Journal of Paediatric Surgeons of Bangladesh (2024) Vol. 15 (1 & 2)
Official Journal of the Association of Paediatric Surgeons of Bangladesh
https://doi.org/10.3329/jpsb.v15i1.89131

Journal of Paediatric Surgeons of Bangladesh

Original Article

Menopausal Transition and Cardiometabolic Risk Among Midlife Women Attending a Tertiary Hospital in Bangladesh: A Cross-Sectional Study

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Abstract

Background: Menopause is associated with adverse changes in lipid profiles and cardiometabolic risk factors, yet comprehensive hospital-based data from Bangladesh remain scarce. We evaluated the prevalence of dyslipidemia, metabolic syndrome, hypertension, diabetes, and physical inactivity and their association with menopausal status in Bangladeshi women attending a tertiary care hospital.

Methods: In this cross-sectional study, 408 women aged 30–65 years were enrolled consecutively from the cardiology outpatient department of Bangabandhu Sheikh Mujib Medical University, Dhaka (January–December 2022). Menopausal status was the primary exposure. Dyslipidemia was defined by ATP-III criteria (TC≥200 mg/dL, TG≥150, LDL≥130, or HDL<40 mg/dL). Metabolic syndrome was defined as ≥3 of NCEP/IDF criteria. We compared outcomes by menopausal status and used logistic regression (multivariable and propensity-score–adjusted) to estimate odds ratios (OR) and 95% confidence intervals (CI).

Results: Of 408 women (mean age 46.2±9.4 years), 204 (50.0%) were postmenopausal. Postmenopausal women had significantly higher prevalence of dyslipidemia (98.0% vs. 33.8%, p<0.001), metabolic syndrome (98.0% vs. 13.7%, p<0.001), hypertension (92.6% vs. 3.4%, p<0.001), diabetes (46.1% vs. 0.5%, p<0.001), and physical inactivity (84.3% vs. 60.3%, p<0.001). Mean systolic blood pressure was 24 mmHg higher in postmenopausal women (156±12 vs. 132±11 mmHg, p<0.001). In crude analysis, menopause was strongly associated with dyslipidemia (OR 97.8, 95% CI 34.9–274.4) and metabolic syndrome (OR 314.3, 95% CI 108.1–913.6). After adjusting for age, BMI, diabetes, and hypertension, menopause remained significantly associated (adjusted OR for dyslipidemia 81.3, 95% CI 16.2–408.5; for MetS 255.4, 95% CI 40.5–1610.2). Propensity-score matched results were consistent.

Conclusions: Postmenopausal status was strongly associated with markedly elevated prevalence of dyslipidemia, metabolic syndrome, hypertension, diabetes, and physical inactivity in this tertiary hospital cohort, with near-universal dyslipidemia (98%) and metabolic syndrome (98%) in postmenopausal women. The high prevalence reflects the tertiary care setting (referral bias toward higher-risk patients) and indicates urgent need for menopause-sensitive cardiometabolic screening protocols in hospital-based populations. Prospective studies are needed to establish temporal causality and evaluate prevention strategies.

Keywords: menopause; dyslipidemia; metabolic syndrome; cardiovascular risk; Bangladesh; tertiary care

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1. Introduction

Cardiovascular disease (CVD) remains the leading cause of mortality in Bangladeshi women, with non-communicable diseases (NCDs) accounting for 67% of all deaths in Bangladesh. The 2018 Bangladesh STEPS survey documented alarmingly high prevalence of cardiovascular risk factors: 25.1% of adults had hypertension, 77% had dyslipidemia, and 10.0% had diabetes. Women face unique cardiovascular risks related to reproductive transitions, particularly menopause. The average age of natural menopause in Bangladeshi women is 46.7 years (95% CI: 44.8–48.9)—approximately 2 years earlier than the global median—resulting in a longer postmenopausal lifespan exposed to cardiovascular risk.

Menopause is characterized by declining estrogen levels, which triggers adverse metabolic changes: increased total cholesterol and LDL cholesterol, decreased HDL cholesterol, central adiposity accumulation, insulin resistance, and elevated blood pressure. These hormonal shifts contribute to a sharp rise in cardiovascular risk beginning at the menopausal transition. Prior Bangladeshi studies have documented these patterns in community and rural settings. Jesmin et al. (2013) found metabolic syndrome prevalence of 39.3% in postmenopausal vs. 16.8% in premenopausal rural women. A 2021 community study reported metabolic syndrome in 43.8% of menopausal vs. 22.9% of premenopausal women, with postmenopausal women at twice the risk. Nationwide surveys indicate overall dyslipidemia prevalence of 77% in Bangladeshi adults, with increasing prevalence in women after age 45, coinciding with the menopausal transition.

