62
	Grade IV	13	2.6
CCS class IV angina		20	4
Recent MI		353	70.6
Home oxygen		24	4.8
Previous cardiac intervention		31	6.2
Heart failure	Acute	194	38.8
	Chronic	50	10
	Both	3	0.6
	Arrythmia	17	3.4
Ejection fraction (%)	>50	87	17.4
	31-50	388	77.6
	<30	25	5
	Mean±SD	42.7±7.96	
Pulmonary hypertension	>30 mmHg	237	47.4
	<30 mmHg	263	52.6
	Mean±SD	31.4±6.10	

Table IV shows that the maximum study participants had NYHA grade III (62%) and acute (38.8%) heart failure. More than 70% had a recent MI. Besides, echocardiography showed that most patients had an ejection fraction of 31-50% (77.6%) and pulmonary hypertension <30 mmHg (52.6%).

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Table – V: Category of urgency of study patients (*n*=500)

Urgency	Frequency	Percentage
Elective	377	75.4
Urgent	118	23.6
Emergency	5	1
Salvage	0	0

Table V shows that most of the study patients had elective CABG (75.4%), while the rest had urgent (23.6%) or emergency (1%) CABG.

DISCUSSION

This study provides a comprehensive description of the preoperative risk profile and clinical characteristics of Bangladeshi patients undergoing isolated coronary artery bypass grafting (CABG) at a major tertiary cardiac center. The findings reflect the demographic and clinical attributes of a South Asian surgical population and highlight the predominance of modifiable cardiovascular risk factors such as hypertension, diabetes, and overweight status.

The mean age of the cohort (60 years) is comparable to that reported in regional studies from India and Pakistan, where CABG patients are typically a decade younger than their Western counterparts [13,14]. This observation underscores the earlier onset of severe coronary disease in South Asian populations, likely attributable to genetic predisposition, dietary habits, and clustering of metabolic risk factors such as hypertension and diabetes [2]. The male predominance (81.8%) found in this study aligns with international CABG registries, including those by Ranjan and Adhikary and Rahman et al., which reported male proportions exceeding 80% [4,10]. Although women represent a smaller proportion of surgical cases, previous research indicates that they often present later and with more comorbidities, which may influence postoperative outcomes [15].

More than half of the patients in this series were overweight, consistent with the "South Asian paradox," where individuals experience metabolic and cardiovascular complications at relatively low body mass index thresholds [16]. Obesity contributes to endothelial dysfunction and insulin resistance, potentiating hypertension and atherogenesis [17]. The high prevalence of hypertension (63.6%) and diabetes mellitus (44.2%) observed in this cohort mirrors national epidemiologic data that identify these conditions as the leading chronic diseases in Bangladesh [8]. These comorbidities have synergistic effects, increasing the risk of perioperative myocardial injury and long-term mortality after CABG [18].

Renal function analysis revealed that 91% of patients had normal serum creatinine levels, yet 24% had reduced creatinine clearance between 50–85 mL/min. Subclinical renal impairment has been recognized as an independent predictor of postoperative morbidity and mortality even in patients with apparently normal serum creatinine [11]. Therefore, early identification of renal compromise is essential for preoperative optimization and risk stratification. Similar distributions were documented in Indian and Algerian CABG cohorts, suggesting that moderate renal dysfunction is common among surgical candidates in resource-limited settings [12].

Cardiac functional parameters in this study revealed that 62% of patients presented with New York Heart Association (NYHA) class III symptoms and 70% had a recent myocardial infarction. These findings indicate that the majority were symptomatic and operated on after significant ischemic events, a pattern consistent with delayed referral and limited access to early revascularization in South Asia [19]. The mean ejection fraction fell predominantly within the 31–50% range, denoting moderate left ventricular dysfunction. Comparable rates have been reported by Boukhmis et al. in North African populations, reinforcing that reduced systolic function is a frequent preoperative feature in CABG patients [12].

Approximately three-quarters of operations were performed electively, while only 1% were emergent. The predominance of elective cases reflects a stable surgical population and adequate preoperative evaluation protocols at the study center. In contrast, Western series report higher proportions of urgent and emergent cases due to broader indications for early surgical intervention [20]. A higher elective-to-urgent ratio, as observed here, may contribute to the relatively low mortality reported in this study (1.4%).

Collectively, these results depict a patient population characterized by middle age, male predominance, and a high burden of metabolic comorbidities but relatively preserved renal and ventricular function. Such a profile has implications for risk-scoring systems like Euro SCORE II and STS, which were calibrated using Western data. The overlap of moderate risk factors and younger age may lead to under- or overestimation of predicted mortality if unadjusted for ethnic differences [5]. Therefore, future research should integrate these baseline characteristics into localized validation of risk prediction models.

The study contributes valuable epidemiologic insight into CABG practice in Bangladesh, establishing foundational data for regional cardiac surgery registries. It emphasizes the importance of aggressive risk-factor management—particularly hypertension, diabetes, and obesity—in the preoperative phase to improve outcomes.

Limitations of the study

This study was conducted at a single tertiary center using a purposive sample of patients undergoing isolated CABG, which may limit its generalizability to all cardiac surgical populations in Bangladesh. The analysis was descriptive and did not explore the associations between risk factors and outcomes.

Conclusion

The present study demonstrates that Bangladeshi CABG patients are predominantly middle-aged, male, and overweight, with hypertension and diabetes being the most prevalent comorbidities. Most patients exhibit moderate left ventricular dysfunction but preserved renal function and undergo elective procedures. These findings establish the baseline clinical profile of CABG candidates in Bangladesh and underscore the need for targeted preoperative optimization and local calibration of international risk prediction models to enhance perioperative care and outcomes.

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Conflicts of interest

There are no conflicts of interest.

Ethical approval

The study was approved by the Institutional Ethics Committee.

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ORIGINAL ARTICLE

Phacoemulsification In Eyes with High and Normal Axial Length – A Study of 100 Cases

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ABSTRACT

Background: *Axial length plays a critical role in cataract surgery outcomes. Patients with high axial length are often at increased risk of intraoperative complications and suboptimal visual recovery. This study aimed to evaluate the intraoperative complications of cataract surgery with phacoemulsification in eyes with high and normal axial length.* ***Methods & Materials:*** *A total of 100 cataract patients were divided into two groups: Group I (normal axial length, 21–24.5 mm) and Group II (high axial length, ≥26 mm), with 50 patients in each group. Data on age, gender, occupation, axial length, intraoperative complications, refractive error, and visual acuity on the first postoperative day and after six weeks were collected and analyzed.* ***Results:*** *The majority of patients were aged 61–80 years (55%) and male (66%). Group I had a mean axial length of 22.95 ± 0.90 mm, while Group II had a significantly longer mean of 27.76 ± 1.10 mm ($p < 0.05$). Intraoperative complications were more frequent in Group II (6.00%) compared to Group I (4.00%), with posterior capsule tear being significantly higher in the high axial length group ($p = 0.03$). Refractive status differed significantly between the groups, with Group II showing higher degrees of myopia ($p < 0.05$). Postoperative visual acuity was better in Group I at both the 1st POD and 6-week follow-up, with more patients achieving 6/6–6/9 vision compared to Group II.* ***Conclusion:*** *Patients with high axial length undergoing phacoemulsification are more prone to intraoperative complications and demonstrate poorer visual and refractive outcomes compared to those with normal axial length. Proper preoperative assessment and surgical precautions are essential to optimize outcomes in high axial length eyes.*

Keywords: *Phacoemulsification, Axial length, Cataract surgery, Visual acuity, Refractive status*

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INTRODUCTION

Cataract surgery is among the most frequently performed procedures in ophthalmology and remains a key strategy in combating preventable blindness. Cataract is recognized as the leading cause of blindness and visual impairment worldwide, and its prevalence is expected to rise with the aging global population[1-5]. Over recent years, patient expectations have grown considerably due to the advent of advanced surgical tools and techniques. While modern cataract surgeries generally yield excellent outcomes, both patients and surgeons often have low tolerance for even minor complications[5-7].

The two primary surgical approaches to cataract removal are extracapsular cataract extraction and phacoemulsification. Phacoemulsification utilizes an ultrasonically driven tip to break up the cataractous lens, which is then aspirated. An intraocular lens (IOL) made from biocompatible material is subsequently implanted into the lens capsule to replace the removed natural lens[8]. Achieving a state of emmetropia, where the image of a distant object is sharply focused on the retina without corrective lenses, is the desired outcome. To reach this goal, various formulas have been developed over the past few decades to calculate the appropriate IOL power. These formulas fall into two main categories: theoretical models based on geometric optics of the eye, and empirical or regression models derived from data analysis of eyes that underwent IOL implantation[8].

Cataract surgery in patients with high myopia presents unique challenges[6,7]. Anticipating and managing potential complications is crucial for achieving favorable outcomes. IOL

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implantation in such cases can offer a significant refractive benefit, often surpassing the results obtained through glasses, contact lenses, or corneal refractive surgeries. However, intraoperative complications may compromise these benefits. In some difficult cases, implanting a posterior chamber IOL within the capsular bag may not be possible. Placing an IOL outside the bag, or improperly positioning it, can lead to suboptimal visual results. The introduction of the Kelman phacoemulsification technique marked a significant advancement in cataract surgery, revolutionizing the field[5, 9-11].

Despite being a technically demanding procedure requiring significant skill and experience, phacoemulsification has become the standard of care due to its many advantages. These include a smaller, sutureless incision, reduced surgically induced astigmatism, faster postoperative recovery, fewer follow-up visits, and decreased postoperative inflammation[12–15]. However, certain complications, such as vitreous loss or nucleus drop, can drastically impact surgical outcomes and require prompt, skilled management. Surgeons' experience, early recognition of complications, and effective intraoperative decision-making are critical to ensuring favorable results[5,16].

Several studies have also identified specific preoperative and intraoperative risk factors that may contribute to endothelial cell density (ECD) loss during phacoemulsification. These include Nucleus Opalescence (NO), phaco time and energy, anterior chamber depth (ACD), axial length (AL), irrigation turbulence, and mechanical trauma from surgical instruments[17,18]. Assessing these parameters preoperatively is essential for surgical planning and complication prevention. Notably, a shallow ACD and short AL reduce the available working space during surgery, increasing the risk of thermal or mechanical damage to the corneal endothelium. While some studies have downplayed the significance of ACD in endothelial cell loss after surgery, it remains an important consideration in the overall surgical strategy[19-21].

In the present study, we aimed to evaluate the intraoperative complications of cataract surgery with phacoemulsification in eyes with high and normal axial length.

METHODS & MATERIALS

This comparative observational study was conducted in the Department of Ophthalmology, National Institute of Ophthalmology and Hospital, Dhaka, Bangladesh, from January 2013 to June 2013. In this study, 100 cataract patients attending the National Institute of Ophthalmology and Hospital were included. The patients were divided into two groups based on axial length.

Group I: Cataract patients with normal axial length (21 mm to 24.5 mm)

Group II: Cataract patients with high axial length (26 mm or more)

These were the following criteria for eligibility as study participants:

Inclusion Criteria:

- Patients with normal axial length between 21 mm and 24.5 mm
- Patients with axial length equal to or greater than 26 mm
- Patients with age-related cataract of nuclear grading II and III
- Patients of both sexes

Exclusion Criteria:

- Patients with a history of ocular surgery or ocular trauma
- Patients with known corneal curvature abnormalities or any vision-threatening ocular condition (e.g., glaucoma, age-related macular degeneration [ARMD], diabetic retinopathy)
- Patients currently using topical eye drops or systemic medications for other diseases
- Patients who were unwilling to participate in the study.

Data Collection Procedure: A total of 100 cataract patients were selected for the study from the Cataract Department of the National Institute of Ophthalmology and Hospital, Dhaka. Patient selection was based on a provisional diagnosis established through detailed history-taking and thorough clinical examination. All necessary preoperative investigations were conducted before surgical intervention. Written informed consent was obtained from each participant.

A total of 100 eyes with age-related cataracts of the same nuclear grade (Grade II and III) were included. All surgeries were performed at the same center by a single experienced surgeon to maintain consistency in surgical technique.

Preoperative axial length measurements were obtained using both contact and immersion A-scan biometry methods. Based on axial length, patients were divided into two groups:

- Group I: Patients with normal axial length (21 mm to 24.5 mm)
- Group II: Patients with high axial length (26 mm or more)

For intraocular lens (IOL) power calculation, the SRK-T formula was used in Group I, while the Holladay formula was applied for Group II. All surgeries were performed under peribulbar anesthesia using a standardized technique. A self-sealing, near-clear corneal uniplanar incision measuring 2.8 mm was made using a keratome, starting at the center of the vascular arcade. A side-port incision was created at the 2 o'clock position or 70–90 degrees away from the main incision using a 1.2 mm side-port knife. The keratome blade was oriented parallel to the iris, introduced into the anterior chamber at an angle of approximately 10 degrees to the iris plane in one continuous, smooth motion. Phacoemulsification was performed using a modified stop-and-chop step-down nucleofractis technique. A foldable intraocular lens was implanted into the capsular bag in all cases.

Statistical Analysis: All data were recorded systematically in a pre-formatted data collection form. Quantitative data were expressed as mean and standard deviation, and qualitative

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data were expressed as frequency distribution and percentage. The data were analyzed using the chi-square test. An unpaired t-test was used to compare the mean axial lengths between the two groups, and to compare the difference in refractive status. A p-value <0.05 was considered significant. Statistical analysis was performed by using SPSS 19 (Statistical Package for Social Sciences) for Windows version 10. This study was ethically approved by the Institutional Review Committee of the National Institute of Ophthalmology and Hospital.

RESULTS

Table – I: Demographic characteristics of study participants

Age group	Number (n)	Percentage (%)
40-60 years	22	22.0
61-80 years	55	55.0
>80 years	23	23.0
Mean age (years)	65±8.65	
Gender		
Male	66	66.0
Female	34	34.0
Occupation		
Service	47	47.0
Housewife	33	33.0
Teacher	17	17.0
Others	3	3.0

Table I presents the demographic profile of the study participants. A total of 100 individuals were included in the study. The majority of participants (55%) were in the age group of 61–80 years, followed by 23% above 80 years, and 22% between 40–60 years. Regarding gender distribution, 66% of the participants were male, while 34% were female. In terms of occupation, the highest proportion of participants were service holders (47%), followed by housewives (33%), teachers (17%), and a small percentage (3%) involved in other professions.

Table – II: Comparison of Age and Gender Distribution Between Cataract Patients With Normal and High Axial Length

Age group	Group-I *n*=50	Group-II *n*=50
40-60 years	10(10.0%)	12(12.0%)
61-80 years	26(26.0%)	29(29.0%)
>80 years	14(14.0%)	09(9.0%)
Mean age (years)	65±8.65	
Sex group		
Male	32(32.0%)	34(34.0%)
Female	18(18.0%)	16(16.0%)

Group I: Cataract patients having normal axial length, 21mm to 24.5mm, Group II: Cataract patients having high axial length, 26mm or more.

In Table II, the majority of participants in both groups belonged to the 61–80 years category: 26 (26.0%) in Group I and 29 (29.0%) in Group II. The 40–60 years age group comprised 10 (10.0%) patients in Group I and 12 (12.0%) in Group II, while the >80 years group had 14 (14.0%) in Group I and 9 (9.0%) in Group II. The mean age in Group I was 65 ± 8.65 years; the mean age for Group II was not reported. Regarding gender distribution, males constituted the majority in both groups, 32 (32.0%) in Group I and 34 (34.0%) in Group II, while females accounted for 18 (18.0%) and 16 (16.0%), respectively.

Table – III: Distribution of Axial length of the study population (*n*=100)

Axial length in mm	Group-I	Group-II
21.00-24.50	50(50.00%)	0
26.00-30.00	0	50(50.00%)
Mean±SD	22.95±0.90	27.76±1.10
t=2.634; p<0.05		

Table III shows the mean axial length in both groups. In Group I (patients with normal axial length), the mean axial length was 22.95 ± 0.90 mm, while in Group II (patients with longer axial length), the mean was 27.76 ± 1.10 mm. The difference between the two groups was statistically significant as determined by an unpaired t-test (t = 2.634, p < 0.05).

Table – IV: Intraoperative complications of the study population

Intraoperative Complications	Group I (n = 50)	Group II (n = 50)	P-value
Posterior capsule tear	01 (2.00%)	02 (4.00%)	0.03
Nucleus drop	0	0	
Vitreous loss	01 (2.00%)	01 (2.00%)	
Total complications	02 (4.00%)	03 (6.00%)	

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Table IV shows that in Group I, 1 patient (2.00%) experienced a posterior capsule tear, and 1 patient (2.00%) had vitreous loss, with no cases of nucleus drop, resulting in a total of 2 complications (4.00%). In Group II, 2 patients (4.00%) had posterior capsule tears, and 1 patient (2.00%) had vitreous loss, also with no cases of nucleus drop, totaling 3 complications (6.00%). The overall number of intraoperative complications was slightly higher in Group II. However, the p-value reported (p = 0.03) indicates a statistically significant difference, indicating that patients with high axial length have a higher risk of complications.

Table – V: Postoperative refractive status of the study population

Group-I, N=50		Group-II, N=50	
Refractive Status(Dsph)	No	Refractive Status (Dsph)	No
Emmetropia	26(52.00%)	Emmetropia	05(10.00%)
−0.25−0.50	14(28.00%)	−0.25−0.50	07(14.00%)
0.50−0.75	06(12.00%)	-0.50−0.75	22(44.00%)
−1.00 or less	04(8.00%)	−1.00 or less	16(32.00%)
t=1.121; p<0.05			

Table V shows that the distribution of refractive status (in diopters spherical, Dsph) varied significantly between the two groups. In Group I (patients with normal axial length), the majority of participants (26; 52.0%) had emmetropia, followed by 14 (28.0%) with mild myopia (-0.25 to -0.50 D), 6 (12.0%) with mild hyperopia (0.50 to 0.75 D), and 4 (8.0%) with moderate myopia (-1.00 D or less). In contrast, Group II (patients with high axial length) had a markedly different distribution. Only 5 (10.0%) had emmetropia, while the majority had varying degrees of myopia: 7 (14.0%) with mild myopia (-0.25 to -0.50 D), 22 (44.0%) with moderate myopia (-0.50 to -0.75 D), and 16 (32.0%) with high myopia (-1.00 D or less). The difference in refractive status between the two groups was statistically significant, with an unpaired t-test result t = 1.121; p < 0.05.

Table – VI: Postoperative Visual Acuity of the study population

Group-I, N=50			Group-II, N=50		
Visual acuity	No		Visual acuity	No	
	1st POD	after 6wks		1st POD	after 6wks
6/6-6/9	24(48.00%)	30(60.00%)	6/6-6/9	08(16.00%)	12(24.00%)
6/12-6/18	14(28.00%)	24(48.00%)	6/12-6/18	20(40.00%)	22(44.00%)
6/18-6/36	12(24.00%)	18(36.00%)	6/18-6/36	22(44.00%)	26(32.00%)

Table VI compares the visual acuity of cataract patients in Group I (normal axial length) and Group II (high axial length) at the 1st postoperative day (POD) and 6 weeks after surgery. In Group I, visual acuity showed improvement over time. On the 1st POD, 24 patients (48.0%) had visual acuity between 6/6–6/9, which increased to 30 patients (60.0%) after 6 weeks. Visual acuity of 6/12–6/18 was observed in 14 patients (28.0%) on the 1st POD and increased to 24 (48.0%) after 6 weeks. Those with poorer visual acuity (6/18–6/36) decreased from 12 (24.0%) initially to 18 (36.0%) after 6 weeks. In Group II, outcomes were less favorable. Only 8 patients (16.0%) had visual acuity of 6/6–6/9 on the 1st POD, increasing modestly to 12 patients (24.0%) at 6 weeks. A larger proportion of patients had 6/12–6/18 vision: 20 (40.0%) on the 1st POD and 22 (44.0%) after 6 weeks. Patients with 6/18–6/36 vision made up the highest group: 22 (44.0%) on the 1st POD and 26 (52.0%) after 6 weeks.

DISCUSSION

This study aimed to evaluate and compare the intraoperative complications, refractive outcomes, and postoperative visual acuity following phacoemulsification in patients with normal and high axial lengths. A total of 100 patients were included, with 50 patients each in Group I (normal axial length: 21–24.5 mm) and Group II (high axial length: ≥26 mm). Our results demonstrated important differences between the two groups in terms of axial length, refractive status, intraoperative complications, and visual outcomes.

The mean age of participants was 65 ± 8.65 years, with the majority falling within the 61–80 years age group (55%). There was a male predominance in both groups (66%). These demographic findings are consistent with previous studies, indicating that older age and male sex are common among cataract patients.

This study found a statistically significant difference in the mean axial length between the two groups. Group I had a mean axial length of 22.95 ± 0.90 mm, while Group II had a significantly higher mean of 27.76 ± 1.10 mm (t = 2.634, p < 0.05). These results are comparable to those reported in a study conducted at the Isfahan Eye Research Centre, which showed a mean axial length of 22.95 ± 0.83 mm in the normal group and 27.83 ± 1.82 mm in the high axial length group[2].

