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Editorial

Cracks in the Protection Shield: The Return of Measles

*Sultana S

Measles remains one of the most contagious viral diseases affecting individuals of all ages despite the availability of a safe, effective, and affordable vaccine for nearly six decades. In the 10th century A.D. Abu Bakr Muhammad ibn Zakariya Al-Razi (860-932) or Rhazes - a Persian philosopher and physician described measles as a disease that is "more dreaded than smallpox." Virus spread by coughing and sneezing, close personal contact or direct contact with infected nasal or throat secretions and it remains active and contagious in the air or on infected surfaces for up to two hours.[1]

Vaccination has prevented an estimated 59 million deaths from measles between 2000 and 2024; nevertheless, approximately 95,000 people died from measles globally in 2024, predominantly unvaccinated or under-vaccinated children younger than five years. These figures indicated that the progress achieved against measles is substantial, but fragile.[2,3]

The resurgence of measles in several regions demonstrates that disease elimination cannot be achieved through temporary gains alone. In 2025, global coverage with the first dose of measles-containing vaccine was approximately 84%, while only 77% of children received the recommended two doses.

The initial symptoms of measles, which usually appear 10-14 days (range 7-23 days) after infection, include high fever, cough, coryza, conjunctivitis, and a prominent exanthema. A person is infectious from four days before up to four days after the appearance of the rash. There is no specific antiviral treatment for measles, and most people recover within 2-3 weeks.[4]

Common complications of measles are pneumonia, bronchiolitis, diarrhea, acute otitis media, febrile seizure, measles encephalitis, tuberculosis. The risk of severe disease is particularly high among young children, malnourished children, individuals with vitamin A deficiency, and those with weak immune systems such as pregnancy. Importantly, measles can also cause profound immune suppression, leaving affected individuals more vulnerable to other infections.[1,2,3] Vaccination with measles containing vaccine is safe and effective, providing protection against measles and its complications for all eligible populations. WHO recommends two doses of Measles Containing Vaccine (MCV) to be provided through the routine immunization schedule.[4]

Bangladesh has made remarkable progress through its Expanded Programme on Immunization (EPI), introduced in 1979. However, persistent immunization gaps remain, particularly among children living in underserved communities, urban informal settlements, and hard-to-reach areas. WHO, UNICEF and Gavi reported in 2025, that approximately 400,000 children in Bangladesh were under-immunized and around 70,000 had received no vaccines at all.[5]

According to the Health emergency operation center & control room, Health Ministry, in the period between 25 March 2026 to 23 July 2026 the suspected measles cases were 1,21,200, among them 710 died. Besides this, confirmed measles cases were 15,007 and 95 patients died in eight divisions in Bangladesh. According to the National Measles - Rubella Immunization Programme 2026, the goal of immunization was1,80,15,064 and vaccine already given in 1,84,82,497 which was 103% coverage (25 March 2026 to 23 July 2026).

Supplementary Immunization Activities (SIAs) or

mass immunization campaigns were further recommended by WHO as an effective strategy for delivering vaccination to children who may have been missed by routine services.[4]

The responsibility for measles prevention extends beyond vaccination services alone. Healthcare professionals have a critical role in recognizing suspected cases early, ensuring appropriate infection-control measures, reporting cases promptly, and promoting vaccination. Medical institutions should strengthen education regarding vaccine-preventable diseases and evidence-based outbreak management. Researchers should continue to investigate immunization gaps, vaccine acceptance, surveillance systems, and effective strategies for reaching underserved populations.[2,4,5]

The global experience with measles provides a clear lesson: complacency can rapidly reverse decades of progress. Sustaining high two dose vaccination coverage, strengthening routine immunization systems, closing equity gaps, maintaining sensitive surveillance and fostering public trust in science remain essential to achieving and sustaining measles elimination.[2,3,5]

The Government of Bangladesh is committed to protecting all children from vaccine – preventable diseases, including those in humanitarian settings. This response reflects our continued efforts to ensure impartial access to life saving vaccines.[6] The recent measles outbreak in Bangladesh makes this message especially timely. The country has demonstrated that strong immunization programmes can achieve remarkable public health gains; the challenge now is to ensure that every child, regardless of geographical location or socioeconomic circumstance, receives timely and complete protection. Through sustained political commitment, professional responsibility, scientific research, community partnership and equitable access to vaccination, we can move closer to a future in which no child suffers or dies from this entirely preventable disease.[1,4,7]

Professor Dr. Sharmin Sultana
Professor, Department of Physiology,
Ad-din Sakina Women's Medical College, Jashore.

***Correspondence:** E-mail: sharminsultana2015@yahoo.com

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Original Article

Impacts of Oat Supplementation on Serum Total Cholesterol and Serum Triglyceride in Patients with Type 2 Diabetes Mellitus

*Hossain F[1], Fatema K[2], Apu SA[3], Halder S[4], Sardar MMR[5], Hasan MM[6]

Abstract

Background: *Type 2 diabetes mellitus (T2DM) is a common metabolic disorder worldwide characterized by insulin resistance and hyperglycemia associated with unhealthy diet, sedentary lifestyle and obesity. People having T2DM and dyslipidemia face increased risk of cardiovascular disease. Healthy life style with proper diet play crucial role in managing T2DM. Oat is associated in lowering serum lipid which causes reduction of cardiovascular diseases (CVDs) by controlling diabetes.* ***Objectives:*** *The aim of this study was to observe the effects of oat supplementation on serum total cholesterol (TC) and serum triglyceride (TG) in patients with T2DM.* ***Materials and Methods:*** *A prospective interventional study was done in Dhaka Medical College from July 2021 to June 2022. Total eighty diagnosed T2DM patients of both genders age ranging 35-60 years were selected on the basis of inclusion and exclusion criteria. Among them 40 T2DM without oat supplementation were considered as control group. Another 40 age and gender matched T2DM with oat supplementation (60gm/day) for 12 weeks were considered as study group. Serum TC and serum TG were estimated at the beginning of the study and after 12 weeks of study period in control and study groups.* ***Results:*** *Serum TC and TG levels were significantly decreased in study group after 12 weeks of oats supplementation in comparison to that of their baseline value and also in comparison to the control group.* ***Conclusion:*** *Regular supplementation of oats lowers serum TC and TG in patients with T2DM.*

Keywords: Diabetes mellitus; Oat; Total cholesterol; Triglyceride.

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Introduction

Diabetes Mellitus is characterized by hyperglycemia with typical symptoms of thirst, polyuria, polydipsia and weight loss.[1] About 537 million adults worldwide are diabetic and 6.7 million adults estimated to die due to diabetes mellitus (DM) or its complications.[2] The risk factor of type 2 diabetes mellitus (T2DM) includes increasing age, obesity, physical inactivity, family history (1st degree relatives) or strong genetic predisposition, women with previous gestational diabetes mellitus (GDM), dyslipidemia, hypertension, polycystic ovarian syndrome and ethnicity.[3]

1. Dr. Farzana Hossain, Lecturer, Department of Physiology, Khulna Medical College, Khulna.
2. Dr. Kaniz Fatema, Lecturer, Department of Physiology, Sir Salimullah Medical College, Dhaka.
3. Dr. Sheam Ahmed Apu, Assistant Professor, Department of Physiology, Dhaka Medical College, Dhaka.
4. Dr. Shweta Halder, Assistant Professor, Department of Physiology, Gonoshasthaya Samaj Vittik Medical College, Dhaka.
5. Professor Dr. Md. Mijanur Rahman Sardar, Professor, Department of Physiology, Khulna Medical College, Khulna.
6. Dr. Md. Mehdi Hasan, Lecturer, Department of Physiology, Khulna Medical College, Khulna.

***Correspondence:** E-mail: drfarzanahossain2008@gmail.com

Diagnostic (modified) criteria for DM are (one or more of the following criteria are met); fasting plasma glucose: ≥7.0mmol/L (126 mg/dL), two-hour plasma glucose after 75g oral glucose load [oral glucose tolerance test (OGTT)] ≥11.1 mmol/L (200 mg/dL), HbA1c: ≥48 mmol/mol (equivalent to 6.5%), random plasma glucose in the presence of symptoms of hyperglycemia: ≥ 11.1 mmol/L (200 mg/dL).[2,4]

Diabetes mellitus is one of the commonest global non-communicable diseases which is epidemic in developing countries. The prevalence of diabetes in Bangladesh is 8.4% in adult population. Modification of life style along with healthy diet, physical activity and drug constitutes management of DM.[5]

Avena sativa (common oat) is a species of cereal grain rich in soluble dietary fiber in which β-glucan is the principal component.[6] Oat supplementation is associated with lowering total cholesterol (TC) by 0.09mmol/L which corresponds to reduction of 2%.[7] The risk of cardiovascular diseases can also be lowered by oat consumption.[8]

Li et al. (2016) observed a significant reduction in serum (TC) and triglyceride (TG) in oat

intervention group after one-year intervention.[9] McGeoch et al. (2013) found that total cholesterol was decreased following the oat diet compared with the standard diet.10 Kabir et al. (2002) found no significant effect on TG. Fasting serum cholesterol was lower in the study group compared with the control group.[11]

The findings of the above studies revealed that the impact of oat supplementation on total cholesterol and triglyceride in T2DM patients are contradictory and not conclusive. Therefore, the aim of this study was to evaluate the effects of oat supplementation on total cholesterol and triglyceride in patients with T2DM.

Materials and Methods

Ethical Approval of the Study Protocol: The research work was carried out after obtaining ethical clearance from concerned departments, Research Review Committee and Ethical Review Committee of Dhaka Medical College, Dhaka.

Study Design and Setting: This prospective interventional study was carried out in the Department of Physiology, Dhaka Medical College, Dhaka from July 2021 to June 2022. A total of 80 diagnosed T2DM patients of both genders with age 35-60 years were selected from outpatient department of Endocrinology, Dhaka Medical College Hospital, Dhaka. Among them 40 T2DM patients without oat supplementation were considered as control group. Another age and gender matched 40 patients of T2DM with oat supplementation (60gm/day) for 12 weeks were considered as study group. Study subjects were allocated in the study group and control group randomly.

Inclusion Criteria: Inclusion criteria were diagnosed patients of T2DM according to World Health Organization (WHO) and International Diabetes Federation (IDF) 2021 of both genders with age ranging 35-60 years. All the diabetic patients were on same oral hypoglycemic drug (Metformin).

Exclusion Criteria: Exclusion criteria were pregnancy and lactation, patients who were on insulin therapy, steroid and OCP, patients with endocrine disorder other than DM, patients with recent or past history of myocardial infarction, heart failure, severe hypertension (BP >180/110 mm Hg), renal and liver disorders, patients with concurrent acute illness including infectious diseases and malignancy, smoking and alcohol intake and known allergic to oat.

Study Procedure: All the patients of T2DM of the study group were supplemented orally 60 grams of oats per day (60gm/day) for 12 weeks.[10] Oats were purchased from local market. The brand of oat was Quaker oats. 1kg oats container pot of Quaker oats and a measuring cup was given to the study group for every 17 days interval and they were encouraged to consume the supplied oat daily. 60 grams oats were measured by supplied measuring cup. A person can consume 1kg of oat for 17 days. Each subject of the study group was supplied a total of 5 kg oats (5 container of 1kg Quaker oats) during 12 weeks of study period. A regular telephonic contact and periodic visit was taken to supply oats and to ensure compliance with intervention. Empty containers of oat and the amount of oats in the container were checked to understand that the subjects were consuming the oats regularly.

Laboratory Procedure: With all aseptic precaution, 6 ml of venous blood was collected from ante-cubital vein by 10cc disposable plastic syringe from each subject after an overnight fasting (at least 12 hours). The blood was transferred in a de-ionized glass test tube and was kept in slanted position till formation of clot. Then blood sample was centrifuged at a rate of 3000 rpm for 10 minutes for separation of serum. After that, supernatant serum was collected in labeled ependrof tube and preserved in a refrigerator below -20°C until analytical measurement of serum TC, TG, serum creatinine and serum ALT were done. Serum creatinine and serum ALT were

done to exclude renal and liver disease respectively. Analytical measurement was done into the Department of Laboratory Medicine, Dhaka Medical College Hospital, Dhaka. Measurement of serum TC and TG were done in all the subjects of both control and study groups, at the beginning of the study (baseline) and after 12 weeks of oat supplementation in the study group and without any oat supplementation for 12 weeks in the control group. Fasting serum TC was estimated by enzymatic endpoint method (Cholesterol oxidase/peroxidase method) and reading was taken by Dimension® Automated Biochemistry Analyzer. Fasting serum TG was estimated by enzymatic endpoint method by Dimension® Automated Biochemistry Analyzer method.

Statistical Analysis: Statistical analysis was performed by using a computer based statistical program SPSS (Statistical package for social science) version 23. Results were expressed as mean and standard deviation (mean ± SD). p value <0.05 was considered as level of significance. Paired student's 't' test was performed to compare quantitative data between baseline and after 12 weeks within same group and unpaired student's 't' test was performed to compare quantitative data between control and study groups. Chi square test was performed to compare qualitative data between control and study groups.