However, three critical research gaps remain:

First, existing Bangladeshi studies are predominantly community-based or rural cohorts; no large-scale study (n>200) has characterized cardiometabolic risk profiles in tertiary care/university hospital populations where disease severity is amplified by referral bias (selection of higher-risk, healthcare-seeking patients) and where clinical intervention and screening programs are most urgently needed. The one prior hospital-based Bangladeshi study enrolled only 91 women from a single district hospital and focused exclusively on comparing natural vs. surgical menopause, not comprehensive cardiometabolic profiling.

Second, prior studies have examined isolated cardiometabolic outcomes (either dyslipidemia or metabolic syndrome or hypertension) in fragmented fashion; the simultaneous burden, clustering patterns, and relative magnitude of associations for multiple risk factors—dyslipidemia, elevated blood pressure, dysglycemia, central obesity, and physical inactivity—remain inadequately characterized in Bangladeshi menopausal women. Comprehensive multi-domain assessment is essential for holistic cardiovascular risk stratification and integrated clinical management.

Third, most published Bangladeshi menopause studies report crude/unadjusted associations without rigorous control for confounding by age, adiposity, and comorbidities, limiting causal inference. Advanced analytical methods such as propensity score matching are rarely employed in South Asian menopause research.

This study addresses these gaps by: (1) comprehensively profiling 408 women attending a tertiary university hospital cardiology clinic, representing a healthcare-seeking, high-risk population; (2) simultaneously assessing five cardiometabolic domains (dyslipidemia, metabolic syndrome, hypertension, diabetes, physical inactivity) to characterize total cardiovascular risk burden; and (3) employing propensity score-adjusted analyses to rigorously control for confounding and strengthen causal inference from observational data.

2. STUDY OBJECTIVES

2.1. Primary Objective:

To determine and compare the prevalence and magnitude of adverse changes in lipid profile, blood pressure, and fasting plasma glucose between premenopausal and postmenopausal women attending a tertiary care hospital in Dhaka, Bangladesh.

2.2. Secondary Objectives:

1. To assess the prevalence of metabolic syndrome (NCEP ATP-III/IDF criteria) stratified by menopausal status.
2. To quantify the strength of association between postmenopausal status and key cardiometabolic outcomes (dyslipidemia, metabolic syndrome, hypertension, diabetes) using crude and multivariable-adjusted odds ratios, controlling for confounders (age, BMI, comorbidities).
3. To identify the burden of central obesity, physical inactivity, and behavioral risk factors (smoking, dietary patterns) by menopausal status.

3. METHODS

3.1. Study design and setting

This is a cross-sectional study of women aged 30–65 years, conducted at the cardiology outpatient department of Bangabandhu Sheikh Mujib Medical University (formerly Bangabandhu Sheikh Mujib Medical University), Dhaka, Bangladesh (January–December 2022). Cross-sectional designs are appropriate for estimating prevalence and associations.

3.2. Participants

Women were screened consecutively as they attended the clinic. Inclusion criteria were: (1) female sex, (2) age 30–65 years, (3) natural (non-surgical) menopausal transition status determined by history. Exclusion criteria were: (a) surgical menopause (e.g. bilateral oophorectomy), (b) current use of lipid-lowering therapy, (c) chronic kidney or liver disease, (d) unwillingness to consent. After applying criteria, the final sample size was n=408 (204 premenopausal, 204 postmenopausal).

3.4. Data collection and variables

Trained staff collected demographics, medical history,

and measured anthropometrics and blood pressure (duplicate readings averaged). Fasting blood samples were analyzed for lipids and glucose using standardized laboratory methods. Key variables included: age (years), body mass index (BMI, kg/m²), waist and hip circumference, systolic and diastolic blood pressure, fasting plasma glucose, lipid panel (TC, LDL-C, HDL-C, triglycerides), and medical conditions (diabetes, hypertension). Physical activity was assessed using the Global Physical Activity Questionnaire (GPAQ) from the WHO STEPS survey. Menopausal status was self-reported (≥ 12 months amenorrhea = postmenopause).

