

TMSS Medical College Journal (TMCJ)

Volume 25, Issue 02, July 2026

Contents

Editorial

- ♦ Medical Care in War and Armed Conflict: When Humanity Must Remain above the Battlefield. 07-09
Montasir AA, Alwawi AA, Abdullah OD

Original Article

- ♦ Knowledge Regarding Drowning among Rural People in a Selected Area of Joypurhat, Bangladesh. 11-17
Zannat K, Habib A, Tasnim T, Ansari AAM, Hoque SMU, Akter R
- ♦ Assessment of Serum Lipid Profile among Patients with Non Alcoholic Fatty Liver Disease by Ultrasonography. 19-27
Hossan MA, Ray J, Acharjee U
- ♦ ABody Mass Index at Third Trimester and Pregnancy Outcome in the Bangladeshi Population Attending a Tertiary Care Hospital. 29-37
Begum A, Montasir AA, Nazim R, Neeger MN, Ghosh UK, SoniaAA
- ♦ Role of Serum Uric Acid and Creatinine as a Prognostic Indicator of the Severity of Maternal and Fetal Complications in Preeclampsia. 39-45
Siddiqua S, Alamgir MH, Parvin A, Afrin F
- ♦ Laboratory-Based Surveillance of Dengue, Malaria, Syphilis, and Viral Hepatitis in Three Rohingya Refugee Camps in Cox's Bazar, Bangladesh. 47-54
Murshid ME, Islam S, Akhiruzzaman, Asha DA, Rahaman MM
- ♦ Study of Sacral Hiatus and its Implication in Caudal Epidural Block. 55-61
Khanam A, Sarker MSA, Naznin RA, Benzir M, Akter T, Talukder AP

Case Report

- ♦ Measles in Adult Patients: A Case Series of 15 Cases from the Medicine Inpatient Department of TMSS Medical College, Bangladesh. 63-66
Montasir AA, Iqbal F, Rahman A, Hossain Z, Ahmad FU, Afrin J



An Official Publication of TMSS Medical College



TMSS Medical College Journal (TMCJ)

July 2026

An Official Publication
of
TMSS Medical College, Bogura, Bangladesh

TMSS Medical College Journal (TMCJ)

Volume 25, Issue. 02, July 2026

An Official Publication of TMSS Medical College, Bogura, Bangladesh

Advisory Board

Prof. Dr. Hosne-Ara Begum
 Prof. Dr. Jawadul Haque
 Prof. Dr. Sayeba Akhter
 Prof. Dr. M. Afzal Hossain
 Prof. Dr. M. Aminul Islam
 Prof. Dr. Shamima Parvin Lasker

Editorial Board

Chairperson : Prof. Dr. Md. Zakir Hossain
Editor-in-Chief : Prof. Dr. Md. Shahjahan Ali Sarker
Associate Editor : Prof. Dr. Md. Abdul Mazid
Advisory Editor : Prof. Dr. Moudud Hossain Alamgir
Managing Editor : Dr. Md. Matiur Rahman

Local Members

Prof. Dr. A.K.M Ahsan Habib
 Prof. Dr. Md. Azfarul Habib
 Prof. Dr. Md. Rafiqul Islam
 Prof. Dr. Md. Anup Rahman Choudhury
 Prof. Dr. Nur-A-Farhana Islam
 Prof. Dr. Nahida Akther Zahan
 Prof. Dr. Tania Yeasmin
 Prof. Dr. Sultana Razia
 Prof. Dr. Shamim Ahmed Choudhury
 Prof. Dr. Md. Amirul Islam
 Dr. D. M Arifur Rahman
 Dr. Fahim Uddin Ahmad
 Dr. Md. Ahamedul Kabir

International Members

Prof. Dr. Dhananjaya Sharma
 Prof. Dr. Anurag Srivastava
 Prof. Dr. Shariq Rashid Mosoodi
 Prof. Olav Muurlink
 Prof. Dr. Paul Mailwaring
 Prof. Dr. Md. Faizus Sazzad
 Prof. Soraj Hongladarom
 Prof. Ravichandran Moorthy
 Prof. Darryl Macer
 Prof. Dr. Hasan Erbay

The TMSS Medical College Journal (TMCJ) is published two times a year (January and July). The TMSS Medical College Journal (TMCJ) is approved by Bangladesh Medical & Dental Council (BM&DC/4-D-2016/1478: Dated 15.01.2017). It accepts original articles, review articles and case reports. While every effort is always made by the Editorial Board and the members of the Journal Committee to avoid inaccurate or misleading information appearing in the TMSS Medical College Journal, information within the individual article are the responsibility of its author(s). The TMSS Medical College Journal, its Editorial Board and Journal Committee accept no liability whatsoever for the consequences of any such inaccurate and misleading information, opinion or statement.

Address of Correspondence

Editor-in-Chief, TMSS Medical College Journal, TMSS Medical College
 Rangpur Road, Thengamara, Bogura, Bangladesh. Phone: 01775-316617
 e-mail: editortmcjournal@gmail.com, Web: www.tmcjournal.org, www.tmssmedicalcollege.com

Printed by: TMSS Printing Press, Bogura, Bangladesh. e-mail: tmssprintingpress@gmail.com

TMSS Medical College Journal (TMCJ)

INFORMATION FOR AUTHORS

TMSS Medical College Journal (TMCJ) follows the guidelines and principles of the International Committee of Medical Journal Editors- ICMJE (www.icmje.org) and the COPE (www.publicationethics.org). Papers are accepted for publication with an understanding that they are submitted solely to the journal of 'TMSS Medical College Journal' and are subject to peer review and editorial revision. The statement, views and opinions expressed in the articles are those of the author(s) and are not necessarily those of the editor or publisher.

General Instructions

- a. Article must be within 5 years of research work.
- b. Authors of research work should be of relevant fields.
- c. Manuscript must be in English, Use Times New Roman 11 sized font.
- d. Type manuscripts double-spaced, on a good quality A4 sized paper, including references, figures with legends and tables on one side of the page only.
- e. Leave a margin of 05 cm on all sides of the page. Beginning with abstract page, all the pages (including pages containing tables, figures and references) will contain page numbers at the lower right-hand corner.
- f. Cite each reference in text in numerical order and list in the reference section.
- g. Begin each component of the manuscript with a new page in the sequence of (i) Title page with author information, name of the department(s) and institutions to which the work should be attributed, name and address of the author with post code responsible for correspondence and requests for reprints (ii) Abstract page (iii) Text (iv) References (v) Tables (vi) Figures with legends, for illustrations.
- h. Present the text in the sequence of Introduction, Methods & Materials, Results and Discussion.
- i. Use SI units of measurements (for blood pressure use mm of Hg).
- j. Define Statistical methods in method section of the paper.
- k. Use standard abbreviations, the full forms of which should precede in its first use in the text
- l. As a general rule, articles should not exceed 10-12 pages. Too much large volume manuscripts will not be accepted for publication.

Submission process

With two copies of manuscript (hard copy) directly or by courier or postal services to Editor-in-chief, TMSS Medical College Journal and/or A soft copy of Manuscript (MS Word) must be sent to editortmcjournal@gmail.com with scanned copy of all desired documents. Online submission will be possible through <https://www.tmcjournal.org>

Covering letter

Article must be accompanied by a covering letter, signed by all authors, containing statements that they are the only authors, The article represents original work and we take full responsibility for the information provided, the Manuscript has not been published elsewhere, accepted for publication elsewhere or under editorial review for publication elsewhere by any other journal. All copyright ownership of the manuscript will be transferred to the publishers of the TMSS Medical College Journal (TMCJ) once the article is accepted for publication in the journal. They must declare that they made the manuscript plagiarism free. On submission of the manuscript, the authors agree not to withdraw their manuscript at any stage prior to publication. Acknowledgements, Conflicts of interest & Funding are clearly mentioned, if any.

Author's contribution

In case of multiple authors, need an author contribution certificate (or statement) about specific contribution of each author in the study and the manuscript has been seen and approved as well as the order of authors in the manuscript.

Ethical Issues

Author must submit a copy of clearance certificate from an Institutional Ethical Review Board (IERB) or Institutional review Board (IRB) or Ethical Committee or from any authorized body along with the manuscript & mention the memo number within bracket in the methodology section while describing ethical issues.

Title page with author information (first page, but do not number)

- a. Full title of the article not exceeding 50 words with three to five key words for use as indexing terms and as running title for use on top of the text pages.
- b. Author's names, highest academic degree, affiliations, and complete address for correspondence including Telephone/Mobile number, and e-mail address.

Abstract page (First numbered page)

- a. Do not cite references in the abstract. Be concise (250 words, maximum).
- b. Limit use of acronyms and abbreviations. Abbreviations must be defined at the first mention.
- c. The abstract should be a total of about 250 words maximum. Abstract should cover Background and Purpose (description of rationale for study); Methods (brief description of methods); Results (presentation of significant results); and Conclusion (succinct statement of data interpretation) in separate headings.

The Text/Main body

The following are typical main headings:

Introduction, Materials and Methods, Results, Discussion and Conclusion

- a. Introduction: Summarize the rationale for the study with pertinent references. The purpose(s) of the study should be clearly stated.
- b. Materials and Methods: Identify type of study and describe the study subjects and methods used. Provide methods of statistical analysis, Cite reference(s) for standard study and statistical methods. Describe new or modified methods. Identify apparatus (with name and address of manufacturer) used. Generic names of drugs must be given. Manuscripts that describe studies on humans must indicate that the study was approved by an Institutional Ethical Committee and that the subjects gave informed consent. Add statistical analysis.
- c. Results: Present only important results/observations in logical sequence in the text, tables or illustrations with relevant statistics.
- d. Discussion: Emphasize new and important results and the conclusions that follow including implications and limitations. Relate observations to other relevant studies.
- e. References: References must be listed following the Vancouver style. These should be numbered consecutively in the order in which they are first mentioned in the text as superscript number. Number of references should be kept below 40 except review article. All authors must be listed if less than six. Use et al, if more.
- f. Table & Figures: Tables & figures should be placed within the text of the manuscript. Number of tables & figures consecutively in the order of their first citation in the text. Tables should not duplicate in the text of the article and avoid internal horizontal & vertical rules. Total number of tables & figures must not exceed 10.

Editorial**Medical Care in War and Armed Conflict: When Humanity Must Remain above the Battlefield**MontasirAA^{1*}, Alwawi AA², Abdullah OD³

1. Dr. Ahmed Al Montasir, Assistant Professor, Department of Medicine, TMSS Medical College, Bogura.

2. Dr. Abdallah A Alwawi, Assistant Professor of Medical & Critical Care, Faculty of Health, Professions, Al-Quds University, Abu Dies, Jerusalem 51000, Palestine.

3. Dr. Omar dheyaab Abdullah, Consultant of Medicine, Al-Ramdi hospital, Iraq.

Corresponding Author*Medical Care in War: A Humanitarian Imperative**

War can transform a regular functioning hospital into a mass-casualty centre within hours. Trauma due to conflicts surges in war while childbirth, sepsis, diabetes, dialysis, cardiovascular emergencies and cancer continue. Damage to power, water, oxygen, blood supply, laboratories, pharmacies, transport and communications therefore produces deaths far beyond the immediate battlefield. International humanitarian law requires protection not only of the wounded and sick, but also of medical personnel, irrespective of nationality, religion, ethnicity, political identity or combatant status.¹

When the Health System Becomes a Casualty

Health systems fail as networks. An operation theatre cannot function without electricity, oxygen, sterilization, anaesthesia, blood and trained staff. Threats, barricades and attacks delay ambulances, displace health workers and deter patients from seeking care. WHO has verified thousands of attacks on health care in Ukraine, while the occupied Palestinian territory has experienced severe degradation of essential services. Each damaged facility represents interrupted surgery, missed dialysis, unsafe childbirth and delayed treatment for infection and chronic disease.¹⁻³

Regional Realities

Gaza illustrates the agony of mass casualties, repeated displacement, damaged hospitals and shortages of food, water, fuel, medicines and consumables. In May 2025, WHO reported that only 19 of 36 hospitals remained operational, including one providing only basic care.³ Aggression has affected renal, maternal, neonatal, cancer, laboratory, mental-health and

rehabilitation services; delayed evacuation can trap patients needing advanced reconstructive, cardiac, oncological or neurosurgical care.⁴ A 2025 BMJ survey of 78 international healthcare workers deployed to Gaza documented 23,726 trauma-related injuries, with burns and limb injuries prominent and explosive mechanisms accounting for most weapon-related trauma, underscoring the need for sustained surgical, rehabilitation and clinical-surveillance capacity.^{4,5}

In the West Bank, checkpoints, road closures, insecurity of medical personnel and restriction of ambulance movements turn a short journey inpatient into a long, critical outcome for obstructed labour, acute coronary syndrome, sepsis, dialysis or chemotherapy. These access challenges have continued in 2026. According to WHO data reported by OCHA, 53 attacks on health care were documented between January and June 2026, affecting four health facilities and 44 ambulances; obstruction of access was the most frequently reported form of interference. Gaza and the West Bank therefore demonstrate complementary failures-loss of capacity and restriction of access.³⁻⁵ Iraq demonstrates the cumulative history of repeated conflict, displacement, underinvestment and workforce loss. The Mosul experience showed that survival depends on the entire trauma pathway, from first aid and safe transport to referral surgery and rehabilitation; persistent gaps may remain long after active fighting.⁵ Iran's 2026 regional escalation showed how rapidly specialist services can be threatened. WHO reported 18 verified attacks on health care between 28 February and 11 March 2026. Conflict interrupted dialysis, insulin supply, cancer therapy, transplantation follow-up, blood transfusion services and emergency cardiac care. Transport

disruption can affect humanitarian supply chains beyond national borders, as it happened in Ukraine.²⁻⁵ Lebanon entered recent hostilities with economic crisis, workforce emigration and medicine shortages already weakening the system. By 16 October 2024, WHO had verified 23 attacks on health care after the September escalation, and 100 of 207 primary-care centres and dispensaries in conflict-affected areas were closed. Subsequent reports emphasized deaths and injuries among health workers, reduced hospital function and prolonged rehabilitation needs.²⁻⁵

The Ethical Compass of the Physician

Conflict does not suspend medical ethics. Humanity, impartiality, confidentiality, dignity and professional independence remain essential. In mass-casualty triage, priority should reflect physiological urgency, time sensitivity, likelihood of benefit and available resources—not social worth, rank, wealth, nationality, ethnicity, religion or political affiliation. Decisions should be transparent, consistent and repeatedly reassessed. When curative treatment is impossible, analgesia, symptom control, communication, psychological support and palliative care remain obligations.^{1,4,5}

Beyond Trauma: Preserve Essential Services

Conflict medicine must extend beyond blast and penetrating injuries. Pregnant women still need safe delivery; premature infants need warmth, oxygen and nutrition; patients with diabetes need insulin; kidney failure requires dialysis; and tuberculosis, HIV, epilepsy, asthma, COPD, cardiovascular disease and malignancy require continuity of therapy. Humanitarian planning should protect a minimum package of essential services, referral routes and stocks of priority medicines.^{3,4,5} Displacement increases overcrowding, unsafe water, poor sanitation, food insecurity and interrupted vaccination, raising communicable-disease and malnutrition risks. Effective response therefore requires primary care, maternal and child health, infection prevention, surveillance, rehabilitation and palliative care alongside emergency surgery.^{4,5}

Mental Health and the Health Workforce

War produces bereavement, displacement, family separation and prolonged insecurity. WHO estimates that about one in five people exposed to war or conflict in the preceding decade lives with a mental disorder such as depression, anxiety or post-traumatic stress disorder.⁶ Recent studies show the particular burden on healthcare workers. In a 2025 cross-sectional study of Palestinian and international healthcare workers who had worked in Gaza, approximately 90% of respondents experienced severe depression, severe anxiety and severe stress, alongside displacement, prolonged work without adequate rest, food insecurity, workplace aggression and loss of colleagues.⁷ Evidence from the southern West Bank likewise demonstrates substantial psychological strain among nurses working during the Gaza war, including symptoms consistent with post-traumatic stress disorder, increased workload, burnout and shortages of staff and medical supplies.⁸ Health workers therefore face not only burnout and grief but also moral distress and moral injury when they know what patients need but cannot provide it. Staff protection should include reasonable rotation, peer support, confidential mental-health care, adequate staffing and clear leadership.

Protecting Medical Neutrality and Building Resilience

Protection must cover the entire chain of care: patients, first responders, ambulances, hospitals, laboratories, pharmacies, blood banks and humanitarian supply routes. Violence, threats, detention, obstruction and interference with impartial care weaken every link. Medical neutrality preserves the professional space to treat every wounded or sick person according to need; it safeguards patients, trust and the integrity of medicine.^{1,8} Hospitals should map dependencies on power, water, oxygen, blood, medicines, information systems and supply routes; establish redundancies; and train staff in triage, haemorrhage control, trauma resuscitation, burns, emergency anaesthesia, infection prevention, evacuation, psychological first aid and ethical allocation. Recent conflict-focused literature emphasizes protection of essential infrastructure, physical hospital preparedness and alternative sources

of water and electricity, while broader evidence from fragile and conflict-affected settings frames resilience as the capacity to absorb shocks, adapt services and, where necessary, transform health-system operations.⁹ Portable ultrasound, point-of-care testing, telemedicine, offline records, decentralized stocks and distributed referral pathways may help maintain continuity when centralized systems are disrupted, but resilience ultimately depends on trained people, simple protocols, local supply capacity and trusted coordination.^{4,5,9}

A Responsibility Beyond Borders

Professional bodies, universities, journals and humanitarian agencies should document attacks, study direct and indirect mortality, strengthen trauma and referral systems, and develop practical approaches to rehabilitation and continuity of chronic-disease care. Data collection must be accurate and ethical and must not expose patients or health workers to additional danger. Medical journals should create space for clinicians working in conflict-affected settings while preserving scientific independence, transparent attribution and acknowledgement of uncertainty.^{1,10}

Conclusion

War is one of the greatest tests of medical ethics. Hospitals should remain places of healing, ambulances vehicles of rescue and healthcare workers free to treat without fear. From Yemen to Gaza and the West Bank, Iraq, Iran, Lebanon, Ukraine and every conflict-affected region, medicine has a duty that transcends geography and politics: to preserve life, relieve suffering, protect dignity and defend the humanitarian space in which care can exist. When societies are divided by conflict, medicine must refuse to divide humanity.

References

1. International Committee of the Red Cross. Health Care in Danger: the responsibilities of health-care personnel working in armed conflicts and other emergencies. Geneva: ICRC; 2012.
2. World Health Organization. Attacks on hospitals and health workers jeopardize provision of health in Lebanon [Internet]. Geneva: WHO; 2024 Oct 16
3. World Health Organization. Health system at breaking point as hostilities further intensify in Gaza, WHO warns [Internet]. Geneva: WHO; 2025 May 22
4. El-Taji O, Ali A, Alser O, Ghali A, Jomaa A, Sultan MJ, et al. Patterns of war related trauma in Gaza during armed conflict: survey study of international healthcare workers. *BMJ*. 2025; 390:e087524.
5. Truppa C, Yaacoub S, Valente M, Celentano G, Ragazzoni L, Saulnier DD. Health systems resilience in fragile and conflict-affected settings: a systematic scoping review. *Confl Health*. 2024;18(1):2.
6. World Health Organization. Mental health in emergencies [Internet]. Geneva: WHO; 2025 May 6
7. Naser AY, Ali MM, Sammour AAH, Skaik AN, Abed A, Musallam R, et al. Prevalence of stress, anxiety and depression among healthcare workers in the Gaza strip. *Medicine (Baltimore)*. 2025;104(36):e44195.
8. Alqaissi N, Qtait M, Jaradat Y, Aburayyan L, Awwad KA, Mesk Z, et al. Psychological challenges of nurses working at hospitals in South West Bank, during war on Gaza Strip. *Disaster Med Public Health Prep*. 2025;19:e209.
9. Truppa C, Saulnier DD, Bertone MP, Yamonn N, Hafez S, Witter S, et al. Getting unstuck: reframing health systems strengthening and resilience in fragile and conflict-affected settings. *BMJ Glob Health*. 2026;11(2):e020061.
10. World Health Organization. Classification and minimum standards for emergency medical teams. Geneva: WHO; 2021.

Original Article**Knowledge Regarding Drowning among Rural People in a Selected Area of Joypurhat, Bangladesh**Zannat K^{1*}, Habib A², Tasnim T³, Ansari AAM⁴, Hoque SMU⁵, Akter R⁶

1. Dr. Kutbul Zannat, Senior Lecturer, Department of Community Medicine and Public Health, TMSS Medical College, Bogura.
2. Dr. Azfarul Habib, Professor, Department of Community Medicine and Public Health, TMSS Medical College, Bogura.
3. Dr. Touhida Tasnim, Lecturer, Department of Community Medicine and Public Health, TMSS Medical College, Bogura.
4. Dr. Abdullah Al Mahfuz Ansari, Lecturer, Department of Community Medicine and Public Health, TMSS Medical College, Bogura.
5. Dr. S.M Mejba-Ul-Hoque, Lecturer, Department of Community Medicine and Public Health, TMSS Medical College, Bogura.
6. Dr. Rubaida Akter, Lecturer, Department of Community Medicine and Public Health, TMSS Medical College, Bogura.

Corresponding Author*Abstract**

Background: Drowning is one of the leading causes of death in Bangladesh and claims the lives of approximately 50 children per day. Rates of drowning are higher in rural populations, most likely due to high number of water sources in rural areas compared to urban areas. Proper knowledge can ease the mortality and morbidity of victims.

Objective: To assess the of knowledge regarding drowning among rural people in a selected area of Joypurhat, Bangladesh.

Materials and Methods: It was a descriptive type of Cross-sectional study conducted at Parulia and Keshobpur villages of Kalai, Joypurhat district on September, 2025. Purposive sampling technique was adopted for selecting respondent's ≥ 18 years of age from rural population. Sample size was 287. Data were collected by face-to-face interview. A pre-designed, pre-tested, structured questionnaire was used, as a tool for collecting data. Ethical issues were maintained strictly at every stages of the study.

Results: The study revealed that, out of 287 respondents majority (26.83%) belonged to the age group below or equal to 30 years. In this study about 60% were female, around 51.57% were housewife and 26.1% had no formal education. Majority (84%) respondents live near water bodies. About 15% mentioned that their family member were experienced drowning in the past. 97% of the children were most vulnerable to drowning and 86% mentioned that drowning mostly occur during moonsoon season. Regarding preventive measure, 44.84% said that it is necessary to keep children away from water bodies, 29.26% mentioned everybody should learn how to swim. In regard to first aid knowledge 71% said that they should jump into water to save drowning victim, 45% said to call for help and 3% don't know how to rescue a drowning victim. After rescuing a drowning victim, 72% of participants said that they should press stomach, 58% preferred hospital treatment and 0.3% did not what to do. Only 17% of respondents said they taken any health education or training on drowning and 68% mentioned that they need to more information on this topic. Study findings signify the need for further awareness programs for rural residents to educate them on this neglected yet preventable public health emergency.

Conclusion: Still now rural people has little knowledge along with some misconceptions regarding this issue and necessary steps should be taken by the concerned authority to enhance appropriate treatment-seeking behavior highlighting the need for targeted public health interventions.

Keywords: General knowledge, Drowning, Rural people, Prevention, First Aid.

Introduction

The third most common cause of unintentional injury deaths globally is drowning. The most vulnerable groups to drowning include men, children, and those with greater access to water. With an expected 236,000 drowning deaths in 2019, drowning is a significant global public health issue.¹ Around 300,000 drowning deaths occur each year, according to the WHO in 2024, making it a significant global public health issue. In

2017, drowning claimed the lives of about 110,000 individuals in Commonwealth nations.² Over half of all drowning deaths worldwide occur in the Western Pacific and South-East Asia regions. In 2021, drowning injuries accounted for almost 8% of all deaths globally. Children and young people are disproportionately affected by drowning. Nearly 25% of drowning deaths occur in children under the age of

five. For children between the ages of one and four, drowning is the fourth most common cause of death; for children between the ages of five and fourteen, it ranks third. Low- and middle-income nations account for 92% of drowning deaths.³ In Bangladesh, drowning is one of the most common causes of death, taking the lives of about 43 children every day. Because there are more water sources in rural areas than in urban ones, drowning rates are higher in rural communities.¹ According to the 2016 Bangladesh Health and Injury Survey (BHIS), drowning is the primary cause of mortality for children aged 0 to 17; at least 14,438 children perish from drowning each year.⁴ According to a recent poll, 83% of drowning victims were youngsters between January 2020 and June 2021. According to data released by UNICEF and the National Institute of Population Research and Training, two-fifths (42%) of all children in Bangladesh between the ages of one and four died from drowning in 2011. Interestingly, children between the ages of 0 and 4 are almost three times more likely to drown than children between the ages of 10 and 17. The risk of drowning is significantly higher in rural children.^{5,6}

Children in low- and middle-income nations are six times more likely to drown to death than children in high-income countries, and multiple studies indicate that youngsters between the ages of one and four are most at danger. In Bangladesh, drowning is a serious public health issue that poses a serious risk to children's survival. According to a nationwide survey, 80% of drownings in children under five occurred within 20 meters of the family home, mostly in ponds, followed by trenches and water containers.⁷

Though drowning is a serious public health issue, it has not received the same attention as other significant causes of infant death.

