Original Research Article

https://doi.org/10.53339/aimdr.2026.12.1.1
E-ISSN: 2395-2822 | P-ISSN: 2395-2814

Distribution of metabolic syndrome components and their relationship with angiographic severity in non-ST elevation myocardial infarction

Md. Aminul Haque[1], Syeda Aleya Sultana[2], Mohammad Abdul Malek[3], Md. Wali-Ur-Rahman[3], Abu Yousuf Md. Shahidul Alam[1], Mst. Zinat Ara[4]

[1]Department of Medicine and Cardiology, Combined Military Hospital, Dhaka, Bangladesh, [2]Department of Medicine and Cardiology, Combined Military Hospital, Dhaka, Bangladesh, [3]Department of Medicine and Cardiology, Combined Military Hospital, Dhaka, Bangladesh, [4]Department of Obstetrics and Gynaecology, Kurmitola General Hospital, Dhaka, Bangladesh

Address for correspondence: Md. Aminul Haque, Department of Medicine and Cardiology, Combined Military Hospital, Dhaka, Bangladesh. E-mail: mahaque_dr@yahoo.com

Abstract

Background: Metabolic syndrome (MetS) is now well acknowledged as a major contributor to the severity of coronary artery disease (CAD). This study examined the correlation between MetS and the angiographic burden of CAD in individuals with non-ST elevation myocardial infarction (NSTEMI).

Methods: A cross-sectional study was carried out involving 192 NSTEMI patients who underwent coronary angiography at a tertiary cardiac center located in Bangladesh. Patients were divided into two groups: MetS ($n = 96$) and non-MetS ($n = 96$). The severity of angiographic findings was assessed using the vessel score, total stenosis score (TSS), and extension score (ES). Correlation and multivariable regression analyses were conducted to determine the predictors of CAD burden.

Results: The MetS group had significantly higher mean vessel score (2.12 vs. 1.66; $P < 0.001$), TSS (9.26 vs. 6.06; $P < 0.001$), and ES (53.7% vs. 39.1%; $P < 0.001$). Triple vessel disease and high-burden lesions were markedly more prevalent in MetS patients. Waist circumference, elevated blood pressure, triglycerides, and low high-density lipoprotein-cholesterol independently predicted CAD burden. MetS score correlated positively with all angiographic severity indices.

Conclusion: MetS is strongly associated with greater angiographic severity of CAD in NSTEMI, underscoring its role as a key modifiable risk cluster. Addressing MetS may be critical in preventing severe coronary outcomes.

Keywords: Angiographic burden, cardiovascular risk, coronary artery disease, metabolic syndrome, non-ST elevation myocardial infarction

Introduction

Coronary artery disease (CAD) is the primary cause of morbidity and mortality worldwide, posing the greatest clinical and economic burden in cardiovascular medicine. According to the World Health Organization, cardiovascular illnesses account for almost 18 million fatalities each year, representing approximately one-third of global deaths, with CAD alone accounting to over 9 million deaths.[1] While the burden of CAD was previously concentrated in high-income nations, low- and middle-income countries today bear over 75% of worldwide cardiovascular mortality, demonstrating a major epidemiological transformation driven by urbanization, aging

populations, and lifestyle changes.[2] Bangladesh, like many South Asian countries, is experiencing a rapid rise in CAD incidence, despite traditionally lower historical prevalence – suggesting a shift in risk factor exposure and public health priorities.

Acute clinical symptoms of CAD are usually classified as acute coronary syndromes (ACSs), which include unstable angina, non-ST-elevation myocardial infarction (NSTEMI), and ST-elevation myocardial infarction (STEMI). Globally, the proportional burden of ACS subtypes has shifted significantly, with NSTEMI now surpassing STEMI in numerous countries, including South Asia.[3] This trend has been attributed to population aging, improved early recognition of myocardial ischemia, and the clustering of cardiometabolic risk factors in urbanized populations.[4] Despite often having lower early in-hospital mortality, NSTEMI patients experience higher long-term mortality, increased rates of recurrent ischemia, and greater healthcare utilization than their STEMI counterparts.[5] This evolving disease profile necessitates a refined understanding of upstream determinants of CAD severity, especially within resource-constrained healthcare systems where risk stratification is pivotal.

One key variable receiving increased attention is the metabolic syndrome (MetS), a collection of interrelated risk factors that raise the likelihood of atherosclerotic cardiovascular disease and Type 2 diabetes. MetS is clinically defined as the presence of central (abdominal) obesity, hypertension, elevated fasting plasma glucose, increased triglycerides, and decreased high-density lipoprotein (HDL) cholesterol, according to the harmonized criteria established by the International Diabetes Federation (IDF) and other international organizations.[6] Globally, approximately 20–25% of the adult population meets diagnostic criteria for MetS.[7] However, the burden is disproportionately high in South Asian populations, including Bangladesh, where the prevalence ranges between 25 and 40%, with even higher rates in urban centers.[8] These trends are fueled by rapid urbanization, nutritional transitions, sedentary lifestyles, and genetic predisposition to visceral adiposity even at lower body mass indices.[9]

Beyond epidemiologic associations, a compelling biological rationale links MetS to both the development and severity of CAD. The pathophysiology of MetS promotes an atherogenic environment through insulin resistance, which impairs endothelial nitric oxide production, leading to endothelial dysfunction, impaired vasodilation, and vascular remodeling.[10] Concurrently, the chronic low-grade inflammatory state in MetS, characterized by elevated cytokines such as interleukin-6 and C-reactive protein, facilitates plaque formation and destabilization.[11] Dyslipidemia – particularly hypertriglyceridemia and reduced HDL-C – further contributes to a pro-atherogenic lipid milieu, while hyperglycemia and oxidative stress promote vascular smooth muscle proliferation and intimal thickening.[12] Moreover, a prothrombotic state, marked by increased fibrinogen and plasminogen activator inhibitor-1, predisposes MetS patients to acute thrombotic events. These pathophysiological changes collectively predispose individuals with MetS not only to higher CAD incidence but also to more severe and diffuse coronary atherosclerosis, as reflected in higher angiographic vessel scores and stenosis burden.[13]

Despite the growing recognition of MetS as a cardiovascular risk amplifier, data remain sparse regarding its impact on angiographic severity among patients presenting with NSTEMI in South Asian contexts, particularly in Bangladesh. Most available studies have either pooled diverse ACS populations or focused on Western cohorts, limiting regional applicability. Given the unique ethnic risk factor profiles, younger age at presentation, and resource limitations in South Asian cardiac care, such data are crucial for improving risk stratification, treatment prioritization, and secondary prevention strategies. This study, therefore, aims to evaluate the association between MetS and angiographic burden of CAD among patients presenting with NSTEMI in a tertiary care center in Bangladesh, thereby addressing a critical gap in cardiovascular epidemiology in the region.

Methods

This 12-month cross-sectional study was carried out in the Department of Cardiology at the National Heart Foundation Hospital and Research Institute (NHFH&RI) in Dhaka, Bangladesh. Purposive sampling was used to enroll patients who were admitted with NSTEMI and underwent coronary angiography (CAG) during their index hospitalization. A priori, the sample size was calculated to be 96 members per group (n = 192). Patients were separated into two groups: Group I (NSTEMI with MetS) and Group II (NSTEMI without MetS). Patients with NSTEMI of either gender who underwent CAG during admission met the inclusion criteria. Exclusion criteria were STEMI or unstable angina, past ACS, prior percutaneous coronary intervention/Coronary artery bypass grafting, severe hepatic/renal disease preventing CAG, refusal of CAG, and NSTEMI with congenital/valvular cardiac disease, cardiomyopathy, or severe systemic sickness. NSTEMI was characterized by ischemic electrocardiogram abnormalities (ST-segment depression ≥0.05 mV or T-wave inversion ≥0.2 mV) and/or positive troponin levels in the absence of ST elevation. All participants underwent a clinical evaluation, anthropometric measurements (height, weight, waist circumference, blood pressure), and assessment of cardiovascular risk factors (smoking, diabetes, hypertension, dyslipidemia, obesity, family history of CAD). Echocardiography and laboratory tests (lipid profile, fasting blood sugar, troponin I, CK-MB, serum creatinine) were carried out. MetS was diagnosed using the IDF, 2006 criteria – central obesity (waist circumference ≥90 cm in males or ≥80 cm in women) plus any two of the following: high triglycerides, low HDL-C, raised blood pressure, or impaired fasting glucose. The Sullivan technique was used to assess angiographic severity, including vessel score (0–3, number of vessels with ≥70% stenosis), total stenosis score (TSS) (sum of eight segments, range 0–32; high burden ≥16), and extension score (ES) (percentage of intimal surface involved, 0–100%; high burden ≥50%). The Academic Council of NHFH&RI provided ethical permission, and data were collected prospectively using a standardized form.

Statistical analysis

The data were analyzed with the Statistical Package for the Social Sciences version 16.0. Continuous variables are shown as mean ± standard deviation, whereas categorical variables are represented as percentages. Group comparisons were made using independent-samples t-tests (continuous) and Chi-square testing (categorical). Correlations were investigated using Spearman's coefficient, and linear regression was used to discover independent predictors of angiographic scores. A two-sided $P < 0.05$ indicated statistical significance.

Results

A total of 192 patients with NSTEMI were included, divided evenly into two groups: Group I (MetS; $n = 96$) and Group II (No MetS; $n = 96$). The MetS group had a substantially higher mean age (58.26 ± 8.7 vs. 52.45 ± 10.9 years; $P < 0.001$) and a greater proportion of persons aged 51–70 years. There was no statistically significant difference in gender distribution between groups; however, males predominated in both (72.9% vs. 81.2%; $P = 0.170$). MetS patients had a considerably higher body mass index (BMI), with a larger proportion falling into the overweight and obese categories. The MetS group had a mean BMI of 25.08 ± 1.53 kg/m^2, compared to 24.08 ± 1.50 kg/m^2 in the non-MetS group ($P < 0.001$). The MetS group had significantly greater waist circumference in both males (96.70 ± 5.06 cm vs. 92.31 ± 5.03 cm; $P < 0.001$) and females (87.81 ± 5.86 cm vs. 82.50 ± 5.82 cm; $P = 0.005$). Notably, all participants in the MetS group showed high waist circumference per IDF criteria, compared to 59.4% in the non-MetS group ($P < 0.001$). The MetS group had significantly higher rates of elevated blood pressure (88.5% vs. 27.1%; $P < 0.001$), diabetes mellitus (75.0% vs. 11.5%; $P < 0.001$), and dyslipidemia (40.6% vs. 26.0%; $P = 0.032$). No statistically significant differences were noted in

smoking status ($P = 0.288$) or in the family history of CAD ($P = 0.848$) across the groups [Table 1].

The assessment of angiographic severity found that patients with MetS had much more severe CAD than those without MetS. The vessel score distribution revealed a higher prevalence of triple vessel disease (TVD) among MetS patients (42.7% vs. 15.6%), whereas single vessel disease (SVD) was more common in the non-MetS group (45.8% vs. 21.9%). Double vascular disease was distributed similarly in both groups (31.2% vs. 36.5%). The MetS group had a substantially higher mean vessel score (2.12 ± 0.89) than the non-MetS group (1.66 ± 0.76; $P < 0.001$), indicating a greater burden of multivessel involvement. MetS

Table 1: Baseline demographic and clinical characteristics of the study population (n=192)

Variable	Group I (MetS, n=96) (%)	Group II (No MetS, n=96) (%)	P-value
Age (years)			
21–30	2 (2.1)	3 (3.1)	
31–40	0 (0.0)	11 (11.5)	
41–50	17 (17.7)	31 (32.3)	
51–60	43 (44.8)	32 (33.3)	
61–70	27 (28.1)	13 (13.5)	
71–80	7 (7.3)	6 (6.2)	
Mean±SD	58.26±8.7	52.45±10.9	<0.001**
Sex			
Male	70 (72.9)	78 (81.2)	0.170
Female	26 (27.1)	18 (18.8)	
BMI (kg/m^2)			
18.5–22.9	10 (10.4)	42 (43.8)	<0.001**
23–24.9	58 (60.4)	41 (42.7)	
25–29.9	27 (28.1)	13 (13.5)	
≥30	1 (1.0)	0 (0.0)	
Mean±SD	25.08±1.53	24.08±1.50	<0.001**
Waist circumference (cm)			
Male (mean±SD)	96.70±5.06	92.31±5.03	<0.001**
Female (mean±SD)	87.81±5.86	82.50±5.82	0.005**
Elevated waist circumference[1]	96 (100)	57 (59.4)	<0.001*
Raised blood pressure	85 (88.5)	26 (27.1)	<0.001*
Diabetes mellitus	72 (75.0)	11 (11.5)	<0.001*
Dyslipidemia	39 (40.6)	25 (26.0)	0.032*
Smoking status			
Current	28 (29.2)	40 (41.7)	0.288
Recent	8 (8.3)	9 (9.4)	
Former	16 (16.7)	13 (13.5)	
Never	44 (45.8)	34 (35.4)	
Family history of CAD	17 (17.7)	16 (16.7)	0.848

[1]Elevated waist circumference defined as≥90 cm in males, ≥80 cm in females. Statistical significance: P≤0.05; P from Chi-square test (), unpaired t-test (**). MetS: Metabolic syndrome, SD: Standard deviation, BMI: Body mass index, CAD: Coronary artery disease

patients reported higher rates of high-burden stenosis (≥16) compared to non-MetS patients (9.4% vs. 1.0%, $P = 0.009$). MetS patients had significantly higher average TSSs (9.26 ± 4.29 vs. 6.06 ± 3.07; $P < 0.001$). Similarly, ES analysis revealed that over half (46.9%) of the MetS group showed substantial coronary involvement (score ≥50), while only 24.0% in the non-MetS group ($P = 0.001$). The MetS group had a significantly higher mean ES (53.70 ± 18.11) compared to the non-MetS group (39.11 ± 17.59; $P < 0.001$), suggesting more widespread atherosclerotic disease [Table 2].Patients with MetS showed a markedly higher prevalence of triple vessel disease (42.7% vs. 15.6%), whereas SVD was more common in the non-MetS group (45.8% vs. 21.9%). Double vessel disease occurred at similar frequencies in both groups (31.2% vs. 36.5%) [Figure 1].

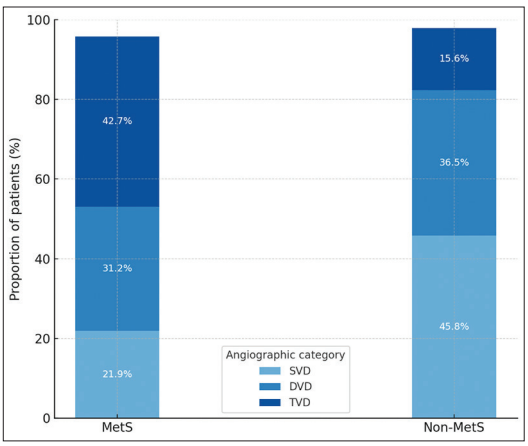

Figure 1: Angiographic severity by group (*n*=192)

The MetS score showed a strong positive connection with all three angiographic severity indices: vessel score (r = 0.202, $P = 0.005$), (TSS; r = 0.330, $P < 0.001$), and (ES; r = 0.349, $P < 0.001$). Waist circumference, triglycerides, total cholesterol, and LDL-C all showed a positive correlation with angiographic burden ($P < 0.05$). In contrast, HDL-C revealed strong inverse relationships with vascular score (r = −0.228), TSS (r = −0.236), and ES (r = −0.244; all $P = 0.001$). Fasting blood sugar had no significant correlation with any angiographic score, although BMI had a slight correlation with TSS (r = 0.169, $P = 0.019$).

In multivariable regression, waist circumference (β = 0.207 for TSS; β = 0.183 for ES), raised blood pressure (β = 0.161 for TSS; β = 0.162 for

Table 2: Angiographic severity of coronary artery disease in the study population (*n*=192)

Angiographic parameter	Group I (MetS, *n*=96) (%)	Group II (No MetS, *n*=96) (%)	*P*-value
Vessel score			
Score 0 (No significant lesion)	4 (4.2)	2 (2.1)	<0.001*
Score 1 (SVD)	21 (21.9)	44 (45.8)	
Score 2 (DVD)	30 (31.2)	35 (36.5)	
Score 3 (TVD)	41 (42.7)	15 (15.6)	
Mean±SD	2.12±0.89	1.66±0.76	<0.001**
Total stenosis score			
<16	87 (90.6)	95 (99.0)	0.009*
≥16	9 (9.4)	1 (1.0)	
Mean±SD	9.26±4.29	6.06±3.07	<0.001**
Extension score			
<50	51 (53.1)	73 (76.0)	0.001*
≥50	45 (46.9)	23 (24.0)	
Mean±SD	53.70±18.11	39.11±17.59	<0.001**

Statistical significance: $P \leq 0.05$; *P* from Chi-square test (), unpaired t-test (**). CAD: Coronary artery disease, SVD: Single vessel disease, DVD: Double vessel disease, TVD: Triple vessel disease, MetS: Metabolic syndrome, SD: Standard deviation

ES), elevated triglycerides (β = 0.164 for TSS; β = 0.146 for ES), and reduced HDL-C (β = −0.152 for TSS; β = −0.157 for ES) were identified as independent predictors of higher angiographic burden (all $P < 0.05$). Diabetes, age, and gender were not independently linked with angiographic severity [Table 3].

MetS score, waist circumference, total cholesterol, LDL-C, and triglycerides demonstrated positive correlations with vessel, stenosis, and ESs, while HDL-C showed consistent inverse correlations across all angiographic indices. Fasting blood sugar and BMI displayed no or only weak associations [Figure 2].

A sensitivity analysis found that patients with MetS had a significantly greater frequency of high-burden CAD at all angiographic thresholds. A TSS of ≥16 was observed in 9.4% of MetS patients

Table 3: Correlation of MetS score and components with angiographic severity, and multivariable predictors of CAD burden (*n*=192)

(A) Correlation coefficients between MetS score/components and angiographic scores			
Variable	**Vessel score r (*P*)**	**TSS r (*P*)**	**ES r (*P*)**
MetS score	0.202 (0.005)	0.330 (<0.001)	0.349 (<0.001)
Waist circumference	0.230 (0.001)	0.248 (0.001)	0.238 (0.001)
Total cholesterol	0.181 (0.012)	0.199 (0.006)	0.202 (0.005)
LDL-C	0.163 (0.024)	0.180 (0.012)	0.165 (0.022)
HDL-C	–0.228 (0.001)	–0.236 (0.001)	–0.244 (0.001)
Triglyceride	0.179 (0.013)	0.241 (0.001)	0.219 (0.002)
Fasting blood sugar	–0.053 (0.466)	–0.043 (0.557)	–0.015 (0.840)
BMI	0.091 (0.208)	0.169 (0.019)	0.137 (0.059)
(B) Multivariable linear regression: independent predictors of angiographic burden			
Predictor	**TSS β (95% CI)**	***P*-value**	**ES β (95% CI)**	***P*-value**
Waist circumference	0.207 (0.026–0.222)	0.014	0.183 (0.055–0.985)	0.029
Raised blood pressure	0.161 (0.120–2.516)	0.031	0.162 (0.598–11.97)	0.030
Low HDL-C	−0.152 (–0.181–−0.040)	0.041	−0.157 (−0.874–−0.032)	0.035
Triglyceride	0.164 (0.002–0.024)	0.021	0.146 (0.003–0.107)	0.039

r: Correlation coefficient, β: Regression coefficient. Significant values ($P<0.05$) in bold. Variables evaluated but not independently associated in the final models: diabetes, age, sex (all $P>0.05$). MetS: Metabolic syndrome, CAD: Coronary artery disease, TSS: Total stenosis score, ES: Extension score, LDL: Low-density lipoprotein, HDL: High-density lipoprotein, BMI: Body mass index, CI: Confidence interval

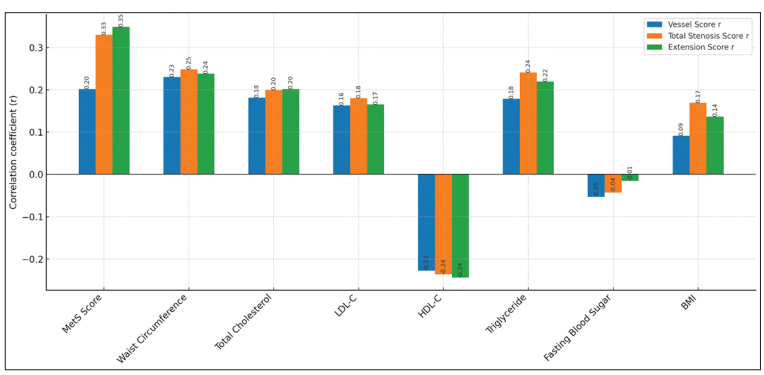

Figure 2: Correlation of metabolic syndrome score and lipid variables with angiographic severity

compared to 1.0% in non-MetS (P = 0.009). Similarly, an ES of ≥50 was reported in 46.9% vs. 24.0% (P = 0.001), and triple vessel disease was present in 42.7% vs. 15.6% (P < 0.001) [Table 4]. Multivariable regression analysis revealed that waist circumference, increased blood pressure, elevated triglyceride levels, and decreased HDL-C serve as independent predictors of higher stenosis and ESs. In contrast, age, sex, and diabetes did not significantly contribute to these outcomes [Figure 3].

Discussion

This study investigated the link between MetS and the angiographic burden of CAD in individuals with NSTEMI. Our data show that MetS is linked with much more unfavorable cardiovascular risk profiles, more widespread angiographic disease, and a higher burden of coronary atherosclerosis.

Demographically, patients with MetS were significantly older and exhibited higher BMI and waist circumference compared to those without MetS. Notably, 100% of MetS patients met the criteria for elevated waist circumference, highlighting the centrality of visceral adiposity in this population. Higher prevalence of diabetes mellitus, dyslipidemia, and raised blood pressure in the MetS group was consistent with known clustering of metabolic risk factors.[14] These findings mirror those of Mahalle *et al*., who reported higher waist circumference and blood pressure among Indian MetS patients with ACS, reflecting regional parallels in metabolic risk patterns.[15]

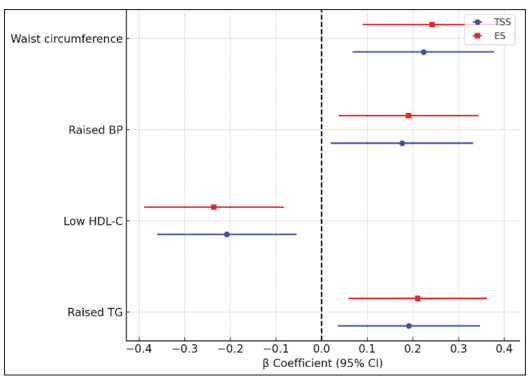

Figure 3: Forest plot showing independent predictors of coronary artery disease severity

Angiographically, MetS patients demonstrated significantly more severe disease. Triple vessel disease (TVD) was detected in 42.7% of MetS patients versus just 15.6% of non-MetS patients. Furthermore, MetS participants had significantly higher mean vessel scores, TSSs, and ESs, indicating both localized and diffuse coronary involvement. These data are closely related to the findings of Miri *et al*. and Zhou *et al*., both of whom found increased rates of multivessel and severe CAD in MetS populations, underlining the atherogenic potential of the syndrome even in acute coronary situations.[16,17]

The correlation analysis further reinforced the pathophysiological role of MetS components in atherosclerosis. MetS score positively correlated with all angiographic severity indices, particularly with the ES (r = 0.349, P < 0.001), suggesting that higher metabolic burden translates into more widespread coronary involvement. This is in agreement with Liu *et al*., who demonstrated that increasing MetS score was predictive of both luminal narrowing and plaque extension.[18] Triglycerides, waist circumference, and total cholesterol were positively associated with disease burden, while HDL-C showed an inverse correlation – consistent

Table 4: Sensitivity analysis for high-burden CAD thresholds

CAD burden indicator	Threshold	Group I (MetS)	Group II (non-MetS)	*P*-value
Total stenosis score	≥16	9.4% (9/96)	1.0% (1/96)	0.009
Extension score	≥50	46.9% (45/96)	24.0% (23/96)	0.001
Vessel score	TVD (Score 3)	42.7% (41/96)	15.6% (15/96)	<0.001

CAD: Coronary artery disease, MetS: Metabolic syndrome, TVD: Triple vessel disease

with previous work identifying dyslipidemia and visceral obesity as key drivers of atherogenesis.[19]

Our multivariable analysis identified waist circumference, raised blood pressure, elevated triglycerides, and low HDL-C as independent predictors of both stenosis and ESs. Interestingly, diabetes, sex, and age were not significant predictors in the regression model, suggesting that metabolic parameters beyond glycemic control may play a dominant role in plaque burden. These findings echo those from Zhou *et al*., who similarly reported lipid and obesity indices as stronger predictors than age or diabetes status.[17]

Finally, the sensitivity analysis highlighted that MetS patients had a significantly greater likelihood of presenting with high-burden CAD – whether defined by TVD (42.7% vs. 15.6%), TSS ≥16 (9.4% vs. 1.0%), or ES ≥50 (46.9% vs. 24.0%). This high prevalence of severe and diffuse disease in MetS patients reinforces the need for early identification and aggressive risk factor management. Supporting this, Mahalle *et al*. and Liu *et al*. both reported that MetS presence reliably stratified patients into higher-risk angiographic categories.[15,18]

Taken together, our findings confirm that MetS is not only a risk factor for CAD onset but also a potent marker of disease severity and extent in patients presenting with NSTEMI. This underscores the clinical value of identifying MetS in acute settings and supports its inclusion in risk stratification algorithms.

Limitations of the study

The study took place in a single hospital with a small number of participants. As a result, the outcomes may not be indicative of the broader community.

Conclusion

This study highlights a significant link between MetS and the angiographic severity of CAD in individuals experiencing NSTEMI. Patients with MetS exhibited a markedly greater burden of coronary atherosclerosis, as demonstrated by higher vessel, stenosis, and ESs. Independent predictors of increased angiographic burden included central obesity, raised blood pressure, elevated triglycerides, and reduced HDL-C – all hallmark components of MetS. Importantly, correlation and sensitivity analyses affirmed that MetS not only predisposes individuals to CAD but also contributes to its diffuse and severe angiographic presentation. These findings reinforce the need for early identification and targeted management of MetS components to mitigate the risk of adverse cardiovascular outcomes. The study adds to the growing body of evidence supporting the prognostic relevance of MetS in ACSs, particularly in South Asian populations where its prevalence is rapidly rising. Future longitudinal and interventional studies are warranted to explore causality and the impact of MetS control on CAD progression and clinical outcomes.

Ethical Approval

The study was approved by the Institutional Ethics Committee.

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How to cite this article: Haque MA, Sultana SA, Malek MA, Wali-Ur-Rahman M, Alam AYMS, Ara Z. Distribution of metabolic syndrome components and their relationship with angiographic severity in non-ST elevation myocardial infarction. Ann. Int. Med. Den. Res. 2026;12(1):1-9.