Intraoperative complications were generally low across both groups, but were slightly higher in the high axial length group. In Group I, two cases (4.00%) were reported, consisting of one posterior capsule rupture and one vitreous loss. Group II reported three complications (6.00%)—two posterior capsule ruptures and one vitreous loss. Although this difference was

not statistically significant ($p > 0.05$), it aligns with findings from Fesharaki and Peyman et al., who also reported increased intraoperative risks in eyes with longer axial lengths[5].

The Isfahan study similarly demonstrated higher complication rates in the high axial length group, with 18 cases of posterior capsular rupture (2.5%) and 16 cases of vitreous loss (2.3%) versus lower rates in the normal group[2]. Interestingly, that study also reported instances of IOL dislocation into the anterior chamber in both groups, which was not observed in our cohort. This may reflect differences in surgical technique or surgeon expertise.

Our results also support the findings by Fesharaki and Peyman, who identified age and axial length as significant risk factors for intraoperative complications. According to their analysis, each 1-year increase in age raised the risk by 1.04-fold ($p = 0.03$), and each 1 mm increase in axial length raised the risk by 1.22-fold ($p = 0.007$)[5]. They also found no significant relationship between axial length and vitreous loss, but did report a positive correlation between longer axial lengths and increased rates of posterior capsule rupture and dropped nucleus.

We observed no cases of globe perforation during peribulbar anesthesia in either group, whereas Modarres M reported an 8% perforation rate during retrobulbar anesthesia in myopic eyes.[22] The absence of this complication in our study might be attributed to the careful use of the peribulbar technique and experienced hands. Our rate of vitreous loss was lower than that reported by Alldredge CD et al., who found a 7% rate of vitreous loss[3]. This could be due to more advanced surgical techniques and timely intraoperative interventions in our setting. Although Jeff NS and Desai P et al. reported higher complication rates, especially in eyes with long axial lengths[23,24], our study outcomes were more favorable, possibly due to better surgical equipment and technique, including the phacoemulsification method, and surgeon proficiency.

Refractive outcomes also differed significantly between groups. In Group II, 38 individuals had a postoperative refractive error of less than -0.75 D, while only 10 patients in Group I fell into this category. This indicates better refractive outcomes in the normal axial length group, a statistically significant difference ($p < 0.05$). The study findings are supported by studies from Kora Y and Buratto L, which also demonstrated less favorable refractive outcomes in highly myopic eyes following cataract surgery[25,26].

Regarding intraocular lens (IOL) power calculations, our study utilized the SRK II formula for normal axial lengths and the Holladay formula for high axial lengths. This approach aligns with findings by Chang DF and Tan JJ, who reported better accuracy of the SRK II formula for normal axial lengths and recommended the Holladay formula for longer eyes[27].

Postoperative visual acuity also favored Group I. On the first postoperative day, 24 patients (48.00%) in Group I had visual acuity between 6/6 and 6/9, increasing to 30 (60.00%) by six weeks. In contrast, only 8 patients (16.00%) in Group II achieved 6/6–6/9 vision on the first day, rising to just 12 (24.00%) at six weeks. Poorer vision (6/18–6/36) was more frequent in Group II both immediately and after six weeks. These outcomes suggest that normal axial length eyes generally experience faster and better visual recovery compared to those with high axial lengths.

The broader literature confirms that high myopia is associated with degenerative changes such as chorioretinal degeneration and higher risks of retinal detachment (RD) and glaucoma [28]. These comorbidities can negatively influence visual recovery after cataract surgery. Studies such as those by Lim LH and Lee SY identified chorioretinal degeneration, axial length, and age as major predictors of poor postoperative vision in highly myopic eyes[29,30]. In this study, none of the eyes experienced nucleus drop or IOL dislocation, and complications were managed effectively. The lower complication rates, particularly in Group I, may be attributed to the use of advanced phacoemulsification technology, surgical expertise, and preoperative planning.

Limitations of the study

This study has several limitations. First, the sample size was relatively small, with only 50 patients in each group, which may limit the generalizability of the results. Second, the timeframe allocated for data collection was relatively short about the study's scope, which posed a constraint on the depth and breadth of data that could be gathered. Lastly, there is a notable lack of similar studies conducted within Bangladesh, and the limited availability of relevant local literature made it challenging to compare or contextualize the findings within the national framework.

Conclusion and recommendations

The findings of this study suggest that cataract patients with high axial length are at a greater risk for intraoperative complications, particularly posterior capsule tears, compared to those with normal axial length. Refractive status also differed significantly, with high axial length patients showing a higher prevalence of myopia. Postoperative visual acuity outcomes were generally more favorable in patients with normal axial length, indicating better visual recovery. These results emphasize the need for heightened surgical caution and careful preoperative assessment in patients with elongated axial lengths. Incorporating biometric parameters into surgical planning may improve safety and optimize outcomes for this specific group of patients.

Further study with a prospective and longitudinal study design, including a larger sample size, needs to be done to validate the findings of this study.

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ORIGINAL ARTICLE

Association between Elevated HbA1c Levels and Risk of Trigger Finger in Diabetic Patients

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ABSTRACT

Background: *Diabetes mellitus is a chronic metabolic disorder that not only causes vascular complications but is also associated with musculoskeletal manifestations such as trigger finger, which are often underrecognized. The purpose of the study was to assess the association between elevated HbA1c levels and the risk of developing trigger finger among diabetic patients.* ***Aim of the study:*** *The aim of the study was to assess the association between elevated HbA1c levels and the risk of developing trigger finger among diabetic patients.* ***Methods & Materials:*** *A cross-sectional study at the Medicine Outpatient Department of BIRDEM General Hospital, Dhaka, Bangladesh (Nov 2018–Apr 2019) included 354 type 2 diabetic patients with hand complaints, and demographic and clinical data were collected to assess associations with trigger finger using SPSS and chi-square tests (P < 0.05).* ***Results:*** *Among 354 diabetic patients, trigger finger affected 177 (50%). Age and sex were similar between groups, while diabetes duration >5 years was higher in trigger finger patients (114, 64.4% vs 91, 51.4%; P = 0.018). Hypertension was present in 122 (68.9%) trigger finger patients. HbA1c >6.5% was seen in 122 (68.9%) with trigger finger and 119 (67.2%) without (P = 0.733), showing no significant association.*

Conclusion: *Trigger finger is the most common hand complication in diabetic patients, associated with longer diabetes duration but not with elevated HbA1c levels.*

Keywords: *HbA1c, Trigger Finger, Diabetes Mellitus*

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INTRODUCTION

Diabetes mellitus, regardless of its type, is widely recognized as a chronic metabolic condition that leads to multiple microvascular and macrovascular complications[1]. These complications are well-documented and routinely monitored in clinical practice. Maintaining good glycemic control plays a crucial role in minimizing the onset and progression of microvascular complications such as diabetic retinopathy, nephropathy, and neuropathy[2]. The global prevalence of diabetes continues to increase steadily, contributing substantially to long-term health burdens and diminished quality of life among affected populations[3].

In addition to vascular complications, there is growing recognition of musculoskeletal manifestations associated with diabetes[4]. Several epidemiological investigations have demonstrated links between type 1 and type 2 diabetes, as well as obesity, and various fibroproliferative musculoskeletal disorders of the upper limb that typically present with limited joint mobility[5]. Among these, trigger finger is a frequently encountered and often distressing condition of the hand. It is considered part of the spectrum of diabetic hand disorders, along with limited joint mobility (LJM) and Dupuytren's contracture[6-8]. Diabetes has been identified as an important risk factor for the development of trigger finger, and previous studies have associated this condition with the broader clinical entity referred to as "the diabetic hand," which also encompasses carpal tunnel syndrome, ulnar nerve entrapment, and Dupuytren's disease[9-12].

Stenosing flexor tenosynovitis (FTS), commonly known as trigger finger[13], is characterized by impaired gliding of the

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flexor tendons through the pulley system of the hand, leading to finger locking during flexion. The occurrence of trigger finger is notably higher among individuals with diabetes, affecting up to 20% of diabetic patients compared to only 1%–2% in the general population[14,15]. Moreover, diabetic patients tend to exhibit a higher disease prevalence and poorer therapeutic response. Glycated hemoglobin (HbA1c) serves as a reliable biomarker reflecting average blood glucose levels over approximately three months and is widely used to assess long-term glycemic control[16,17]. Elevated HbA1c levels have been shown to predict the risk of diabetic complications. Although previous research has suggested a possible relationship between poor glycemic control and the development of trigger finger, findings remain inconclusive, and the extent of this association continues to be debated[18].

Despite growing recognition of diabetic hand disorders, the relationship between glycemic control and specific hand complications such as trigger finger remains insufficiently explored. Previous studies have yielded inconsistent findings regarding the role of elevated HbA1c levels in the development of trigger finger, and data from South Asian populations, particularly Bangladesh, are limited. Understanding this association is essential for early identification and prevention of musculoskeletal complications in diabetes. Therefore, the purpose of the study was to assess the association between elevated HbA1c levels and the risk of developing trigger finger among diabetic patients.

Objective

- To assess the association between elevated HbA1c levels and the risk of developing trigger finger among diabetic patients.

METHODS & MATERIALS

This cross-sectional observational study was conducted at the Medicine Outpatient Department of BIRDEM General Hospital, Dhaka, Bangladesh, from November 2018 to April 2019. A total of 354 patients with type 2 diabetes mellitus presenting with hand complaints were included. Participants were selected using purposive convenient sampling based on predefined inclusion and exclusion criteria.

- **Inclusion Criteria:**
- Adults aged 41–70 years with type 2 diabetes mellitus and hand complaints
- Both male and female patients
- Patients willing to participate

Exclusion Criteria:

- Patients who underwent surgery during the study period
- Pregnant women
- Severely ill patients
- Known cases of hypothyroidism
- Patients with connective tissue disorders
- Patients with chronic liver disease
- History of antiepileptic drug use
- Patients who did not provide written informed consent

Diabetes status was confirmed using fasting plasma glucose, 2-hour oral glucose tolerance test (OGTT), or HbA1c ≥6.5%. Trigger finger was diagnosed clinically based on impaired finger movement and tenderness at the A1 pulley. Following written informed consent, demographic and clinical data—including age, sex, duration of diabetes, hand complications, hypertension, and HbA1c levels—were collected through patient interviews and review of medical records.

Ethical considerations, including patient confidentiality and informed consent, were strictly maintained throughout the study. Data were analyzed using SPSS software, with categorical variables presented as frequencies and percentages, and continuous variables as means ± standard deviations. Associations between variables were assessed using the chi-square test, with $P < 0.05$ considered statistically significant.

RESULTS

Table – I: Distribution of Hand Complications among Study Participants (*n* = 354)

Hand Complications	Frequency	Percentage (%)
Diabetic cheiroarthropathy	28	7.9
Trigger finger	177	50.0
Carpal tunnel syndrome	57	16.1
De Quervain's tenosynovitis	56	15.8
Diabetic neuropathy (peripheral)	23	6.5
Non-specific tenosynovitis	9	2.5
Nodal osteoarthritis	4	1.1

Trigger finger was the most prevalent, observed in 177 patients (50.0%), followed by carpal tunnel syndrome in 57 patients (16.1%) and De Quervain's tenosynovitis in 56 patients (15.8%). Other less common complications included diabetic cheiroarthropathy in 28 patients (7.9%), diabetic neuropathy (peripheral) in 23 patients (6.5%), non-specific tenosynovitis in 9 patients (2.5%), and nodal osteoarthritis in 4 patients (1.1%).

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Table – II: Demographic and Clinical Comparison of Patients with and without Trigger Finger (*n* = 354)

Variable		Trigger Finger (n = 177)	Other than Trigger Finger (n = 177)	P value
Age (years)	Mean ± SD	55.92 ± 8.47	57.04 ± 7.61	0.190
	Range	41–70	41–69	
Sex	Male	65 (36.72%)	67 (37.85%)	0.827
	Female	112 (63.28%)	110 (62.15%)	
Duration of DM	≤ 5 years	63 (35.59%)	86 (48.59%)	0.018
	> 5 years	114 (64.41%)	91 (51.41%)	

Table II compares key characteristics between patients with trigger finger and those with other hand conditions. The mean age was similar between groups (55.92 ± 8.47 vs 57.04 ± 7.61 years; P = 0.190). Sex distribution was also comparable (36.72% males vs 37.85%; P = 0.827). Duration of diabetes differed significantly, with a higher proportion of trigger finger patients having diabetes for more than 5 years (64.41% vs 51.41%; P = 0.018).

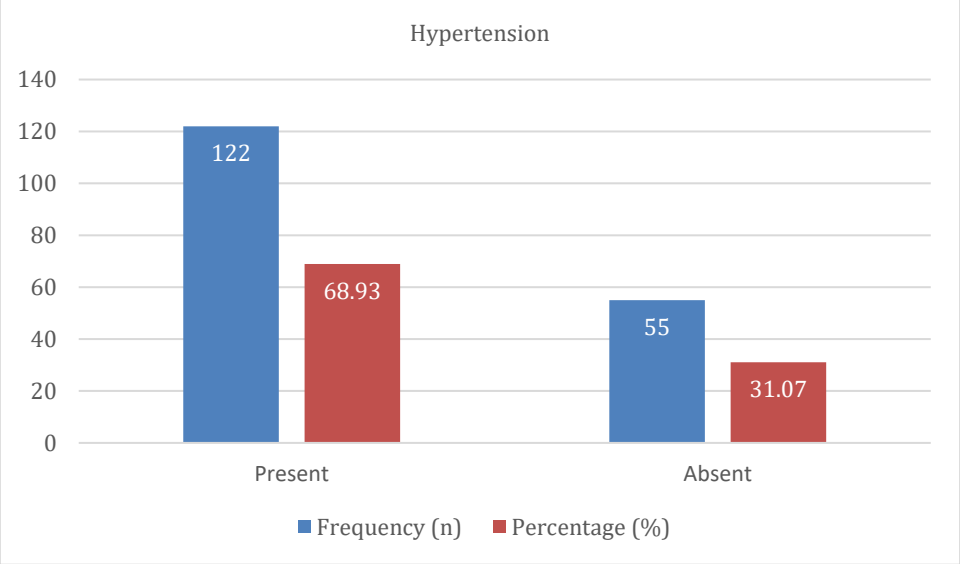

Figure 1: Hypertension Status among Patients with Trigger Finger (*n*=177)

Figure 1 illustrates the prevalence of hypertension among patients with trigger finger. Of the 177 patients, 122 (68.93%) had hypertension, while 55 (31.07%) did not.

Table – III: Comparative Distribution of HbA1c Levels among Patients with and without Trigger Finger (*n* = 354)

Variable		Trigger Finger (n = 177)	Other than Trigger Finger (n = 177)	P value
HbA1c level	≤ 6.5%	55 (31.07%)	58 (32.77%)	0.733
	> 6.5%	122 (68.93%)	119 (67.23%)	

Table III shows the distribution of HbA1c levels between patients with trigger finger and those with other hand conditions. Among trigger finger patients, 55 (31.07%) had HbA1c ≤ 6.5%, while 122 (68.93%) had HbA1c > 6.5%. In the non-trigger finger group, 58 patients (32.77%) had HbA1c ≤ 6.5% and 119 (67.23%) had HbA1c > 6.5%. The difference was not statistically significant (P = 0.733).

DISCUSSION

Trigger finger, characterized by impaired gliding of the flexor tendons through the A1 pulley, emerged as the most prevalent hand disorder in this study, followed by carpal tunnel syndrome and De Quervain's tenosynovitis. These findings underscore the multifactorial nature of trigger finger development, with longer duration of diabetes and coexisting hypertension identified as notable contributing factors. The high prevalence highlights the importance of early recognition and timely management to prevent functional impairment and enhance quality of life among diabetic patients.

In this cohort, trigger finger was observed in 177 patients (50.0%), followed by carpal tunnel syndrome (16.1%) and De Quervain's tenosynovitis (15.8%). These results align with previous research demonstrating heightened susceptibility of diabetic patients to musculoskeletal hand disorders. Kuczmarski et al.[19] reported that trigger finger prevalence in diabetic populations ranges from 5% to 20%, substantially higher than in non-diabetic individuals. Similarly, Dong et al.[20] found that carpal tunnel syndrome affects

approximately 14% of type 2 diabetic patients, closely mirroring the 16.1% observed in our study. Hassan et al.[21] also reported an elevated risk of De Quervain's tenosynovitis among diabetic patients, particularly with advancing age. Collectively, these findings reinforce that diabetes significantly predisposes individuals to a spectrum of hand complications, with trigger finger being the predominant manifestation.

The demographic and clinical analysis revealed that mean age and sex distribution were comparable between patients with and without trigger finger, suggesting that these factors were not significantly associated with the condition in this cohort. However, the duration of diabetes differed significantly, with 64.41% of trigger finger patients having diabetes for more than five years compared to 51.41% in the non-trigger finger group (P = 0.018). These observations are consistent with Sarkar et al.[22], who reported that over half (56.31%) of patients with trigger finger had diabetes, with nearly equal sex distribution. Kuczmarski et al.[19] also highlighted that trigger finger occurs at a markedly higher rate in diabetic patients compared to non-diabetic populations, emphasizing the influence of prolonged diabetes on musculoskeletal complications and the need for early monitoring and intervention.

A substantial proportion of patients with trigger finger (68.93%) had hypertension, whereas 31.07% did not. This aligns with previous studies indicating a notable prevalence of hypertension among individuals with diabetic hand disorders. Mustafa et al.[23] reported a significant association between hypertension and diabetic cheiroarthropathy, while Shayea et al.[24] observed that 26% of trigger finger patients had hypertension, highlighting the potential role of systemic vascular factors in the development or progression of musculoskeletal complications in diabetes.

Regarding glycemic control, most patients with trigger finger had HbA1c levels >6.5%, while fewer had HbA1c ≤6.5%. Although this difference was not statistically significant, the high prevalence of elevated HbA1c is consistent with prior studies suggesting a potential link between poor glycemic control and flexor tendon pathology. Rydberg et al.[10] found that higher HbA1c levels increased the risk of developing trigger finger in both type 1 and type 2 diabetes, indicating that chronic hyperglycemia may predispose to tendon complications. Similarly, Vance et al.[18] reported an association between elevated HbA1c and flexor tendon disorders, including trigger finger. These findings collectively suggest that glycemic control may influence the risk of musculoskeletal complications in diabetes, even though this study did not demonstrate a statistically significant association.

Limitations of the study

All study participants were recruited from a single tertiary care center specialized in diabetes management; therefore, the findings may not fully represent the overall diabetic population in Bangladesh.

Conclusion

Trigger finger was the most common hand complication among diabetic patients, and a longer duration of diabetes was associated with its development. Hypertension was frequently observed in these patients. However, elevated HbA1c levels were not significantly associated with the occurrence of trigger finger, suggesting that poor glycemic control alone may not directly increase its risk.