In rural people, traditional first aid and resuscitation responses to drowning are very poor. However, the common practices on management of drowning in the community is not well documented in Bangladesh. In

Bangladesh, as in other developing countries, sociodemographic and economic factors may influence child drowning, but the evidence is insufficient. Understanding these various risk variables is vital for developing effective preventative programs. Against this backdrop, this study explored an in-depth understanding of surrounding circumstances and associated factors of each drowning child fatality occurring in Bangladesh. In addition, this paper seeks to fill the knowledge gap on drowning deaths in prior research and provide updates on related factors for child drowning fatalities in Bangladesh.

This study aims to assess the knowledge of rural populations in a selected area of Joypurhat regarding and drowning, focusing on prevention, first aid, and treatment-seeking behaviors. The findings will be helpful for further public health interventions.

Materials and Methods

This descriptive type of cross-sectional study was conducted among rural people at Parulia and Keshobpur villages of Kalai, Joypurhat district from June to September, 2025. The study population was rural people of more than 18 years of age in the selected area irrespective of gender. Purposive sampling technique was used for selecting (287) sample. A pre-designed, pre-tested, structured questionnaire was used, as a tool for collecting data. The questionnaire consisted of 3 (three) separate sections as Socio demographic profile, Knowledge regarding drowning and Sources of Information. 4th year MBBS students of TMSS Medical College, Bogura collected data by face to face interview under the supervision of Community Medicine and Public Health Department. All participants were briefed about the process of data collection and assured about confidentiality of data. It was also emphasized that their participation was voluntary, and they have the right to withdraw at any stage throughout the research. The collected questionnaires were checked for cleaned, edited, coded, and analyzed manually. Only descriptive study was done and results were expressed as frequency and percentage and displayed in tables and figures.

Results

Table I: Distribution of the Respondents based on Socio-demographic Variables (n=287)

Variables	Frequency	Percentage (%)
Age (years)		
≤30	77	26.84
31-40	64	22.24
41-50	47	16.39
51-60	50	17.43
>60	49	17.10
Gender		
Female	173	60
Male	114	40
Religion		
Muslim	171	59
Hindu	116	41
Educational qualification.		
No formal education	75	26.1
Primary	53	18.5
Secondary	39	13.6
SSC	54	18.8
HSC	50	17.4
Others	16	5.6
Total	287	100

Table-I: shows that out of 287 respondents, 26.84% of respondents were below 30 years of age, 60% of respondents were female and 59% of the respondents were muslim. 26.1% of respondents had no formal education.

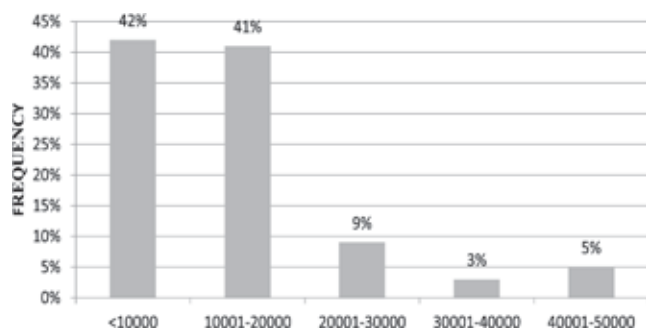


Figure 1: Distribution of the Respondents according to Monthly Family Income. n=287

Figure 1: shows that 42% of respondents had family income less than 10,000 taka and 3% respondents had monthly family income between 30,001 - 40,000 taka.

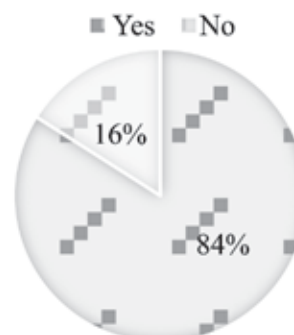


Figure 2: Distribution of the Respondents according to Living Place Near Water Bodies. n=287

Figure 2 : shows that 84% of respondents said they live near water bodies and 16% said that don't live near any water bodies.

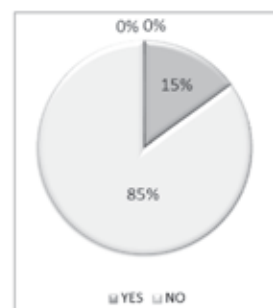


Figure 3: Distribution of the Respondents according to Experience of Household Members Drowning. n=287

Figure 3 shows that 85% of respondents never experienced drowning and 15% respondents had experience drowning in their family.

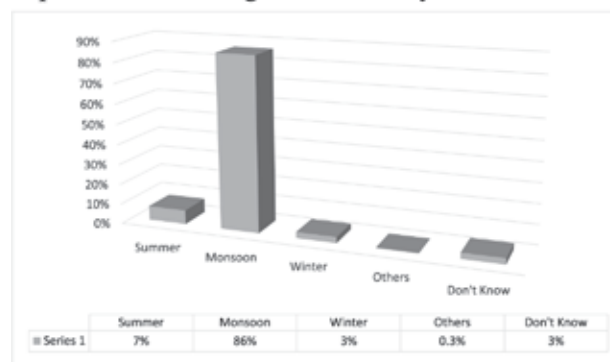


Figure 4: Distribution of the Respondents according to Knowledge Regarding Season of Drowning. n=287

Figure 4: mentioned that 86% of the respondents said drowning occur mostly in monsoon season.

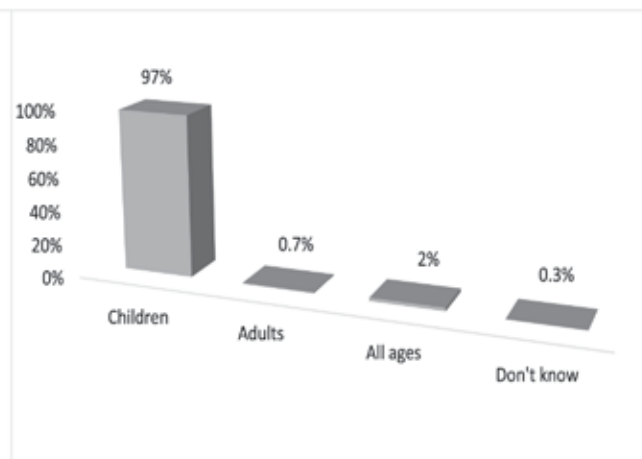


Figure 5: Distribution of the Respondents according to Knowledge of most Vulnerable Group of Drowning. n=287

Figure 5: revealed that, 97% of the respondents said children are most vulnerable to drowning.

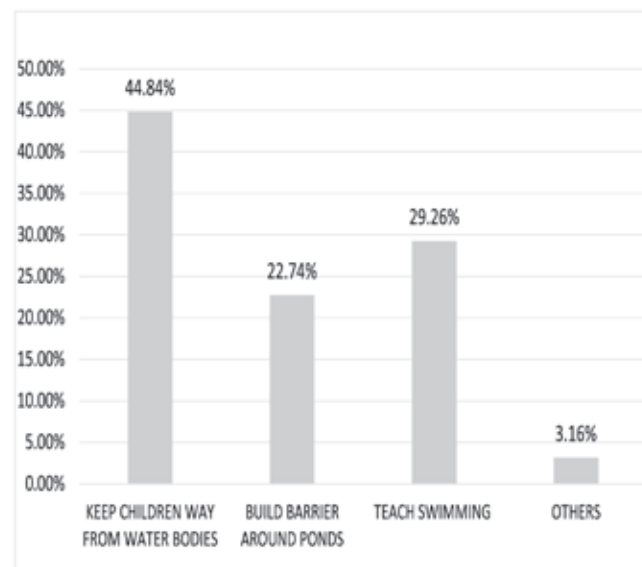


Figure 6: Distribution of the Respondents according to Preventive Knowledge of Drowning. n=287

Figure 6: Revealed that 44.84% respondents said that it is necessary to prevent drowning by keeping children away from water bodies and 29.26% of respondents said they should teach swimming.

Table II: Distribution of the Respondents according to Action for Rescuing a Drowning Victim. n=287

Variable	Frequency	Percentage (%)
Call for help	130	45
Jump into water to save them	205	71
Use a stick/ rope to help	44	15
Don't know	1	3
❖ Multiple answer		

Table II: showed that 71% respondents said they must jump into water to save drowning victim, 45% respondent said that they should call for help and 3% don't know what to do.

Variable	Frequency	Percentage (%)
Take to Hospital	167	58
Press their stomach	208	72
Lay them sideways	20	7
Wait for them to recover	10	3
Don't know	1	0.3
❖ Multiple answer		

Table III: Distribution of the Respondents according to Immediate Action after Drowning. n=287

Table III: showed that, 72% respondents were mentioned 'press stomach' as immediate action after drowning. Then other responses are 'take the victim to hospital' (58%) and 0.3% said they didn't know about that.

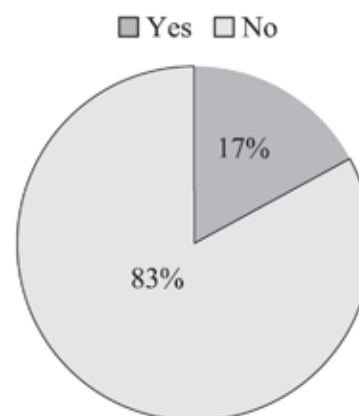


Figure 7: Distribution of the Respondents according to Take any Health Education or Training on Drowning. n=287

Figure 7: showed that maximum 83% of respondents said they did not take any health education or training on drowning.

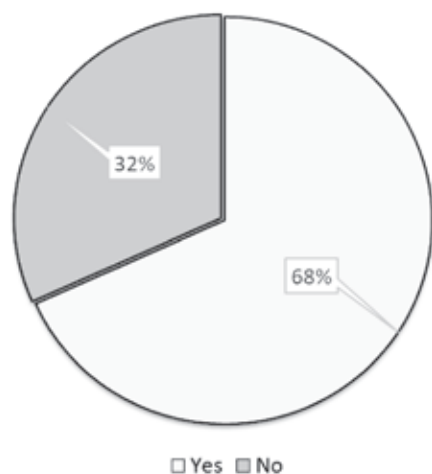


Figure 8 : Distribution of the Respondents according to Need for More Information on This Topic.(n=287)

Figure 8: Showed 68% of respondents need more information on this topic.

Discussion

Study reveals that the highest age group of respondents were below or equal to 30 years of age (26.84%), Females accounted for 60% of the study subjects where 51.57% were housewife. 26.1% of respondents had no formal education. This inconsistency may be due to the fact that in this study purposive sampling was done in rural area and also for time of data collection when most of male go for work. Most (59%) of the respondents were Muslims and rest were hindu. This Finding of the study is consistent with the national data of Bangladesh.

The data showed that only a small proportion of respondents (15%) had experience drowning in their family. This low prevalence of direct experience could potentially contribute to a lack of perceived risk and insufficient knowledge about prevention.

The study also assessed knowledge regarding most vulnerable group of drowning that is children 97%,

which is another significant public health concern. Most of the respondents (79.5%) in Parbatipur study expressed that children less than six years are more vulnerable to drowning.⁷ In this study, majority of respondents 86 % were aware that the monsoon season is when drowning is most common same. This seasonal awareness is positive, as it aligns with peak risks during floods and high-water levels. However, awareness of the vulnerable age for drowning was specific. While more detailed knowledge regarding the most critical age group (often children under five) is vital for targeted interventions like community-based supervised child-care.

In this study regarding action for rescuing a drowning victim 71 % respondents said jump into water to save them and only 15 % said use a stick or rope to help. But against that, saying it's safer to throw a lifesaving device, towel, rope or even a pool noodle to the person in the water, wait until the person grabs hold and then tow the person to safety. In this another study regarding first response on drowning 62.0% mentioned of seeking for help by calling or shouting to seek help in rescuing a drowning person and 34.3% mentioned of throwing a flotation device or giving an extension to save the drowning person.⁸

Regarding rescue and first aid for a drowning victim, only 58% of respondents reported that the first step is 'taking to the hospital'. The most common first action reported was "press the stomach" 72%. In another survey conducted on responses to drowning victims, it was found that 68.3% of participants mentioned the application of pressure on the belly to expel water, while 31.4% recommended immediate referral to a hospital.¹ According to the Health & Safety Institute, Performing CPR with rescue breaths on a drowning victim is crucial element of emergency preparedness, serving as a vital safeguard that, if administered correctly, has the potential to save lives.⁹ Although getting to the hospital is important, the low knowledge of immediate life-saving first-aid measures like Cardiopulmonary Resuscitation (CPR) or mouth-to-mouth ventilation in the critical moments after rescue is alarming. Effective first-aid knowledge is critical for improving survival rates, particularly in

rural settings where emergency medical services are often delayed.

According to preventive knowledge of drowning, in this study revealed that 44.84% respondents said that it is necessary to prevent drowning by keeping children away from water bodies, 29.26% said they should teach swimming and only 22.74% said build barrier around ponds. In another study revealed that 93% of the respondents said that adult supervision is the best way to prevent drowning among children. About 65% of the parents agreed to letting their children attend swimming lessons. When asked to specify measures to prevent drowning 33% said that place barrier or fence around water bodies and only 7.2% said do not allowed to go near water bodies.

In our study 83 % respondents said they had not received any health education or training on drowning. In other study said that more than 93% of the parents have not participated in any program or activity on drowning prevention.¹⁰

Nonetheless, substantial majority 7% of the respondents of our study expressed school is the main source of receiving health education or training on drowning and 68% of respondents interested to getting more information about drowning. Present study exposed that till now a major number of rural people do not have right knowledge regarding prevention and appropriate first aid after drowning incidence. Respondent's willingness and expressed need for further knowledge present a clear opportunity for local health authorities to implement effective, targeted health education programs.

Conclusion

It was important to assess the current knowledge and identify the preventive knowledge gap on drowning and first aid management with the aim to frame future awareness programs for the rural community to prevent further mortality and morbidity resulting from drowning. Our study findings would be a baseline data hopefully for further in depth large scale study. By enhancing community knowledge regarding this negligible issue can change remarkable preventive data in future.

Limitation and recommendations

1. The small study population from selected villages was identified as the main limitation of the study, meaning that the study findings cannot be generalised.
2. Local health sectors should coordinate for implementing health education programs about this public health emergency.
3. The results obtained in this study could be used to guide strategic planning for Health sectors of Bangladesh. .
4. It could be a wise idea to conduct large scale research.

Ethical Considerations

The project was approved by Community Medicine and Public Health department of TMSS Medical College, Bogura for Residential Field Site Training (RFST) programme. The concerned authorities were informed and took permission for data collection with formal letters by the Head of Department of Community Medicine and the Principal of TMSS Medical College, Bogura, Bangladesh. All the respondents were briefed about the purpose and procedure of data collection.

Funding The study was conducted without any funding, commercial or financial relationships.

Conflict of Interest- The authors confirm that there is no conflict of interest among the authors.

Acknowledgement

We express thanks to the beloved students of TMC 14 for collecting data as a part of their Residential Field Site Training (RFST) programme of Community Medicine and Public Health Curriculum. Authors also acknowledge the contribution of Dr. Shamim Ahmed Choudhury, Professor and Head of the department of Community Medicine & Public Health, TMC for guiding us in this regard.

References

1. Hasan R, Akber T, Rahman SL, Jahan MI, Biswas SN, Haque MM. Knowledge and Practice on management of Drowning in a Rural Community of Bangladesh. Khwaja Yunus Ali Medical College Journal. 2025 Mar. 16 ;15(2):66-72.
2. Phad LG, Dhawane SG. Epidemiological profile of drowning deaths: a cross sectional study. Egyptian J Foren Sci. 2018;8(1):26.
3. World Health Organization (WHO). Drownings report. 2021. <https://www.who.int/news-room/fact-sheets/detail/drowning>
4. Alam I. A neglected national crisis. The Daily Star [Inter-net]. 2023 Jul 25
5. Rahman A, Alonge O, Bhuiyan A-A, et al. Epidemiology of drowning in Bangladesh: an update. Int J Environ Res Public Health 2017; 14.
6. Hossain M, Mani KK, Sidik SM, Hayati KS, Rahman AK. Socio-demographic, environmental and caring risk factors for childhood drowning deaths in Bangladesh. BMC Pediatr. 2015 Sep 10;15:114.
7. Caesar U, Islam M.M, Bose B.K, Sarker S.K, Ashrafi S.A, Ali S.A. et.al. Awareness Regarding Drowning Prevention among the Rural People of Parbatipur Upazilla in Dinajpur District. Dinajpur Medical College Journal, 2018 Jul; 11 (2):258-264.
8. The Atlanta Journal-Constitution. Would you know what to do if someone was drowning? [Internet]. Atlanta: The Atlanta Journal-Constitution; 2023.
9. National Drowning Prevention Alliance. Emergency Preparation by Using Drowning CPR With Rescue Breaths [Internet]. United States: NPDA; 2023.
10. Guevarra JP, Albornoz R, Go JJ, et al .Knowledge, attitudes and practices of parents in an urban coastal community on preventing childhood drowning. ACTA MEDICA PHILIPINA, 2010 ; 44(1): 32-39

Original Article**Assessment of Serum Lipid Profile among Patients with Non Alcoholic Fatty Liver Disease by Ultrasonography**Hossan MA^{1*}, Ray J², Acharjee U³

Dr. Md. Alamgir Hossen, Assistant Professor, Department of Medicine, Tangail Medical College, Tangail.

2. Dr. Jewel Ray, Assistant Professor, Department of Medicine, Insitu, Upazila Health Complex, Ajmirigonj, Hobigonj.

3. Dr. Urmi Acharjee, Assistant Professor, Department of Paediatrics, Sylhet MAG Osmani Medical College, Sylhet.

Corresponding Author*Abstract**

Background: Non-alcoholic fatty liver disease (NAFLD) is a common chronic liver condition closely associated with metabolic abnormalities, including obesity and dyslipidaemia. Alterations in lipid metabolism may contribute to the development and progression of hepatic steatosis.

Objective: To evaluate the correlation between NAFLD with serum lipid profile and BMI status.

Material and Methods: This cross-sectional study was conducted in the Departments of Medicine and Hepatology at Sylhet MAG Osmani Medical College Hospital, Sylhet, Bangladesh, from July 2023 to June 2025. A total of 200 patients aged 18–70 years with ultrasonographically diagnosed NAFLD were enrolled. Clinical assessment, anthropometric measurements, and laboratory investigations, including fasting blood glucose, lipid profile, liver and renal function tests, and viral markers, were performed. Data were analyzed using SPSS version 25.0.

Results: The mean age was 39.84 ± 12.84 years, and 58% of participants were male. The mean BMI and waist circumference were 25.78 ± 2.58 kg/m² and 85.23 ± 5.61 cm, respectively. Obesity was present in 58% of participants. Mean triglyceride, LDL, HDL, and total cholesterol levels were 256.13 ± 69.41 , 118.83 ± 21.68 , 43.67 ± 7.41 , and 250.96 ± 52.41 mg/dL, respectively. Mild and moderate fatty liver were observed in 72% and 28% of participants, respectively. TG, LDL, and total cholesterol were significantly higher, while HDL was significantly lower, among patients with moderate fatty liver.

Conclusions: NAFLD is strongly associated with obesity, dysglycaemia, and dyslipidaemia. An increasingly adverse lipid profile is associated with greater severity of fatty liver disease.

Keywords: Non-alcoholic fatty liver disease (NAFLD), Serum lipid profile, Ultrasonography, Dyslipidemia, Fatty liver severity, Metabolic syndrome.

Introduction

Non-alcoholic fatty liver disease (NAFLD) is one of the most prevalent chronic liver diseases worldwide and encompasses a spectrum of hepatic disorders ranging from simple steatosis, characterized by excessive triglyceride accumulation within hepatocytes, to non-alcoholic steatohepatitis (NASH), which may progress to fibrosis, cirrhosis, and ultimately hepatocellular carcinoma.^{1,2} According to the American Association for the Study of Liver Diseases (AASLD), NAFLD is defined as the accumulation of fat in more than 5%–10% of the liver by weight.³ NAFLD is strongly associated with metabolic risk factors including obesity,

dyslipidaemia, insulin resistance, metabolic syndrome, and type 2 diabetes mellitus (T2DM).^{4,5} Metabolic syndrome, which is highly prevalent among South Asian populations, is considered a major risk factor for NAFLD. Bangladeshi ethnicity has also been identified as an independent risk factor for the development of NAFLD. Consequently, NAFLD is often regarded as the hepatic manifestation of metabolic syndrome and insulin resistance.^{4,6}

The prevalence of NAFLD has increased markedly in the Asia-Pacific region owing to rapid urbanization, sedentary lifestyles, increased dietary fat consumption, and the growing burden of T2DM.^{7,8} The occurrence of

NAFLD is influenced by several factors, including age, sex, ethnicity, obstructive sleep apnea, and endocrine disorders such as hypothyroidism, hypopituitarism, hypogonadism, and polycystic ovarian syndrome.⁹ NAFLD has been reported in approximately 40% of obese individuals and 15% of overweight individuals. Furthermore, a strong association exists between NAFLD and T2DM. NAFLD is frequently asymptomatic and is often diagnosed incidentally in patients without overt signs or symptoms of liver disease.¹⁰⁻¹²

Patients with cardiovascular disease (CVD) risk factors, particularly dyslipidaemia and diabetes mellitus, are more likely to develop NAFLD. Studies have demonstrated a strong association between NAFLD and hypertriglyceridaemia, elevated low-density lipoprotein (LDL) cholesterol, increased very low-density lipoprotein (VLDL) levels, and reduced high-density lipoprotein (HDL) cholesterol levels. This dyslipidaemic pattern is highly atherogenic and contributes significantly to the increased cardiovascular morbidity and mortality observed among NAFLD patients. Moreover, NAFLD itself may serve as an important marker of metabolic syndrome, insulin resistance, and cardiovascular risk.¹

Several observational studies have shown that individuals with NAFLD are at increased risk of developing extrahepatic complications, including metabolic syndrome, cardiovascular disease, and diabetes mellitus. The accumulation of triglycerides within hepatocytes is considered a central event in the pathogenesis of NAFLD, although the precise mechanisms remain incompletely understood. Elevated serum concentrations of VLDL, triglycerides, and LDL cholesterol, together with reduced HDL cholesterol levels, have consistently been associated with NAFLD and may contribute to the increased cardiovascular disease burden observed in these patients.¹⁻⁵

Although many patients with NAFLD remain asymptomatic, some may complain of fatigue, malaise, or a feeling of fullness and discomfort in the right upper quadrant of the abdomen. Hepatomegaly is often the only physical finding. In most cases, NAFLD is

detected incidentally during abdominal ultrasonography or during evaluation for associated conditions such as obesity, hypertension, or diabetes mellitus.¹³ The risk of progression from NASH to cirrhosis is estimated to range from 8% to 15%, and patients with NASH have a risk of cirrhosis comparable to that of patients with chronic hepatitis C virus infection.¹⁴

Recent evidence suggests that chronic systemic inflammation plays a pivotal role in the pathogenesis of metabolic dysfunction-associated fatty liver disease (MAFLD). C-reactive protein (CRP), a widely recognized biomarker of systemic inflammation, has been shown to be significantly associated with NAFLD in several recent studies.¹⁵⁻²⁰

Although liver biopsy remains the gold standard for the diagnosis and staging of NAFLD, it is an invasive procedure associated with pain, expense, patient discomfort, and potential complications. In contrast, ultrasonography is a safe, non-invasive, inexpensive, and readily available diagnostic modality for detecting fatty liver disease. It is widely used as the first-line imaging technique for the diagnosis and grading of NAFLD and for screening asymptomatic individuals with elevated liver enzymes.^{21,22,23} Ultrasonographic grading systems classify fatty liver into different severity grades that correlate reasonably well with histopathological findings and clinical outcomes.