Results

In this study, total 80 patients were included. Among them 77 patients completed this study. 3 patients from the study group were excluded due to their personal reason. General characteristics of the study population was shown by age (years), gender (percentage), systolic blood pressure (mmHg) and diastolic blood pressure (mmHg) [Table-I].

Serum total cholesterol showed no significant difference in the control group after 12 weeks in comparison to their baseline value and also in comparison to the study group. Total cholesterol decreased significantly in the study group after 12 weeks of oat supplementation in comparison to their baseline value and also in comparison to the control group [Table-II]

Serum triglyceride showed no significant difference in the control group after 12 weeks in comparison to their baseline value and also in comparison to the study group. Triglyceride decreased significantly in the study group after 12 weeks of oat supplementation in comparison to their baseline value and also in comparison to the control group [Table-III].

Table-I: General Characteristics of the subjects in control and study groups (n=77)

Parameters		**Control group (*n*=40)**	**Study group (*n*=37)**	***p*-value**
Age (years)		46.7±7.7 (35-59)	46.4±7.6 (31-59)	>0.05
Gender	Male	18(53%)	16(47%)	>0.05
	Female	22(51%)	21(49%)	>0.05
Systolic BP (mmHg)		124.5±6.4 (110-130)	122.8±8.4 (110-140)	>0.05
Diastolic BP (mmHg)		79.8±7.3 (70-90)	79.9±5.3 (70-90)	>0.05

Results were expressed as mean ± SD. Unpaired Student's 't' test was performed to compare age, systolic BP and diastolic BP between control and study groups. Chi Square test was performed to compare gender between control and study groups. P value < 0.05 was accepted as level of statistical significance. n = number of study population.

Table II: Serum total cholesterol in study and control groups (*n*=77)			
Parameters	**Serum Total Cholesterol (TC) in mg/dl**		
	Control Group (*n*=40)	**Study Group (*n*=37)**	***p* value**
At baseline	220.2±14.0 (203-257)	220.9±13.5 (204-250)	0.481
After 12 weeks	220.1±12.0 (170-235)	201.1±14.8 (200-250)	0.000
***p* value**	0.931	0.000	
Results were expressed as mean ± SD. Paired t test was performed for comparison between baseline and after 12 weeks within group. Unpaired t test was performed to compare between control and study groups. p value <0.05 was accepted as level of statistical significance. n = number of subjects.			

Table III: Serum triglyceride in study and control groups (*n*=77)			
Parameters	**Serum Triglyceride (TG) in mg/dl**		
	Control Group (*n*=40)	**Study Group (*n*=37)**	***p* value**
At baseline	207.5±65.4 (87-358)	192.9±44.1 (60-368)	0.792
After 12 weeks	208.8±62.3 (85-300)	172.3±41.6 (60-359)	0.000
***p* value**	0.385	0.000	
Results were expressed as mean ± SD. Paired t test was performed for comparison between baseline and after 12 weeks within group. Unpaired t test was performed to compare between control and study groups. p value <0.05 was accepted as level of statistical significance. n = number of subjects.			

Discussion

The objective of the present study was to observe the impacts of oat supplementation on serum TC and serum TG in patients with T2DM. In this present study, serum TC and serum TG decreased significantly in the study group after 12 weeks of oat supplementation in comparison to their baseline value and also in comparison to the control group. These findings are compatible with some studies.[12] It may be due to decreased reabsorption and increased excretion in feces of micelles containing bile acid which is entrapped by β-glucan in intestine because of its high viscosity. Increased excretion of bile acid decreases fat absorption and thus lowers plasma lipid. Fermentation capacity of oat also produced short chain fatty acid (SCFA) which inhibit hepatic cholesterol synthesis.[1,13,14]

Pino et al. (2020) found that TC and TG was decreased significantly in oat group possibly due to SCFA which modulate lipolysis in adipocytes but in control group TC and TG was not increased significantly.[15]

On the contrary, Tessari and Lante (2017) found no significant differences in TC and TG level between the control and the study groups possibly because of the already near-normal lipid values of the subjects.[16]

Liatis et al. (2009) observed significant reduction in total cholesterol in the oat beta glucan group compared with their baseline value. No significant changes were observed in TC and TG in the control group. This lipid lowering mechanism may be due to increased binding of oats with bile acids in the small intestine leading to disrupting their reabsorption (enterohepatic circulation) and subsequently forcing the liver to use more cholesterol to synthesize new bile acids to compensate for the loss of bile acids in feces. Oats also forms a thick (gel-like), undisturbed (stagnant) water layer near intestinal mucosa which act as physical barrier against the absorption of bile acids.[17]

Reyna et al. (2003) observed that following supplementation with oat, TC and TG were reduced non-significantly in the study group in comparison to the control group. The possible mechanisms may be decreased absorption of lipid and reduced lipolysis.[18]

Strengths of this study was that the study subjects were age and gender matched and they were allocated randomly in the study group as well as in the control group and the period of observation was long (12 weeks) for better interpretation of the impact of oat supplementation. However, the number of the study population was small and serum adiponectin level was not measured to confirm the mechanism of action of oat on adipose tissue to decrease serum TG level.

Conflict of Interest: The authors of this manuscript declare no conflict of interest.

Conclusion

Findings of the present study prove that oat supplementation for 12 weeks reduces total cholesterol and triglyceride. As a result, supplementation of oat may be recommended in Diabetes Mellitus patients for proper control and better management of the disease and to minimize the complications of the disease.

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Original Article

Financial Toxicity and Socioeconomic Barriers to Medication Adherence Among Outpatients with Type 2 Diabetes Mellitus in Bangladesh

*Rizwan ASM[1], Ghosh S[2], Ahmed T[3], Noor AF[4], Islam S[5], Akhter S[6]

Abstract

Background: *Medication non-adherence remains a major barrier to optimal glycemic control among patients with Type 2 Diabetes Mellitus (T2DM). Although behavioral and treatment-related causes of non-adherence have been extensively studied, the contribution of financial toxicity—the objective and subjective financial burden imposed by healthcare expenditures—remains insufficiently characterized in lower-middle-income settings such as Bangladesh. This study evaluated socioeconomic determinants and risk subgroups associated with cost-driven medication non-adherence among outpatients with T2DM.* ***Materials and Methods:*** *A cross-sectional study was conducted among 213 adults with T2DM attending the outpatient department of Ad-din Sakina Women's Medical College Hospital. Demographic, socioeconomic, and treatment-related data were collected using a structured questionnaire. Bivariate associations were examined using Pearson's Chi-square tests, and independent predictors of cost-driven medication non-adherence were identified through multivariable binary logistic regression, reported as Adjusted Odds Ratios (AORs) with 95% confidence intervals.* ***Results:*** *Participants had a mean age of 56.77±11.81 years; 54.5% were male and 62.0% resided in rural areas. Financial toxicity was highly prevalent: 56.3% reported financial difficulty related to treatment costs, while 60.1% reported running out of medications before scheduled follow-up visits. Rural residence independently predicted medication skipping (AOR=7.97, 95% CI: 2.98–21.34). Household income below 20,000 BDT was strongly associated with non-adherence, particularly among those earning 10,000–20,000 BDT (AOR=10.00) and <10,000 BDT (AOR=8.94). Low educational attainment also markedly increased risk (AOR=26.72).* ***Conclusion:*** *Financial toxicity is a major structural determinant of diabetes medication non-adherence in Bangladesh. Policies addressing affordability, rural access, and socioeconomic inequities are essential to improve long-term diabetes outcomes.*

Keywords: Type 2 diabetes mellitus; Medication adherence; Healthcare costs; Socioeconomic factors; Rural population; Bangladesh; Financial toxicity.

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Introduction

Type 2 Diabetes Mellitus (T2DM) has emerged as a major public health crisis globally, with its burden disproportionately rising across low- and middle-income countries (LMICs).[1] In South Asia, and specifically in Bangladesh, the prevalence of diabetes has grown sharply over the last few decades, driven by rapid urbanization, metabolic shifts, and demographic transitions.[1] Effective management of T2DM commonly demands lifetime adherence to multi-drug pharmacotherapy regimens, regular clinical checkups, and routine metabolic monitoring. Despite the proven benefits of consistent therapy in avoiding microvascular and macrovascular complications, medication non-adherence remains a pervasive challenge in clinical practice.[2]

While clinical research traditionally attributes non-adherence to psychological forgetfulness, complex dosing regimens, or medication-related adverse effects, there is increasing recognition that structural socioeconomic barriers substantially influence treatment adherence.[3] In Bangladesh, where healthcare financing remains predominantly dependent on out-of-pocket expenditure, the economic burden of chronic disease management is often transferred directly to households.[4] Consequently, many patients face difficult decisions regarding the allocation of limited financial resources among healthcare, food, education, and other essential needs.

1. Dr. ASM Rezwan, Associate Professor, Department of Medicine, Ad-din Sakina Women's Medical College, Jashore.
2. Dr. Sharmistha Ghosh, Intern doctor, Ad-din Sakina Women's Medical College, Jashore.
3. Dr. Tasnim Ahmed, Intern doctor, Ad-din Sakina Women's Medical College, Jashore.
4. Dr. Aysha Fauzia Noor, Intern doctor, Ad-din Sakina Women's Medical College, Jashore.
5. Dr. Sanjida Islam, Intern doctor, Ad-din Sakina Women's Medical College, Jashore.
6. Lt. Col, Dr. Shahida Akhter, Army Medical Core, Bangladesh Army.

***Correspondence:** E-mail: dr.asmrizwan@gmail.com

The concept of financial toxicity has gained increasing attention in chronic disease research. Originally developed within oncology literature, the term describes the objective financial burden and subjective financial distress experienced by patients as a consequence of medical treatment costs.[5] More recently, investigators have highlighted the relevance of financial toxicity in diabetes care because of the lifelong nature of treatment and the recurring costs associated with medications, laboratory investigations, transportation, physician consultations, and management of complications.[6]

Diabetes imposes a particularly challenging economic burden because successful disease control depends on uninterrupted treatment. Even short interruptions in medication availability can lead to poor glycemic control, increased risk of acute metabolic events, accelerated progression of microvascular complications, and higher long-term healthcare expenditures.[7,8] Cost-related non-adherence therefore represents both a clinical and economic concern. International evidence suggests that patients facing financial hardship frequently engage in coping behaviors such as delaying prescription refills, reducing doses, sharing medications, or completely foregoing treatment.[9]

In LMIC settings, these challenges are amplified by limited social protection mechanisms and inadequate insurance coverage. Bangladesh has made substantial progress in improving population health indicators; however, financial risk protection for chronic disease care remains insufficient.[4,8] Several studies have shown that households affected by chronic illnesses are at increased risk of catastrophic health expenditure and financial hardship.[10,11] The burden is especially pronounced among individuals requiring long-term pharmacotherapy, including patients with diabetes, hypertension, and cardiovascular disease.

Socioeconomic disparities further shape the experience of financial toxicity. Educational attainment may influence health literacy, treatment-seeking behavior, and the ability to navigate healthcare systems effectively.[7] Individuals with higher education levels are often better equipped to understand the consequences of treatment interruption, compare therapeutic alternatives, and communicate financial concerns with healthcare providers. Conversely, lower educational attainment may compound the adverse effects of poverty and restricted access to health information.[12]

Geographic inequities also remain highly relevant in Bangladesh. Rural residents frequently encounter additional barriers beyond medication prices themselves, including transportation costs, reduced availability of specialized services, fewer pharmacy options, and longer travel times to healthcare facilities.[13,14] These factors may increase the total cost of care and contribute to treatment discontinuation even when prescribed medicines are theoretically affordable.

Although the relationship between socioeconomic disadvantage and adverse health outcomes is well established, relatively few Bangladeshi studies have specifically examined cost-driven medication non-adherence through a financial toxicity framework while simultaneously evaluating income, education, and geographic residence using multivariable modeling approaches. Existing studies often focus on general adherence behaviors without isolating the independent contributions of these structural determinants.[2,3]

Therefore, the present study sought to evaluate the prevalence of financial toxicity and identify socioeconomic predictors of cost-driven medication non-adherence among Bangladeshi outpatients with T2DM. By examining both subjective financial distress and objective medication-purchasing behaviors, this investigation aims to provide evidence capable of informing targeted policy interventions. Identifying vulnerable populations is essential for

designing equitable strategies that improve medication access, reduce preventable complications, and strengthen chronic disease management systems in resource-constrained settings.[8,15]

Materials and Methods

Study Design and Setting: This cross-sectional study was carried out among patients with diagnosed Type 2 Diabetes Mellitus attending the outpatient department (OPD) in Ad-din Sakina Women's Medical College Hospital, Jashore, Bangladesh. Data collection spanned a period of 6 months (January to June 2026) to evaluate the real-world treatment adherence behaviors of chronic disease patients navigating routine outpatient care.

Participant Selection and Sample Size: A total of 213 participants were recruited using a purposive sampling method based on their presentation at the OPD. Eligible participants met the following inclusion criteria: (1) an established clinical diagnosis of T2DM for at least 6 months, (2) current prescription for active pharmacological management [oral anti-diabetic drugs (OADs), insulin, or combination therapy], and (3) age $\geq$ 18 years. Patients with cognitive impairments, those presenting with acute medical emergencies requiring immediate intensive care, or those who declined to provide informed oral or written consent were excluded from the study.