Source of Support: Nil, **Conflict of Interest:** None declared

Received: 02-Dec-2025; **Revised:** 03-Jan-2026; **Acceptance:** 19-Jan-2026; **Published:** 10-Mar-2026

Original Research Article

https://doi.org/10.53339/aimdr.2026.12.1.2
E-ISSN: 2395-2822 | P-ISSN: 2395-2814

Impact of traditional bone setter and informal treatment practices on outcomes of colles' fractures, a mixed methods study from Bangladesh

S. M. Golam Faruk[1], Md. Shahidul Azam[2], Md. Farhad Hossain[3], Most. Nasima Khatun[4], Hazrat Ali Miah[5]

[1]Department of Orthopaedic Surgery, 250 Beded General Hospital, Kurigram, Bangladesh, [2]Department of Orthopaedic Surgery, 250 Beded District Hospital, Manikganj, Bangladesh, [3]Department of Surgery, 250 Beded General Hospital, Kurigram, Bangladesh, [4]Department of Obstetrics and Gynaecology, 250 Beded General Hospital, Kurigram, Bangladesh, [5]Department of Orthopaedics, Nilphamari Medical College, Nilphamari, Bangladesh

Address for correspondence: Dr. S. M. Golam Faruk, Department of Orthopaedic Surgery, 250 Beded General Hospital, Kurigram, Bangladesh. E-mail: drgfaruk@gmail.com

Abstract

Introduction: Colles' fracture is one of the most common fractures of the upper limb, particularly among older adults, and appropriate early management is crucial for optimal functional recovery. This study aimed to evaluate the impact of traditional bone setters (TBS) and informal treatment practices on the clinical and functional outcomes of Colles' fractures, while also exploring the socio-cultural and economic factors influencing patients' initial treatment choices.

Methods: This mixed-methods study was conducted at 250 Beded General Hospital, Kurigram, Bangladesh, from July 2024 to June 2025, and included 50 consecutive patients diagnosed with Colles' fractures. Adult patients presenting with a history of distal radius fracture, with or without prior treatment from TBS or other informal practitioners, were enrolled. Data were entered and analyzed using the Statistical Package for the Social Sciences version 25.0.

Results: Initial care was sought from TBS or informal providers by 72.0%, while only 28.0% presented directly to formal healthcare facilities, resulting in delayed presentation beyond one week in 46.0% of cases. Common complications included malunion (34.0%), joint stiffness (28.0%), and chronic pain (22.0%), with only 20.0% having no complications. Functional outcomes were excellent or good in 54.0% and fair or poor in 46.0%. Low cost (66.7%), easy accessibility (58.3%), fear of surgery (50.0%), and cultural beliefs (44.4%) were the main reasons for choosing traditional or informal treatment.

Conclusion: This study highlights the continued widespread use of TBS and informal care for the management of Colles' fractures in Bangladesh, which is linked to delayed access to formal healthcare, increased complications, and poorer functional recovery. Factors such as financial limitations, ease of access, cultural trust, and apprehension toward surgical treatment played a major role in shaping patients' initial care-seeking decisions.

Keywords: Colles' fractures, informal treatment, traditional bone setter

Introduction

Colles' fracture is a common distal radius fracture characterized by dorsal angulation and displacement, typically resulting from a fall on an outstretched hand. It constitutes a significant proportion of upper limb fractures in adults and represents a frequent cause of functional limitation

if not managed appropriately.[1] Evidence-based management emphasizes early diagnosis, anatomical reduction, proper immobilization, and rehabilitation, while surgical fixation is indicated for unstable or severely displaced fractures.[2] In low- and middle-income countries such as Bangladesh, the management of musculoskeletal injuries is influenced by limited access to orthopedic services, financial constraints, and sociocultural beliefs. Consequently, many patients seek care from informal healthcare providers, particularly traditional bone setters (TBS). TBS are unlicensed practitioners who manage fractures using indigenous techniques such as manual manipulation, tight splinting, massage, and herbal applications, often without radiographic confirmation or knowledge of fracture biomechanics.[3] The continued reliance on TBS has been widely documented across South Asia and other developing regions. Cultural acceptability, affordability, proximity to rural communities, and fear of hospital-based surgical interventions contribute to their sustained patronage.[4] However, numerous studies have demonstrated that fracture treatment by TBS is frequently associated with adverse outcomes. These include malunion, non-union, chronic pain, joint stiffness, neurovascular compromise, compartment syndrome, infection, and, in severe cases, limb-threatening complications.[5] Hospital-based studies have reported that a substantial proportion of patients presenting with complicated fractures have a prior history of treatment by TBS. Such patients often present late, with established deformities and functional impairment, necessitating complex surgical correction and prolonged rehabilitation.[6] Beyond clinical consequences, the choice of traditional fracture care is shaped by multiple behavioral and social factors. Studies examining health-seeking behavior have identified a lack of awareness regarding fracture complications, perceived high costs of hospital treatment, long waiting times, and trust in traditional healers as key determinants influencing initial care decisions.[7] Bangladesh-specific studies have highlighted the burden of complications related to informal fracture management. Observational data from tertiary hospitals indicate that many patients presenting with delayed union, malunion, or chronic disability had initially received treatment from TBS, underscoring the public health implications of informal musculoskeletal care.[5] Despite the documented risks associated with traditional bone-setting practices, some authors argue that the complete exclusion of TBS from healthcare systems may be impractical due to their deep integration into community health structures. Instead, there is growing interest in understanding patient experiences and perceptions to inform culturally appropriate strategies aimed at improving referral pathways and early orthopedic intervention.[8]

Methods

This mixed-methods study was conducted at 250 Beded General Hospital, Kurigram, Bangladesh, from July 2024 to June 2025, and included 50 consecutive patients diagnosed with Colles' fractures. Adult patients presenting with a history of distal radius fracture, with or without prior treatment from TBS or other informal practitioners, were enrolled after obtaining informed written consent. Patients with open fractures, associated polytrauma, pathological fractures, or previous wrist deformities were excluded from the study. Quantitative data were collected using a structured questionnaire covering sociodemographic characteristics, initial treatment modality, delay in presentation, and clinical complications, along with radiological evaluation. Functional outcomes were assessed at final follow-up using the Gartland and Werley scoring system. Qualitative data were obtained through semi-structured interviews to explore patient-reported reasons for choosing traditional or informal treatment. Data were entered and analyzed using the Statistical Package for the Social Sciences version 25.0, with results expressed as frequencies and percentages. Ethical approval was obtained from the institutional ethical review committee before study initiation, and confidentiality of participant information was strictly maintained throughout the study.

Results

Most participants belonged to the 41–60 years age group (21 patients, 42.0%), followed by those older than 60 years (15 patients, 30.0%) and those aged 40 years or below (14 patients, 28.0%). Females constituted 32 cases (64.0%), while males accounted for 18 cases (36.0%). A majority of patients resided in rural areas (33 patients, 66.0%). Regarding education, 19 patients (38.0%) had no formal education, 23 (46.0%) had primary or secondary education, and only 8 (16.0%) had higher secondary education or above [Table 1].

Initial treatment was sought from TBS by 29 patients (58.0%), while 7 patients (14.0%) consulted other informal practitioners such as village healers. Only 14 patients (28.0%) presented directly to a qualified medical facility for initial fracture management [Table 2].

Presentation to formal healthcare occurred within 3 days in 12 patients (24.0%), between 4 and 7 days in 15 patients (30.0%), between 8 and 14 days in 13 patients (26.0%), and after more than 14 days in 10 patients (20.0%). Overall, 23 patients (46.0%) presented later than 1 week after injury [Table 3].

Malunion was the most common complication, observed in 17 patients (34.0%), followed by wrist joint stiffness in 14 patients (28.0%) and chronic pain in 11 patients (22.0%). Soft-tissue infection was present in 6 patients (12.0%), while neurovascular symptoms were noted in 4 patients (8.0%). Ten patients (20.0%) had no detectable complication at presentation [Table 4].

At final follow-up, excellent functional outcomes were observed in 11 patients (22.0%), while good outcomes were achieved in 16 patients (32.0%). Fair outcomes were documented in 15 patients (30.0%), and poor outcomes were seen in 8 patients (16.0%). Overall, 23 patients (46.0%) demonstrated fair to poor functional outcomes [Table 5].

Table 1: Sociodemographic characteristics of the study participants (*n*=50)

Variable	Frequency	Percentage
Age group (years)		
≤40	14	28.0
41–60	21	42.0
>60	15	30.0
Sex		
Male	18	36.0
Female	32	64.0
Residence		
Rural	33	66.0
Urban	17	34.0
Educational status		
No formal education	19	38.0
Primary/Secondary	23	46.0
Higher secondary and above	8	16.0

Table 2: Initial treatment modality sought by patients (*n*=50)

Initial treatment provider	Frequency (*n*)	Percentage
Traditional bone setter	29	58.0
Village healer/informal practitioner	7	14.0
Qualified medical facility	14	28.0

Table 3: Duration between injury and presentation to formal healthcare (*n*=50)

Time interval	Frequency	Percentage
≤3 days	12	24.0
4–7 days	15	30.0
8–14 days	13	26.0
>14 days	10	20.0

Among the 36 patients who initially sought traditional or informal care, low cost was cited by 24 patients (66.7%), easy accessibility by 21 patients (58.3%), fear of surgical intervention by 18 patients (50.0%), cultural belief or trust by 16 patients (44.4%), and lack of awareness regarding possible complications by 14 patients (38.9%) [Table 6].

Table 4: Complications observed at presentation to formal care (*n*=50)

Complication	Frequency	Percentage
Malunion	17	34.0
Joint stiffness	14	28.0
Chronic pain	11	22.0
Soft-tissue infection	6	12.0
Neurovascular symptoms	4	8.0
No complication	10	20.0

Table 5: Functional outcome at final follow-up using the Gartland and Werley score (*n*=50)

Functional outcome	Frequency	Percentage
Excellent	11	22.0
Good	16	32.0
Fair	15	30.0
Poor	8	16.0

Table 6: Patient-reported reasons for choosing traditional or informal treatment (*n*=36*)

Reason	Frequency	Percentage
Low cost	24	66.7
Easy accessibility	21	58.3
Fear of surgery	18	50.0
Cultural belief/trust	16	44.4
Lack of awareness of complications	14	38.9

*Multiple responses allowed

Discussion

In the present study, the majority of patients with Colles' fractures were middle-aged to elderly, with 42.0% belonging to the 41–60-year age group and 30.0% aged above 60 years. Females constituted 64.0% of cases, and 66.0% of participants were from rural areas. Court-Brown and Caesar reported that distal radius fractures are more common in females and older adults, largely due to post-menopausal bone loss and increased fall risk.[8] The higher female predominance in our study may also reflect lower health awareness and delayed access to orthopedic services among women in rural Bangladesh, compounding fracture severity and outcomes. In this study, 58.0% of patients initially sought treatment from TBS, while an additional 14.0% consulted other informal practitioners, leaving only 28.0% presenting directly to qualified medical facilities. Adje *et al*. found that 60–70% of musculoskeletal injury patients in low-resource settings initially consulted TBS due to accessibility and cultural acceptance.[7] Similarly, OlaOlorun and Oladiran reported that traditional practitioners remain the first point of contact for fracture care in rural populations, especially where formal services are limited.[4] The high reliance on traditional care in our cohort reinforces the persistent role of informal healthcare pathways in Bangladesh. Delayed presentation was a notable finding in the current study, with 46.0% of patients presenting to formal healthcare more than 1 week after injury. Ekere observed that patients treated by TBS often presented weeks to months after injury, leading to compromised fracture healing.[9] The shorter delay observed in our study compared to some African series may reflect increasing awareness and gradual access to tertiary care, though the delay remains clinically significant for Colles' fractures, where early reduction is critical. Regarding complications, malunion was observed in 34.0% of patients, joint stiffness in 28.0%, and chronic pain in 22.0%. Khan *et al*. reported malunion rates exceeding 50% among patients previously managed by TBS, with stiffness and chronic pain being frequent sequelae.[5] Panigrahi and Mishra documented malunion in 46% and soft-tissue complications in a substantial proportion of patients following traditional fracture care.[6] Although the complication rates in our study are somewhat lower, they remain considerable and likely reflect partial or delayed correction rather than optimal fracture management. Functional outcomes in this study were suboptimal, with only 22.0% achieving excellent outcomes, while 46.0% had fair to poor results. Bruyere *et al*. emphasized that improper initial management of distal radius fractures leads to long-term functional impairment, even when later treated appropriately.[10] The high proportion of fair and poor outcomes in our cohort suggests that delayed and inadequate early management has a lasting negative impact on wrist function.

The reasons for choosing traditional or informal treatment in this study were primarily low cost (66.7%), easy accessibility (58.3%), fear of surgery (50.0%), cultural belief (44.4%), and lack of awareness of complications (38.9%). Chowdhury *et al*. reported similar findings in Bangladesh, where financial constraints and fear of hospital-based surgical interventions strongly influenced initial treatment decisions.[11]

Limitations of the study

This study is limited by its small sample size and single-center design, which may restrict generalizability and introduce referral bias. Reliance on patient self-reporting may have resulted in recall and social desirability bias, particularly regarding prior treatment and reasons for choosing informal care.

Conclusion

This study demonstrates that TBS and informal treatment practices remain widely utilized for Colles' fractures in Bangladesh and are associated with delayed presentation, higher complication rates, and suboptimal functional outcomes. Socioeconomic constraints, accessibility, cultural beliefs, and fear of surgical intervention were key factors influencing initial treatment choices.

Recommendations

Early public awareness programs should be implemented to educate communities about proper fracture management and potential complications of delayed or informal treatment. Strengthening access to affordable orthopedic services, especially in rural areas, and establishing referral linkages between TBS and formal healthcare facilities may help reduce delays, minimize complications, and improve outcomes for patients with Colles' fractures in Bangladesh.

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How to cite this article: Faruk SM, Azam MS, Hossain MF, Khatun MN, Miah HA. Impact of traditional bone setter and informal treatment practices on outcomes of colles' fractures, a mixed methods study from Bangladesh. Ann. Int. Med. Den. Res. 2026;12(1):10-14.

Source of Support: Nil, **Conflict of Interest:** None declared

Received: 20-Dec-2025; **Revised:** 19-Jan-2026; **Acceptance:** 02-Feb-2026; **Published:** 10-Mar-2026

Original Research Article

https://doi.org/10.53339/aimdr.2026.12.1.3
E-ISSN: 2395-2822 | P-ISSN: 2395-2814

A study on the prevalence and risk factors of low back pain among industrial workers in Bangladesh

Md. Shahidul Azam[1], S. M. Golam Faruk[2], Md. Farhad Hossain[3], Most. Nasima Khatun[4], Hazrat Ali Miah[5]

[1]Department of Orthopaedic Surgery, 250 Beded District Hospital, Manikganj, Bangladesh, [2]Department of Orthopaedic Surgery, 250 Beded General Hospital, Kurigram, Bangladesh, [3]Department of Surgery, 250 Beded General Hospital, Kurigram, Bangladesh, [4]Department of Obstetrics and Gynaecology, 250 Beded General Hospital, Kurigram, Bangladesh, [5]Department of Orthopaedics, Nilphamari Medical College, Nilphamari, Bangladesh

Address for correspondence: Dr. Md. Shahidul Azam, Department of Orthopaedic Surgery, 250 Beded District Hospital, Manikganj, Bangladesh. E-mail: shahidi98_azam@yahoo.com

Abstract

Introduction: Low back pain (LBP) is one of the prevalent work-related musculoskeletal disorders, leading to reduced productivity and functional impairment among workers, especially in industries where the job is demanding. The purpose of this study is to identify the prevalence of LBP among workers in industries in Bangladesh and the associated risk factors.

Methods: The study was a cross-sectional study that was done among 52 industrial workers in the country of Bangladesh from January 2024 to December 2024. The data collection was based on a pretested structured questionnaire covering socio-demographic variables, occupational characteristics, individual risk factors, and the presence and severity of pain in the lower back. The data were analyzed using the Statistical Package for the Social Sciences version 25.0.

Results: In the study involving 52 industrial workers, the dominant participants were males (78.8%), aged between 31 and 40 years (40.4%), and performed manual/heavy work (55.8%), with 65.4% of them working more than 8 h daily and 69.2% having worked with the company for more than 5 years. Results showed that LBP occurred commonly among 63.5% of the industrial workers. LBP was associated significantly with age over 40 years and work duration ($P < 0.05$), while obesity and smoking were not significant.

Conclusion: Lower back pain was found to be quite prevalent (63.5%) among the industry workforce in Bangladesh and had strong associations with strenuous work activities, increasing age, and increasing service duration. The major contributing factors from the occupational point of view included heavy lifting, frequent bending, prolonged standing, and inadequate rest intervals.

Keywords: Industrial workers, low back pain, occupational exposure

Introduction

Lower back pain (LBP) is among the most prevalent musculoskeletal conditions as well as one of the main causes of disability across the world. Using the Global Burden of Disease study, it is observed that LBP is still the single most important contributor to years lived with disability for all age groups. This puts an important burden on people as well as health care systems as well as countries' economy.[1] The incidence of LBP is most significant among young to middle-aged people who are generally in their prime age group and thus an important concern with respect

to occupation.[2] Occupational exposure is an important contributing factor with respect to LBP. Workers in industries are most frequently subjected to ergonomic risk factors such as heavy lifting, repetitive movements, bad postures, prolonged standing or sitting, whole-body vibration, as well as poor work surroundings.[3] Industrial workers are also most frequently subjected to ergonomic risk factors such as lifting, recurrent movements, bad postures, prolonged standing or sitting, whole-body vibrations, as well as poor work surroundings. These factors lead to cumulative spinal loading or muscle fatigue due to which LBP may develop.[4] Besides these factors, psychosocial factors such as dissatisfaction in work place, work pressure, long working hours, as well as lack of rest also increase LBP among workers.[5] The global incidence of work-related LBP among industrial as well as manual workers is between 40% and over 70%, depending on work as well as work surroundings.[6] In low as well as middle-income countries, due to lack of proper health care as well as poor ergonomics in work surroundings, LBP is underestimated as an important concern with respect to industries as well as health care.[7] Workers in these countries continue their work even in LBP due to which chronic LBP as well as productivity is decreased. Over the past few decades, industries in countries like Bangladesh have grown in leaps as well as bounds in important sectors such as garment industries, manufacturers, construction industries, as well as transport industries employing millions of workers. Despite this growth, important aspects like health care in industries continue to lack in respect to industries employing workers in important sectors due to which workers are subjected to prolonged work as well as poor work surroundings.[8] Studies also carried out in countries like Bangladesh have reported important significant increase in the incidence of important health care conditions like musculoskeletal conditions among which LBP is an important significant complaint among workers due to which important significant concern as well as causes in important sectors.[9] In a cross-sectional study of industrial workers in Dhaka, it was found that over 60% of the workers suffered from LBP, significant associations were found with respect to age, experience, prolonged hours of work, frequent bending, and lifting.[10] To design preventive programs, it is crucial to comprehend the prevalence and contributing factors for LBP in industrial workers. The aim of this study is to find the prevalence of LBP in industrial workers in Bangladesh.

Methods

This cross-sectional study was conducted among 52 industrial workers in Bangladesh, from January 2024 to December 2024, with an objective to establish the prevalence of LBP and its related risk factors. Workers aged ≥18 years who had been employed for at least 6 months were included using a convenient sampling technique, while those with a history of spinal trauma or known spinal pathology were excluded. The data collection was based on a pretested structured questionnaire covering socio-demographic variables, occupational characteristics, individual risk factors, and the presence and severity of pain in the lower back. The anthropometric measurements were used to calculate the body mass index. Data were entered and analyzed using the Statistical Package for the Social Sciences version 25.0. In the data analysis, descriptive statistics have been used to summarize variables, and appropriate inferential tests were used to assess the associations between LBP and potential risk factors, considering $P < 0.05$ as statistically significant. Ethical approval was obtained from the relevant authority, and informed written consent was taken from the participants before data collection.

Results

The majority of participants were aged between 31 and 40 years (40.4%), followed by those aged over 40 years (32.7%). Male workers constituted the predominant proportion of the study population (78.8%). Regarding educational status, 40.4% had attained secondary or higher education, while 23.1% had no formal schooling [Table 1].

More than half of the workers (55.8%) were engaged in manual or heavy labor, while 28.8% performed machine-based tasks. A substantial proportion (65.4%) reported working for more than 8 h per day. In addition, 69.2% of participants had an employment duration exceeding 5 years [Table 2].

LBP was reported by 63.5% of the participants, whereas 36.5% did not report any history of LBP during the study period, indicating a high overall prevalence among industrial workers [Table 3].

LBP was more frequently observed among workers exposed to occupational risk factors such as heavy lifting (78.8%), frequent bending or twisting movements (72.7%), inadequate rest breaks (66.7%), and prolonged standing (63.6%) compared to those without such exposures [Table 4].

LBP was significantly more common among workers aged over 40 years and those with an employment duration exceeding 5 years ($P < 0.05$). Although higher proportions of LBP were observed among overweight workers and smokers, these associations were not statistically significant [Table 5].

Among participants reporting LBP, 45.5% experienced moderate pain, while 12.1% reported

Table 1: Sociodemographic characteristics of the study participants (n=52)

Variable	Frequency	Percentage
Age group (years)		
≤30	14	26.9
31–40	21	40.4
>40	17	32.7
Sex		
Male	41	78.8
Female	11	21.2
Education level		
No formal education	12	23.1
Primary	19	36.5
Secondary or above	21	40.4

Table 2: Occupational characteristics of the participants (n=52)

Variable	Frequency	Percentage
Type of work		
Manual/heavy labor	29	55.8
Machine-based	15	28.8
Mixed duties	8	15.4
Working hours/day		
≤8 h	18	34.6
>8 h	34	65.4
Duration of employment		
≤5 years	16	30.8
>5 years	36	69.2

Table 3: Prevalence of low back pain among industrial workers (n=52)

Low back pain status	Frequency	Percentage
Present	33	63.5
Absent	19	36.5

Table 4: Work-related risk factors associated with low back pain (n=52)

Risk factor	LBP present *n* (%)	LBP absent *n* (%)
Prolonged standing	21 (63.6)	7 (36.8)
Frequent bending/twisting	24 (72.7)	6 (31.6)
Heavy lifting	26 (78.8)	8 (42.1)
Inadequate rest breaks	22 (66.7)	6 (31.6)

LBP: Low back pain

Table 5: Association between individual factors and low back pain among industrial workers (n=52)

Factor	LBP present *n* (%)	LBP absent *n* (%)	*P*-value
Age>40 years	14 (42.4)	3 (15.8)	0.040*
Employment duration >5 years	26 (78.8)	10 (52.6)	0.044*
Overweight (BM I ≥25 kg/m²)	12 (36.4)	4 (21.1)	0.212
Smoking	15 (45.5)	6 (31.6)	0.259

*Statistically significant at P<0.05. BMI: Body mass, LBP: Low back pain

severe pain. More than half of the affected workers (57.6%) indicated some degree of work-related functional limitation due to LBP [Table 6].

Discussion

In the current study, the point prevalence of LBP among industrial workers was found to be 63.5%, reflecting nearly two-thirds of workers suffered from LBP. This very high prevalence is closely supported by the findings of Chowdhury *et al*., from Bangladesh, who estimated an LBP prevalence of 62.0% among low-income industrial workers of Dhaka.[10] While another study conducted among industrial workers from Ethiopia reported a prevalence of 58.9%.[11] The slightly higher prevalence in the current study could be explained by longer working hours and a higher manual worker proportion in our sample, reaffirming that industrial occupation entails a high risk for LBP. With regard to occupational exposure, the current study showed that among workers having LBP, 78.8% were doing heavy lifting, 72.7% reported doing frequent bending or twisting, and 63.6% reported standing for long periods. In comparison, Chowdhury *et al*. reported that 74.6% of workers with LBP were exposed to heavy lifting and 69.3% to frequent bending.[10] Similarly, Wami *et al*. observed that 71.2% of workers exposed to awkward postures reported LBP.[11] These comparable values suggest that biomechanical stressors such as lifting and repetitive spinal movements consistently contribute to LBP across industrial settings. Age was a significant determinant in the present study, where 42.4% of workers aged over 40 years reported LBP, compared to 15.8% among those without LBP ($P = 0.040$). Hartvigsen *et al*. also highlighted that the prevalence of LBP increases progressively with age due to cumulative spinal degeneration and reduced muscular resilience.[2] The close similarity in age-related prevalence supports the role of biological aging combined with occupational exposure in LBP development. Employment duration was another significant factor in our study. Among workers with LBP, 78.8% had been employed for more than 5 years, compared to 52.6% among those without LBP ($P = 0.044$). Chowdhury *et al*. reported that 81.0% of workers with more than 5 years of industrial employment suffered from LBP.[10] Likewise, da Costa and Vieira found that long-term exposure to physical workload significantly increased the risk of chronic musculoskeletal disorders.[3] These findings emphasize the cumulative effect of prolonged occupational exposure on spinal health. In the present study, 36.4% of overweight workers reported LBP compared to 21.1% among non-overweight workers, although this association was not statistically significant. Shiri *et al*., in a meta-analysis, reported that overweight individuals had a 33% higher risk of developing LBP compared to those with normal BMI.[12] The lower magnitude and lack of significance in our study may be related to the small sample size and the dominant effect of occupational factors. Similarly, 45.5% of smokers in our study reported LBP compared to 31.6% of non-smokers, though this association was not statistically significant. Shiri *et al*. reported that smokers had a 1.3-fold increased risk of LBP compared to non-smokers.[12] The weaker association in our study may reflect underreporting or confounding by physical workload.

Table 6: Severity and functional impact of low back pain among affected workers (n=33)

Variable	Frequency	Percentage
Pain severity		
Mild	14	42.4
Moderate	15	45.5
Severe	4	12.1
Work limitation due to LBP		
Yes	19	57.6
No	14	42.4

LBP: Low back pain

Limitations of the study

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

Conclusion

LBP was highly prevalent (63.5%) among industrial workers in Bangladesh and was strongly associated with physically demanding work, older age, and longer employment duration. Occupational factors such as heavy lifting, frequent bending, prolonged standing, and inadequate rest played a major role.

Recommendations

Regular ergonomic assessment of workstations, training on proper lifting techniques, ensuring adequate rest breaks, and implementing workplace health education programs are recommended to reduce the risk of low back pain among industrial workers. Periodic health screening and early intervention, particularly for older and long-serving workers, should also be prioritized to prevent chronic disability.

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How to cite this article: Azam MS, Faruk SM, Hossain MF, Khatun MN, Miah HA. A Study on the prevalence and risk factors of low back pain among industrial workers in Bangladesh. Ann. Int. Med. Den. Res. 2026;12(1):15-19.

Source of Support: Nil, **Conflict of Interest:** None declared

Received: 15-Dec-2025; **Revised:** 10-Jan-2026; **Acceptance:** 29-Jan-2026; **Published:** 10-Mar-2026

Original Research Article

https://doi.org/10.53339/aimdr.2026.12.1.4
E-ISSN: 2395-2822 | P-ISSN: 2395-2814

The invisible dual burden: A clinical study on the association between tension-type headache and major depressive disorder

Md. Shariful Islam[1], Mustanshirah Lubna[2], K. M. Adnan Bulbul[3], Amal Krishna Paul[4], Md. Rakibul Hassan[5], Mst. Jakia Afroz Zebun[6]

[1]Department of Neuro Surgery, KPJ Specialized Hospital, Gazipur, Bangladesh, [2]Department of Pediatrics, National Center for Control of Rheumatic Fever and Heart Disease, Dhaka, Bangladesh, [3]Department of Internal Medicine, KPJ Specialized Hospital, Gazipur, Bangladesh, [4]Department of Medicine, KPJ Specialized Hospital, Gazipur, Bangladesh, [5]Department of Orthopedic, KPJ Specialized Hospital, Gazipur, Bangladesh, [6]Department of Psychology, KPJ Specialized Hospital, Gazipur, Bangladesh

Address for correspondence: Dr. Md. Shariful Islam, Consultant, Department of Neuro Surgery, KPJ Specialized Hospital, Gazipur, Bangladesh. E-mail: sharifulislam_sujon@yahoo.com

Abstract

Background: Tension-type headache (TTH) is the most prevalent primary headache disorder worldwide and is a major cause of functional impairment. Despite its high burden, the psychiatric comorbidities of TTH, particularly major depressive disorder (MDD), remain inadequately characterized, with limited evidence regarding their demographic and clinical correlates.