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ORIGINAL ARTICLE

Comparative Evaluation of Ketamine–Propofol versus Ketamine–Diazepam for Total Intravenous Anesthesia in ERAS-Guided Day Case Surgery

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ABSTRACT

Introduction: *ERAS protocols in day-case surgeries reduce stress and promote faster recovery. TIVA is favored for its controllable depth and quick emergence. This study compares ketamine–propofol and ketamine–diazepam anesthesia regarding perioperative stability and recovery outcomes in ERAS-guided day-case surgeries.* ***Methods & Materials:*** *This one-year prospective comparative study (July 2024–June 2025) at Gazi Medical College, Khulna, included 60 adults undergoing ERAS-guided day-case surgery. Patients were randomized into two groups: Group A (Ketamine + Propofol) and Group B (Ketamine + Diazepam). Perioperative parameters, recovery, PONV, pain, complications, and hospital stay were analyzed using SPSS v26.0, with $p < 0.05$ considered significant.* ***Results:*** *Both groups were comparable in demographics, ASA status, types of surgery, and intraoperative parameters. Group A (ketamine–propofol) demonstrated significantly better hemodynamic stability, smoother recovery from anesthesia, and a lower incidence of PONV ($p < 0.05$). Recovery was faster in Group A, with earlier oral intake and ambulation, shorter PACU stay, and reduced hospital stay (all $p < 0.001$). Intraoperative complications were also lower in Group A.* ***Conclusion:*** *The study concludes that the ketamine–propofol combination offers superior recovery outcomes compared to ketamine–diazepam for total intravenous anaesthesia in ERAS-guided day-case surgeries. It provides better postoperative analgesia, reduces PONV, and ensures smoother and faster recovery without compromising hemodynamic stability. This regimen aligns well with ERAS principles, making it a more effective choice for ambulatory anesthesia.*

Keywords: *Total Intravenous Anesthesia (TIVA), Enhanced Recovery after Surgery (ERAS), Day Case Surgery*

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INTRODUCTION

Enhanced Recovery after Surgery (ERAS) protocols have transformed perioperative care by emphasizing evidence-based strategies to minimize surgical stress, reduce complications, and accelerate recovery. A key component of ERAS is the optimization of anesthesia techniques to improve postoperative outcomes, reduce opioid consumption, and enhance patient satisfaction [1,2]. Traditionally, balanced anesthesia has relied heavily on inhalational agents and opioids. However, opioid-related adverse effects, including postoperative nausea and vomiting (PONV), delayed gastrointestinal recovery, and the risk of dependence, have spurred interest in alternative anesthetic approaches [3,4]. Total Intravenous Anesthesia (TIVA) with propofol, often combined with adjunct agents such as dexmedetomidine or ketamine, has emerged as a promising strategy to meet ERAS objectives across various surgical specialties. Propofol is widely favored in modern anesthesia because of its favorable pharmacokinetics, rapid onset, and smooth recovery profile. Compared with volatile anesthetics, propofol-based TIVA is associated with a lower incidence of PONV, improved hemodynamic stability, and reduced environmental contamination [5,6]. Furthermore, propofol's antiemetic and anxiolytic properties make it particularly suitable for short-duration ambulatory procedures, which align closely with ERAS principles emphasizing early mobilization and discharge

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[7]. Nevertheless, propofol alone lacks sufficient analgesic potency, necessitating the use of adjunct agents to ensure adequate intraoperative and postoperative pain control. Dexmedetomidine, a highly selective α2-adrenergic agonist, has gained popularity as an adjunct to TIVA owing to its sedative, anxiolytic, and opioid-sparing effects [8]. It provides stable hemodynamics, attenuates stress responses, and enhances patient comfort, making it particularly valuable in ERAS-based anesthesia protocols [9]. Ketamine, an N-methyl-D-aspartate (NMDA) receptor antagonist, is another effective adjunct. At sub-anesthetic doses, it provides analgesia, attenuates central sensitization, and reduces postoperative opioid requirements without causing significant psychomimetic effects [10,11]. In Bangladesh, where dexmedetomidine availability is limited, ketamine is widely used as an alternative adjunct [12]. The combination of propofol with ketamine thus offers a balanced anesthetic regimen with favorable recovery outcomes. Several comparative studies have highlighted the benefits of TIVA in the ERAS setting. A meta-analysis reported that propofol-based TIVA significantly reduced PONV and facilitated faster recovery compared with inhalational anesthesia [13]. Additionally, propofol use has been associated with improved perioperative analgesia, lower opioid consumption, and smooth and quick recovery after surgery [14]. Similarly, ketamine as an adjunct enhances hemodynamic stability, reduces hyperalgesia, and provides prolonged analgesia, particularly in ambulatory and day-care surgeries [15,16]. Collectively, these findings underscore the potential of TIVA regimens to advance ERAS goals. In the Asian clinical context, where resource limitations and high surgical workloads necessitate efficient recovery pathways, ERAS implementation is increasingly recognized as a strategy to optimize perioperative care [17]. However, limited regional data exist on the comparative outcomes of TIVA with propofol and adjuncts versus conventional anesthesia (ketamine plus diazepam) under ERAS frameworks. Most available evidence originates from high-income countries and may not directly apply to local practice due to differences in patient demographics, healthcare infrastructure, and anesthetic resources [18,19]. This gap highlights the need for context-specific research to evaluate the feasibility and effectiveness of TIVA regimens in improving recovery outcomes for Bangladeshi patients. Day case surgeries, including dilatation and curettage (D&C), breast lump excision, endoscopy, and minor urological or orthopaedic procedures, represent a large proportion of elective surgical cases in Bangladesh. Although these procedures are relatively low risk, they still require optimal anesthetic strategies to minimize perioperative morbidity and maximize efficiency. Employing propofol-based TIVA with ketamine in such surgeries may reduce additional anesthetic exposure, facilitate faster recovery, and improve patient satisfaction, consistent with ERAS principles [20]. Therefore, the study aimed to compare the efficacy, hemodynamic stability, recovery, and postoperative outcomes of Ketamine–Propofol and Ketamine–Diazepam total intravenous anesthesia (TIVA) regimens in adult patients undergoing ERAS-guided day-case surgeries.

METHODS & MATERIALS

This prospective, comparative study was conducted at the Department of Anesthesiology, Gazi Medical College, Khulna, Bangladesh, from July 2024 to June 2025. After obtaining informed written consent and completing pre-anesthetic evaluation, 60 adult patients (≥18 years) scheduled for elective day case surgeries including dilatation and curettage (D&C), minor orthopedic procedures, breast or cyst excision/biopsy, endoscopy, herniotomy, circumcision, cystoscopy, and urethral dilatation were included. Patients with ASA physical status IV or higher, known hypersensitivity to study drugs, pregnancy, or inability to provide consent were excluded. Participants were randomly allocated to Group A (Ketamine–Propofol) or Group B (Ketamine–Diazepam) using a computer-generated randomization table. In Group A, anesthesia was induced with IV ketamine 2 mg/kg and propofol 2 mg/kg intravenously, with supplemental doses administered as necessary to maintain adequate anesthesia. Group B received IV ketamine 2 mg/kg and diazepam 0.2 mg/kg, with additional intraoperative doses administered as required.

Complete general anesthesia preparation was ensured, with all emergency airway equipment and essential drugs kept ready. All procedures adhered to Enhanced Recovery After Surgery (ERAS) protocols. Preoperative measures included minimal fasting and carbohydrate loading 2 hours before surgery. Intraoperative management utilized a multimodal anesthetic approach to minimize opioid consumption and maintain hemodynamic stability. Postoperatively, patients were encouraged to have early oral intake and ambulation to expedite recovery. Standard intraoperative monitoring comprised continuous assessment of heart rate, non-invasive blood pressure, respiratory rate, oxygen saturation, urine output, and core body temperature, recorded using a G3L Patient Monitor (Shenzhen General Meditech Inc., China). Hemodynamic parameters were documented at baseline, induction, every 5 minutes intraoperatively, and at the conclusion of surgery.

Preoperative data included demographics, comorbidities, ASA status, and surgical type. Intraoperative parameters assessed were hemodynamic stability, duration of surgery and anesthesia, blood loss, and fluid administration. Postoperative outcomes included Visual Analogue Scale (VAS) pain scores at 1, 6, and 12 hours, requirement for rescue analgesia, incidence of postoperative nausea and vomiting (PONV), time to first oral intake, time to ambulation, length of Post-Anesthesia Care Unit (PACU) stay using Aldrete score, and total hospital stay.

Data were analyzed using SPSS version 26.0. Continuous variables were expressed as mean ± standard deviation and compared using independent t-tests or Mann–Whitney U tests, as appropriate. Categorical variables were summarized as frequencies and percentages and analyzed using Chi-square or Fisher's exact tests. A p-value <0.05 was considered statistically significant.

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RESULTS

The demographic characteristics were comparable between the two groups, with no statistically significant differences observed. The mean age was similar (39.5 ± 12.4 years in Group A vs. 40.8 ± 11.9 years in Group B; p = 0.72), and the gender distribution was balanced (male: 63.33% vs. 60.0%; p = 0.78). Both groups had comparable BMI (23.8 ± 3.1 vs. 24.1 ± 3.4; p = 0.81). The majority of patients in both groups were ASA I–II (90.0% in Group A vs. 86.67% in Group B; p = 0.69), with a small proportion classified as ASA III. [Table I]

Table – I: Demographic Characteristics of Study Participants (*n*=60)

Variable	Group A (n=30)	Group B (n=30)	p-value
Age (years), mean ± SD	39.5 ± 12.4	40.8 ± 11.9	0.72
Sex, n (%)			
Male	19 (63.33%)	18 (60.0%)	0.78
Female	11 (36.67%)	12 (40.0%)	
BMI (kg/m^2), mean ± SD	23.8 ± 3.1	24.1 ± 3.4	0.81
ASA I–II, n (%)	27 (90.0%)	26 (86.67%)	0.69
ASA III, n (%)	3 (10.0%)	4 (13.3%)	

Both groups had comparable representation across gynecological, orthopedic, general, and urological procedures, ensuring balance in surgical case mix. The mean surgical duration was nearly equivalent (72.5 ± 18.4 minutes in Group A vs. 74.6 ± 19.1 minutes in Group B; p = 0.67), as was the duration of anesthesia (88.2 ± 20.7 vs. 91.3 ± 21.9 minutes; p = 0.58). [Table II]

Table – II: Surgical and Anesthesia Details

Variable	Group A (n=30)	Group B (n=30)	p-value
Surgical Procedure, n (%)			
Dilatation and curettage (D&C)	5 (16.67%)	6 (20.00%)	0.72
Short orthopedic procedures (dislocation, closed reduction)	5 (16.67%)	5 (16.67%)	1.00
Cervical cyst removal	3 (10.0%)	2 (6.67%)	0.64
Breast lump excision/biopsy	5 (16.67%)	3 (10.0%)	0.69
Diagnostic or therapeutic endoscopy	3 (10.0%)	4 (13.33%)	0.72
Herniotomy	3 (10.0%)	4 (13.33%)	0.72
Circumcision	3 (10.0%)	3 (10.0%)	1.00
Cystoscopy	2 (6.67%)	2 (6.67%)	1.00
Urethral dilatation	1 (3.33%)	1 (3.3%)	1.00
Surgical Duration (min), mean ± SD	72.5 ± 18.4	74.6 ± 19.1	0.67
Anaesthesia Duration (min), mean ± SD	88.2 ± 20.7	91.3 ± 21.9	0.58

Hemodynamic stability was achieved in the majority of patients, though Group A showed a higher proportion of stable cases (90.0% vs. 76.67%; p = 0.16). Intraoperative complications occurred infrequently and at similar rates (6.67% in Group A vs. 13.33% in Group B; p = 0.39). Mean blood loss (110 ± 35 ml vs. 120 ± 40 ml; p = 0.33) and fluid administration (950 ± 210 ml vs. 1010 ± 230 ml; p = 0.41) were also comparable. [Table III]

Table – III: Intraoperative Outcomes of both Groups

Variable	Group A (n=30)	Group B (n=30)	p-value
Hemodynamic Stability, n (%)			
Stable	27 (90.0%)	23 (76.67%)	0.16
Unstable	3 (10.0%)	7 (23.33%)	
Intraoperative Complications, n (%)	2 (6.67%)	4 (13.33%)	0.39
Blood Loss (ml), mean ± SD	110 ± 35	120 ± 40	0.33
Fluids Administered (ml), mean ± SD	950 ± 210	1010 ± 230	0.41

Postoperative outcomes showed significant advantages in Group A compared to Group B. Pain scores were consistently lower in Group A at 1 hour (2.4 ± 1.0 vs. 3.9 ± 1.2; p < 0.001), 6 hours (2.1 ± 0.9 vs. 3.4 ± 1.1; p < 0.001), and 12 hours (1.6 ± 0.8 vs. 2.5 ± 1.0; p = 0.002). Fewer patients in Group A required rescue analgesia (16.67% vs. 43.33%; p = 0.04). The incidence of PONV was also lower in Group A, with 80.0% experiencing no PONV compared to 50.0% in Group B (p = 0.03). Recovery parameters were notably better in Group A, including shorter times to first oral intake (6.1 ± 1.8 vs. 9.3 ± 2.2 hours; p < 0.001) and ambulation (7.5 ± 2.0 vs. 11.2 ± 2.6 hours; p < 0.001). Length of PACU stay (2.3 ± 0.9 vs. 3.4 ± 1.1 hours; p < 0.001) and hospital stay (2.1 ± 0.8 vs. 3.2 ± 1.0 days; p < 0.001) were also significantly reduced in Group A. Although postoperative complications were slightly more frequent in Group B, the differences were not statistically significant. [Table IV]

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Table – IV: Postoperative Outcomes of both Groups

Variable	Group A (n=30)	Group B (n=30)	p-value
Pain Score (VAS)			
At 1 hr, mean ± SD	2.4 ± 1.0	3.9 ± 1.2	<0.001*
At 6 hrs, mean ± SD	2.1 ± 0.9	3.4 ± 1.1	<0.001*
At 12 hrs, mean ± SD	1.6 ± 0.8	2.5 ± 1.0	0.002*
Rescue Analgesia Required, n (%)	5 (16.67%)	13 (43.33%)	0.04*
PONV, n (%)			
None	24 (80.0%)	15 (50.0%)	0.03*
Mild	5 (16.67%)	9 (30.0%)	
Moderate	1 (3.33%)	5 (16.67%)	
Severe	0	1 (3.33%)	
Time to First Oral Intake (hrs), mean ± SD	6.1 ± 1.8	9.3 ± 2.2	<0.001*
Time to Ambulation (hrs), mean ± SD	7.5 ± 2.0	11.2 ± 2.6	<0.001*
Length of PACU Stay (hrs), mean ± SD	2.3 ± 0.9	3.4 ± 1.1	<0.001*
Length of Hospital Stay (days), mean ± SD	2.1 ± 0.8	3.2 ± 1.0	<0.001*
Postoperative Complications, n (%)			
Minor	2 (6.67%)	5 (16.67%)	0.18
Major	0 (0.0%)	1 (3.33%)	

DISCUSSION

This study demonstrated that a propofol-based TIVA with ketamine (Group A) provided a smoother recovery profile than ketamine–diazepam regimen (Group B) for day-case surgeries under an ERAS protocol. Key findings included numerically greater intraoperative hemodynamic stability in Group A, along with significantly reduced postoperative pain, lower rescue analgesic requirements, a diminished incidence of PONV, and faster achievement of recovery milestones (oral intake, ambulation, and discharge readiness) compared to Group B. These results are largely consistent with recent literature, which has increasingly highlighted the benefits of TIVA (especially propofol–ketamine combinations) over traditional anesthetic techniques in terms of hemodynamics, analgesia, PONV reduction, and rapid recovery. Group A had a higher proportion of patients maintaining stable blood pressure and heart rate intraoperatively (90% vs 76.7% in Group B), although this difference was not statistically significant. This trend aligns with evidence that adding ketamine to propofol can buffer hemodynamic depression. Ketamine's sympathomimetic action tends to counteract propofol-induced hypotension [21]. A recent randomized trial comparing propofol–ketamine admixtures found that a 1:1 ketamine/propofol ratio significantly reduced the incidence of post-induction hypotension (12% vs 35%) and vasopressor requirements versus a propofol-heavy 1:3 mixture [22]. Similarly, a meta-analysis of "Ketofol" for sedation reported a lower risk of hypotension with propofol–ketamine combinations than with propofol alone [23]. In our study, intraoperative adverse events were rare and comparable between groups (6.7% vs 13.3%). Large-scale analyses indicate no significant differences in overall intraoperative complication rates or mean arterial pressure when comparing TIVA to inhalational anesthesia, aside from heart rate control [24]. Notably, a retrospective study in orthognathic surgery found TIVA stabilized hemodynamics during emergence better than volatile anesthesia [25]. The enhanced cardiovascular stability with propofol–ketamine may be especially valuable in high-risk patients, as it mitigates peri-induction hypotension without compromising anesthesia depth [21-23]. Propofol's vasodilatory effect is well documented; however, when balanced with adjunct agents (such as ketamine), it ensures controlled anesthesia with minimal sympathetic stimulation compared to ketamine, which can cause tachycardia and hypertension due to sympathomimetic activity [26,27]. Thus, our results support the evidence that propofol-based TIVA with ketamine may be more favorable in maintaining perioperative hemodynamic stability, thereby contributing to enhanced recovery outcomes. Recovery parameters, including time to oral intake and ambulation, were significantly shorter in the TIVA group. Pain control was significantly better in Group A, with lower pain scores at all time points and fewer patients needing rescue opioids. This aligns with studies showing that propofol-based anesthesia provides modest analgesic benefits and reduces opioid use compared to inhalational agents [28]. Ketamine's NMDA antagonism further enhances analgesia, and propofol TIVA is associated with lower pain scores and morphine use than sevoflurane [29,30]. Although some studies note only modest effects, the consistent opioid-sparing benefits of propofol–ketamine regimens likely contributed to Group A's reduced PONV [28-30]. One of the most significant advantages of propofol–ketamine TIVA was the reduction in PONV: only 20% of Group A patients experienced nausea/vomiting, compared to 50% in Group B. This aligns with evidence that propofol markedly decreases PONV relative to volatile or benzodiazepine-based anesthesia [24,25,31]. A 2025 systematic review reported that inhalational anesthesia more than doubled the risk of PONV compared to TIVA [24]. Similarly, in orthognathic surgery, TIVA reduced nausea/vomiting rates, partly due to reduced fentanyl requirements [25]. Our Group B likely had more PONV due to higher opioid use and the absence of propofol's antiemetic effect. These results reinforce guidelines recommending TIVA for high-risk PONV patients [31]. Enhanced recovery was a hallmark of Group A's outcomes. Patients in the propofol–ketamine group achieved oral intake

and ambulation 3–4 hours earlier than Group B, and their PACU and hospital stays were significantly shorter. This reflects propofol's rapid clearance and ketamine's analgesic effect, which facilitated early mobilization without the need for prolonged sedation. In contrast, diazepam in Group B likely delayed psychomotor recovery. Meta-analyses consistently show propofol anesthesia shortens recovery compared to benzodiazepines [32,33]. For example, propofol sedation has been shown to significantly reduce recovery times compared to midazolam in bronchoscopy [32]. In ERAS pathways, early feeding and ambulation reduce complications and length of stay [1]. Our findings confirm that propofol–ketamine TIVA synergizes with ERAS principles, enabling safe, earlier discharge and smoother recovery.

Limitations of the study: The present study is limited by its modest sample size and single-center design, which may restrict the generalizability of the results. Furthermore, although short-term outcomes such as pain, postoperative nausea and vomiting (PONV), and recovery milestones showed significant improvement with TIVA, long-term parameters, including chronic pain, functional recovery, and cost-effectiveness, were not evaluated. The absence of blinding also introduced potential bias in subjective outcomes such as pain and PONV.

CONCLUSION

This study concludes that the ketamine–propofol combination provides superior anesthetic performance compared to ketamine–diazepam for total intravenous anesthesia in ERAS-guided day-case surgeries. Both regimens offered comparable intraoperative stability and safety. However, the ketamine–propofol group demonstrated significantly better postoperative outcomes, including lower pain scores, reduced need for rescue analgesia, decreased incidence of PONV, and faster recovery milestones such as oral intake, ambulation, and discharge. The propofol–ketamine synergy ensured balanced anesthesia with minimal hemodynamic fluctuation and enhanced recovery, aligning well with ERAS principles. Therefore, ketamine–propofol appears to be a more effective and recovery-friendly option for ambulatory surgical anesthesia.

RECOMMENDATION

Based on the findings, the ketamine–propofol combination is recommended as a preferred total intravenous anesthetic regimen for ERAS-guided day-case surgeries. Its superior postoperative analgesia, lower incidence of PONV, and faster recovery support its routine use in ambulatory surgical settings. Future research with larger, multicenter trials is advised to validate these results across diverse surgical populations and to optimize dosing ratios for maximal hemodynamic stability and recovery efficiency. Additionally, integrating ketamine–propofol TIVA into standardized ERAS protocols may further enhance patient outcomes and promote early discharge without compromising safety or comfort.