Given the close relationship between NAFLD and dyslipidaemia, assessment of serum lipid abnormalities according to the severity of fatty liver disease may provide valuable information regarding disease progression and cardiovascular risk. Therefore, the present study was undertaken to evaluate the serum lipid profile among patients with ultrasonographically diagnosed NAFLD.

Materials and Methods

This cross-sectional study was conducted in the Departments of Medicine and Hepatology at Sylhet MAG Osmani Medical College Hospital, Sylhet, Bangladesh, from July 2023 to June 2025. The study aimed to assess the serum lipid profile and body mass

index (BMI) among patients with non-alcoholic fatty liver disease (NAFLD). The study population consisted of patients diagnosed with NAFLD who attended the Departments of Medicine and Hepatology at MMCH during the study period. A total of 200 patients were enrolled in the study. Patients aged 18–70 years who were diagnosed with NAFLD and agreed to participate were included in the study.

After enrollment, a detailed medical history was obtained, and a thorough physical examination was performed for each participant. Information regarding age, sex, residence, occupation, religion, monthly income, educational status, and associated comorbidities was recorded. Physical examination included measurement of blood pressure, height, weight, and waist circumference, along with calculation of body mass index (BMI). Laboratory investigations were performed using 5 mL of venous blood collected from each participant. The investigations included fasting blood sugar, fasting lipid profile, liver function tests, serum creatinine, thyroid function tests, hepatitis B surface antigen (HBsAg), and anti-hepatitis C virus (anti-HCV) antibody. General and systemic physical examination findings were documented in the data collection form. Following completion of the investigations, patients identified with one or more risk factors were counseled regarding the disease and its potential consequences. Data were collected using a structured questionnaire from patients attending the Departments of Medicine and Hepatology at MMCH. The collected data were processed and analyzed using the Statistical Package for the Social Sciences (SPSS), version 25.0. Continuous variables were expressed as mean $\pm$ standard deviation, while categorical variables were presented as frequencies and percentages. Student's t-test was used to compare continuous variables, whereas the chi-square test or Fisher's exact test was applied for categorical variables, as appropriate. A p-value <0.05 was considered statistically significant for all analyses.

Results

Table I: Socio-demographic characteristics of the study population (n=200)

Characteristics	No. of patient	Percentage (%)
Age in years		
≤25	22	11.0
26-30	28	14.0
31-35	26	13.0
36-40	46	23.0
>40	78	39.0
Mean $\pm$ SD	39.84 $\pm$ 12.84	
Sex		
Male	116	58.0
Female	84	42.0

A total of 200 patients were included in the study. The mean age of the participants was 39.84 $\pm$ 12.84 years, with the majority (39.0%) being aged above 40 years, followed by 23.0% aged 36–40 years. Male participants predominated (58.0%), while females constituted 42.0% of the study population (Table I).

Table II: Distribution of the study according to waist circumference, BMI and blood pressure (n=200)

Variables	No. of patient	Percentage (%)
Waist circumference (cm)		
Normal	68	34.0
≥90 (men) ≥80 (women)	132	66.0
Mean $\pm$ SD	85.23 $\pm$ 5.61	
Range (min-max)	(75-100)	
BMI (kg/m ²)		
<23 (normal)	22	11.0
23-25 (over weight)	62	31.0
>25 (Obesity)	116	58.0
Mean $\pm$ SD	25.78 $\pm$ 2.58	
Range (min-max)	(20.95-29.95)	

Assessment of anthropometric parameters showed that 66.0% of the subjects had increased waist circumference (≥ 90 cm in men and ≥ 80 cm in women), with a mean waist circumference of 85.23 $\pm$ 5.61 cm. Regarding body mass index, obesity (BMI >25 kg/m²) was observed in 58.0% of the patients and overweight (BMI 23–25 kg/m²) in 31.0%, whereas only 11.0% had normal BMI. The mean BMI was 25.78 $\pm$ 2.58 kg/m².

Table III: Distribution of study subject according to SGPT, SGOT and FBS (n=200)

Variables	No. of patient	Percentage (%)
SGPT (U/L)		
<60	14	7.0
>60	186	93.0
Mean±SD	68.43±9.11	
Range (min-max)	(31-189)	
SGOT (U/L)		
<60	26	13.0
>60	174	87.0
Mean±SD	49.13±7.58	
Range (min-max)	(39-71)	
Fasting blood sugar		
<6.1	48	24.0
≥6.1	116	58.0
≥7.1 mmHg	36	18.0
Mean±SD	7.17±2.35	
Range (min-max)	(3.8-25.8)	

Serum SGPT levels exceeded 60 U/L in 93.0% of patients, with a mean value of 68.43±9.11 U/L, while SGOT levels were >60 U/L in 87.0%, with a mean of 49.13±7.58 U/L. Fasting blood sugar levels were ≥6.1 mmol/L in 76.0% of the subjects, and the mean fasting blood sugar was 7.17±2.35 mmol/L.

Table IV: Distribution of the study subject according to fasting lipid profile (n=200)

Variables	No. of patient	Percentage (%)
TG (mg/dl)		
<150	24	12.0
>150	176	88.0
Mean±SD	256.13±69.41	
Range (min-max)	(139-398)	
LDL (mg/dl)		
<100	36	18.0
≥100	164	82.0
Mean±SD	118.83±21.68	
Range (min-max)	(90-181)	
HDL (mg/dl)		
<40 (male)<50 (female)	152	76.0
≥40 (male)≥50 (female)	48	24.0
Mean±SD	43.67±7.41	
Range (min-max)	(31-59)	
TC (mg/dl)		
<200	32	16.0
≥200	168	84.0
Mean±SD	250.96±52.41	
Range (min-max)	(159-399)	

Regarding lipid profile, hypertriglyceridemia (TG >150 mg/dl) was present in 88.0% of participants, elevated LDL cholesterol (≥100 mg/dl) in 82.0%, low HDL cholesterol in 76.0%, and raised total cholesterol (≥200 mg/dl) in 84.0%. Mean values of TG, LDL, HDL, and total cholesterol were 256.13±69.41 mg/dl, 118.83±21.68 mg/dl, 43.67±7.41 mg/dl, and 250.96±52.41 mg/dl.

Table V: Distribution of the study subject according to fatty liver on USG (n=200)

	No. of patient	Percentage (%)
Mild	144	72.0
Moderate	56	28.0

Ultrasonographic evaluation showed that 72.0% of patients had mild fatty liver, whereas 28.0% had moderate fatty liver changes (Table V).

Table VI: Comparison between USG and Serum Lipid Profile

Serum lipid profile (mg/dl)	Mild fatty liver (Mean ± SD)	Moderate fatty liver (Mean ± SD)	p-value
TG	161.70 ± 51.59	222.56 ± 118.51	0.001
LDL	104.98 ± 25.26	124.67 ± 31.18	0.001
HDL	44.28 ± 5.67	41.72 ± 4.78	0.001
TC	185.24 ± 36.52	215.29 ± 47.69	0.001

Comparison of serum lipid parameters according to the severity of fatty liver demonstrated that patients with moderate fatty liver had significantly higher mean levels of triglycerides (222.56±118.51 mg/dl vs. 161.7±51.59 mg/dl), LDL cholesterol (124.67±31.18 mg/dl vs. 104.98±25.26 mg/dl), and total cholesterol (215.29±47.69 mg/dl vs. 185.24±36.52 mg/dl) compared with those with mild fatty liver. Conversely, HDL cholesterol was significantly lower in the moderate fatty liver group (41.72±4.78 mg/dl) than in the mild fatty liver group (44.28±5.67 mg/dl). These differences were statistically significant (p=0.001), indicating a strong association between worsening fatty liver severity and an adverse lipid profile.

Discussion

Non-Alcoholic Fatty Liver Disease (NAFLD) is a clinico-pathological condition where fat (predominantly Triglyceride) accumulates in liver.²⁴ NAFLD is emerging as the most common chronic liver condition in the Western world. It is associated with insulin resistance and frequently occurs with features of the metabolic syndrome.¹⁰ Common metabolic aberrations like obesity, hyperglycemia, dyslipidemia, and are known as major health risk factors worldwide leading to an increase in hepatic steatosis regardless of age and gender.⁵ This was a hospital based observational study was carried out with an aim to evaluate the correlation between NAFLD with serum lipid profile. The present study findings were discussed and compared with previously published relevant studies.

This study shows the mean age of the patients was 39.84 (SD $\pm$ 12.84) years. It was found that more patients were from >40 years age group (39%) followed by 36-40 years age group (23%). In a study by Agarwal et al.²⁵ maximum numbers of patients were between 3rd and 4th decades of age and mean age was found 42.70 $\pm$ 10.09. This is almost similar in this study. Similar study Adam et al.²⁴ who reported mean age 45.0 $\pm$ 11.0 with the range of 19-65 years. In western communities, studies had shown mean age of subjects ranging from 41-45 years.²⁶

In the study, NAFLD had male predominance with almost 58% cases were found males. The current study is in agreement to the previous studies in Khanal et al.²⁷ Similar results were found by Som et al.²⁸ in which male predominance was noted in cases of NAFLD. Tanwani et al.²⁹ also studied the sex distribution among people with NAFLD and found that it was predominant in males.

This study found waist circumference, the mean waist circumference was found in 85.23 $\pm$ 5.61 cm. Person who have waist circumference $\geq$ 90 cm (man) or $\geq$ 80 cm (women) was 66%. Normal waist circumference was found 34%. Increase in abdominal girth is more linked to develop NAFLD probably due to different distribution of body fat in Asian, like abdominal fat, which influence to develop fatty liver as apple type of

abdomen and high waist circumference is more consistent with metabolic syndrome or due to follow the Asian parameter. Jian-Gao et al.³⁰ found the mean waist circumference was 83.79 $\pm$ 9.70 cm and 78.06 $\pm$ 9.69 cm in man and women respectively. This is almost similar in my study. On the other hand, Marchesini et al.³¹ obtained the mean waist circumference was 91 $\pm$ 8 cm in NASH and 89 $\pm$ 4 cm in control groups.

In this study body mass index (BMI) of participants varied from 20.95 to 29.95 kg/m² with mean value of 25.78 $\pm$ 2.58 kg/m². Most (58%) were of obese (BMI >25 kg/m²), 31% were overweight (BMI 23-25 kg/m²), 11% were normal BMI (BMI <23 kg/m²). Similar study Bhusal et al.³² found body mass index (BMI) of participants varied from 18.14 to 44.75 kg/m² with mean value of 27.97 $\pm$ 4.28 kg/m². Most (42%) were of normal BMI, 34% were overweight (BMI 25-29 kg/m²), 23% were obese (BMI >30kg/m²), and 1% underweight (BMI <18kg/m²). This is almost similar in my study. Another study Khanal et al.²⁷ found only 30% had normal weight. 70% cases had increased weight with 56% being overweight, 16% had Class I obesity, and 9% had Class II obesity. In a study conducted by Juurinen et al.³³ it was found that 52.8% were overweight and 22.6% were obese. These findings in other studies correlate quite well with this study showing that there is higher prevalence of overweight and obesity in people with NAFLD.

The mean SGPT was found 68.44 $\pm$ 9.05 U/L. The mean SGOT was 50.0 $\pm$ 7.89 U/L. The commonest presentation of fatty liver is increased SGPT. The mean fasting blood sugar was found 7.13 $\pm$ 2.30 mmol/l. Fasting blood sugar >6.1 was found in 57(57%) and $\geq$ 7.0 mmol/l were found in 18(18%) and <6.1 was found in 25(25%) cases. This findings consistent with Brea et al.³⁴ they found mean fasting glucose 6.4 $\pm$ 1.3 mmol/L in patients and 5.5 $\pm$ 0.7 mmol/L in control.

This study shows regarding the fasting lipid profile, the mean TG was found 256.13 $\pm$ 69.41 mg/dl. The mean LDL was found 118.83 $\pm$ 21.68 mg/dl. The mean HDL was found 43.67 $\pm$ 7.41 mg/dl. The mean TC was found 250.96 $\pm$ 52.41 mg/dl. Pagano et al.³⁵ showed the mean triglycerides was 99 $\pm$ 43 mg/dl in NASH and

75±31 mg/dl in control, mean total cholesterol was 175±36 mg/dl in NASH and 185±27 mg/dl in control, mean HDL cholesterol was 47±9 mg/dl in NASH and 59±17 mg/dl in control and mean LDL cholesterol was 108±36 mg/dl in NASH and 106±27 mg/dl in control group. Similar observation also documented by Park et al.³⁶ which are comparable with the current study. This is comparable may be different type of methodological study.

This study shows ultrasonogram findings of the fatty liver. Mild fatty changes was found in 72(72%) and moderate change in 28(28%). We had no enrolled subject of severe fatty liver. Similar study showed by Bhusal et al.³² among the enrolled 100 patients, 83% had mild fatty liver and 17 % had moderate fatty liver also confirming. They had no enrolled subject of severe fatty liver.

This study shows the cholesterol value was abnormal in 84(84%), while normal in remaining 16 (16%) patients. Triglycerides was abnormal in 88 (88%) while in 12(12%) patients was normal. HDL in 76 (76%) patients was abnormal while 24(24%) patients had normal values. Low density lipoprotein value in 82 (82%) patient was abnormal and in 18 (18%) patient was normal. Previous study reported total serum cholesterol and serum triglyceride levels increased in fatty liver (non-alcoholic disease) patients as compared with controls.¹⁴⁻²⁰

Another study Tanwani et al.³² found the cholesterol value was abnormal in 186 (62%), while normal in remaining 114 (38%) patients. Triglycerides were abnormal in 152 (50.7%) while in 148 (49.3%) patients was normal. HDL in 155 (51.7%) patients was abnormal while 145 (48.3%) patients had normal values. Low density lipoprotein value in 117 (39%) patient was abnormal and 183 (61%) patient was normal. Very low-density lipoprotein in 117 (39%) patients was abnormal and 183 (61%) patient was normal.

This study shows comparison of lipid changes in different grades of NAFLD by statistical analysis using analysis of variance test (student 't' test). P values <0.05 were considered as significant. It was

observed that increasing grades of NAFLD were significantly associated with increasing levels of serum total cholesterol (P value-0.001), TG (P value-0.001), LDL (P value-0.001) and decreasing HDL (P value-0.001) and increasing grades of ultrasonographically diagnosed NAFLD. The current study is in agreement to the previous studies in Mahaling et al.³⁷ they found NAFLD were significantly associated with increasing levels of serum total cholesterol (P value-0.001), LDL (P value-0.000) and VLDL (P value-0.003) and decreasing HDL (P value-0.000). No significant association was found between serum triglyceride levels (P value-0.05) and increasing grades of sonographically diagnosed NAFLD.

Ultrasonographic findings along with considerably raised fasting lipid profile are the safe, cheap, easy, and accurate available diagnostic tool for fatty liver (non-alcoholic disease).^{1,5,15-20,38} Ultrasound (USG) foremost imaging technique used to establish and categorize the fatty liver disease and extensively used for the suspects of NAFLD and also asymptomatic subjects having raised hepatic enzymes. In current study, ultrasound provided excellent utility for diagnosis of fatty liver (NAFLD) by means of raised levels of fasting lipid profile. This is detected earlier by ultrasonography. There is statistically significant relation in subjects diagnosed on ultrasound and serum fasting lipid profile of fatty liver (non-alcoholic disease). Ultrasound is cost effective technique to analyze the changes seen in various grades of NAFLD.

The present study had certain limitations. The sample size was relatively small, which may limit the generalizability of the findings. In addition, no follow-up of the participants was performed to reassess clinical or biochemical changes over time, thereby restricting evaluation of disease progression and long-term outcomes. Moreover, as the study was conducted in a tertiary care hospital, the study population may not accurately represent the general community, and thus may not reflect the true population burden of the disease. Therefore, larger community-based studies are recommended to provide a more comprehensive understanding of the condition in the country.

Conclusion

In conclusion, the present study highlights a strong association between non-alcoholic fatty liver disease (NAFLD) and metabolic abnormalities, particularly dyslipidaemia. Most patients demonstrated elevated serum triglyceride, total cholesterol, and LDL levels, along with reduced HDL levels, indicating an atherogenic lipid profile. Ultrasonographic grading showed that the majority of patients had mild fatty liver, while a smaller proportion had moderate disease. Significant worsening of lipid parameters was observed with increasing severity of NAFLD, suggesting that dyslipidaemia is closely associated with disease progression. These findings emphasize that NAFLD is strongly linked to adverse metabolic risk factors and underscore the importance of early detection and management of lipid abnormalities to prevent disease progression and reduce cardiovascular risk.

References

1. Ravish SK, Garg D, Kapoor A. Association of Lipid Profile with Non-Alcoholic Fatty Liver Disease Diagnosed on Ultrasound. National Board of Examinations - Journal of Medical Sciences 2025;3(9):1026-1035.
2. Chalasani N, Younossi Z, Lavine JE, Diehl AM, Brunt EM, Cusi K, et al. The diagnosis and management of non-alcoholic fatty liver disease: Practice guideline by the American Association for the Study of Liver Diseases, American College of Gastroenterology and the American Gastroenterological Association. Hepatology 2012; 55: 2005-23.
3. Neuschwander-Tetri BA, Caldwell SH. Nonalcoholic steatohepatitis: summary of an AASLD Single Topic Conference. Hepatology 2003; 37: 1202-1219.
4. Fon Tacer K, Rozman D. Nonalcoholic Fatty liver disease: focus on lipoprotein and lipid deregulation. J Lipids 2011; 2011: 783976.
5. Zahoor A, Iqbal I, Naseem S, Zahoor ZI, Iqbal I, Naseem S, Choudhary ZI. Association of Lipid Profile with Non-Alcoholic Fatty Liver Disease diagnosed on Ultrasound. Journal of Rawalpindi Medical College. 2020;24(4):334-338.
6. Alazawi W, Mathur R, Abeysekera K, Hull S, Boomla K, Robson J, Foster GR. Ethnicity and the diagnosis gap in liver disease: A population-based study. The British Journal of General Practice. 2014;64:e694-e702.
7. Pandey, G. and Balakrishnan, V. Clinico-Pathological Spectrum of Non-Alcoholic Fatty Liver Disease among Patients in Kerala. Indian Journal of Clinical Biochemist 2009;24:155-158.
8. Sharma S, Bhattarai S. A cross sectional study of lipid profile in ultrasonography-Diagnosed Fatty Liver. Biosciences Biotechnology Research Asia. 2023;20(2):667-71.
9. Vernon G, Baranova A, Younossi ZM, Systematic Review: the epidemiology and natural history of non-alcoholic fatty liver disease and non-alcoholic Steatohepatitis in adults. Aliment Pharmacol Ther 2011;34(3):274-85.
10. Sen A, Kumar J, Misra RP, Uddin M and Shukla PC. Lipid Profile of Patients Having Non-Alcoholic Fatty Liver Disease as per Ultrasound Findings in North Indian Population: A Retrospective Observational Study. Journal of Medical and Allied Sciences 2013;3:59-62.
11. Schild BZ, Santos LN and Alves MK. Non-Alcoholic Fatty Liver Disease and Its Association with Metabolic Syndrome in the Preoperative Period in Patients Undergoing Bariatric Surgery. Revista da Associa Medica Brasileira 2013;59:155-160.
12. McCullough AJ and Hawkins C. Clinical Spectrum of Non-Alcoholic Fatty Liver Disease in Diabetic and Non-Diabetic Patients. BBA Clinical 2015;3:141-145.
13. Obika M, Noguchi H. Diagnosis and evaluation of nonalcoholic fatty liver disease. Exp Diabetes Res 2012; 2012: 1-12.
14. Matteon CA, Younossi ZM, Gramlich T, Boparai N, Liu YC, McCullough AJ.

- Non-alcoholic Fatty liver disease: a spectrum of clinical pathological severity *Gastroenterology* 1999;11666:1413.
15. Pan X, Lv J, Liu M, Li Y, Zhang Y, Zhang R et al. Chronic systemic inflammation predicts long-term mortality among patients with fatty liver disease: data from the National Health and Nutrition Examination Survey 2007-2018. *PLoS ONE*. 2024;19(11): e0312877.
 16. Li W, Wang F, Li Z, Feng W, Huang H, Kwan MP, Tse LA. Lipid profile and non-alcoholic fatty liver disease detected by ultrasonography: is systemic inflammation a necessary mediator?. *Annals of Medicine*. 2025;57(1):2480250.
 17. Zhou X-D, Chen Q-F, Targher G, Byrne CD, Shapiro MD⁷, Tian Net al. High-sensitivity C-reactive protein is associated with heart failure hospitalization in patients with metabolic dysfunction-associated fatty liver disease and normal left ventricular ejection fraction undergoing coronary angiography. *J Am Heart Assoc*. 2024;13(3):e032997.
 18. Xia G, Xu Y, Zhang C, Li M¹, Li H, Chen C et al. High levels of serum hyper sensitive C-reactive protein are associated with non-alcoholic fatty liver disease in non-obese people: a cross-sectional study. *Eur J Med Res*. 2024;29(1):496.
 19. Doustmohammadian A, Amirkalali B, Esfandyari S, Motamed N, Maadi M, Shivappa N et al. The association between dietary inflammatory index (DII) scores and c-reactive protein (CRP) and nonalcoholic fatty liver disease (NAFLD) in a general population cohort. *Clin Nutr ESPEN*. 2024;60:156–164.
 20. Ding Z, Wei Y, Peng J. The potential role of C-reactive protein in metabolic-dysfunction-associated fatty liver disease and aging. *Biomedicines*. 2023;11(10):2711.
 21. Holterman A and Somma ND. Nonalcoholic Fatty Liver Disease and Bariatric Surgery in Adolescents. *Seminars in Pediatric Surgery* 2014; 23:49-57.
 22. Narendran A, Venkadesh GA, Brinda JA. Algin Danny. Comparison of lipid profile in different grades of non-alcoholic fatty liver disease on ultrasonography. *Int J Acad Med Pharm* 2023; 5 (2); 378-382.
 23. Khadgi K, Singh TB. Study of Sonographically Diagnosed Non-Alcoholic Fatty Liver Disease and Association with its Risk Factors in Nepal Police Hospital. *Nepal Medical Journal*. 2022;5(2):30-8.
 24. Adams LA, Sanderson S, Lindor KD, Angilo P. The histological course of non alcoholic fatty liver disease. A longitudinal study of 103 patients with sequential liver biopsies. *J hepatal*. 2015;42:132-138.
 25. Agrawal R, Mishra S, Dixit VK, Rai S. Association of Non-Alcoholic Fatty Liver Disorder with Obesity. *Indian J Prev Soc Med*. 2009;40(3):126-129.
 26. Santoshini A, Swathi P and Ravindra B. Estimation of Lipid Profile in Various Grades of Non Alcoholic Fatty Liver Disease Diagnosed on Ultrasonography. *International Journal of Pharma and Bio Sciences* 2016;7:1198-1203.
 27. Khanal UP, Paudel B, Gurung G, Hu YS, Kuo CW. Correlational study of nonalcoholic fatty liver disease diagnosed by ultrasonography with lipid profile and Body Mass Index in adult nepalese population. *J Med Ultrasound* 2019;27:19-25.
 28. Som K, Swaika BC, Pramanik S, Chakraborty P, Gantait K. Lipid Profile in Alcoholic and Non Alcoholic Patients of Chronic Liver Disease A Comparative and Analytical Study in a Rural-based Tertiary Care Centre. *JAPI* 2019;37:355-360.
 29. Tanwani B, Jamali A, Jamali G, Jamali A and Sohail M. Non Alcoholic Fatty Liver Disease: Assessment of Lipid Profile Estimation in Different Grades of Fatty Liver on Ultrasound. *Open Journal of Preventive Medicine* 2018; 8:70-83.
 30. Jian-Gao, FAN, June ZHU, Xing-Jian LI, Yuan-San LU, Lui LI, Fei D. Fatty liver and the

- metabolic syndrome among Shanghai adult. *Journal of Gastroenterology and Hepatology* 2015;20:1825-1832.
31. Marschesini G, Bugianesi E, Forlani G. Non-alcoholic fatty liver steatohepatitis and the metabolic syndrome. *Hepatology* 2013;37:917-23.
 32. Bhusal KR, Simkhada R, Nepal P. Lipid profile in different grades of Ultrasonic NonAlcoholic Fatty Liver Disease. *JCMS Nepal*. 2017;13(2):258-61.
 33. Juurinen L, Tiikkainen M, Häkkinen AM, Hakkarainen A, Yki-Jarvinen H. Effects of insulin therapy on liver fat content and hepatic insulin sensitivity in patients with type 2 diabetes. *Am J Physiol Endocrinol Metab* 2017;292:E829-35.
 34. Brea A, Mosquera D, Martin E, Arizti A, Cordero JL, Ros E. Non-alcoholic fatty liver disease is associated with carotid atherosclerosis: a case control study. *Arteriosclerosis and Thrombosis* 2015;25:1045-50.
 35. Pagano C, Pacini G, Musso G, Gambino R, Mecca F, Depetris N, Cassader M. Non-alcoholic steatohepatitis, insulin resistance and metabolic syndrome. Further evidence for an etiologic association. *Hepatology* 2012;35:367-72.
 36. Park HS, Han JH, Lee SY, Kim DJ, Kim SE. Prevalence of the metabolic syndrome among Korean adults according to the criteria of the International Diabetes Federation. *Diabetes Care* 2016;29:933-4.
 37. Mahaling DU and Basavaraj MM. Comparison of Lipid Profile in Different Grades of Non-Alcoholic Fatty Liver Disease Diagnosed on Ultrasound. *Asian Pacific Journal of Tropical Biomedicine* 2013;3:907-912.
 38. Zafar U, Ahmad MN, Nadeem N, Uddin MM, Zafar B, Baig S, Zafar F, Pervez H, Akram S. Correlation of Grades of Non-alcoholic Fatty Liver on Ultrasound With Blood Parameters. *Cureus*. 2024;16(1):1-7.