Data Collection Tool and Variables: Data were gathered using a structured survey instrument administered through face-to-face interviews by trained data collectors. The survey tool was divided into three main components:

1) **Socioeconomic and Demographic Characteristics:** Age (analyzed continuously and grouped into brackets), Gender (Male/Female), Geographic Residence (Urban/Rural), Educational Qualification (Categorized into No Formal Education, Primary, Secondary, Higher Secondary Certificate [HSC], and University), Employment Status (Unemployed, Homemaker, Retired, Employed), and Monthly Family Income (divided into brackets: <10,000 BDT, 10,000–20,000 BDT, and >20,000 BDT).
2) **Subjective and Behavioral Financial Indicators:** To capture multiple dimensions of financial toxicity, variables included:
   - Subjective Financial Distress: "Do treatment costs cause financial difficulty for you?" (Yes/No).
   - Supply Gaps Before Follow-up: "Do you sometimes run out of medicines before your next visit?" (Yes/No).
   - Frequency of Medication Depletion: "How often do you run out of your medicines?" (None/Some/Most/All of the time).
   - Prescription Refill Latency: "How often do you forget to get prescriptions filled?" (None/Some/Most of the time).
3) **Primary Outcome Measure:** The primary dependent variable for this article was cost-driven medication non-adherence, operationalized through the binary question: "Do you sometimes skip purchasing medicines due to cost?" (Yes/No).

Statistical Analysis: All statistical analyses were executed using IBM SPSS Statistics for macOS (Version 30.0). First, descriptive statistics were generated to describe the baseline demographic and socioeconomic characteristics of the 213 participants. Categorical variables were expressed as absolute frequencies (*n*) and relative percentages (%) while continuous age data was summarized as Mean Standard Deviation (SD). Second, bivariate analysis was performed using Pearson's Chi-Square Test of Independence to examine associations between socioeconomic characteristics and the primary outcome (cost-driven medication skipping). Row percentages were computed to evaluate the distribution across specific subcategories.
Finally, to isolate independent predictors of

cost-driven non-adherence and control for confounding variables, a multivariate binary logistic regression model was constructed. The primary outcome variable ("Do you sometimes skip purchasing medicines due to cost?" [0=No, 1=Yes]) was entered as the dependent variable. Socioeconomic and demographic characteristics including age, gender, geographic residence, monthly family income, and educational level were entered simultaneously as independent predictors (covariates). To optimize model stability and ensure adequate cell counts within the regression matrix, adjacent subcategories with matching risk profiles identified in bivariate cross-tabulations were collapsed (Education collapsed into: University [Reference], Secondary/HSC, and No Formal Education/Primary). Adjusted Odds Ratios (AOR) alongside their 95% Confidence Intervals (CI) and regression coefficients (beta) was derived. Model fitness was confirmed utilizing the Omnibus Tests of Model Coefficients. For all tests, statistical significance was strictly defined as a two-tailed *p*-value < 0.05.

Results

Baseline socioeconomic and demographic characteristics: The complete baseline demographic and socioeconomic profile of the 213 surveyed T2DM outpatients is detailed in Table 1.

The mean age of the study population was 56.77 ± 11.81 years, with the largest age bracket falling between 51 and 60 years (*n*=69, 32.4%). Males comprised 54.5% (*n*=116) of the cohort, while females represented 45.5% (*n*=97). More than three-fifths of the participants resided in rural regions (*n*=132, 62.0%), with the remaining 38.0% (*n*=81) based in urban areas. Educational background was highly varied: 28.2% (*n*=60) had no formal education, 18.3% (*n*=39) completed primary school, 20.7% (*n*=44) completed secondary schooling, 12.2% (*n*=26) achieved an HSC, and 20.7% (*n*=44) had attained a university-level education. Regarding occupational distribution, 39.0 (*n*=83) were actively employed, 39.0% (*n*=83) identified as homemakers, 17.8% (*n*=38) were retired, and 4.2% (*n*=9) were unemployed. Half of the participants reported a monthly family income exceeding 20,000 BDT (*n*=107, 50.2%), while 35.7% (*n*=76) earned between 10,000 and 20,000 BDT, and 14.1% (*n*=30) survived on a monthly income below 10,000 BDT.

Table 1: Baseline demographic and socioeconomic characteristics of participants (*n* = 213)

Characteristics	*Frequency (n)*	*Percentage (%)*
Age		
21-30	4	1.9
31-40	14	6.6
41-50	50	23.5
51-60	69	32.4
61-70	52	24.4
71-80	23	10.8
>80	1	0.5
Gender		
Female	97	45.5
Male	116	54.5
Residence		
Rural	132	62
Urban	81	38
Educational qualification		
No formal education	60	28.2
Primary	39	18.3
Secondary	44	20.7
HSC	26	12.2
University	44	20.7
Employment status		
Unemployed	9	4.2
Homemaker	83	39
Retired	38	17.8
Employed	83	39
Monthly family income (BDT)		
<10,000	30	14.1
10,000-20,000	76	35.7
>20,000	107	50.2

Bivariate associations with cost-driven non-adherence: Table 2 displays the bivariate

cross-tabulations between socioeconomic markers and the explicit behavior of skipping medicine purchases due to financial constraints. Age (χ^2= 1.638, p = 0.950) and Gender (χ^2= 0.251, p = 0.616) did not show statistically significant associations with cost-driven skipping.

Table 2: Bivariate association between socioeconomic characteristics and cost-driven medication non-adherence (n = 213)

Socioeconomic factor	Total sample (n)	Skipped purchase due to cost (n,%)	Did not skip purchase (n,%)	χ^2 value	p-value
Residence				78.92	<0.001
Rural	132	105 (79.5%)	27 (20.5%)		
Urban	81	14 (17.3%)	67 (82.7%)		
Monthly Income (BDT)				81.84	<0.001
< 10,000	30	26 (86.7%)	4 (13.3%)		
10,000 - 20,000	76	66 (86.8%)	10 (13.2%)		
> 20,000	107	27 (25.2%)	80 (74.8%)		
Education Level				92.01	<0.001
No formal education	60	52 (86.7%)	8 (13.3%)		
Primary	39	33 (84.6%)	6 (15.4%)		
Secondary	44	25 (56.8%)	19 (43.2%)		
HSC	26	7 (26.9%)	19 (73.1%)		
University	44	2 (4.5%)	42 (95.5%)		

Conversely, geographic residence, monthly income, and educational attainment demonstrated highly powerful associations (p<0.001). Rural residents were disproportionately affected, with 79.5% (n=105) admitting to cost-driven medication skipping compared to only 17.3% (n=14) of urban residents (χ^2= 78.923, p < 0.001). Unpacking the income subcategories revealed an clear economic threshold: patients in the lowest income bracket (<10,000 BDT) and the moderate income bracket (10,000–20,000 BDT) showed nearly identical, high rates of medication skipping (86.6% and 86.8%, respectively). This behavior dropped substantially to 25.2% (n=27) among patients earning above 20,000 BDT (χ^2= 81.842, p<0.001). Educational background showed a strong protective gradient: 86.7% of patients with no formal education and 84.6% of those with primary education skipped purchases due to costs, whereas only 4.5% (n=2) of university-educated individuals reported doing so (χ^2= 92.013, p < 0.001).

Indicators of overall financial burden: The secondary behavioral parameters of financial toxicity are presented in Table 3. Subjective financial distress was highly prevalent, with 56.3% (n=120) of the total sample stating that treatment costs caused them clear financial difficulty. This financial pressure translated into objective gaps in medication supply: 60.1% (n=128) of the 213 patients reported running out of their medications before their next scheduled clinical follow-up visit. Furthermore, 69.5% (n=148) reported running out of their medicines at least "some" or "most" of the time, and 64.8% (n=138) regularly experienced delays or failed to get their medical prescriptions filled due to cost-related barriers.

Multivariate predictors of financial non-adherence: The independent structural drivers of cost-driven medication non-adherence were isolated using multivariate binary logistic regression, as compiled in Table 4. The regression model was highly significant (χ^2= 152.81, df = 7,

Table 3: Indicators of financial burden and medication non-adherence (*n* = 213)

Adherence & Cost Indicator	Frequency (*n*)	Percentage (%)
Subjective Financial Distress		
Do treatment costs cause financial difficulty for you?		
Yes	120	56.3%
No	93	43.7%
Supply Gaps Before Follow-up		
Do you sometimes run out of medicines before your next visit?		
Yes	128	60.1%
No	85	39.9%
Frequency of Running Out of Medication		
None of the time	65	30.5%
Some of the time	108	50.7%
Most of the time / All of the time	40	18.8%
Frequency of Delays in Filling Prescriptions		
None of the time	75	35.2%
Some of the time	98	46.0%
Most of the time	40	18.8%

$p < 0.001$). After adjusting for all demographic and socioeconomic covariates simultaneously, Age remained non-significant (β = -0.027, AOR = 0.97, $p = 0.208$). Gender reached the threshold of statistical significance, indicating that male patients had 2.82 times higher adjusted odds of skipping purchases compared to female patients (AOR = 2.82, 95% CI: 1.00–7.96, $p = 0.050$).

Geographic residence emerged as a powerful structural predictor: rural residents exhibited a nearly eightfold increase in the adjusted odds of cost-driven medication skipping compared to urban peers (β = 2.08, AOR = 7.97, 95% CI: 2.98–21.34, $p < 0.001$).

The household income ceiling effect was also confirmed. Compared to the highest earning reference tier (>20,000 BDT), patients earning 10,000–20,000 BDT had ten times higher adjusted odds of skipping purchases (β = 2.30, AOR= 10.00, 95% CI: 3.67–27.21, $p < 0.001$), and those earning <10,000 BDT had nearly nine times higher odds (β = 2.19, AOR= 8.94, 95% CI: 2.12–37.60, $p < 0.001$).

Finally, lower educational attainment was an independent driver of non-adherence. Compared to university-educated patients, those with mid-level education (Secondary/HSC) had 7.53 times higher odds of non-adherence (AOR= 7.53, $p = 0.022$), while patients with low-level education (No Formal Education/Primary) exhibited a massive increase in risk (β = 3.29, AOR= 26.72, 95% CI: 4.16–171.65, $p < 0.001$).

Discussion

The findings of this study provide clear evidence of the profound impact of financial toxicity on diabetes care in Bangladesh. They show that cost-driven medication non-adherence is not an isolated issue of personal neglect, but is structurally determined by specific socioeconomic thresholds.[3] As demonstrated in Table 3, over half of the study population (56.3%) experienced subjective financial distress due to treatment costs, and a striking 60.1% physically ran out of their medications before their next clinical follow-up.[3] These figures expose a systemic vulnerability in chronic disease management

Table 4: Multivariate logistic regression of factors associated with cost-driven medication non-adherence (*n* = 213)

Predictor Variable	β Coefficient	Adjusted Odds Ratio (AOR)	95% Confidence Interval (CI)	*p*-value
Age (Continuous)	-0.027	0.97	0.93 – 1.02	0.208
Gender				
Female	—	1.00 (Reference)	—	—
Male	1.04	2.82	1.00 – 7.96	0.050
Residence				
Urban	—	1.00 (Reference)	—	—
Rural	2.08	7.97	2.98 – 21.34	<0.001
Monthly family income (BDT)				
> 20,000	—	1.00 (Reference)	—	—
10,000 - 20,000	2.30	10.00	3.67 – 27.21	<0.001
< 10,000	2.19	8.94	2.12 – 37.60	<0.001
Education level				
University	—	1.00 (Reference)	—	—
Secondary and HSC	2.02	7.53	1.34 – 42.45	0.022
No formal education and Primary	3.29	26.72	4.16 – 171.65	<0.001

within out-of-pocket healthcare systems, demonstrating how economic barriers frequently interrupt vital long-term pharmacotherapy, which mirrors patterns observed broadly across the country's private healthcare sector.[5]

The most notable finding from our multivariate analysis is the exceptionally strong independent impact of rural residence. Rural patients were found to be 7.97 times more likely to skip purchasing medications due to cost compared to urban patients, even when holding family income and education levels constant.[3] This indicates that the rural-urban adherence gap is not merely a reflection of rural poverty. Instead, it highlights deep structural inequalities in the healthcare delivery system of Bangladesh, where rural regions historically face supply disparities.[4] Urban patients benefit from concentrated, highly competitive pharmaceutical markets where multiple generic options are available, and pharmacies frequently compete on pricing.