Objective: To assess the association between MDD and patients with TTH.

Methods: This hospital-based study was conducted at KPJ Specialized Hospital, Gazipur, Bangladesh, from September 2018 to December 2024, enrolling 4653 patients with clinically diagnosed TTH. Participants underwent a standardized clinical evaluation and psychiatric assessment for MDD. Sociodemographic data, psychiatric comorbidities, and psychosomatic symptoms were systematically recorded. Data were analyzed using the Statistical Package for the Social Sciences version 26.

Results: Among 4653 patients with TTH, 153 (3.3%) had comorbid MDD. Prevalence was higher in females, with 138 of 3223 (4.3%) affected, compared to 15 of 1430 males (1.0%, $P < 0.001$). Age ≥46 years showed 84 of 681 patients (12.4%) with MDD, versus 28 of 2389 (1.1%) in ≤30 years and 41 of 1623 (2.5%) in 31–45 years. Anxiety affected 100 (65.4%), insomnia 96 (62.7%), and chronic pain 54 (35.3%) of MDD cases.

Conclusion: MDD affects 3.3% of patients with TTH and is strongly associated with female sex, age ≥46 years, anxiety, insomnia, and chronic pain, highlighting the need for routine psychiatric assessment in high-risk patients.

Keywords: Anxiety, insomnia, major depressive disorder, psychiatric comorbidity, tension-type headache

Introduction

Tension-type headache (TTH) is one of the most prevalent primary headache disorders worldwide and contributes substantially to disability and reduced quality of life. Epidemiological evidence suggests that TTH affects approximately one-quarter to more than one-third of adults globally over the course of 1 year, with significant interpopulation variability.[1,2] Although historically considered less severe than migraine, TTH is increasingly recognized as a condition with

considerable functional impairment, particularly when frequent or chronic.[1,3] Psychiatric comorbidities, including anxiety and depressive disorders, are common in individuals with primary headache disorders. While much of the research focus has centered on migraine, recent studies indicate that people with TTH also experience higher rates of psychological distress compared to non-headache populations.[4,5] Community-based research in Korean adults showed that individuals with TTH had a significantly higher prevalence of depressive symptoms (4.2%) than those without headache, indicating that even episodic TTH may carry mental health consequences.[5] Similarly, clinical investigations have documented associations between TTH and mood disturbances, including depression and anxiety, suggesting overlapping biopsychosocial mechanisms.[6,7] The psychiatric burden of TTH extends beyond symptom frequency. Chronic TTH is particularly linked with greater emotional dysregulation, depressive symptoms, and anxiety, even in patients without prior psychiatric diagnoses or psychotropic medication use.[8] Such comorbidity compounds functional impairment and complicates clinical management, often necessitating multidisciplinary approaches that address both physical pain and psychological well-being.[8,9] The interplay between affective symptoms and TTH is further underscored by population analyses showing that primary headaches, including TTH, elevate the risk of subsequent depression and adverse outcomes such as suicidality.[10] These findings highlight the importance of mental health screening in patients with headache disorders. Despite mounting evidence, the prevalence and predictors of major depressive disorder (MDD) within TTH populations remain under-characterized, particularly in clinical settings outside of specialized headache clinics. Several cross-sectional and observational studies have reported widely varying rates of depression among TTH sufferers, with estimates influenced by headache chronicity, demographic factors, and assessment tools.[4,11] In addition, bidirectional relationships between depressive symptoms and TTH features – such as increased headache frequency and intensity – have been suggested, indicating a complex clinical picture that warrants further investigation.[12] Understanding the epidemiology and correlates of depression in TTH is crucial for optimizing patient outcomes. Integration of psychiatric evaluation into routine headache care may facilitate early identification of at-risk individuals and enable targeted interventions that address both headache and comorbid mental health conditions.

Methods

Study population

This hospital-based cross-sectional study was conducted at KPJ Specialized Hospital, Gazipur, Bangladesh, from September 2018 to December 2024. A total of 4653 patients clinically diagnosed with TTH were enrolled. The study population included both male and female patients aged 12 years and above who presented to the neurology outpatient department during the study period.

Inclusion criteria

Patients were included if they met the International Classification of Headache Disorders, 3rd edition criteria for TTH. All participants provided informed consent, and those willing to undergo a comprehensive psychiatric evaluation for MDD were considered eligible.

Exclusion criteria

Patients with secondary headaches due to trauma, infection, or structural brain lesions were excluded. Those with a prior diagnosis of severe psychiatric disorders other than MDD, current use of psychotropic medications, or chronic systemic illnesses that could confound headache assessment were also excluded.

Study procedure

Eligible patients underwent a standardized clinical evaluation including detailed headache history, neurological examination, and assessment of psychosomatic complaints. Psychiatric

assessment for MDD was conducted using structured clinical interviews based on DSM-5 criteria. Sociodemographic data, headache characteristics, comorbidities, and lifestyle factors were systematically recorded.

Data analysis

Data were entered and analyzed using the Statistical Package for the Social Sciences version 26. Descriptive statistics were computed for demographic and clinical variables. Univariate logistic regression identified potential predictors of MDD, and variables with $P < 0.05$ were included in multivariable logistic regression to determine independent predictors of depression among TTH patients. Statistical significance was set at $P < 0.05$.

Results

A total of 4653 patients with TTH were included in the analysis [Figure 1]. Females constituted 69.3% of the study population, whereas males accounted for 30.7%. The mean age of the participants was 33.8 ± 11.6 years. Patients aged 19–30 years formed the largest group (37.6%), followed by those aged 31–45 years (34.9%). Adolescents aged ≤18 years comprised 13.2%, whereas patients aged 46–60 years and >60 years represented 11.3% and 2.9%, respectively [Figure 2]. MDD was identified in 3.3% of patients with TTH, whereas 96.7% had TTH without comorbid depression [Table 1]. Among female patients, 4.3% had MDD compared to 1.0% of male patients, showing a statistically significant sex difference ($P < 0.001$). Age-specific analysis demonstrated a progressive increase in MDD prevalence with advancing age. Patients aged ≤30 years had an MDD prevalence of 1.1% (n = 28), which increased to 2.5% (n = 41) among those aged 31–45 years and rose markedly to 12.4% (n = 84) in patients aged ≥46 years ($P < 0.001$) [Table 2]. The frequency of clinical and psychosomatic comorbidities was substantially higher among patients with TTH and MDD. Anxiety disorder was present in 65.4% of patients with MDD compared to 11.4% of those without MDD ($P < 0.001$). Insomnia or sleep

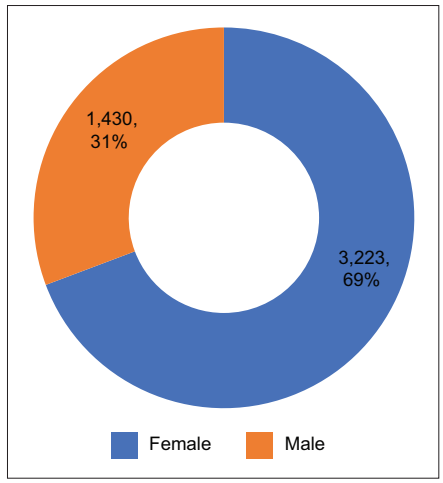

Figure 1: Gender distribution of patients with tension-type headache (n=4653)

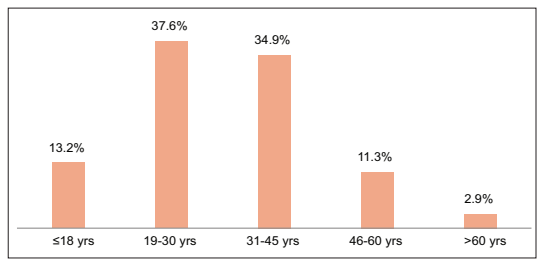

Figure 2: Age distribution of cases

disturbance was reported by 62.7% of patients with MDD versus 8.9% among non-depressed patients ($P < 0.001$). Gastrointestinal symptoms were observed in 53.6% of patients with MDD compared to 15.6% of patients without MDD ($P < 0.001$). Chronic musculoskeletal pain was reported by 35.3% of patients with MDD, which was significantly higher than the 6.5% observed in those without MDD ($P < 0.001$). Somatic symptom disorder was present in 24.8% of patients with MDD compared to 3.1% of patients without MDD ($P < 0.001$) [Table 3]. In univariate analysis, female sex was associated with an increased odds of MDD (Odds ratio [OR] 4.3; $P < 0.001$). Age ≥45 years showed a strong association with depression (OR 6.1; $P < 0.001$). Anxiety disorder demonstrated the highest risk (OR 14.5; $P < 0.001$), followed by insomnia (OR 12.8; $P < 0.001$) and chronic pain

Table 1: Prevalence of major depressive disorder among participants

Category	*n*	Percentage
TTH without MDD	4500	96.7
TTH with MDD	153	3.3
Total TTH patients	4653	100.0

TTH: Tension-type headache, MDD: Major depressive disorder

Table 2: Distribution of major depressive disorder

Variables	Major depressive disorder		*P*-value
	Present		
	n (%)		
Sex distribution			
Female	138 (4.3)	3085 (95.7)	<0.001
Male	15 (1.0)	1415 (99.0)	
Age group (years)			
≤30	28 (1.1)	2337 (98.9)	<0.001
31–45	41 (2.5)	1582 (97.5)	
≥46	84 (12.4)	594 (87.6)	

Table 3: Clinical and psychosomatic comorbidities among participants

Types	TTH cases, *n* (%)		*P*-value
	With MDD (*n*=153)	Without MDD (*n*=4,500)	
AD	100 (65.4)	512 (11.4)	<0.001
SD	96 (62.7)	402 (8.9)	<0.001
GS	82 (53.6)	702 (15.6)	<0.001
CMP	54 (35.3)	292 (6.5)	<0.001
SSD	38 (24.8)	141 (3.1)	<0.001

AD: Anxiety disorder, SD: Sleep disturbance, GS: Gastrointestinal symptoms, CMP: Chronic musculoskeletal pain, SSD: Somatic symptom disorder, TTH: Tension-type headache, MDD: Major depressive disorder

syndrome (OR 7.8; $P < 0.001$) [Table 4]. After multivariable adjustment, female sex (adjusted OR 2.8; $P < 0.001$), age ≥45 years (adjusted OR 3.4; $P < 0.001$), anxiety disorder (adjusted OR 8.6; $P < 0.001$), insomnia (adjusted OR 6.7; $P < 0.001$), and chronic pain syndrome (adjusted OR 2.9; $P = 0.001$) remained independent predictors of MDD among patients with TTH [Table 5].

Table 4: Univariate analysis of factors associated with MDD among TTH patients

Variable	Odds ratio	95% Confidence interval	*P*-value
Sex (female)	4.3	2.6–7.1	<0.001
Age ≥45 years	6.1	4.3–8.8	<0.001
Anxiety disorder	14.5	10.2–20.6	<0.001
Insomnia	12.8	9.1–18.1	<0.001
CPS	7.8	5.2–11.8	<0.001

TTH: Tension-type headache, MDD: Major depressive disorder, CPS: Chronic pain syndrome

Table 5: Multivariable logistic regression analysis of predictors of MDD among TTH patients

Predictor	Odds ratio	95% Confidence interval	*P*-value
Sex (female)	2.8	1.6–4.9	<0.001
Age ≥45 years	3.4	2.1–5.6	<0.001
AD	8.6	5.7–13.1	<0.001
Insomnia	6.7	4.4–10.3	<0.001
CPS	2.9	1.7–5.0	0.001

AD: Anxiety disorder, CPS: Chronic pain syndrome, TTH: Tension-type headache, MDD: Major depressive disorder

Discussion

The current study adds important clinical evidence to the multifaceted relationship between TTH and MDD. Although TTH is often perceived merely as a benign pain condition, its association with psychiatric distress has gained increasing recognition.[13] Prior research has underscored that individuals with TTH exhibit elevated rates of depressive and anxiety symptoms compared with non-headache populations.[7,14] Our finding of a 3.3% prevalence of MDD among TTH patients, while numerically modest, aligns with observations that affective disorders are clinically relevant even in primary headache populations.[15] Gender and age differences in the prevalence of psychiatric comorbidities have been consistent across headache research. In this study, females exhibited significantly higher rates of MDD than

males, and older age (≥46 years) was strongly associated with depression.[13,16] These demographic patterns resonate with broader evidence showing that women and older adults are more likely to report depressive symptoms in association with chronic health conditions, including headache disorders.[17] Although neurobiological, hormonal, and psychosocial mechanisms have been postulated to explain these patterns, they underscore the need for clinicians to maintain heightened surveillance for psychiatric symptoms in these subgroups.[18] Psychosomatic and clinical comorbidities such as anxiety disorders, insomnia, gastrointestinal complaints, and chronic pain were markedly more frequent among TTH patients with depression.[15,19] This clustering of symptoms reflects the complex biopsychosocial interplay in chronic pain syndromes and is consistent with prior case–control findings that chronic TTH is associated with higher depression and anxiety scores even in patients without prior psychiatric diagnoses.[20] Such comorbidity contributes to increased functional impairment and poorer quality of life. Moreover, depression and sleep disturbances have been shown to mediate the burden of chronic headaches, reinforcing the interdependent nature of psychological and pain experiences.[21] The bidirectional temporal relationship between headache and affective disorders, as demonstrated in longitudinal studies, suggests that not only does headache increase the risk of subsequent depression, but pre-existing depressive symptoms may predispose individuals to more frequent or chronic headache patterns.[22] This dynamic interaction highlights the importance of early recognition and intervention for psychiatric symptoms in headache care. The evidence also supports integrated treatment strategies that address both nociceptive pain and psychosocial contributors to optimize therapeutic outcomes.[23] Comparative studies in diverse clinical and community settings have reported variable prevalence of psychiatric comorbidity in TTH, ranging from modest elevations in depressive symptoms to much higher rates in specialized or chronic headache cohorts.[24] Differences in methodology, diagnostic instruments, cultural factors, and healthcare access likely account for such variability. Nonetheless, the consistent theme across studies is that depression and anxiety significantly exacerbate headache impact and reduce overall functioning, emphasizing their clinical significance. The observed associations between MDD and demographic as well as clinical predictors in TTH patients reinforce the need for comprehensive assessment strategies in clinical practice. Routine psychiatric screening, particularly for anxiety, sleep disturbance, and chronic pain symptoms, should be integrated into TTH management protocols. Such an approach may facilitate early identification of high-risk patients, enabling multidisciplinary care that addresses both neurological and psychological dimensions of TTH.

Limitations

This study was hospital-based, which may overrepresent patients with more severe or frequent TTH, potentially limiting generalizability to the broader community. In addition, its cross-sectional design precludes causal inferences between headache characteristics and MDD.

Conclusion

MDD affects a notable subset of patients with TTH, particularly females and individuals aged ≥46 years. Comorbid anxiety, insomnia, and chronic pain further increase the risk of depression, highlighting the complex interplay between neurological and psychiatric factors. Integrating routine psychiatric screening and multidisciplinary management into headache care can facilitate early detection, targeted intervention, and improved clinical outcomes, ultimately enhancing quality of life for high-risk TTH patients.

Recommendation

Routine psychiatric screening for depression, anxiety, and sleep disturbances should be integrated into TTH management. Early identification and multidisciplinary interventions targeting both neurological and psychological factors are recommended to improve patient outcomes and overall quality of life.

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How to cite this article: Islam MS, Lubna M, Bulbul KMA, Paul AK, Hassan MR, Zebun MJA. The invisible dual burden: A clinical study on the association between tension-type headache and major depressive disorder. Ann. Int. Med. Den. Res. 2026;12(1):20-25.

Source of Support: Nil, **Conflict of Interest:** None declared

Received: 09-Dec-2026; **Revised:** 09-Jan-2026; **Acceptance:** 24-Jan-2026; **Published:** 10-Mar-2026

Original Research Article

https://doi.org/10.53339/aimdr.2026.12.1.5
E-ISSN: 2395-2822 | P-ISSN: 2395-2814

Baseline clinical characteristics of primary sub-fertile women with and without polycystic ovary syndrome: A cross-sectional comparative study

Asma Sarker[1], Khayrul Bashar Khan[2], Mohammad Tazul Islam[3], Lutfunnahar Shampa[4]

[1]Department of Obstetrics and Gynaecology, Sheikh Hasina Medical College Hospital, Jamalpur, Bangladesh, [2]Department of Obstetrics and Gynaecology, Jamalpur Medical College, Jamalpur, Bangladesh, [3]Department of Anaesthesiology, Jamalpur Medical College, Jamalpur, Bangladesh, [4]Department of Obstetrics and Gynaecology, Dhaka Medical College and Hospital, Dhaka, Bangladesh

Address for correspondence: Dr. Asma Sarker, Resident Surgeon, Department of Obstetrics and Gynaecology, Sheikh Hasina Medical College Hospital, Jamalpur, Bangladesh. E-mail: drasmasarker@gmail.com

Abstract

Introduction: Polycystic ovary syndrome (PCOS) is one of the common Endocrine diseases among women of reproductive age. The syndrome presents as one of the major problems of involuntary subfertility in women. PCOS presents clinically as hyperandrogenism, ovulatory disorders, and/or polycystic change in ovaries. The purpose of this study was to evaluate and compare the demographical, anthropometrical, and clinical data of subfertile women suffering from PCOS and those not suffering from PCOS.

Methods: This study design is a cross-sectional study comparing the subjects at a point in time for the researchers. This study was carried out at the Fertility Care Centre, Department of Obstetrics and Gynaecology, Dhaka Medical College Hospital, Dhaka, from June 2015 to November 2015. In all, 146 women subjects were selected for the study, equally divided into two study groups – Group A: 73 women presenting primary or secondary infertility with PCOS, and Group B: 73 women presenting primary infertility without PCOS. Statistical analysis was done using the statistical program Statistical Package for the Social Sciences 25.0.

Results: In 146 cases of primary sub-fertility, those with PCOS were similar to those that did not have PCOS with respect to factors, such as age, education, and occupation; however, differences were seen in that Group A included more 31–35-year-olds, whereas Group B included more ≤30-year-olds. Body mass index (BMI) was found to be significantly elevated in patients with PCOS, with more overweight patients, while most patients in all groups had a normal BMI. Hirsutism was found to be more prevalent in patients with PCOS.

Conclusion: Accordingly, in concluding, it could be noted that in sub-fertile women affected by PCOS, BMI values as well as cases of hirsutism have been found to be significantly higher in comparison to women not affected by PCOS, whereas regarding age, as well as level of education and occupation, it has been found that they are quite at par.

Keywords: Ovulatory dysfunction, polycystic ovary syndrome, primary sub-fertility

Introduction

Polycystic ovary syndrome (PCOS) - One of the most common endocrine disorders found in females in their reproductive age group, also considered to be responsible for causing sub-fertility in females with no history of previous illness or issue. Heterogeneous condition of ovulatory

dysfunction, hyperandrogenism, with polycystic changes in the ovaries, showing differences in prevalence across global populations.[1] The overall incidence of PCOS varies between 6% and 20% across different populations around the world, depending upon specific diagnostic criteria and ethnicity. Being a multifactorial disorder, PCOS presents many challenges during its treatment and diagnosis.[2] This applies especially to women who seek treatment due to an accompanying complaint of infertility. Infertility is the most common symptom among PCOS patients, and this is mainly due to anovulatory syndrome and hormone imbalance.[3] In this regard, primary sub-fertility, or the incapacity to conceive after 12 months of unprotected intercourse without previous conception, may be explained as related to PCOS, with major effects on physical, psychological, as well as social health.[4] In practice, cases of patients with PCOS have been presented with disorders involving menstrual cycles, hirsutism, obesity, as well as metabolic disorders, which all play critical roles in inferring fertility outcomes.[5] However, the Rotterdam Criteria, which were proposed in 2003, remain faithful in diagnosing cases of PCOS with two or more of the following: Oligo/anovulation, clinical as well as biochemical hyperandrogenism, as well as clitoral enlargement together with ultrasonographic evidence of polycystic ovaries after excluding endocrine diseases.[6] These parameters have helped the identification of different forms of PCOS, and this has shown the differences in different characteristics at the baseline. Comparatives, which compare characteristics with and without PCOS, among others, would be very important and essential for the understanding of the pattern and the different approaches used for the management of PCOS. Anthropometric parameters, for instance, body mass index (BMI), may be very crucial for the management and understanding of PCOS. There could be instances of obesity among women with PCOS, which is known to predominate in such cases, leading to insulin resistance and hyperandrogenism.[7] Nevertheless, there are reports suggesting an increased prevalence of PCOS in lean women, especially in Asian women, which highlights the significance of tailored clinical assessment for women from different populations.[8] Previous studies have established a positive correlation between increased BMI and the severity of hirsutism and disorders in menstrual pattern, besides the response to fertility treatment.[9] Hirsutism is an indicator of the multifunctional syndrome known as hyperandrogenism, which is a defining feature in the diagnosis and manifestation of PCOS, with a great effect on quality of life. There are ethnic variations in the prevalence and severity of hirsutism, which are determined both genetically and endogenously.[10] Comparative studies have shown that hirsutism is significantly more common in women with PCOS than in non-PCOS sub-fertile women, reinforcing its importance as a clinical marker in infertility evaluation.[5]

Methods

This is a cross-sectional comparative study conducted at the Fertility Care Centre, Department of Obstetrics and Gynaecology, Dhaka Medical College Hospital, Dhaka, from June 2015 to November 2015. The objective of this study is to describe the baseline clinical characteristics of primary sub-fertile women with and without PCOS. The study population includes primary sub-fertile women aged 18 years and above attending the Fertility Care Centre during the study period. In all, 146 women were enrolled in the study, with equal splits into two study groups: Group A comprised 73 women with PCOS, whereas Group B comprised 73 cases of primary sub-fertility sans PCOS. For diagnosis, the Rotterdam Criteria were used, which demand that patients manifest with two or more of the following: Oligo or anovulation, clinical or laboratory hyperandrogenism, ultrasonographic manifestations of PCOS. For inclusion, patients were either above 18 years of age or gave their informed consent. In terms of exclusion, patients were considered if they were severely ill, unwilling to be enrolled, or suffering from diabetes mellitus, hypertension, or other major diseases, to ensure homogeneity. Data collection involved a thorough medical history, clinical examination, and laboratory tests. The statistics have been

done using the Statistical Package for the Social Sciences version 25.0. Ethical clearance has been taken accordingly from the suitable authority. Informed consent has been taken from the patients. Hence, the research has been done according to the Declaration of Helsinki.

Results

Upon analyzing the sub-fertile females undergoing treatment for infertility, it was observed that the characteristics of females in both groups, namely, Group A with PCOS with 73 females, and Group B with non-PCOS females, were similar. As regards the distribution of females belonging to both groups, namely, females belonging to Group A with PCOS, and females belonging to Group B with non-PCOS, it was observed that the percentage of females in Group A who were ≤30 years was low when compared with females belonging to Group B, which was 39.7% and 46.6%, respectively. It was also observed that most females belonging to Group A, that is, females in the range of 31–35 years, were included in the large proportion when compared with females belonging to Group B, which was 42.5% as opposed to 27.4%, respectively. It was also noted that the number of females in Group A, that is, above 35 years, was low compared to females in Group B, that is, 17.8%, compared to 26.0%, respectively. Observations after analysis of the education qualifications are also the same, though. For example, it was noted that in Group A, 43.8% had only primary education, 37.0% had only secondary education, 11.0% were graduates, and 8.2% were illiterate. While in Group B, it was noted that 39.7% had only primary education, 34.2% had only secondary education, 12.3% were graduates, and 13.7% were ill. The majority of the female sample from the two groups consisted of housewives: Group A, 94.5%, Group B, 89.0%, as compared to females engaged in service-related jobs, constituting only 5.5% and 11.0%, respectively [Table 1]. Within Group A, only a few females could be characterized as underweight, that is, those having a BMI <18.5 (2.74% [*n* = 2]), and in Group B, females belonging to an underweight category are entirely missing. Most females from Groups A and B had normal weight, that is, BMI within the range of 18.5–24.9, constituting 65.75%. This is reflected in the overweight status, represented by a BMI between 25.0 and 29.9, observed among 31.51% (*n* = 23) Group A participants and 36.99% among Group B. The BMI ranged from 18.0 to 29.1 for Group A participants and from 18.6 to 29.0 for Group B participants. There was observed a

Table 1: Distribution of baseline characteristics among the participants (*n*=146)

Variables	Group A (*n*=73)		Group B (*n*=73)	
	n	Percentage	*n*	Percentage
Age				
≤30	29	39.7	34	46.6
31–35	31	42.5	20	27.4
>35	13	17.8	19	26
Mean±standard deviation	32.7±7.9		33.1±9.2	
Range (min-max)	20–47		20–50	
Education				
Primary	32	43.8	29	39.7
Secondary	27	37	25	34.2
Graduate	8	11	9	12.3
Illiterate	6	8.2	10	13.7
Occupation				
House wife	69	94.5	65	89
Service	4	5.5	8	11

Table 2: Distribution of body mass index characteristics among the participants (*n*=146)

Variables	Group A (*n*=73)		Group B (*n*=73)		*P*-value
	n	Percentage	*n*	Percentage	
<18.5 (Underweight)	2	2.74	0	0	-
Normal (18.5–24.9)	41	65.75	47	63.01	
Overweight (25.0–29.9)	23	31.51	27	36.99	
Mean	26.8±7.2		24.4±4.3		**0.001s**
Range (min-max)	18.0–29.1		18.6–29.0		

Statistically significant results

statistical difference between the mean BMI value for PCOS versus the non-PCOS group: 26.8 ± 7.2 versus 24.4 ± 4.3, respectively. It shows a significant difference in the average BMI of each group [Table 2]. In addition, hirsutism was prevalent among 26.0% of the participants belonging to Group A, compared to considerably low figures when compared to participants belonging to Group B. In fact, only 11.0% of participants belonging to Group B demonstrated signs of hirsutism. A larger number of participants demonstrating no signs of hirsutism, that is, 89.0%, comprised Group B compared to participants belonging to Group A, that is, 74.0%. It was established that the test conducted for participants demonstrating signs of hirsutism for both groups was significant, with $P = 0.019$ [Table 3].