Original Article

Body Mass Index at Third Trimester and Pregnancy Outcome in the Bangladeshi Population Attending a Tertiary Care Hospital

Begum A^{1*}, Montasir AA², Nazim R³, Neeger MN⁴, Ghosh UK⁵, SoniaAA⁶

1. Dr. Aeysha Begum, Assistant Professor, Department of Obstetrics & Gynaecology, Khawja Yunus Ali Medical College, Sirajganj.
2. Dr. Ahmed Al Montasir, Assistant professor, Department of Medicine, TMSS Medical College, Bogura.
3. Dr. Roksana Nazim, Assistant Professor, Department of Obstetrics & Gynaecology, Khawja Yunus Ali Medical College, Sirajganj.
4. Dr. Most. Nasrin Neeger, Associate Professor, Department of Obstetrics & Gynaecology, Khawja Yunus Ali Medical College, Sirajganj.
5. Dr. Uzzal Kumar Ghosh, Associate Professor, Department of Pediatrics, Khawja Yunus Ali Medical College, Sirajganj.
6. Dr. Asma Akter Sonia, Assistant Professor, Department of Obstetrics & Gynaecology, Khawja Yunus Ali Medical College, Sirajganj.

Corresponding Author*Abstract**

Background: Maternal body mass index (BMI) is an important predictor of pregnancy outcomes; however, evidence regarding the prognostic value of third-trimester BMI in Bangladesh remains limited. This study evaluated the association between maternal BMI measured during the third trimester and maternal, obstetric, neonatal and postpartum outcomes.

Materials and Methods: A prospective observational cohort study was conducted among 250 singleton pregnant women attending the Department of Obstetrics and Gynaecology, Khawja Yunus Ali Medical College Hospital (KYAMCH), Bangladesh, between January 2024 and December 2025. Participants were classified using WHO Asian BMI criteria into underweight, normal weight, overweight, and obese groups. Maternal complications, mode of delivery, neonatal outcomes, and one-year postpartum maternal and infant outcomes were compared across BMI categories using appropriate statistical tests, with $p \leq 0.05$ considered statistically significant.

Results: Underweight women constituted 28.4% of the cohort, whereas 22.4% were overweight or obese. Underweight mothers had significantly higher rates of anemia, preterm birth, low birth weight, and NICU admission. Conversely, overweight and obese women experienced significantly increased frequencies of gestational diabetes mellitus, pre-eclampsia, Caesarean delivery, meconium-stained amniotic fluid, fetal macrosomia, postpartum weight retention, and persistent glucose intolerance. Infants born to mothers at both BMI extremes demonstrated increased neonatal morbidity and greater NICU utilization.

Conclusion: Third-trimester maternal BMI is a simple, inexpensive, and clinically valuable predictor of adverse maternal and neonatal outcomes. Routine BMI assessment during late pregnancy may facilitate risk stratification, targeted nutritional intervention, individualized obstetric management, and improved maternal and neonatal outcomes in resource-limited settings such as Bangladesh.

Keywords: Third trimester BMI, Pregnancy outcome, Maternal complications, Gestational diabetes mellitus, Neonatal outcomes.

Introduction

Maternal nutritional status is a major determinant of maternal, fetal, and neonatal health. Among available anthropometric measures, body mass index (BMI) remains a practical, inexpensive, reproducible, and widely applicable tool for assessing nutritional status and stratifying obstetric risk. Both low and high maternal BMI are associated with increased maternal morbidity, adverse pregnancy outcomes, and neonatal complications.^{1,2} The coexistence of undernutrition and overweight/obesity-the “double burden of

malnutrition”-is particularly important in low- and middle-income countries (LMICs).³ A large systematic review has demonstrated that abnormal maternal BMI is associated with preterm birth, hypertensive disorders, operative delivery, abnormal birth weight, and neonatal intensive care unit (NICU) admission.⁴

Bangladesh is experiencing this nutritional transition. Maternal undernutrition, anemia, and micronutrient deficiencies remain prevalent, particularly among

socioeconomically disadvantaged women, while urbanization, dietary changes, and reduced physical activity have contributed to increasing overweight and obesity among women of reproductive age.^{5,6} Maternal underweight is associated with inadequate nutritional reserves, impaired fetal growth, low birth weight (LBW), preterm birth, and neonatal morbidity.^{2,7,8} Conversely, maternal overweight and obesity increase insulin resistance, systemic inflammation, and endothelial dysfunction, contributing to gestational diabetes mellitus (GDM), hypertensive disorders, pre-eclampsia, fetal macrosomia, operative delivery, and Caesarean section.⁹⁻¹⁴

Although BMI is ideally assessed before conception or during early pregnancy,¹⁵ this information is frequently unavailable in Bangladesh because many women initiate antenatal care late or first present to tertiary hospitals during the third trimester.^{5,6} In this context, third-trimester BMI may provide a pragmatic measure for late-pregnancy risk stratification. Despite physiological gestational weight gain, late-pregnancy BMI remains associated with hypertensive disorders, GDM, operative delivery, fetal growth abnormalities, and neonatal complications.^{16,17}

Prospective evidence regarding the prognostic value of third-trimester BMI in Bangladesh remains limited, particularly regarding postpartum maternal health and infant outcomes.¹⁸⁻²² Therefore, this prospective observational cohort study evaluated the association between third-trimester maternal BMI and maternal, obstetric, neonatal, and one-year postpartum outcomes among women attending Khawja Yunus Ali Medical College Hospital, Bangladesh. We hypothesized that both underweight and overweight/obesity would be independently associated with adverse pregnancy outcomes.

Materials and Methods

This prospective observational cohort study was conducted in the Department of Obstetrics and Gynaecology, Khawja Yunus Ali Medical College Hospital, Bangladesh, from January 2024 to December 2025. Of 300 consecutively enrolled women, 250

completed the one-year follow-up and were included in the final analysis. Eligible participants were aged 18–40 years with singleton pregnancies at ≥ 28 weeks of gestation. Women with multiple gestation, hydramnios, pre-existing diabetes, chronic hypertension, severe renal or cardiac disease, or intrauterine fetal death at presentation were excluded.

Maternal height and weight were measured using standard equipment, and BMI was calculated as kg/m^2 . According to WHO Asian criteria, participants were categorized as underweight (<18.5), normal weight ($18.5\text{--}22.9$), overweight ($23.0\text{--}24.9$), or obese (≥ 25.0 kg/m^2). Maternal, obstetric, and neonatal outcomes, including anemia, pre-eclampsia, gestational diabetes, mode of delivery, birth weight, Apgar scores, and NICU admission, were recorded. Maternal metabolic and weight outcomes, breastfeeding, and infant growth were assessed during one-year postpartum follow-up.

Data were analyzed using SPSS version 25.0. Appropriate parametric, non-parametric, and categorical tests were applied, with $p \leq 0.05$ considered statistically significant. Institutional ethical approval and written informed consent were obtained.

Institutional ethical approval was obtained from KYAMC. All participants were counselled regarding the study, and written informed consent was obtained before enrollment.

Results

Baseline Demographic Profiles of the 300 women enrolled at baseline, 250 (83.3%) completed the one-year postpartum follow-up and were included in the final analysis, while 50 (16.7%) were lost to follow-up.

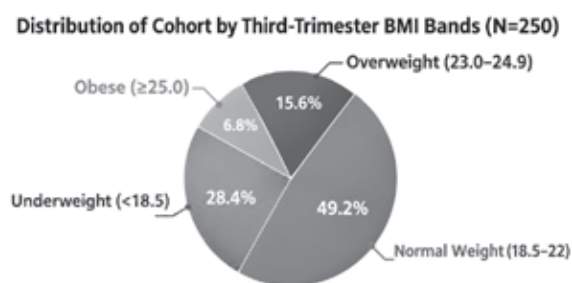


Figure 1: Pie chart cohort distribution by BMI bands

Among the 250 enrolled women, the cohort distribution across third-trimester BMI bands revealed a distinct presentation of the malnutrition: Underweight (28.4%), Normal Weight (49.2%), Overweight (15.6%), and Obese (6.8%, including morbid obesity) (Figure 1).

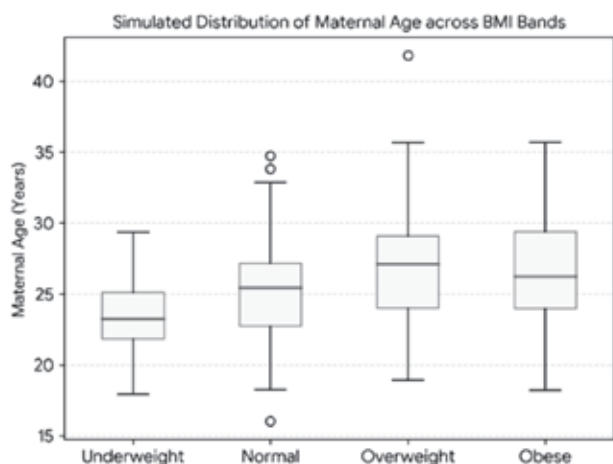


Figure 2: Box plot showing distribution of maternal age across BMI categories Maternal Antepartum Complications

The mean age of the participants were associated with weight tiers, spanning from 23.8 years in the underweight group to over 26.5 years within higher weight ranges (Figure 2). Obese women demonstrated a higher likelihood of being multigravida (73.33%) compared to the underweight, who were mostly primigravida

Table I: Maternal antenatal complications stratified by third-trimester BMI bands

Maternal Complication (%)	Underweight (<18.5)	Normal Weight (18.5-22.9)	Overweight (23.0-24.9)	Obese (≥ 25.0)	p-value
Maternal Anemia	23.94%	5.69%	7.69%	6.67%	<0.05
Pre-eclampsia	21.13%	22.76%	38.46%	40.00%	<0.05
Gestational Diabetes (GDM)	2.82%	3.25%	10.26%	26.67%	<0.01

The clinical outcomes of the pregnancy was heavily influenced by third-trimester weight statuses. Anemia was overwhelmingly clustered within the underweight group, affecting 23.94% of its members, compared to only 5.69% of normal-weight individuals ($p < 0.05$). Conversely, hypertensive and glycemic complications were dominant within the overweight and obese groups. Pre-eclampsia risk ranged from 21.13% in the underweight group up to 40.00% within the obese category. Similarly, GDM rates rose sharply from a baseline of 3.25% in normal-weight women to 26.67% among obese patients ($p < 0.01$) (Table I).

Table II : Association of Third-Trimester Maternal Body Mass Index with Obstetric and Neonatal Outcomes.

(Values are presented as n/N (%)). BMI was categorized according to WHO Asian BMI criteria: underweight ($<18.5 \text{ kg/m}^2$), normal weight ($18.5\text{--}22.9 \text{ kg/m}^2$), overweight ($23.0\text{--}24.9 \text{ kg/m}^2$), and obese ($\geq 25.0 \text{ kg/m}^2$). Overall differences among BMI categories were assessed using Pearson's χ^2 test. A two-sided $p < 0.05$ was considered statistically significant. BMI, body mass index; NICU, neonatal intensive care unit).

Outcome	Underweight (n=71), n/N (%)	Normal weight (n=123), n/N (%)	Overweight (n=39), n/N (%)	Obese (n=17), n/N (%)	χ^2	p-value
Spontaneous vaginal delivery	51/71 (71.8)	84/123 (68.3)	23/39 (59.0)	8/17 (47.1)	4.95	0.175
Caesarean delivery	20/71 (28.2)	39/123 (31.7)	16/39 (41.0)	9/17 (52.9)	4.95	0.175
Preterm birth	23/71 (32.4)	15/123 (12.2)	2/39 (5.1)	3/17 (17.6)	17.67	<0.001
Low birth weight ($<2.5 \text{ kg}$)	26/71 (36.6)	18/123 (14.6)	4/39 (10.3)	2/17 (11.8)	17.51	<0.001
Macrosomia ($>4.0 \text{ kg}$)	0/71 (0.0)	1/123 (0.8)	3/39 (7.7)	3/17 (17.6)	21.03	<0.001
Meconium-stained amniotic fluid	7/71 (9.9)	15/123 (12.2)	8/39 (20.5)	6/17 (35.3)	8.88	0.031
NICU admission	10/71 (14.1)	4/123 (3.3)	8/39 (20.5)	5/17 (29.4)	18.00	<0.001

Intrapartum Profiles and Delivery Modes

Delivery modes varied widely based on third-trimester BMI status. Spontaneous vaginal deliveries were most frequent among underweight (71.8%) and normal-weight (68.3%) cohorts. Caesarian section were needed among over weight and obese cohorts: the Caesarean section rate reached 41.0% in overweight women and 53.3% in obese women ($p < 0.05$). Primary clinical indications for caesarian section in high-BMI cohorts included labor dystocia, induction failures, and acute fetal distress signaled by meconium-stained liquor. Meconium-stained amniotic fluid was documented in 36% of obese mothers deliveries, contrasted against just 12% within the normal-weight control group.

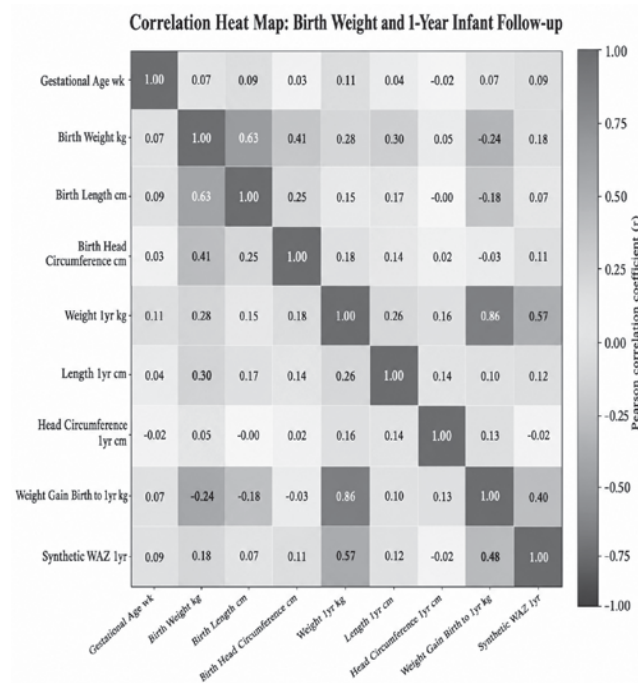


Figure 3. Correlation heat map of birth anthropometric parameters and infant growth outcomes at 1-year follow-up.

The heat map shows correlations between birth characteristics and infant growth at 1 year. The strongest correlation was between 1-year weight and weight gain ($r = 0.86$), followed by birth weight and birth length ($r = 0.63$). One-year weight was also moderately associated with WAZ ($r = 0.57$). Most other relationships were weak to moderate.

Neonatal Outcomes

Maternal third-trimester weight variations correlated strongly with neonatal birth profiles (Figure 3).

Neonatal Outcomes

Maternal third-trimester weight variations correlated strongly with neonatal birth profiles. Preterm labor pains were prominent in the underweight group (32%) relative to normal weight (12%) and overweight cohorts (4%) ($p = 0.000$) (Table II).

Birth Weight: Mean birth weight showed a direct linear relationship with maternal BMI status. Underweight mothers frequently delivered Low Birth Weight infants (<2.5 kg). In contrast, macrosomia (>4.0 kg) was uniquely seen within the high-BMI categories, tracking at 15.38% in the obese subgroup.

Apgar Scores and NICU Admissions: While average 1-minute and 5-minute APGAR scores did not deviate much across the different groups ($p > 0.05$), the total numbers of neonates requiring immediate care interventions did. NICU admissions peaked at the newborns of mothers with extreme groups of BMI: 14% of infants born to underweight mothers (primarily for low birth weight and prematurity) and 26.7% born to obese mothers (for birth asphyxia and respiratory distress) required intensive care.

NICU Admission Rates Trend Profile:

- Underweight (<18.5 kg/m²): 14.0% requiring critical care intervention
- Normal Weight (18.5–22.9 kg/m²): 3.3% baseline operational care
- Overweight (23.0–24.9 kg/m²): 20.5% transitional observation
- Obese (≥ 25.0 kg/m²): 26.7% intensive metabolic and respiratory support

One-Year Postpartum Follow-Up Outcomes

The one-year longitudinal phase identified lingering effects from the third-trimester classifications:

1. Maternal Metabolic Path: Over 18% of the obese and overweight mothers who developed GDM exhibited persistent impaired fasting glucose or frank Type 2 diabetes mellitus at their 6-week and 1-year screening intervals.

2. Postpartum Weight Trends: Women entering the third trimester with an overweight and obese BMI profile retained a mean of 6.4 kg above their early pregnancy estimates at one year postpartum, aggravating baseline obesity levels.

3. Infant Lactation and Development: Underweight mothers experienced higher rates of subjective lactation insufficiency within the first six months. At the one-year followup milestone, infants born to the underweight cohort had higher rates of persistent mild-to-moderate wasting and failure to thrive compared to normal-weight controls.

Multivariable Logistic Regression Analysis

After multivariable adjustment, both extremes of maternal BMI remained independently associated with adverse pregnancy outcomes. Compared with women with normal BMI, obese women had significantly higher adjusted odds of pre-eclampsia (AOR 8.06; 95% CI 2.35–27.68; $p < 0.001$), NICU admission (AOR 9.66; 95% CI 1.95–47.89; $p = 0.005$), and meconium-stained amniotic fluid (AOR 11.40; 95% CI 3.01–43.16; $p < 0.001$). Overweight women had increased odds of Caesarean delivery (AOR 2.78; 95% CI 1.19–6.51; $p = 0.019$). Maternal underweight was independently associated with preterm birth (AOR 2.74; 95% CI 1.16–6.46; $p = 0.021$), low birth weight (AOR 3.45; 95% CI 1.52–7.80; $p = 0.003$), and NICU admission (AOR 4.32; 95% CI 1.33–13.97; $p = 0.015$). Urban residence was associated with lower adjusted odds of Caesarean delivery and NICU admission. Other adjusted covariates did not demonstrate statistically significant independent associations in the respective models.

Discussion

The present prospective observational cohort study demonstrates that maternal body mass index (BMI) measured during the third trimester is significantly associated with maternal, obstetric, neonatal, and postpartum outcomes among Bangladeshi women. Both ends of the BMI spectrum showed distinct patterns of risk: underweight was predominantly associated with nutritional deficiency, preterm birth, low birth weight (LBW), and neonatal morbidity,

whereas overweight and obesity were associated with metabolic, hypertensive, and operative complications. These findings support the clinical usefulness of late-pregnancy BMI for risk stratification, particularly in resource-limited settings where early antenatal BMI is frequently unavailable.

Nearly one-third of the study population was underweight, highlighting the persistent burden of maternal undernutrition in Bangladesh despite improvements in maternal healthcare. This finding is consistent with national evidence showing that undernutrition remains particularly important among rural and socioeconomically disadvantaged women. Maternal anemia was substantially more frequent among underweight women, plausibly reflecting reduced nutritional reserves and deficiencies of iron and other micronutrients. Previous Bangladeshi studies have similarly demonstrated associations between maternal undernutrition, anemia, and adverse neonatal outcomes.²³

Underweight women also experienced significantly more preterm births and LBW infants.^{24,25} Maternal nutritional deficiency may impair placental development and fetal nutrient supply, thereby restricting fetal growth and increasing susceptibility to premature delivery.²⁶ Comparable studies from Pakistan and India have demonstrated associations between low maternal BMI, fetal growth restriction, LBW, and neonatal morbidity.²⁷⁻²⁹ In the present study, infants of underweight mothers also required NICU admission more frequently, predominantly because of prematurity, LBW, respiratory problems, and feeding difficulties. These observations emphasize the importance of nutritional assessment and intervention during pregnancy.³⁰

Conversely, overweight and obese women experienced higher frequencies of gestational diabetes mellitus (GDM), pre-eclampsia, Caesarean delivery, meconium-stained amniotic fluid, and neonatal complications.³¹ These findings are consistent with evidence identifying maternal obesity as an important modifiable risk factor for adverse pregnancy outcomes.³² Increasing maternal adiposity promotes

insulin resistance, chronic inflammation, oxidative stress, endothelial dysfunction, and abnormal placental function, providing plausible mechanisms for these associations.^{33–36}

The frequency of GDM increased markedly with increasing BMI. Excess adiposity aggravates the physiological insulin resistance of pregnancy, increasing maternal hyperglycaemia and fetal glucose exposure and subsequently contributing to macrosomia and neonatal metabolic complications.³³ Similarly, pre-eclampsia increased progressively among overweight and obese women, consistent with the established relationship between obesity, endothelial dysfunction, systemic inflammation, and impaired placental vascular adaptation.^{34–36} These findings support intensified metabolic and blood-pressure surveillance in pregnant women with increased BMI. Caesarean delivery was also more frequent with increasing BMI. Maternal obesity may increase operative delivery through fetal macrosomia, dysfunctional labour, prolonged labour, failed induction, and concern regarding fetal compromise.^{32,37,38} Meconium-stained amniotic fluid was likewise more common among obese mothers, potentially reflecting placental dysfunction and increased fetal susceptibility to intrapartum stress.³⁹ These observations indicate that women with elevated BMI may require more intensive intrapartum surveillance and preparedness for operative delivery.

NICU admission showed a U-shaped relationship with maternal BMI, with increased admission among infants of both underweight and obese mothers. Underweight-related admissions were mainly associated with prematurity and LBW, whereas infants of obese mothers more frequently required intensive care for respiratory compromise, hypoglycaemia, birth asphyxia, and complications associated with macrosomia. Similar patterns of neonatal morbidity associated with abnormal maternal BMI have been reported previously.⁴⁰

The one-year follow-up adds an important longitudinal dimension to this study. Women with elevated BMI demonstrated greater postpartum weight retention and persistent glucose abnormalities, supporting the

concept that pregnancy may identify women at future metabolic risk.^{33,41} In contrast, underweight mothers experienced more perceived lactation insufficiency, while their infants showed greater growth impairment. Maternal nutritional status may therefore have consequences extending beyond delivery, affecting both maternal metabolic health and early childhood growth.⁴²

These findings have practical implications for Bangladesh, where delayed antenatal presentation remains common. Third-trimester BMI is inexpensive, non-invasive, and readily available and may help identify women requiring enhanced antenatal surveillance, nutritional intervention, delivery planning, and neonatal preparedness. Although pre-pregnancy or early-pregnancy BMI remains preferable, late-pregnancy BMI may provide useful supplementary risk information when earlier measurements are unavailable. The study's prospective design, Asian-specific BMI classification, and one-year follow-up strengthen its clinical relevance; however, its single-centre design, use of third-trimester BMI, loss to follow-up, and absence of detailed information on gestational weight gain, dietary intake, physical activity, and nutritional biomarkers should be considered when interpreting the findings. Future multicentre studies incorporating serial anthropometric and metabolic assessments are warranted.

Overall, the study demonstrates a clinically important U-shaped relationship between maternal BMI and adverse pregnancy outcomes. Maternal underweight primarily increases nutritional, fetal-growth, and prematurity-related risks, whereas overweight and obesity increase metabolic, hypertensive, operative, and neonatal complications. Routine BMI assessment, combined with targeted nutritional and obstetric management, may therefore represent a practical approach to improving maternal and neonatal outcomes in Bangladesh.