In contrast, rural patients face a less competitive supply chain, longer travel distances to well-stocked urban center pharmacies, and higher indirect transport expenses.[5] These factors stack atop the baseline cost of the medicine, creating cumulative cost barriers documented in broader prescription cost-sharing literature.[6] When a rural family must balance these cumulative costs against a limited monthly budget, skipping purchases becomes a common, unfortunate outcome.[3]

Our detailed analysis of monthly family income brackets revealed a clear economic threshold. As shown in Table 2, bivariate and multivariate models both showed that patients earning between 10,000 and 20,000 BDT faced a risk profile almost identical to those in the absolute lowest income tier (<10,000 BDT), with skipping rates reaching 86.8% and 86.7% respectively.[3] The protection against cost-driven medication skipping only becomes apparent when a household's income crosses the 20,000 BDT threshold, where skipping dropped sharply to 25.2%.[3] This observation carries major policy implications for health equity in Bangladesh, as general systemic

gaps continually fail to protect middle-to-low income brackets.[4] It indicates that financial vulnerability in diabetes care extends well beyond those living in extreme poverty; it impacts a broad layer of low-to-moderate-income families. For households earning less than 20,000 BDT, the cumulative monthly cost of multiple anti-diabetic agents represents a major economic burden that regularly triggers cost-driven skipping, reinforcing patterns of socioeconomic adherence disparities highlighted in regional reviews.[2]

Our study also highlights educational attainment as a key protective asset against financial non-adherence. Patients with no formal education or only primary schooling were 26.72 times more likely to skip medication purchases due to costs compared to university-educated counterparts.[3] Education serves as a key proxy for health literacy and health navigation skills, which are crucial for managing chronic diseases.[7] Highly educated individuals are often better equipped to communicate with clinicians regarding financial constraints, request lower-cost generic alternatives, understand the long-term clinical dangers of skipping doses, or seek out subsidized care channels.[3] Conversely, patients with lower formal education face a dual disadvantage: they lack the financial resources to easily afford care, and they navigate a complex healthcare market with less health literacy, leaving them highly vulnerable to cost-driven non-adherence, an independent vulnerability seen across varied global cohorts.[7]

Interestingly, while age was non-significant, gender reached the margin of statistical significance in the multivariate regression model.[3] Male patients exhibited 2.82 times higher adjusted odds of cost-driven medication skipping than female patients (p = 0.050).[3] In the socio-cultural context of Bangladesh, men traditionally act as the primary financial providers for extended households, which profoundly shapes how family healthcare resources are distributed.[4] This economic responsibility can lead male patients to intentionally deprioritize their own chronic medical needs and skip purchasing their medications to preserve limited household funds for their children's education, food, or other immediate family demands.[3] This gendered finding underscores the value of factoring socio-cultural dynamics into the study of financial toxicity.

Beyond the individual-level implications, the findings reinforce the growing understanding that medication adherence should be viewed through a health-systems lens rather than solely as a patient behavior. Financial toxicity represents a multidimensional phenomenon encompassing direct medical expenditures, indirect costs such as transportation and lost wages, and the psychological stress associated with maintaining long-term treatment.[9,11] The high prevalence of subjective financial distress observed in this study suggests that many patients experience substantial economic strain even before overt treatment interruption occurs. This observation is important because perceived financial hardship itself has been linked to poorer self-management behaviors, lower quality of life, and reduced engagement with healthcare services.[16]

The observed rural disadvantage is consistent with evidence from other LMIC settings where geographic inequities contribute significantly to chronic disease outcomes. Rural communities frequently experience reduced healthcare accessibility, fewer specialized providers, and weaker pharmaceutical distribution networks.[14] Even when medication prices are identical, the cumulative costs associated with travel, missed workdays, and repeated healthcare visits may substantially increase the effective cost of treatment. Consequently, interventions focused exclusively on reducing medication prices may be insufficient unless accompanied by broader efforts to improve healthcare accessibility in underserved regions.

The income-related findings are particularly noteworthy because they suggest the existence of a practical affordability threshold. Rather than demonstrating a simple linear relationship between income and adherence, the results indicate that households earning below 20,000 BDT share a similarly elevated risk profile. This pattern aligns with international research demonstrating that moderate-income households may remain vulnerable to treatment interruption when chronic disease expenditures consume a substantial proportion of disposable income.[12] Such findings emphasize the importance of targeting assistance programs according to financial vulnerability rather than extreme poverty alone.

Our findings also support the growing literature linking health literacy and educational attainment with medication adherence. Education may influence not only knowledge of disease management but also the ability to evaluate treatment options, access trustworthy health information, and communicate effectively with healthcare providers.[7,13] Patients with limited education may be less aware of lower-cost generic alternatives or available support services, thereby increasing their vulnerability to financial toxicity. Educational interventions designed to improve treatment literacy may therefore complement economic support measures.

From a policy perspective, the results support the development of integrated strategies addressing both affordability and accessibility. Potential approaches include expansion of essential medicine subsidy programs, strengthening public-sector medicine supply chains, increasing availability of low-cost generic medications, and improving chronic disease services at primary healthcare facilities.[15] Furthermore, incorporation of financial hardship screening into routine diabetes care may allow clinicians to identify patients at risk of cost-related non-adherence before treatment interruption occurs.[9]

Several limitations of our study should be acknowledged. The cross-sectional design precludes causal inference, and self-reported adherence measures may be subject to recall or social desirability bias. Additionally, participants were recruited from a single tertiary-care outpatient setting, which may limit generalizability to all regions of Bangladesh. Nevertheless, the study provides valuable evidence regarding the structural determinants of medication non-adherence and highlights the importance of financial toxicity as a public health concern in diabetes management.

Conclusion and Recommendations

In conclusion, cost-driven medication non-adherence among Type 2 Diabetes patients in Bangladesh is a structural problem driven by geographic inequalities, an income vulnerability threshold beneath 20,000 BDT, and low formal education. Currently, non-communicable disease corners in government hospitals across the nation is serving a crucial role to provide the much needed chronic care support among diabetic patients. Unfortunately though, the drug dispensing is frequently unregulated and unsynchronised to individual cases. To shield chronic disease patients from the clinical risks of financial toxicity, structural public health reforms are urgently required:

1. Mandatory price standardization and caps: The government should expand price control mechanisms for all essential anti-diabetic medications (both oral hypoglycemic agents and insulins) to prevent pricing volatility in private retail markets.

2. Decentralized rural pharmacy networks: Government-subsidized community clinics and public upazila health complexes must be stocked with consistent supplies of free or highly subsidized generic anti-diabetic agents. This will help eliminate the transport cost barriers faced by rural residents.

3. Targeted subsidies for vulnerable households: Public health programs should introduce targeted medical voucher systems or social safety nets for chronic disease patients whose household incomes fall below the critical 20,000 BDT threshold.

4. Health literacy campaigns: Clinical institutions should design accessible, low-literacy health communication tools that educate patients on the vital clinical importance of continuous therapy and empower them to actively request affordable generic options from their healthcare providers.

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Original Article

Outcome of Distal Tibial Extra Articular Fracture Fixation by Anatomical Plate Using Minimally Invasive Plate Osteosynthesis Technique

*Biswas T[1], Chanda M[2], Islam DR[3], Newaz KK[4], Islam MR[5], Bhuiyan ARMM[6], Haque MN[7]

Abstract

Background: *Dealing with -articular distal tibial fractures can be tough because the skin and other soft tissues around the fracture are not very strong and the blood supply is not very good. Doctors have started using a technique called minimally invasive plate osteosynthesis (MIPO) with anatomical locking plates to help the bone heal and get better results for patients.* ***Objective:*** *The goal of this study was to see how well extra-articular distal tibial fractures did when treated with plate fixation using the minimally invasive plate osteosynthesis technique.* ***Materials and Methods:*** *The study was conducted with 20 adult patients who had closed -articular distal tibial fractures and treated them with minimally invasive plate osteosynthesis using an anatomically contoured distal tibial locking plate. Olerud–Molander Ankle Score was used to see how well the patients were doing.* ***Results:*** *Fracture healing was achieved in every patient, with radiological union occurring at an average of 18.50 ± 1.93 weeks. Full weight bearing was most commonly attained between 17 and 18 weeks, which was observed in 45% of the patients. In addition, 80% of the patients were able to regain a walking ability comparable to their pre-injury level. Functional recovery, as evaluated using the Olerud–Molander Ankle Score, was satisfactory in 80% of the patients, indicating favourable overall clinical outcomes.* ***Conclusion:*** *Using invasive plate osteosynthesis with an anatomically contoured distal tibial locking plate is a good way to treat extra-articular distal tibial fractures.*

Keywords: Tibial fractures; Fracture fixation, internal; Bone plates; MIPO; Treatment outcome.

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Introduction

The distal tibia is a part of the body that's very hard for doctors to fix when it gets broken. This is because of where it's located and the fact that it does not have a lot of soft tissue around it. The distal tibia is also very close to the ankle joint, which is important for being able to walk and move around. When the distal tibia gets broken it can be very hard to heal because it does not have a lot of blood flowing to it.[1] Extra-articular fractures of the tibia are a common type of broken bone in the lower leg. These types of breaks often happen because of accidents, such as car crashes or falls from high places.[2]

In the past doctors would often treat tibial fractures by keeping the leg still for a long time. However this can cause a lot of problems, such as the joint getting stiff the bone not healing properly and the leg getting shorter. It can also take a time for the person to be able to move around and do their daily activities again.[3] Because of these problems many doctors prefer to do surgery to fix the break. This is especially true for breaks that're not stable. Surgery can help the person get back to moving sooner and can also help the bone heal properly.

However surgery for tibial fractures can also be very challenging. One type of surgery called

1. Dr. Tapos Biswas, Assistant Professor, Department of Orthopedic Surgery, Dhaka Medical College Hospital, Dhaka, Bangladesh
2. Dr. Manashe Chanda, Lecturer, Department of Biochemistry, Tangail Medical College, Tangail, Bangladesh
3. Dr. Dewan Rakibul Islam, Assistant Professor, Department of Orthopaedic Surgery, International Medical College Hospital, Gazipur, Bangladesh
4. Dr. Kazi Karim Newaz, Junior Consultant, Department of Orthopaedics, Gopalganj Medical College Hospital, Gopalganj, Bangladesh
5. Dr. Md. Rakibul Islam, Junior Consultant, Department of Orthopaedic Surgery, Shahid Sayed Nazrul Islam Medical College Hospital, Kishoreganj, Bangladesh
6. Dr. A.R.M Masum Bhuiyan, Resident MS Orthopaedics, Department of Orthopaedic Surgery, Dhaka Medical College Hospital, Dhaka, Bangladesh
7. Dr. Muhammad Neamul Haque, Medical Officer, Department of Orthopaedic and Traumatology, Upazila Health Complex, Nasirnagor, Brahmanbaria, Bangladesh

***Correspondence:** E-mail: taposbiswas86@gmail.com

reduction and internal fixation requires the doctor to make a big cut in the leg and move the soft tissue around. This can cause a lot of problems, such as infection the bone not healing properly and the wound not closing.[4] Another type of surgery called fixation uses pins and frames to hold the bone in place. However this type of surgery can also cause problems, such as infection and the bone not healing properly.[5] There is another type of surgery called interlocking nailing that uses a rod to hold the bone in place. However this type of surgery can be very hard to do for breaks that are close to the ankle joint.[6]

A newer type of surgery called minimally invasive plate osteosynthesis (MIOP) is a more gentle way of fixing the break. This type of surgery uses a plate to hold the bone in place without having to make a big cut in the leg. This can help the bone heal faster. Can also reduce the risk of problems. By avoiding direct exposure of the fracture site, MIPO facilitates indirect fracture reduction and preserves the fracture hematoma, which is essential for bone healing.[7] The plate used in this type of surgery is specially designed to fit the shape of the tibia. This helps the doctor to put the plate in the place without having to make a big cut in the leg. This type of surgery has been shown to be very effective in helping the bone heal and in reducing the risk of problems.[8]

Anatomical distal tibial plates are side-specific and precontoured to match the medial surface of the tibia, enabling accurate alignment and stable fixation without extensive soft tissue dissection. This technique has been associated with favourable radiological union rates, early weight bearing, reduced postoperative complications, and improved functional outcomes.[9] Despite increasing adoption of MIPO with anatomical plates, evidence from prospective studies in low and middle-income countries, including Bangladesh, remains limited. This study aimed to evaluate the functional and radiological outcomes of extra-articular distal tibial fractures treated with anatomical plate fixation using the minimally invasive plate osteosynthesis technique.

Materials and Methods

Study Design, Setting, and Population: This prospective observational study was carried out in the Department of Orthopaedic Surgery at Dhaka Medical College Hospital, Dhaka, Bangladesh, between July 2020 and October 2022. Patients presenting with radiologically confirmed extra-articular distal tibial fractures were enrolled in the study. All participants underwent assessment and treatment following a uniform management protocol that was consistently applied throughout the study period.

Sample Size and Sampling Technique: The sample size was determined using previously reported rates of satisfactory functional outcomes, with the calculation based on a statistical power of 80% and a significance level of 10%. This yielded a required sample size of 26 patients. Nevertheless, disruptions associated with the COVID-19 pandemic affected patient follow-up, and complete data were ultimately obtained for 20 patients, who were included in the final analysis. Participant selection was carried out through purposive sampling, and eligibility was assessed according to predefined inclusion and exclusion criteria.

Eligibility Criteria: Patients were considered eligible for inclusion if they were older than 18 years, irrespective of gender, and had closed extra-articular distal tibial fractures classified as AO type 43-A1, 43-A2, or 43-A3. Only fractures presenting within three weeks of injury were included. Patients with open fractures, intra-articular involvement of the distal tibia, pathological fractures, neglected old fractures, or unstable medical conditions that substantially increased operative risk were excluded from the study.