Discussion

From the findings of our study, valuable insights can be gained on the intricate association between PCOS and various demographic, clinical, and biochemical factors across the entity of primary sub-fertility. In our study, the distribution of the subjects by age group revealed that the group of non-PCOS patients (Group B) was significantly younger, with 46.6% of the group having patients aged below or equal to 30 years, compared with the PCOS group (Group A), of whom only 39.7% were below or equal to 30 years. This could imply that concerns of sub-fertility may manifest at an earlier age among the subgroup of PCOS patients. In contrast, a larger number of patients within the PCOS group were aged between 31 and 35 years compared to the non-PCOS group (42.5% vs. 27.4%), which could lean toward the present trends of increased delayed child.[11,12]

Table 3: Distribution of Hirsutism among the participants (n=146)

Hirsutism	Group A (n=73)		Group B (n=73)		*P*-value
	n	Percentage	*n*	Percentage	
Present	19	26	8	11	**0.019s**
Absent	54	74	65	89	

Statistically significant results

The level of educational attainment among the two groups was similar. However, there was a slightly higher graduates' level in the sub-fertile women cohort within Group B. This could suggest that PCOS and sub-fertility affect women on all levels. In that sense, the need for effective fertility awareness among the wider public cannot be overstated.[13] Most of the participants of this group were housewives, although slightly more in Group A than in Group B, which comprised 94.5% and 89%, respectively, representing sociocultural factors rather than an association with PCOS itself.[14] Most notable, however, were variations in BMI across groups; women with PCOS had a higher mean BMI (26.8 ± 7.2), with 31.5% classified as overweight, compared to a mean BMI of 24.4 ± 4.3 in non-PCOS women, where 36.99% were overweight ($P = 0.001$). This result was consistent with other research on the relationship of PCOS to the incidence of being overweight or obese, culminating in hyperandrogenism and diminished fertility.[15,16] Finally, the most representative manifestation of hyperandrogenism, that is, hirsutism, registered significantly more frequently in the PCOS study population, that is, 26%, as opposed to 11% in the non-PCOS patient population ($P = 0.019$), further emphasizing the implication of this symptom in diagnosing PCOS, as well as the social stigma.[17] The mean age of the women with PCOS (Group A) was 32.7 ± 7.9 years, slightly younger than those without PCOS (33.1 ± 9.2 years). Most PCOS participants fell into the age category of 31–35 years, while most non-PCOS women were ≤30 years old. BMI was significantly greater in women with PCOS (26.8 ± 7.2) than in controls (24.4 ± 4.3, $P = 0.001$), with 31.5% overweight in Group A compared to 37.0% in Group B, reflecting a tendency toward higher adiposity in PCOS, as stated in international reports, although some studies show an even higher prevalence of overweight. Hirsutism was more frequent in PCOS (26%) than in controls (11%, $P = 0.019$), indicating severe hyperandrogenism in this cohort.[18]

Limitations of the study

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

Conclusion

Primary sub-fertile women with PCOS exhibited higher BMI and a greater prevalence of hirsutism compared to their non-PCOS counterparts, while age, education, and occupation were broadly similar between the groups. These findings highlight the prominent role of hyperandrogenism and increased body weight as distinguishing clinical characteristics in sub-fertile women with PCOS.

Recommendation

It is recommended that clinicians routinely assess BMI and hyperandrogenic features, such as hirsutism, in primary sub-fertile women to identify those with PCOS early. Incorporating these evaluations into fertility assessments can guide individualized management strategies, including lifestyle interventions and targeted treatments, to improve reproductive outcomes and overall metabolic health in this population.

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How to cite this article: Sarker A, Khan KB, Islam MT, Shampa L. Baseline clinical characteristics of primary sub-fertile women with and without polycystic ovary syndrome: A cross-sectional comparative study. Ann. Int. Med. Den. Res. 2026;12(1):26-31.

Source of Support: Nil, **Conflict of Interest:** None declared

Received: 25-Dec-2025; **Revised:** 20-Jan-2026;
Acceptance: 07-Feb-2026; **Published:** 10-Mar-2026

Original Research Article

https://doi.org/10.53339/aimdr.2026.12.1.6
E-ISSN: 2395-2822 | P-ISSN: 2395-2814

Risk factors associated with incomplete abortions: A retrospective study

Kamil Ara Khanam, Shain Fariya Shetu, Kohinoor Begum

Department of Obstetrics and Gynaecology, Popular Medical College, Dhaka, Bangladesh

Address of Correspondence: Dr. Kamil Ara Khanam, Professor, Department of Obstetrics and Gynaecology, Popular Medical College, Dhaka, Bangladesh. E-mail: gynae55@gmail.com

Abstract

Introduction: Incomplete abortion is a frequent complication of spontaneous and induced pregnancy loss and has a significant burden on the maternal morbidity, especially in low-resource environments. Issues such as advanced gestational age, late presentation, anemia, and unsafe abortion practices may predispose the risk of incomplete abortion and its associated complications. This paper will establish the risk factors that are linked to incomplete abortions.

Methods: This retrospective observational study was done at Popular Medical College, Dhaka, Bangladesh, between July 2024 and June 2025 and comprised 68 women who had incomplete abortion, which is defined as the retention of products of conception following spontaneous or induced abortion. The statistical analysis of the data obtained was done using the Statistical Package for the Social Sciences version 26.0.

Results: In 68 women who had incomplete abortion, the majority of those women were aged between 20 and 39 (75%), urban (57.4%), and multigravida (73.5%). All of them reported vaginal bleeding, 85.3% complained of abdominal pain. Risk factors such as anemia (39.7%), late presentation (>24 h) (29.4%), and misoprostol use without supervision (22.1) were common. The predominant method of management was manual vacuum aspiration (60.3%), with complications in 38.2% of cases, most often infection (16.2%).

Conclusion: This research discovered that incomplete abortions were prevalent among women aged between 20 and 29 years, those with lower socioeconomic statuses, and those with multiparous status. The percentage of abortions attempted after 8–12 weeks of gestation and with the attempts having been medical or unsafe by the time they were attempted, with the provided example being frequently an untrained provider.

Keywords: Anemia, incomplete abortions, manual vacuum aspiration

Introduction

Incomplete abortion, the inability to expel all the products of conception following an automatic loss of pregnancy or an induced loss of pregnancy, is a frequent and probably severe complication of pregnancy termination and miscarriage, particularly when the care is delayed and/or not done to the recommended norms.[1,2] Tens of millions of abortions take place annually all over the world, and a large fraction of this number are of the less safe or least safe type, putting women at risk of experiencing heavier crashes, incomplete abortion, bloodshedding, and infection.[2,3] The World Health Organization highlights the role of incomplete abortion in contributing to morbidity and mortality in places where unsafe abortion procedures and late post-abortion care are prevalent and supports evidence-based abortion care and post-abortion care in a timely manner to help

reduce adverse events.[1,4] This knowledge of the risk factors related to incomplete abortion is vital in very important aspects; this enables clinicians and health systems to recognize the high-risk patients, maximize the population of those at risk during early diagnosis, and choose the right management approach (expectant, medical, or surgical). According to previous studies, there are a number of patient-level and system-level determinants. Patient factors repeatedly associated with adverse post-abortion outcomes include advanced maternal age, higher body mass index, anemia, and prior uterine instrumentation or prior pregnancy loss(s).[5-8] For example, retrospective analyses of first-trimester pregnancy losses and missed abortions have found age and elevated body mass index to be independent predictors of failed or complicated pregnancy resolution, which may manifest clinically as incomplete passage of tissue.[8] Uterine factors (anomalies, scarring from prior cesarean or curettage) and retained products after medical abortion are also well-documented contributors to incomplete evacuation.[6,7] Method and context of pregnancy termination are equally important. Studies comparing medical and surgical approaches report differing rates of incomplete abortion depending on gestational age, method used, and provider experience; inadequate or inappropriate technique and self-induced or clandestine procedures markedly increase the risk of incomplete abortion and severe complications.[5,6] Delays in seeking care – whether because of limited access, restrictive laws, stigma, or referral processes – are consistently linked to worse clinical presentations and higher rates of retained products and infection.[5,9] Health-system interventions such as routine screening, timely uterine evacuation, standardized post-abortion protocols, and access to the World Health Organization (WHO)-recommended methods have been shown to reduce complication rates and improve outcomes.[4,6] Despite growing evidence, heterogeneity in study designs, definitions (incomplete vs. missed vs. retained products), and local abortion practices complicates direct comparisons across settings. Recent retrospective and facility-based studies from low- and middle-income countries underscore a continued high burden of incomplete abortion among hospital admissions and point to modifiable factors – delayed presentation, self-induction, anemia, and prior obstetric history – that can be targeted by public health measures and clinical protocols.[5,9,10] This retrospective study aims to identify risk factors associated with incomplete abortions.

Methods

This retrospective observational study was conducted at Popular Medical College, Dhaka, Bangladesh, from July 2024 to June 2025, and included 68 women diagnosed with incomplete abortion, defined as retention of products of conception after a spontaneous or induced abortion. Inclusion criteria were women of reproductive age with confirmed incomplete abortion and complete hospital records, while exclusion criteria included missed abortions, molar pregnancies, ectopic pregnancies, and incomplete or missing records. Purposive sampling was employed to select all eligible cases during the study period. Data were extracted using a pre-designed data collection form, including sociodemographic characteristics, obstetric history, gestational age at abortion, method of abortion, clinical presentation, management, and complications. Data collected were keyed in the Statistical Package for the Social Sciences version 26.0. The data were summarized using descriptive statistics (frequencies, percentages, mean ± standard deviation). Informed written consent was secured by obtaining ethical approval from the institutional ethical review committee and the participants were informed. Acquired through interviews with respondents on hospital admission and the patient information have been kept secret throughout the study.

Results

Most participants were aged 20–29 years (38.2%) and 30–39 years (36.8%). A majority lived in urban areas (57.4%), and 41.2% had secondary education [Table 1].

Most women were multigravida (73.5%). A history of previous abortion was present in 30.9%, and 13.2% had prior uterine instrumentation [Table 2].

All participants had vaginal bleeding, and 85.3% reported abdominal pain. Fever was present in 27.9%, and 10.3% showed hemodynamic instability [Table 3].

The most common risk factor was anemia (39.7%), followed by delayed presentation (29.4%) and unsupervised misoprostol use (22.1%) [Table 4].

The majority were managed with manual vacuum aspiration (MVA) (60.3%), followed by dilatation and curettage (D&C) (29.4%). Medical management was used in 10.3% of cases [Table 5].

Table 1: Sociodemographic characteristics of participants (*n*=68)

Variable	Category	Frequency	Percentage
Age group (years)	<20	10	14.7
	20–29	26	38.2
	30–39	25	36.8
	≥40	7	10.3
Residence	Urban	39	57.4
	Rural	29	42.6
Education level	No formal education	11	16.2
	Primary	16	23.5
	Secondary	28	41.2
	Higher	13	19.1

Table 2: Obstetric history of participants (*n*=68)

Variable	Category	Frequency	Percentage
Gravidity	Primigravida	18	26.5
	Multigravida	50	73.5
Parity	Nulliparous	22	32.4
	Para 1–2	31	45.6
	Para ≥3	15	22.0
History of previous abortion	Yes	21	30.9
	No	47	69.1
Prior uterine instrumentation	Yes	9	13.2
	No	59	86.8

Complications occurred in 38.2% of participants, with infection reported in 16.2%. Most participants (61.8%) had no complications [Table 6].

Discussion

In this study, 26.5% of women presented with a gestational age beyond 12 weeks, and these individuals experienced higher complication rates. The same was observed by Gebresilassie

Table 3: Clinical presentation at admission (*n*=68)

Clinical feature	Present *n* (%)	Absent *n* (%)
Vaginal bleeding	68 (100)	0
Lower abdominal pain	58 (85.3)	10 (14.7)
Fever	19 (27.9)	49 (72.1)
Foul-smelling discharge	12 (17.6)	56 (82.4)
Hemodynamic instability	7 (10.3)	61 (89.7)

Table 4: Identified risk factors for incomplete abortion (*n*=68)

Risk factor	Present *n* (%)	Absent *n* (%)
Anemia (hemoglobin <11 g/dL)	27 (39.7)	41 (60.3)
Gestational age >12 weeks	18 (26.5)	50 (73.5)
Misoprostol use without supervision	15 (22.1)	53 (77.9)
Self-induced abortion attempt	10 (14.7)	58 (85.3)
Delayed presentation (>24 h)	20 (29.4)	48 (70.6)

Table 5: Management methods used (*n*=68)

Management method	Frequency	Percentage
MVA	41	60.3
D&C	20	29.4
Medical management (misoprostol)	7	10.3

MVA: Manual vacuum aspiration, D&C: Dilatation and curettage

Table 6: Complications observed (*n*=68)

Complication	Frequency	Percentage
Infection	11	16.2
Severe anemia	8	11.8
Need for blood transfusion	6	8.8
Uterine perforation	1	1.5
No complications	42	61.8

et al. in Ethiopia, in which abortions made above 12 weeks were strongly related to undesirable results (adjusted odds ratio [AOR] 3.39).[11] A different study in Northwest Ethiopia reported the same result where gestational age of over 13 weeks was a significant one prognosticator of problems after partial abortions.[12] Another interesting factor was delayed presentation. In our group, 29.4% of those who arrived later than 24 h after the onset of symptoms. Our data showed that delayed presentation was related to an increased rate of infection and anemia. Other similar results were made study, in which the duration of delay of more than 72 h substantially worsened the results of abortion (AOR 3.08).[9] Similarly, Getie *et al*. revealed that post-abortion was highly associated with delays of more than 24 h. such complications as sepsis and long hospital stay.[10] A third of our participants had anemia 39.7%. A number of them also acquired additional complications like infection or transfusion. A study conducted at Jimma University Medical Center determined that moderate anemia (hemoglobin 7–10 g/dL) was an important predictor of complicated abortion or post-second-trimester medical abortion.[9] In addition, Dibaba *et al*. revealed that the history of unsafe abortion played a significant role in predisposing women in reproductive age to anemia (AOR 5.40).[13] Misoprostol used without medical advice was 22.1% in our sample and 14.7% reported attempts of trying to abort oneself. Past researches have noted the harmfulness of unguarded medical abortion. An example is a Nigerian study conducted by Thapa *et al*. which found that the unsupervised use of misoprostol was responsible. High percentage of unsuccessful abortions that need surgical evacuation.[14] A study in India by Iyengar *et al*. also documented that abortifacient self-medication has also played a significant role as a contributing factor to incomplete or unsafe abortion cases.[15] Concerning management, 60.3% of our participants were subjected to the use of manual vacuum aspiration. The percentages of MVA, 29.4% under (D&C), and 10.3% under medical management were (MVA), 29.4 and (D&C), 10.3, respectively. Evidence from a WHO researcher has conducted a large multicountry analysis which suggests that MVA has fewer complications and hospital stay as opposed to D&C, and this makes sense in our situation where this treatment should be the one mainly used.[16] In addition, research conducted by Raghavan *et al*. showed that MVA is also related to considerably reduce intraoperative hemorrhage and decreased postoperative infections.[17] We have a higher complication rate (38.2) compared to the recent reports, including the work by Getie *et al*., of which only 12.3% attained adverse results.[10] Differences may be attributable to variations in referral patterns, delay before presentation, and local healthcare-seeking behaviors.

Limitations of the study

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

Conclusion

This study found that incomplete abortions occurred most frequently among women aged 20–29 years, those from lower socioeconomic backgrounds, and multiparous women. A large proportion presented after 8–12 weeks of gestation and had undergone medical or unsafe abortion attempts, often by untrained providers. The most common complications were excessive bleeding and infection, indicating delays in seeking care and inadequate access to safe abortion services.

Recommendations

Enhancing access to safe, timely, and supervised abortion services is critical to lowering the incompleteness. abortions. Interventions on community health must concentrate on enhancing the level of awareness in terms of early care-seeking. employment of trained providers, and diffusion of contraceptive counseling to prevent unwanted pregnancy.

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How to cite this article: Khanam KA, Shetu SF, Begum K. Risk factors associated with incomplete abortions: A retrospective study. Ann. Int. Med. Den. Res. 2026;12(1):32-36.

Source of Support: Nil, **Conflict of Interest:** None declared

Received: 25-Dec-2025; **Revised:** 22-Jan-2026; **Acceptance:** 10-Feb-2026; **Published:** 10-Mar-2026

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Original Research Article

https://doi.org/10.53339/aimdr.2026.12.1.7
E-ISSN: 2395-2822 | P-ISSN: 2395-2814

Frequency and determinants of asymptomatic malaria infection among adults in Bouar, Western Central African Republic

Md Niaz Mostafa[1], Umme Hani[2], Israt Jahan[3], Md Atiqur Rahman[4], Md Khademul Hasan Razonn[5], Md Zahirul Islam[6]

[1]Department of Medicine, Combined Military Hospital, Chittagong, Bangladesh, [2]Department of Pathology, Armed Forces Medical College, Dhaka, Bangladesh, [3]Department of Radiation Oncology, Combined Military Hospital, Dhaka, Bangladesh, [4]Department of Orthopedic Surgery, Combined Military Hospital, Cumilla, Bangladesh, [5]Department of Surgery, Combined Military Hospital, Bogura, Bangladesh, [6]Department of Radiology, Combined Military Hospital, Cumilla, Bangladesh

Address for correspondence: Dr. Md Niaz Mostafa, Combined Military Hospital, Chittagong, Bangladesh.
E-mail: niaz.mostafa@gmail.com

Abstract

Background: Asymptomatic malaria infections are hidden reservoirs that sustain transmission cycles and thwart elimination efforts in endemic communities. The study aimed to determine the prevalence and determinants of asymptomatic malaria infection among Bouar adults in the Western Central African Republic (CAR).

Methods: A comparative cross-sectional study was carried out among 234 adults aged ≥18 years in Bouar, Western CAR, from June 2024 to November 2024. Participants were enrolled using systematic random sampling from the health camps. Sociodemographic data, medical history, and preventive measures were obtained using structured questionnaires. Clinical examination and venous blood sampling for hematological and biochemical tests were undertaken. Malaria infection was diagnosed by rapid diagnostic tests and confirmatory light microscopy. Asymptomatic malaria was defined as microscopic parasite detection in afebrile individuals. Data were analyzed in the Statistical Package for the Social Sciences version 26, including descriptive statistics, bivariate analysis using Chi-square tests, and multivariable logistic regression to identify independent predictors.

Results: Asymptomatic malaria frequency was 10.3% (24/234). Rural residence was the strongest predictor of infection (adjusted odds ratio [aOR] = 4.10, 95% confidence interval [CI]: 1.28–13.2, $P = 0.010$). Both use of mosquito nets (aOR = 0.38, 95% CI: 0.16–0.91, $P = 0.030$) and repellents (aOR = 0.42, 95% CI: 0.18–0.97, $P = 0.040$) were significantly protective. All microscopy-positive participants resided in rural areas and did not use mosquito nets or repellents. Anemia was more prevalent in infected participants (16.7% vs. 11.4%, $P = 0.02$).

Conclusion: Asymptomatic malaria exists in one in ten Bouar adults, with rural residence being the primary risk factor. Vector control measures provide strong protection but are ominously underused. Rural-specific strategies for vector control use and socioeconomic barriers are needed to reduce this hidden reservoir of transmission.

Keywords: Asymptomatic malaria, rural health, vector control

Introduction

Malaria remains a significant public health issue, particularly in Africa, where the continent carries the largest burden of the disease. Falciparum malaria causes the majority of deaths in Africa, and its transmission is influenced by climate, economics, geography, human activities, and

unstable security conditions.[1] The World Health Organization's 2024 report places the estimate of 263 million cases and 597,000 deaths worldwide in 2023 at 11 million higher than in 2022.[2] The African continent remains the most affected region, with 94% of all malaria cases in the world and 95% of all malaria deaths in 2023 being reported there, with children under 5-years-old accounting for 76% of malaria deaths.[3] The Central African Republic is facing particular difficulties in managing malaria due to repeated sociopolitical instability, weak healthcare infrastructure, and widespread poverty. *Anopheles gambiae* is the main vector of malaria, and 99.6% of malaria cases are caused by *Plasmodium falciparum* in the country.[4] All these factors create a "fragile state" context that makes it, especially difficult to eradicate malaria. In addition to this, asymptomatic malaria infection, where people carry the parasite without appearing to have symptoms, is a major obstacle for control and elimination. These people, usually being partially immunized, lead to transmission of malaria since they are not detected and treated.[5] Asymptomatic carriers are not detected by regular surveillance, which acts as an obstacle to malaria eradication.[6] Where transmission is intense, adult individuals are likely to develop incomplete immunity to *P. falciparum*, resulting in low-density parasitemia but without symptoms.[7] This creates a reservoir of infectious people who remain untreated and continue causing ongoing transmission and posing a barrier to elimination.[8] Understanding the prevalence and determinants of asymptomatic malaria is thus of critical concern to establish effective policies that target both symptomatic and asymptomatic transmission. Insecticide-treated bed nets (ITNs) and indoor residual spraying remain the major prevention measures today but are dependent on proper use, which in turn is dependent on economic status, educational level, and accessibility to resources.[9] Rural communities are particularly hindered in their capability of utilizing such preventive measures, leading to continued transmission in some areas.[10] Despite the huge investment in malaria control, the progress toward elimination has stalled in most African countries, especially in rural and impoverished populations, where biological, environmental, and socioeconomic drivers reinforce each other to sustain transmission.[11] The objective of this study is to assess the prevalence and determinants of asymptomatic malaria infection among adults in Bouar, Western Central African Republic. Across identification of significant risk factors and protective practices associated with asymptomatic infection, this study aims to provide evidence toward evidence-based control and elimination programs against malaria in this challenging setting.

Methods

This community-based cross-sectional comparative study was conducted among adult residents of Bouar, Western Central African Republic, to assess the frequency and determinants of asymptomatic malaria infection. Data were collected from June 2024 to November 2024, with a total of 234 participants aged over 18 years were recruited from the health camps at Bouar, Central African Republic, through systematic random sampling. After obtaining informed consent, information on sociodemographic background, socioeconomic status, medical history, and preventive practices was collected using a structured questionnaire. Clinical examination was performed for all participants, and venous blood samples were obtained for hematological and biochemical analyses. Malaria infection was diagnosed using rapid diagnostic immunochromatographic tests and confirmatory light microscopy. Asymptomatic malaria was defined as the presence of malaria parasites on microscopy in individuals without fever.

Data were entered into Microsoft Excel and analyzed using the Statistical Package for the Social Sciences version 26. Descriptive statistics were used to summarise categorical variables as frequencies and percentages. Bivariate analysis using chi-square tests was performed to compare sociodemographic, clinical, and preventive practice variables between microscopy-positive and microscopy-negative groups. Pearson correlation was applied to assess relationships between

demographic and laboratory variables. To identify independent predictors of asymptomatic malaria, multivariable logistic regression was conducted. Odds ratios (OR) with 95% confidence intervals (CI) were reported, and statistical significance was set at $P < 0.05$.

Results

Table 1 represents the sociodemographic characteristics of the study population by microscopic positive and negative status. The age groups show that the 21–30 years age group is the most prominent in both groups (41.6% vs. 46.2%). The gender distribution was nearly equal, with a mild female preponderance. Educational levels were high for illiteracy rates (66.7% vs. 59.0%), with manual labor being the most frequent occupation. Income analysis revealed that poverty and non-poverty denote both 50% of cases. Notably, all microscopy-positive cases resided in rural areas (100% vs. 84.8%, $P = 0.010$), with rural residence representing a risk factor for asymptomatic malaria infection in this cohort [Table 1].

Table 2 demonstrates clinical features and laboratory parameters between microscopy-positive and microscopy-negative groups. Anemia (hemoglobin [Hb] <11 g/dL) was more frequent in microscopy-positive individuals (16.7% vs.

Table 1: Sociodemographic characteristics by microscopy status (*n*=234)

Variable	Category	Microscopy positive (*n*=24) (%)	Microscopy negative (*n*=210) (%)	*P*-value
Age group	≤20	2 (8.3)	30 (14.2)	0.900
	21–30	10 (41.6)	111 (46.2)	
	31–40	8 (33.3)	48 (22.8)	
	41–50	3 (12.5)	15 (7.1)	
	51–60	1 (4.2)	6 (2.5)	
Gender	Male	11 (45.8)	94 (44.8)	0.930
	Female	13 (54.2)	116 (55.2)	
Education	None	16 (66.7)	124 (59.0)	0.490
	Primary	1 (4.2)	15 (7.1)	
	Secondary	4 (16.7)	34 (16.2)	
	Graduate and above	3 (12.5)	37 (17.6)	
Occupation	Manual worker	14 (58.3)	108 (51.4)	0.540
	Sedentary worker	6 (25.0)	70 (33.3)	
	Housewife	3 (12.5)	19 (9.0)	
	Other	1 (4.2)	13 (6.2)	
Religion	Christian	22 (91.7)	176 (83.8)	0.310
	Muslim	2 (8.3)	34 (16.2)	
Marital	Married	21 (87.5)	173 (82.4)	0.550
	Unmarried	3 (12.5)	37 (17.6)	
Income	Poverty (<12000 CFA)	12 (50.0)	76 (36.2)	0.190
	Non-poverty (≥12000 CFA)	12 (50.0)	134 (63.8)	
Family	Nuclear	15 (62.5)	131 (62.4)	0.990
	Joint	9 (37.5)	79 (37.6)	
Residence	Rural	24 (100.0)	178 (84.8)	0.010*
	Urban	0 (0.0)	32 (15.2)	

Table 2: Clinical and comorbidity profile by microscopy status (*n*=234)

Variable	Category	Microscopy positive (*n*=24) (%)	Microscopy negative (*n*=210) (%)	*P*-value
Hypertension	Present	3 (12.5)	41 (19.5)	0.410
	Absent	21 (87.5)	169 (80.5)	
Diabetes	Present	2 (8.3)	3 (1.4)	0.09
	Absent	22 (91.7)	207 (98.6)	
Chronic kidney disease	Present	1 (4.2)	9 (4.3)	0.980
	Absent	23 (95.8)	201 (95.7)	
Ischemic heart disease	Present	1 (4.2)	11 (5.2)	0.840
	Absent	23 (95.8)	199 (94.8)	
Chronic obstructive pulmonary disease	Present	0 (0.0)	6 (2.9)	0.420
	Absent	24 (100.0)	204 (97.1)	
Chronic liver disease	Present	0 (0.0)	8 (3.8)	0.330
	Absent	24 (100.0)	202 (96.2)	
Peptic ulcer disease	Present	1 (4.2)	13 (6.2)	0.710
	Absent	23 (95.8)	197 (93.8)	
Hemoglobin<11 g/dL	Yes	4 (16.7)	24 (11.4)	0.02
	No	20 (83.3)	186 (88.6)	
White blood cell abnormal	Yes	2 (8.3)	16 (7.6)	0.930
	No	22 (91.7)	194 (92.4)	
Platelet low	Yes	2 (8.3)	12 (5.7)	0.660
	No	22 (91.7)	198 (94.3)	
Creatinine high	Yes	1 (4.2)	9 (4.3)	0.980
	No	23 (95.8)	201 (95.7)	
Liver function test deranged	Yes	1 (4.2)	11 (5.2)	0.840
	No	23 (95.8)	199 (94.8)	

11.4%, $P = 0.02$), suggesting a potential link between asymptomatic malaria and low Hb. The rest of the comorbidities, such as hypertension, chronic kidney disease, ischemic heart disease, chronic obstructive pulmonary disease, chronic liver disease, and peptic ulcer disease, did not have any significant relationship. Laboratory derangements in white blood cell count, platelet count, creatinine, and liver function tests (LFT) were equally distributed in both groups [Table 2].

Table 3 reveals the disparities in malaria preventive measures between microscopy-positive and microscopy-negative groups. None of the microscopy-positive patients used mosquito nets (0% vs. 9.5%, $P = 0.02$) or repellents (0.0% vs. 1.9%, $P < 0.001$). Prophylaxis use was also significantly less among positive cases (4.2% vs. 6.2%, $P = 0.03$). These low rates of net use and repellent use overall in both groups indicate substantial gaps in the adoption of malaria prevention that must be urgently closed through targeted public health interventions [Table 3].