Conclusion

Maternal body mass index (BMI) measured during the third trimester is a significant predictor of adverse maternal, obstetric, neonatal, and postpartum

outcomes. Underweight mothers were more likely to experience anemia, preterm birth, low birth weight, and increased NICU admissions, whereas overweight and obese mothers had higher risks of gestational diabetes, pre-eclampsia, Caesarean delivery, and postpartum metabolic complications. In resource-limited settings where early antenatal booking is often delayed, third-trimester BMI provides a simple and cost-effective tool for risk stratification. Routine BMI assessment, nutritional interventions, and structured postpartum follow-up may improve maternal and neonatal outcomes and strengthen obstetric care in Bangladesh.

Limitations

This study has several limitations. Its single-centre design may limit generalizability, and third-trimester BMI cannot fully represent pre-pregnancy nutritional status because of physiological gestational weight gain. Dietary intake and gestational weight gain were not formally assessed, while 16.7% loss to follow-up may have introduced attrition bias. Finally, the observational design precludes causal inference, and residual confounding from unmeasured factors cannot be excluded.

References

1. Goldenberg RL, Culhane JF, Iams JD, Romero R. Epidemiology and causes of preterm birth. *Lancet*. 2008;371(9606):75–84.
2. Ehrenberg HM, Dierker L, Milluzzi C, Mercer BM. Low maternal weight, failure to thrive in pregnancy, and adverse pregnancy outcomes. *Am J Obstet Gynecol*. 2003;189(6):1726–30.
3. Black RE, Victora CG, Walker SP, Bhutta ZA, Christian P, de Onis M, et al. Maternal and child undernutrition and overweight in low-income and middle-income countries. *Lancet*. 2013;382(9890):427–51.
4. Rahman MM, Abe SK, Kanda M, Narita S, Bilano V, Ota E, et al. Maternal body mass index and the risk of birth and maternal health outcomes in low- and middle-income countries: a systematic review and meta-analysis. *Obes Rev*. 2015;16(9):758–70.
5. World Health Organization. WHO recommendations on antenatal care for a positive pregnancy experience. Geneva: WHO; 2016.
6. National Institute of Population Research and Training (NIPORT), ICF. Bangladesh Demographic and Health Survey 2022. Dhaka and Rockville, MD: NIPORT, ICF; 2024.
7. Han Z, Mulla S, Beyene J, Liao G, McDonald SD. Maternal underweight and the risk of preterm birth and low birth weight: a systematic review and meta-analysis. *Int J Epidemiol*. 2011;40 (1): 65-101.
8. Kramer MS. Determinants of low birth weight: methodological assessment and meta-analysis. *Bull World Health Organ*. 1987;65(5):663-737.
9. O'Brien TE, Ray JG, Chan WS. Maternal body mass index and the risk of preeclampsia: a systematic overview. *Epidemiology*. 2003;14(3): 368-74.
10. Torloni MR, Betrán AP, Horta BL. Prepregnancy BMI and the risk of gestational diabetes: a systematic review and meta-analysis. *Obes Rev*. 2009;10(2):194-203.
11. Cedergren MI. Maternal morbid obesity and the risk of adverse pregnancy outcome. *Obstet Gynecol*. 2004;103(2):219-24.
12. Sebire NJ, Jolly M, Harris JP. Maternal obesity and pregnancy outcome: a study of 287,213 pregnancies in London. *Int J Obes Relat Metab Disord*. 2001;25(8):1175-82.
13. Usha Kiran TS, Hemmadi S, Bethel J, Evans J. Outcome of pregnancy in women with an increased body mass index. *BJOG*. 2005; 112 (6):768–72.
14. Catalano PM, Ehrenberg HM. The short- and long-term implications of maternal obesity on the mother and her offspring. *BJOG*. 2006; 113(10): 1126–33.
15. Institute of Medicine, National Research Council. Weight Gain During Pregnancy: Reexamining the Guidelines. Washington, DC: National Academies Press; 2009.

16. World Health Organization. Obesity: Preventing and Managing the Global Epidemic. WHO Technical Report Series No. 894. Geneva: WHO; 2000.
17. WHO Expert Consultation. Appropriate body-mass index for Asian populations and its implications for policy and intervention strategies. *Lancet*. 2004;363(9403):157–63.
18. American College of Obstetricians and Gynecologists. ACOG Practice Bulletin No. 230: Obesity in Pregnancy. *Obstet Gynecol*. 2021; 137(6):e144.
19. American Diabetes Association Professional Practice Committee. Management of diabetes in pregnancy: Standards of Care in Diabetes-2025. *Diabetes Care*. 2025;48(Suppl 1)–S266.
20. Vogel JP, Chawanpaiboon S, Moller AB. The global epidemiology of preterm birth. *Best Pract Res Clin Obstet Gynaecol*. 2018;52:3-12.
21. Islam MT, Rahman MM, Rahman A. Maternal BMI and nutritional status in early pregnancy and its impact on neonatal outcomes in Bangladesh. *BMC Pregnancy Childbirth*. 2019;19:413.
22. Akter S, Rahman MM, Abe SK, Maternal overweight and obesity and adverse pregnancy outcomes in Bangladesh: evidence from tertiary hospitals. *Bangladesh Med Res Counc Bull*. 2021;47(3):239-247.
23. Begum F, Khatun M, Yasmin S. Maternal factors affecting low birth weight in an urban area of Bangladesh. *J Dhaka Med Coll*. 2009;18(1):64-69.
24. Bano R, Akhtar S, Ahmed A, Maternal body mass index and adverse neonatal outcomes in a tertiary care hospital in Pakistan. *J Pak Med Assoc*. 2021; 71(5):1348–1354.
25. Sharma R, Dogra P, Dogra J. Association of maternal body mass index with pregnancy and neonatal outcomes in North Indian women. *J Obstet Gynaecol India*. 2018;68(2):112-118.
26. Sheikh S, Qureshi RN, Khowaja AR, Maternal obesity and adverse pregnancy outcomes in a tertiary care hospital in Pakistan. *J Pak Med Assoc*. 2020;70(12):2165–2171.
27. Roberts JM, Hubel CA. The two-stage model of preeclampsia: variations on the theme. *Placenta*. 2009;30 (Suppl A)–S37.
28. Redman CW, Sargent IL. Placental stress and pre-eclampsia: a revised view. *Placenta*. 2009;30(Suppl A)–S42.
29. Kominiarek MA, Peaceman AM. Gestational weight gain and obesity in pregnancy: implications for maternal and infant health. *Nat Rev Endocrinol*. 2017;13(9):577–591.
30. Marchi J, Berg M, Dencker A, Olander EK, Begley C. Risks associated with obesity in pregnancy for the mother and baby: a systematic review of reviews. *Obes Rev*. 2015; 16(8): 621- 638.
31. McDonald SD, Han Z, Mulla S, Beyene J; Knowledge Synthesis Group. Overweight and obesity in mothers and risk of preterm birth and low birth weight infants: a systematic review and meta-analysis. *BMJ*. 2010;341.
32. Leddy MA, Power ML, Schulkin J. The impact of maternal obesity on maternal and fetal health. *Rev Obstet Gynecol*. 2008;1(4):170–178.
33. Bellamy L, Casas JP, Hingorani AD, Williams D. Type 2 diabetes mellitus after gestational diabetes: a systematic review and meta-analysis. *Lancet*. 2009;373(9677):1773–1779.
34. Gunderson EP. Childbearing and obesity in women: weight before, during, and after pregnancy. *Obstet Gynecol Clin North Am*. 2009;36(2):317–332.
35. Victora CG, Adair L, Fall C, Hallal PC, Martorell R, Richter L, et al. Maternal and child undernutrition: consequences for adult health and human capital. *Lancet*. 2008;371(9609):340- 357.
36. Zhang CXW, Candia AA, Sferruzzi-Perri AN. Placental inflammation, oxidative stress, and fetal outcomes in maternal obesity. *Trends Endocrinol Metab*. 2024;35(7):638-647. doi: 10.1016/j.tem.2024.02.002.
37. Ramonienė G, Maleckienė L, Nadišauskienė RJ, Bartusevičienė E, Railaitė DR, Mačiulevičienė R,

- et al. Maternal obesity and obstetric outcomes in a tertiary referral center. *Medicina (Kaunas)*. 2017;53(2):109-113.doi:10.1016/j.medici.2017.03.003.
38. Wolfe KB, Rossi RA, Warshak CR. The effect of maternal obesity on the rate of failed induction of labor. *Am J Obstet Gynecol*.2011; 205(2): 128.e1-128.e7.doi:10.1016/j.ajog.2011.03.051.
 39. Avcı ME, Şanlıkan F, Çelik M, Avcı A, Kocaer M, Göçmen A. Effects of maternal obesity on antenatal, perinatal and neonatal outcomes. *J Matern Fetal Neonatal Med*. 2015;28(17): 2080-2083. doi:10.3109/14767058.2014.978279.
 40. Almutairi FS, Alsaykhan AM, Almatrood AA. Obesity prevalence and its impact on maternal and neonatal outcomes in pregnant women: a systematic review. *Cureus*. 2024;16(12):e75262. doi:10.7759/cureus.75262.
 41. Meyer D, Gjika E. How does gestational weight gain influence short- and long-term postpartum weight retention? An updated systematic review and meta- analysis. *Obes Rev*. 2024;25(4): e13679. doi:10.1111/obr.13679.
 42. Islam M, Rahman S, Kamruzzaman, Islam M, Samad A. Effect of maternal status and breastfeeding practices on infant nutritional status- a cross sectional study in the south-west region of Bangladesh. *Pan Afr Med J*. 2013;16: 139.doi:10.11604/pamj.2013.16.139.2755.

Original Article

Role of Serum Uric Acid and Creatinine as a Prognostic Indicator of the Severity of Maternal and Fetal Complications in Preeclampsia

Siddiqua S^{1*}, Alamgir MH², Parvin A³, Afrin F⁴

1. Dr. Sinthia Siddiqua, Assistant Professor, Department of Obstetrics and Gynaecology, Rangpur Medical College, Rangpur.

2. Dr. Moudud Hossain Alamgir, Professor, Department of Surgery, TMSS Medical College, Bogura.

3. Dr. Alina Parvin, Assistant Professor, Department of Obstetrics and Gynaecology, Rangpur Medical College, Rangpur.

4. Dr. Fariha Afrin, Assistant Professor, Department of Obstetrics and Gynaecology, Z H Sikder Women's Medical College, Dhaka.

Corresponding Author*Abstract**

Background: Background: Preeclampsia is a multi system disorder that can affect 5-8% of all pregnancies and is a major contributor for maternal and perinatal morbidity and mortality. There is no single test to fulfill all the criteria for a good predictor of preeclampsia.

Objective: To determine the outcome of pregnancy in preeclampsia with impaired renal functions.

Materials and Methods: This Analytic observational study was carried out in the Department of Obstetrics and Gynaecology in Rangpur Medical College Hospital, Rangpur, from January 2025 to December 2025. 20 preeclamptic patients with impaired renal function were considered as group A and 80 preeclamptic patients with normal renal function were considered as group B.

Results: Out of these 100 study subjects serum Creatinine and Uric acid level were deranged (group A) compared to group B. Maternal and perinatal complications were higher among group A than group B.

Conclusion: Impaired Creatinine and uric acid level in preeclampsia adversely affect pregnancy outcome. Therefore prior information in such patients may help to reduce perinatal and maternal morbidity and mortality.

Key words: Preeclampsia, Renal functions.

Introduction

Preeclampsia is the most challenging clinical entity affecting both mother and fetus. It is a predisposing factor for maternal as well as perinatal morbidity and mortality. Incidence of preeclampsia in developing nation has been reported to be around 4-18%.¹ Preeclampsia is defined as pregnancy specific syndrome observed usually after 20 weeks of gestation with systolic blood pressure ≥ 140 mmHg and diastolic blood pressure ≥ 90 mmHg accompanied by significant proteinuria with or without edema. Severe preeclampsia is associated with elevated blood pressure $\geq 160/110$ mmHg, on two occasions at least 6 hrs apart, on bed rest; with proteinuria ≥ 5 gm in 24 hrs urine sample; along with other symptoms such as headache, visual disturbances, hyper reflexia, epigastric or right upper quadrant pain, vomiting, oliguria, impaired liver function and thrombocytopenia (HELLP Syndrome).² In most of the cases, about 75% preeclampsia appear to be mild and 25% are severe.³ Serum uric acid and creatinine levels are a part of work

up for the pregnant women with hypertension. The elevated levels of these parameters were due to decreased urinary clearance secondary to reduced GFR and increased reabsorption.⁴ Serum uric acid is not only a marker of severity of disease but also contributes to the pathology of disorder.⁵ Serum uric acid is a marker of oxidative stress, tissue injury and renal dysfunction. It is the product of purine metabolism and is synthesised by the enzyme xanthine oxidase. Hypoxia and ischemia of the placenta and cytokines such as interferon induce the expression of xanthine oxidase and therefore increase production of uric acid and reactive oxygen species. In uncomplicated pregnancies, serum uric acid concentration fall in first and 2nd trimester 25-35 % due to an elevation in renal clearance secondary to increased GFR or reduced proximal tubular re-absorption and due to changes in its production rate continue to remain low during second trimester and slowly and slowly increase during third trimester, possibly due to raised fetal production,

decreased binding to albumin and a decline in uric acid clearance until towards the end of pregnancy.⁶

Several studies have reported a positive correlation between elevated maternal serum uric acid and creatinine adversely affect maternal and foetal outcome.⁷ Up to now, there is no reliable, valid, and cost-effective screening test for the early detection of preeclampsia. It seems that measuring the blood level of uric acid and creatinine is one of the available and cheap screening tests that may help to early detection of the disease.⁸

Referral to higher center in appropriate time and giving appropriate treatment at that center may reduce the maternal and perinatal morbidity and mortality.

Materials and Methods

This study was conducted on dept of Obst and

Gynaecology in Rangpur Medical College Hospital, Rangpur, from January 2022 to December 2022. Study population was all the admitted patients after 28 weeks of gestation diagnosed as a preeclampsia by history, thorough clinical examination and relevant investigations. Investigations was carried out in this study include CBC, proteinurea, serum creatinine, serum uricacid. Then the study population was divided into two groups. Group A comprises 20 patients of severe preeclampsia and Group B comprises 80 patients of non- severe preeclampsia .Feto - maternal complications were compared between these two groups. All the information was collected in a predesigned interview schedule. Data was analyzed using SPSS software version 23. Chi square test was done to see significance of difference and p value $p < 0.05$ was taken as significant.

Results

Table I: Socio - Demographic profile of study subject (n=100)

Parameter	Preeclamptic mother		X ² Value	P Value
	Group A	Group B		
	Severe Preeclampsia	Non severe Preeclampsia		
Age group (years)				
<20 years	02 (10%)	07 (8.75%)	2.108	0.349 (NS)
20-30 years	15 (75%)	48 (68%)		
>30 years	03 (15%)	25 (31.25%)		
Mean ± SD	25.65±4.757	25.65±4.757		
Socioeconomicstatus				
Low	18 (90%)	66 (82.5%)	1.030	0.597 (NS)
Middle	02 (10%)	11 (13.75%)		
Upper	00 (00%)	03 (3.75%)		
Gestational age				
<34 weeks	07 (35%)	17 (21.25%)	1.658	0.198 (NS)
>34 weeks	13 (65%)	63 (78.75%)		
Mean±SD	31.44±2.439	35.00±2.645		
Gravida				
Primi	15 (75%)	59 (73.75%)	0.909	0.013 (NS)
Multi	05 (25%)	21 (26.25%)		
ANC				
Yes	03 (15%)	29(36.25%)	3.320	0.068 (NS)
No	17 (75%)	51 (63.75%)		
Level of education				
Illiterate	08 (40%)	06 (7.5%)	14.196	0.003 (S)
Primary	09 (45%)	51 (63.75%)		
SSC	02 (10%)	14 (17.5%)		
HSC	01 (5%)	09 (11.25%)		

X²: Chi-square test was done, P: Probability, n: Number of patients, NS: Non-significant, S: Significant ($p < 0.05$)

Table I shows most of the study subject (75% in group A & 68% in group B) were 20-30 years age group. 90% of group A & 82.5% of group B were from low socioeconomic status. 45% of group A and 63.75% of group B were primarily educated. Majority of the patient of both group were house wife and majority of the rural population in both group. Most of the patient in both groups were matched in age, socioeconomic status, occupation and residence was not statistically

significant ($p>0.05$). 75% of group A and 73.75% of group B were primi gravid. 75% of group A & 63.75% of group B were not taking ANC. 65% of group A and 78.75% of group B were >34 weeks pregnancy. Gravida, ANC & Gestational age are not statistically significant ($p>0.05$).

Table II: Routine Investigations (Biochemical) profile of study subject (n=100)

Parameter	Preeclamptic mothers		X ² value	P value
	Group-A	Group-B		
	Severe PE (n=20)	Non severel PE (n=80)		
Routine investigations (%)				
Hb%(gm%)				
>10gm%	00 (00)	07 (8.75%)	1.882	0.170 (NS)
<10gm%	20 (100%)	73 (91.25%)		
Platelet count				
1.5-4.0 lack/μL	04 (25%)	80 (100%)	76.190	p<0.001 (S)
<1.5 lack/μL	16 (75%)	00 (00)		
Proteinurea				
Trace	00 (00)	25 (31.25%)	8.913	0.012 (NS)
+	00 (00)	00 (00)		
++	02 (10%)	09 (11.25%)		
+++	18 (90%)	46 (57.5%)		

X2: Chi-square, P: Probability, n: Number of patients, S: Significant, NS: Non-significant. in Chi-square test of significance of difference.

Table II shows in group A 100% of Hb% & 75% of platelet count was decrease which was statistically significant ($p<0.005$). 90% of group A patient having +++ proteinuria.

Table III: Special Investigations (Renal functions) profile of study subject (n=100)

Renal Functions	Preeclamptic mothers		X ² value	P value
	Group-A	Group-B		
	Severe PE (n=20)	Non severe PE (n=80)		
Serum creatinine Normal (0.6 – 1.2 mg/dl)	02(10%)	80(100%)	87.805	$P<0.001$ (s)
Raised (>1.2 mg/dl)	18(90%)	00(00%)		
Serum uric acid Normal (2.4 – 5.7 mg/dl)	07(35%)	80(100%)	59.770	$P<0.001$ (s)
Raised(>5.7 mg/dl)	13(65%)	00(00%)		

X²: Chi-square, P: Probability, n: Number of patients, S: Significant, NS: Non-significant. in Chi-square test of significance of difference.

Table III shows Serum uric acid and creatinine was raised in 65% and 90% of population respectively. Which was also statistically significant (P<0.001).

Table IV: Distribution of maternal outcome of the study subject (n=100)

Parameter	Pre eclamptic mothers		x ² value	P value
	Group-A	Group-B		
	Severe PE(n=20)	Non severe PE (n=80)		
Mode of delivery				
VD	09 (45%)	55 (68.75%)	3.917	0.048 (S)
LSCS	11 (55%)	25 (31.25%)		
Maternal morbidity	20 (100%)	12 (15%)	53.125	p<0.001 (S)
PPH	04 (20%)	04 (5%)	4.891	0.027 (S)
Abruppio placentae	00 (00)	02 (2.5%)	.510	0.475 (NS)
Hepatic dysfunction	02 (10%)	00 (00)	8.163	0.004 (S)
Pulmonary oedema	07 (35%)	06 (7.5%)	10.698	0.001 (S)
HELLP syndrome	05 (25%)	00 (00)	21.053	p<0.001 (S)
DIC	04 (20%)	00 (00)	16.667	p<0.001 (S)
Maternal mortality	07 (35%)	03 (3.75%)	25.781	p<0.001 (S)

X²: Chi-square, P: Probability, n: Number of patients, S: Significant, NS: Non-significant. in Chi-square test of significance of difference

Table IV shows LSCS was more in group A than group B which was statistically significant (p<0.005). Maternal complication were significantly higher in women of group A compared to group B among them pulmonary edema is highest. Maternal mortality was 45% in group A and 3.75% in group which was statistically significant (p<0.001).

Table V: Distribution of feta and perinatal outcome of the study subject (n=100)

Neonatal Issues	Pre eclamptic mothers		X ² value	P value
	Group-A	Group-B		
	Severe PE (n=20)	Non severe PE (n=80)		
Live birth	15 (75%)	75 (82.5%)	.199	0.656 (NS)
APGAR score (1 minute)	5.06±3.104	7.76±1.216	3.475	0.062 (NS)
	08 (45%)	54 (68%)		
APGAR score (5 minutes)	5.82±3.555	8.73±1.387	4.720	0.030 (S)
	12 (60%)	66 (83%)		
Low birth weight <2.5Kg	08 (40%)	25 (31.25%)	0.554	0.457 (NS)
Asphyxia	06 (30)	08 (10%)	5.316	0.021 (S)
NICU Admission	10 (50%)	28(35%)	1.528	0.216 (NS)
IUGR	08 (40%)	09 (11.25%)	9.373	0.002 (S)
IUD	05 (25%)	05 (6.25%)	12.524	<0.001 (S)
Death within 7 days	05 (25%)	04(5.0%)	2.512	0.113 (NS)

χ^2 : Chi-square, P: Probability, n: Number of patients, S: Significant, NS: Non-significant. in Chi-square test of significance of difference.

Table V shows no significant difference in birth weight of babies between group A and group B. 1 minute and 5 minute both Apgar score was better in group B. Neonatal complications are more in group A compared to group B and it was statistically significant. Perinatal death is high in group A (25%) than in group B (11.25%) which was statistically not significant ($p > 0.005$).

Discussion

This study was conducted in Obstetrics and Gynecology dept in Rangpur Medical College and Hospital, Rangpur, is an important referral hospital of North Zone in Bangladesh. In the present study, study population were 100 having preeclampsia, had been divided into two group. Severe Preeclampsia 20 were in group A and Non severe PE 80 were in group B.

Younger age (Table- I) group is an important risk factor for preeclampsia. Though it is a disease of adolescent group but in the present study, mean age was 25.65 ± 4.757 years in both groups are matched. Majority of the population were 20-30 years. These ages are more vulnerable due to early marriage and pregnancy in our country as compared to western countries. This age difference was not statistically significant ($p > 0.34$). It is consistent with the study of Amit G *et al* where mean age was 25.12 ± 3.65 years. Maximum 82.82% of patient were between 20-29 years of age.⁹ Also consistent with S Kishwara *et al* in Bangladesh Medical Journal (2011).¹⁰

In the present study majority came from low socioeconomic status (Table-I) which was statistically not significant ($p < 0.597$). It correlates with the study of Savita Rani *et al* where 84% belongs to low socioeconomic status.¹¹

Regarding educational background (Table-I) majority of the patient were primarily educated and very few are illiterate in both groups which was statistically significant ($p < 0.05$). It is due to primary education is free in our country so, majority of the people were primarily educated. This study was matched with the

study of Cicih O, Lelly A. They showed that lowered educated women had highest risk of preeclampsia compared to high education.¹² It was also consistent with Koido Pet *et al*.¹³

In this study most of the population were came from rural area (Table-I). rural people are more vulnerable to developed preeclampsia, because in rural area there is lack of ANC facilities, women are less empowered due to lack of education and also the study was conducted in Rangpur Medical College Hospital which is a public hospital where maximum case were came from low affluent society and referred from different rural zone. It correlates with the study of Savita Rani Singhal *et al* where 84% had rural background.¹¹

The incidence of preeclampsia is more in primigravid. This is comparable to Mac Gillivray which shows that primigravida has 15 times greater risk compared to multigravida.¹⁴ It also correlate with Savita Rani Singhal *et al* where primigravida were 70%.¹¹

In present study 75% of group A and 63.75% of group B took irregular and no antenatal care at all (Table-I). Group B comparatively took more ANC but it was not significant ($p > 0.068$). According to Majhi *et al*, shows 82.3% of patient did not have a regular antenatal check-up.¹⁵ Which indicates that low socioeconomic status, lack of education poverty and inadequate antenatal check-up has a close relationship with preeclampsia and poor foeto – maternal outcome.

Present study show mean gestational age of the mother was 31.44 ± 4.39 and 35.00 ± 2.645 weeks in group A and B respectively (Table- I), which statistically insignificant ($p > 0.0198$). Amit G *et al* also observed similar finding with that of present study, their study was also statistically not significant.⁹ Barua found mean gestational age was 37.55 weeks.¹⁶ This study indicates more the gestational age less the maternal and perinatal complications.