Data Collection: Information was gathered using a pretested structured questionnaire designed to capture demographic characteristics, clinical and radiological findings, operative details,

postoperative outcomes, and any complications encountered during follow-up. Patients were reviewed at scheduled intervals and monitored until radiological union was achieved or the designated follow-up period was completed.

Study Variables: The study evaluated several demographic, clinical, and outcome variables. Demographic characteristics included age, sex, and occupation. Clinical parameters comprised the side of injury, mechanism of trauma, fracture pattern, and the interval between injury and surgical intervention. Outcome measures included the time required for radiological union, pain status at the final follow-up visit, ankle dorsiflexion, varus or valgus deformity, limb length discrepancy, postoperative complications, and functional recovery as measured by the Olerud–Molander Ankle Score.

Operational Definitions: Radiological union was considered present when bridging callus formation was visible across the fracture site with complete or near-complete disappearance of the fracture line, accompanied by painless weight bearing. Delayed union was defined as slower-than-expected fracture healing with evidence of ongoing healing potential. Non-union referred to failure of fracture healing by nine months after surgery, with no radiological signs of progression during the preceding three months. Full weight bearing was defined as the ability to support the entire body weight without pain, whereas partial weight bearing indicated the ability to bear approximately 50% of body weight.

Preoperative Assessment: All patients were initially assessed and stabilized in accordance with Advanced Trauma Life Support (ATLS) guidelines. A comprehensive clinical evaluation was performed, followed by radiographic examination using anteroposterior and lateral views of the affected limb, including both the knee and ankle joints. Standard preoperative investigations were completed to determine fitness for anesthesia and surgery. Prior to definitive fixation, the injured limb was immobilized with a posterior splint, elevated to reduce swelling, and managed with appropriate analgesia.

Surgical Technique: Surgery was carried out under spinal anesthesia with the patient positioned supine on a radiolucent operating table. A tourniquet was applied in all cases. Fracture fixation was performed using the minimally invasive plate osteosynthesis (MIPO) technique with an anatomically contoured distal tibial locking compression plate placed along the anteromedial aspect of the tibia. Indirect reduction methods under fluoroscopic guidance were used to restore alignment while preserving the surrounding soft tissues. Through a small incision over the medial malleolar region, the plate was introduced subcutaneously and advanced across the fracture site. Temporary stabilization was obtained with Kirschner wires, after which definitive fixation was achieved using a combination of locking and non-locking screws with adequate bicortical purchase. Following satisfactory fixation, the wound was closed in layers and a below-knee posterior plaster slab was applied.

Postoperative Management and Follow-up: Following surgery, limb elevation was maintained and early mobilization of the knee joint was encouraged. Patients were advised to ambulate with crutch support while avoiding weight bearing as tolerated. Ankle range-of-motion exercises were initiated after suture removal at two weeks. Partial weight bearing was permitted once radiological evidence of callus formation became apparent, and progression to full weight bearing was allowed after both clinical and radiological union had been confirmed. Regular follow-up evaluations were conducted for a minimum duration of six months to monitor fracture healing, functional recovery, and any postoperative complications.

Data Analysis: Data were compiled and analyzed using the Statistical Package for Social Sciences (SPSS), version 26.0. Descriptive statistics were

used to summarize patient characteristics, clinical variables, and outcomes.

Ethical Considerations: The study protocol was approved by the Ethical Review Committee of Dhaka Medical College (ERC-DME/ECC/2021/14). Written informed consent was obtained from all participants after explaining the study objectives, procedures, and potential risks in the local language.

Results

A total of 20 patients with extra-articular distal tibial fractures were included in the study. Male patients constituted the majority of the study population (60.0%), with a male-to-female ratio of 1.5:1. The mean (±SD) age of the patients was 43.55 (±11.49) years (range: 26–68 years), and the largest (30%) proportion of patients belonged to the 31–40 years age group (Table 1).

Table 1. Demographic Characteristics of the Study Participants (n = 20)

Variable	Category	*n*	%
Gender	Male	12	60.0
	Female	8	40.0
	Male : Female ratio	—	1.5 : 1
Age group (years)	18–30	3	15.0
	31–40	6	30.0
	41–50	5	25.0
	51–60	4	20.0
	61–70	2	10.0
Age (years)	Mean ± SD	43.55 ± 11.49	—
	Range	26–68	—

n; Number of cases, %; Percentage

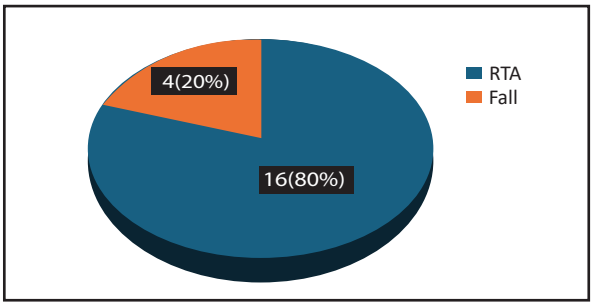


Figure 1: Pie diagram showing the mechanism of injury of study patients (n=20)

Figure 1 shows the mechanism of injury. Road traffic accident (RTA) was most common cause of injury up to the extent of 16(80.0%).

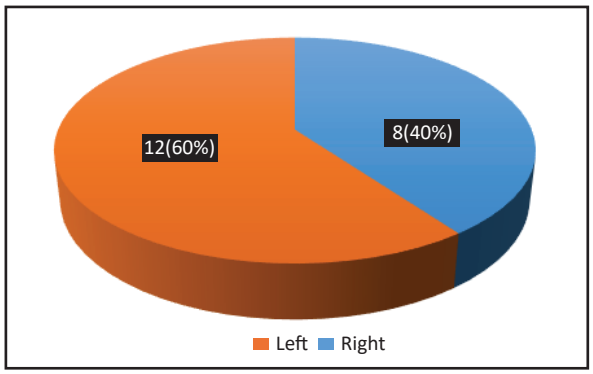


Figure 2: Pie diagram showing the side distribution of injured limb (n=20)

Figure 2 shows that among 20 patients, 12(60%) patients had injury on right side while 8(40%) patients had left sided injury.

Regarding fracture configuration, the majority of patients sustained AO type 43-A3 fractures (70.0%), followed by type 43-A2 fractures in 25.0% of cases, while only one patient (5.0%) had a type 43-A1 fracture. Assessment of soft tissue injury revealed that most patients had minimal soft tissue involvement, with 75.0% classified as Tscherne grade 0 and the remaining 25.0% as grade 1. No patients presented with grade 2 or grade 3 soft tissue injuries (Table 2).

Table 2: Fracture Type and Soft Tissue Injury Distribution (n = 20)

Variable	Category	*n*	%
AO fracture type	AO 43-A1	1	5.0
	AO 43-A2	5	25.0
	AO 43-A3	14	70.0
Tscherne soft tissue grade	Grade 0	15	75.0
	Grade 1	5	25.0
	Grade 2	0	0.0
	Grade 3	0	0.0

n; Number of cases, %; Percentage

Table 3 shows that the operative time for most of the patient's 16(80.0%) took ≤ 90 minutes and 4 (20.0%) patients took 91-120 minutes. Mean operative time was 84.5±11.1 minutes.

Table 3: Duration of surgery of the study patients (n =20)

Operative time	*n*	%
≤ 90 minutes	16	80.0
91-120 minutes	4	20.0
>120 minutes	0	0.0
Total	20	100.00
n; Number of cases, %; Percentage		

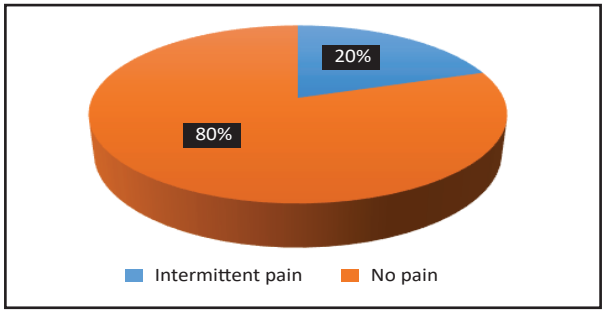


Figure 3: Pie diagram showing pain status of study patients (n=20)

Figure 3 shows the pain status of the study patients, 16 (80.0%) patients' complaints of no pain and 4 (20.0%) patients' complaints of intermittent pain.

Most patients achieved both full weight bearing and radiological union between 17 and 18 weeks (45.0%), as shown in Table 4. The mean time to full weight bearing and radiological union was 18.50 ± 1.93 weeks. No cases of delayed union or non-union were observed during the follow-up period.

Table 4: Time to Full Weight Bearing and Radiological Union (n = 20)

Outcome measure	Time interval	*n*	%
Full weight bearing	14–16 wks	4	20.0
	17–18 wks	9	45.0
	>18 wks	7	35.0
Radiological union	14–16 wks	4	20.0
	17–18 wks	9	45.0
	>18 wks	7	35.0
	Delayed union	0	0.0
	Non-union	0	0.0
wks; Weeks, *n*; Number of cases, %; Percentage			

Table 5 showing the range of motion, maximum 4 (20.0%) patients had ankle dorsiflexion at 0 to 5 degree and 11 (55.0%) patients had 6-10degreeofankle dorsiflexion then 5 (25.0%) patients had more than 10-degree ankle dorsiflexion. Mean ankle dorsiflexion was 10 ±3.97 degrees.

Table 5: Ankle dorsiflexion of the study patients (n=20)

Ankle dorsiflexion	*n*	%
≤ 5degree	4	20.0
6-10 degree	11	55.0
>10 degree	5	25.0
Total	20	100.00
n; Number of cases, %; Percentage		

Table 6 shows the walking capacity of the patients, in 16(80.0%) patient's walking capacity was same as before. But, 2(10.0%) patients had mild restriction to walk and 2(10.0%) patients used walking aids.

Table 6: Walking capacity of the study patients (n =20)

Walking capacity	*n*	%
Same as before	16	80.0
Mild restriction	2	10.0
Use walking aids	2	10.0
Total	20	100.0
n; Number of cases, %; Percentage		

Majority of the patients 16(80%) had no complications. Superficial infection was found in 02 (10.0%) patients, 01 (5.0%) patient had deep infection and 01 (5.0%) patient had ankle stiffness.

Table 7: Complications after surgery of the study patients (n =20)

Complications	*n*	%
Superficial infection	2	10.0
Ankle stiffness	1	5.0
Deep infection	1	5.0
Non-union	-	-
Implant failure	-	-
No complications	16	80.0
Total	20	100.0
n; Number of cases, %; Percentage		

Functional outcome assessment using the Olerud–Molander Ankle Score demonstrated favourable results in the majority of patients (Table 8). Excellent outcomes were observed in 25.0% of patients, while 55.0% achieved good functional recovery. Overall, 80.0% of patients attained a satisfactory outcome, whereas 20.0% had an unsatisfactory outcome. No patients were classified as having a poor functional outcome.

Table8: Functional Outcomes by Olerud–Molander Score (*n* = 20)

Outcome category	OMS score range	*n*	%
Excellent	91–100	5	25.0
Good	61–90	11	55.0
Fair	31–60	4	20.0
Poor	<30	0	0.0
Satisfactory (Excellent + Good)	—	16	80.0
Unsatisfactory (Fair + Poor)	—	4	20.0
n; Number of cases, %; Percentage			

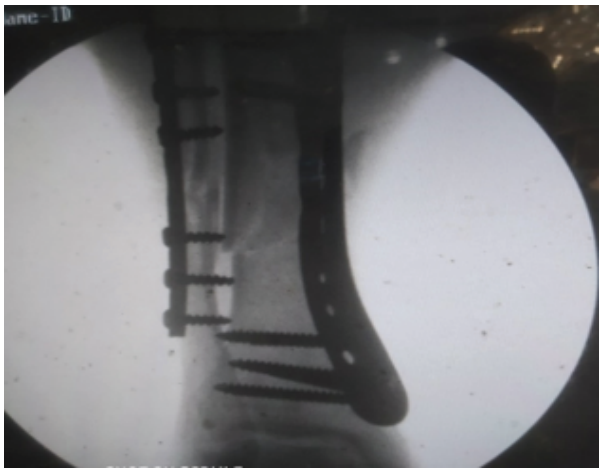
A. Medial malleolar incision



B. Subcutaneous plate insertion



C. C-Arm View for confirmation



D. Completion of Screw fixation



E. Closure of wound



Figure 4: Intraoperative steps of minimally invasive plate osteosynthesis for distal tibial fracture.

All patients underwent fracture fixation using the minimally invasive plate osteosynthesis technique with an anatomically contoured distal tibial locking plate. The procedure was successfully completed through a limited medial incision with subcutaneous plate insertion under fluoroscopic guidance. Intraoperative images demonstrate key steps of the surgical technique, including medial malleolar incision, subcutaneous plate tunnelling, fluoroscopic confirmation of fracture reduction, completion of screw fixation, and wound closure (Figure 4).