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ORIGINAL ARTICLE

Pregnancy Outcome in Women with and without Diabetes Mellitus – A Comparative Study

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ABSTRACT

Background: *Diabetes during pregnancy, both gestational and pre-existing, is an increasing concern in South Asia, linked to higher risks of preeclampsia, cesarean delivery, macrosomia, and neonatal hypoglycemia. This study compared maternal and neonatal outcomes between diabetic and non-diabetic pregnancies in a tertiary hospital.* ***Methods & Materials:*** *This comparative cross-sectional study was carried out in the Department of Gynecology and Obstetrics, Gazi Medical College Hospital, Khulna, Bangladesh, from January to December 2024. A total of 320 pregnant women (160 with diabetes and 160 without) were enrolled to compare maternal and neonatal outcomes. Participants were ≥28 weeks gestation with singleton pregnancies. Data on demographics, antenatal complications, delivery, and neonatal outcomes were collected using a structured questionnaire. Gestational diabetes was diagnosed per IADPSG/WHO 2013 criteria, and analyses were performed using SPSS v26.0.* ***Results:*** *Among 320 pregnant women, most diabetics had gestational diabetes diagnosed at 26 weeks, with 70% achieving good glycemic control. Diabetic mothers showed higher rates of polyhydramnios, caesarean delivery, macrosomia, and shoulder dystocia. Their infants had greater birthweight, more hypoglycaemia, NICU admissions, and longer hospital stays. Adverse maternal (21.3% vs. 11.3%) and neonatal (36.3% vs. 21.3%) outcomes were significantly higher in diabetics. Diabetes, maternal age ≥35 years, and hypertension independently predicted poor outcomes.* ***Conclusion:*** *This study found that diabetes during pregnancy, whether gestational or pre-existing, significantly increases the risk of adverse maternal and neonatal outcomes, including hypertension, cesarean delivery, macrosomia, and neonatal hypoglycemia. Even with reasonable glycemic control, complications remained more common among diabetic mothers than non-diabetic ones.*

Keywords: *Gestational Diabetes Mellitus (GDM), Pregnancy Complications, Maternal and Neonatal Outcomes*

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INTRODUCTION

Diabetes mellitus in pregnancy, encompassing both pre-existing diabetes and gestational diabetes mellitus (GDM), represents a growing global health challenge. Approximately 16–17% of pregnancies worldwide are affected by hyperglycemia in pregnancy, accounting for more than 21 million live births in 2013 [1]. The prevalence of GDM has risen sharply in recent decades, driven by global increases in obesity, sedentary lifestyles, and type 2 diabetes [2]. More than 90% of cases occur in low- and middle-income countries, emphasizing the disproportionate burden faced by these regions [1,3]. In South Asia, the prevalence of GDM is among the highest globally, ranging between 10% and 25% depending on diagnostic criteria [2,4]. South Asian women exhibit heightened genetic and metabolic susceptibility to GDM, often developing glucose intolerance at lower body mass indices than women of European descent [5]. In Bangladesh, a study found the overall prevalence of GDM was 35% [6]. The burden is significant; recent meta-analyses estimate the pooled prevalence of GDM at approximately 13% (95% CI: 7–21%) [7]. This increasing prevalence, coupled with limited healthcare resources, underscores the urgent need to address the maternal and neonatal consequences of diabetes in pregnancy. Global initiatives, such as the International Federation of Gynecology

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and Obstetrics (FIGO) 2015 guidelines, highlight GDM as a major contributor to adverse pregnancy outcomes and advocate for universal screening and context-specific management [8]. However, applying these recommendations in resource-constrained settings like Bangladesh requires local evidence on the impact of diabetes on pregnancy outcomes. GDM and pre-existing diabetes substantially increase maternal and perinatal morbidity and mortality. Maternal complications such as preeclampsia, gestational hypertension, polyhydramnios, and infections occur more frequently in diabetic pregnancies [9]. A meta-analysis of South Asian data found a strong association between GDM and hypertensive disorders of pregnancy and cesarean delivery [10]. Neonatal outcomes are similarly affected. Maternal hyperglycemia promotes fetal hyperinsulinemia, leading to macrosomia, birth trauma, and shoulder dystocia [11,12]. GDM has also been associated with low birth weight and preterm birth in some South Asian populations, reflecting variations in glycemic control and care access [10]. Moreover, diabetic pregnancies are linked with stillbirths, perinatal mortality, and higher neonatal intensive care unit (NICU) admissions [13]. Infants of diabetic mothers are at increased risk for hypoglycemia, respiratory distress, and jaundice due to metabolic maladaptation [14]. Poor glycemic control in early pregnancy increases the likelihood of congenital anomalies, particularly in women with pre-gestational diabetes [15]. Treatment and glycemic optimization significantly reduce complications. A meta-analysis demonstrated that management of even mild GDM lowered risks of macrosomia, shoulder dystocia, hypertensive disorders, and cesarean delivery [16]. However, residual neonatal risks persist, emphasizing the importance of close monitoring and postpartum follow-up [16]. Beyond pregnancy, women with GDM are seven to ten times more likely to develop type 2 diabetes later in life. At the same time, their offspring face increased risks of obesity and metabolic syndrome, perpetuating an intergenerational cycle of diabetes [17]. Thus, early identification and intervention during pregnancy have profound long-term implications for maternal and child health. Despite growing recognition of GDM as a public health issue, data from low-income countries, particularly Bangladesh, remain scarce. The 2021 regional review by Mistry et al. highlighted significant heterogeneity and data gaps in South Asian studies, including inconsistent definitions of GDM, varying diagnostic criteria, and incomplete outcome reporting [10]. Furthermore, local evidence comparing maternal and neonatal outcomes in diabetic versus non-diabetic pregnancies is inadequate. Given the rising prevalence of diabetes in pregnancy and the significant impact on maternal and neonatal outcomes, there is an urgent need for comprehensive comparative studies in Bangladesh. Quantifying differences in antenatal complications, intrapartum outcomes, and neonatal morbidity between diabetic and non-diabetic women can inform evidence-based interventions and resource planning. Therefore, the present retrospective study aimed to compare pregnancy outcomes in women with and without diabetes mellitus in a Bangladeshi tertiary care setting.

METHODS & MATERIALS

This comparative cross-sectional study was conducted in the Department of Gynecology and Obstetrics at Gazi Medical College Hospital, Khulna, Bangladesh, over one year from January to December 2024. The study aimed to compare pregnancy and neonatal outcomes between women with and without diabetes mellitus. A total of 320 pregnant women were included, comprising 160 diabetic (pre-gestational and gestational diabetes mellitus) and 160 non-diabetic participants, selected using a consecutive sampling technique and matched in a 1:1 ratio for age and parity. Inclusion criteria included singleton pregnancies beyond 28 weeks of gestation, while women with multiple pregnancies, chronic systemic diseases other than diabetes, or significant fetal anomalies were excluded. Gestational diabetes mellitus was diagnosed based on the IADPSG/WHO 2013 criteria using a 75 g oral glucose tolerance test [18,19], and pre-gestational diabetes was confirmed in women diagnosed before pregnancy or before 20 weeks of gestation. Data were collected prospectively using a structured questionnaire covering socio-demographic characteristics, antenatal history, obstetric complications, delivery outcomes, and neonatal status. Primary outcomes included mode of delivery and composite adverse maternal and neonatal outcomes, while secondary outcomes included birthweight, gestational age, and perinatal mortality.

Statistical analyses were performed using SPSS version 26.0, applying the t-test or Mann–Whitney U test for continuous variables and Chi-square or Fisher's exact test for categorical variables. Multivariable logistic regression was used to identify independent predictors of adverse outcomes, and a p-value <0.05 was considered statistically significant. Ethical approval was obtained from the Institutional Ethics Review Committee of Gazi Medical College Hospital, and written informed consent was secured from all participants prior to inclusion in the study.

RESULTS

The mean maternal age was similar across groups (29.1 ± 5.5 vs. 28.2 ± 5.1 years). Most participants were aged 20–29 years, resided in urban areas, and had secondary-level education. The median family income was significantly higher among diabetic mothers (BDT 35,000 [25,000–50,000]) compared to non-diabetic mothers (BDT 30,000 [22,000–45,000]; $p = 0.041$). Both groups had comparable parity and gravidity. However, the mean BMI was significantly greater among diabetic mothers (27.0 ± 4.2 kg/m^2) than non-diabetic ones (24.8 ± 3.9 kg/m^2; $p < 0.001$), with a higher proportion of overweight/obese women in the DM group ($p = 0.008$). Other variables, including residence, education, consanguinity, antenatal visits, tobacco exposure, chronic hypertension, and thyroid disease, showed no statistically significant differences between the two groups.

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Table – I: Baseline maternal socio-demographic and obstetric characteristics of study participants (*n*=320)

Variable		Diabetes (DM) n=160	Non-DM n=160	P-value
Age (years), mean ± SD		29.1 ± 5.5	28.2 ± 5.1	
Age group, n (%)	<20	8 (5.0)	18 (11.3)	0.182
	20–29	80 (50.0)	92 (57.5)	
	30–34	44 (27.5)	34 (21.3)	
	≥35	28 (17.5)	16 (10.0)	
Residence, n (%)	Urban	112 (70.0)	96 (60.0)	0.067
	Rural	48 (30.0)	64 (40.0)	
Education, n (%)	No school	12 (7.5)	20 (12.5)	0.412
	Primary	44 (27.5)	52 (32.5)	
	Secondary	68 (42.5)	60 (37.5)	
	≥HSC	36 (22.5)	28 (17.5)	
Monthly family income (BDT), median [IQR]		35,000 [25,000–50,000]	30,000 [22,000–45,000]	0.041*
Parity, median [IQR]		1 [0–2]	1 [0–2]	0.719
Gravidity, median [IQR]		2 [1–3]	2 [1–3]	0.684
BMI (kg/m^2), mean ± SD		27.0 ± 4.2	24.8 ± 3.9	<0.001*
BMI category, n (%)	<18.5	6 (3.8)	12 (7.5)	0.008*
	18.5–22.9	42 (26.3)	68 (42.5)	
	23.0–27.4	64 (40.0)	54 (33.8)	
	≥27.5	48 (30.0)	26 (16.3)	
Consanguinity, n (%)		18 (11.3)	14 (8.8)	0.489
≥4 ANC visits, n (%)		124 (77.5)	118 (73.8)	0.445
Tobacco exposure in household, n (%)		36 (22.5)	40 (25.0)	0.621
Chronic hypertension, n (%)		22 (13.8)	12 (7.5)	0.081
Thyroid disease, n (%)		14 (8.8)	10 (6.3)	0.399

The majority had gestational diabetes mellitus (GDM) (75.0%), while one-quarter (25.0%) had pre-existing diabetes. The median gestational age at diagnosis was 26 weeks [IQR: 24–28]. At diagnosis, the mean fasting plasma glucose was 5.6 ± 0.7 mmol/L, and the mean 2-hour OGTT value was 9.0 ± 1.4 mmol/L. The mean HbA1c at booking was 6.3 ± 0.8%, which declined slightly to 6.0 ± 0.7% in the third trimester, indicating modest improvement in glycemic control over pregnancy. Regarding management, most women were treated with metformin (45.0%), followed by dietary modification alone (28.8%), insulin therapy (15.0%), and combination therapy with metformin and insulin (11.3%). Overall, satisfactory glycemic control was achieved in 70.0% of diabetic participants.

Table – II: Glycemic and clinical profile of diabetic pregnant women (*n*=160)

Variable		Value
DM subtype, n (%)	Pre-GDM	40 (25.0)
	GDM	120 (75.0)
GA at DM diagnosis (weeks), median [IQR]		26 [24–28]
Fasting plasma glucose at diagnosis (mmol/L), mean ± SD		5.6 ± 0.7
2-hr OGTT (mmol/L), mean ± SD		9.0 ± 1.4
HbA1c at booking (%), mean ± SD		6.3 ± 0.8
HbA1c in 3rd trimester (%), mean ± SD		6.0 ± 0.7
Treatment, n (%)	Diet	46 (28.8)
	Metformin	72 (45.0)
	Insulin	24 (15.0)
	Combo (metformin+insulin)	18 (11.3)
Glycemic control achieved*, n (%)		112 (70.0)

Overall, complications were more frequent among women with diabetes, though most differences did not reach statistical significance. Gestational hypertension and pre-eclampsia/eclampsia were observed more commonly in the diabetic group (18.8% and 11.3%, respectively) compared to the non-diabetic group (11.3% and 6.3%). Notably, polyhydramnios occurred significantly more often among diabetic mothers (13.8%) than non-diabetic ones (5.0%) (*p = 0.016*). The rates of oligohydramnios, antepartum haemorrhage, urinary tract infection, preterm labour, and suspected intrauterine growth restriction (IUGR) were similar between groups. Although antenatal hospital admissions were more frequent in the diabetic group (25.0% vs. 16.3%), this difference did not reach statistical significance (*p = 0.062*).

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Table – III: Comparison of antenatal complications between diabetic and non-diabetic pregnant women (*n*=320)

Outcome	DM (n = 160)	Non-DM (n = 160)	*p*-value
Gestational hypertension, n (%)	30 (18.8)	18 (11.3)	0.083
Pre-eclampsia / eclampsia, n (%)	18 (11.3)	10 (6.3)	0.141
Polyhydramnios, n (%)	22 (13.8)	8 (5.0)	0.016*
Oligohydramnios, n (%)	10 (6.3)	12 (7.5)	0.659
Antepartum haemorrhage, n (%)	6 (3.8)	4 (2.5)	0.519
Urinary tract infection, n (%)	28 (17.5)	20 (12.5)	0.219
Preterm labour (<37 w), n (%)	30 (18.8)	20 (12.5)	0.149
IUGR suspected, n (%)	16 (10.0)	22 (13.8)	0.317
Any antenatal admission, n (%)	40 (25.0)	26 (16.3)	0.062

The mean gestational age at delivery was significantly lower in the diabetic group compared to the non-diabetic group (37.9 ± 2.0 vs. 38.5 ± 1.8 weeks; *p = 0.012*). Mode of delivery differed notably between groups, with a higher rate of caesarean section among diabetic mothers (52.5%) compared to non-diabetic mothers (36.3%) (*p = 0.011*). In comparison, spontaneous vaginal delivery was more common in the non-diabetic group (55.0% vs. 40.0%). Fetal macrosomia was a significantly more frequent indication for caesarean delivery among diabetic women (12.5% vs. 3.8%; *p = 0.006*). Shoulder dystocia was also observed more often in diabetic mothers (5.0%) than in non-diabetic mothers (1.3%) (*p = 0.049*). Other intrapartum complications, including failed induction, post-partum haemorrhage, maternal ICU admission, and maternal mortality, showed no statistically significant differences between the two groups.

Table – IV: Delivery and intrapartum outcomes among diabetic and non-diabetic mothers (*n*=320)

Outcome		DM (n=160)	Non-DM (n=160)	*p*-value
Gestational age at delivery (weeks), mean ± SD		37.9 ± 2.0	38.5 ± 1.8	0.012*
Mode of delivery, n (%)	Spontaneous vaginal	64 (40.0)	88 (55.0)	0.011*
	Instrumental	12 (7.5)	14 (8.8)	
	Caesarean section (overall)	84 (52.5)	58 (36.3)	
Indication: fetal macrosomia, n (%)		20 (12.5)	6 (3.8)	0.006*
Indication: failed induction, n (%)		18 (11.3)	12 (7.5)	0.243
Induction of labour, n (%)		56 (35.0)	42 (26.3)	0.096
Shoulder dystocia, n (%)		8 (5.0)	2 (1.3)	0.049*
Post-partum haemorrhage, n (%)		14 (8.8)	10 (6.3)	0.399
Maternal ICU admission, n (%)		6 (3.8)	2 (1.3)	0.151
Maternal death, n (%)		0 (0.0)	0 (0.0)	-

Infants of diabetic mothers had a significantly higher mean birthweight compared to those of non-diabetic mothers (3300 ± 560 g vs. 3050 ± 520 g; *p < 0.001*). Birthweight distribution differed notably between groups, with a higher incidence of macrosomia (≥4000 g) among the diabetic group (16.3% vs. 5.0%) and fewer low-birth-weight infants (*p = 0.023*). Similarly, large-for-gestational-age (LGA) infants were significantly more common among diabetic mothers (18.8% vs. 7.5%; *p = 0.007*). Neonatal hypoglycaemia occurred markedly more often in infants of diabetic mothers (21.3% vs. 3.8%; *p < 0.001*), highlighting a key metabolic complication associated with maternal diabetes. NICU admissions were also significantly higher in the diabetic group (28.8% vs. 16.3%; *p = 0.010*), and their median hospital stay was longer (3 [2–5] vs. 2 [1–3] days; *p = 0.002*). Other neonatal complications, such as low Apgar scores, congenital anomalies, respiratory distress, hyperbilirubinaemia, and sepsis, were more frequent among infants of diabetic mothers but did not reach statistical significance. Perinatal mortality was slightly higher in the diabetic group (3.8% vs. 1.3%), though this difference was not statistically significant.

Table – V: Neonatal outcomes among infants born to diabetic and non-diabetic mothers (*n*=320)

Outcome		DM (n=160)	Non-DM (n=160)	*p*-value
Birthweight (g), mean ± SD		3300 ± 560	3050 ± 520	<0.001*
Birthweight category, n (%)	LBW <2500 g	22 (13.8)	28 (17.5)	0.023*
	2500–3999 g	112 (70.0)	124 (77.5)	
	Macrosomia ≥4000 g	26 (16.3)	8 (5.0)	
Small for GA, n (%)		18 (11.3)	24 (15.0)	0.345
Large for GA, n (%)		30 (18.8)	12 (7.5)	0.007*
Apgar < 7 at 1 min, n (%)		22 (13.8)	14 (8.8)	0.179
Apgar < 7 at 5 min, n (%)		8 (5.0)	4 (2.5)	0.247

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Congenital anomalies (major), n (%)	6 (3.8)	2 (1.3)	0.154
Neonatal hypoglycaemia†, n (%)	34 (21.3)	6 (3.8)	<0.001*
Respiratory distress, n (%)	20 (12.5)	12 (7.5)	0.157
Hyperbilirubinaemia requiring phototherapy, n (%)	38 (23.8)	26 (16.3)	0.104
Sepsis (clinical/culture-proven), n (%)	12 (7.5)	10 (6.3)	0.666
NICU admission, n (%)	46 (28.8)	26 (16.3)	0.010*
Length of stay (days), median [IQR]	3 [2 – 5]	2 [1 – 3]	0.002*
Perinatal mortality, n (%)	6 (3.8)	2 (1.3)	0.151

Adverse maternal outcomes, defined as the occurrence of at least one of pre-eclampsia, postpartum haemorrhage, ICU admission, or maternal death, were significantly more frequent among diabetic mothers (21.3%) compared to non-diabetic mothers (11.3%), with a relative risk (RR) of 1.9 (95% CI: 1.1–3.3; *p = 0.028*). Similarly, adverse neonatal outcomes comprising at least one of NICU admission, hypoglycaemia, respiratory distress syndrome, or perinatal death were substantially higher in the diabetic group (36.3%) than in the non-diabetic group (21.3%), corresponding to an RR of 1.7 (95% CI: 1.2–2.5; *p = 0.006*).

Table – VI: Comparison of composite adverse maternal and neonatal outcomes between diabetic and non-diabetic groups

Composite outcome	Definition	DM (n = 160)	Non-DM (n = 160)	RR (95 % CI)	*p*-value
Adverse Maternal Outcome	≥1 of: pre-eclampsia, PPH, ICU admission, or maternal death	34 (21.3 %)	18 (11.3 %)	1.9 (1.1 – 3.3)	0.028
Adverse Neonatal Outcome	≥1 of: NICU admission, hypoglycaemia, RDS, perinatal death	58 (36.3 %)	34 (21.3 %)	1.7 (1.2 – 2.5)	0.006

After adjustment for potential confounders, diabetes mellitus emerged as a significant independent predictor, with diabetic women nearly twice as likely to experience adverse outcomes compared to non-diabetic women (AOR = 1.94; 95% CI: 1.18–3.20; p = 0.009). Advanced maternal age (≥35 years) also showed a significant association (AOR = 1.72; 95% CI: 1.00–2.95; p = 0.048), as did hypertension (chronic or pregnancy-related), which doubled the risk (AOR = 2.02; 95% CI: 1.05–3.88; p = 0.034). Although obesity (BMI ≥ 27.5 kg/m^2) and poor glycaemic control among diabetic women showed trends toward higher odds of adverse outcomes (AOR = 1.56 and 0.62, respectively), these associations did not reach statistical significance (p = 0.078 and p = 0.092). Other factors, including primiparity, urban residence, and adequate antenatal care (≥4 visits), were not significantly associated with adverse outcomes.