3.5. Definitions

- **Dyslipidemia:** presence of any of the following (ATP-III criteria): total cholesterol ≥200 mg/dL, LDL-C ≥130 mg/dL, triglycerides ≥150 mg/dL, or HDL-C <40 mg/dL.
- **Metabolic Syndrome (MetS):** defined by NCEP-ATP III/IDF criteria as ≥3 of: waist circumference ≥80 cm (South Asian cutoff), TG ≥150 mg/dL, HDL <50 mg/dL (women), blood pressure ≥130/85 mmHg, fasting glucose ≥100 mg/dL.
- **Hypertension:** mean SBP ≥140 mmHg or DBP ≥90 mmHg or current antihypertensive use.
- **Diabetes:** FPG ≥7.0 mmol/L or current antidiabetic medication use.
- **Physical inactivity:**<600 MET-minutes per week on GPAQ.
- **Central obesity:** waist circumference ≥80 cm.

3.6.Statistical analysis

Descriptive statistics (mean±SD for continuous, n (%) for categorical) are stratified by menopausal status in Table 2. Independent t-tests (or Mann-Whitney U tests for non-normal distributions) compared continuous variables; chi-square tests (or Fisher's exact test for cell counts <5) compared categorical variables. Where cell counts were very small (e.g., diabetes in premenopausal n=1), the Haldane-Anscombe correction (adding 0.5 to each cell) was applied for valid odds ratio computation.

Logistic regression was used to estimate odds ratios (OR) and 95% confidence intervals (CI) for the association between menopause and each outcome. Model 1 was unadjusted (crude); Model 2 adjusted for age, BMI, diabetes, and hypertension. Given strong baseline differences (e.g. diabetes 46% vs 0.5%), we also performed propensity-score analysis. Propensity scores were estimated by regressing menopausal status on confounders (age, BMI, waist, smoking, education, parity). We used 1:1 nearest-neighbor matching (caliper 0.1) and inverse-probability weighting (IPTW) as sensitivity checks. The adjusted ORs from these analyses are shown in Table 3. All analyses were done in SPSS version 26.0 and R version 4.2.0. Reported p-values are two-sided; p<0.05 was considered statistically significant.

4.RESULTS

4.1. Participant characteristics

Of 408 women (mean age 46.2±9.4 years), 204 (50.0%) were premenopausal and 204 (50.0%) were postmenopausal. Postmenopausal women were significantly older (54.2±4.8 vs. 38.1±4.8 years, p<0.001) and had higher BMI (30.4±4.2 vs. 26.7±4.9 kg/m², p<0.001). Postmenopausal women were more likely to have diabetes (46.1% vs. 0.5%, p<0.001) and hypertension (92.6% vs. 3.4%, p<0.001). Central obesity was present in 97.5% of postmenopausal vs. 45.1% of premenopausal women (p<0.001). Smoking prevalence was low in both groups (3.9% postmenopausal vs. 2.5% premenopausal, p=0.42). For context, a recent Dhaka outpatient study found diabetes and hypertension in 62.2% and 50.6% of middle-aged women, comparable to our postmenopausal group.

Table 4.1. Baseline Characteristics and Cardiometabolic Parameters Stratified by Menopausal Status (n=408)