Discussion

Extra-articular distal tibial fractures remain a therapeutic challenge because of the subcutaneous location of the bone, limited soft tissue envelope, and compromised blood supply.[10] In the present study, functional and radiological outcomes of extra-articular distal tibial fractures treated with anatomical plate fixation using the minimally invasive plate osteosynthesis (MIPO) technique were evaluated, demonstrating overall favourable clinical results.

The present study demonstrated that minimally invasive plate osteosynthesis (MIPO) using an anatomically contoured distal tibial locking plate provided favourable clinical, radiological, and functional outcomes in patients with extra-articular distal tibial fractures. The study population was predominantly male (60.0%) with a mean age of 43.55 ± 11.49 years, reflecting the greater exposure of economically active adults to high-energy trauma. Road traffic accidents accounted for 80.0% of injuries, consistent with previous studies by Ronga et al., Redfern et al., and Hasenboehler et al., which also identified road traffic accidents as the leading cause of distal tibial fractures among adults. These findings highlight the substantial burden of high-energy trauma in this patient population.[11]

Most fractures were classified as AO type 43-A3 (70.0%), while 75.0% of patients had Tscherne grade 0 soft tissue injury. The predominance of fractures with minimal soft tissue damage likely contributed to the favourable postoperative outcomes observed in this study. Similar fracture patterns and patient selection have been reported in previous studies, which demonstrated that preservation of the soft tissue envelope is a key determinant of successful fracture healing following MIPO.[12,13]

The mean operative time was 84.5 ± 11.1 minutes, and 80.0% of procedures were completed within 90 minutes, indicating that MIPO can be performed efficiently with adequate surgical expertise. Furthermore, all fractures achieved radiological union, with a mean union time of 18.50 ± 1.93 weeks, and no cases of delayed union or non-union were observed. These findings are comparable to previous studies reporting high union rates and satisfactory healing times following MIPO.[12,14] The excellent union rate in the present study is likely related to preservation of the periosteal blood supply and fracture hematoma, which are recognized biological advantages of minimally invasive fixation.[15]

Functional recovery was also encouraging. At final follow-up, 80.0% of patients were pain-free, 80.0%

regained their pre-injury walking capacity, and 80.0% achieved satisfactory functional outcomes based on the Olerud–Molander Ankle Score. Only four patients experienced fair outcomes, and none had poor functional recovery. These results are consistent with previous studies demonstrating good to excellent functional outcomes following MIPO for distal tibial fractures.[14,16] Early mobilization combined with stable fixation may have contributed to the satisfactory restoration of ankle function observed in the present study.

The postoperative complication rate was low, with 80.0% of patients experiencing no complications. Superficial infection occurred in only 10.0% of patients, while deep infection and ankle stiffness were each observed in 5.0% of cases. No implant failure or non-union was encountered. These findings agree with previous studies reporting that MIPO is associated with fewer wound complications than conventional open plating because it minimizes soft tissue dissection and preserves local vascularity.[17]

Conflict of Interest: The authors declare that there is no conflict of interest regarding the publication of this article.

Conclusion

Minimally invasive plate osteosynthesis using an anatomically contoured distal tibial locking plate provides stable fixation, promotes reliable fracture union, and results in favourable functional outcomes in extra-articular distal tibial fractures. The technique allows early weight bearing with a low complication rate while preserving soft tissue integrity and fracture biology. Based on the findings of this study, MIPO with anatomical plating appears to be a safe and effective treatment option for managing extra-articular distal tibial fractures.

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Original Article

Association of Overweight and Obesity with Hypertensive Disorders of Pregnancy in Bangladeshi Women: A Hospital-Based Case-Control Study

*Ghosh E[1], Biswas PK[2], Shaheen MM[3], Hasan T[4], Saha D[5]

Abstract

Background: *Prevalence of Hypertensive disorders of pregnancy (HDP) is ≈ 5 to 10 % worldwide. In Bangladesh it was estimated ≈ 10 to 15%. HDP are leading cause of maternal mortality and other adverse feto-maternal outcome of pregnancy. Overweight & obesity has been recognized as an important risk factor for HDP in studies conducted in developed countries, but there is a scarcity of evidence from Bangladesh.* ***Objective:*** *The objective of this study was to determine the association of overweight and obesity with HDP, and to evaluate potential confounding factors.* ***Materials and Methods:*** *It was an observational analytic study with case-control design conducted in the period of January 2026 to June 2026. Data was collected by face to face interview, physical examination and going through medical records using a structured questionnaire. Descriptive and analytic statistics was conducted using IBM SPSS Statistics 25.* ***Results:*** *Adjusted odds ratio (AOR) for age = 1.126 (95% CI: 1.065 - 1.189, p <0.001); for gravidity AOR = 1.133 (95% CI: 0.561 – 2.286, p =0.728). AOR for gestational diabetes mellitus (GDM) was 6.482 (95% CI: 1.631 - 25.769, p =0.008), and AOR for overweight & obesity = 3.023 (95% CI: 1.675 - 5.454, p <0.001).* ***Conclusion:*** *Overweight or obese individuals are 3.023 times more likely to develop HDP when compared to subjects with normal BMI (< 25 kg/m²) after adjusting for age, gravidity, and GDM. Emphasizing modifiable risk factors such as overweight and obesity can reduce HDP induced maternal morbidity and mortality.*

Keywords: Hypertensive disorders, Pregnancy; Body mass index; Overweight; Obesity; Gestational diabetes mellitus; Risk factors.

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Introduction

Hypertensive disorders of pregnancy (HDP) are the leading causes of maternal morbidity and mortality worldwide, remarkably in low and middle-income countries.[1,2] Globally, 5% to 10% of all pregnancies are complicated with HDP.[3] Despite advances in antenatal care (ANC), HDP continue to contribute to maternal deaths, preterm births, intrauterine growth restriction (IUGR), stillbirths, and other adverse neonatal outcomes.[4]

The scenario is worse in developing countries like Bangladesh where access to quality ANC is limited, diagnosis is delayed, and resources for management are inadequate.[5] According to previous studies conducted in Bangladesh, 10% to 15% of maternal deaths were due to HDP.[6] This was also associated with an increased risk of preterm delivery, IUGR, perinatal mortality, and cesarean delivery. Despite ongoing efforts to improve maternal health services, HDP continue to inflict significant clinical and economic burdens on the healthcare system of Bangladesh.[7]

HDP comprises gestational hypertension, preeclampsia, severe preeclampsia, eclampsia, chronic hypertension with superimposed preeclampsia and HELLP syndrome. Gestational hypertension is defined as new onset hypertension (BP ≥140/90 mmHg) after 20 weeks of pregnancy without proteinuria or any other features of preeclampsia. Preeclampsia is categorized as newly developed (gestational age >20 weeks) hypertension with proteinuria (≥300 mg/24 hour or dipstick reading of 2+) or, in the absences of proteinuria, maternal end organ dysfunction. Severe preeclampsia is diagnosed as preeclampsia complicated with systolic BP ≥160 mmHg and diastolic BP ≥110 mmHg with one or

1. Dr. Emu Ghosh, Associate Professor, Department of Physiology, Ad-din Sakina Women's Medical College, Jashore.
2. Dr. Palash Kumar Biswas, Assistant Professor, Department of Pediatrics, Jashore Medical College & Hospital, Jashore.
3. Dr. Ms Mukaddas Shaheen, Intern Doctor, Ad-din Sakina Women's Medical College Hospital, Jashore.
4. Dr. Tania Hasan, Intern Doctor, Ad-din Sakina Women's Medical College Hospital, Jashore.
5. Dr. Disha Saha, Intern Doctor, Ad-din Sakiina Women's Medical College Hospital, Jashore.

***Correspondence:** E-mail: 716e.biswas@gmail.com

more severe features including evidence of hepatic dysfunction, persistent abdominal pain, progressive renal impairment, platelet count < 100000/µL, pulmonary edema or visual disturbance. Eclampsia includes patients with new onset seizures in preeclamptic cases that cannot be explained by another neurologic or metabolic cause.[8] New onset proteinuria or maternal end organ dysfunction in subjects with chronic hypertension (hypertension diagnosed before 20 weeks of pregnancy) is defined as chronic hypertension with superimposed preeclampsia.[8,9] HELLP syndrome is defined by the presence of hemolysis, elevated liver enzymes, and low platelet count (<100000/µL).[8,10]

Obesity is one of the most well-known modifiable risk factors for undesirable pregnancy outcomes both for the mother and her baby. Overweight and obesity in women of reproductive age have remarkably increased over the last few decades.[11,12] Excess adipose tissue deposition contributes to chronic inflammation, insulin resistance, endothelial dysfunction and altered placental vascular development, all of which are concerned in the pathogenesis of HDP.[12] Many systematic reviews and meta-analyses have demonstrated a strong positive association between high pre-pregnancy body mass index (BMI) and the risk of developing HDP. A recent meta-analysis involving more than 50 million pregnancies demonstrated that each 5 kg/m² increase in pre-pregnancy BMI was associated with a ≈ 75% to 82% higher risk of HDP including preeclampsia. Studies have also shown that maternal adiposity indicators measured in early pregnancy are significant predictors of developing HDP.[13,14]

High BMI has been recognized as an important risk factor for HDP in studies conducted in developed countries, but there is a scarcity of evidence from Bangladesh.[15,16] Available Bangladeshi studies on HDP have primarily focused on prevalence, clinical characteristics, maternal outcomes, and perinatal outcomes rather than evaluating obesity as an independent risk factor.[15,17] Furthermore, the relationship between pre-pregnancy BMI defined overweight & obesity with HDP among Bangladeshi women has not been adequately investigated using an analytical epidemiological design such as a case-control study. There is also a scarcity of hospital-based evidence from the southwestern part of Bangladesh. Conducting this study in Ad-din Sakina Medical College Hospital (ASMCH), Jashore, which serves a large population of pregnant women from both urban and rural settings, was expected to be insightful.

Materials and Methods

This was an observational analytical study with a case-control design conducted in ASMCH, Jashore from January 2026 to June 2026. Clearance and approval was taken from the institutional review board (IRB) of Ad-din Sakina Women's Medical College (ASWMC) and ASMCH authority to conduct the study. Informed written consent was taken from each subject after explaining the study procedures and its implication. Confidentiality of data was ensured. No intervention was done. No experimental animal was involved in the study.

A non-probability consecutive sampling technique was used until target sample size for case and control group was achieved. Sample size was estimated to be 266 (Case = 92 / Control = 174) at CI = 95%, Power = 80% and Ratio = 1:2 using Epi Info™ (Desktop Version) for unmatched case-control study. All our study subjects (cases & controls) were volunteer singleton pregnant women of more than 20 weeks of gestational age from the outpatient and inpatient facilities of ASMCH, Jashore.

We included cases with a confirmed diagnosis of hypertensive disorders of pregnancy (HDP), which comprised gestational hypertension, preeclampsia, severe preeclampsia, eclampsia, chronic hypertension with superimposed preeclampsia, and HELLP syndrome. Controls included otherwise healthy pregnant women from

the same facilities. Overweight & Obesity was defined collectively as a BMI ≥25 kg/m² for subjects aged >19 years according to World Health Organization (WHO).[18] Age and sex specific growth reference chart was employed for subjects aged ≤ 19 years for defining overweight & obesity.[19] BMI was calculated using pre-pregnancy weight (kg) and height(m) of subjects from medical records. Any subjects with multiple pregnancies, gestational age ≤20 weeks, with any chronic medical disorder, severely sick and who refused to participate in the study was excluded.

Data were collected from face-to-face interviews, clinical examination and medical records. A structured data collection form captured sociodemographic details (age, residence, income, education), obstetric history (gravidity, parity, ANC visits, previous HDP), and health data, including pre-pregnancy BMI and symptoms such as recent onset visual disturbance and edema. Clinical measurements, including blood pressure and pulse were recorded. Lab reports regarding proteinuria, CBC with platelet count and liver and renal function tests were reviewed to distinguish HDP.

Statistical analysis was performed using IBM SPSS Satistics™ to summarize subject characteristics and assess associations. Descriptive statistics outlined baseline data, while bivariate analyses using chi-square tests explored relationships between risk factors (independent variables) and HDP. Student t test and Mann Whitney U test (wherever appropriate) was performed for parametric data to compare between case and control group. We used unconditional binary logistic regression to model HDP (case group) versus the control group (comparison group), adjusting for age, gravidity, GDM, and overweight & obesity. Logistic regression identified independent risk factors, with adjusted odds ratio (AOR) quantifying associations.

Results

In this case control study, among 266 study subjects, 92 was incorporated in the case group and 174 in the control group. Majority of the study subjects came from Jashore sadar thana (37.0% of cases and 38.5% of controls). We had subjects from 19 different thana of Jashore, Jhenaidah, Satkhira, Chuadanga and Narail district (Figure 1).

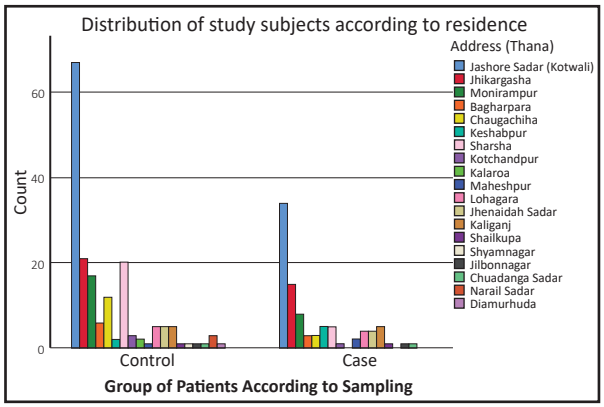

Figure 1: Distribution of study subjects according to residence.