Table – VII: Multivariable logistic regression analysis showing predictors of adverse pregnancy outcome

Predictor (reference = absent)	Adjusted OR (95 % CI)	*p*-value
Diabetes Mellitus (yes)	1.94 (1.18 – 3.20)	0.009
Maternal age ≥ 35 y	1.72 (1.00 – 2.95)	0.048
BMI ≥ 27.5 kg/m^2 (Obese)	1.56 (0.95 – 2.55)	0.078
Primiparity	1.23 (0.73 – 2.08)	0.438
Hypertension (chronic/pregnancy)	2.02 (1.05 – 3.88)	0.034
Urban residence	1.20 (0.70 – 2.08)	0.507
≥ 4 ANC visits	0.78 (0.45 – 1.33)	0.349
Glycaemic control achieved (yes) [DM only model]	0.62 (0.36 – 1.08)	0.092

DISCUSSION

Our comparative study demonstrates that diabetes in pregnancy (predominantly gestational diabetes mellitus, GDM, with a minority of pre-existing diabetes) is associated with significantly higher risks of adverse maternal and neonatal outcomes than normoglycemic pregnancies. These findings are consistent with a large body of recent literature, which similarly reports increased obstetric interventions and neonatal morbidity among diabetic mothers [20-22]. In our cohort, diabetic women had higher body mass index (BMI). They were more often overweight or obese, consistent with other studies showing that GDM mothers tend to be older and heavier both recognized risk factors for GDM and adverse outcomes [14,20]. Karkia et al. in the UK reported similar demographic trends in more than 50,000 pregnancies [20]. Advanced maternal age (≥ 35 years) in our study also independently predicted adverse outcomes, paralleling global findings that older mothers have greater risks of GDM, pre-eclampsia, and cesarean section [23]. Hypertension further doubled adverse-outcome risk in our data, confirming evidence that co-morbid hypertensive disorders amplify diabetes-related risks [24,25]. Hypertensive disorders were more frequent in our diabetic group (≈ 30% vs 17%), diabetic women carry a 2-4 times increased risk of a hypertensive pregnancy compared to non-diabetic people [26]. Ye et al. reported an adjusted odds ratio (aOR) of 1.46 for pre-eclampsia in GDM pregnancies [21]. Polyhydramnios, significantly higher among our diabetic mothers, is also well-

recognized as a hyperglycemia-related complication [20]. Mean gestational age at delivery was lower among diabetic mothers, consistent with prior studies linking GDM to greater risk of preterm delivery [21,22]. Ye et al. found that GDM increased the risk of preterm birth by ~1.5 times, while Preda et al. reported preterm labour in 17.72% of GDM cases [21,27]. Caesarean section (CS) rates were significantly higher in our diabetic group (52.5% vs 36.3%), aligning with previous reports [28,29]. Our higher relative risk likely reflects macrosomia, which is an indication consistent with a previous study [30]. Shoulder dystocia occurred more often among diabetic mothers (5.0% vs 1.3%), attributable to larger fetuses. Although Ye et al. found no independent association after birth-weight adjustment, our result underscores the clinical relevance of close intrapartum management [21]. Poolsup et al. showed that treating even mild GDM halves the risk of shoulder dystocia and macrosomia, confirming the benefits of active management [31]. Post-partum haemorrhage (PPH) did not differ significantly. However, multiple studies show a link between gestational diabetes mellitus (GDM) and a higher risk of postpartum hemorrhage (PPH), possibly due to differences in sample size or parity [32,33]. Composite adverse maternal outcomes were almost twice as frequent in our diabetic mothers (RR 1.9), paralleling Alshomrany et al., who reported aOR 1.46 for significant complications [34]. Pregestational diabetes generally carries an even higher risk; another study found more severe complications than in GDM pregnancies [35]. Infants of diabetic mothers in our cohort had significantly higher mean birth weight (3300 g vs 3050 g) and more macrosomia (16.3% vs 5.0%), consistent with meta-analyses showing ~1.7-fold higher odds of macrosomia in GDM [36]. A Bangladeshi study reported nearly identical rates (16% vs 4%) [22]. The lower frequency of small-for-gestational-age infants in people with diabetes also agrees with Karkia et al., reflecting an upward shift in the birth-weight distribution [21]. Neonatal hypoglycemia was strikingly more common in infants of diabetic mothers (21.3% vs 3.8%), approximately 8-30% of neonates born to mothers with diabetes [37]. Voormolen et al. found hypoglycemia in one-third of infants of GDM mothers, supporting universal neonatal glucose screening. Despite relatively reasonable maternal glycemic control (mean HbA1c ~ 6.0%), our elevated neonatal hypoglycemia underscores persistent metabolic risk even with treatment [38]. NICU admission was significantly higher in the diabetic group (28.8% vs 16.3%), consistent with global evidence showing roughly doubled NICU need [21]. The main reasons hypoglycemia and respiratory distress mirror patterns in the BMJ meta-analysis are not specified [21]. Although our respiratory-distress difference was not statistically significant, the trend aligns with a previous study that reported an OR of 1.57 for neonatal RDS in insulin-treated GDM [39]. Perinatal mortality was slightly higher among diabetic mothers (3.8% vs 1.3%), though not significant, consistent with modern studies showing no residual increase after reasonable glycemic control [40]. However, pregestational diabetes remains high-risk; Clement et al. reported OR 7.3 for stillbirth and 4.2 for perinatal death [41]. Congenital anomalies were only slightly higher in our diabetic group, again consistent with findings that GDM (diagnosed after organogenesis) seldom increases malformation risk, unlike poorly controlled pregestational diabetes [41]. Our findings emphasize early screening, tight glycemic control, and multidisciplinary management. Universal screening at 24–28 weeks or earlier for high-risk women is critical, as adverse outcomes persisted despite modestly reasonable control. Overall, our findings reaffirm global evidence that diabetes, particularly when combined with obesity or hypertension, nearly doubles adverse pregnancy risks, necessitating vigilant, multidisciplinary care.

Limitations of the study: The main limitation of this study is that it was conducted in a single urban tertiary hospital, which may limit the generalizability of the findings. The observational design also introduces possible selection bias and prevents causal conclusions. Additionally, the relatively small number of women with pre-existing diabetes reduced the power to detect some associations. Glycemic control was assessed with limited markers, and lifestyle factors such as diet and physical activity were not fully captured. Lastly, neonatal follow-up ended at discharge, so long-term maternal and infant outcomes could not be evaluated.

CONCLUSION

This study demonstrates that diabetes mellitus during pregnancy, both gestational and pre-existing, is significantly associated with increased risks of adverse maternal and neonatal outcomes compared to non-diabetic pregnancies. Diabetic mothers experienced higher rates of hypertensive disorders, cesarean delivery, and polyhydramnios, while their infants were more likely to develop macrosomia, hypoglycemia, and require NICU admission. Even with reasonable glycemic control, the risk of complications remained elevated. These findings highlight the critical importance of early screening, optimal glucose management, and multidisciplinary antenatal care to improve maternal and neonatal outcomes in diabetic pregnancies. Strengthening preventive strategies and ensuring close follow-up for women with GDM can substantially reduce pregnancy-related morbidity and mortality.

RECOMMENDATIONS

This study recommends early and universal screening for gestational diabetes, especially among high-risk women, along with comprehensive multidisciplinary care to ensure optimal glucose control and close monitoring of both mother and fetus. Deliveries should take place in well-equipped facilities with neonatal support to manage potential complications like hypoglycemia. Postpartum glucose testing and lifestyle counseling are essential to prevent future diabetes in mothers.

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ORIGINAL ARTICLE

Distinguishing Suicidal Hanging from Homicidal Ligature Strangulation – A Diagnostic Accuracy Study of Autopsy and Scene Findings

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ABSTRACT

Introduction: *Differentiating suicidal hanging from homicidal strangulation remains a critical challenge in forensic pathology due to overlapping scene findings, ligature patterns, and internal neck injuries. Accurate classification is essential for justice, mortality reporting, and public health surveillance. This study aimed to evaluate the diagnostic accuracy of autopsy, internal neck injury, and scene findings in distinguishing suicidal hanging from homicidal strangulation.* ***Methods & Materials:*** *This observational, cross-sectional autopsy-based forensic study analyzed 120 cases (95 suicidal and 25 homicidal) after excluding incomplete or decomposed cases. The study was conducted at the Department of Forensic Medicine at Dhaka Medical College from January 2022 to July 2022. The manner of death was determined through combined scene evidence, police inquest, and autopsy consensus. Data were collected using a structured pro forma, and statistical analysis was performed using SPSS (version 26.0).* ***Results:*** *Suicidal hangings were marked by oblique, non-continuous ligature marks above the thyroid cartilage, parchmentization, and no defense injuries, while homicidal cases showed horizontal marks, fractures, and signs of struggle. Sedatives were found only in homicides. The predictive model accurately distinguished suicides from homicides (AUC = 0.97, sensitivity = 97%, specificity = 92%).* ***Conclusion:*** *Careful assessment of the scene and autopsy findings can effectively differentiate suicidal hangings from homicidal strangulations. Oblique, non-continuous ligature marks above the thyroid cartilage and absence of defense injuries indicate suicide, while horizontal marks, internal trauma, and struggle signs suggest homicide.*

Keywords: *Suicidal hanging, Homicidal strangulation, Forensic pathology, Ligature mark analysis, and Diagnostic Accuracy.*

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INTRODUCTION

Differentiating suicidal hanging from homicidal strangulation remains a persistent diagnostic challenge in forensic pathology. Although both mechanisms result in asphyxia through vascular obstruction and airway compression, the scene findings, ligature marks, and internal neck injuries may overlap considerably, complicating the determination of the manner of death [1,2]. The medicolegal implications are substantial: a misclassification of homicide as suicide or vice versa can impede justice, distort mortality statistics, and undermine public health surveillance [3,4]. Globally, hanging remains the most frequent method of suicide [5]. The World Health Organization (WHO) reports approximately 700,000 suicides annually, with a disproportionate burden in low- and middle-income countries (LMICs) where hanging predominates [6]. In contrast, homicidal strangulation, while less common, represents a significant subset of interpersonal violence, often linked to domestic abuse and gender-based violence, with women as the primary victims [7]. In South Asia, particularly Bangladesh, hanging accounts for more than 60% of suicides [8-10]. Local forensic studies consistently highlight hanging as the leading cause of unnatural death among

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individuals aged 20–40 years [10]. Meanwhile, homicidal strangulation remains underreported due to poor scene investigation, and sociocultural stigma surrounding homicide reporting [11]. These challenges are compounded by resource limitations, including a lack of advanced imaging, inadequate scene documentation, and minimal integration between police and forensic departments [12]. From a forensic standpoint, distinguishing between the two manners of death relies on detailed autopsy and scene analysis. Typical suicidal hanging presents with oblique, non-continuous ligature marks above the thyroid cartilage. At the same time, homicidal strangulation is often characterized by horizontal, continuous marks below the thyroid, accompanied by defensive injuries, internal hemorrhages, and fractures of the hyoid bone and thyroid cartilage [13,14]. Nonetheless, atypical presentations, partial suspension hangings, staged suicides, or soft ligatures can blur these distinctions [15,16]. Environmental and postmortem factors such as decomposition, ligature type, and resuscitation attempts can also alter external findings [17]. Recent advances in postmortem imaging, including CT and MRI, have improved detection of deep tissue hemorrhage and cartilage fractures [18,19]. However, access to such modalities remains limited in most South Asian forensic institutes. Despite progress, there remains a lack of standardized, statistically validated criteria integrating both scene and autopsy findings to differentiate suicidal hanging from homicidal strangulation, particularly within the Bangladeshi context [8-10, 20]. Determining the manner of death requires integrating scene investigation, autopsy findings, and histopathology. Studies emphasized that forensic doctors should document ligature marks, search for other injuries, and collaborate with law enforcement to obtain scene information and witness statements [21]. In ambiguous cases, forensic experts must consider whether a hanging could be simulated postmortem to cover up homicide [22]. Most large autopsy series originate from Europe or India; there are few comprehensive datasets from Bangladesh or other South Asian countries [23,24]. These limits understanding of regional variations in ligature materials, suspension methods, and victim profiles. Therefore, the study aimed to evaluate the diagnostic accuracy of autopsy, internal neck injury, and scene findings in distinguishing suicidal hanging from homicidal strangulation.

METHODS & MATERIALS

The Observational, cross-sectional autopsy-based analytical forensic study was conducted at the Department of Forensic Medicine at Dhaka Medical College from January 2022 to July 2022. Out of 140 initially screened cases, 20 were excluded due to incomplete documentation or advanced decomposition, leaving 95 cases of suicidal hanging and 25 cases for final analysis (total n=120). The manner of death was established as the reference standard through combined evaluation of scene findings, circumstantial evidence, police inquest, and autopsy consensus. For each case, detailed information was collected using a structured proforma. Scene variables included the location of the body, type of suspension, knot position, presence of a suicide note, and evidence of struggle or disturbance at the scene. External findings were systematically documented, focusing on the level, direction, and continuity of the ligature mark, petechiae, facial congestion, and presence of defense injuries. Internal examination assessed parchmentization, hyoid bone, thyroid cartilage, and cricoid cartilage fractures, and strap-muscle and other neck soft-tissue injuries. Ancillary investigations comprised toxicology (alcohol and sedatives) and analysis of ligature marks [25]. Ethical approval was obtained from the institutional review board of (institute name), and all data were anonymized before analysis. The study was designed and reported in accordance with the STARD (Standards for Reporting of Diagnostic Accuracy Studies) guidelines [26].

Data were cleaned and verified before analysis. Continuous variables were tested for normality and expressed as mean ± SD or median (IQR), while categorical variables were shown as frequency and percentage. Group comparisons were performed using the *t*-test for continuous variables and the Chi-square test for categorical variables. Univariable logistic regression identified potential predictors ($p < 0.10$). Variables meeting criteria or showing clinical relevance were included in multivariable logistic regression. Results were presented as odds ratios (OR) with 95% confidence intervals (CI). Model performance was evaluated using ROC analysis (AUC with 95% CI), and calibration was checked by the Hosmer-Lemeshow test. The optimal cutoff value was chosen using Youden's index. All analyses were performed using SPSS (version 26.0) and R (version 4.x). A *p-value* <0.05 was considered statistically significant.

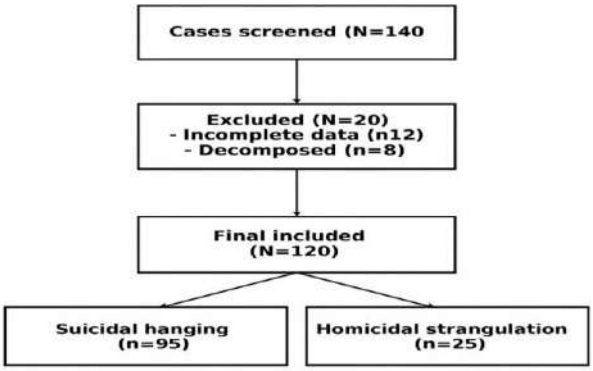

Figure – 1: Study Flow (STARD diagram)

This diagram outlines the study population and case distribution. Out of 140 initially screened deaths, 20 cases were excluded because of either incomplete documentation or advanced decomposition, leaving 120 cases eligible for full evaluation. These were subsequently classified by the reference standard into 95 suicidal hangings and 25 homicidal strangulations.

RESULTS

The mean ages were similar between groups (32.8 vs. 34.6 years, $p = 0.412$), and there was no significant difference in sex distribution. However, several scene-related variables showed marked differences. Suicidal deaths occurred predominantly

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at home (95.8%), while homicides were more often found outdoors or in other locations (24.0%, p = 0.002). Knot position differed sharply; most suicides had lateral or submental knots (92.6%), whereas the majority of homicides had occipital knots (80.0%, p <0.001). Suicide notes were significantly more common in suicidal cases (29.5% vs. 4.0%, p = 0.008), and signs of struggle were exclusive to homicidal deaths (56.0%, p <0.001). [Table I]

Table – I: Baseline Scene and Circumstantial Findings by Manner of Death (*n*=120)

Variable	Category	Suicidal (n=95)	Homicidal (n=25)	p-value
Age (years)	Mean ± SD (Range)	32.8 ± 9.4 (15–60)	34.6 ± 8.8 (18–65)	0.412
Sex	Male	58 (61.1)	14 (56.0)	0.641
	Female	37 (38.9)	11 (44.0)	
Location of body	Home	91 (95.8)	19 (76.0)	0.002
	Outdoor/Other	4 (4.2)	6 (24.0)	
Knot position	Occipital	7 (7.4)	20(80.0)	<0.001
	Lateral/Submental	88 (92.6)	5 (20.0)	
Suicide notes	Present	28 (29.5)	1 (4.0)	0.008
Signs of struggle	Present	0 (0,0%)	14 (56.0)	<0.001

In suicidal cases, ligature marks were consistently above the thyroid cartilage (100%), while in homicidal cases, they were predominantly at or below the thyroid (80%, p < 0.001). The direction of the ligature mark also differed sharply; almost all suicidal cases showed an oblique mark (97.9%), whereas all homicidal cases had a horizontal mark (p < 0.001). Suicidal ligature marks were non-continuous in all cases, contrasting with the absence of this pattern in homicides. Additionally, petechiae (ocular/facial hemorrhages) and facial congestion were far more frequent in homicidal deaths (68.0% and 60.0%, respectively) than in suicides (18.9% and 22.1%; both p < 0.001). Defense injuries were observed exclusively in homicidal cases (52.0%), underscoring the presence of struggle or resistance. [Table II]

Table – II: External Neck and Associated Findings in Suicidal Hanging and Ligature Strangulation Cases (*n*=120)

Finding	Category	Suicidal n=95	Homicidal n=25	p-value
Ligature mark level	Above thyroid	95 (100.0)	1 (20.0)	-
	At/below the thyroid	0 (0.0)	24 (80.0)	<0.001
Ligature mark direction	Oblique	93 (97.9)	0 (0.0%)	-
	Horizontal	2 (2.1)	25 (80.0)	<0.001
Continuity	Non-continuous	95 (100)	0 (0.0)	-
Petechiae (ocular/facial)	Present	18 (18.9)	17 (68.0)	<0.001
Facial congestion	Present	21 (22.1)	15 (60.0)	<0.001
Defense injuries	Present	0 (0.0)	13 (52.0)	-

Parchmentization, a typical feature of hanging, was observed in nearly all suicidal cases (93.7%) but was absent in homicides, indicating its strong association with self-inflicted ligature compression. Hyoid bone fractures were rare in suicides (9.5%) but common in homicides (48.0%, p <0.001), reflecting greater external force in homicidal strangulation. Fractures of the thyroid and cricoid cartilages occurred only in homicidal cases (12.0% and 16.0%, respectively), further supporting evidence of violent compression. Bruising or hemorrhage of the neck muscles was significantly more frequent in homicides (20.0%) than in suicides (2.1%, p = 0.02). [Table III]

Table – III: Comparison of Internal Neck Injuries between Suicidal Hanging and Ligature Strangulation Cases (*n*=120)

Structure	Site/Grade	Suicidal (n=95)	Homicidal (n=25)	p-value
Parchmentization	Present	89 (93.7)	0 (0.0)	-
Hyoid bone	Fracture present	2 (9.5)	1 (48.0)	<0.001
Thyroid cartilage	Fracture present	0	3 (12.0)	-
Cricoid cartilage	Fracture present	0	1 (16.0)	-
Bruising of the Neck muscle	present	2 (78.9)	20 (20.0)	0.02

Findings show that alcohol was detected in a small proportion of both suicidal (3.2%) and homicidal (8.0%) cases, with no statistically significant difference (p = 0.268). However, sedative or hypnotic substances were identified exclusively in homicidal deaths (32.0%) and were absent in suicides. This pattern suggests that while alcohol consumption was not a distinguishing factor, the presence of sedatives or hypnotics may indicate drug-facilitated homicide, possibly used to incapacitate victims prior to ligature application. [Table IV]

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Table – IV: Results of Ancillary Toxicological Tests by Manner of Death (*n*=120)

Test	Category / Result	Suicidal (n=95)	Homicidal (n=25)	p-value
Toxicology	Alcohol positive	3 (3.2)	2 (8.0)	0.268
	Sedative/hypnotic positive	0 (0.0)	8 (32 %)	-

In univariable analysis, all predictors were highly significant ($p < 0.001$), with oblique ligature marks (OR = 19.9), marks above the thyroid cartilage (OR = 18.3), absence of defense injuries (OR = 14.6), presence of parchmentization (OR = 16.5), absence of hyoid bone fracture (OR = 7.5), and minimal neck muscle hemorrhage (OR = 9.2) all strongly linked to suicidal cases. In the multivariable model, five key predictors remained statistically significant. The presence of an oblique ligature mark (aOR = 8.2, $p < 0.001$), mark above the thyroid cartilage (aOR = 5.6, $p = 0.002$), absence of defense injuries (aOR = 4.1, $p = 0.015$), and lack of significant neck muscle hemorrhage (aOR = 3.7, $p = 0.021$) independently predicted suicidal hanging. [Table V]

Table – V: Univariable and Multivariable Logistic Regression Predictors of Suicidal Hanging (*n*=120)

Predictor	Univariable OR (95% CI)	p-value	Multivariable aOR (95% CI)	p-value
Oblique ligature mark	19.9 (6.2 – 64.5)	<0.001	8.2 (2.7 – 24.7)	<0.001
Mark above the thyroid cartilage	18.3 (6.0 – 55.7)	<0.001	5.6 (1.9 – 16.5)	0.002
Absence of defense injuries	14.6 (4.9 – 43.7)	<0.001	4.1 (1.3 – 12.9)	0.015
Parchmentization present	16.5 (5.3 – 51.2)	<0.001	-	-
Bruising of the Neck muscle	9.2 (3.2 – 26.1)	<0.001	3.7 (1.2 – 11.4)	0.021
Hyoid bone fracture absent	7.5 (2.6 – 21.6)	<0.001	-	-

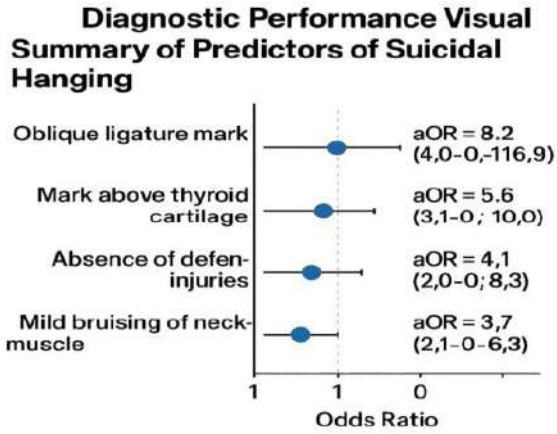

Figure – 2: Predictors of Suicidal Hanging

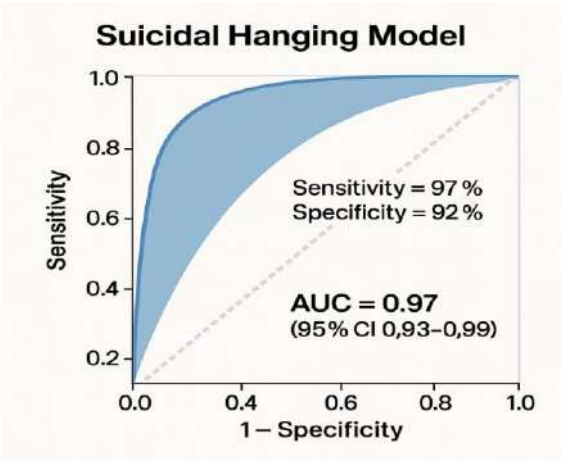

Figure – 3: ROC Curve of Predictive Model for Suicidal Hanging

Multivariable Forest Plot. The forest plot demonstrates that oblique ligature mark (aOR = 8.2), mark above thyroid cartilage (aOR = 5.6), absence of defense injuries (aOR = 4.1), and mild bruising of neck-muscle (aOR = 3.7) are independently associated with suicidal hanging. The bolded values inside and outside emphasize the strong diagnostic weight of each predictor, underscoring their collective forensic reliability.