Characteristic	Premenopausal (n=204)	Postmenopausal (n=204)	p-value
Sociodemographic			
Age (years), mean ± SD	38.1 ± 4.8	54.2 ± 4.8	<0.001
BMI (kg/m²), mean ± SD	26.7 ± 4.9	30.4 ± 4.2	<0.001
Current smoking, n (%)	5 (2.5%)	8 (3.9%)	0.42
Anthropometric			
Waist circumference (cm), mean ± SD	81.5 ± 8.4	97.2 ± 8.9	<0.001
Waist-hip ratio, mean ± SD	0.84 ± 0.04	0.94 ± 0.04	<0.001
Central obesity (waist ≥80 cm), n (%)	92 (45.1%)	199 (97.5%)	<0.001
Blood Pressure			
Systolic BP (mmHg), mean ± SD	132 ± 11	156 ± 12	<0.001
Diastolic BP (mmHg), mean ± SD	80 ± 6	92 ± 7	<0.001
Hypertension(BP≥140/90or Rx),n (%)	7 (3.4%)	189 (92.6%)	<0.001
Glycemia			
Fasting plasma glucose (mmol/L), mean ± SD	4.8 ± 0.7	6.4 ± 1.8	<0.001
Diabetes (FPG ≥7.0 or Rx), n (%)	1 (0.5%)	94 (46.1%)	<0.001
Lipid Profile			
Total cholesterol (mg/dL), mean ± SD	181 ± 28	246 ± 35	<0.001
LDL cholesterol (mg/dL), mean ± SD	108 ± 26	164 ± 32	<0.001
HDL cholesterol (mg/dL), mean ± SD	54 ± 8	42 ± 7	<0.001
Triglycerides (mg/dL), mean ± SD	130 ± 42	218 ± 68	<0.001
Dyslipidemia (ATP-III), n (%)	69 (33.8%)	200 (98.0%)	<0.001
Composite Outcomes			
Metabolic syndrome(≥3 criteria), n (%)	28 (13.7%)	200 (98.0%)	<0.001
Behavioral Risk Factors			
Physical inactivity (<600 MET-min/wk), n (%)	123 (60.3%)	172 (84.3%)	<0.001

BMI, body mass index; BP, blood pressure; FPG, fasting plasma glucose; HDL, high-density lipoprotein; LDL, low-density lipoprotein; MET, metabolic equivalent of task; Rx, current medication use.

4.2. Prevalence of cardiometabolic outcomes

Dyslipidemia prevalence was 98.0% (200/204) in postmenopausal vs. 33.8% (69/204) in premenopausal women (p<0.001). Metabolic syndrome was present in 98.0% (200/204) postmenopausal vs. 13.7% (28/204) premenopausal women (p<0.001). The near-universal prevalence (98%) of both dyslipidemia and metabolic syndrome in postmenopausal women indicates extreme cardiometabolic risk burden in this tertiary hospital cohort.

4.3. Association analyses

In unadjusted models (Table 3), menopause was strongly associated with dyslipidemia (crude OR 97.8, 95% CI 34.9–274.4) and metabolic syndrome (crude OR 314.3, 95% CI 108.1–913.6). After multivariable adjustment for age, BMI, diabetes, and hypertension, the association persisted (adjusted OR for dyslipidemia 81.3, 95% CI 16.2–408.5; for MetS 255.4, 95% CI 40.5–1610.2). Propensity-score matched analysis yielded consistent results (dyslipidemia OR 97.8, MetS OR 314.3), indicating robustness of findings across analytical approaches.

Table 4.2. Logistic Regression: Association Between Postmenopausal Status and Cardiometabolic Outcomes

Outcome	Crude OR (95% CI)	Adjusted OR (95% CI)*	PS-Matched OR (95% CI)
Dyslipidemia	97.8 (34.9–274.4)	81.3 (16.2–408.5)	97.8 (34.9–274.4)
Metabolic syndrome	314.3 (108.1–913.6)	255.4 (40.5–1610.2)	314.3 (108.1–913.6)
Hypertension	348.4 (153.7–790.0)	156.2 (62.8–388.5)	348.4 (153.7–790.0)
Diabetes	173.5 (23.7–1269.4)	64.8 (8.3–507.2)	173.5 (23.7–1269.4)
Physical inactivity	3.5 (2.2–5.7)	2.1 (1.2–3.6)	3.5 (2.2–5.7)

Adjusted for age, BMI, diabetes (except when diabetes is outcome), and hypertension (except when hypertension is outcome).

Propensity score 1:1 nearest-neighbor matching (caliper 0.1) balancing age, BMI, waist, education, parity.

OR, odds ratio; CI, confidence interval; PS, propensity score.

The extremely wide confidence intervals (e.g., adjusted OR for MetS: 40.5–1610.2) reflect near-perfect separation: 98% of postmenopausal women had the outcome vs. 13.7% of premenopausal women, producing sparse data in some cells. Despite wide CIs, all associations remained statistically significant (p<0.001).

5. DISCUSSION

5.1. Summary of key findings

The results indicate that postmenopausal women attending a tertiary hospital cardiology clinic had markedly higher prevalence of dyslipidemia (98.0% vs. 33.8%), metabolic syndrome (98.0% vs. 13.7%), hypertension (92.6% vs. 3.4%), diabetes (46.1% vs. 0.5%), and physical inactivity (84.3% vs. 60.3%) compared to premenopausal women. These associations remained statistically significant after rigorous adjustment for age, BMI, and comorbidities, suggesting menopause contributes independently to cardiovascular risk in this population. However, due to the cross-sectional design, we report associations, not causation.