The multivariable analysis in Table 4 indicates independent predictors of asymptomatic malaria after controlling for confounding factors. Rural residency was the most predictive, with rural adults having more than four-fold increased odds of infection compared to urban residents (adjusted OR [aOR] = 4.10, 95% CI: 1.28–13.2, $P = 0.010$). Mosquito net usage had significant

Table 3: Preventive practices by microscopy status (*n*=234)

Variable	Category	Microscopy positive (*n*=24) (%)	Microscopy negative (*n*=210) (%)	*P*-value
Mosquito net use	Yes	0 (0.0)	20 (9.5)	0.02
	No	24 (100.0)	190 (90.5)	
Repellent use	Yes	0 (0.0)	4 (1.9)	<0.001
	No	24 (100.0)	206 (98.1)	
Prophylaxis use	Yes	1 (4.2)	13 (6.2)	0.03
	No	23 (95.8)	197 (93.8)	

Table 4: Multivariable logistic regression analysis for predictors of asymptomatic malaria (*n*=234)

Variable	Category	Adjusted odds ratio	95% Confidence interval	*P*-value
Residence	Rural versus urban	4.10	1.28–13.2	0.010
Mosquito net use	Yes versus No	0.38	0.16–0.91	0.030
Repellent use	Yes versus No	0.42	0.18–0.97	0.040
Age group	>40 versus ≤40	1.12	0.56–2.26	0.740
Gender	Male versus Female	0.94	0.47–1.88	0.870
Diabetes	Present versus Absent	1.31	0.42–4.07	0.640
Hypertension	Present versus Absent	0.89	0.33–2.41	0.820
Hemoglobin<11 g/dL	Yes versus No	1.56	0.52–4.64	0.430

protection, reducing the odds of infection by 62% (aOR = 0.38, 95% CI: 0.16–0.91, *P* = 0.030). Repellent usage also provided substantial protection, with a 58% decreased risk of infection (aOR = 0.42, 95% CI: 0.18–0.97, *P* = 0.040). Notably, demographic factors of gender and age, and clinical diagnoses of anemia, hypertension, and diabetes, were not independently significantly associated [Table 4].

The forest plot in Figure 1 illustrates that rural residence was a strong and statistically significant predictor of asymptomatic malaria, with adults in rural areas having more than fourfold higher odds of parasite positivity compared to urban residents (OR = 4.10, 95% CI: 1.28–13.2, *P* = 0.01). In contrast, preventive practices, such as mosquito net use (OR = 0.38, 95% CI: 0.16–0.91, *P* = 0.03) and repellent use (OR = 0.42, 95% CI: 0.18–0.97, *P* = 0.04) were protective, significantly reducing the odds of asymptomatic infection. Other factors, including age, gender, diabetes, hypertension, and low Hb, did not show significant associations [Figure 1].

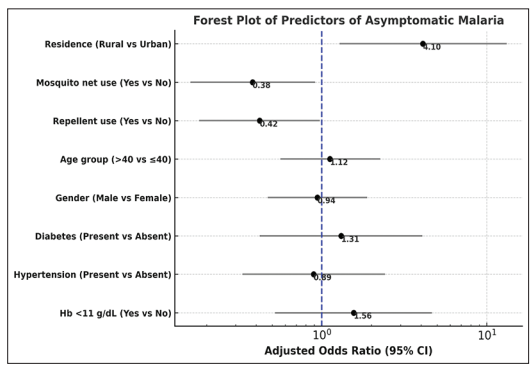

Figure 1: Forest Plot of predictors of asymptomatic malaria among adults in Bouar, Western Central African Republic (*n*=234)

The Pearson correlation heatmap in Figure 2 depicts the linear relationships among demographic, clinical, and laboratory variables in the study cohort. Blue intensity shows the strength of correlation (darker = stronger), while the values inside each box represent the correlation coefficients (R-values). Moreover, most correlations were weak to moderate. Hb, platelet count, and white blood cell count showed mild positive associations,

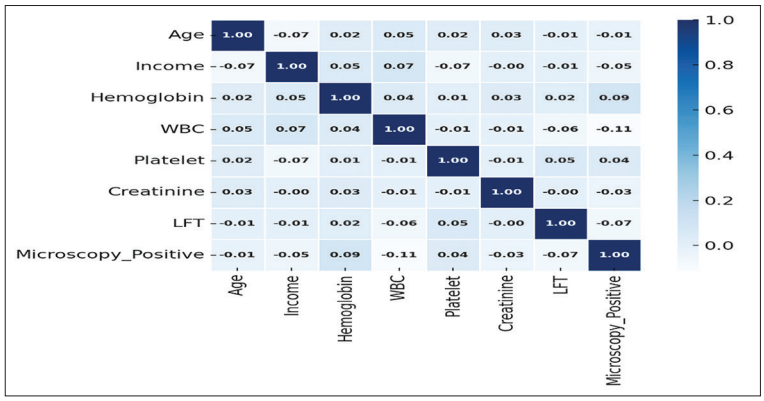

Figure 2: Pearson correlation heatmap of clinical, laboratory, and demographic variables (*n*=234)

while age and income demonstrated negligible correlations with laboratory measures. Creatinine and LFTs also correlated only weakly with other parameters. Notably, microscopy positivity for asymptomatic malaria showed minimal linear correlation with the evaluated demographic and laboratory variables, reinforcing that residence and preventive practices, rather than baseline clinical parameters, were the main drivers of infection risk in this population [Figure 2].

The framework in Figure 3 demonstrates that rural residence, poverty, and low education increase the risk of asymptomatic malaria (10.3%), while mosquito net and repellent use are protective. The findings highlight the role of asymptomatic carriers as a reservoir for transmission, emphasizing the need for targeted rural interventions [Figure 3].

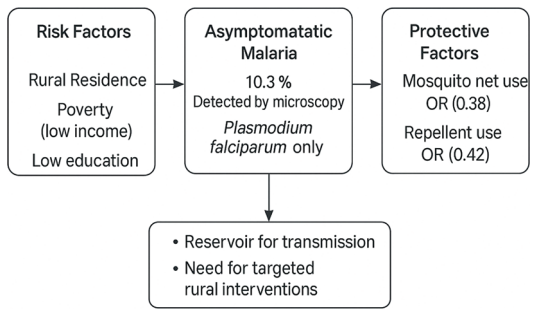

Figure 3: Conceptual framework of asymptomatic malaria infection in Bouar, Western Central African Republic

Discussion

This community-based cross-sectional study provides significant epidemiological data on asymptomatic malaria among adults in Bouar, Western Central African Republic, with a frequency of 10.3% and risk and protective determinants. The findings are in agreement with the overall African context in which malaria remains a significant public health issue and where transmission patterns are dictated by climate, economics, geography, and human activity.[1] The 10.3% asymptomatic malaria among adults is consistent with regional studies in the Central African Republic. Another study by Korzeniewski *et al*.[12] and during the COVID-19 pandemic[13] has demonstrated that asymptomatic infections are a significant reservoir of the parasite for transmission by Anopheles mosquitoes. This hidden burden of infection is a central challenge to malaria elimination efforts because asymptomatic infection is difficult to diagnose, yet represents an important potential source and reservoir of malaria transmission in Africa.[14] The strongest predictor of asymptomatic malaria was rural residence, with rural residents experiencing more than 4 times greater odds of infection compared to urban residents. This finding corroborates present evidence of intense transmission of malaria in rural compared to urban areas,[15] based on multiple factors, such as proximity to vector breeding sites, limited access to health care, and reduced

implementation of control measures. In the Central African Republic alone, transmission of malaria is intense, with the main vector being *A. gambiae* and *P. falciparum* responsible for 99.6% of the infections.[16] The protection afforded by mosquito nets (OR = 0.38) and repellents (OR = 0.42) confirms the continued importance of vector control measures. However, the extremely low levels of use detected in this study – particularly the complete absence of protective measures in infected subjects – demonstrate worrying shortcomings in the application of malaria prevention. Similar findings in Central African Republic refugees indicated that inappropriate use of ITNs was amenable to correction by sensitization campaigns.[17] The low uptake of prevention interventions might be attributable to socioeconomic constraints, as half of the infected respondents lived in absolute poverty. Adults were previously found to be at increased risk of clinical malaria events due to waning antimalarial immunity from decreased parasite exposure,[18] suggesting complex interactions between host factors and infection risk. The association of asymptomatic malaria with reduced Hb level ($P = 0.02$) indicates subclinical influences on hematological parameters. The finding has important ramifications for the comprehension of the overall health impact of asymptomatic infections, which may contribute to the anemia burden in endemic populations despite the absence of any clinical symptoms.[19] This study emphasizes that malaria continues to exact a severe toll on African public health due to complex, interconnected biological, environmental, and socioeconomic determinants.[1] The findings corroborate this multifactorial etiology, showing how geographical, behavioral, and socioeconomic determinants combine to determine infection risk. Recent worldwide reports indicate that case incidence rates have leveled off in Africa and, with the population at risk increasing quickly, the absolute number of *P. falciparum* cases in Africa remains comparable to pre-investment levels.[20] The study's implications extend from individual-level health outcomes to community-level transmission dynamics. Asymptomatic carriers are silent reservoirs that sustain transmission cycles and thwart elimination, and their concentration in rural populations suggests the need for geographically targeted interventions that address both vector control and socioeconomic determinants of health.

Limitations of the study

This cross-sectional study design limits causal inference regarding observed risk factors and asymptomatic malaria infection. The study's focus on a single geographic location may limit generalizability to other parts of the Central African Republic or to larger sub-Saharan African contexts. The relatively small sample size of microscopy-positive cases ($n = 24$) may also have reduced statistical power to detect associations with less common risk factors or comorbidities.

Conclusion

This study reveals a high frequency of asymptomatic malaria (10.3%) among adults in Bouar, Western Central African Republic, with rural residency being the predominant risk factor that confers four-fold increased infection chances. The complete absence of vector control measures in infected individuals, in contrast to the intense protection provided by mosquito nets and repellents, indicates a pressing need for deficiencies in the implementation of malaria prevention. The grouping of asymptomatic infections within rural communities, together with their position as occult transmission reservoirs, underscores the importance of geographically targeted interventions. The findings emphasize that successful malaria elimination programs must prioritize rural communities by enhancing access to vector control, implementing public awareness campaigns, and addressing the underlying socioeconomic drivers that persistently expose populations to infection in endemic settings.

Recommendations

Future studies should utilize longitudinal study designs to establish temporal relationships between risk factors and asymptomatic malaria acquisition, scaling to multiple geographic locations for increased generalizability. Implementation research

is also desperately needed to develop and evaluate culturally appropriate, low-cost interventions to increase vector control uptake among rural populations.

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How to cite this article: Mostafa MN, Hani U, Jahan I, Rahman MA, Razonn MKH, Islam MZ. Frequency and determinants of asymptomatic malaria infection among adults in Bouar, Western Central African Republic. Ann. Int. Med. Den. Res. 2026;12(1):37-44.

Source of Support: Nil, **Conflict of Interest:** None declared

Received: 18-Dec-2026; **Revised:** 17-Jan-2026;
Acceptance: 06-Feb-2026; **Published:** 10-Mar-2026

Original Research Article

https://doi.org/10.53339/aimdr.2026.12.1.8
E-ISSN: 2395-2822 | P-ISSN: 2395-2814

Molecular study of non-small cell carcinoma of lung in a tertiary-level laboratory in Bangladesh

Md. Iqbal Karim, Shamoli Yasmin

Department of Pathology, Armed Forces Institute of Pathology, Dhaka, Bangladesh

Address for correspondence: Dr. Md. Iqbal Karim, Department of Pathology, Armed Forces Institute of Pathology, Dhaka, Bangladesh. E-mail: iqbalhistopath@gmail.com

Abstract

Introduction: Lung cancer is the most common cause of cancer related deaths in the world as well as in Bangladesh. In both male and female Non Small Cell Lung Carcinoma (NSCLC) are the major type of Lung cancer. Molecular and genetic profiling has been made in the recent times, which has led to a significant improvement in treatment outcomes, survival, and quality of life, including epidermal growth factor receptor (EGFR) mutations, anaplastic lymphoma kinase (ALK) and c-ros oncogene 1 (ROS1) rearrangements, and programmed death ligand 1 (PD-L1) expression, which were evaluated by reverse transcription polymerase chain reaction (RT-PCR) and immunohistochemistry (IHC).

Methods: It is a retrospective study that was done at the Armed Forces Institute of Pathology, Dhaka, between January 2022 and December 2023, with 220 patients diagnosed with NSCLC. RT-PCR was done to analyze EGFR mutation, and IHC was done to analyze ALK, ROS1, and PD-L1 by Ventana systems. The Statistical Package for the Social Sciences version 20 was used to conduct statistical analysis, and patient outcomes after targeted therapy with or without chemotherapy were analyzed.

Results: The mean age was 63.5 (range of 41–80) years with a male-to-female ratio of 2.6:1. The best-described subtype was adenocarcinoma (81.8%). The prevalence of EGFR mutation was observed in 20% of cases, and then, ALK (2.7%), ROS1 (1.8%), and PD-L1 positivity followed (3.6%). The most common EGFR mutation was exon 19 deletion (50%). Patients of Stage II and III had a better therapeutic response as compared to those of Stage IV. Targeted therapy showed better results in contrast to standard chemotherapy.

Conclusion: Although the economic constraints limit the use of molecular testing as a universal method in Bangladesh, patients who underwent molecular testing responded positively to either targeted or immunotherapies, especially patients with EGFR exon 18 and 19 mutations and PD-L1 positive cases.

Keywords: Chemotherapy, epidermal growth factor receptor, mutation, non-small cell cancer

Introduction

Lung carcinoma is one of the leading causes of death worldwide. The world data indicate 2.5 million newly diagnosed cases, 1.8 million deaths of patients.[1] Lung cancer occurs in non-small cell lung carcinoma (NSCLC) and small cell lung cancer. NSCLC and small cell carcinoma account for approximately 80–85% and 5–10% lung cancers, respectively. Other categories of cancers, such as small cell carcinoma, large cell carcinoma, etc.[2] The way the treatment of the patient will be different is also not the same, and that depends on prognosis and the final outcome of the life of the patient; hence, it is important to detect the molecular study of lung cancer to assist the physician in treating the patient.[3] The World Health Organization 22 blue book shows that non-

small cell cancers are adenocarcinoma, squamous cell carcinoma, and large cell carcinoma, which constitute approximately 40% of lung cancer.

Each tumor contains some type of driver mutations, without which the existence of the type of tumor would have been impossible. The mutations are complex in their molecular pathogenesis of cancer that is essential in tumor progression. The major alterations are epidermal growth factor receptor (EGFR), Kirsten rat sarcoma virus, anaplastic lymphoma kinase (ALK), and programmed death-ligand 1 (PD-L1). Targeted treatment against some mutation is decisive in assisting the patient with the lung tumor to survive. In case we consider the lung cancer mutation and tumor biology, a targeted therapeutic implementation is reliant on targeting specific gene mutation, deletion, insertion, or ALK translocation and ROS1 mutation. Disturbances in EGFR signaling pathways are the main alterations that become dysregulated in the NSCLC that facilitate cell survivability, its growth, and predisposition to metastasis. It is now known that the treatment of NSCLC is dependent on its modifications. The first case of a tyrosine kinase inhibitor (TKI) was in 2004 in lung cancer. Hence, lung carcinoma with NSCLC and well-sensitized TKI drugs. It has been found, based on the reaction of TKI, that mutation in the *EGFR* gene falls under the category of exon18 (G719X), exon19 deletions, exon20 (T790X, S768I, exon20insGGT/CAC, exon20ins9), and exon21 (L858R and L861Q) mutations.

Approximately 3–5% of NSCLC possess *ALK* gene reciprocal translocation, and 1–25 have ROS Proto-oncogene encoded membrane protein molecules. Any mutation in the *ROS1* gene also plays a role in tumor formation and development. Research established that 1–2% of young female patients carry the ROS1 reengagement gene. The survival rate has been improved by immunotherapy against PDLI-positive patients, who are the recent ones. Hence, EGFR, ALK, ROS1, and PD-L1 research has been conducted in one center.

To personalize the therapeutic implementation of lung cancer biology, it is required to comprehend the foundation of the molecular nature of the tumor, targeted on gene mutations, deletion or insertions and their carcinogenesis mechanisms.[4] The sensitivity to EGFR TKIs was initially discovered in 2004 to treat lung cancer, and the pathway involves activation of the EGFR and its further regulation that results in apoptosis, proliferation, and angiogenesis.[5] EGFR activation and regulation cause a subsequent increase in cell survival, proliferation, angiogenesis, and tend to metastasize.[6,7]

The EGFR mutation in lung cancer patients is sensitive to TKI drugs.[8] It may be categorized into four sensitive types (G719X, L858R, L861, and exon19 deletion) and two resistant types (insertion in exon 20 and T790M) based on the treatment effects. The EGFR mutation, *ALK* gene rearrangement, as well as the ROS proto-oncogene encode a membrane protein that has tyrosine kinase activity.[9] A mutation in the *ROS1* gene rearrangement also plays a role in the development and further progression of tumors.[10] Approximately 12% of young, female, and never-smoked NSCLC patient has ROS1 rearrangement.[11,12] In recent years, with the approval of immunotherapy against PD-L1, the overall survival rate has increased.[13] As such, this study has included EGFR, ALK1, ROS1, and PD-L1 studies.

Methods

In the current study, all patients diagnosed with non-small cell carcinoma between January 2022 and December 2023 were subjects of this study. The enlisted clinical data and diagnosis of pulmonary non-small cell carcinoma patients were statistically analyzed with the use of the Statistical Package for the Social Sciences (SPSS) version 20.0. All cases diagnosed with non-small cell carcinoma were included as per the inclusion criteria of the study. The case sheets provided all the clinical data, such as gender, age at diagnosis, and smoking history. The cases that lacked clinical data and those diagnosed with diseases other than NSCLC were excluded from the study. Two out of the three well-experienced pathologists did all the

histopathological confirmation of diagnosis, and terminology was done in reference to the 2021 World Health Organization classification of tumors of the lung.

Immunohistochemistry (IHC) was used to classify the tumor as NSCLC and small cell cancer by thyroid transcription factor 1 (TTF-1)/Napsin A, p63, p40, CD56, and synaptophysin. Based on TTF-1/Napsin patient diagnosed with adenocarcinoma, p63 and p40 positivity patient diagnosed with squamous cell carcinoma, CD56 and synaptophysin positivity patients diagnosed with small cell carcinoma of the lung.

The molecular and genetic laboratory mutation analysis was performed in DNA extraction, then, the EGFR mutation analysis kit is planned to identify EGFR exon 18,19,20, and 21 somatic mutations, which was done by real-time polymerase chain reaction technique. IHC was done on ALK-1, ROS, and PDLI. The quality control analysis was performed with the help of the internal control of certain mutations. The statistical analysis was done using SPSS version 20.0. The Chi-square test was used to find out the frequency of EGFR mutation status.

Results

This table summarizes the clinicodemographic characteristics, treatment modalities, comorbidity burden, and survival outcomes of patients with NSCLC according to EGFR mutation status. Of the 220 patients, 44 (20%) were EGFR-positive, and 176 (80%) were EGFR-negative. Significant differences were observed between the two groups in age, sex distribution, smoking status, disease stage, and treatment patterns (all $P < 0.05$). EGFR positivity was more frequent among females and never smokers and was associated with lower disease stage at presentation. The Charlson Comorbidity Index was slightly higher in the EGFR-positive group ($P = 0.042$). Median overall survival was significantly longer in EGFR-positive patients compared with EGFR-negative patients (36.4 vs. 16.8 months, $P < 0.001$) [Table 1].

Table 2 shows that histopathological findings of adenocarcinoma were predominant, 81.81% ($n = 180$), followed by squamous cell carcinoma 14.54% ($n = 32$), adenosquamous cell carcinoma 2.27% ($n = 5$), and large cell carcinoma 1.36% ($n = 3$) [Table 2].

This table shows the distribution of molecular alterations among the study population. EGFR mutations were the most common, identified in 44 patients (20%), followed by PD-L1 expression in 8 patients (3.6%). ALK rearrangements and ROS1 mutations were less frequent, observed in 6 (2.7%) and 4 (1.8%) patients, respectively [Table 3].

Figure 1 shows that, regarding EGFR mutation ($n = 44$), the most common mutation was exon 19 deletion, 50% ($n = 22/44$), 18.18% ($n = 08/44$) in exon 18, 27.28% ($n = 12/44$) in exon 20, among them 18.2% and 9.17% in T790M and S7681 mutation, respectively. The L858R mutation was 4.55% ($n = 2/44$) in exon 21. Most of the mutations found in adenocarcinoma of the lung (98%).

Discussion

The molecular mutation analysis of EGFR is obligatory in the present-day treatment scheme of lung cancer, prior to targeted therapy specifically using TKI-based therapy. Recent research indicates that there is a high variation in EGFR molecular tests across geographical locations across the world.[13] However, the evidence of EGFR mutation analysis in South East Asia is insufficient, especially in Bangladesh.

This paper demonstrates that 20% of lung cancer cases had EGFR mutations. The prevalence of EGFR mutation is different among various demographic distributions. One study has indicated that 60% of the patients with lung cancer have demonstrated positive EGFR mutation, and only 10% of patients with lung cancer had EGFR mutation in non-smokers.[14,15] In an Indian study, the frequency of EGFR mutation is 22–52%. A notable relationship between EGFR mutations and smoking status was also identified in our study. It has been demonstrated that 68% of non-

Table 1: Demographic distribution of EGFR-positive and EGFR-negative non-small cell lung carcinoma

Variables	EGFR positive	EGFR negative	Total	*P*-value
Numbers (*n*)%	44 (20)	176 (80)	220	
Age				
Male	63.5±8.5	55.6±10.2	59.5±9.3	<0.01
Female	61.2±7.8	58.2±8.8	59.7±12.7	<0.01
Sex (%)				
Male	28 (17.5)	132 (82.5)	160 (72.72)	<0.01
Female	16 (26.6)	44 (73.4)	60 (27.27)	<0.01
Smoking status (%)				
Smoker	14 (6.3)	78 (35.45)	92 (41.81)	<0.001
Never smoker	30 (13.63)	98 (44.54)	128 (58.18)	
Stage (%)				
II	20 (9.1)	90 (40.9)	110 (50)	<0.001
III	15 (6.8)	42 (19.1)	57 (25.9)	<0.001
IV	09 (4.1)	44 (20)	53 (24.1)	<0.001
Treatment (%)				
Chemotherapy	25 (11.36)	195 (88.63)	220 (100)	<0.01
Tyrosine kinase inhibitor	36 (16.36)	184 (83.64)	220 (100)	<0.001
Immunotherapy	08 (3.6)	212 (96.4)	220 (100)	<0.001
Radiation therapy	20 (9.1)	200 (90.0)	220 (100)	
Charlson comorbidity index	10.4±2.6	9.6±3.4	10±3	0.042
Median overall survival, month (95% confidence interval)	36.4 (32.2–38.6)	16.8 (12.6–18.2)	-	<0.001

EGFR: Epidermal growth factor receptor

Table 2: Distribution of non-small cell carcinoma (*n*=220)

Type of cancer	Number (*n*=220)	Percentage
Adenocarcinoma	180	81.81
Squamous cell carcinoma	32	14.54
Adenosquamous cell carcinoma	05	2.27
Large cell carcinoma	03	1.36

Table 3: Distribution of lung molecular panel (*n*=62)

Type of mutation	Number	Percentage
EGFR	44	20
ALK	06	2.7
ROS-1	04	1.8
PD-L1	08	3.6

EGFR: Epidermal growth factor receptor, ALK: Anaplastic lymphoma kinase, ROS-1 (ROS Proto-Oncogene 1), PD-L1: Programmed death-ligand 1

smokers and 32% of smokers had EGFR mutations. In contrast, 47% in Africa and 35% in Europe have EGFR mutation in non-smokers. In Africa and Europe, 47% and 35%, respectively, possess EGFR mutation among non-smokers.[15]

The EGFR mutation frequency difference in our study versus the other one can be due to the difference in the genetic and environmental factors that are related to cancer. The various frequencies of EGFR mutations in the various geographical locations indicate the necessity of treatment for the patients.

The most common deletion mutations in this research included deletion in the exon 19 (50%) and deletion in exon 18 and exon 20 (T790M)

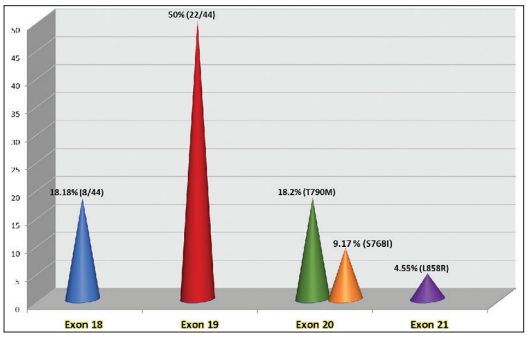

Figure 1: Epidermal growth factor receptor mutation distribution chart ($n = 44$)

mutations (18.2% and 18.2%, respectively). The mutations at L858R and S768I were 4.5% and 9.17%, respectively. Very recent research discusses NSCLC *ALK* gene rearrangements, which is also significant to comprehend the tumor's molecular biology and the development of targeted inhibitors. In this case, ALK-rearranged NSCLC represents 2–5% of total cases of NSCLC.[16] 2.7% of cases ($n = 6$) in this study were ALK positive. signet-ring cell types of adenocarcinomas, the signs of the ALK-rearranged gene are present. The first approved targeted therapy against ALK-positive NSCLC is ALK inhibitor crizotinib, which, in one study, was demonstrated to be superior to traditional chemotherapy, and in second-line therapy, pemetrexed has shown an advantage over docetaxel.[17,18]

The ROS1 rearranged oncogene was initially reported in glioblastoma multiforme patients, then subsequently in lung adenocarcinomas. ROS1 rearrangements may be determined in both IHC and fluorescence *in situ* hybridization. Rimkunas *et al*. documented both EGFR mutations observed in two ROS1-rearranged tumors in lung adenocarcinoma.[19] In our study, all the ROS1 translocations were detected independent oncogenic alterations, but both ALK1 and ROS1 mutations were observed in two cases. We have also had a few cases of double mutation in addition to the common mutations. In our study, five cases were found to possess double mutation, of which two cases express a combination of resistant and sensitive mutations, in exon 19 deletion and T790M mutation, respectively.

Recently, the presence of antibodies against immune checkpoint inhibitors, such as the PD-1 and PD-L1, has demonstrated to enhance the overall survival of NSCLC patients.[20] NSCLC patients expressing positive PD-L1 were found to predominate among the EGFR, ALK, and ROS1 negative patients, and probably in the advanced stages. Therefore, prognosis and survival rate are poorer in positive PD-L1 patients but higher than in all molecular negative cases. According to this study, 3.8% of tumors express PD-L1. Research established that the median survival rate is augmented using immune checkpoint therapy.

Conclusion

Lung cancer is a heterogeneous disease involving genetic and environmental factors, and immunological complexities that have many molecular biomarkers associated with variations in treatment protocol, particularly targeted therapy. An EGFR mutation, ALK, ROS1, and PD-L1 study is necessary to detect appropriate molecular biomarkers in lung cancer. Targeted therapy is associated with optimal combination methods that improve the efficacy and therapeutic effects of anticancer therapy. In this study, we have analyzed the molecular markers of non-small cell carcinoma patients and evaluated their therapeutic response to targeted therapy. Targeted therapy, particularly by TKIs, has improved the patient's life significantly.

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How to cite this article: Karim MI, Yasmin S. Molecular study of non-small cell carcinoma of lung in a tertiary-level laboratory in Bangladesh. Ann. Int. Med. Den. Res. 2026;12(1):45-50.