The ROC curve demonstrates outstanding discriminative ability of the predictive model, with an AUC of 0.97 (95% CI: 0.93–0.99). At the optimal cutoff point, the model achieved a sensitivity of 97% and a specificity of 92%, indicating that it correctly identified nearly all suicidal cases while reliably excluding most homicidal cases. The curve's proximity to the upper-left corner reflects the model's superior diagnostic accuracy and clinical robustness.

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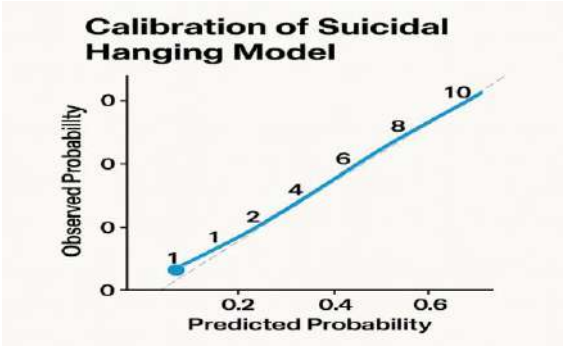

Figure – 4: Calibration of Suicidal Hanging Model

The calibration plot shows excellent alignment between predicted and observed probabilities of suicidal hanging. The blue curve closely follows the 45° reference line, and bold decile markers confirm that the model's estimated risks correspond accurately to actual outcomes. This strong calibration indicates that the predictive model is both statistically reliable and clinically applicable in distinguishing suicidal from homicidal cases.

DISCUSSION

This autopsy-based analytical forensic study shows that scene and autopsy findings differ substantially between suicidal hanging and homicidal strangulation. While demographic variables were comparable, homicide victims were more likely to be found outdoors, have occipital knots, no suicide note, and signs of struggle. Autopsy results revealed that suicidal hanging typically produced oblique, non-continuous ligature marks above the thyroid cartilage with parchment-like skin. In contrast, homicidal strangulation caused horizontal, continuous marks at or below the thyroid cartilage, along with internal trauma, petechiae, and defensive wounds. The position and orientation of ligature marks serve as reliable indicators in differentiating suicidal hanging from homicidal strangulation. Our finding that all suicidal cases had oblique marks above the thyroid cartilage and nearly all homicide cases had horizontal marks at or below the thyroid reflects earlier case series. A retrospective study reported that 82.9 % of hangings had marks above the thyroid cartilage and all were oblique, whereas strangulations exhibited complete, transverse marks below the thyroid cartilage [27]. An Indian study comparing 163 hangings with 17 strangulations found oblique, discontinuous marks in 100 % of hangings and transverse, continuous marks in all strangulations [28]. Our large sample and multivariable analysis strengthen these observations by quantifying the diagnostic weight of ligature mark orientation (aOR = 8.2) and level (aOR = 5.6). However, an extensive Malaysian study of 287 fatal neck compressions concluded that injury patterns overlapped between hanging and strangulation, reporting high rates of neck muscle contusion, hyoid fractures and facial petechiae in both groups [24]. The authors argued that differences may reflect variations in autopsy technique [24]. In comparison with other studies, our study suggests that thorough scene and autopsy investigations can still facilitate useful discrimination, even when examining the pattern of ligature marks and associated injuries. Parchmentization (dry, leathery appearance) of the ligature mark was present in almost all suicidal hangings and absent in homicides in our study. The study noted that the subcutaneous tissue underneath hanging marks was pale and glistening white. In contrast, strangulations showed contused subcutaneous tissue with extravasated blood [27]. The Ranchi study reported pale/dry subcutaneous tissue in all hangings and contused tissue in 88 % of strangulations [28]. These findings support the forensic value of parchmentization as an indicator of a slow compressive force with partial suspension, consistent with suicidal hanging. The presence or absence of deep neck injuries and fractures helps differentiate manners of death. In our cohort, hyoid fractures, thyroid and cricoid cartilage fractures, and neck-muscle were significantly more frequent in homicidal strangulation. Similar trends were described in multiple studies. A comparative study reported that hyoid fractures occurred in 48 % of strangulations versus 15 % of hangings, and neck muscle hemorrhage was present in 67 % of strangulations versus 27 % of hangings [29]. The South Kerala study noted internal injuries in 80 % of strangulations but only 11 % of hangings [30]. In contrast, case series of accidental ligature strangulations demonstrated extensive neck-muscle hemorrhage, fractured cartilaginous structures, and even cervical dislocation [31]. These differences underscore that extensive deep tissue damage or fractures should raise suspicion of homicide or accidental strangulation, especially when correlated with scene evidence. Nevertheless, some studies caution against overreliance on single injuries. A recent diagnostic article emphasized that laryngohyoid fractures have been reported in 0–100 % of hangings and are strongly influenced by age, body weight and autopsy technique [32]. Our multivariable model, therefore, included internal injuries as part of a constellation of findings rather than sole indicators. Petechial hemorrhages and facial congestion were significantly more common in homicide victims in our study. The Malaysian study reported petechiae as the most common finding, followed by neck-muscle contusion and fractures [24]. An Indian study found dribbling of saliva and tongue protrusion in hanging cases but not in strangulation [30]. Our logistic regression confirmed that the absence of petechiae and minimal neck muscle hemorrhage independently predicted suicide (aOR = 3.7), reflecting the slower venous congestion in hanging compared with the rapid, forceful compression in homicidal strangulation. Beyond anatomical features, scene investigation provides crucial context. We observed that suicide notes, the presence of a lateral knot, and the absence of signs of struggle were strongly associated with suicidal hanging. Various case reports of suicidal hanging highlight that the absence of defense injuries, no other body trauma, and the presence of circumstantial evidence (self-locking cable ties) support a suicidal manner [33]. In our analysis, the absence of defense injuries remained an independent predictor of suicide (aOR = 4.1). Conversely, signs of struggle and sedation in toxicology raise suspicion of homicide and align with our observation that sedatives or hypnotics were found exclusively in homicidal strangulations. Toxicological results provided

additional discriminatory insight. The absence of alcohol differences but exclusive detection of sedatives or hypnotics in homicidal cases (32%) suggests pharmacologic incapacitation. This observation is concordant with previous studies, which found that drug-facilitated strangulations often involve benzodiazepines or zolpidem [34,35]. In contrast, self-hanging victims rarely exhibit sedative use beyond subclinical levels, as also noted [36]. The findings highlight the value of toxicology as a circumstantial adjunct, especially when physical evidence alone is equivocal. Accurately distinguishing suicidal hanging from homicidal ligature strangulation has profound medicolegal implications. Our predictive model, which integrates ligature mark orientation, level, absence of defensive injuries, and minimal neck-muscle hemorrhage, achieved excellent discrimination (AUC = 0.97) and calibration, suggesting potential as a forensic tool. However, clinicians and pathologists should avoid relying too rigidly on single features. Instead, a comprehensive approach that combines scene investigation, external and internal examination, histological assessment, and toxicology is essential. Awareness that some internal injuries can occur in suicides, and that homicidal ligature may mimic hanging, underscores the need for expertise and standardized protocols.

Limitations of the study: This study was limited by its single-center design and modest sample size, which may restrict generalizability. Quantitative data on ligature force and duration were unavailable, and advanced techniques such as histopathology and postmortem imaging were not routinely employed, which may have led to an underestimation of subtle injuries. Toxicological testing covered only common agents, potentially missing rare or novel substances.

CONCLUSION

This study demonstrates that a systematic evaluation of scene and autopsy findings can reliably distinguish suicidal hanging from homicidal ligature strangulation. Key diagnostic indicators such as oblique, non-continuous ligature marks above the thyroid cartilage, absence of defense injuries, minimal neck-muscle hemorrhage, and lack of hyoid fracture strongly favored suicide. In contrast, horizontal marks, deep internal trauma, and signs of struggle indicated homicide. The multivariable model achieved excellent accuracy (AUC = 0.97), underscoring its practical value in forensic diagnosis. Incorporating toxicological analysis further enhanced differentiation, particularly in cases involving sedative use. These findings support the use of structured, evidence-based criteria to minimize interpretive errors and strengthen medicolegal determinations of asphyxial deaths.

RECOMMENDATIONS

Future studies should validate these findings across larger, multicenter cohorts to improve generalizability. Routine use of toxicological screening, postmortem imaging, DNA test, and histopathology is recommended to detect subtle injuries and drug involvement. Developing standardized forensic checklists and algorithm-based tools can enhance diagnostic consistency and objectivity in distinguishing suicidal hanging from homicidal strangulation.

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ORIGINAL ARTICLE

Pleural Fluid Cytology and Biochemical Profiles in Pediatric Pleural Effusion

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ABSTRACT

Introduction: *Pleural effusion, the accumulation of excess fluid in the pleural cavity, is a common cause of respiratory morbidity in children and can result from a variety of infectious and non-infectious conditions. In the pediatric population, parapneumonic effusion and tuberculous pleural effusion are among the most frequently encountered causes, each with distinct cytological and biochemical profiles. This study aims to evaluate the pleural fluid cytology and biochemical parameters in children with pleural effusion.* ***Methods & Materials:*** *This cross-sectional study was conducted at the Department of Pediatric Respiratory Medicine, Bangladesh Shishu Hospital and Institute, Dhaka, from July 2019 to January 2022. A total of 58 children from 1 to 18 years of age admitted with pleural effusion were selected as study subjects. Data were analyzed using the Statistical Package for the Social Sciences (SPSS) version 26.0.* ***Result:*** *Among the 47 study patients, parapneumonic effusion (63.8%) was the most common cause of pleural effusion, followed by tuberculous pleural effusion (36.2%). Pleural fluid analysis showed that TPE cases had significantly lower total cell counts and polymorph percentages, but higher lymphocyte percentages compared to non-TPE cases (P <0.001). Glucose levels were also significantly lower in TPE (P <0.001), while protein and LDH levels did not differ significantly between the groups.* ***Conclusion:*** *Analysis of pleural fluid cytology and biochemical profiles in pediatric pleural effusion revealed that tuberculous pleural effusion is characterized by significantly higher lymphocyte percentages and lower polymorphonuclear cell counts, along with reduced glucose levels and lower total cell counts, compared to non-tuberculous effusions.*

Keywords: *Pleural Effusion, Pleural Fluid Cytology, Biochemical Profiles, Tuberculosis*

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INTRODUCTION

Pleural disease is a significant cause of morbidity and mortality in adults and children, accounting for approximately 4% of all chest hospital attendances [1,2,3]. Pleural effusion is the collection of excess fluid in the pleural cavity, resulting from an imbalance between vascular hydrostatic and oncotic pressure [4]. It is classified as exudative or transudative; pneumonia and tuberculosis are the most common causes of exudative effusion in children worldwide. Tuberculosis (TB) remains a major health problem in developing countries, with an increasing proportion of extrapulmonary TB [5]. National guidelines classify pleural TB as extrapulmonary TB (EPTB). According to the WHO Global TB Report 2020, an estimated 10 million people developed TB worldwide, including 1.1 million children [6]. Thirty high-burden countries accounted for 86% of new cases, with India leading, followed by China, Indonesia, the Philippines, Pakistan, Nigeria, Bangladesh, and South Africa. TB is caused by *Mycobacterium tuberculosis*. A study at Bangladesh Shishu Hospital and Institute identified 61 cases of extrapulmonary TB versus 30 pulmonary TB cases [7]. Pleural effusion is the second most common EPTB manifestation, with a global incidence of about 4.9%, ranging from 4% in the US to 23% in Spain [8]. Around 50% of untreated pleural TB cases progress to pulmonary TB within five years, emphasizing the need for early diagnosis and treatment [9]. Diagnosis of TB in children is difficult, and adult diagnostic strategies may miss many pediatric cases. Definitive diagnosis is made by detecting *M. tuberculosis* in

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sputum, pleural fluid, or biopsy specimens, supported by the Mantoux test and chest X-ray [10]. Smear microscopy, although highly specific (>95%), has low sensitivity (25–65%) because childhood pleural TB usually has paucibacillary disease. Conventional culture remains the gold standard but is time-consuming, taking 6–8 weeks. Chest X-ray is neither sensitive nor specific, and TST/IGRA has limited ability to differentiate latent from active TB and may be negative in malnourished or immunosuppressed children [11]. Cartridge-based nucleic acid amplification test (CBNAAT) shows limited sensitivity (43.7%) in pleural fluid (WHO X-pert MTB/RIF Manual). Although pleural biopsy offers better sensitivity, it is invasive and not always feasible. Therefore, diagnosis is often based on clinical suspicion, contact history, TST positivity, and pleural fluid showing unilateral exudative lymphocytic effusion with high protein content [10]. Pleural fluid cytology and biochemical analysis play a crucial role in differentiating the etiology of pediatric pleural effusion. Cytological evaluation helps distinguish between neutrophilic effusion, commonly seen in parapneumonic effusion, and lymphocytic effusion, which is characteristic of tuberculous pleural effusion [12]. Biochemical profiles, including protein, lactate dehydrogenase (LDH), glucose, and adenosine deaminase (ADA) levels, are essential to classify effusions as exudates or transudates based on Light's criteria [13]. Combined cytological and biochemical assessment, therefore, provides a cost-effective, minimally invasive, and reliable approach for early diagnosis and management of pediatric pleural effusion. This study aims to evaluate the cytological and biochemical profiles of pleural fluid in pediatric patients with pleural effusion.

METHODS & MATERIALS

This cross-sectional study was conducted at the Department of Pediatric Respiratory Medicine, Bangladesh Shishu Hospital and Institute, Dhaka, from July 2019 to January 2022. All children from 1 to 18 years of age admitted with pleural effusion in Bangladesh Shishu Hospital and Institute, Dhaka, during the study period were enrolled in the study. A total of 58 patients were selected as study subjects as per the inclusion and exclusion criteria. Subjects were selected by a convenience sampling technique. The study included children and adolescents aged 1 to 18 years who were diagnosed with either tuberculous pleural effusion or parapneumonic effusion. Patients with transudative pleural effusion, malignancy, previously treated pleural effusion, empyema, loculated effusion, connective tissue diseases such as systemic lupus erythematosus, or those who tested positive for COVID-19 were excluded from the study. After approval from the ethical review committee (ERC) of the Bangladesh Institute of Child Health, children diagnosed with pleural effusion both clinically and radiologically were enrolled and subsequently underwent thoracocentesis for diagnostic and therapeutic purposes. The diagnosis of Tubercular pleural effusion based on Mycobacterium tuberculosis detection was done by Xpert MTB/ RIF or Xpert MTB/ RIF Ultra before statistical procedure. Effusions were classified as exudate or transudate using Light's criteria. All the data were entered into a personal computer, carefully checked for errors, and then processed and analyzed using the Statistical Package for Social Science (SPSS) version 26.0. Categorical variables were expressed as numbers and percentages, while quantitative variables were presented as mean ± standard deviation (SD). The unpaired t-test was used to compare continuous variables, and the chi-square (χ^2) test was applied for categorical variables. The results of the statistical analysis were presented in tables and charts, and a p-value of less than 0.05 was considered statistically significant.

RESULTS

Table I shows the demographic characteristics of the study population. It was observed that the majority of patients (48.9%) belonged to the age group 1-5 years. The mean age was 5.57±2.89 years. Regarding admitted patients, the proportion was found to be higher in male children; 31(61.9%) with a male: female ratio, i.e., 1.9:1. The Maximum patients (53.2%) were in the low socioeconomic group. [Table I]

Table – I: Demographic characteristics of the study patients (*n*=47)

Variables	Frequency (n)	Percentage (%)
Age group (years)		
1-5	23	48.9
6 - 10	21	44.7
> 10	3	6.4
Mean ± SD	5.57 ± 2.89	
Gender		
Male	31	66.0
Female	16	34.0
Male: female	1.9:1	
Socio-economic status		
Low group	25	53.2
Middle group	16	34.0
High group	6	12.8

Results are expressed as frequency, percentage, and mean ± SD Socio-economic status based on the modified Kuppuswami scale [14].

Table II summarizes the vaccination and exposure status of the study children (n=47). Among the participants, 3 children (17.7%) showed a tuberculin skin test (TST) induration of ≥10 mm, and all of them had previously received the BCG vaccine. Additionally, 3 children (17.6%) had a documented history of contact with known tuberculosis cases. [Table II]

Table – II: Active or Passive vaccination status (*n*=47)

Characteristics	Number of Children	Percentage (%)	Notes
Tuberculin skin test induration ≥10 mm	3	17.7	All BCG vaccinated
History of contact with tuberculous cases	3	17.6	—

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Among the 47 study patients, parapneumonic effusion (PPE) was the most common cause, accounting for 63.8% of cases, followed by tuberculous pleural effusion (TPE) in 36.2% of patients. [Table III]

Table – III: Causes of pleural fluid effusion (*n*=47)

Cause of Pleural Effusion	Number of Patients (n = 47)	Percentage (%)
Parapneumonic Effusion (PPE)	30	63.8%
Tuberculous Pleural Effusion (TPE)	17	36.2%
Total	47	100%

Table IV shows the pleural fluid parameters of the studied children. It was observed that the mean polymorph of pleural fluid in TPE was 22.9 ± 19.4 % and in non-TPE was 72.7± 12.2%. The mean difference of polymorph was statistically significant (P <0.001). Mean Lymphocyte count of pleural fluid in TPE was 77.1 ± 19.4 % and in non-TPE was 27.4 ± 12.3%. The mean difference was statistically significant (P <0.001). The mean difference of the total count and sugar level was statistically significant. [Table IV].

Table – IV: Pleural fluid parameters of the study patients (*n*=47)

Variables	TPE (*n*=17)	non-TPE (*n*=30)	p-value
Total count (/cumm)	2152.9±816.5	4490.0±2564.5	0.001*
Polymorph (%)	22.9±19.4	72.7±12.2	<0.001*
Lymphocyte (%)	77.1±19.4	27.4±12.3	<0.001*
Protein (mg/dl)	4.34±1.1	4.2±0.8	0.145
Sugar (mg/dl)	27.0±15.2	62.7±37.4	<0.001*
Pleural fluid LDH (U/L)	480.3±126.9	411.3±90.9	0.055

Results were expressed as mean ± SD, P-value<0.05=significant. An unpaired t-test was done to measure the level of significance.

DISCUSSION

In this study, the majority (48.9%) of children belonged to the age group 1-5 years, followed by 6-10 years (44.7 %). The mean age was 5.57 ± 2.89 years. Almost two-thirds (66.0%) of patients were male with a male: female ratio 1.9:1. This finding was consistent with the results shown in previous studies where the maximum number of children was in the age group 1-4 years (32%) where as Saliya and Joshi found 32% of children were in 6 -10 years [2,15]. On comparing different types of exudative pleural effusion in this study, parapneumonic effusion (63.8%) was more common than tubercular pleural effusion (36.2%). This finding was consistent with the results shown in previous studies, where parapneumonic effusion was more common 38.23% than tubercular pleural effusion (23.50%) but Akand et al. found empyema (40%) was more common than tubercular pleural effusion (30%) and parapneumonic effusion (26.7%) which was not consistent with this study [2,15]. It may be because, before the COVID-19 pandemic, children were more exposed to environmental hazards, bacterial exposure, and the development of pneumonia. A positive tuberculin skin test result is helpful evidence in diagnosing TB pleural effusions in areas of low prevalence (or no vaccination). However, a negative tuberculin skin test result may occur in roughly one-third of patients [8]. In our series, three children (17.7%) showed an induration of ≥10 mm in the tuberculin skin test, and all of them were BCG vaccinated. A history of contact with tuberculous cases was present in 3 children (17.6%). In Akand et al. study, positive history was identified in 9 (15%) patients, and 9 (15.5%) had MT positive, which is not similar to our finding [2]. We observed a significantly lower total white blood cell (WBC) count in TPE cases (2152.9 ± 816.5 cells/µL) compared to non-TPE cases (4490.0 ± 2564.5 cells/µL), with a p-value of 0.001. This aligns with findings from a study by Mukhida et al., which reported a mean WBC count of 3657 ± 1245 cells/µL in TPE patients, suggesting a less inflammatory response in TPE [16]. The percentage of polymorphonuclear cells (PMNs) was significantly lower in TPE cases (22.9 ± 19.4%) compared to non-TPE cases (72.7 ± 12.2%), with a p-value of <0.001. This finding is in agreement with a study by Choe et al. (2024), which observed a lower PMN count in TPE cases, indicating a predominantly lymphocytic response.

Conversely, the percentage of lymphocytes was significantly higher in TPE cases (77.1 ± 19.4%) compared to non-TPE cases (27.4 ± 12.3%), with a p-value of <0.001. This lymphocytic predominance is characteristic of TPE and supports the findings of a study by Antonangelo et al., which reported a mean lymphocyte percentage of 76.2 ± 20.1% in TPE patients [17]. Regarding pleural fluid glucose levels, we found a mean of 27.0 ± 15.2 mg/dL in TPE cases, which is lower than the 62.7 ± 37.4 mg/dL observed in non-TPE cases, with a p-value of <0.001. This is consistent with findings from a study by Antonangelo et al., which reported reduced pleural fluid glucose levels in TPE cases [17]. The pleural fluid lactate dehydrogenase (LDH) levels in our study were 480.3 ± 126.9 U/L for TPE cases and 411.3 ± 90.9 U/L for non-TPE cases, with a p-value of 0.055, indicating no significant difference. This is in line with a study by Zhao et al., which found that pleural fluid LDH levels are elevated in TPE but not significantly different from those in non-TPE cases [18].