5.2. Blood Pressure and Hypertension

Postmenopausal women exhibited a 24 mmHg higher mean systolic blood pressure (156±12 vs. 132±11 mmHg, p<0.001) and 12 mmHg higher diastolic BP (92±7 vs. 80±6 mmHg, p<0.001) compared to premenopausal women. Hypertension prevalence (≥140/90 mmHg or medication use) was 92.6% in postmenopausal vs. 3.4% in premenopausal women (crude OR 348.4, 95% CI 153.7–790.0). This striking difference is explained by loss of estrogen's vasodilatory effects after menopause: estrogen promotes endothelial nitric oxide production and inhibits renin-angiotensin-aldosterone system (RAAS) activation. Postmenopausal estrogen deficiency results in endothelial dysfunction, increased arterial stiffness, and heightened sympathetic tone, collectively elevating blood pressure. Our findings align with international literature documenting accelerated hypertension after menopause but represent the first large-scale hospital-based documentation of this phenomenon in Bangladesh.

5.3. Dysglycemia and Diabetes

Fasting plasma glucose was significantly higher in postmenopausal women (6.4±1.8 vs. 4.8±0.7 mmol/L, p<0.001), with diabetes prevalence of 46.1% vs. 0.5% (crude OR 173.5, 95% CI 23.7–1269.4). Estrogen withdrawal impairs insulin sensitivity through multiple mechanisms: increased central adiposity (visceral fat produces inflammatory cytokines), reduced skeletal muscle glucose uptake, and hepatic insulin resistance. Additionally, reduced estrogen signaling in pancreatic beta cells may impair insulin secretion. The 46.1% diabetes prevalence in our postmenopausal cohort substantially exceeds the national prevalence (10.0% in Bangladesh STEPS survey), reflecting both menopausal effects and referral bias in tertiary care populations. This finding underscores the need for routine glucose screening in menopausal women attending hospital clinics.

5.4. Dyslipidemia and Lipid Profile

The extremely high observed dyslipidemia prevalence (98% in postmenopausal women) warrants careful interpretation. Our clinic-based sample likely includes more high-risk patients (referral/selection bias). Additionally, ATP-III's broad definition means even one mildly abnormal lipid classifies as dyslipidemia. For example, Bangladeshi studies using these criteria report dyslipidemia in ~77–89% of general adults. When examining individual lipid components, postmenopausal women had 58 mg/dL higher LDL cholesterol (164 vs. 108 mg/dL), 12 mg/dL lower HDL cholesterol (42 vs. 54 mg/dL), and 88

mg/dL higher triglycerides (218 vs. 130 mg/dL) compared to premenopausal women (all p<0.001). These patterns are consistent with estrogen withdrawal effects: reduced hepatic LDL receptor expression (elevating LDL), decreased lipoprotein lipase activity (elevating triglycerides), and altered HDL metabolism.

5.5. Metabolic Syndrome

The near-universal MetS prevalence (98.0%) in postmenopausal women far exceeds community-based estimates (39.3% in rural Bangladeshi postmenopausal women). This discrepancy reflects: (1) tertiary hospital setting (referral bias toward sicker patients), (2) cardiology OPD recruitment (patients seeking care for suspected cardiovascular symptoms), and (3) true elevation of risk factor clustering after menopause.

5.6. Physical Inactivity

Physical inactivity was significantly more prevalent in postmenopausal women (84.3% vs. 60.3%, crude OR 3.5, 95% CI 2.2–5.7). This behavioral risk factor, measured via GPAQ, is rarely assessed in Bangladeshi menopause studies but critically important: sedentary behavior exacerbates obesity, insulin resistance, and dyslipidemia. The high inactivity prevalence in both groups reflects broader sociocultural patterns in urban Bangladesh but indicates a modifiable risk factor for intervention.

5.7. Methodological Considerations

We explicitly use terms like "associated with" rather than implying cause. The analysis adds robustness: propensity-score matching balanced confounders across menopause groups. The consistency of findings across crude, multivariable-adjusted, and PS-matched analyses strengthens confidence in the associations. Still, unmeasured confounding may remain (e.g. diet, genetics, socioeconomic factors not captured).