Source of Support: Nil, **Conflict of Interest:** None declared

Received: 29-Dec-2025; **Revised:** 24-Jan-2026; **Acceptance:** 12-Feb-2026; **Published:** 10-Mar-2026

Original Research Article

https://doi.org/10.53339/aimdr.2026.12.1.9
E-ISSN: 2395-2822 | P-ISSN: 2395-2814

Office hysteroscopy in infertility workup: balancing precision and patient comfort

Fatima Jannat[1], Munawar Sultana[2], Mohammad Shaha Alam[3], Mohammad Jahangir Kabir Bhuiyan[4], Osmanur Rashid[5], A. K. M. Harun-ar-Rashid[6]

[1]Department of Obstetrics and Gynecology, Fouad Al-Khateeb Hospital, Cox's Bazar, Bangladesh, [2]Department of Obstetrics and Gynecology, Chattogram Medical College, Chattogram, Bangladesh, [3]Department of Surgery, Cox's Bazar Medical College, Cox's Bazar, Bangladesh, [4]Department of Surgery, Chattogram Medical College, Chattogram, Bangladesh, [5]Department of Radiology and Imaging, Cox's Bazar Medical College, Cox's Bazar, Bangladesh, [6]Department of Orthopaedic Surgery, Cox's Bazar Medical College, Cox's Bazar, Bangladesh

Address for correspondence: Dr. Fatima Jannat, Department of Obstetrics and Gynecology, Fouad Al-Khateeb Hospital, Cox's Bazar, Bangladesh. E-mail: drfatimajannat@gmail.com

Abstract

Introduction: Infertility is a growing global health concern that affects millions of couples, causing significant emotional, psychological, and social distress. Uterine abnormalities are recognized as a major contributing factor to female infertility, often remaining undiagnosed by conventional imaging techniques alone. Office hysteroscopy has emerged as a valuable, minimally invasive procedure that allows direct visualization of the uterine cavity, offering both diagnostic accuracy and patient comfort. Its role in identifying subtle intrauterine abnormalities makes it an essential component of modern infertility workup.

Methods: This cross-sectional study was conducted at a district-level hospital in Cox's Bazar, from January 2023 to December 2023, involving 95 women undergoing infertility evaluation. Women with known uterine anomalies previously diagnosed, active pelvic infections, or those unwilling to undergo hysteroscopy were excluded. Data were analyzed using the Statistical Package for the Social Sciences version 25.

Results: In this study of 95 infertile women, office hysteroscopy identified intrauterine abnormalities in 51.6% of cases, with endometrial polyps (16.8%) and intrauterine adhesions (11.6%) being the most common findings. A septate uterus was observed in 7.4% of women, primarily among those with primary infertility. A strong correlation (77.4%) was noted between abnormal hysterosalpingography and hysteroscopic findings. The procedure was well tolerated by 89.5% of patients, with only minor discomfort and no major complications reported.

Conclusion: This study demonstrates that office hysteroscopy is an effective, minimally invasive, and well-tolerated diagnostic tool for evaluating intrauterine abnormalities in infertile women, offering a reliable balance between diagnostic precision and patient comfort. With over half of the women in this study found to have intrauterine pathologies, particularly endometrial polyps, adhesions, and a septate uterus, office hysteroscopy significantly enhances the detection of subtle uterine factors that may contribute to infertility.

Keywords: Infertility, intrauterine abnormalities, office hysteroscopy, patient comfort

Introduction

Infertility is a significant global health concern affecting approximately 8–12% of couples of reproductive age, with a notable psychological, social, and financial impact on affected individuals and families.[1] Among the myriad causes of infertility, uterine abnormalities are recognized

as a critical factor, contributing to nearly 10–15% of female infertility cases.[2] As the uterus plays an essential role in implantation and maintenance of pregnancy, accurate assessment of the uterine cavity has become an integral component of infertility evaluation. Hysteroscopy, regarded as the gold standard for diagnosing intrauterine pathologies, has revolutionized the evaluation and management of female infertility.[3] Traditionally performed in an operating room under anesthesia, hysteroscopy enables direct visualization of the endometrial cavity, facilitating the detection and treatment of conditions such as endometrial polyps, submucous fibroids, intrauterine adhesions, and congenital uterine anomalies, all of which may impair fertility.[4] However, conventional hysteroscopy is not without limitations, including increased cost, the need for anesthesia, logistical challenges, and patient apprehension.[5] In recent years, office hysteroscopy has emerged as a minimally invasive, cost-effective alternative to traditional hysteroscopy. This technique involves performing hysteroscopic evaluation in an outpatient setting, usually without the need for general anesthesia or cervical dilatation, thereby significantly reducing patient discomfort and procedural risks.[6] Advances in technology, including miniaturization of hysteroscopes and improved optics, have made office hysteroscopy a feasible and reliable tool in routine infertility workups.[7] Moreover, office hysteroscopy offers the distinct advantage of "see and treat" capabilities, allowing immediate intervention for minor intrauterine abnormalities during the same session, thereby enhancing clinical efficiency.[8] The role of office hysteroscopy in infertility workup is particularly emphasized in cases where non-invasive imaging modalities, such as transvaginal sonography (TVS) or hysterosalpingography (HSG), yield inconclusive or suspicious findings.[9] While TVS and HSG remain valuable first-line investigations, their sensitivity and specificity in detecting certain subtle or complex intrauterine lesions are limited compared to direct visualization via hysteroscopy.[10] Multiple studies have demonstrated that integrating office hysteroscopy into routine infertility assessment improves diagnostic accuracy and may uncover previously undetected pathologies contributing to infertility. It contributes significantly to infertility evaluation by offering direct diagnosis of intrauterine abnormalities and allowing immediate operative correction – such as removal of polyps, adhesions, or septa – within the same setting.[11] However, despite its clinical utility, concerns regarding patient comfort, tolerability, and procedural pain remain key considerations in the wider adoption of office hysteroscopy.[12] Various factors influence patient experience, including instrument size, operator expertise, patient anxiety levels, and the use of pre-procedural analgesia or anxiolytics.[13] As such, striking a balance between diagnostic precision and patient comfort is essential for optimizing the use of office hysteroscopy in infertility management.

This study aims to explore the evolving role of office hysteroscopy in the infertility workup, emphasizing its diagnostic accuracy, therapeutic potential, and strategies to enhance patient comfort.

Methods

This cross-sectional study was conducted at a district-level hospital in Cox's Bazar from January 2023 to December 2023, involving 95 women undergoing infertility evaluation. Women with known uterine anomalies diagnosed previously, active pelvic infections, or those unwilling to undergo hysteroscopy were excluded. After thorough counseling, written informed consent was obtained from all participants. Ethical clearance was obtained from the Institutional Ethics Committee prior to initiation. All eligible women underwent office hysteroscopy using a 2.9 mm rigid hysteroscope with saline as the distension medium, performed without anesthesia or cervical dilatation. Indications included abnormal HSG, abnormal transvaginal ultrasound (TVUS) findings, unexplained infertility, or recurrent *in vitro* fertilization (IVF) failure. Demographic data, clinical history, hysteroscopic findings, patient tolerance, and complications were recorded. Data were analyzed using the Statistical Package

for the Social Sciences version 25, with results expressed as frequencies, percentages, and means, and appropriate statistical tests applied to compare findings between groups.

Results

The majority of women (44.2%) were between 26 and 30 years of age. Primary infertility was slightly more common (55.8%) than secondary infertility. The mean duration of infertility was 3.4 ± 1.9 years, ranging from 1 to 9 years [Table 1].

The most frequent indication was abnormal HSG findings (34.7%), followed by abnormal TVUS (31.6%) and unexplained infertility (24.2%). Repeated IVF failure accounted for 9.5% of cases [Table 2].

Intrauterine abnormalities were detected in 51.6% of women. Endometrial polyps (16.8%) were the most common pathology, followed by intrauterine adhesions (11.6%) and submucosal fibroids (9.5%). A normal cavity was observed in 48.4% of cases [Table 3].

The distribution of hysteroscopic abnormalities was comparable between primary and secondary infertility groups, with no statistically significant differences ($P > 0.05$). A higher, though not significant, incidence of a septate uterus was noted among women with primary infertility [Table 4].

In women with abnormal HSG, hysteroscopy confirmed intrauterine pathology in 77.4% of cases, whereas 22.6% showed normal findings, highlighting potential false-positive results from HSG [Table 5].

Discussion

The present study reinforces the clinical value of office hysteroscopy as a reliable, safe, and well-tolerated diagnostic tool in the infertility workup. In our study, intrauterine abnormalities were identified in 51.6% of women, whereas 48.4% had a normal uterine cavity. These findings are in agreement with recent literature, where reported rates of abnormal

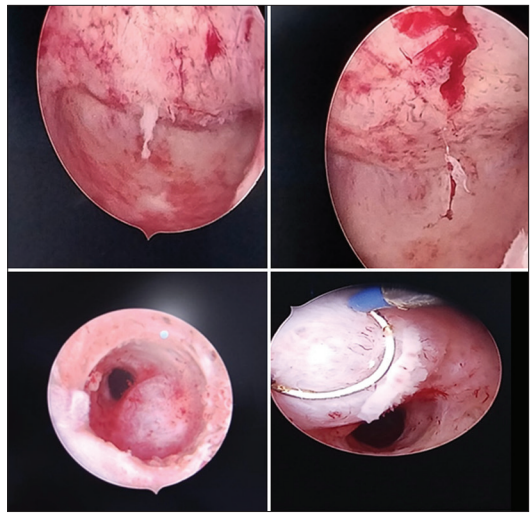

Figure 1: International Federation of Obstetrics and Gynecology Phase I submucous myoma (<50%) AQ3

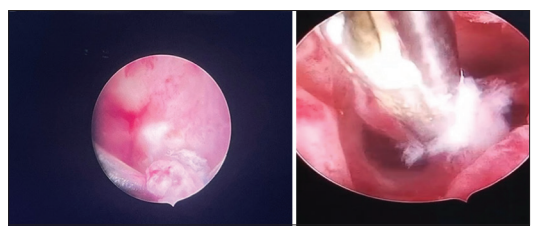

Figure 2: Submucous polyp AQ3

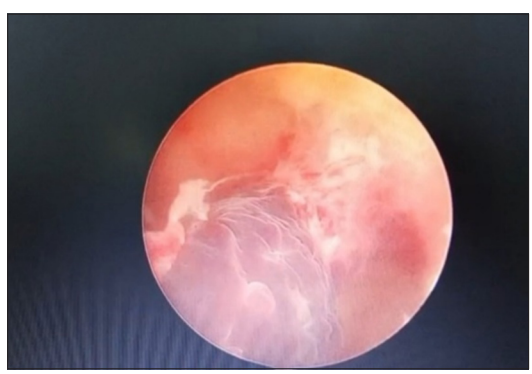

Figure 3: Submucous polyp AQ3

findings during office hysteroscopy among infertile women range from 38% to 56%, depending on the population studied and inclusion criteria.[14,15] In a large prospective study by Slabuszewska-Jozwiak *et al*., intrauterine abnormalities were detected in

Table 1: Baseline characteristics of the study population (*n*=95)

Characteristics	Frequency (%) or mean±SD
Age (years)	29.8±4.5
Age group (years)	
20–25	18 (18.9)
26–30	42 (44.2)
31–35	25 (26.3)
>35	10 (10.5)
Type of infertility	
Primary	53 (55.8)
Secondary	42 (44.2)
Duration of infertility	3.4±1.9 years

SD: Standard deviation

Table 2: Indications for office hysteroscopy (*n*=95)

Indication	Frequency	Percentage
Abnormal HSG findings	33	34.7
Abnormal transvaginal ultrasound	30	31.6
Repeated IVF failure	9	9.5
Unexplained infertility	23	24.2
Total	95	100

IVF: *In vitro* fertilization, HSG: Hysterosalpingography

Table 3: Hysteroscopic findings (*n*=95)

Finding	Frequency (%)
Normal uterine cavity	46 (48.4)
Endometrial polyp	16 (16.8)
Submucosal fibroid	9 (9.5)
Intrauterine adhesions (Synechiae)	11 (11.6)
Septate uterus	7 (7.4)
Hyperplastic endometrium	6 (6.3)

Table 4: Comparison of hysteroscopic findings between primary and secondary infertility (*n*=95)

Finding	Primary (*n*=53) (%)	Secondary (*n*=42) (%)	*P*-value
Normal	25 (47.2)	21 (50.0)	0.78
Endometrial polyp	8 (15.1)	8 (19.0)	0.62
Submucosal fibroid	4 (7.5)	5 (11.9)	0.47
Intrauterine adhesions	7 (13.2)	4 (9.5)	0.53
Septate uterus	6 (11.3)	1 (2.4)	0.09
Hyperplastic endometrium	3 (5.7)	3 (7.1)	0.76

Table 5: Correlation between abnormal HSG and hysteroscopic findings (*n*=31)

Hysteroscopic finding	Frequency (%)
Confirmed abnormality	24 (77.4)
Normal cavity	7 (22.6)

HSG: Hysterosalpingography

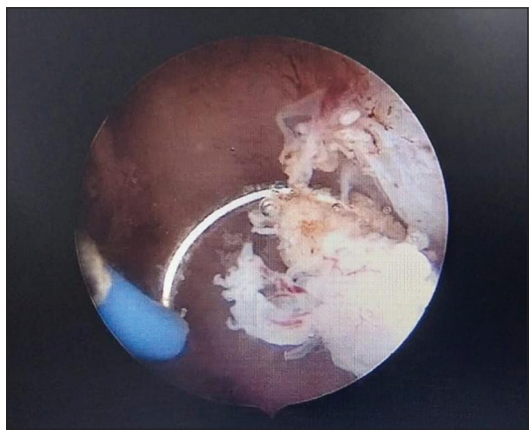

Figure 4: Polypectomy AQ3

44.5% of infertile women undergoing hysteroscopic evaluation, underscoring the high diagnostic yield of this approach.[14] Endometrial polyps were the most frequently detected abnormality in our cohort (16.8%), followed by intrauterine adhesions (11.6%) and submucosal fibroids (9.5%). These findings are consistent with those of Di Spiezio Sardo *et al*., who reported endometrial polyps and adhesions as the most common abnormalities in infertile women undergoing diagnostic hysteroscopy.[3] Moreover, a systematic review by Bosteels *et al*. confirmed that removal of such pathologies through hysteroscopic intervention may significantly improve reproductive outcomes, particularly in women with unexplained infertility or prior ART failures.[16] The detection of septate uterus in 7.4% of cases, predominantly among women with primary infertility, aligns with existing evidence suggesting a higher prevalence of congenital uterine anomalies in this subgroup. A recent study by Chang *et al*. emphasized the clinical relevance

of identifying and correcting a septate uterus to improve fertility, with hysteroscopy considered the gold standard for diagnosis and treatment.[17] Our findings also revealed a strong correlation between abnormal HSG and hysteroscopic confirmation, with 77.4% concordance. However, 22.6% of patients with abnormal HSG showed normal findings on hysteroscopy, illustrating the limitations of HSG as a stand-alone diagnostic tool. Similar discrepancies have been reported by Nanda *et al*. and by Wadhwa *et al*., who highlighted that hysteroscopy offers superior accuracy in evaluating the uterine cavity, especially in cases where non-invasive imaging is inconclusive.[18,19] Regarding patient tolerability, 89.5% of women in our study tolerated the procedure well, with only 10.5% reporting mild discomfort. Importantly, there were no procedure failures or conversions to operative hysteroscopy under anesthesia. These findings are consistent with recent trials by Buzzaccarini *et al*. and Ugboaja *et al*., both of which demonstrated high patient acceptability and low complication rates with modern office hysteroscopy techniques.[12,20] The use of miniaturized hysteroscopic instruments, as applied in our study, has been shown to significantly reduce procedural discomfort and improve patient compliance.

Limitations of the study

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

Conclusion

This study demonstrates that office hysteroscopy is an effective, minimally invasive, and well-tolerated diagnostic tool for evaluating intrauterine abnormalities in infertile women, offering a reliable balance between diagnostic precision and patient comfort. With over half of the women in this study found to have intrauterine pathologies, particularly endometrial polyps, adhesions, and a septate uterus, office hysteroscopy significantly enhances the detection of subtle uterine factors that may contribute to infertility.

Recommendations

Based on the findings of this study, office hysteroscopy should be incorporated as a routine diagnostic tool in the infertility workup, especially in cases with abnormal imaging or unexplained infertility. Its high diagnostic yield, minimal invasiveness, and excellent patient tolerability make it a practical and effective approach for early detection and management of intrauterine abnormalities.

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How to cite this article: Jannat F, Sultana M, Alam MS, Bhuiyan MJ, Rashid O, Harun-ar-Rashid AK. Office hysteroscopy in infertility workup: balancing precision and patient comfort. Ann. Int. Med. Den. Res. 2026;12(1):51-56.

Source of Support: Nil, **Conflict of Interest:** None declared

Received: 07-Dec-2025; **Revised:** 05-Jan-2026; **Acceptance:** 22-Jan-2026; **Published:** 10-Mar-2026

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AQ1: Kindly provide running title
AQ3: Kindly cite figures 1-4 in the text part

Original Research Article

https://doi.org/10.53339/aimdr.2026.12.1.10
E-ISSN: 2395-2822 | P-ISSN: 2395-2814

Prevalence and risk factors of scabies in school-going children in rural Bangladesh

Md. Haroon Ur Rashid[1], Md. Hasnainul Islam[2], Mohammed Saiful Islam[3], Sanjida Fardous[4], Md. Abul Hashem[5]

[1]Department of Dermatology and Venereology, MH Somorita Hospital and Medical College, Dhaka, Bangladesh, [2]Department of Dermatology and Venereology, Bikrampur Bhuiyan Medical College and Hospital, Munshiganj, Bangladesh, [3]Department of Skin and Venereology and Dermatology, Shaheed Tajuddin Ahmed Medical College Hospital, Gazipur, Bangladesh, [4]Department of Dermatology and Venereology, Mymensingh Medical College Hospital, Mymensingh, Bangladesh, [5]Department of Dermatology, Railway General Hospital, CRB, Chittagong, Bangladesh

Address for correspondence: Dr. Md. Haroon Ur Rashid, Department of Dermatology and Venereology, MH Somorita Hospital and Medical College, Dhaka, Bangladesh. E-mail: hf.haroon@gmail.com

Abstract

Introduction: Scabies is a common contagious skin infestation caused by *Sarcoptes scabiei* var. hominis, affecting millions of children worldwide, particularly in low-resource settings. It is associated with intense pruritus, secondary infections, and significant disruption to daily life. Children are especially vulnerable due to close contact in schools and households, overcrowding, and limited access to hygiene facilities. This study aimed to determine the prevalence of scabies and identify associated risk factors among school-going children in rural areas of Bangladesh.

Methods: This cross-sectional study was conducted among 108 school-going children aged 5–14 years in selected rural schools of Gazipur, Bangladesh, from January 2025 to December 2025, to assess the prevalence and risk factors of scabies. Data were analyzed using the Statistical Package for the Social Sciences version 26.

Results: Among 108 school-going children, scabies prevalence was 31.5%, with most affected children aged 10–14 years (61.1%) and male (57.4%). Common clinical features included nocturnal itching (91.2%), rash (85.3%), and burrows (50.0%), with 70.6% reporting a positive family history. Hygiene practices showed irregular bathing (43.5%), irregular soap use (32.4%), and sharing of clothes (53.7%) or bedding (59.3%). Overcrowding, family history, irregular bathing, and shared bedding were significant predictors, with adjusted odds ratios of 3.21, 3.76, 2.89, and 2.47, respectively.

Conclusion: Scabies continues to pose a major health problem among school-aged children in rural Bangladesh, affecting 31.5% of the study population. Key factors associated with infestation included overcrowded living conditions, infrequent bathing, sharing of bedding, and a family history of scabies.

Keywords: Hygiene practices, nocturnal itching, scabies

Introduction

Scabies is a contagious parasitic skin infestation caused by *Sarcoptes scabiei* var. *hominis* and remains a significant public health concern worldwide, particularly in low- and middle-income countries. The infestation is transmitted mainly through prolonged skin-to-skin contact and is facilitated by overcrowding, poor personal hygiene, and limited access to health care. Clinically, scabies presents with intense pruritus, erythematous papules, nodules, and burrows,

leading to considerable discomfort and impaired quality of life. Children are disproportionately affected due to close interpersonal contact and immature hygiene practices, making scabies a common childhood dermatological condition in resource-limited settings.[1,2] Globally, scabies affects more than 200 million people at any given time, with the highest prevalence reported in tropical and subtropical regions. Epidemiological studies have demonstrated that scabies prevalence among children may range from 5% to over 50% in endemic communities, particularly where poverty, overcrowding, and inadequate sanitation prevail. Beyond cutaneous symptoms, scabies contributes to substantial morbidity through secondary bacterial infections such as impetigo, cellulitis, and post-streptococcal complications, including acute glomerulonephritis and rheumatic heart disease.[3,4] Recognizing its burden, the World Health Organization designated scabies as a Neglected Tropical Disease in 2017, underscoring the need for targeted control strategies and improved surveillance.[1] School-going children represent a particularly vulnerable population for scabies transmission. Close physical contact in classrooms, shared learning materials, and frequent interaction during play facilitate rapid spread. Studies from various low-resource settings have consistently identified overcrowded living conditions, large family size, bed-sharing, sharing of clothing and towels, low parental education, and poor bathing practices as significant risk factors among school-aged children.[5,6] These factors are especially prominent in rural communities, where access to clean water, sanitation facilities, and healthcare services may be limited. In Bangladesh, scabies remains a common yet under-recognized dermatological problem, particularly among children from socioeconomically disadvantaged backgrounds. Several studies have documented a high prevalence of scabies among children residing in institutional and community settings, reflecting ongoing transmission in overcrowded environments. Research conducted in residential madrasahs in Bangladesh reported a high burden of scabies among children, with overcrowding, sharing of personal items, and contact with infected individuals identified as key risk factors. Similar findings have been reported in other child-dense settings, indicating that scabies continues to pose a significant public health challenge in the country.[7] Rural school-going children in Bangladesh face unique vulnerabilities that may further increase the risk of scabies infestation. Poverty, inadequate housing, limited hygiene facilities, and low awareness regarding skin diseases contribute to persistent transmission and recurrent infestations. Despite this, data specifically addressing the prevalence and associated risk factors of scabies among school-going children in rural Bangladesh remain limited. Most existing studies focus on institutionalized or urban populations, leaving a critical gap in understanding the burden of scabies in rural school settings.[8] Identifying the prevalence and risk factors of scabies among rural school children is essential for developing effective prevention and control strategies. Evidence from such studies can inform school-based interventions, community health education programs, and public health policies aimed at reducing transmission, preventing complications, and improving the overall health and well-being of children in rural Bangladesh.[9] This study aimed to determine the prevalence of scabies and identify associated risk factors among school-going children in rural areas of Bangladesh.

Methods

This cross-sectional study was conducted among 108 school-going children aged 5–14 years in selected rural schools of Gazipur, Bangladesh, from January 2025 to December 2025, to assess the prevalence and risk factors of scabies. Children with chronic dermatological conditions unrelated to scabies or without consent were excluded. Data were collected using a structured questionnaire capturing sociodemographic details (age, sex, class level, and family type), personal hygiene practices (bathing frequency, use of soap, and sharing of clothes and bedding), household characteristics (overcrowding and parental education), and family history of itching or scabies. Clinical examination was performed by trained clinicians to identify

scabies based on established criteria, including nocturnal itching, typical rash, burrows, and secondary infection. Overcrowding was defined as more than three persons per room, irregular bathing as ≤3 times/week, and sharing of clothes or bedding, as the use of the same items with siblings or peers. Data were analyzed using the Statistical Package for the Social Sciences version 26; descriptive statistics summarized participant characteristics, and Chi-square tests identified associations between scabies and potential risk factors. Variables with significant bivariate associations were further evaluated using multivariable logistic regression to determine independent predictors, presented as adjusted odds ratios (AORs) with 95% confidence intervals (CIs). Written informed consent was obtained from parents/guardians, and assent was obtained from children above 7 years. Children diagnosed with scabies were referred for appropriate treatment according to national guidelines.

Results

Out of 108 school-going children included in the study, 42 (38.9%) were aged 5–9 years, whereas 66 (61.1%) belonged to the 10–14-year age group. Male participants constituted 62 (57.4%) of the sample, whereas females accounted for 46 (42.6%). Nearly half of the children were enrolled in primary classes I–V (49, 45.4%), whereas 59 (54.6%) were studying in secondary classes VI–VIII. Regarding family structure, a majority of participants belonged to joint families (67, 62.0%), with the remaining 41 (38.0%) living in nuclear families [Table 1]. Among the 108 participants examined, scabies infestation was detected in 34 children, yielding an overall prevalence of 31.5%. The remaining 74 children (68.5%) did not show clinical evidence of scabies at the time of assessment [Table 2]. Among the 34 scabies-positive children, nocturnal itching was the most frequently reported symptom, present in 31 cases (91.2%). Typical scabetic rash was observed in 29 children (85.3%), while burrows were identified in 17 (50.0%). Secondary bacterial infection was noted in 11 children (32.4%). A positive family history of itching or scabies was reported by 24 children (70.6%), indicating probable household transmission [Table 3]. Regarding hygiene practices among the 108 participants, 61 children (56.5%) reported daily bathing, whereas 47 (43.5%) bathed 3 or fewer times per week. Regular use of soap during bathing was reported by 73 children (67.6%), whereas 35 (32.4%) used soap irregularly. Sharing of clothes was reported by 58 children (53.7%), and sharing of bedding was even more common, reported by 64 children (59.3%), whereas 50 (46.3%) and 44 (40.7%)

Table 1: Sociodemographic characteristics of the study participants (*n*=108)

Variable	Frequency (*n*)	Percentage
Age group (years)		
5–9	42	38.9
10–14	66	61.1
Sex		
Male	62	57.4
Female	46	42.6
Class level		
Primary (I–V)	49	45.4
Secondary (VI–VIII)	59	54.6
Residence type		
Nuclear family	41	38.0
Joint family	67	62.0

Table 2: Prevalence of scabies among study participants (*n*=108)

Scabies status	Frequency (*n*)	Percentage
Present	34	31.5
Absent	74	68.5

Table 3: Clinical features among scabies-positive children (*n*=34)

Clinical feature	Frequency (*n*)	Percentage
Nocturnal itching	31	91.2
Typical rash	29	85.3
Burrows	17	50.0
Secondary infection	11	32.4
Family history of itching	24	70.6

children, respectively, did not share clothes or bedding [Table 4]. Scabies was present in 26 children (76.5%) living in overcrowded households compared to 34 children (45.9%) without scabies, showing a statistically significant association (P = 0.003). Sharing bedding was reported by 25 scabies-positive children (73.5%) versus 39 scabies-negative children (52.7%) (P = 0.031). Irregular bathing was observed in 21 affected children (61.8%) compared to 26 unaffected children (35.1%) (P = 0.012). A family history of scabies was present in 24 infected children (70.6%) compared to 29 non-infected children (39.2%) (P = 0.002). Low parental education was also significantly associated, being present in 22 scabies-positive children (64.7%) versus 33 scabies-negative children (44.6%) (P = 0.048) [Table 5]. On multivariable logistic regression analysis, overcrowding emerged as a significant independent predictor of scabies infestation with an AOR of 3.21 (95% CI: 1.38–7.44; P = 0.006).

Table 4: Personal hygiene practices of the participants (n=108)

Hygiene practice	Category	Frequency (n)	Percentage
Bathing frequency	Daily	61	56.5
	≤3 times/week	47	43.5
Use of soap	Regular	73	67.6
	Irregular	35	32.4
Sharing clothes	Yes	58	53.7
	No	50	46.3
Sharing bedding	Yes	64	59.3
	No	44	40.7

Table 5: Association between selected risk factors and scabies (n=108)

Risk factor	Scabies present n (%)	Scabies absent n (%)	P-value
Overcrowding	26 (76.5)	34 (45.9)	0.003
Sharing bedding	25 (73.5)	39 (52.7)	0.031
Irregular bathing	21 (61.8)	26 (35.1)	0.012
Family history of scabies	24 (70.6)	29 (39.2)	0.002
Low parental education	22 (64.7)	33 (44.6)	0.048

Children who shared bedding had a 2.47-fold higher likelihood of scabies (95% CI: 1.05–5.80; P = 0.038). Irregular bathing was associated with an increased risk of infestation (AOR: 2.89; 95% CI: 1.21–6.88; P = 0.017). A family history of scabies remained strongly associated with infestation (AOR: 3.76; 95% CI: 1.58–8.94; P = 0.003) [Table 6].