Regarding Renal function (Table-III) Serum creatinine and uric acid level are raised 90% and 65% of group A patient respectively. Was statistically significant ($p < 0.001$) which was consistent with Maryam Asgharnia *et al* where Mean level of uric

acid in women with severe pre-eclampsia (5.66 ± 1.46) was significantly higher than non-severe preeclampsia (5.12 ± 1.29) ($p=0.031$).¹⁷

Regarding maternal outcome (Table-IV) out of 20 patient in group A, 25% developed HELLP, 20% PPH, 10% renal dysfunction, 35% pulmonary edema, 20% DIC and maternal mortality was 45% all are statistically significant ($p<0.001$). Abruptio placenta were 2.5% in group B population which was statistically not significant ($p>0.0475$). As per Loi K *et al*¹⁸ HELLP 6%, pulmonary edema 5%, ARF 14%, Abruptio 2% were noted in preeclamptic patient with deranged liver function. As per PunnetMet *et al*¹⁹ support these result which was statistically significant ($p<0.001$).

In the present study 75% of group A and 82.5% of group B were live birth which was statistically not significant. In these study fetal complication is more in group A population compared to group B. Out of 20 patient in group A 30% developed fetal asphyxia, 40% IUGR, 25% IUD and 25% perinatal death occur within 7days which was statistically significant. 40% are LBW and 50% of them need NICU admission which was not statistically significant. Apgar score in both one minute and five minute were deranged in group B neonate but Apgar score in one minute is nonsignificant ($p>0.062$ and Apgar score in five minute is statistically significant ($p<0.05$). This study was consistent with Savita Rani Singha *et al*.¹¹

So, from this study we found that nulliparous, primarily educated women with low socioeconomic status and lower gestational age group those who are not in antenatal care are more prone to develop impaired liver function. People with impaired liver functions showed adverse pregnancy outcome.

Conclusion

Serum uric acid and creatinine are elevated in severe PE whereas no significant difference was observed between severe and non severe PE. Serum uric acid level showed better specificity and sensitivity for severe PE and also correlated negatively with fetal outcome. Serum uric acid and creatinine levels vary with gestational age hence studies should focus on

estimating these markers in 2nd and 3rd trimesters. To diagnose or to predict a possible PE at an early stage and avert maternal and fetal outcome estimation of these two marker to be recommended at an earlier sages of pregnancy.

References

1. Villar J, Betran AP, Gulmezoglu M. Epidemiological basis for the planning maternal health service. WHO /RHR 2001.
2. ACOG Committee on Obstetric Practice. ACOG practice bulletin. Diagnosis and management of preeclampsia and eclampsia. Obstet and Gynecol 2002;99(1):159-67.
3. Sibai BM. Magnesium sulphate prophylaxis in preeclampsia: Lessons learned from recent trials. Am J Obstet and Gynecol 2004;190:1520-1526.
4. Jayabalan A, Conrad kp. Renal function during normal pregnancy and preeclampsia. Front Biosci, 2007;12:2425-2437.[Pub Med] [Google Scholar]
5. Bainbridge SA, Robrerts JM, Uric acid as a pathogenic factor in preeclampsia. 2008;22: S67 -S72 [PMC free article] [Pub Med] [Google Scholar]
6. Maryam Asgharnia M.D, Fabia Mirbiouk M.D, Soudabeh Kazemi Maternal serum uric acid level and maternal & neonatal complications in preeclamptic women: A cross-sectional study. Int J Reprod Bio Med, 2017; 15: 583 -588.
7. Noura AJ, Hajera T, Huda AM, Latifa AO, Farah AK; Liver Function Test as Proable Merkers of Preeclampsia - A Prospective Study Conducted in Riyadh. J Clin Anal Med 2015;6(4):461-4.
8. Alan H, Lauren N, Neri L, Ashley SR. Hypertension in pregnancy: David AM; In: CURRENT diagnosis and treatment Obstetrics and Gynecology, 11th edition, The McGraw- Hill Companies, New York; 2013: 462.
9. Amit G, Bidhu A comparison of platelet count in severe preeclampsia, mild preeclampsia and normal pregnancy. International Journal of Research in Medicine Science 2018 Feb;6(2):671-76.

10. S Kishwara, S Tanira Effects of Preeclampsia on Perinatal Outcome- A Study Done in the Specialized Urban Hospital SetUp in Bangladesh. Bangladesh medical Journal 2011; 40:1
11. Savita RS, Deepika Maternal and Perinatal Outcome in Severe Pre-eclampsia and Eclampsia. South Asia Federation of Obstetrics and Gynecology 2009;1(3):25-28.
12. Cicih O, Lelly A. Parity, education level and risk for preeclampsia in selected hospital in Jakarta. National institute of health research and Development, Ministry of Health, Republic of Indonesia, Jakarta. 2014 June;5(1).
13. Kiondo P, Wamuyu-Maina G, Bimenya GS, Risk factors for pre-eclampsia in Mulago Hospital, Kampala, Uganda. Trop Med Int Health 2012;17:480-7.
14. C K Rajamma, P sridevi. Maternal and Perinatal Mortality and Morbidity in Hypertensive Disorder Complicating Pregnancy. International Journal of Scientific Study 2016; 3:11.
15. Majhi AK, Chakraborty PS Eclampsia present scenario in a referred medical college hospital. J ObstetGynaecol India 2001;51:143-7.
16. Yucesoy G, Ozkan S, Bodur H Maternal and perinatal outcome in pregnancies complicated with hypertensive disorder of pregnancy: A seven years experience of a tertiary care center. Arch GynecolObstet 2005 Nov;273(1):43-9.
17. Dilip KB, Rafia A Alteration of Liver Function in Preeclampsia and Eclampsia. Chattagram Maa-O-Shishu Hospital Medical College Journal 2013; 12:3.
18. Loi K, Khoo CK A review of 93 cases of severe preeclampsia in Singapore: are there risk factors for complications? Singapore Med J 2007;48(9):808-12.
19. Puneeta M, Vinita G Maternal and neonatal outcome in pre-eclamptic mothers with elevated liver enzymes: A prospective analytic study. Indian Journal of Obstetrics and Gynecology Research 2018;5(2):233-238.

*Original Article***Laboratory-Based Surveillance of Dengue, Malaria, Syphilis, and Viral Hepatitis in Three Rohingya Refugee Camps in Cox's Bazar, Bangladesh**Murshid ME^{1*}, Islam S², Akhiruzzaman³, Asha DA⁴, Rahaman MM⁵

1. Dr. Munzur-E-Murshid, Director in Charge, Gonoshasthaya Kendra, Cox's Bazar.
2. Dr. Shutopa Islam, Assistant Professor, Department of Community Medicine and Public Health, Gonoshasthaya Samaj Vittik Medical College, Savar, Dhaka.
3. Dr. Akhiruzzaman, Associate Professor and Head, Department of Community Medicine and Public Health, TMSS Medical College, Bogura.
4. Dr. Dilara Ahmed Asha, Senior Lecturer, Department of Community Medicine and Public Health, TMSS Medical College, Bogura.
5. Md. Matiur Rahaman, Project Coordinator, GK-MI Project, Cox's Bazar.

Corresponding Author*Abstract**

Background: Refugee settlements can face increased risks of communicable diseases because of population density, environmental constraints, population mobility, and pressure on health services. Cox's Bazar hosts a large Rohingya refugee population and has experienced recurrent dengue transmission and substantial viral hepatitis concerns.

Objective: To describe laboratory test positivity patterns for dengue, malaria, syphilis, hepatitis B virus (HBV), and hepatitis C virus (HCV) among clients tested at three health posts in Camps 1E, 11, and 22 of Cox's Bazar, Bangladesh.

Materials and Methods: We conducted a retrospective cross-sectional analysis of cumulative laboratory register data from July 2024 through April 2026. The dataset comprised 5,053 test records for dengue NS1 antigen, dengue IgM and IgG, hepatitis B surface antigen (HBsAg), anti-HCV, venereal disease research laboratory (VDRL) testing, and malaria rapid diagnostic tests and/or microscopy. Positivity was summarized as percentages with 95% confidence intervals (CIs) using the Wilson method. Chi-square tests were used to assess differences in positivity across the three camps. Because the source data were aggregate and test-based, the analysis did not estimate population prevalence, incidence, or patient-level risk.

Results: HCV had the highest observed positivity, 23.3% (367/1,573; 95% CI 21.3–25.5), with the highest camp-specific positivity in Camp 11 (31.2%). Dengue NS1 positivity was 16.2% (76/468; 95% CI 13.1–19.9), ranging from 2.3% in Camp 1E to 28.7% in Camp 22 ($p < 0.001$). Dengue IgG positivity was 15.0% (44/293), while IgM positivity was 2.2% (7/318). HBsAg positivity was 3.3% (51/1,549), and VDRL positivity was 0.6% (5/823). No positive malaria tests were recorded among 29 tests. Anti-HCV results represent screening positivity and do not establish active HCV infection.

Conclusion: The findings demonstrate substantial HCV test positivity and marked between-camp variation in dengue NS1 positivity among clients who were tested. These findings support continued decentralized hepatitis diagnosis and linkage to treatment, camp-specific dengue surveillance and vector-control activities, and stronger routine laboratory surveillance. The results should not be interpreted as population prevalence or as evidence of temporal trends because the analysis was based on cumulative test records without monthly counts or individual-level denominators.

Keywords: laboratory surveillance, Dengue, Hepatitis C, Hepatitis B, Syphilis, Malaria, Rohingya refugees.

Introduction

Displaced populations may experience increased exposure to communicable diseases because of crowded living conditions, population mobility, environmental constraints, interrupted access to preventive services, and limited health-system capacity. In humanitarian settings, blood-borne infections and vector-borne diseases may coexist and place different demands on surveillance and clinical services. Global WHO reporting continues to identify

viral hepatitis B and C as major public health priorities, while dengue has expanded geographically and reached historically high levels of global reporting.^{1,2}

In Bangladesh, the Rohingya refugee response in Cox's Bazar comprises densely populated camps with substantial and continuing health-service needs. Dengue has been repeatedly reported in the camps and surrounding host communities, including a major upsurge during 2024. WHO described the 2024 dengue

outbreak in the Rohingya camps and host communities as the largest and most prolonged since 2018.^{3,4}

Viral hepatitis is also an important concern in the Rohingya refugee population. Previous studies and humanitarian health reports have documented substantial HCV seropositivity and active infection in this population. WHO reporting from Cox's Bazar has also highlighted the need to expand HCV diagnosis and access to treatment.^{5,6}

The epidemiological information available at district or response level may mask differences between individual camps. Camp-specific laboratory data can therefore provide operationally useful information for prioritizing surveillance, clinical services, referral, and prevention. However, positivity among people who are tested is not equivalent to population prevalence, and aggregate laboratory data do not permit patient-level risk-factor analysis.

The present study therefore describes laboratory test positivity for dengue, malaria, syphilis, HBV, and HCV among clients tested at three Gonoshasthaya Kendra (GK)-operated health posts in Camps 1E, 11, and 22. The study specifically examines differences between camps and avoids interpreting cumulative test positivity as population prevalence or temporal incidence.

Materials and Methods

Study design and setting

This was a retrospective cross-sectional analysis of secondary, laboratory-based surveillance data. The study setting comprised three GK-operated primary health posts in Camp 1E, Camp 11, and Camp 22 in Ukhiya sub-district, Cox's Bazar, Bangladesh. The study was restricted to these three sites because the available laboratory register dataset covered the three GK health posts during the study period. Consequently, the sample represents clients tested at these service points and is not a population-representative sample of all residents of the three camps.

Study period

The study period was July 2024 to April 2026, corresponding to the period covered by the laboratory registers used for this analysis.

Data source and eligibility

Data were extracted from standardized laboratory registers covering the study period. Eligible records were laboratory test records for one of the predefined assays performed at the three study health posts during the study period. The included tests were: (1) dengue NS1 antigen, dengue IgM, and dengue IgG; (2) HBsAg and anti-HCV; (3) VDRL for syphilis; and (4) malaria rapid diagnostic testing and/or microscopy.

The analytical unit was the test record rather than a unique individual. Because the source dataset was aggregated and did not contain personal identifiers or a patient-level linkage key, it was not possible to determine whether the same client contributed more than one test record or to perform patient-level deduplication. Accordingly, denominators represent the number of tests recorded for each assay, not the number of unique persons.

No patient-level demographic or clinical exclusion criteria could be applied because age, sex, clinical history, and other individual-level variables were not available in the aggregated analytical dataset. Records outside the specified study period or unrelated to the predefined assays were outside the study dataset.

Laboratory measures

Dengue NS1 antigen was treated as evidence compatible with acute dengue infection at the time of testing; dengue IgM and IgG were interpreted as markers of recent and past exposure, respectively. HBsAg was used as the laboratory marker of current HBV infection, while anti-HCV was interpreted as evidence of previous or current HCV exposure and cannot by itself establish active HCV infection. VDRL was used for syphilis screening. Malaria testing was based on rapid diagnostic testing and/or microscopy. The study reports laboratory test positivity and does not establish clinical diagnoses beyond the test information available.

Statistical analysis

Analyses were performed using SPSS version 25. For each assay, positivity was calculated as the number of positive tests divided by the number of tests recorded for that assay. Exact denominators were retained for transparency. Aggregate 95% confidence intervals (CIs) were calculated using the Wilson score method. Pearson's chi-square test was used to assess heterogeneity in positivity across Camps 1E, 11, and 22 when expected cell counts were adequate; Fisher's exact test was used for sparse contingency tables. A two-sided $p < 0.05$ was considered statistically significant.

The analysis was intentionally descriptive because the available data were cumulative, aggregate, and test-based. No multivariable regression was undertaken because individual-level covariates and patient identifiers were unavailable. Likewise, no monthly or seasonal trend analysis was performed because monthly test counts and monthly positivity

data were not available in the analytical dataset. The absence of temporal analysis is therefore treated as a limitation rather than interpreted as evidence of stable or changing transmission over time.

Reporting framework

The manuscript was prepared with reference to the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidance for cross-sectional studies, while recognizing that the underlying dataset was aggregate and laboratory-register based.

Results

Overall laboratory activity

A total of 5,053 infectious-disease test records were included. Camp 1E contributed 2,052 records (40.6%), Camp 11 contributed 1,727 (34.2%), and Camp 22 contributed 1,274 (25.2%). These figures describe laboratory testing activity and should not be interpreted as the number of unique clients.

Table 1. Camp-specific laboratory test positivity, July 2024–April 2026

Disease/test	Camp 1E	Camp 11	Camp 22	P-value
Dengue NS1 (acute)	4/174 (2.3%)	20/113 (17.7%)	52/181 (28.7%)	<0.001
Dengue IgG (past exposure)	31/158 (19.6%)	7/45 (15.6%)	6/90 (6.7%)	0.023
Dengue IgM (recent exposure)	1/159 (0.6%)	2/56 (3.6%)	4/103 (3.9%)	0.130
Hepatitis C (anti-HCV)	109/576 (18.9%)	202/648 (31.2%)	56/349 (16.0%)	<0.001
Hepatitis B (HBsAg)	20/577 (3.5%)	19/631 (3.0%)	12/341 (3.5%)	0.875
Syphilis (VDRL)	3/389 (0.8%)	0/233 (0.0%)	2/201 (1.0%)	0.574
Malaria	0/19 (0.0%)	0/1 (0.0%)	0/9 (0.0%)	—

(Values are positive tests/total tests (% positivity). P-values were calculated from the camp-specific 2×2 contingency tables using Pearson's chi-square test when expected cell counts were adequate and Fisher's exact test for sparse tables. Denominators represent test records, not unique individuals. A dash indicates that no formal comparison was performed for malaria because of the very small number of tests and zero positive results.)

Dengue NS1 antigen positivity differed significantly across the camps. Positivity was 2.3% (4/174) in Camp 1E, 17.7% (20/113) in Camp 11, and 28.7% (52/181) in Camp 22 ($p < 0.001$). Thus, Camp 22 had the highest proportion of positive NS1 test results and Camp 1E the lowest. These differences indicate marked variation in the distribution of positive NS1 results among clients tested at the three sites. However, the cross-sectional laboratory data cannot determine

whether these differences reflect an outbreak, seasonal effects, differences in clinical testing thresholds, or other factors.

Dengue IgG positivity also differed significantly among the camps ($p=0.023$). Positivity was highest in Camp 1E at 19.6% (31/158), followed by Camp 11 at 15.6% (7/45), and was lowest in Camp 22 at 6.7% (6/90).

Dengue IgM positivity was relatively low across all three camps and did not differ significantly ($p=0.130$). Positivity was 0.6% (1/159) in Camp 1E, 3.6% (2/56) in Camp 11, and 3.9% (4/103) in Camp 22.

Hepatitis C (anti-HCV) positivity varied substantially across the camps ($p<0.001$). Positivity was 18.9% (109/576) in Camp 1E, 31.2% (202/648) in Camp 11, and 16.0% (56/349) in Camp 22, with the highest positivity observed in Camp 11. The finding indicates a high burden of HCV-positive test results among

clients tested at these health posts, but it does not estimate community prevalence because testing was not population-based and the denominator comprised laboratory tests.

Hepatitis B (HBsAg) positivity was similar across the three camps ($p=0.875$), with positivity of 3.5% (20/577) in Camp 1E, 3.0% (19/631) in Camp 11, and 3.5% (12/341) in Camp 22.

Syphilis (VDRL) positivity was low and did not differ significantly between camps ($p=0.574$). Positivity was 0.8% (3/389) in Camp 1E, 0% (0/233) in Camp 11, and 1.0% (2/201) in Camp 22.

Malaria testing was very limited. No positive test was recorded in Camp 1E (0/19), Camp 11 (0/1), or Camp 22 (0/9). No formal statistical comparison was performed because of the very small number of tests and the absence of positive results.

Table II. Aggregate laboratory test positivity and 95% confidence intervals

Disease/test	Total tests	Positive	Positivity	95% CI
Hepatitis C (anti-HCV)	1,573	367	23.3%	21.3–25.5
Dengue NS1 antigen	468	76	16.2%	13.1–19.9
Dengue IgG	293	44	15.0%	11.2–19.6
Hepatitis B (HBsAg)	1,549	51	3.3%	2.5–4.3
Dengue IgM	318	7	2.2%	0.9–4.5
Syphilis (VDRL)	823	5	0.6%	0.2–1.4
Malaria	29	0	0.0%	0.0–11.9

(Aggregate positivity was calculated from the combined test records of Camps 1E, 11, and 22. Confidence intervals were estimated using the Wilson score method. The malaria interval is wide because only 29 malaria tests were recorded)

Dengue NS1 antigen positivity was 16.2% (76/468; 95% CI: 13.1–19.9). This aggregate estimate reflects the combined laboratory records from all three camps.

Dengue IgG positivity was 15.0% (44/293; 95% CI: 11.2–19.6), while **Dengue IgM positivity** was 2.2%

(7/318; 95% CI: 0.9–4.5).

Hepatitis B (HBsAg) positivity was 3.3% (51/1,549; 95% CI: 2.5–4.3).

Syphilis (VDRL) positivity was 0.6% (5/823; 95% CI: 0.2–1.4).

No malaria-positive test was recorded among the 29 malaria tests performed. The observed positivity was therefore 0.0%, with a wide 95% CI of 0.0–11.9%, demonstrating substantial statistical uncertainty associated with the very small denominator.

Discussion

Principal findings

This laboratory-register analysis identified two operationally important patterns: high anti-HCV positivity among tested clients, particularly in Camp 11, and marked between-camp variation in dengue NS1 positivity. These findings are consistent with the coexistence of blood-borne and vector-borne disease priorities described in humanitarian and Bangladesh-specific health reports.^{1,3,5} In contrast, HBsAg and VDRL positivity were lower and relatively consistent across camps, while malaria testing was too limited to support a meaningful conclusion about malaria transmission.

HCV positivity in the humanitarian context

The overall anti-HCV positivity of 23.3% indicates a substantial burden of HCV-positive test results among clients tested at these health posts. Previous work in Rohingya refugee settings has also documented substantial HCV seropositivity and active infection, supporting the interpretation that hepatitis C warrants sustained attention in humanitarian health services.^{1,5,6} This interpretation also aligns with broader evidence on viral-hepatitis epidemiology and prevention in low- and middle-income settings.^{7,8}

The 31.2% anti-HCV positivity observed in Camp 11 is particularly important for service planning. However, the study cannot determine why positivity was higher in Camp 11. Explanations such as previous exposure to unsafe medical procedures, differences in referral patterns, screening practices, or other risk factors are plausible but were not measured in this dataset. Such explanations should therefore be treated as hypotheses for further investigation rather than as established causes.

From a programmatic perspective, the findings support strengthening decentralized pathways for confirmatory testing, linkage to care, and access to direct-acting antiviral treatment. WHO has emphasized the effectiveness of direct-acting antivirals and the need to expand access to diagnosis and treatment¹, and experience from Rohingya refugee services illustrates

the operational relevance of linking diagnosis with treatment pathways.⁶ The feasibility and design of decentralized treatment should, however, be guided by national policy, confirmatory diagnostic capacity, and humanitarian health-sector coordination.

Dengue and camp-level heterogeneity

The overall NS1 positivity of 16.2% and the range from 2.3% in Camp 1E to 28.7% in Camp 22 indicate substantial heterogeneity in positive dengue tests among clients who were tested. This pattern is consistent with the importance of camp-level dengue surveillance in Cox's Bazar, where dengue has been a recurrent humanitarian health concern. WHO reporting and recent epidemiological work have described substantial dengue activity in the camps and host communities and have emphasized preparedness, surveillance, and vector-control measures.^{2,3,4}

Several environmental and operational factors could contribute to between-camp differences, including water and waste management, vector breeding conditions, population density, timing of testing, healthcare-seeking patterns, and variation in vector-control activities. These are plausible considerations in densely populated humanitarian settings and are relevant to the surveillance and preparedness priorities described for Cox's Bazar.^{3,4,9} However, these variables were not available in the present dataset. The observed differences should therefore be interpreted as descriptive camp-level heterogeneity rather than proof of a specific environmental mechanism or a confirmed localized outbreak.

The 15.0% dengue IgG positivity suggests previous exposure among the tested population, consistent with the role of serological surveillance in describing prior dengue circulation.^{2,9} Because the data do not include serotype information, clinical severity, or longitudinal follow-up, the study cannot estimate the risk of secondary infection or severe dengue in this population. The finding nevertheless supports continued clinical vigilance and laboratory surveillance during periods of increased dengue activity.

Syphilis, HBV, and malaria surveillance

VDRL positivity was low (0.6%), but continued screening remains relevant to sexual and reproductive health and prevention of mother-to-child transmission, particularly because sexually transmitted infections have been documented among Rohingya refugees 9. The relatively consistent HBsAg positivity across camps suggests a need for continued hepatitis B prevention, diagnosis, and linkage to care, consistent with the broader public-health importance of hepatitis B prevention and treatment.^{1,7,8,10}

No positive malaria test was identified, but this finding should not be interpreted as evidence that malaria is absent from the camps. Only 29 malaria tests were recorded, producing a very wide confidence interval. The low number of tests may reflect the clinical testing context, service priorities or other surveillance factors that cannot be evaluated from the aggregated dataset. Maintaining appropriate malaria surveillance remains important in Cox's Bazar because humanitarian populations are mobile and service needs can change across time and location.^{3,11}

Implications for humanitarian surveillance

The findings illustrate the value of linking routine laboratory surveillance with service-level planning. A more informative surveillance system would retain monthly counts, test type, camp, age group, sex, and where ethically and operationally appropriate-unique patient identifiers or a secure linkage mechanism. Such data would permit analysis of temporal patterns, demographic inequalities, repeat testing, and service utilization without exposing personal identifiers. WHO's Cox's Bazar reporting and recent dengue analyses demonstrate the importance of integrated, camp-sensitive disease surveillance within the humanitarian health-sector coordination system.^{3,4,9}

Strengths

The study has several strengths. First, it uses laboratory-record data from more than 5,000 test records rather than relying solely on syndromic reporting. Second, it provides camp-specific estimates that can reveal heterogeneity hidden by district-level aggregation. Third, it examines multiple pathogens

relevant to humanitarian health planning. Fourth, the use of exact test denominators and Wilson confidence intervals improves transparency around the uncertainty of the observed positivity estimates.