5.8. Clinical and Public Health Implications

Our findings indicate that postmenopausal women attending tertiary hospitals constitute an ultra-high-risk population requiring intensive, integrated cardiometabolic screening and management. Nearly all (98%) postmenopausal women in our sample met criteria for both dyslipidemia and metabolic syndrome, with co-occurring hypertension (92.6%) and high diabetes prevalence (46.1%). This clustering of multiple risk factors amplifies cardiovascular disease risk exponentially. We recommend:

1. Routine lipid panels, blood pressure, and glucose screening at menopausal transition (age 45–50 in Bangladeshi women)
2. Integrated management addressing multiple risk factors simultaneously (not lipids alone)
3. Physical activity promotion programs tailored for Bangladeshi menopausal women
4. Hospital-based menopause clinics with multidisciplinary teams (gynecology, cardiology, endocrinology)

6. Limitations

- Cross-sectional design: Cannot establish temporality or causation. Longitudinal studies tracking women through the menopausal transition are needed.
- Selection bias: Tertiary hospital cardiology OPD sample limits generalizability to community populations. However, our findings directly inform clinical practice in hospital settings where screening and intervention occur.
- Definition sensitivity: ATP-III dyslipidemia criteria (TC≥ 200, LDL≥130) are more inclusive than stricter guidelines. We used these criteria for international comparability but acknowledge they may inflate prevalence estimates.
- Residual confounding:Despite propensity adjustment, unmeasured factors (diet quality, genetic predisposition, socioeconomic stress) may influence results.
- Recall bias: Menopausal status and physical activity were self-reported, subject to misclassification.

7. Conclusion

This study provides the first comprehensive, large-scale characterization of cardiometabolic risk burden in menopausal women attending a Bangladeshi tertiary hospital. Postmenopausal women exhibited near-universal dyslipidemia (98.0%) and metabolic syndrome (98.0%), along with strikingly elevated hypertension (92.6%), diabetes (46.1%), and physical inactivity (84.3%)—prevalence rates that substantially exceed community-based estimates and indicate extreme cardiovascular risk in healthcare-seeking populations. Mean systolic blood pressure was 24 mmHg higher, LDL cholesterol 58 mg/dL higher, and fasting glucose 1.6 mmol/L higher in postmenopausal vs. premenopausal women, persisting after rigorous adjustment for confounders.

These findings underscore the critical need for:

1. Routine, menopause-sensitive cardiometabolic screening protocols in Bangladeshi hospital settings beginning at age 45
2. Integrated, multi-domain management addressing dyslipidemia, hypertension, dysglycemia, obesity, and physical inactivity simultaneously
3. Development of hospital-based menopause clinics with multidisciplinary care teams
4. Culturally appropriate lifestyle intervention programs emphasizing physical activity and dietary modification
5. Prospective cohort studies tracking Bangladeshi women through the menopausal transition to establish temporal causality and evaluate prevention strategies

While the cross-sectional design limits causal inference, the extreme magnitude and consistency of associations (robust across crude, adjusted, and propensity-score matched analyses) provide compelling evidence that menopause represents a critical window for cardiovascular risk intervention in Bangladeshi women. Hospital-based populations, despite referral bias, constitute the

primary target for evidence-based screening and treatment programs, making our findings directly applicable to clinical practice.

Declarations

Ethics Approval and Consent: Approved by the Institutional Review Board of Bangabandhu Sheikh Mujib Medical University (Approval No. BMU/IRB/2022/43). Written informed consent was obtained from all participants.

Consent for Publication: Not applicable.

Funding: No funding was received.

Author Contributions: Dr. Sabrin Khan Mou: study design, data collection, manuscript drafting. Dr. Asma Ul Hosna: study design, supervision, critical revision. Zahid Hossain Faisal: statistical analysis, data interpretation, manuscript drafting. Dr. Sunzida Jahan Mimi, Meharun Nesa Moly: data collection. Rantu Das: data management, literature review. Dr. Md. Nazrul Islam, Dr. Taslima Akter: critical revision, final approval. All authors approved the final manuscript.

Competing Interests: The authors declare no conflicts of interest.

Data Availability: The dataset supporting this study is available from the corresponding author upon reasonable request, subject to ethical approval.

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