Age of our subjects ranged from 15 years to 45 years. Mean age ±SD of the case group was 28.67 ±6.23 years and for control group this was 24.32 ±5.44 years. Mean age of cases appeared to be higher significantly (p <0.001) when compared to control group of our study. Considering age groups, there was also significant differences among cases and controls in between <20 years age group, 20-35 years age group and >35 years age group in our study (p <0.001), which is displayed in table 1.

41.3% of cases and 36.8% of controls used to live in urban areas and 58.7% of cases and 63.2% of controls in rural areas respectively. Statistically there were no significant (p =0.471) differences in respect of living in rural or urban areas among cases and controls (Table 1).

In view of household monthly income of the family they belonged was (mean ±SD) 34,467.39

±16,295.66 BDT vs 38,017.24 ±24,953.71 BDT in case and control group respectively and there was no significant (p =0.164) difference statistically (Table 1). After categorizing monthly income into low (>30000 BDT), middle (30000 to 80000 BDT) and high (>80000 BDT) income group; there was also no significant (p = 0.400) difference statistically among the case and control group (Table 1).

Taking Institutional education into account, majority of case and control group subjects belonged to SSC (34.8% vs 40.2%) and HSC (50.1% vs 39.1%) group respectively (Figure 2). The differences among case and control groups based on institutional education appeared not to be significant (p = 0.115) statistically (Table 1).

Table 1: Siciodemographic characteristics of the study subjects (n=266)

Variables		Case (n=92)	Control (n=174)	p value
Age (years)		28.67 ±6.23	24.32 ±5.44	<0.001
Age Group	<20 years	5 (5.4%)	37 (21.3%)	
	20 - 35 years	77 (83.7%)	133 (76.4%)	
	>35 years	10 (10.9%)	4 (2.3%)	<0.001
Residence	Urban	38 (41.3%)	64 (36.8%)	
	Rural	54 (58.7%)	110 (63.2%)	0.471
Household Monthly Income (BDT)		34467.39 ±16295.66	38017.24 ±24953.71	0.164
Income Group	Low (<30000 BDT)	53 (57.6%)	90 (51.8%)	
	Middle (30000-80000 BDT)	48 (41.3%)	78 (44.8%)	
	High (>80000 BDT)	1(1.1%)	6 (3.4%)	0.400
Institutional Education	None	1 (0.9%)	0 (0.0%)	
	Primary	3 (3.3%)	17 (9.8%)	
	SSC	32 (34.8%)	70 (40.2%)	
	HSC	46 (50.1%)	68 (39.1%)	
	Graduate & Above	10 (10.9%)	19 (10.9%)	0.115

n; number of subject, Parametric data was expressed as mean ± standard deviation (SD) and categorical data was expressed as frequency (percentage). p <0.05 was considered as level of significance at 95% confidence interval. Independent sample t-test and Mann Whitney U test (whenever appropriate) was performed for parametric data and Chi-square test for categorical data.

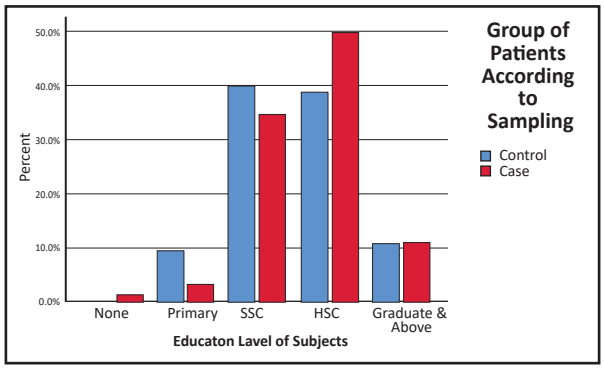

Figure 2: Bar chart showing education level of the subjects according to sampling.

Mean ±SD BMI (kg/m2) of the case group (24.93 ±3.68) was significantly (p <0.001) higher than the control group (22.16 ±3.43). Taking overweight & obesity (BMI ≥25 kg/m2) into account, case group showed fairly higher percentages (48.9% vs 23.0%) than the control group. Mean ±SD BMI of case and control group according to different age group is shown in a box and plot chart (Figure 3). The difference was also significant (p <0.001) statistically (Table 2).

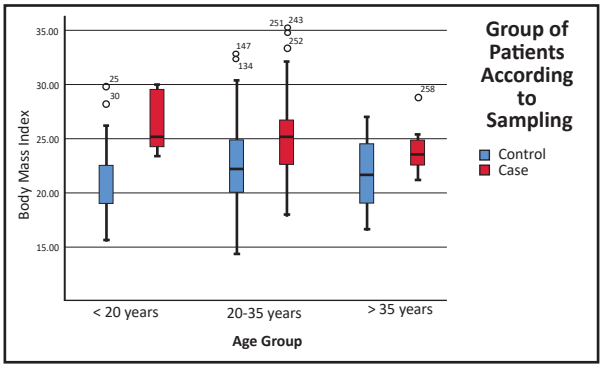

Figure 3: Box and plot chart showing body mass index (BMI) of different age group according to sampling. Horizontal line within the box indicates the median value.

14.1% subjects of the case group was diagnosed as GDM while in the control group comprised only 1.7% of subjects with GDM. It was evident that GDM among cases was significantly (p <0.001) higher when compared with the controls. Mean ±SD of gestational age during data collection was 33.52 ± 3.88 weeks vs 32.71 ± 5.90 weeks among case and control group respectively. Gestational age of the subjects appeared to be similar and statistically there was no significant (p =0.153) difference when compared (Table 2).

Considering number of pregnancies including the current one (gravida), the mean ±SD gravida of the cases was 2.54 ±1.19 and 1.97 ±1.12 for controls. The difference was statistically significant (p <0.001) and indicated an association of HDP (case) with increasing number of pregnancies. Conversely 78.3% of the case group subjects were multigravida and 57.5% subjects of control group were multigravida. Only 21.7% of cases were primigravida and 42.5% of controls were primigravida. The predominance of multigravidity among cases was significant (p =0.001) statistically (Table 2).

The exponential of regression coefficient [Exp(B)] for the variable 'age' was 1.126 (95% CI: 1.065 to 1.189, p <0.001); the odds of having HDP (case) increases by 12.6% with each year increase in subject's age. Exp(B) or adjusted odds ratio (AOR) for gravidity was 1.133 but was not significant statistically (p =0.728). Exp(B) or AOR for GDM was 6.482 (95% CI: 1.631 to 25.769, p =0.008), which is a significant finding. Exp(B) or AOR for overweight & obesity (BMI ≥25 kg/m2) was 3.023 (95% CI: 1.675 to 5.454, p <0.001); overweight or obese are 3.023 times more likely to develop HDP compared to non-obese (BMI <25 kg/m2) subjects after adjusting for age, gravidity and GDM (Table 3).

Table 2: Anthropometric and clinical characteristics of the study subjects (n=266)

Variables		Case (n=92)	Control (n=174)	p value
BMI (kg/m^2)		24.93 ±3.68	22.16 ±3.43	<0.001
Overweight & Obesity	No	47 (51.1%)	134 (77.0%)	
	Yes	45 (48.9%)	40 (23.0%)	<0.001
GDM	No	79 (85.9%)	171 (98.3%)	<0.001
	Yes	13 (14.1%)	3 (1.7%)	
Gestational Age (weeks)		33.52 ±3.88	32.71 ±5.90	0.153
Gravida		2.54 ±1.19	1.97 ±1.12	<0.001
Gravidity	Primigravida	20 (21.7%)	74 (42.5%)	
	Multigravida	72 (78.3%)	100 (57.5%)	0.001

n; number of subject, BMI; Body mass index, GDM; Gestational diabetes mellitus, Parametric data was expressed as mean ± standard deviation (SD) and categorical data was expressed as frequency (percentage). p <0.05 was considered as level of significance at 95% confidence interval. Independent sample t-test was performed for parametric data and Chi-square test for categorical data.

Table 3: Result of the logistic regression analysis showing contribution of the independent variables in predicting HDP in our study.

Independent Variables	B	Exp(B) or AOR	95% CI of Exp(B)		*Significance (p value)*
			Lower	Upper	
Age	0.118	1.126	1.065	1.189	<0.001
Gravidity	0.125	1.133	0.561	2.286	0.728
GDM	1.869	6.482	1.631	25.769	0.008
Overweight & Obesity	1.106	3.023	1.675	5.454	<0.001

HDP; Hypertensive disorders of pregnancy, GDM; Gestational diabetes mellitus, B; Logistic regression coefficient, Exp(B); Exponential B, AOR; Adjusted odds ratio, , CI; Confidence interval, p <0.05 was considered as level of significance at 95% CI.

Hosmer-Lemeshow goodness-of-fit test was non-significant (p =0.663) indicating the model was a good fit for prediction. The area under the receiver-operating characteristic (ROC) curve was 0.756 (95% CI: 0.695 to 0.817, p <0.001), which is an indication of acceptable discriminating accuracy of our logistic regression model.

Discussion

Primary objective of this study was to determine the association between BMI-defined overweight and obesity with HDP. The study aimed to determine the odds of HDP among overweight and obese women. It also tried to identify other confounding factors of HDP as well as making comparisons between cases and controls.

This case-control study was conducted in ASMCH, Jashore which is a tertiary care hospital, providing quality maternal and child health care support in an affordable cost. Majority of participants came from different thana of Jashore district. Some of them came from neighboring Jhenaidah, Satkhira, Chuadanga and Narail district. There was no significant (p =0.471) difference in respect of living in rural or urban areas among case and control group of our study subjects. Mean ±SD of gestational age of our study subjects was 33.52 ± 3.88 weeks vs 32.71 ± 5.90 weeks among case and control group respectively. Gestational age of the subjects was similar in both group and statistically non-significant (p =0.153). In our study, average household monthly income was 34,467.39 BDT and 38,017.24 BDT among case and control group respectively. Our observation was more or less consistent with Bangladesh household income and expenditure survey.[20] Although among control group the average monthly income was higher; the difference was not significant statistically. In the context of institutional education majority of subject completed either SSC or HCS exam and there was no significant statistical difference among case and control group.

The principle exposure of our study was pre-pregnancy overweight and obesity (BMI ≥25 kg/m^2). We found the mean BMI of the case group was significantly higher than the control group. Taking overweight & obesity into account, case group showed fairly higher percentages (48.9% vs 23.0%) than the control group. Xiong et al., in a very recent systematic review and dose-response meta-analysis involving 157 cohort studies and >51.8 million pregnancies also found a strong positive association between increasing pre-pregnancy BMI and pregnancy-induced hypertension, preeclampsia, eclampsia and overall HDP. Xiong et al, also showed adjusted OR of 1.75 (95% CI: 1.68–1.82) for HDP per 5-unit increase in BMI.[13] In our logistic regression analysis, we calculated the adjusted OR for overweight & obesity as 3.023 (95% CI: 1.675 to 5.454, p <0.001) after adjusting for subject's age, gravidity and GDM. Duckitt & Harrington, in a systematic review found that raised pre-pregnancy BMI was associated with increased risk of preeclampsia (RR

2.47, 95% CI: 1.66-3.67).[21] Salma U (2022) in her case-control study from Bangladesh also found significantly higher basal BMI among women with preeclampsia compared with normal pregnant controls (p =0.002).[22] A systematic review by Bartsch et al. also identified pre-pregnancy BMI >30 kg/m² as a major risk factor for preeclampsia (RR 2.8 95% CI: 2.6–3.1).[23] Our study findings is directionally consistent with previous studies in respect of BMI as well as overweight & obesity.

In this study, age of the subject was significantly higher among HPD cases (Case: Control = 28.67 ± 6.23: 24.32 ± 5.44 years). There was also significant differences among the three age categories (p <0.000). Salma U, in her study demonstrated mean age of 24.71 ± 2.56 years among preeclampsia women compared with 23.09 ± 2.1 years among controls, with a significant difference (p=0.005).[22] Saccone et al. and Duckitt et al. showed, women aged ≥40 years had significantly greater risk of preeclampsia and several other adverse outcomes.[21,24] Age remained an independent predictor in our logistic regression with an AOR = 1.126 (95% CI 1.065–1.189, p<0.001) indicating each one-year increase in age was associated with approximately 12.6% higher odds of HDP in our adjusted model. A recent prediction study by Xi Q et al., also identified maternal age as an independent predictor of preeclampsia, although its population and model differed from us.[25] The independent association of maternal age with HDP in our study is broadly consistent with previous multivariable prediction studies.