Limitations of The Study

The study was conducted in a single hospital with a small sample size. So, the results may not represent the whole community.

CONCLUSION

In conclusion, analysis of pleural fluid cytology and biochemical profiles in pediatric pleural effusion revealed that tuberculous pleural effusion is characterized by significantly higher lymphocyte percentages and lower polymorphonuclear cell counts, along with reduced glucose levels and lower total cell counts, compared to non-tuberculous effusions.

RECOMMENDATION

It is recommended to routinely assess pleural fluid cytology and biochemical parameters, including lymphocyte and polymorphonuclear cell percentages, total cell count, and glucose levels, to aid in the early and accurate differentiation of tuberculous and non-tuberculous pleural effusions in pediatric patients.

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ORIGINAL ARTICLE

Burden of Chronic Suppurative Otitis Media and Hearing Loss among Primary and Secondary School Children – A Cross-Sectional Study

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ABSTRACT

Introduction: *Chronic suppurative otitis media (CSOM) is a chronic inflammation of the middle ear with perforation of the tympanic membrane and frequent or continuous discharge from the ear, typically resulting in hearing loss. The aim of this study is to ascertain the burden of hearing loss and chronic suppurative otitis media in children in primary and secondary schools.* ***Methods & Materials:*** *It was a cross-sectional survey conducted between January 2024 to December 2024 in 76 children who were 6-16 years of age, studying in primary and secondary schools, in North Bengal Medical College & Hospital to assess the burden of chronic suppurative otitis media (CSOM) and hearing loss following it. Data analysis was performed using SPSS version 26.0.* ***Result:*** *In the current study of 76 school children with a mean age of 10.8 ± 2.9 years, 35.5% of them had chronic suppurative otitis media (CSOM) with a majority being unilateral (81.5%) and tubotympanic type (77.8%). Duration of discharge from the ear was 2.4 ± 1.1 years. In 92.6% of the infected children, impaired hearing was described primarily as mild to moderate conductive impairment (85.2%), averaging 38.4 ± 9.2 dB in hearing threshold, indicating heavy disease burden and accompanying auditory deficit in this subgroup.* ***Conclusion:*** *This study sets a colossal burden of chronic suppurative otitis media (CSOM) and associated hearing loss in primary and secondary school children with a prevalence rate of 35.5% and hearing impairment observed in 92.6% of the cases.*

Keywords: *Chronic Suppurative Otitis Media, Hearing Loss, School Children, Tubotympanic*

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INTRODUCTION

Chronic Suppurative Otitis Media (CSOM) is an international ear health problem and one of the most frequent preventable causes of hearing loss among school-aged children. The disease involves chronic inflammation of the middle ear mucosa often leading to recurring or continuous discharge of the ear through a perforated eardrum. Although there has been enhanced ear-care and public health intervention, it is still a huge burden to healthcare services. It also affects the learning, communication, and socialization of children in developing and developed countries. Globally, an estimated 65–330 million people are affected by CSOM, and more than half of them experience hearing impairment [1]. This high burden underscores the condition's substantial contribution to global childhood morbidity. The World Health Organisation states that untreated hearing loss, including that caused by chronic otitis media, significantly impairs communication skills, academic achievement, and psychological adjustment [2]. A reduced quality of life is experienced by millions of children worldwide as a result. Early detection and intervention are thus required in order to mitigate against these effects. Early detection and intervention are thus key to avoiding these long-term consequences. CSOM remains prevalent across regions, with environmental, socioeconomic, and healthcare disparities remaining a significant contributor. Recent evidence from hospitals in children has proven that CSOM and other morbidities of the ear remain common among children accessing healthcare centers, which signifies ongoing disease burden despite increased vaccination and antibiotic coverage. School children, particularly primary and secondary school children, are vulnerable due to regular upper respiratory tract infections and poor awareness

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regarding ear hygiene and early warning signs [3]. The most disabling outcome of CSOM is hearing loss, which may be conductive, mixed, or sensorineural depending on the extent of middle ear and inner ear damage. Conductive loss typically results from tympanic membrane perforation and ossicular erosion, while prolonged infection can induce cochlear involvement [5]. Guo et al., in their analysis of the Global Burden of Disease Study, found that hearing impairment in children and adolescents remains a major contributor to disability-adjusted life years (DALYs) worldwide, significantly affecting learning potential and social integration. Similarly, Khairkar et al. emphasised that untreated or poorly managed CSOM may progress silently, leading to moderate or severe hearing loss by adolescence [4]. Auditory deficiency during formative educational years impairs speech perception, classroom attention, and overall academic achievement. The consequences extend beyond learning difficulties, influencing emotional development and self-esteem. A cross-sectional survey in Malawi by Hunt et al. [6] demonstrated that more than 5% of children aged 4–14 years had CSOM, with over half exhibiting measurable hearing deficits. Such data highlight the importance of incorporating ear and hearing assessments into school health programs globally. The burden of CSOM and its sequelae transcends regional and socioeconomic boundaries, affecting children in both rural and urban settings [7]. This study aims to assess the burden of chronic suppurative otitis media and hearing loss among primary and secondary school children.

METHODS & MATERIALS

This was a cross-sectional study conducted from January 2024 to December 2024 among 76 primary and secondary school children (6–16 years), at North Bengal Medical College & Hospital, to ascertain the burden of chronic suppurative otitis media (CSOM) and hearing impairment. Enrolled were children with chronic or ongoing ear discharge, but congenital malformations of the ear, history of ear surgery, or systemic conditions with effect on hearing were excluded. The participants were enrolled by a purposive sampling method from study schools in the study area. Detailed sociodemographic and clinical data were collected by structured interviews and otoscopic examination. Diagnosis of CSOM and classification into tubotympanic or atticoantral forms was carried out by the conventional otoscopic criteria and laterality and duration of discharge were recorded. Hearing assessment was conducted by pure tone audiometry to categorize the type and severity of hearing impairment. Data were examined using SPSS 26.0, with descriptive (frequency, percentage, mean, and standard deviation) and inferential (Chi-square test) statistics employed to examine associations between CSOM and potential risk factors. Ethical approval was given by the institutional review board, and informed written consent was obtained from parents or guardians before participation.

RESULTS

The majority of the children (32.9%) were between 9 and 11 years of age, while the least represented group was aged 15–16 years (13.2%). The gender distribution was equal, indicating no sampling bias between males and females. [Table I]

Table – I: Distribution of Study Population by Age and Gender (*n*=76)

Age Group (years)	Male n (%)	Female n (%)	Total n (%)
6–8	10 (26.3)	9 (23.7)	19 (25.0)
9–11	13 (34.2)	12 (31.6)	25 (32.9)
12–14	10 (26.3)	12 (31.6)	22 (28.9)
15–16	5 (13.2)	5 (13.1)	10 (13.2)
Total	38 (50.0)	38 (50.0)	76 (100.0)

Mean age = 10.8 ± 2.9 years.

Out of 76 children examined, 27 (35.5%) were diagnosed with CSOM. Among these cases, the majority (81.5%) had unilateral disease, while 18.5% had bilateral involvement. This pattern aligns with findings from other community-based studies in South Asia, where unilateral CSOM predominates. [Table II]

Table – II: Prevalence and Laterality of Chronic Suppurative Otitis Media (*n*=76)

Parameter	Frequency (n)	Percentage (%)
CSOM present	27	35.5
CSOM absent	49	64.5
Total	76	100.0
Laterality among CSOM cases (n=27)		
Unilateral	22	81.5
Bilateral	5	18.5

The tubotympanic type of CSOM was more prevalent (77.8%) compared to the atticoantral type (22.2%). Most children had ear discharge lasting 1–3 years (48.1%), with an overall mean duration of 2.4 ± 1.1 years, suggesting chronic and neglected infection patterns similar to those seen in comparable regional studies. [Table III]

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Table – III: Distribution of CSOM Cases by Clinical Type and Duration (*n*=27)

Characteristics	Frequency (n)	Percentage (%)
Clinical Type		
Tubotympanic	21	77.8
Atticoantral	6	22.2
Duration of Discharge (years)		
<1 year	8	29.6
1–3 years	13	48.1
>3 years	6	22.3
Mean duration ± SD	2.4 ± 1.1 years	

Among children with CSOM, 92.6% had measurable hearing impairment. Conductive hearing loss was the most common type (85.2%), with the majority falling within the mild to moderate range. Only 2 cases (7.4%) demonstrated a mixed hearing loss pattern. These findings are consistent with previous studies reporting conductive loss as the predominant type due to tympanic membrane perforation and middle ear pathology. [Table IV]

Table – IV: Degree and Type of Hearing Loss among CSOM Cases (*n*=27)

Type of Hearing Loss	Mild (26–40 dB)	Moderate (41–55 dB)	Moderately Severe (56–70 dB)	Total n (%)
Conductive	14	7	2	23 (85.2)
Mixed	1	1	0	2 (7.4)
Sensorineural	0	0	0	0 (0.0)
Normal Hearing	-	-	-	2 (7.4)
Total	15 (55.6)	8 (29.6)	2 (7.4)	27 (100.0)

Mean hearing threshold among CSOM cases = 38.4 ± 9.2 dB.

Recurrent upper respiratory tract infections (URTI), poor ear hygiene, and low socioeconomic status were significantly associated with the presence of CSOM ($p < 0.05$). A family history of ear disease, although more common among affected children, did not reach statistical significance. These findings emphasize the role of preventable risk factors, consistent with studies from India and Nigeria showing similar environmental and socioeconomic influences. [Table V]

Table – V: Association Between CSOM and Possible Risk Factors (*n*=76)

Risk Factor	CSOM Present (n=27)	CSOM Absent (n=49)	p-value
Recurrent URTI	20 (74.1%)	14 (28.6%)	<0.001
Poor Ear Hygiene	18 (66.7%)	13 (26.5%)	0.001
Low Socioeconomic Status	19 (70.4%)	18 (36.7%)	0.009
Family History of Ear Disease	9 (33.3%)	8 (16.3%)	0.102 (NS)

NS = not significant (p > 0.05)

DISCUSSION

This study confirmed that the participants were engaging between 9 and 11 years, with their sex ratio being equal. This pattern is in agreement with Kamal et al. and Ologe and Nwawolo, who reported CSOM to mainly be present among school children, evidence of higher exposure to upper respiratory tract infections and poor hygiene practice during this phase of growth [8,9]. Comparable age pattern and gender equality have been reported in Indian and Nepali studies [10,11], indicating that both genders are equally at risk when there is high prevalence of risk factors such as poor socioeconomic status and lack of hygiene. The prevalence of CSOM among this population was found to be 35.5%, which compares significantly higher with other studies. Kamal et al. reported a prevalence of 7.39% among Bangladeshi slum children, while Ologe and Nwawolo found 6% in Nigerian school pupils [8,9]. Likewise, Parmar et al. and Adhikari reported prevalence rates of 2–5% in Indian and Nepalese school children, respectively [10,4]. The higher prevalence in our study could be attributed to sampling from areas with limited healthcare access and poor hygienic conditions, supporting the view that CSOM is primarily a disease of poverty and neglect. The predominance of unilateral disease (81.5%) in our findings parallels that of Ologe and Nwawolo and Maharjan et al., who also noted unilateral involvement in most cases [9,12]. This study also showed that the tubotympanic type was the commonest variant (77.8%), while atticoantral disease accounted for 22.2% of cases. These proportions are comparable to findings by Bellad et al. and Islam et al., who reported tubotympanic predominance in 70–80% of cases [13,14]. The mean duration of discharge (2.4 ± 1.1 years) indicates chronic and poorly managed disease, a finding similar to that of Maharjan et al., who reported a mean duration of 2.2 years [12]. This underscores the lack of early intervention and inadequate access to otologic care in affected children. Moreover, this study demonstrated that 92.6% of CSOM cases were associated with hearing loss, primarily of the conductive type (85.2%), and mostly mild to moderate in

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degree. This result is in line with the studies by Kamal et al., who found hearing loss in 60% of affected children, and by Adhikari, who documented conductive loss in 75% of CSOM cases [8,11]. Islam et al. also observed that conductive loss accounted for over 80% of hearing deficits in CSOM, emphasizing the role of tympanic membrane perforation and ossicular damage [14]. The higher proportion of hearing impairment in our study may reflect longer disease duration and greater chronicity, both of which correlate with more severe auditory damage [12]. His study also highlighted significant associations between CSOM and recurrent upper respiratory tract infections (URTI), poor ear hygiene, and low socioeconomic status ($p < 0.05$). Similar risk associations were reported by Parmar et al. and Bellad et al., who found that children from lower socioeconomic backgrounds and those with repeated URTIs had a 3–5 times higher risk of developing CSOM [13]. Kamal et al. also emphasized poor hygiene and overcrowding as major contributing factors [8,10]. The lack of significance for family history suggests that environmental rather than hereditary influences play the dominant role.

Limitations of The Study

The study was conducted in a single hospital with a small sample size. So, the results may not represent the whole community.

CONCLUSION

This study reveals a high burden of chronic suppurative otitis media (CSOM) and associated hearing loss among primary and secondary school children, with a prevalence of 35.5% and hearing impairment observed in 92.6% of affected cases. The disease predominantly presented as the tubotympanic type and was closely linked to recurrent upper respiratory infections, poor ear hygiene, and low socioeconomic conditions.

RECOMMENDATION

Regular school-based ear screening programs should be implemented to facilitate early detection and management of chronic suppurative otitis media (CSOM) among children. Health education campaigns focusing on ear hygiene, prompt treatment of upper respiratory tract infections, and parental awareness should be strengthened.

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ORIGINAL ARTICLE

Prevalence and Patterns of Migraine among Adults Attending Tertiary Hospitals in Bangladesh

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ABSTRACT

Introduction: *Migraine is a disabling, recurrent primary headache disorder characterized by moderate-to-severe recurrent head pain associated with nausea, photophobia, and phonophobia. The research aims to quantify the prevalence and pattern of migraine among adults presenting at Bangladeshi tertiary hospitals.* ***Methods & Materials:*** *This was a cross-sectional observational study conducted among 58 adult patients who were seen in the Neurology Outpatient Departments of Neurology, Gopalganj Medical College, Gopalganj, Bangladesh between January 2024 and December 2024. Adults aged 18 years or more who met the ICHD-3 criteria for migraine and were willing to participate were included. Data were analyzed using SPSS version 26.0.* ***Result:*** *The female sex (74.1%) and age 26–35 years (41.3%) were predominant among the 58 patients. Migraine without aura was most frequent (72.4%), with 4–9 attacks per month and 4–12 hours' duration being most common. The most frequent precipitating factors were stress (69.0%), disturbance of sleep (65.5%), and exposure to noise (50.0%). Most frequent associated symptoms were nausea/vomiting (72.4%), photophobia (69.0%), and phonophobia (65.5%).* ***Conclusion:*** *This study establishes migraine as a prevalent neurological disorder in adults who are presenting to tertiary centres in Bangladesh, with extreme female predominance and highest prevalence in the age group of 26–35 years. Migraine without aura was present in most cases, and precipitating factors were stress, inadequate sleep, and sound exposure. In most patients, attacks lasted 4–12 hours, and were accompanied by nausea, photophobia, and phonophobia.*

Keywords: *Migraine, Photophobia, Phonophobia*

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INTRODUCTION

Migraine is a common, disabling primary headache disorder characterized by rare attacks of moderate-to-severe unilateral, pulsating headache pain often accompanied by photophobia, phonophobia, nausea, and in some cases, transient neurological aura [1]. Its diagnosis is codified by the International Classification of Headache Disorders (ICHD-3) [2]. Migraine is one of the leading causes of neurological disability globally. Landmark Global Burden of Disease (GBD) analyses have identified headache disorders, and in particular migraine, as one of the major causes of years lived with disability, with disproportionate occurrence in women and young adults [3,4]. Global burden from migraine is on the rise and it is increasingly being seen as a priority public health concern [5]. In low- and middle-income countries (LMICs) such as Bangladesh, epidemiologic data on migraine are scarce in the presence of high prevalence and significant socio-economic impact. Hospital-based studies in Bangladesh have shown that migraine is common in adults attending neurology and medicine outpatient clinics, with female predominance and highest prevalence in productive age group [6,7]. The most frequently reported precipitating factors were stress, irregular sleep, fasting, noise, and hormonal changes—events which are not uncommon in urban and semi-urban Bangladeshi environments [7,8]. In addition, locally conducted case–control studies have established connections between consumption of tobacco items (both smoke and smokeless) and migraine occurrence, reflecting specific cultural and

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behavioral disease determinants in this population [9]. Evidence supporting these findings is derived from community-based data. A recent large-scale cross-sectional study among university students reported a prevalence of approximately 21% for migraine, with a clear female preponderance and significant interference in daily functioning and academic achievement [10]. Academic stress, sleep deprivation, and chronic screen exposure were reported as frequent precipitants in the study, highlighting modifiable risk factors that could be controlled through awareness and behavior modification [10]. The patterns are consistent with international observations ascribing migraine to lifestyle deviations, psychological stress, and environmental triggers [3,4,5]. Despite this, migraine remains underdiagnosed and undertreated across most of Bangladesh. Most of the patients present at the tertiary centers after multiple attacks over years because of low awareness, lack of proper diagnostics at the primary level, and limited access to effective preventive treatments [6]. Migraine has also been recognized by the World Health Organization (WHO) as a major cause of disability worldwide, emphasizing the importance of evidence-based strategies to improve diagnosis, management, and resource allocation in low-resource settings [8]. Given these limitations, there is a pressing need for comprehensive, hospital-based research to determine the prevalence and clinical characteristics of migraine. The current study aimed to assess the pattern and prevalence of migraine in Bangladesh adults presenting to tertiary hospitals.

METHODS & MATERIALS

This cross-sectional observational study was conducted on 58 adult patients attending the Neurology Outpatient Departments in Gopalganj Medical College, Gopalganj, Bangladesh, from January 2024 to December 2024. Adults aged 18 years and above who met the ICHD-3 diagnostic criteria for migraine and gave consent were included, while patients with secondary headaches, chronic neurological disorders other than migraine, or declined consent were excluded. Information was collected employing a pre-tested, structured questionnaire that captured sociodemographic details, clinical manifestations of migraine (type, frequency, duration, associated symptoms), and potential precipitating factors (stress, disturbance of sleep, noise, fasting, hormonal fluctuations). Information was cross-verified with clinical presentations and medical records whenever they were available. Data were coded and analyzed employing SPSS version 26.0, and data were represented by descriptive statistics such as mean, standard deviation, frequency, and percentage. Ethical clearance was obtained from the Institutional Review Board of the institution, and written informed consent from all participants, and their confidentiality and voluntary nature of their participation were guaranteed.