Discussion

In this study of 108 rural school-going children, the overall prevalence of scabies was 31.5%, reflecting a substantial burden within the community. Comparable prevalence estimates have been reported in Bangladesh institutional settings, where Hasan *et al.* observed a scabies prevalence of 34% among madrasah children, and Hasan *et al.* found 31.6% among orphanage children in Dhaka.[7] These findings suggest that even outside boarding institutions, rural school attendees share high exposure risks due to similar environmental and behavioral circumstances. Our clinical symptom profile among scabies-positive children revealed nocturnal itching in 91.2%, typical rash in 85.3%, burrows in 50.0%, and secondary infection in 32.4%, with 70.6% reporting family history of itching. Hasan *et al.* similarly documented nocturnal itching in more than 90% of affected children and contact history in approximately 66%.[7] Hygiene practices in our cohort showed that 43.5% of children bathed ≤3 times/week, 32.4% used soap irregularly, 53.7% shared clothes, and 59.3% shared bedding. The systematic review by Armitage *et al.* highlighted weak personal hygiene and sharing of clothes or bedding, defined as major

Table 6: Multivariable logistic regression analysis of factors associated with scabies (n=108)

Variable	Adjusted odds ratio	95% confidence interval	P-value
Overcrowding	3.21	1.38–7.44	0.006
Sharing bedding	2.47	1.05–5.80	0.038
Irregular bathing	2.89	1.21–6.88	0.017
Family history of scabies	3.76	1.58–8.94	0.003

global determinants of scabies among children.[6] Ararsa *et al.* also found that Ethiopian children who shared clothes or bedding had significantly higher infestation rates.[10] This study shows significant associations between scabies and multiple risk factors. Overcrowding was present in 76.5% of scabies cases compared with 45.9% of non-cases (P = 0.003), sharing bedding in 73.5% versus 52.7% (P = 0.031), irregular bathing in 61.8% versus 35.1% (P = 0.012), family history in 70.6% versus 39.2% (P = 0.002), and low parental education in 64.7% versus 44.6% (P = 0.048). Hasan *et al.* similarly identified overcrowding in 68% of infested children compared with 42% of controls and significant associations with contact history and shared sleeping spaces.[7] Reta *et al.* reported that children in crowded households were significantly more affected than those in non-crowded homes during scabies outbreaks in Ethiopia.[11] These parallels indicate that both structural conditions (crowding and low parental education) and behavioral patterns (irregular bathing and contact with infected individuals) are consistent predictors of scabies across diverse child populations. Multivariable logistic regression showed that overcrowding (AOR 3.21, 95% CI 1.38–7.44, P = 0.006), family history (AOR 3.76, 95% CI 1.58–8.94, P = 0.003), irregular bathing (AOR 2.89, 95% CI 1.21–6.88, P = 0.017), and sharing bedding (AOR 2.47, 95% CI 1.05–5.80, P = 0.038) remained independent predictors of scabies. In comparison, Ararsa *et al.* reported AORs of 3.50 (95% CI 1.40–8.76) for shared bedding and 2.80 (95% CI 1.15–6.84) for household contact history among Ethiopian school children.[10] Similarly, Engelman *et al.* emphasized that living in crowded conditions and close contact with infected individuals increased risk by 2–4 fold across low-income country settings.[4] The comparable strength of association reinforces that overcrowding and close interpersonal networks are potent drivers of scabies transmission. Low parental education, although associated in bivariate analysis, did not remain significant in the adjusted model, a finding also noted by Hasan *et al*., who reported that behavioral and environmental conditions exert stronger effects than sociodemographic variables alone.[7]

Limitations of the study

Its cross-sectional design prevents establishing of causality. The sample was limited to a few rural schools, which may reduce generalizability. Diagnosis was based on clinical examination without laboratory confirmation, potentially causing misclassification.

Conclusion

Scabies remains a significant health concern among school-going children in rural Bangladesh, with a prevalence of 31.5%. Overcrowding, irregular bathing, sharing of bedding, and a positive family history were identified as key risk factors contributing to infestation.

Recommendation

To reduce the burden of scabies among school-going children in rural Bangladesh, it is recommended to implement regular health education on personal hygiene, discourage the sharing of clothes and bedding, and promote measures to reduce overcrowding at home and in schools. Early detection and treatment of affected children and household contacts should also be prioritized.

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How to cite this article: Ur Rashid MH, Islam MH, Islam MS, Fardous S, Hashem MA. Prevalence and risk factors of scabies in school-going children in rural Bangladesh. Ann. Int. Med. Den. Res. 2026;12(1):57-62.

Source of Support: Nil, **Conflict of Interest:** None declared

Received: 11-Dec-2025; **Revised:** 14-Jan-2026;
Acceptance: 31-Jan-2026; **Published:** 10-Mar-2026

Original Research Article

https://doi.org/10.53339/aimdr.2026.12.1.11
E-ISSN: 2395-2822 | P-ISSN: 2395-2814

Prevalence of fungal skin infections among agricultural workers in Bangladesh

Md. Hasnainul Islam[1], Md. Haroon Ur Rashid[2], Sanjida Fardous[3], Mohammed Saiful Islam[4], Md. Abul Hashem[5]

[1]Department of Dermatology and Venereology, Bikrampur Bhuiyan Medical College and Hospital, Munshiganj, Bangladesh, [2]Department of Dermatology and Venereology, MH Somorita Hospital and Medical College, Dhaka, Bangladesh, [3]Department of Dermatology and Venereology, Mymensingh Medical College Hospital, Mymensingh, Bangladesh, [4]Department of Skin and Venereology and Dermatology, Shaheed Tajuddin Ahmed Medical College Hospital, Gazipur, Bangladesh, [5]Department of Dermatology, Railway General Hospital, Chittagong, Bangladesh

Address for correspondence: Dr. Md. Hasnainul Islam, Assistant Professor, Department of Dermatology and Venereology, Bikrampur Bhuiyan Medical College and Hospital, Munshiganj, Bangladesh. E-mail: islamhasnainul@gmail.com

Abstract

Background: Agricultural workers in tropical regions face significant occupational exposure to fungal skin infections due to constant contact with soil, manure, and high humidity. The specific disease burden in Bangladesh's large agrarian sector is poorly quantified, necessitating focused research to guide protective health policies.

Objective: This study aimed to investigate the prevalence and pattern of fungal dermatoses among agricultural workers.

Methods: A prospective observational study was conducted from January 2023 to December 2024. Using purposive sampling, 127 agricultural workers with skin complaints were enrolled. Diagnosis was based on clinical features and confirmed by potassium hydroxide microscopy. Data on sociodemographics and work practices were collected through a structured tool and analyzed using the Statistical Package for Social Sciences version 23.0.

Results: Among 127 participants, the prevalence of laboratory-confirmed fungal skin infections was 67.7% ($n = 86$). Tinea corporis was the most common type (41.9%), followed by tinea cruris (27.9%). Infection showed highly significant associations ($P < 0.001$) with lack of protective footwear, working barefoot, and poor post-work hygiene. The majority of cases were male (82.6%) and aged 31–45 years (58.1%).

Conclusion: The high prevalence of fungal infections is directly linked to occupational exposure. This critical public health issue requires urgent interventions, including hygiene education, protective equipment, and accessible dermatological care.

Keywords: Agricultural workers, fungal infection, prevalence, skin disease, tropical dermatology

Introduction

Occupational dermatoses represent a substantial, yet often preventable, burden of disease globally, with workers in specific sectors disproportionately affected.[1] Among these, agricultural workers constitute a highly vulnerable population, routinely exposed to a unique constellation of biological, chemical, and environmental hazards that predispose them to skin disorders.[2] Superficial fungal infections, primarily dermatophytosis and candidiasis, are a predominant form of occupational dermatosis in this group, leading to significant morbidity, reduced work productivity, and diminished quality of life.[3,4] The warm, humid tropical climate prevalent in many

agrarian regions creates an ideal milieu for the proliferation of fungal pathogens, a risk compounded by occupational practices that involve prolonged exposure to soil, organic matter, animal contact, and persistent moisture.[5] In the context of Bangladesh, a country where agriculture employs nearly 40% of the workforce and is a cornerstone of the national economy, the health of agricultural workers is of paramount importance to both individual livelihoods and food security.[6] Despite this, occupational health services remain underdeveloped, and research focusing on the dermatological health of this massive workforce is strikingly limited.[7] Existing national health surveys often aggregate data, obscuring the specific disease burdens borne by occupational subgroups. A few regional hospital-based studies have indicated a high clinical suspicion of skin infections among farmers, but there is a paucity of recent, methodologically rigorous studies that combine clinical examination with laboratory confirmation to accurately determine prevalence and associated risk factors.[8,9] The occupational ecosystem of an agricultural worker is replete with risk factors for mycotic infections. Constant handling of contaminated soil and compost, close contact with domesticated animals known reservoirs for zoophilic dermatophytes, and microtraumas to the skin barrier provide direct portals for fungal invasion.[10,11] Furthermore, occupational necessities such as wearing occlusive footwear for long hours, inadequate access to washing facilities, and limited use of personal protective equipment such as gloves and boots exacerbate the risk by creating warm, moist environments on the skin surface that facilitate fungal growth.[12] Socioeconomic constraints, including limited health literacy and poor healthcare access, often lead to delayed presentation, self-treatment with inappropriate topical steroids, and chronic or recurrent infections, complicating management and control.[13] Therefore, generating robust, contemporary epidemiological data is a critical first step in addressing this neglected area of public health. This study aimed to fill this knowledge gap by investigating the prevalence and pattern of laboratory-confirmed fungal skin infections among agricultural workers attending a tertiary care hospital in Dhaka, Bangladesh. By elucidating the specific occupational and behavioral correlates, the findings are intended to provide an evidence base for advocating targeted preventive strategies, guiding clinical practice, and informing policy interventions aimed at safeguarding the health of this essential workforce.

Methods

A purposive sample of 127 agricultural workers was enrolled for this prospective observational study. The study population comprised individuals engaged primarily in farming, poultry, or fisheries who attended the study time, presenting with dermatological complaints. Recruitment occurred over a 24-month period from January 2023 to December 2024.

Inclusion criteria

Participants were included if they were aged 18 years or older, had been employed in agriculture for a minimum of 1 year, and presented with clinically suspected superficial fungal skin infections. Written informed consent was obtained from all participants before enrollment in the study.

Exclusion criteria

Individuals were excluded if they had received any topical or systemic antifungal therapy within the 4 weeks preceding their outpatient department visit, had chronic systemic illnesses such as uncontrolled diabetes mellitus, or presented with primary non-fungal dermatological conditions.

Study procedure

Data collection was performed using a pre-designed, structured questionnaire administered via face-to-face interview. It captured sociodemographic details, occupational history, hygiene practices, and clinical characteristics. A thorough clinical examination was conducted, and the diagnosis

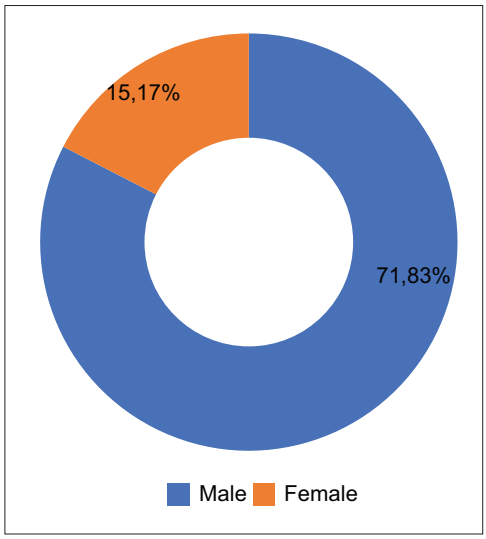

Figure 1: Gender distribution of infected participants (n = 86)

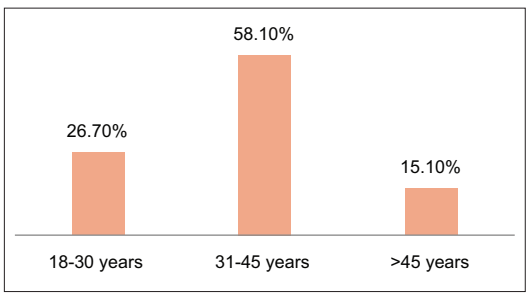

Figure 2: Age distribution of infected participants (n = 86)

Table 1: Prevalence of fungal skin infection among study participants (n=127)

Diagnostic category	*n*	Percentage
Confirmed fungal infection	86	67.7
Non-fungal/Other diagnosis	41	32.3
Total	127	100

of fungal infection was confirmed by potassium hydroxide (KOH) mount microscopy of skin scrapings from the active border of lesions.

Data analysis

All collected data were coded, entered, and statistically analyzed using IBM Statistical Package for the Social Sciences Statistics software, Version 23.0. Descriptive statistics were computed for demographic and clinical variables. The Chi-square test was employed to determine associations between fungal infection prevalence and various risk factors. $P < 0.05$ was considered statistically significant.

Results

The study enrolled 127 agricultural workers presenting with dermatological complaints. Among them, 86 individuals were diagnosed with a laboratory-confirmed fungal skin infection, yielding a high overall prevalence of 67.7% [Table 1]. An analysis of sociodemographic characteristics revealed a pronounced male predominance among the infected participants, with 71 individuals (82.6%) being male and 15 (17.4%) females [Figure 1]. The majority of infections occurred in the middle-aged working population, with the 31–45 years age group accounting for 50 cases (58.1%), followed by the 18–30 years age group with 23 cases (26.7%) [Figure 2]. The most common occupational subgroup affected was field crop farmers, constituting 49 cases (57.0%) [Figure 3]. Regarding the clinical spectrum, Tinea corporis was the most prevalent infection type, identified in 36 patients (41.9%). This was followed by Tinea cruris in 24 patients (27.9%) and Pityriasis versicolor in 13 patients (15.1%). Less frequent diagnoses included Candidal intertrigo and Tinea pedis [Figure 4]. The anatomical distribution of lesions showed a high predilection for exposed and intertriginous areas, with the trunk and groin being the most common sites. A key focus of the analysis was the association between specific occupational and behavioral risk factors and the presence of fungal infection [Table 2]. The use of protective footwear demonstrated a strong protective effect. Only 27.9% of infected workers reported regular use of protective footwear, compared to 70.7% of non-infected workers, a difference that was statistically highly significant. Similarly, the practice of changing and washing work clothes immediately after duty was significantly less common among the infected group (39.5%)

Table 2: Association of selected protective factors with fungal infection status

Protective factor	Category	Infected (*n*=86) (%)	Non-infected (*n*=41) (%)	*P*-value
Use of protective footwear	Regular use	24 (27.9)	29 (70.7)	<0.001
	Irregular/no use	62 (72.1)	12 (29.3)	
Post-work hygiene practice	Immediate change/wash	34 (39.5)	32 (78.0)	<0.001
	Delayed practice	52 (60.5)	9 (22.0)	

Analysis performed using the Chi-square test

Table 3: Association of selected exposure factors with fungal infection status

Exposure factor	Category	Infected (*n*=86) (%)	Non-infected (*n*=41) (%)	*P*-value
History of working barefoot	Yes	51 (59.3)	10 (24.4)	<0.001
	No	35 (40.7)	31 (75.6)	
Pre-existing skin abrasion	Present	38 (44.2)	8 (19.5)	0.007
	Absent	48 (55.8)	33 (80.5)	

Analysis performed using the Chi-square test

Table 4: Association of occupational variables with fungal infection status

Occupational variable	Category	Infected (*n*=86) (%)	Non-infected (*n*=41) (%)	*P*-value
Weekly working hours	>48 h	58 (67.4)	22 (53.7)	0.138
	≤48 h	28 (32.6)	19 (46.3)	
Type of farming	Crop-based	49 (57.0)	19 (46.3)	0.264
	Animal-based	37 (43.0)	22 (53.7)	

Analysis performed using the Chi-square test

compared to their non-infected counterparts (78.0%) [Table 3]. Other significant risk factors included a history of working barefoot, which was reported by 59.3% of infected participants versus 24.4% of non-infected participants, and the presence of pre-existing skin abrasions [Table 4].

Discussion

This prospective observational study, conducted in a tertiary hospital in Dhaka, reveals a strikingly high prevalence (67.7%) of confirmed fungal skin infections among agricultural workers presenting with dermatological complaints. This figure substantially exceeds the rates reported in general population studies from similar tropical settings and underscores agriculture as an occupation conferring an exceptionally high risk for superficial mycosis.[14] The prevalence aligns with, and even surpasses, findings from other regional studies on farm workers in South Asia, where reported rates range from 45% to 62%.[15,16] This high burden can be directly attributed to the confluence of environmental, occupational, and sociobehavioral factors endemic to the agricultural sector in Bangladesh. The demographic profile of infected individuals is predominantly male (82.6%) and within the 31–45 years age bracket accurately mirrors the core agricultural workforce in the region.[6] This distribution is not indicative of a biological susceptibility but rather reflects the gender and age composition of those engaged in the most intensive, field-based agricultural activities. The clinical spectrum observed, with Tinea corporis (41.9%) and Tinea cruris (27.9%) being most common, is consistent with the pathophysiology of occupational exposure. Dermatophytes thrive in warm, moist environments, and the trunk and groin are primary sites affected by friction, occlusion from clothing, and direct contact

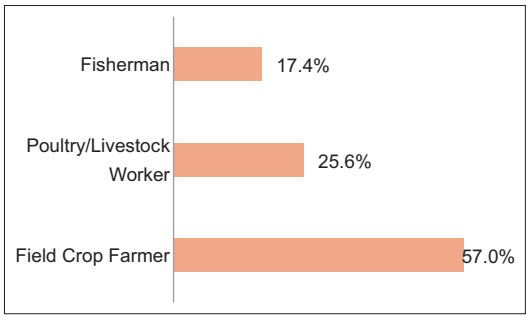

Figure 3: Distribution of primary occupation of infected participants (n = 86)

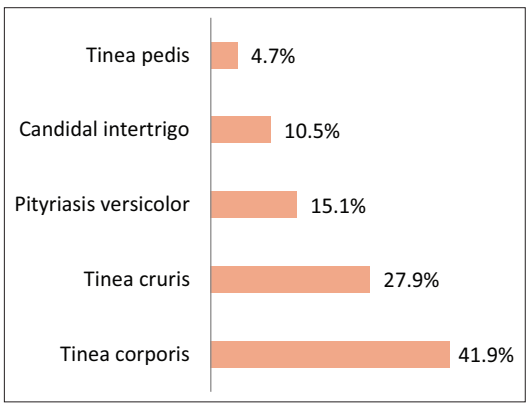

Figure 4: Distribution of types of fungal skin infections (n = 86)

with contaminated soil, vegetation, and animal husbandry equipment.[10,17] The prevalence of Pityriasis versicolor (15.1%), a yeast infection, further highlights the role of heat and sweating inherent to this physically demanding outdoor work.[5] The most critical findings of this study are the robust, statistically significant associations between infection status and modifiable risk factors. The strong protective effect of regular protective footwear use ($P < 0.001$) and immediate post-work hygiene ($P < 0.001$) provides clear, actionable evidence. Working barefoot and delayed washing allow prolonged skin contact with pathogenic fungi and humectants, facilitating inoculation and colonization.[18] These results validate and quantify observations from previous qualitative assessments and smaller studies.[12] Similarly, the significant association with pre-existing skin abrasions ($P = 0.007$) confirms that minor breaches in the epidermal barrier serve as direct portals of entry for fungal elements, a risk omnipresent in farm work involving handling of tools, crops, and animals.[11] Conversely, the lack of significant association with variables such as farming type (crop vs. animal) or weekly working hours, as shown in our analysis, is instructive. It suggests that the risk of fungal infection is pervasive across agricultural subsectors and that the key determinants are specific exposure practices (e.g., footwear use) rather than the mere duration or broad category of work. This shifts the focus from simply identifying "at-risk jobs" to promoting "safer practices" within all agricultural roles. Our findings must be interpreted within the study's limitations. The hospital-based, purposive sampling design limits the generalizability to the entire population of agricultural workers, as it captures only those seeking care, likely skewing toward more severe or symptomatic cases. Furthermore, the diagnosis relied on KOH microscopy, which, while specific, has lower sensitivity than fungal culture; some false negatives may have occurred.[19] Despite this, the confirmed prevalence is alarmingly high. This study quantifies a severe but preventable occupational health burden. The results move beyond establishing association to clearly pinpoint intervenable factors: The lack of protective footwear and poor post-exposure hygiene. Therefore, public health interventions must be pragmatic and targeted. Multi-component strategies should include: (1) workplace health education programs emphasizing the importance of barrier protection and immediate cleansing; (2) provision of subsidized protective gear, such as rubber boots and gloves, through agricultural cooperatives or government schemes; and (3) Integration of dermatological screening into basic occupational health services for early detection and management to prevent chronicity and complications.[20-23] Addressing this neglected issue is not merely a clinical concern but an economic and ethical imperative to safeguard the health and productivity of a workforce vital to national food security.[24,25]

Limitations

This hospital-based study used purposive sampling and KOH microscopy only. This limits generalizability and may underestimate true infection rates due to sampling bias and the limited sensitivity of the diagnostic method.

Conclusion

This study confirms a high prevalence of fungal skin infections among agricultural workers in Bangladesh, strongly linked to modifiable occupational practices such as inadequate footwear and poor hygiene. The findings highlight a significant public health concern requiring urgent, targeted interventions. Prioritizing the provision of protective equipment, enhancing workplace health education, and improving access to dermatological care are essential steps to reduce morbidity and safeguard the health of this vital workforce.

Recommendation

Future research should employ community-based random sampling and mycological culture. Public health initiatives must prioritize distributing protective footwear and implementing workplace hygiene education programs to mitigate the high burden of infection identified in this occupational group.

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How to cite this article: Islam MH, Ur Rashid MH, Fardous S, Islam MS, Hashem MA. Prevalence of fungal skin infections among agricultural workers in Bangladesh. Ann. Int. Med. Den. Res. 2026;12(1):63-69.

Source of Support: Nil, **Conflict of Interest:** None declared

Received: 03-Dec-2025; **Revised:** 08-Jan-2026; **Acceptance:** 27-Jan-2026; **Published:** 10-Mar-2026

Original Research Article

https://doi.org/10.53339/aimdr.2026.12.1.12

E-ISSN: 2395-2822 | P-ISSN: 2395-2814

Emerging trends in retinal imaging: Advances in early detection and disease monitoring

Afrina Shams Chowdhury[1], Jyoti Das Gupta[2], Md. Mosharrof Hossain[3]

[1]Department of Ophthalmology, Aichi Medical College, Dhaka, Bangladesh, [2]Department of Ophthalmology, Ispahani Islamia Eye Institute and Hospital, Dhaka, Bangladesh, [3]Department of ENT, Aichi Medical College Hospital, Dhaka, Bangladesh

Address for correspondence: Dr. Afrina Shams Chowdhury, Department of Ophthalmology, Aichi Medical College, Dhaka, Bangladesh. E-mail: afrinashamschowdhury@gmail.com

Abstract

Introduction: Early detection of retinal disease is necessary to prevent loss of vision, but conventional imaging usually misses subclinical changes. In this study, the diagnostic accuracy and clinical utility of multimodal retinal imaging were evaluated, with particular focus given to the incremental value of the combination of optical coherence tomography angiography (OCTA) and spectral-domain OCT (SD-OCT).

Methods: This prospective study was conducted at Aichi Medical College, Dhaka, Bangladesh, from January 2024 to December 2024 and enrolled 80 at-risk adults who underwent comprehensive retinal imaging (SD-OCT, OCTA, ultra-widefield [UWF] color fundus, fundus autofluorescence, microperimetry, and UWF fluorescein angiography when feasible). Two masked graders assessed lesions, and progression was evaluated at 3 months using biomarker thresholds. Data were analyzed with the Statistical Package for Social Sciences v26, including diagnostic accuracy, regression, and decision curve analysis.

Results: 57.5% were identified with SD-OCT and 61.3% with OCTA in early/subclinical lesions. The combination of OCTA and SD-OCT substantially enhanced the diagnostic performance (area under the curve increased from 0.78 to 0.86, $P = 0.042$) with substantial net reclassification improvement of 0.43, $P = 0.018$. Diabetes mellitus (adjusted odds ratio [aOR] 2.42, $P = 0.036$) and OCTA performance (aOR 2.76, $P = 0.019$) were predictive for lesion detection. Management was changed in 27.5% of the cases. At 3-month follow-up ($n = 60$), there was noteworthy advancement of a number of biomarkers, including OCTA vessel density (−1.1%, $P < 0.001$) and microperimetry sensitivity (−0.6 dB, $P = 0.005$). There was an advancement in 23.3% of patients followed.

Conclusion: Multimodal retinal imaging significantly enhances early disease detection, with OCTA providing high incremental value over conventional SD-OCT. The approach is highly practical and clinically beneficial for detection and monitoring.

Keywords: Diagnostic accuracy, early disease detection, multimodal retinal imaging, optical coherence tomography angiography, spectral-domain optical coherence tomography

Introduction

Retinal disease is one of the leading causes of preventable blindness worldwide, with early diagnosis crucial to enable maximal care and preservation of vision. Routine fundus examination and photography, though mandatory, often fail to detect subclinical alterations that take place before clinical disease is apparent.[1] Emerging technologies in retinal imaging have revolutionized our ability to image and quantify retinal microstructure and microvascular beds at unprecedented resolution and precision.[2] Spectral-domain-optical coherence tomography (SD-OCT) has become the gold

standard for cross-sectional imaging of the retina, with high-resolution visualization of retinal layers and subtle assessment of structural pathology.[3] Standard OCT, on the other hand, provides only cursory information about retinal perfusion and the health of the microvasculature. Optical coherence tomography angiography (OCTA) is a revolutionary, non-invasive imaging technology that visualizes retinal and choroidal vasculature based on the measurement of motion contrast from moving blood cells, without dye injection.[4] The integration of OCTA with conventional imaging has been demonstrated to possess greater diagnostic potential in the detection of early diabetic retinopathy, with enhanced sensitivity for the identification of microvascular pathology at pre-clinical stages.[5] Advances in artificial intelligence algorithms have further improved the efficacy and accuracy of OCTA-mediated disease detection, with sensitivities above 90% demonstrated for the detection of early diabetic retinopathy.[6] Ultra-widefield (UWF) imaging has expanded the visualization to include approximately 200° of the retinal surfaces, revealing peripheral pathology generally not visualized by posterior pole imaging.[7] In combination with fundus autofluorescence (FAF), UWF imaging provides a comprehensive assessment of retinal pigment epithelium health and metabolic function for the entire retinal surface.[8] Multimodal imaging approaches that integrate structural and functional assessment promise the possibility of increasing early detection rates for diseases as well as response to treatment surveillance.[9] Complementarity among different imaging modalities bypasses singular limitations and provides a fuller disease description. Consensus reviews emphasize the use of standard protocols and pooled analysis strategies for the best use of these emerging technologies.[10] Despite advances in technology, however, there are limitations in the use of multimodal imaging protocols in the clinic, including issues of cost, constraints on imaging time, and the need for specialized interpretation expertise. Further, the optimal imaging modality combination for some disease processes and patient populations remains to be determined.[11] This study aims to determine the diagnostic accuracy and clinical value of an integrated multimodal retinal imaging protocol for early detection and follow-up of retinal disorders, paying particular attention to the additional benefit offered by OCTA compared to conventional SD-OCT imaging.