14.1% of cases (HPD) and 1.7% of controls in this study was found to have GDM and the difference was statistically significant (p <0.000). A systematic review specifically examining GDM and adverse pregnancy outcomes in South Asia conducted by Mistry SK et al. found that GDM was positively associated with preeclampsia.[26] Findings of this study strongly align with our findings. Our adjusted analysis calculated an AOR = 6.482 (95% CI 1.631–25.769, p =0.008) indicating that after adjustment women with GDM had approximately 6.5-fold higher odds of HDP. As the number of subjects with GDM was small (13 cases and only 3 controls), the confidence interval was wide, indicating considerable statistical uncertainty and the estimation of association should be interpreted with caution.

In our study gravidity was significantly higher among HDP cases (Mean gravida: 2.54 ±1.19 vs 1.97 ±1.12, p <0.001). 78.3% of the cases were multigravida and 57.5% controls group were multigravida. Only 21.7% of cases were primigravida and 42.5% of controls were primigravida. AOR for gravidity was 1.133, p=0.728, meaning that gravidity was not independently associated with HDP after adjustment. It was clearly evident that our finding of a greater proportion of multigravidas among HDP cases is not necessarily consistent with the classical literatures. For instance, Duckitt and Harrington found nulliparity to be associated with increased preeclampsia risk (RR 2.91, 95% CI 1.28–6.61).21

Our study included several key variables in our analysis; some unmeasured confounding factors may still influence the results. Some sociodemographic data like monthly income, institutional education, was self-declared and we had no scope to verify. This was a hospital based study, although ASWMCH is an affordable hospital for middle and lower-middle income group of subject; nationally representative sampling is required to generalize the study outcome.

Conclusion

Pre-pregnancy overweight and obesity are independently associated with threefold higher odd of hypertensive disorders of pregnancy among Bangladeshi women. Identification and programmed intervention in modifiable factors, particularly excess body weight, may help to reduce the burden of HDP and its associated maternal morbidity and mortality.

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Case Report

Iatrogenic Cushing's Syndrome and Severe Corticosteroid-Induced Osteoporosis Masking Advanced Chronic Tophaceous Gout: A 14-Year Cautionary Tale

*Rizwan ASM[1], Akhter S[2]

Abstract

Long-term, unmonitored glucocorticoid administration carries an immense risk of multi-systemic iatrogenic complications. We report the case of a 56-year-old female presenting with severe deforming arthritis, multiple vertebral compression fractures, secondary diabetes mellitus, and profound secondary adrenal insufficiency following 14 years of self-administered daily high-dose dexamethasone (15 mg/day). The steroid therapy was initially initiated for uncharacterized arthritis, masking an underlying, relentlessly progressing chronic tophaceous gout. Attempts to discontinue the steroid repeatedly triggered life-threatening adrenal crises characterized by severe rebound pain, vomiting, and vertigo. Laboratory and radiological investigations confirmed advanced tophaceous disease, profound osteopenia with multiple compression fractures resulting in a 2-inch loss of height, and a serum uric acid level of 13 mg/dL. This case underscores the catastrophic consequences of unregulated over-the-counter availability and unmonitored administration of potent corticosteroids, particularly in resource-limited clinical environments.

Keywords: Cushing syndrome; Iatrogenic; Gout; Osteoporosis; Glucocorticoids

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Abstract

Gangrenous cholecystitis (GC) is a serious complication of acute cholecystitis.[1,2] GC is seen in 10%–40% of patients with acute cholecystitis.[3-5] GC has been described since 1894, and figures vary depending on the percentage of acute cholecystitis (AC) that GC makes up. GC patients tend to be sicker than the average AC patients, and their surgical procedure tends to be more challenging and is associated with an increased risk of morbidity and mortality when compared to all causes of AC.[6] GC risk factors include diabetes mellitus, males, older age, elevated white blood cells, and coronary heart disease.[2,3] GC is the progression of AC, which is commonly due to obstruction of the cystic duct due to an impacted stone, which commonly dislodges on its own and does not progress to GC. If the stone does not dislodge, then there will be vascular compromise and epithelial injury leading to ischemia locally and necrosis of that region's gallbladder wall.

1. Dr. A S M Rizwan, Associate Professor, Department of Medicine, Ad-din Sakina Women's Medical College, Jashore

2. Dr. Shahida Akhter, Associate Professor, Department of Physiology, Bangladesh Army Medical Corps.

***Correspondence:** E-mail: dr.asmrizwan@gmail.com

These patients will require early interventions to decrease morbidity and mortality.[7,8] The incidence of GC is more common in older patients and is associated with a higher white blood cell count (WBC) and diabetes.[9]

Case Presentation

A 56-year-old female patient had presented to outpatient department with severe, generalized, deforming joint pain, progressive physical disability, and an observed 2-inch reduction in her height over the preceding decade.

Fourteen years prior, she had visited a local physician for vague joint pains. She was told it was a suspected form of "arthritis" and was prescribed a short 7-day course of oral dexamethasone. Experiencing immediate and dramatic symptomatic relief, she independently opted to continue the medication. Over the next 14 years, she took an astonishing daily dose of 15 mg of oral dexamethasone. Midway through this period, she developed secondary diabetes mellitus as an iatrogenic consequence of the steroid abuse and was initiated on oral Metformin 500 mg twice daily.

On detailed systemic inquiry, the patient reported multiple previous attempts to taper or discontinue the dexamethasone. Each attempt invariably precipitated severe, debilitating withdrawal episodes characterized by unremitting, generalized rebound musculoskeletal pain, persistent vomiting, and profound vertigo, which were clinically diagnostic of an impending secondary adrenocortical crisis due to deep HPA axis suppression. Fearing these symptoms, she returned to her daily 15 mg dexamethasone regimen each time.

Physical examination revealed classic features of long-standing iatrogenic Cushing's syndrome alongside advanced, asymmetrical joint inflammation. Marked, hard subcutaneous nodules and asymmetric deformities were visible over her bilateral wrists, proximal interphalangeal (PIP) joints, distal interphalangeal (DIP) joints, and first metatarsophalangeal (MTP) joints.



Figure 1: *Clinical photograph of the patient's hands showcasing severe, asymmetric deforming arthritis with multiple visible subcutaneous gouty tophi over the small joints of the fingers and wrists.*



Figure 1: *Clinical photograph of the patient's right foot displaying a large gouty tophus involving the first metatarsophalangeal joint with overlying cushingoid skin changes.*

Laboratory evaluation revealed a markedly elevated serum uric acid level of 13 mg/dL (normal range: 2.4–6.0 mg/dL), indicative of severe, uncontrolled hyperuricemia. Marked systemic inflammation was present, with an erythrocyte sedimentation rate (ESR) of 82 mm in the first hour and a c-reactive protein (CRP) level of 54 mg/L. Her random blood sugar (RBS) was elevated at 9.7 mmol/L, reflecting suboptimal glycemic control under high-dose steroid pressure. Her serum creatinine was stable at 0.9 mg/dL.

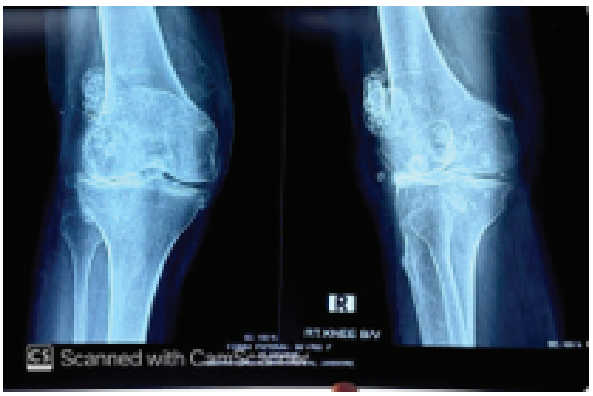

Figure 3: *Plain radiograph of the right knee showing extensive, calcified soft-tissue tophaceous deposits in the periarticular/patellar region along with profound joint space narrowing.*

Radiological investigations of her knees and lumbar spine confirmed widespread tissue and bony damage.

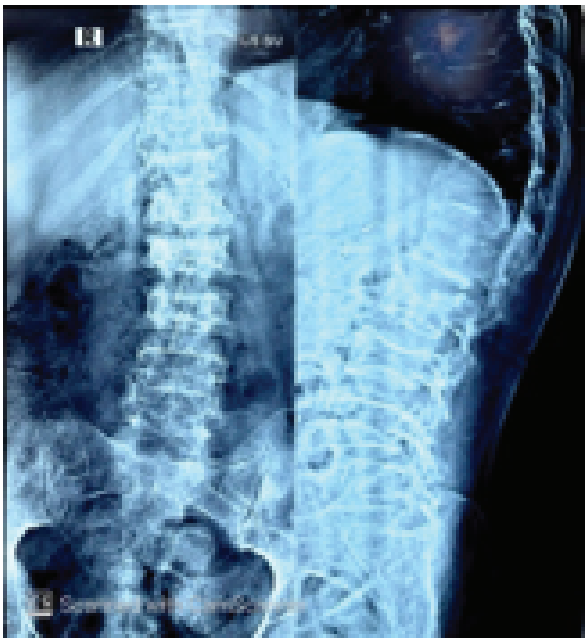

Figure 4: *Plain anteroposterior and lateral radiograph of the lumbosacral spine demonstrating severe, diffuse osteopenia and multiple biconcave, "codfish" vertebral compression fractures, correlating with her 2-inch height loss.*

Due to acute financial constraints, a formal dual-energy x-ray absorptiometry (DEXA) scan to quantify bone mineral density and a short synacthen (ACTH stimulation) test to map her exact adrenal reserve could not be executed. However, her clinical presentation of severe, recurrent withdrawal-induced hemodynamic instability and vomiting provided clear evidence of profound adrenocortical insufficiency.

The immediate management strategy required stabilizing her severe systemic pathologies while avoiding an acute adrenal crisis. She was maintained on her baseline morning dose of Dexamethasone 15 mg OD, with a structured plan for an extremely gradual, long-term endocrinological taper once her acute joint inflammation was under control. To aggressively target her severe hyperuricemia and prevent further tophaceous deposition, she was started on Febuxostat 80 mg OD. For her severe steroid-induced osteoporosis, she was prescribed Alendronic acid 70 mg combined weekly with vitamin D3 2800 IU, alongside Rabeprazole 20 mg OD for gastric cytoprotection. Unfortunately, the patient did not return for her scheduled follow-up appointments and was lost to further monitoring.

Discussion

This case illustrates the extreme, combined clinical toll of iatrogenic Cushing's syndrome, secondary adrenal insufficiency, and steroid-induced osteoporosis (SIO), which directly masked advanced chronic tophaceous gout. A daily intake of 15 mg of dexamethasone is a massive dose, approximately equivalent to 100 mg of prednisone per day. Glucocorticoids administered at this magnitude for over a decade completely suppress the paraventricular nucleus of the hypothalamus and the anterior pituitary gland, inducing profound atrophy of the adrenal cortex.[3] The patient's recurring presentation of severe vomiting, vertigo, and agonizing rebound pain upon withdrawal represents classic, dangerous clinical features of secondary adrenal insufficiency.[4]

Simultaneously, chronic glucocorticoid exposure stands as the primary iatrogenic driver of secondary osteoporosis. Glucocorticoids directly accelerate osteocyte and osteoblast apoptosis while upregulating RANK-ligand expression, triggering an initial phase of aggressive bone resorption followed by a permanent halt in bone formation.[5] This pathophysiology is vividly displayed in the patient's spine radiograph, showing classic "codfish" vertebral deformities and multiple compression fractures that cost the patient two inches of height.

The most unique aspect of this case is how these massive steroid doses interacted with her

underlying, unmanaged chronic tophaceous gout. Gout is a metabolic disease characterized by the systemic deposition of monosodium urate (MSU) crystals. While high-dose dexamethasone effectively shut down the acute, neutrophilic inflammatory cascades that cause painful gouty flares, it exerted zero impact on the severe hyperuricemia itself. As a result, her serum uric acid climbed to a critically high level of 13 mg/dL, facilitating relentless, silent crystal deposition directly into the joints and soft tissues. This produced the advanced, asymmetric joint destruction and prominent tophi seen on her hands and feet, as well as the prominent calcified tophaceous masses noted on her knee radiograph. Glucocorticoid induced diabetes mellitus (GIDM) is another concern that had menifested in our patient. Age of the patient, type of steroid used, duration and route all play integral part in developing the secondary diabetes. In a research that studied the incidence of GIDM among rheumatic and renal patient, 66.5% study subjects developed diabetes over a course of four weeks.[6] They have postulated that, for such patients with long term steroid use, age and estimated glomerular filtration rate are important predictors of GIDM.

In many low- and middle-income countries, including resource-limited regions of Bangladesh, potent steroids are frequently dispensed without a valid prescription or taken continuously by patients without laboratory monitoring.[7] When financial barriers prevent confirmatory gold-standard diagnostics—such as DEXA scans or ACTH stimulation testing—clinicians must rely entirely on precise physical examinations, baseline biochemistry, and classic radiographic features to direct life-saving care. It is mandatory to take responsibility of prescribing glucocorticoids in right causes, for right duration and in right dose. This is crucial to maintain steroid stewardship and make it a prescription-only medication to avoid catastrophic clinical outcome like this case.[8]

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Ad-din Sakina Women's Medical College
Pulerhat,Jashore, Bangladesh.
Phone: +880421-68808, E-mail:www.asmc.addinmedical.org