Limitations

Several limitations are important. First, the data are derived from clients who were tested at three health posts and are therefore subject to selection and testing-practice biases; the results cannot be interpreted as population prevalence. Second, the analytical unit is a test record rather than a unique individual, and repeat testing could not be identified. Third, individual-level variables such as age, sex, symptoms, pregnancy status, clinical indication, treatment history, and risk factors were unavailable, preventing adjusted analyses. Fourth, the study used cumulative data rather than monthly observations, so temporal and seasonal trends could not be assessed. Fifth, the malaria denominator was very small, limiting inference. Sixth, the study covers three health posts and cannot automatically be generalized to all 33 refugee camps or to the host population. Finally, the available data do not permit causal explanations for the differences between camps.

Conclusion

Among clients tested at three GK-operated health posts in Camps 1E, 11, and 22, anti-HCV positivity was substantial and dengue NS1 positivity varied markedly between camps. HBsAg and VDRL positivity were lower, while the very small number of malaria tests prevented meaningful conclusions about malaria absence. The findings support strengthening decentralized hepatitis diagnosis and linkage to treatment, maintaining camp-specific dengue surveillance and vector-control activities, and improving routine laboratory data systems so that monthly, demographic, and patient-level patterns can be evaluated in future analyses. Importantly, the reported percentages represent laboratory test positivity among tested clients, not population prevalence or incidence.

Public Health Recommendations

- Strengthen decentralized HCV confirmatory testing, linkage to care, and access to direct-acting antiviral treatment in coordination with national and humanitarian health-sector guidance.
- Maintain camp-specific dengue surveillance and strengthen targeted vector-control and environmental management where surveillance identifies increased activity.
- Continue routine HBV and syphilis screening, particularly through antenatal and other relevant clinical services.
- Maintain appropriate malaria surveillance despite the absence of positive tests in this small dataset.
- Standardize routine laboratory reporting to retain monthly test and positivity counts and relevant non-identifying demographic variables, enabling future temporal and equity analyses.
- Develop secure approaches for distinguishing unique clients from repeat test records where operationally and ethically feasible.

Ethical Considerations

This study used retrospective, aggregated, category-wise cumulative laboratory information without personal identifiers. During routine service delivery at the health posts, client information was recorded in the electronic medical record system after informed consent for healthcare delivery and service improvement. Permission to access and use the retrospective data for this analysis was obtained from Gonoshasthaya Kendra and Malteser International. No additional identifiable participant data were accessed for this study.

Data Availability

The underlying laboratory registers are institutional service records and are not publicly deposited because they are subject to organizational data-governance requirements. The aggregate data used for the analyses are presented in Tables 1 and 2. Any additional data sharing should follow the policies of Gonoshasthaya Kendra, Malteser International, and the relevant humanitarian health-sector authorities.

Funding

The health posts in Camps 1E, 11, and 22 are operated by Gonoshasthaya Kendra with financial support from Malteser International, Germany. Malteser International provided support to Gonoshasthaya Kendra during the operational period.

Conflict of Interest

The authors declare that they have no conflict of interest regarding the publication of this paper.

Acknowledgements

The authors sincerely acknowledge the contribution of all team members of GK-MI health response team.

Generative AI Statement

During the preparation and restructuring of this manuscript, generative artificial intelligence (GPT-5.6) was used solely to assist with grammatical refinement, technical editing, and standardization of academic language and citation style. The study design, data aggregation, statistical analysis, interpretation of findings, and policy recommendations were developed by the authors. The authors reviewed and verified the AI-assisted text and take full responsibility for the accuracy, integrity, and originality of the manuscript.

References

1. World Health Organization. Global hepatitis report 2024: action for access in low- and middle-income countries. Geneva: World Health Organization; 2024.
2. World Health Organization. Dengue: global situation, surveillance and progress-2024 update. *Weekly Epidemiological Record*. 2025;100: 665-678.
3. World Health Organization Bangladesh. WHO Cox's Bazar: Rohingya emergency crisis – Situation Report: June 2024. Dhaka: WHO Bangladesh; 2024.
4. World Health Organization Bangladesh. WHO leads after action review to boost dengue preparedness in Cox's Bazar. 29 May 2025.

5. Schramm B, Khondaker A, Ashakin, Firuz W, Hadiuzzaman M, Farhat JB, et al. Prevalence of hepatitis C virus seropositivity and active infection in Rohingya refugee camps. *Lancet Gastroenterol Hepatol*. 2025;10(7):648–657.
6. Ceccarelli G, Branda F, Fairouz F, Albanese M, Scarpa F, d’Ettorre G, et al. Management of hepatitis C infections among Rohingya refugees, Bangladesh. *Bull World Health Organ*. 2026;104(4):282-284. doi:10.2471/BLT.24.292920.
7. Jefferies M, Rauff B, Rashid H, Lam T, Rafiq S. Update on global epidemiology of viral hepatitis and preventive strategies. *World J Clin Cases*. 2018;6(13):589–599. doi:10.12998/wjcc.v6.i13.589.
8. Mamun-Al-Mahtab. Past, present, and future of viral hepatitis in Bangladesh. *Euroasian J Hepatogastroenterol*. 2016;6(1):43-44. doi:10.5005/jp-journals-10018-1164.
9. Halder CE, Hasan MA, Soma ER, Okello JC, Rahman MM, Das PP, et al. Epidemiological, clinical, and diagnostic characteristics of a large-scale upsurge of dengue in the Rohingya refugee camps and host communities in Cox’s Bazar, Bangladesh, 2021 to 2024: a retrospective study. *medRxiv*. 2026;2026.03.27. 26349486. doi:10.64898/2026.03.27.26349486.
10. Hossain MM, Sultana A, Mazumder H, Munzur-E-Murshid. Sexually transmitted infections among Rohingya refugees in Bangladesh. *Lancet HIV*. 2018;5 (7):e342. doi:10.1016/S2352-3018(18)30140-1.
11. UNHCR. Bangladesh: Operational Data Portal. United Nations High Commissioner for Refugees; 2026.

Original Article

Study of Sacral Hiatus and its Implication in Caudal Epidural Block

Khanam A^{1*}, Sarker MSA², Naznin RA³, Benzir M⁴, Akter T⁵, Talukder AP⁶

1. Dr. Afsana Khanam, Professor, Department of Anatomy, TMSS Medical College, Bogura.
2. Dr. Md. Shahjahan Ali Sarker, Professor, Department of Anatomy, TMSS Medical College, Bogura.
3. Dr. Rawshon Ara Naznin, Associate Professor, Department of Anatomy, TMSS Medical College, Bogura.
4. Dr. Maskura Benzir, Assistant Professor, Department of Anatomy, TMSS Medical College, Bogura.
5. Dr. Mst. Taslima Akter, Assistant Professor, Department of Anatomy, TMSS Medical College, Bogura.
6. Dr. Anamika Parvin Talukder, Lecturer, Department of Anatomy, TMSS Medical College, Bogura.

*Corresponding Author

Abstract

Background: Morphological variations occur frequently in the lower region of the vertebral column, and sacrum is the most variable portion. The present study was undertaken to analyze the morphometric characteristics of the sacral hiatus and its sex differences to provide baseline data for the northern region of variation.

Materials and Methods: A cross-sectional observational study was conducted among 100 dry adult human sacra collected from the Department of Anatomy, TMSS Medical College and Shaheed Ziaur Rahman Medical College, Bogura. Data were recorded using a pre-designed questionnaire prepared for the study. Sex determination was done by using discriminant function analysis (DFA) and found 43 male and 57 female sacra. Location and shape of sacral hiatus was observed and noted. With the help of digital slide calipers different measurements of sacral hiatus were recorded to the nearest millimeter.

Results: The most common shape of sacral hiatus was found as inverted U shaped in both sexes and it was 48.84% in male and 44.83% in female. The second common type was inverted V shaped, and the frequency was 23.26% and 25.86% in male and female respectively. Location of apex of sacral hiatus at the level of 4th sacral vertebra was found most commonly 67.44% in male and 56.90% in females. In most of the sacra, location of base of the sacral hiatus was found at the level of 5th sacral vertebra; 95.35% in male and 91.38% in female. Regarding different other parameters of sacral hiatus there was no statistically significant difference between male and female sacra.

Conclusion: Though findings of present study regarding different parameters of sacral hiatus were not statistically different between male and female; it can provide a baseline data associated with clinical application in caudal epidural block.

Keywords: Human sacrum, Sacral hiatus, Sex variation, Caudal epidural block.

Introduction

The sacral hiatus is the terminal part of the sacral canal as well as the vertebral canal that transmits the fifth pair of sacral spinal nerves and coccygeal nerves. It is produced by the non-fusion of the laminae of the fifth sacral vertebra to meet in the median plane and as a result the posterior surface of the body of that vertebra is exposed on the dorsal surface of the sacrum. The inferior articular processes of the fifth sacral vertebra are free and project downwards at the sides of the sacral hiatus as sacral cornua.

The variation in anatomical features of sacra and the dorsal wall of sacral canal is associated with clinical application in caudal epidural anesthesia. Through the

sacral hiatus caudal anesthesia is introduced in operation of the anal region, the external genital organs, as well as cystoscopy examination of male. It is also used in obstetrics during parturition for better cervical dilatation and shortening of the first stage of labor.¹

Metrical study of sacral hiatus done by various authors revealed that mean value may be significantly different in bones from different zones even within the same general population.^{2,3} Anatomical abnormalities of the sacral hiatus include upward and downward displacement of sacral hiatus, narrowing or partial obliteration of the sacral canal, ossification of the

sacrococcygeal membrane, absence of bony posterior wall of the sacral canal and variation of shape of sacral hiatus^{4,5} studied that caudal epidural block has 25% failure rate.

The reliability and success of caudal epidural anesthesia depends upon the knowledge of anatomical variations of sacral hiatus. Depth, surrounding bony irregularities, different shapes and defects in dorsal wall of sacral canal and hiatus may cause failure of needle insertion. The present study was undertaken to study the morphometric analysis of sacral hiatus and also their sex differences to provide a baseline data for the northern region of Bangladesh.

Materials and Methods

This study was conducted on dry human sacra taken from the Department of Anatomy, TMSS Medical College and Shaheed Ziaur Rahman Medical College, Bogura. Data were collected by using a pre-designed questionnaire prepared for the study during the period from January 2023 to June 2024. Grossly malformed sacrum or incomplete sacrum were excluded. Lumbarization and sacralization would affect the measurements of normal sacra, so they are excluded too. Location and shape of sacral hiatus was carefully observed and noted. With the help of digital slide calipers different measurements were done and recorded to the nearest millimeter.

Measurement of the length of the sacral hiatus: Length of hiatus was measured from apex of the sacral hiatus to midpoint of base at the level of the cornu.⁶

Measurement of the transverse diameter of the sacral hiatus at the base: Transverse diameter of sacral hiatus at the base was measured between the inner aspects of inferior limit of sacral cornua by the digital slide calipers.⁶

Measurement of the antero-posterior diameter of the sacral hiatus at the apex: Anteroposterior diameter of sacral hiatus at the apex was measured by digital slide calipers⁶. For this purpose, a flat metallic structure was introduced vertically through the hiatus at the level of the apex and the point was marked and measured.

Observation of the level of position of the apex of sacral hiatus: Position of the apex of sacral hiatus situated at the level of which vertebra was observed and recorded. For this purpose, a stick was placed transversely at the level of the apex of hiatus on its dorsal surface and its position on which sacral vertebra was observed on the ventral surface and recorded.

Observation of the level of position of the base of sacral hiatus: Position of the base of sacral hiatus situated at the level of which vertebra was observed and recorded. For this purpose, a stick was placed transversely at the level of the base of hiatus on its dorsal surface and its position on which sacral vertebra was observed on the ventral surface and recorded.

Results

Results are shown as frequency and percentage

Table – I: Shape of the sacral hiatus (n=100)

Shape of the sacral hiatus	Number	Percentage (%)
Inverted U	47	47
Inverted V	25	25
Irregular	24	24
Dumbbell	2	2
Bifid	2	2

Table I shows the percentage of different types of shape sacral hiatus of total 100 sacra. The most common shape of the sacral hiatus was inverted U (47%) in both male and female.

Table II: Shape of the sacral hiatus in male and female

Shape of the sacral hiatus	Male (n=43)		Female (n=57)	
	No	%	No	%
Inverted U	40	48.84	52	44.83
Inverted V	33	23.26	29	25.86
Irregular	10	25.58	12	24.14
Dumbbell	0	0	7	3.45
Bifid	1	2.33	1	1.72

Again Table - II reveals most common shape of the sacral hiatus in male was inverted U shaped was (48.84%), followed by irregular shaped (25.58%),

inverted V shaped (23.26%), bifid shaped (2.33%) and dumbbell shaped (0%) whereas in female inverted U shaped was (44.83%), followed by inverted V shaped was (25.86%), irregular shaped (24.14%), dumbbell shaped (3.45%) and bifid shaped (1.72%). No significance test was done regarding this variable.

Location of apex of sacral hiatus in male and female sacra

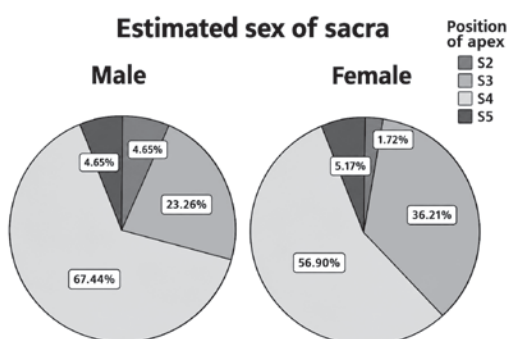


Figure: 1 Pie chart showing the percentage of location of the apex of sacral hiatus in male and female.

Figure 1 shows the location of the apex of sacral hiatus. It was found that in the highest number of sacra, the apex was at the level of 4th sacral vertebra in male (67.44%) and in females (56.90%). The second commonest position of the apex of sacral hiatus at the level of 3rd sacral vertebra was found in male (23.26%) and in female (36.21%) cases. Position of the apex of sacral hiatus at the level of 5th sacral vertebra was found in male (4.65%) and in female (5.17%) cases and lowest in number at the level of 2nd sacral vertebra in male (4.65%) and in female (1.72%).

Location of apex of sacral hiatus in male and female sacra

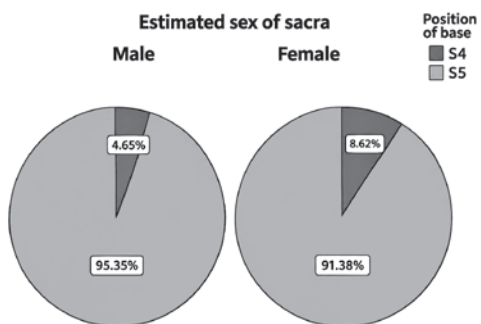


Figure: 2 Pie chart showing the percentage of location of the base of sacral hiatus in male and female

DOI: <https://doi.org/----->

Figure 2 shows the location of the base of sacral hiatus. It was found that in the highest number of sacra, the base was at the level of 5th sacral vertebra in male (95.35%) and in females (91.38%). The rest of the case shows a base of sacral hiatus at the level of 4th sacral vertebra in male (4.65%) and in female (8.62%) cases.

Table III: Length, antero-posterior diameter at the apex and transverse diameter at the base of sacral hiatus in male and female

Variables (mm)	Sex	Measurement		P value
		Range	Mean $\pm$ SD	
Length (mm)	Male	53.80-5.65	20.13 $\pm$ 10.43	0.180 (NS)
	Female	42.22-5.58	22.00 $\pm$ 8.62	
Antero-posterior diameter at the apex (mm)	Male	13.07-3.66	7.52 $\pm$ 2.07	0.074 (NS)
	Female	20.73-1.92	6.79 $\pm$ 2.76	
Transverse diameter at the base (mm)	Male	21.40-7.72	14.48 $\pm$ 3.62	0.220 (NS)
	Female	23.31-5.65	15.01 $\pm$ 3.23	

P values reached from unpaired |'t' tests for male and female values

Results are shown as mean $\pm$ SD

NS=non-significant

Table III shows the mean of length, antero-posterior diameter at the apex and transverse diameter at base of sacral hiatus in male and female. Length of sacral hiatus was found 20.13 $\pm$ 10.43 mm and 22.00 $\pm$ 8.62 mm in male and female respectively. The greater length of sacral hiatus in females was not statistically significant than male (P=0.180). On the other hand, the mean of antero-posterior diameter of sacral hiatus at the apex was found 7.52 $\pm$ 2.07 mm in male and 6.79 $\pm$ 2.76mm in female and the transverse diameter of the sacral hiatus at the base found 14.48 $\pm$ 3.62 mm in male and 15.01 $\pm$ 3.23 mm in female. Both the measurements, antero-posterior diameter of sacral hiatus at the apex and transverse diameter of the sacral hiatus at the base were not significantly different in male and female (P=0.074 and 0.220 respectively).

Discussion

Skeletal measurements vary widely among populations due to genetic and environmental factors, food habits and other factors. Considering this regional variability, each population should have specific standards to optimize the accuracy of its implication. The present work was undertaken to study various morphometric variables of sacral hiatus. The sacral hiatus is an important anatomical landmark for access to the caudal epidural space, and its morphology and morphometric characteristics show considerable variation among different populations.^{7,8} Previous studies have demonstrated regional and population-related differences in sacral measurements, suggesting that population-specific anatomical data may be useful for improving the accuracy and safety of procedures involving the sacral hiatus.^{9,10} The present study was therefore undertaken to evaluate the morphological and morphometric characteristics of the sacral hiatus and to assess their variation between male and female sacra in a population from northern Bangladesh. In this study sacra of both sex, inverted U shaped was more common in males than females (48.84% and 44.83%) likewise irregular shaped was (25.58% and 24.14%), but inverted V shaped was more common in female than males (25.86% and 23.26%) and Other less common shapes were bifid shaped was 2.33% and 1.72% in male and female respectively. It could also be stated that dumbbell shaped was only found in females 3.45%.¹¹ stated among the samples inverted U shaped was 38.86% and 37.05%, inverted V shaped was 32.25% and 38.27%, irregular shaped was 16.68% and 13.57%, elongated shaped was 6.66% and 4.94%, dumbbell shaped was 5.55% and 4.94% and bifid shaped was 0.0% and 0.60% in male and female respectively.

Another study stated that inverted U shaped was more common in females than males (44.1% and 37.0%) but inverted V shaped was more common in male than females (30.6% and 24.6%). Other less common shapes were irregular shaped was 9.3% and 10.2%, elongated shaped was 6.5% and 7.6%, M shaped was 7.4% and 5.1%, dumbbell shaped was 2.8% and 5.9% and bifid shaped was 1.9% and 0.80% in male and female respectively.¹²

Similar morphological variations have been reported by several investigators. Desai et al. found inverted U to be the most common shape (42.12%), followed by inverted V (35.43%) and irregular shape (12.99%) in Indian dry sacra.⁴ Another study also reported inverted U as the most frequent configuration, accounting for 40.35% of sacral hiatuses.¹¹ Another study reported that inverted U and inverted V were among the most common forms, with variation between male and female sacra.¹³ A study also similarly found the inverted U shape to be common in both sexes.¹⁴ These findings support the observation of the present study that the inverted U configuration is the predominant morphology of the sacral hiatus, although the frequency of individual shapes varies among populations.

Regarding the level of the apex of the sacral hiatus, the present study found that the fourth sacral vertebra was the most common level in both males (67.44%) and females (56.90%). The third sacral vertebra was the second most common level, occurring in 23.26% of males and 36.21% of females. The apex was located at the fifth sacral vertebra in 4.65% of males and 5.17% of females, while the second sacral vertebra was the least common level, occurring in 4.65% of males and 1.72% of females. The predominance of the fourth sacral vertebral level is consistent with previous anatomical studies. A study reported that the apex and base of the sacral hiatus were most commonly located opposite the fourth and fifth sacral vertebrae, respectively.⁹ Another study similarly reported S4 as the most common level of the apex and S5 as the common level of the base.¹³ Another study also found S4 to be the most frequent level of the apex.⁴ These findings indicate that although the fourth sacral vertebra is the most frequent location of the apex, considerable variation may occur between individuals and populations.

In the present study, the base of the sacral hiatus was most commonly located at the level of the fifth sacral vertebra, occurring in 95.35% of males and 91.38% of females. The remaining sacra showed the base at the fourth sacral vertebra in 4.65% of males and 8.62% of females. This finding is comparable with previous

studies in which the fifth sacral vertebra was reported as the commonest level of the base.^{14,15} The consistent predominance of S5 as the level of the base is clinically relevant because the base and sacral cornua serve as important anatomical landmarks during identification of the sacral hiatus for caudal epidural procedures.^{9,10}

Regarding the length of the sacral hiatus, the present study found mean values of 20.13 ± 10.43 mm in males and 22.00 ± 8.62 mm in females. The difference was not statistically significant ($P=0.180$). Kamal reported mean lengths of 20.71 ± 8.39 mm in males and 17.85 ± 8.41 mm in females, with a significantly greater length in males ($P=0.011$).¹¹ A study reported mean lengths of 26.38 ± 12.02 mm in males and 25.63 ± 10.46 mm in females.¹² Thus, the direction and magnitude of sex-related differences in sacral hiatus length have not been consistent across populations. Another study reported a mean sacral hiatus length of 21.70 mm, which is close to the overall magnitude observed in the present study.⁴ Another study reported a considerably higher mean length of 27.16 mm in Egyptian sacra, further demonstrating population-related variation in this parameter.¹⁰

The anteroposterior diameter of the sacral hiatus at the apex was 7.52 ± 2.07 mm in males and 6.79 ± 2.76 mm in females in the present study. The difference was not statistically significant ($P=0.074$). The transverse diameter at the base was 14.48 ± 3.62 mm in males and 15.01 ± 3.23 mm in females, and this difference was also not statistically significant ($P=0.220$). These findings indicate that, in the present sample, the measured morphometric parameters of the sacral hiatus did not show significant sexual dimorphism. Similar variability in these measurements has been reported in different populations. A study reported a mean anteroposterior diameter of 5.50 mm at the apex, while Another study reported anteroposterior depth values ranging from 1.90 to 10.40 mm and a mean intercornual distance of 11.95 ± 2.78 mm.^{4,9} A study also demonstrated variation in the length, AP diameter and transverse width of the sacral hiatus and reported sex-related differences in some parameters.¹³

Another study reported anteroposterior diameters at

the apex of 5.01 ± 1.34 mm in males and 5.67 ± 1.71 mm in females, with the female value being significantly greater ($P=0.001$).¹¹ Other studies have also demonstrated variation in the anteroposterior diameter of the sacral hiatus among populations.^{14,15} The difference between these findings and those of the present study may be related to population characteristics, sample size, methods of measurement and the morphological variability of the sacral hiatus. Therefore, the absence of statistically significant sex differences in the present study does not exclude the possibility of clinically important individual variation.

The morphometric characteristics of the sacral hiatus have direct clinical relevance for caudal epidural procedures. Anatomical variations in the shape, level, depth and dimensions of the hiatus may influence identification of the epidural entry point and may contribute to difficulty or failure during blind caudal epidural block.^{13,14,15} Another study demonstrated that different shapes, bony irregularities and defects of the dorsal wall may affect successful needle placement during caudal epidural block.⁹ A study also emphasized the relationship between sacral hiatus dimensions and the success of caudal epidural anesthesia.¹⁰

Other study suggested that knowledge of the anatomical variations of the hiatus is important for safe and uncomplicated caudal epidural access.¹³ Thus, the morphometric data obtained in the present study may provide useful baseline information for clinical procedures involving the sacral hiatus in the studied population.

The present findings should also be interpreted in the context of broader sacral morphology. Studies of sacral sexual dimorphism and population-specific sacral measurements have demonstrated differences in sacral dimensions among populations and between sexes.^{16,17,18,19} However, the present study specifically focused on the sacral hiatus, and none of the measured hiatus parameters showed statistically significant sex differences. Therefore, the findings suggest that sexual dimorphism of the whole sacrum does not necessarily translate into statistically significant sexual differences in every parameter of the sacral hiatus.

Overall, the present study demonstrates considerable

morphological variation in the sacral hiatus, with the inverted U shape, apex at S4 and base at S5 being the predominant findings. Although the measured parameters did not demonstrate statistically significant differences between male and female sacra, comparison with previous studies shows substantial inter-population variation. Knowledge of these variations is important for improving the identification of the sacral hiatus and may contribute to safer and more reliable caudal epidural procedures.