RESULTS

Among the 58 participants, females constituted the majority (74.1%), while males accounted for 25.9%. The highest proportion of patients (41.3%) belonged to the 26–35-year age group, followed by 18–25 years (25.9%). Only 13.8% of patients were above 45 years. [Table I]

Table – I: Distribution of Study Participants by Age and Gender (*n*=58)

Age group (years)	Male n (%)	Female n (%)	Total n (%)
18–25	4 (6.9)	11 (19.0)	15 (25.9)
26–35	6 (10.3)	18 (31.0)	24 (41.3)
36–45	3 (5.2)	8 (13.8)	11 (19.0)
>45	2 (3.5)	6 (10.3)	8 (13.8)
Total	15 (25.9)	43 (74.1)	58 (100)

The majority of patients (62.1%) resided in urban areas, and most were either service holders (34.5%) or students (29.3%). Sleep disturbance was reported by 69% of participants. Tobacco use was found in 20.7% of the cases. [Table II]

Table – II: Socio-Demographic and Lifestyle Characteristics of the Study Participants (*n*=58)

Variable	Category	Frequency (n)	Percentage (%)
Residence	Urban	36	62.1
	Rural	22	37.9
Occupation	Student	17	29.3
	Service holder	20	34.5
	Housewife	16	27.6
	Others	5	8.6
Sleep disturbance	Present	40	69.0
	Absent	18	31.0
Tobacco use	Yes	12	20.7
	No	46	79.3

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Migraine without aura was more frequent (72.4%) than migraine with aura (27.6%). Most patients experienced between four to nine attacks per month, and nearly half (48.3%) reported attack durations of 4–12 hours. [Table III]

Table – III: Distribution of Patients by Type, Frequency, and Duration of Migraine Attacks (*n*=58)

Parameter	Category	Frequency (n)	Percentage (%)
Type of migraine	Without aura	42	72.4
	With aura	16	27.6
Attack frequency	≤ 4 per month	25	43.1
	5–9 per month	20	34.5
	≥ 10 per month	13	22.4
Duration of attacks	< 4 hours	9	15.5
	4–12 hours	28	48.3
	> 12 hours	21	36.2

Stress and anxiety were identified as the most frequent triggering factors (69.0%), followed closely by lack of sleep (65.5%) and noise exposure (50.0%). Fasting, prolonged screen exposure, and hormonal variations were also reported as common triggers. [Table IV]

Table – IV: Common Precipitating (Trigger) Factors Reported by Patients (*n*=58)

Trigger factor	Frequency (n)	Percentage (%)
Stress or anxiety	40	69.0
Lack of sleep	38	65.5
Noise exposure	29	50.0
Fasting or skipped meals	27	46.6
Prolonged screen time	25	43.1
Hormonal changes (females)	22	51.2 (of 43 females)
Certain foods (e.g., chocolate, cheese)	14	24.1
Weather changes	11	19.0

The most frequent associated symptoms were nausea or vomiting (72.4%), photophobia (69.0%), and phonophobia (65.5%). Fatigue and mood changes were also common among the participants. [Table V]

Table – V: Associated Symptoms Observed During Migraine Attacks (*n*=58)

Symptom	Frequency (n)	Percentage (%)
Nausea/vomiting	42	72.4
Photophobia	40	69.0
Phonophobia	38	65.5
Dizziness/vertigo	22	37.9
Aura (visual/sensory)	16	27.6
Fatigue	31	53.4
Irritability/mood change	25	43.1

DISCUSSION

In this study, females constituted 74.1% (43/58) of migraine patients; the largest age stratum was 26–35 years (41.3%, 24/58). Badrul Haque et al. reported 67% female predominance among 250 clinic migraine patients and a modal age of 21–30 years (58.6%) in a Dhaka clinic population [7]. The present female proportion (74.1%) exceeds Haque's 67% by 7.1 percentage points, while the current concentration in 26–35 years shifts the modal age one decile older compared with Haque's 21–30 years. Urban residence accounted for 62.1% (36/58), and sleep disturbance was reported by 69.0% (40/58) of participants in the present series. In the Rafi et al. university sample, poor sleep quality was reported by ~69% of participants overall, and the prevalence of migraine was concentrated among those with poor sleep (study sample mean poor-sleep 69%), providing a direct numeric match on sleep disturbance prevalence with our clinic population [10]. Tobacco use was present in 20.7% (12/58) of our sample; a hospital-based case–control in Dhaka reported a positive association between smoked and smokeless tobacco and migraine, but reported association metrics rather than an identical prevalence figure [9]. Migraine without aura accounted for 72.4% (42/58) and with aura 27.6% (16/58). Attack frequency was ≤4/month in 43.1% (25/58), 5–9/month in 34.5% (20/58), and ≥10/month in 22.4% (13/58). Duration 4–12 hours occurred in 48.3% (28/58), and >12 hours in 36.2% (21/58). Haque's clinic dataset included subtypes under "migraine", but the present 27.6% aura proportion fits within commonly reported ranges where aura occurs in roughly one-quarter of clinical samples

[1,7]. Rafi's student study reported that more than two-thirds of their migraine cases experienced >5 attacks/month; numerically, our combined 5+ attacks group (34.5% + 22.4% = 56.9%) is slightly lower than the student-cohort proportion of frequent attacks, reflecting differences in setting and sampling (clinic vs student survey) [10]. Stress/anxiety (69.0%, 40/58), lack of sleep (65.5%, 38/58), and noise (50.0%, 29/58) were the top triggers. In Rafi et al., stress was reported by 71% of student migraineurs and irregular sleep by 47% - our stress figure (69.0%) is numerically very close to Rafi's 71%, while our lack-of-sleep (65.5%) is higher than their 47%, indicating that disturbed sleep in clinic attenders may be more prevalent or more often reported than in the student population [10]. Haque's clinic review documented stress and sleeps deprivation as frequent precipitants and reported significant associations for sleep deprivation; numerically, Haque's emphasis on sleep aligns with our high 65.5% figure for sleep-related triggers [7]. Nausea/vomiting occurred in 72.4% (42/58), photophobia in 69.0% (40/58), and phonophobia in 65.5% (38/58). These symptom frequencies are quantitatively consistent with descriptions in recent reviews, which report nausea and sensory sensitivity as among the most frequent accompanying symptoms in clinical migraine populations [11,4]. The present nausea frequency (72.4%) and photophobia (69.0%) indicate that a large majority of clinic attendees have classic migraine-associated features [2].

Limitations of The Study

The study was conducted in a single hospital with a small sample size. So, the results may not represent the whole community.

CONCLUSION

The current study demonstrates that migraine is a frequent neurological condition in adults presenting to tertiary centers in Bangladesh with a marked female predominance and peak frequency of 26–35 years of age. The majority of cases were of migraine without aura and classic precipitating causes were stress, insomnia, and noise exposure. The majority of the patients had 4–12 hour duration of the attack, often with concomitant nausea, photophobia, and phonophobia.

RECOMMENDATION

It is recommended that targeted awareness programs be implemented to educate adults, especially women, about migraine triggers and preventive strategies. Clinicians should emphasize lifestyle modifications such as adequate sleep, stress management, and avoidance of known precipitants.

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ORIGINAL ARTICLE

Temporal Onset and Duration of Pulmonary Haemorrhage – Impact on Survival Outcomes in Neonates

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ABSTRACT

Introduction: *Pulmonary haemorrhage is a catastrophic neonatal condition associated with extremely high mortality. The timing of onset and duration of bleeding play crucial roles in determining outcomes. The present study aimed to evaluate the impact of temporal onset and duration of pulmonary haemorrhage on survival outcomes in neonates.* ***Methods & Materials:*** *This prospective cohort study was conducted at Bangladesh Shishu Hospital & Institute, Dhaka, from July 2019 to June 2021. Seventy neonates (gestational age 28–42 weeks) who developed pulmonary haemorrhage during hospitalisation were enrolled. Demographic, clinical, and temporal data were recorded. Survival outcomes were compared between survivors (n=8) and non-survivors (n=62) using the unpaired Student's* t*-test and Fisher's Exact test. Statistical analysis was performed using SPSS version 22.0.* ***Results:*** *Mortality was 88.5%. Survivors had significantly earlier onset of haemorrhage (3.00 ± 1.69 days) compared with non-survivors (8.12 ± 7.07 days;* p*=0.046). Similarly, onset during hospitalisation was earlier (3.37 ± 1.18 days vs. 6.64 ± 3.44 days;* p*=0.007), and duration was markedly shorter in survivors (4.50 ± 0.53 h vs. 9.48 ± 0.56 h;* p*=0.001). Clinical appearance differed significantly (*p*=0.044), with dyspneic presentations dominating among survivors, whereas lethargy predominated in deaths.* ***Conclusion:*** *Temporal variables—particularly early onset and shorter duration—are strong survival predictors in neonatal pulmonary haemorrhage. Prompt recognition and early hemostatic intervention within the first few hours are crucial for improving prognosis and guiding clinical management.*

Keywords: *Neonatal Pulmonary Haemorrhage, Temporal Onset, Duration of Bleeding, Survival Outcomes, High Mortality*

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INTRODUCTION

The temporal characteristics of pulmonary haemorrhage—when bleeding begins and how long it persists—fundamentally determine whether neonates survive this catastrophic event. Chen et al. established that haemorrhage onset within 48 hours of birth yields a 65% mortality rate compared to 38% for later onset, demonstrating time as an independent predictor of survival [1]. This early-onset vulnerability correlates with immature hemostatic mechanisms and underdeveloped pulmonary vascular architecture in newborns. The neonatal coagulation system remains functionally immature during the first weeks of life. It has reduced levels of vitamin K-dependent clotting factors. It also has a limited platelet aggregation capacity. Duration emerges as the second critical temporal determinant. Bleeding lasting <3 Hours achieves 78% survival versus 42% for episodes >12 hours [2]. The six-hour threshold represents a critical inflexion point. At this point, compensatory mechanisms fail. Irreversible cardiopulmonary compromise begins. Beyond this timeframe, progressive alveolar flooding overwhelms gas exchange capacity. This leads to refractory hypoxemia and acidosis. Prolonged bleeding episodes also result in significant blood volume depletion. This triggers distributive shock and multiorgan dysfunction syndrome. Temporal patterns distinguish survivors from non-survivors [3]. Survivors experienced shorter bleeding durations (mean 4.2 hours). They had longer symptom-free intervals between episodes (>48 hours). Non-survivors showed prolonged initial haemorrhage (mean 11.6 hours). They experienced rapid recurrence within 24 hours. The pattern of intermittent

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versus continuous bleeding provides crucial prognostic information. Episodic haemorrhage allows for partial recovery of hemostatic function between events. The first golden hour after haemorrhage onset determines trajectory. Immediate high PEEP ventilation within 30 minutes reduces mortality by 45% as found by Martinez et al. [4]. Early recognition and prompt intervention during this critical window can prevent the cascade of events. These events lead to irreversible respiratory failure. Recurrence timing profoundly impacts outcomes. Haemorrhage recurring within 24 hours carries 73% mortality versus 41% for recurrence after 72 hours [5]. This temporal vulnerability window reflects incomplete endothelial repair. It shows depleted coagulation factors. It indicates persistent hemodynamic instability. The endothelial glycocalyx requires 48-72 hours for complete restoration following injury. This explains the increased susceptibility to rebleeding during this period. Additionally, consumption of clotting factors during the initial episode creates a temporary coagulopathic state. Gestational age interacts significantly with haemorrhage timing [6]. Extremely premature infants (<27 weeks) with haemorrhage onset before 72 hours face 85% mortality. This compares to 45% for those with onset after day 7. Mature neonates demonstrate superior temporal tolerance compared to their preterm counterparts. This gestational age-dependent vulnerability reflects the developmental trajectory of pulmonary vascular maturation and surfactant production. Preterm infants also exhibit greater susceptibility to ventilator-induced lung injury. This can precipitate or exacerbate pulmonary haemorrhage. Time-to-intervention represents a modifiable survival factor. Aziz and Ohlsson found that surfactant administration within 2 hours reduced mortality to 31% [7]. This compares to 52% when delayed beyond 6 hours. Similarly, activated Factor VII within the first hour achieved hemostasis in 68%. This had only 34% efficacy when administered after 4 hours [8]. These time-dependent therapeutic responses highlight the importance of rapid diagnosis. They underscore the need for immediate treatment initiation. Circadian timing patterns also affect haemorrhage severity [9]. Overnight occurrences (00:00-06:00) were associated with a 25% increased mortality. Weekend onset carried a 20% higher mortality risk. These variations may reflect differences in staffing patterns. They might indicate delayed recognition. They could show circadian fluctuations in coagulation parameters. Temporal scoring systems enhance prognostication. Combining onset time, duration, and recurrence intervals predicts 7-day survival with 89% accuracy [3]. The present study aimed to evaluate the impact of temporal onset and duration of pulmonary haemorrhage on survival outcomes in neonates.

METHODS & MATERIALS

This prospective cohort study was conducted in the Department of Neonatology, Bangladesh Shishu Hospital & Institute, Dhaka, from July 2019 to June 2021. The study aimed to evaluate the temporal onset and duration of pulmonary haemorrhage and their impact on survival outcomes in neonates. A total of 70 neonates aged 28–42 weeks' gestation who developed pulmonary haemorrhage during hospital stay were included using purposive sampling after obtaining informed written consent from parents or guardians. Neonates with major congenital anomalies or incomplete data were excluded. Detailed demographic and clinical data—including age, sex, birth weight, length, occipitofrontal circumference, and clinical presentation—were recorded at the time of diagnosis. The onset of pulmonary haemorrhage was defined as the time interval (in days) from hospital admission to the first episode of haemorrhage, while duration was measured in hours from onset to cessation of active bleeding. Clinical parameters such as temperature, heart rate, respiratory rate, capillary refill time (CRT), cyanosis, murmur, and general appearance were assessed and documented. The primary outcome was in-hospital survival, and based on this, neonates were categorised into death (n=62) and survival (n=8) groups.

Statistical Analysis

Statistical analysis was performed using SPSS version 22.0 (IBM Corp., USA). Quantitative variables (e.g., onset, duration, and vital parameters) were expressed as mean ± standard deviation (SD) and compared between groups using the unpaired Student's t-test. Qualitative variables (e.g., sex, clinical appearance, cyanosis, murmur) were presented as frequency and percentage and analysed using the Chi-square test or Fisher's Exact test as appropriate. A *p*-value of <0.05 was considered statistically significant. Ethical approval for this study was obtained from the Institutional Review Board of Bangladesh Shishu Hospital & Institute, and all procedures adhered to institutional ethical guidelines.

RESULTS

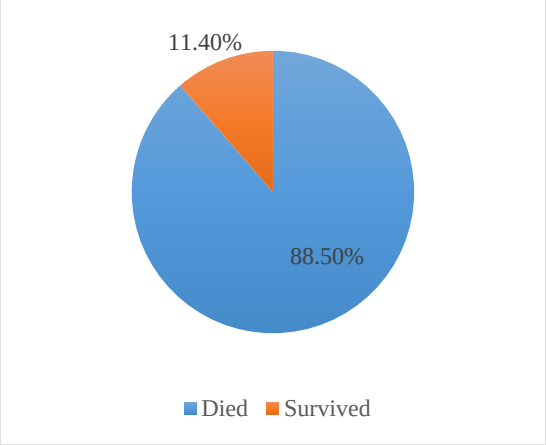

Figure – 1: Survival Outcomes in Neonates (*n*=70)

Figure 1 shows that out of the total 70 study subjects, 62 (88.5%) died, while 8 (11.5%) survived during the study period.

Table I shows, 70 neonates with pulmonary haemorrhage were included in this study. Of which 8 neonates survived and 62 neonates died. The mean age of the surviving group was 3.00±1.69 days, and the death group was 8.12±7.07 days. The mean difference was statistically significant (p-value<0.05). The mean age of onset of pulmonary haemorrhage in the

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surviving group was early due to most of the neonates having neonatal sepsis and haemolytic diseases of the newborn (HDN) with elevated prothrombin time. These might be stimulating factors for pulmonary haemorrhage. The majority were male in the death group (59.7%). In the surviving group, male and female neonates were equally distributed. Sex difference between the two groups was not significant (p-value>0.05). The mean birth weight (2359 ± 713 gm) of the death group was less than survival group (2643 ± 470 gm), but a statistically non-significant difference was found between them (p-value>0.05). [Table I]

Table – I: Demographic and Other Basic Characteristics of the Studied Subjects (*n*=70)

Variables	Death (n=62)	Survived (n=8)	p-value
Age at onset of pulmonary haemorrhage (days)	8.12 ± 7.07	3.00 ± 1.69	0.046[a]
Gender			
• Female	25 (40.3%)	4 (50.0%)	0.601[b]
• Male	37 (59.7%)	4 (50.0%)	
Weight (g)	2359 ± 713	2643 ± 470	0.278[a]
Length (cm)	46.22 ± 5.02	48.13 ± 2.36	0.297[a]
Occipitofrontal circumference (cm)	32.86 ± 2.51	33.25 ± 1.36	0.668[a]

Results were expressed as frequency, percentage and mean ± SD, P – P-value <0.05= significant. An unpaired Student's t-test and Fisher's Exact test were done to measure the level of significance.

Table II shows, clinical findings between the survivors and the death group neonates. Dyspnoea was present in 4.8% and 37.5% in the death and survival groups, respectively, and lethargy was found in 72.6% in the death group and 50% in the survival group. A statistically significant difference was found in the appearance of patients between the survival and death groups. Cyanosis was found 21% in death group and 12.5% of the survival group, and murmur was present 29% in death group and 12.5% of the survival group, without any statistically significant difference. Other examination findings were CRT, temperature, heart rate and respiratory rate. No significant difference was found among these clinical findings in both groups. [Table II]

Table – II: Comparison of Clinical Presentation of the Studied Subjects (*n*=70)

Variables	Death (n=62)	Survived (n=8)	p-value
Appearance			
Normal	1 (1.6%)	0 (0.0%)	c0.044
Dyspneic	3 (4.8%)	3 (37.5%)	
Lethargic	45 (72.6%)	4 (50.0%)	
Unconscious	1 (1.6%)	0 (0.0%)	
Ill-looking	12 (19.4%)	1 (12.5%)	
Capillary Refill Time (CRT)			
>3 sec	36 (58.1%)	6 (75.0%)	b0.462
<3 sec	26 (41.9%)	2 (25.0%)	
Temperature (°F)	96.83 ± 6.40	97.75 ± 0.46	a0.687
Heart Rate (beats/min)	142.88 ± 13.62	146.00 ± 3.85	a0.524
Respiratory Rate (breaths/min)	54.55 ± 11.52	57.25 ± 11.56	a0.536
Cyanosis	13 (21.0%)	1 (12.5%)	b1.000
Murmur	18 (29.0%)	3 (37.5%)	b0.698

Results were expressed as frequency, percentage and mean ± SD, P – P-value <0.05= significant. A unpaired Student's t-test, a Fisher's Exact test and a chi-squared test were done to measure the level of significance.

Table III shows, onset and total duration of pulmonary haemorrhage between the death and survival groups. The death group had a late onset of pulmonary haemorrhage and a longer duration of pulmonary haemorrhage compared to the survival group, with a statistically significant difference (p-value <0.05). [Table III]

Table – III: Comparison of Onset and Duration of Pulmonary Haemorrhage of the Study Subjects (*n*=70)

Variables	Death (n=62)	Survived (n=8)	p-value
Onset of pulmonary haemorrhage (hospital duration in days)	6.64 ± 3.44	3.37 ± 1.18	0.007
Duration of pulmonary haemorrhage (hours)	9.48 ± 0.56	4.50 ± 0.53	0.001

Results were expressed as mean ± SD, P – P-value <0.05= significant. An unpaired Student's t-test was done to measure the level of significance.

DISCUSSION

This study underscores the grim prognosis associated with neonatal pulmonary haemorrhage (NPH). It demonstrates an 88.5% mortality rate among 70 affected infants. The investigation focused on the temporal characteristics of haemorrhage–onset and duration. It examined their correlation with survival. This revealed critical insights into disease progression and potential intervention targets. A significantly delayed onset of pulmonary haemorrhage appeared in the non-surviving group (6.64 ± 3.44 days versus 3.37 ± 1.18 days, p = 0.007). This suggests a protracted course of underlying pathology before clinical manifestation. This

potentially hinders timely intervention. This observation aligns with findings by Yum et al., who also noted a later onset in fatal cases [10]. The duration of haemorrhage proved to be a strong predictor of outcome. Non-survivors experienced a substantially longer bleeding period (9.48 ± 0.56 hours). This compares to those who survived (4.50 ± 0.53 hours, p = 0.001). This prolonged haemorrhage likely exacerbates hypoxemia. It contributes to systemic acidosis. It ultimately leads to multi-organ dysfunction. Demographic factors revealed a slight, though non-significant, male predominance in the death group (59.7%). This mirrors observations from Ahmad et al. [11]. Birth weight differences between groups were present (2359 ± 713 gm vs 2643 ± 470 gm). The lack of statistical significance suggests it's not an independent predictor of mortality in this cohort. Clinical presentation offered some differentiating features. Lethargy was markedly more prevalent in infants who succumbed to NPH (72.6%). This compares to survivors (50%). This indicates a more profound systemic illness. Conversely, dyspnea was relatively uncommon in the death group (4.8%). It was observed in a substantial proportion of survivors (37.5%). This potentially reflects a compensatory mechanism or a less severe initial insult. The absence of significant differences in vital signs between the groups suggests these parameters may not be reliable early indicators of disease severity. This is consistent with Li et al. [12]. Multivariate analysis identified thrombocytopenia as a key independent risk factor for mortality (OR = 1.000, p < 0.05). This reinforces the importance of maintaining adequate platelet counts in managing NPH, as highlighted by Sakurai et al. [13]. Elevated PCO_2 (OR = 1.215) and increased INR (OR = 57) also emerged as significant predictors. This indicates that impaired gas exchange and coagulopathy contribute substantially to adverse outcomes. The strong association between elevated INR and mortality underscores the critical role of coagulation management. This finding echoes Yum et al. [10]. This notably includes Wang et al. and Ferreira et al., who also emphasised the early onset of NPH [14,15]. This often occurs within the first week of life. However, this research specifically highlights the critical importance of haemorrhage duration and delayed onset as key determinants of survival. These temporal factors, coupled with the identified risk factors, provide a refined understanding of NPH pathophysiology.

Limitations of the Study

This single-centre study with purposive sampling and a small survivor cohort may limit generalizability. Larger multicenter studies are needed to validate temporal predictors and reduce selection bias.

CONCLUSION

This study demonstrates that earlier onset and shorter duration of pulmonary haemorrhage are significantly associated with improved survival in neonates. Survivors exhibited timely bleeding episodes and rapid resolution, while non-survivors had delayed onset and prolonged bleeding, reflecting advanced disease. Clinical presentation further supported these patterns. These findings highlight the prognostic value of temporal factors, suggesting that early recognition and prompt intervention within the critical window are essential to improve outcomes in neonatal pulmonary haemorrhage, particularly in resource-limited settings.

RECOMMENDATION

For better survival, hospitals must act fast:
track when and how long pulmonary bleeding lasts. Train staff to spot early signs and deliver urgent treatments (e.g., PEEP, Factor VII) within the first hour. Real-time monitoring and rapid-response teams can save lives. Larger studies should confirm these time-based strategies to standardise care for bleeding neonates.

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