Conclusion

Sacral approach to epidural space produces reliable and effective block of sacral nerves. Appropriate knowledge about the variations of sacral hiatus is necessary to improve both the reliability and safety of caudal epidural anesthesia. The findings of this study may also help to prevent failure or injury of the dural sac. Again, knowledge about the different shapes of hiatus and defects in the dorsal wall of sacral canal, various morphometric measurements and variations of structures around sacral hiatus were also studied to evaluate the possible anatomical reasons of failure.

Acknowledgement

I am highly grateful to all my colleagues in anatomy departments for their help and encouragement during this study.

Funding

This research project is funded by TMSS Medical College, Bogura.

Limitation:

The study was carried out on sacra collected from different medical colleges of Bogura, within limited time and no sophisticated technology was used.

References

1. Levine W, Halperin J, Herzlich J, Taller H. 2004. Continuous caudal anesthesia in obstetrics. *The American Journal of Surgery*, 64(1), 31-39.
2. Mazumdar S, Ray A, Mazumdar A, Majumdar S, Sinha A, Vasisht S. 2012. Sexual Dimorphism and Regional Difference in Size of Sacrum: A Study in Eastern India. *Al Ameen J Med Sci* 5(3), 298-307.
3. Dubey A, Roy SS, Verma S. 2016. Significance of sacral index in sex determination and its comparative study in different races. *Int J Anat Res*, 4(1), 2096-2098.
4. Desai R, Jadhav SD, Doshi MA, Ambali P, Desai AR. 2014. Variations in anatomical features of the sacral hiatus in Indian dry sacra. *Int J Med Res Health Sci*. 3(3):634-638.
5. Sinha MB, Rathore M, Sinha HP. 2014. A Study of variation of sacral hiatus in dry bone in central Indian region. *International J. of Healthcare and Biomedical Research*, 2(4); pp 46-52.
6. Nagar SK. 2004. A study of sacral hiatus in dry human sacra. *J Anat Soc India*, 53(2), 18-21.
7. Newell RLM, Collins P, Heary JC, Mahadevan V. 2008. The Back and Pelvic Girdle, Gluteal Region and Thigh. In: Standring S, ed, In: *Gray's Anatomy: The Anatomical basis of Clinical Practice*. 40th edition. Spain: Churchill Livingstone Elsevier; p.724-1349.
8. Snell RS. 2008. *Clinical Anatomy by Region*. 8th ed. USA: Lippincott & Wilkins; pp. 310-6.
9. Aggarwal, A., Harjeet, Sahni, D., 2009. Morphometry of sacral hiatus and its clinical relevance in caudal epidural block. *Journal of Anatomy*, 31(10), pp. 793-99.
10. Ashraf YN, Youssef HA, Naser AE. 2014 The Sacral hiatus: an anatomic study on both cadaveric and dry bones. *Trans Clin Bio* 2 (1): PP: 4-12.
11. Kamal AHMM. 2010. Morphometric study of adult dry human sacrum [M.Phil, Thesis]. Dhaka University, Bangladesh.
12. Rahman MM. 2016. Morphometric study of dry ossified human sacrum. Bangabandhu Sheikh Mujib Medical University, Dhaka.
13. Mustafa MS, Mahmoud OM, El-Raouf HHA, Atef HM. 2013. Morphometric study of sacral hiatus in adult human Egyptian sacra: their significance in caudal epidural anesthesia. *Soudi*

- Journal of Anesthesia.6(4). pp350-357.
14. Punja R, Sumalatha S, Afrah F, Hosapatna M. 2023. Clinically relevant Morphometry of Sacral Hiatus and Morphology of Sacrum. Turk Neurosurg, 33(3), 373-378
 15. Poudel S, Sinha P, Bhutia KL. 2020. Morphometric measurmens of Sacral Hiatus in Dry Human Sacrum. JHAS, 10(2), 73-77. Doi:<https://doi.org/10.37107/jhas.169>.
 16. Naznin RA. 2018.Determination of Sex by Morphometric Study of Dry Adult Human Sacrum, Bangabandhu Sheikh Mujib Medical University, Dhaka.
 17. Arora S, Verma M, Kaur S, Chhabra S, Jain P.2018,Feb. Measurement of Sacral Parameters of Surgical Importance in North Indian Population. Journal of Clinical and Diagnostic Research. Vol-12(2): AC05-AC09. DOI: 10.7860/ JCDR/ 2018/28616.11185
 18. Kabakci AG, Senol GT. 2023. Morphometric Analysis and clinical ignificance of the os sacrum. J Med Palliat care, 4(3), 211-218.
 19. Gómez-Valdés JA, Ramírez GT, Molgado SB, Sain-Leu PH, Caballero CJL, Sánchez-Mejorada G. 2011. Discriminant function analysis for sex assessment in pelvic girdle bones: Sample from the contemporary Mexican population. J Forensic Sci, 56(2), 297–301.

Case Report

Measles in Adult Patients: A Case Series of 15 Cases from the Medicine Inpatient Department of TMSS Medical College, Bangladesh

Montasir AA^{1*}, Iqbal F², Rahman A³, Hossain Z⁴, Ahmad FU⁵, Afrin J⁶

1. Dr. Ahmed Al Montasir, Assistant Professor, Department of Medicine, TMSS Medical College, Bogura.
2. Dr. Faruk Iqbal, Assistant Professor, Department of Medicine, TMSS Medical College, Bogura.
3. Dr. Azizur Rahman, Professor, Department of Medicine, TMSS Medical College, Bogura.
4. Dr. Zakir Hossain, Professor, Department of Medicine, TMSS Medical College, Bogura.
5. Dr. Fahim Uddin Ahmad, Associate Professor, Department of Microbiology, TMSS Medical College, Bogura.
6. Dr. Mst. Jeneya Afrin, Associate Professor, Department of Microbiology, TMSS Medical College, Bogura.

*Corresponding Author

Abstract

Background: Measles is a highly contagious viral illness predominantly affecting children; however, outbreaks among adults have been increasingly reported in different regions of the world. Adult measles is often associated with more severe clinical manifestations and complications than childhood disease. This case series describes the clinical characteristics, laboratory findings, management, and outcomes of 15 adult measles patients admitted to the Medicine Inpatient Department of TMSS Medical College, Bangladesh.

Materials and Methods: A prospective descriptive case series was done among 15 consecutive adult patients admitted with clinically and by molecular test Reverse Transcription Polymerase Chain Reaction (RT PCR) confirmed measles between March and May 2026. Demographic data, clinical manifestations, laboratory investigations, treatment modalities, complications, and outcomes were analyzed.

Results: The mean age of the patients was 26.8 ± 6.1 years (range 18–42 years). Nine (60%) were male and six (40%) were female. All patients presented with fever and generalized maculopapular rash. Other common symptoms included cough (80%), conjunctivitis (67%), coryza (60%), headache (53%), and sore throat (47%). Koplik spots were observed in six patients (40%). Laboratory findings revealed lymphopenia in seven patients (46.7%), elevated liver enzymes in five patients (33.3%), and thrombocytopenia in one patient (6.7%). Complications occurred in four patients, including 26.7% pneumonitis (n=4), 6.7% otitis media (n=1), and 6.7% respiratory failure (n=1). All patients recovered with supportive treatment, and no mortality was recorded.

Conclusion: Adult measles remains an important differential diagnosis in adults presenting with acute febrile rash illness. Early recognition, isolation, and supportive management are crucial for preventing complications and controlling outbreaks.

Keywords: Measles, Adult measles, Rash, Viral exanthem, Bangladesh, Case series.

Introduction

Historically categorized as a childhood illness, measles among adult populations is increasingly recognized as a public health concern worldwide as well as within South Asia.^{1,2} Widespread immunization initiatives have remarkably diminished the global burden of the disease. However, sporadic outbreaks persist worldwide, predominantly driven by suboptimal vaccination coverage or pockets of incompletely vaccinated populations.^{2,3} Measles is an acute, highly contagious viral infection caused by the measles virus, a member of the Paramyxoviridae

family.⁴ Classic clinical features typically include high fever, cough, coryza, conjunctivitis, and a pathognomonic generalized maculopapular rash.⁵

This demographic shift is clinically significant; as adult measles frequently manifests as a more severe clinical course.^{6,7} Adults experience higher rates of hospitalization and are significantly more susceptible to debilitating complications, including pneumonitis, severe hepatitis, otitis media, and neurological sequelae.^{2,6,7} In Bangladesh, despite significant

advancements in national immunization coverages, localized outbreaks continue to challenge public health infrastructure.^{4,5} To better understand these shifting dynamics, this study presents a descriptive case series of fifteen adult measles patients admitted to the Medicine Inpatient Department of TMSS Medical College Hospital in Bogura, Bangladesh. We evaluated their clinical presentations, laboratory findings, associated complications, and therapeutic outcomes to inform better clinical management and outbreak control strategies.

Materials and Methods

Study Design & Site

This hospital-based prospective descriptive case series was conducted at the Medicine Inpatient Department, TMSS Medical College Hospital, Bogura, Bangladesh. The study period spanned from March 2026 to May 2026.

Study Population & Selection Criteria

The study population comprised adult patients (≥ 18 years) admitted with clinically suspected and laboratory-confirmed measles. The inclusion criteria required:

- Age ≥ 18 years.
- Fever with generalized maculopapular rash.
- Presence of one or more constitutional features: cough, coryza, conjunctivitis, or Koplik spots.
- Molecular confirmation via RT PCR.

Exclusion criteria included patients presenting with alternative causes of febrile rash illness or those with incomplete clinical records.

Data Collection & Statistical Analysis

Relevant clinical, demographic, laboratory, and outcome parameters were systematically recorded on patients admission using a standardized data collection form and statistical analysis done while preparing manuscript. Descriptive statistics were utilized for analysis. Continuous variables are expressed as mean $\pm$ standard deviation (SD), while categorical parameters are reported as absolute frequencies and percentages.

Results

Demographic Characteristics

Table I: Demographic characteristics of patients with measles.

Variable	Value (N = 15)
Number of cases	15
Mean age	26.8 $\pm$ 6.1 years
Age range	18–42 years
Male	9 (60%)
Female	6 (40%)

A total of 15 consecutive adult patients met the inclusion criteria during the study timeframe. The cohort displayed a mean age of 26.8 $\pm$ 6.1 years, with ages extending from 18 to 42 years. Gender distribution revealed a male preponderance with 9 cases (60.0%) compared to 6 female cases (40.0%) (Table I).



Image 1: Erythematous maculopapular rash on the face, neck and the trunk.

Table II: Clinical presentation of measles patients.

Clinical Feature	Number (%)
Fever	15 (100.0)
Rash	15 (100.0)
Cough	12 (80.0)
Conjunctivitis	10 (66.7)
Coryza	9 (60.0)
Headache	8 (53.3)
Sore throat	7 (46.7)
Koplik spots	6 (40.0)
Myalgia	6 (40.0)
Diarrhea	2 (13.3)

Clinical Presentation

Fever and a generalized maculopapular rash were present in all 15 patients (100.0%). The rash typically appeared 3–5 days after the initial onset of fever, following a classic cephalocaudal pattern of spread from the face downwards to the trunk and extremities (Image 1). Prominent systemic prodromal and constitutional features included cough (80.0%), conjunctivitis (66.7%), and coryza (60.0%). Pathognomonic Koplik spots were identified in only 6 patients (40.0%) (Table II).

Table III: Ct values in RT PCR for measles, presence of pneumonia, necessity of ICU support and duration of hospital stay in measles patients.

Patient ID	Ct Value	Pneumonia	ICU Support	Hospital Stay (Days)
P01	14.2	Yes	No	10
P02	15.8	Yes	No	9
P03	17.1	Yes	Yes	8
P04	18.7	Yes	No	7
P05	24.1	No	No	7
P06	24.3	No	No	6
P07	24.5	No	No	6
P08	24.7	No	No	5
P09	24.9	No	No	5
P10	25.0	No	No	5
P11	25.2	No	No	5
P12	25.4	No	No	4
P13	25.6	No	No	4
P14	25.8	No	No	3
P15	25.9	No	No	3

Laboratory Findings

Confirmation via RT PCR for Measles was done for all 15 patients (100.0%). The most frequent hematological finding was transient lymphopenia, present in 7 patients (46.7%), followed by leukopenia in 4 patients (26.7%). Biochemical analysis identified elevated transaminases (ALT/AST) in 5 patients (33.3%), signaling acute viral hepatic involvement. Inflammatory markers were prominently elevated, with 9 patients (60.0%) demonstrating high C-reactive protein (CRP) levels. Among the 15 hospitalized adult measles patients, Ct values ranged from 14.2 to 25.9. Four patients had Ct values below 20, indicating a high viral load. All four of these patients developed measles-associated pneumonia, and one required ICU admission due to severe respiratory compromise. In contrast, none of the patients with Ct values between 24 and 26 experienced respiratory complications. The mean duration of hospitalization was 5.8 ± 2.1 days, with longer hospital stays observed among patients with lower Ct values (Table III). Pearson correlation analysis demonstrated a strong inverse relationship between RT-PCR Ct value and duration of hospital stay ($r = -0.83$, $p < 0.001$), indicating that patients with lower Ct values (higher viral loads) experienced significantly longer hospitalizations.

These findings support the potential utility of Ct value as a prognostic marker for identifying adult measles patients at risk of severe clinical outcomes.

Table IV: Complications developed in measles patients.

Complications	Number of Patients
Pneumonitis	4
Otitis media	1
Respiratory failure	1
No complication	11

Complications & Treatment

Clinical complications were documented in 4 patients (26.7%). Pneumonitis was the leading manifestation, occurring in all 4 complicated cases. One patient experienced concomitant otitis media, and one patient

rapidly progressed to acute hypoxemic respiratory failure, requiring intensive care module intervention (Table IV).

All 15 patients were managed under isolation precautions. Mainstay therapeutic interventions included adequate hydration, antipyretics, nutritional support, and systematic high-dose Vitamin A supplementation. Patients presenting with complications received targeted medical therapy, including oxygen titration and empirical antimicrobial coverage where secondary bacterial pathogens were strongly suspected.

Clinical Outcomes

The overall clinical trajectory was favorable, with a 100.0% recovery rate. One patient required shifting to the Intensive Care Unit (ICU) due to acute respiratory failure but was successfully managed and stepped down. Zero mortality was recorded. The mean hospital stay was 5.8 ± 2.1 days.

Discussion

This prospective case series underscores the persistence and changing epidemiological paradigm of measles within adult populations in South Asia, specifically focusing on data from a tertiary care center in Bogura, Bangladesh. While historically considered an exclusively pediatric disease, shifting susceptibility due to waning vaccine-induced immunity, incomplete primary vaccination coverage, or lack of natural boost may be responsible for a rise in adult outbreaks globally.^{2,8} The demographic configuration observed in this study, featuring a mean age of $26.8 (\pm 6.1)$ years and a male predisposition (60%), closely aligns with reports from neighboring regional and international cohorts.^{2,9} The adults included in this study were 18–42 years of age and therefore were born during different phases of Bangladesh's national measles immunization programme. Older participants may have been born before high vaccination coverage was achieved, whereas younger adults may have missed routine vaccination, supplementary immunization campaigns, or the recommended second vaccine dose. Although waning immunity has been proposed as one explanation for adult measles outbreaks, our study did

not assess vaccination history or measles-specific antibody titres. Consequently, we could not determine whether susceptibility resulted from primary vaccine failure, secondary vaccine failure, incomplete vaccination, or absence of vaccination. Future studies incorporating verified vaccination records and serological testing are needed to clarify these mechanisms.

For instance, recent epidemiologic studies investigating adult outbreaks in South and Southeast Asia have similarly demonstrated an increased vulnerability among young adults in their third decade of life, a demographic cohort that often displays suboptimal antibody titers over time.^{2,3}

Our clinical findings closely resemble those reported in studies from Europe and Somalia. Fever and generalized maculopapular rash were present in all patients, while cough, conjunctivitis, and coryza constituted the classic prodromal triad. Hassan et al., during a measles outbreak in Somalia, similarly reported fever and rash as universal manifestations, with respiratory symptoms being highly prevalent among hospitalized adults.¹⁰ Likewise, Romanian investigators reported that fever, rash, cough, and conjunctivitis remained the predominant presenting features among adult patients requiring hospitalization.¹⁰ These findings reinforce that the classical clinical presentation of measles remains remarkably consistent across diverse geographical settings.

Our clinical findings confirm that classic hallmarks, namely fever and a generalized maculopapular rash, were present in all the cases we recorded (100%). However, the lower prevalence of pathognomonic Koplik spots (40%) noted in our series deserves clinical attention. International literature notes Koplik spots in up to 70% to 80% of classic pediatric presentations^{10,11}. This discrepancy accentuates the potential for modified clinical phenotypes in adults, making the absolute reliance on this clinical sign misleading. Previous European and international studies have reported higher frequencies, particularly when patients are evaluated during the early prodromal phase before the appearance of the generalized rash.^{2, 10}

The lower prevalence observed in our cohort may reflect delayed presentation to hospital after rash onset, emphasizing that the absence of Koplik spots should not exclude the diagnosis of measles in adults during outbreaks.

Clinicians operating in endemic regions must maintain a high index of suspicion based on the prodrome-cough (80%), conjunctivitis (66.7%), and coryza (60%)-regardless of mucosal findings.^{6,11}

The frequency of complications in our patients also corresponds well with previous international reports. Hematologically and biochemically, transient lymphopenia (46.7%) and elevated aminotransferases (33.3%) emerged as the most frequent anomalies. The observed transient immunosuppression is a well-characterized feature of acute measles virus infection, resulting from the viral targeting of CD150+ lymphocytes.^{2,4} This process predisposes adult patients to severe secondary infections and localized organ involvement, such as acute hepatic parenchymal inflammation.^{2,6} Notably, complications manifested in approximately 27% of our patient cohort, with pneumonitis being the primary contributor (n=4). This stands in stark agreement with global data identifying measles-associated pneumonia (MAP) as the most common complication necessitating intensive hospitalization in adults.^{6,12} Similar findings have been reported in adult cohorts from Europe and Romania, where pneumonitis represents the leading cause of hospitalization, intensive care admission, and severe disease.¹³ Adult patients are known to experience more severe respiratory complications than children because of greater inflammatory responses and higher rates of secondary bacterial infections.^{2,6}

One of our patients progressed to acute respiratory failure requiring ICU admission (6.7%), a finding that reflects international literature highlighting that adult measles incurs a significantly higher risk of severe visceral damage and intensive care requirement than standard childhood courses.^{6,13-15}

An important finding of the present study was the strong inverse correlation between RT-PCR cycle threshold (Ct) values and duration of hospitalization (r

$= -0.82$, $p < 0.001$), indicating that patients with lower Ct values, which reflect higher viral loads, experienced more prolonged hospital stays. Furthermore, all patients with Ct values below 20 developed measles-associated pneumonia, and one required intensive care support, whereas none of the patients with Ct values between 24 and 26 experienced respiratory complications. These findings suggest that viral burden at the time of diagnosis may be closely associated with disease severity in adult measles. Although RT-PCR Ct values are primarily used for laboratory diagnosis, increasing evidence from respiratory viral infections indicates that lower Ct values generally correlate with greater viral replication and worse clinical outcomes, although Ct values should not be considered direct quantitative measures of viral load because they are influenced by specimen collection, timing of testing, and assay methodology.¹⁶⁻¹⁸ Similar associations between low Ct values and prolonged hospitalization or severe disease have been reported in COVID-19 and influenza.¹⁶⁻¹⁸ While published evidence evaluating Ct values as prognostic markers in adult measles remains limited, our findings suggest that Ct values may provide additional prognostic information when interpreted together with clinical assessment. Patients presenting with low Ct values may benefit from closer monitoring, early identification of respiratory complications, and timely supportive management. Nevertheless, Ct values should be interpreted cautiously because of inter-laboratory variability and lack of assay standardization.^{17,18} Larger prospective multicenter studies are required to validate Ct values as independent prognostic markers in adult measles.

Despite the clinical severity and systemic complications, the overall mortality rate in this series was 0%. This highly favorable clinical trajectory can be directly attributed to early laboratory-supported confirmation and management strategy including immediate airborne isolation precautions, aggressive hydration, and systematic Vitamin A supplementation.^{5,13} This study has certain limitations, including its modest sample size, and the lack of exact quantitative vaccination histories for the subjects.

Nonetheless, these findings carry pivotal public health implications for Bangladesh and similar middle-income countries. They highlight the urgent need for robust surveillance, adult booster programs, and the maintenance of aggressive infection-control protocols in tertiary medical facilities to mitigate future outbreak vectors^{14,15}. This study reinforces the importance of considering measles in adults presenting with fever and rash, particularly during outbreaks or when epidemiological links are present.^{2,14}

References

1. Barkin RM. Measles: historic perspective and current status. *South Med J.* 1975;68(11): 1438-1442.
2. Wong RD, Goetz MB, Mathisen G, Henry D. Clinical and laboratory features of measles in hospitalized adults. *Am J Med.* 1993;95 (4):377-383. doi:10.1016/0002-9343(93)90306-a
3. Perry RT, Halsey NA. The clinical significance of measles: a review. *J Infect Dis.* 2004;189(Suppl 1):S4-S16. doi:10.1086/377712
4. Moss WJ. Measles. *Lancet.* 2017;390 (10111): 2490-2502. doi:10.1016/S0140-6736(17)31463-0
5. Measles - Bangladesh [Internet]. Who.int. 2024. Available from: <https://www.who.int/emergencies/disease-outbreak-news/item/2026-DON598>.
6. Mahmud AS, Alam N, Metcalf CJE. Drivers of measles mortality: the historic fatality burden of famine in Bangladesh. *Epidemiology and Infection.* 2017;145(16):3361-3369. doi:10.1017/s0950268817002564.
7. Patel MK, Goodson JL, Alexander JP Jr, Progress Toward Regional Measles Elimination -Worldwide, 2000–2019. *MMWR Morb Mortal Wkly Rep.* 2020;69(45):1700-1705. doi:10.15585/mmwr.mm6945a6
8. Khetsuriani N, Deshevoi S, Goel A, Increased Burden of Measles as a Childhood and Adult Disease in the WHO European Region, 2011–2019. *J Infect Dis.* 2021;224(Suppl 6):S624-S635. doi:10.1093/infdis/jiab381
9. Yan WW, Tang J, Wang SC, Shifting epidemiology and severity of adult measles outbreaks in post-elimination eras. *Int J Infect Dis.* 2022;118:54-61. doi:10.1016/j.ijid.2022.02.041
10. Hassan MY, Mohamud RYH, Kassim MM, et al. Clinical characteristics and outcomes of patients hospitalized with measles during an outbreak in Somalia. *IJID Regions.* 2023;8:31-35. doi:10.1016/j.ijregi.2023.05.003
11. Kuddus MA, Rahman A, Alam F, Mohiuddin M. Analysis of the different interventions scenario for programmatic measles control in Bangladesh: A modelling study. *PLOS ONE.* 2023;18(6): e0283082. doi:10.1371/journal.pone.0283082.
12. Khanal S, Bura V, Sangal L, Sethi R, Dhongde D, Bahl SK. Progress towards Measles and Rubella Elimination in the South-East Asia Region-2013-2023. *Vaccines.* 2024; 12(10): 1094. doi:10.3390/vaccines12101094
13. Bîrluțiu V, Bîrluțiu RM. Measles-Clinical and Biological Manifestations in Adult Patients, Including a Focus on the Hepatic Involvement: Results from a Single-Center Observational Cohort Study from Romania. *J Clin Med.* 2024;13(18):5535. doi:10.3390/jcm13185535
14. Center for Disease Control and Prevention. Characteristics of Patients Hospitalized with Measles During an Outbreak- West Texas, January-March 2025. *MMWR Morb Mortal Wkly Rep.* 2026;75(20):1-5.
15. Qin M, Hong NY, Kim SW, Serological Susceptibility to Measles Among International Students in South Korea After a Cluster of Cases: A Cross-Sectional Study. *TropicalMed.* 2026; 11(6):150. doi:10.3390/vac24140150
16. Christopher A. Binnicker. Challenges and controversies to testing for COVID-19. *J Clin Microbiol.* 2020;58(11): e01695-20.
17. Lance B. Becker, et al. SARS-CoV-2 viral load is associated with increased disease severity and mortality. *Nat Commun.* 2021;12:5493.
18. T. Uyeki, et al. Clinical management of influenza in adults and the relationship between viral burden and disease severity. *Clin Infect Dis.* 2019; 68(6):895–902.

TMSS Medical College Journal (TMCJ)

Approved by Bangladesh Medical & Dental Council (BM&DC/4-D-2016/1478: Dated 15.01.2017).