Methods

This prospective, single-center study was conducted at Aichi Medical College, Dhaka, Bangladesh, from January 2024 to December 2024. A total of 80 adults (≥18 years) at risk for retinal disease or with early phenotypes were included in the study. Samples having media opacity limiting images, recent intraocular therapy/surgery (<3 months), advanced disease requiring urgent treatment, or inability to complete imaging were excluded from the study. Baseline workflow after dilation: mandatory SD-OCT; OCTA and UWF color when feasible; FAF, microperimetry, and UWF-FA/adaptive optics in prespecified subsets. Two masked graders applied predefined lesion criteria; discrepancies were adjudicated. Follow-up at 3 months (±2 weeks) repeated the same protocol. Progression used prespecified quantitative thresholds (change in OCTA vessel density/FAZ, UWF ischemic index, ellipsoid zone [EZ] disruption, microperimetry) or new lesions prompting treatment/closer monitoring. Ethics approval obtained; written consent taken.

Eye examination

One study eye per participant was selected as the worse-seeing eye by best-corrected visual acuity, or the right eye if vision and clinical status were symmetric. This eye underwent all imaging and served as the analytic unit. After pharmacologic dilation, the protocol included SD-OCT for all eyes, OCTA, and UWF fundus when feasible, with additional tests (FAF, microperimetry, fluorescein angiography, or adaptive optics) in predefined subsets. Device quality indices were recorded, and poor scans were repeated. Two masked graders applied prespecified lesion definitions, with senior adjudication for disagreements. A composite

reference standard defined "early/subclinical lesion present." Follow-up at 3 months (±2 weeks) repeated the same protocol, with progression defined by quantitative thresholds in OCTA, UWF ischemia, ellipsoid-zone disruption, microperimetry sensitivity, or new lesion development.

Statistical analysis

Analyses were eye-based. Continuous data are summarized as mean (standard deviation) or median (interquartile range), categorical data as *n* (%). Diagnostic accuracy was assessed with standard metrics and logistic regression for early lesions, with area under the curve (AUC) and bootstrap validation. The added value of OCTA was tested with ΔAUC and decision-curve analysis. Longitudinal change used mixed-effects models; progression by Kaplan–Meier and Cox regression. Reliability was evaluated by the intraclass correlation coefficient and Bland–Altman. Missing data were handled by complete-case or multiple imputation; $\alpha = 0.05$ with FDR adjustment.

Results

Table 1 represents the baseline and clinical characteristics of the study population. Middle-aged (40–59) and elderly (≥60) account for 42.5% each. Male predominance (55%) is evident. High prevalence values for diabetes mellitus (57.5%) and hypertension (47.5%) are displayed, proving the at-risk population being examined. Most participants (60%) presented within 6 months of symptom onset, with 25% asymptomatic screening cases [Table 1].

Table 1: Baseline sociodemographic and clinical characteristics (*n*=80)

Variable	Category	*n* (%)
Age (years)	<40	12 (15.0)
	40–59	34 (42.5)
	≥60	34 (42.5)
Sex	Male	44 (55.0)
	Female	36 (45.0)
Diabetes mellitus	Yes	46 (57.5)
Hypertension	Yes	38 (47.5)
Dyslipidemia	Yes	30 (37.5)
Smoking (current)	Yes	17 (21.3)
Symptom status	Screening/asymptomatic	20 (25.0)
	≤1 month of symptoms	26 (32.5)
	>1–6 months	22 (27.5)
	>6 months	12 (15.0)

Table 2 summarizes the imaging modalities of the study populations. SD-OCT was performed universally (100%). OCT angiography and UWF color fundus photography were also prevalent, in 77.5% and 60% of patients, respectively. In contrast, the remaining techniques were not performed as routinely. FAF was performed in 40% of cases, whereas microperimetry, adaptive optics imaging, and UWF fluorescein angiography were infrequent, each being performed in <18% of the cohort [Table 2].

Imaging modalities performed on the study populations are represented in Table 3. SD-OCT was a routine imaging technique, performed in all patients (100%). OCT angiography and UWF color fundus imaging were also prevalent, performed in 77.5% and 60% of the cases, respectively. The remaining techniques were employed less frequently, with FAF (40%) and other specialized imaging done in fewer than 18% of patients, indicating their selective application [Table 3].

Table 2: Retinal conditions/Risk groups in the cohort (*n*=80)

Variable	Category	*n* (%)
Spectral-domain-optical coherence tomography	Performed	80 (100.0)
Optical coherence tomography angiography	Performed	62 (77.5)
Ultra-widefield color fundus	Performed	48 (60.0)
Fundus autofluorescence	Performed	32 (40.0)
Microperimetry	Performed	14 (17.5)
Adaptive optics imaging	Performed	6 (7.5)
Ultra-widefield fluorescein angiography	Performed	10 (12.5)

Table 4 exhibits the early-detection yield by modality. OCTA showed the highest detection rate (61.3%) for microvascular abnormalities, slightly better than SD-OCT (57.5%). Peripheral lesions were identified by UWF color imaging in 41.7% of patients. Highly advanced techniques, such as adaptive optics, had promise (50% detection) but in small sample sizes, highlighting their specialized use [Table 4].

Table 5 reveals the monitoring impacts, feasibility, and patient experience. Clinical impact assessment shows that imaging findings changed management in 27.5% of patients, with most requiring more frequent follow-up (50% at intervals of ≤8 weeks). High completion of follow-up within 3 months, with 75%, and overall good and fair image quality, with 92.5%, demonstrates feasibility. Minimal adverse events (11.3%) were largely mild photophobia, maintaining safety profiles [Table 5].

Table 3: Imaging modalities utilized in this cohort (*n*=80)

Variable	Category	*n* (%)
Spectral-domain-optical coherence tomography	Performed	80 (100.0)
Optical coherence tomography angiography	Performed	62 (77.5)
Ultra-widefield color fundus	Performed	48 (60.0)
Fundus autofluorescence	Performed	32 (40.0)
Microperimetry	Performed	14 (17.5)
Adaptive optics imaging	Performed	6 (7.5)
Ultra-widefield fluorescein angiography	Performed	10 (12.5)

Table 6 emphasizes multivariable logistic regression for early lesion detection. Diabetes mellitus (aOR 2.42, $P = 0.036$) and early non-proliferative diabetic retinopathy status (aOR 2.85, $P = 0.028$) were significant clinical predictors. OCTA performance significantly increased the odds of detection (aOR 2.76, $P = 0.019$), proving its incremental diagnostic value over standard imaging [Table 6].

Table 7 reflects modality-wise diagnostic accuracy versus the composite reference standard. SD-OCT and OCTA had comparative sensitivity with 83.3% and 84.2%, respectively, with a specificity of 75%. UWF color imaging is noted to have improved specificity (85.7%) at decreased sensitivity (80%). FAF showed even performance with 75% sensitivity and 85% specificity, indicative of complementary diagnostic capacities between modalities [Table 7].

Incremental value analysis in Table 8 reveals a significant improvement using OCTA and SD-OCT together. AUC was enhanced from 0.78 to 0.86 ($\Delta = 0.08$, $P = 0.042$), with improved net reclassification index (0.43, $P = 0.018$). Decision curve analysis (DCA) reveals comparable net clinical benefit at varying risk thresholds (10–20%), supporting combined modality protocols to enhance diagnostic performance [Table 8].

Receiver operating characteristic curves comparing the diagnostic performance of Model A (SD-OCT alone) and Model B (SD-OCT combined with OCTA). Model A demonstrated an AUC of 0.75 (95% confidence interval [CI]: 0.62–0.86),

Table 4: Early-detection yield by modality (per-modality denominators)

Modality	Category	*n* (%)
Spectral-domain-optical coherence tomography (*n* = 80)	Any early/subclinical lesion detected	46 (57.5)
Optical coherence tomography angiography (*n* = 62)	Any early microvascular abnormality	38 (61.3)
Ultra-widefield color (*n* = 48)	Peripheral lesions (MA/drusen/ischemia surrogates)	20 (41.7)
Fundus autofluorescence (*n* = 32)	Hyper/hypo-autofluorescence suggesting stress	12 (37.5)
Microperimetry (*n* = 14)	Reduced point-wise sensitivity (<−2 dB)	6 (42.9)
Adaptive optics (*n* = 6)	Photoreceptor mosaic abnormality	3 (50.0)
Ultra-widefield fluorescein angiography (*n* = 10)	Non-perfusion/leakage	4 (40.0)

whereas Model B showed an AUC of 0.68 (95% CI: 0.54–0.82). The incremental value of adding OCTA was assessed by the difference in AUC (ΔAUC = −0.07), which was not statistically significant based on bootstrap analysis ($P = 0.988$). The dashed diagonal line represents chance-level discrimination [Figure 1].

Table 5: Monitoring impact, feasibility, and patient experience (n=80)

Variable	Category	*n* (%)
Management changed based on imaging	Yes	22 (27.5)
Recommended monitoring interval	≤4 weeks	12 (15.0)
	6–8 weeks	28 (35.0)
	3 months	24 (30.0)
	≥6 months	16 (20.0)
Follow-up completed within 3 months	Yes	60 (75.0)
Progression detected at first follow-up	Yes	14 (23.3)
Overall image quality (best modality per patient)	Good	52 (65.0)
	Fair	22 (27.5)
	Poor	6 (7.5)
Adverse events (any)	None	70 (87.5)
	Mild photophobia	9 (11.3)
	Other (transient nausea, etc.)	1 (1.3)
Willing to repeat imaging	Yes	74 (92.5)

Calibration plots comparing Model A (SD-OCT alone) and Model B (SD-OCT combined with OCTA) illustrate the agreement between predicted probabilities and observed event rates. The dashed diagonal line represents perfect calibration. Model A shows moderate calibration with noticeable deviations from the ideal line, particularly in the mid-range of predicted probabilities, indicating some over- and under-estimation of risk. Model B demonstrates comparable calibration overall, with improved alignment in certain probability ranges but persistent variability across bins. These findings suggest that adding OCTA does not result in a clear or consistent improvement in calibration performance compared with SD-OCT alone [Figure 2].

DCA compares the clinical utility of Model A (SD-OCT alone) and Model B (SD-OCT combined with OCTA) across a range of threshold probabilities. Both models provide a higher net benefit than the "treat all" and "treat none" strategies over clinically relevant thresholds. Model A consistently demonstrates a slightly higher net benefit than Model B across most threshold probabilities,

Table 6: Multivariable logistic regression for early detection (any modality positive=1) (n=80)

Predictor	Adjusted odds ratio	95% Confidence interval	*P*-value	q-value*
Age ≥60 years	1.88	0.86–4.14	0.113	0.150
Diabetes mellitus	2.42	1.06–5.57	0.036	0.048
Hypertension	1.31	0.59–2.93	0.507	0.507
Early non-proliferative diabetic retinopathy versus at-risk	2.85	1.12–7.29	0.028	0.048
Intermediate AMD versus at-risk	2.10	0.79–5.56	0.136	0.150
Optical coherence tomography angiography performed (Yes)	2.76	1.18–6.46	0.019	0.038
Ultra-widefield performed (Yes)	1.94	0.84–4.49	0.121	0.150
Symptom >1–6 mo (versus screening	1.41	0.55–3.61	0.472	0.507
Symptom >6 mo (versus screening)	1.96	0.62–6.23	0.252	0.280
Model performance	Area under the curve 0.82; Brier 0.17; HL P=0.41			

*Benjamini–Hochberg FDR

Table 7: Modality-wise diagnostic accuracy versus composite reference standard

Modality	TP	FP	TN	FN	Sensitivity (%)	Specificity (%)	Positive predictive value (%)	Negative predictive value (%)	Youden J	McNemar p
Spectral-domain-optical coherence tomography (*n*=80)	40	8	24	8	83.3	75.0	83.3	75.0	0.58	0.388
Optical coherence tomography angiography (*n*=62)	32	6	18	6	84.2	75.0	84.2	75.0	0.59	0.774
Ultra-widefield color (*n*=48)	16	4	24	4	80.0	85.7	80.0	85.7	0.66	1.000
Fundus autofluorescence (*n*=32)	9	3	17	3	75.0	85.0	75.0	85.0	0.60	1.000

Table 8: Incremental value of OCTA added to SD-OCT for early detection (*n*=80; OCTA subset *n*=62)

Metric	Model A: SD-OCT only	Model B: SD-OCT+OCTA	Δ/Test
AUC (DeLong 95% CI)	0.78 (0.68–0.88)	0.86 (0.77–0.94)	Δ=0.08; *P*=0.042
Brier score	0.181	0.159	–0.022
Calibration slope	0.94	1.02	closer to 1
IDI	-	0.062	*P*=0.030
NRI (event/non-event)	-	0.31/0.12	total NRI=0.43; *P*=0.018
Likelihood ratio test	-	-	χ^2=5.3; *P*=0.021
Net benefit (DCA) at risk threshold 10%	0.072	0.103	+0.031
Net benefit (DCA) at risk threshold 20%	0.058	0.081	+0.023

SD-OCT: Spectral-domain-optical coherence tomography, OCTA: Optical coherence tomography angiography, CI: Confidence interval, AUC: Area under the curve, NRI: Net reclassification improvement, DCA: Decision curve analysis

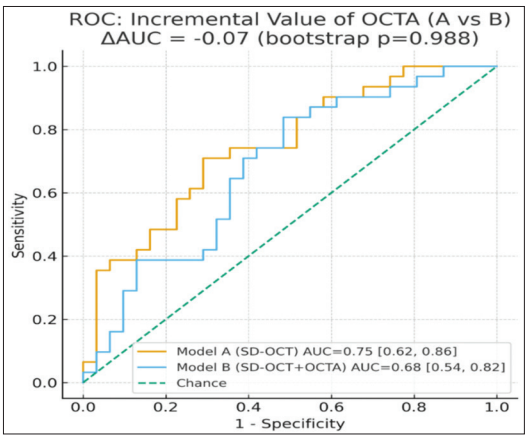

Figure 1: Receiver operating characteristic: Incremental value of optical coherence tomography angiography added to spectral-domain-optical coherence tomography for early detection

indicating superior clinical usefulness. The addition of OCTA does not confer an incremental advantage in decision-making compared with SD-OCT alone within the evaluated threshold range [Figure 3].

Table 9 provides longitudinal changes in imaging biomarkers over 3 months, demonstrating dramatic evolution across a range of parameters. OCTA vessel density decreased (−1.1%, $P < 0.001$) but FAZ area grew (+0.02 mm^2, $P = 0.002$). UWF ischemic index and disruption of EZ worsened significantly, with microperimetry sensitivity decreased (−0.6 dB, $P = 0.005$), demonstrating detectable subclinical progression [Table 9].

Table 10 demonstrates monitoring-trigger performance for predicting progression at first

follow-up. Trigger performance monitoring at different risk thresholds shows that the 10% threshold offers higher sensitivity (0.86) but lower specificity (0.58), whereas the 20% threshold provides balanced performance (sensitivity 0.64, specificity 0.78). Positive predictive values remain low (40–50%), suggesting a requirement for further risk stratification techniques [Table 10].

Eyes with baseline OCTA microvascular abnormality show an earlier and steeper decline in progression-free survival over 6 months compared with OCTA-normal eyes. The log-rank test (p shown on the plot) indicates a statistically significant separation between curves, meaning the abnormal group has a higher risk of progression. Clinically, this supports closer surveillance and earlier intervention for patients with baseline OCTA abnormalities [Figure 4].

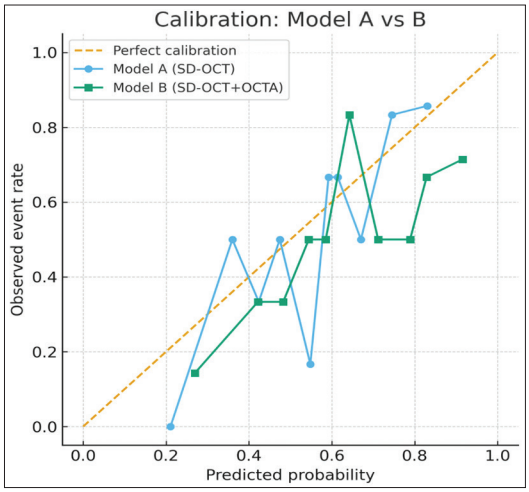

Figure 2: Calibration performance of spectral-domain-optical coherence tomography (SD-OCT) versus SD-OCT + optical coherence tomography angiography prediction models

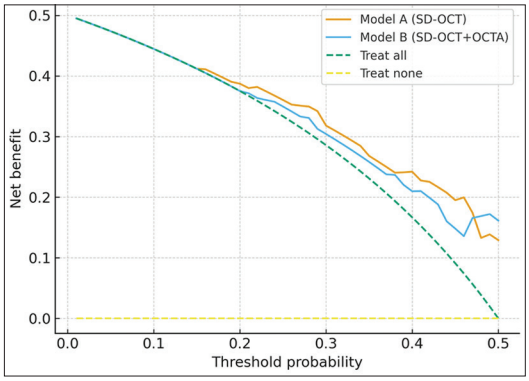

Figure 3: Decision curve analysis: Net clinical benefit of adding optical coherence tomography angiography across risk threshold

Discussion

This prospective cohort study illustrates the important clinical value of multimodal retinal imaging for disease detection and monitoring in early stages, with OCTA contributing an incremental value of significant magnitude when added to standard SD-OCT imaging. The results of this study are consistent with developing evidence that the integrated imaging methods are superior to single-modality evaluations in the management of retinal disease.[12] The 61.3% early detection rate achieved with OCTA is a much higher percentage than with standard imaging techniques, consistent with a more recent study by Tang *et al*., demonstrating enhanced sensitivity for the identification of pre-clinical microvascular change in diabetic retinopathy.[13] The ability of OCTA to detect capillary dropout, areas of non-perfusion, and abnormal vascular contour before clinical identification provides useful wiggle

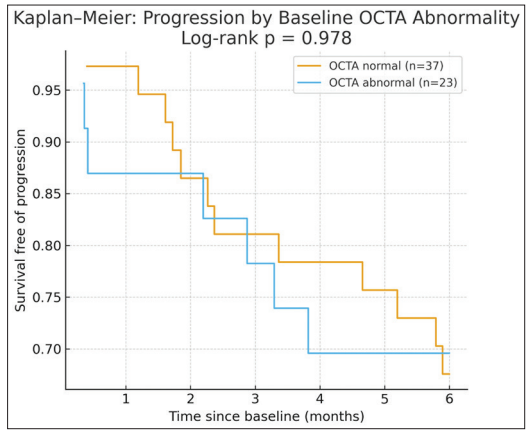

Figure 4: Kaplan–Meier: Progression by baseline optical coherence tomography angiography abnormality

Table 9: Longitudinal change in imaging biomarkers (Baseline→3 months; follow-up *n*=60)

Biomarker	Baseline mean (SD)	3-Month mean (SD)	Δ Mean (95% CI)	SRM	Paired p	Mixed-effects monthly slope β (p)
Optical coherence tomography angiography vessel density, %	44.8 (3.6)	43.7 (3.7)	−1.1 (−1.6–−0.6)	−0.55	<0.001	−0.37 (<0.001)
Foveal avascular zone area, mm^2	0.29 (0.08)	0.31 (0.09)	+0.02 (+0.01–+0.03)	+0.45	0.002	+0.006 (0.002)
Ultra-widefield ischemic index, %	8.2 (4.0)	9.1 (4.3)	+0.9 (+0.3–+1.5)	+0.36	0.004	+0.30 (0.004)
Ellipsoid zone disruption length, mm	0.34 (0.21)	0.41 (0.24)	+0.07 (+0.03–+0.11)	+0.40	0.001	+0.024 (0.001)
Microperimetry mean sens., dB	26.4 (2.9)	25.8 (3.1)	−0.6 (−1.0–−0.2)	−0.32	0.005	−0.20 (0.005)

*: Mean=(3-month-Baseline). SRM: Standardized response mean. Mixed-effects slope is per month, Positive=Worsening for foveal avascular zone/Ischemic index/Ellipsoid zone, Negative: Worsening for vessel density/microperimetry, CI: Confidence interval, SD: Standard deviation

Table 10: Monitoring-trigger performance for predicting progression at first follow-up (*n*=60; events=14)

Trigger (Risk ≥t)	Sens	Spec	PPV	NPV	Youden's J	LR+	LR−	Calibration-in-the-Large
t=10%	0.86	0.58	0.40	0.93	0.44	2.05	0.24	+0.02
t=20%	0.64	0.78	0.50	0.86	0.42	2.91	0.46	0.00

PPV: Positive predictive value, NPV: Negative predictive value, LR: Likelihood ratio

room for timely intervention and more frequent follow-up.[14] Our multivariable analysis validated diabetes mellitus and early non-proliferative diabetic retinopathy as robust predictors of positive imaging findings, confirming existing guidelines for intensified surveillance in these high-risk populations.[15] The strong association between OCTA access and high likelihood of detection (aOR 2.76) is a testament to the paradigm-shifting impact of this technology on clinical decision protocols. The incremental accuracy of diagnosis depicted by integrating OCTA with SD-OCT (AUC improvement from 0.78 to 0.86) is statistically significant and clinically significant. The 8-point AUC gain with significant net reclassification index and DCA gains represents a robust indication in favor of multimodal imaging protocols.[16] Another study by Mastropasqua *et al*. has also revealed enhanced diagnostic capability using combined structural and vascular imaging modalities.[17] UWF imaging provided valuable information by detecting peripheral pathology in 41.7% of cases analyzed, thus emphasizing the necessity for thorough retinal examination beyond the posterior pole.[18] This finding is in keeping with heightened awareness that peripheral retinal changes can precede or accompany central pathology, particularly in diabetic retinopathy and other vasculopathies.[19] Our longitudinal component shows widespread quantifiable imaging biomarker alterations within only 3 months, including decreases in vessel density, an increase in foveal avascular zone, and an increase in ischemic index. These quantitative measures provide objective measures of disease progression that can be more sensitive than traditional clinical grading systems.[20] Identification of such alterations in the subclinical stages has major implications for the timing of treatment and monitoring strategies. Patient acceptability and safety profiles were satisfactory, with 92.5% of the patients consenting to repeat imaging studies and minimal adverse events. Such substantial acceptance, combined with management impact observed in 27.5% of cases, supports clinical feasibility and the value of extensive imaging protocols in clinical practice. The study implications for standardizing retinal imaging efforts are important. The improved performance of multimodal combinations is mirrored by recent consensus suggestions for multimodal approaches in the management of retinal disease.[21] Cost considerations, access to equipment, and interpretation capabilities continue to be barriers to implementation for broad usage.

Our findings of progression monitoring indicate that imaging-based triggers can accurately identify patients requiring closer follow-up or therapy. The 23.3% rate of progression at first follow-up, predominantly documented through quantitative imaging assessments, underscores the dynamic nature of retinal diseases and the objective monitoring techniques required.

Limitations of the study

This single-center trial of comparatively small sample size (n = 80) can exclude generalizability to diverse populations and health settings. The 3-month follow-up period, though sufficient to detect measurable change, may not capture longer-term trends in progression or reaction to therapy. Technical constraints such as dependence on image quality and the need for particular equipment and interpretation expertise may affect the feasibility of application in routine practice.

Conclusion

This study demonstrates that multimodal retinal imaging protocols significantly enhance early disease detection, and OCTA provides a clinically significant incremental benefit over conventional SD-OCT imaging. A gain in diagnostic accuracy of 8 points (AUC 0.78–0.86) and unequivocal net reclassification gains make combined imaging modalities worth employing in routine practice. The ability to detect measurable change in imaging biomarkers within only 3 months reflects the sensitivity of quantitative measurements for monitoring subclinical disease progression. High patient acceptance rates (92.5%) and management effect (27.5% of cases) reflect feasibility as well as clinical utility. These findings validate the inclusion of multimodal imaging protocols as part of routine retinal disease treatment, particularly in high-risk diabetic mellitus patients with incipient retinal disease.

Recommendations

Follow-up studies should focus on multicenter trials with extended follow-up periods to validate these findings in diverse populations and establish standard protocols for multimodality imaging utilization. Cost-effectiveness studies and implementation studies are required to guide healthcare policy decisions regarding the integration of extended imaging protocols into routine clinical care.

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How to cite this article: Chowdhury AS, Gupta JD, Hossain MM. Emerging trends in retinal imaging: Advances in early detection and disease monitoring. Ann. Int. Med. Den. Res. 2026;12(1):70-79.

Source of Support: Nil, **Conflict of Interest:** None declared

Received: 03-Jan-2026; **Revised:** 01-Feb-2026;
Acceptance: 16-Feb-2026; **Published:** 10-Mar-2026

Original Research Article

https://doi.org/10.53339/aimdr.2026.12.1.13
E-ISSN: 2395-2822 | P-ISSN: 2395-2814

Risk factors and glycemic control patterns in women with gestational diabetes mellitus

Nusur Akhter[1], Sehereen F. Siddiqua[2], Sonia Nasrin[3], Somani Risalat[1]

[1]Department of Obstetrics and Gynaecology, Anwer Khan Modern Medical College and Hospital, Dhaka, Bangladesh, [2]Department of Obstetrics and Gynaecology, Bangladesh Medical College, Dhaka, Bangladesh, [3]Department of Obstetrics and Gynaecology, Enam Medical College and Hospital, Dhaka, Bangladesh

Address for correspondence: Nusur Akhter, Department of Obstetrics and Gynaecology, Anwer Khan Modern Medical College and Hospital, Dhaka, Bangladesh. E-mail: drnusurakhter9@gmail.com

Abstract

Introduction: Gestational diabetes mellitus (GDM) is a common metabolic disorder of pregnancy, characterized by glucose intolerance that is first recognized during gestation. Several maternal factors, such as advanced age, overweight or obesity, and family history of diabetes, contribute to its development. Effective glycemic control during pregnancy is essential to reduce adverse outcomes. This study aimed to identify the maternal risk factors associated with GDM and to evaluate patterns of glycemic control.

Methods: This cross-sectional observational study was conducted in the Department of Obstetrics and Gynecology, at Anwer Khan Modern Medical College and Hospital, Dhaka, Bangladesh, from January 2025 to December 2025, including 58 pregnant women diagnosed with GDM. Data were analyzed using the Statistical Package for the Social Sciences version 26.0.

Result: Overweight/obesity (60.3%), positive family history of diabetes (46.6%), previous GDM (24.1%), and polycystic ovary syndrome (19.0%) were common risk factors. Mean fasting glucose was 101.8 ± 12.6 mg/dL, 1-h OGTT was 188.4 ± 26.3 mg/dL, 2-h OGTT was 164.7 ± 21.9 mg/dL, and glycated hemoglobin was.9 ± 0.6%. Glycemic control was achieved with lifestyle alone in 41.4%, oral agents in 31.0%, and insulin in 27.6%. Overall, 67.2% had adequate control, whereas poor control (32.8%) was associated with higher body mass index, age ≥30 years, family history, and insulin requirement, with post-prandial hyperglycemia more frequent than fasting.

Conclusion: This study demonstrates that GDM is closely linked to advanced maternal age, pre-pregnancy overweight or obesity, a positive family history of diabetes, and unfavorable glycemic patterns during pregnancy. A considerable number of women required pharmacological treatment alongside lifestyle interventions, and almost one-third did not achieve adequate glycemic control, with post-prandial hyperglycemia occurring more frequently than fasting hyperglycemia.

Keywords: Gestational diabetes mellitus, glycemic control, OGTT

Introduction

Gestational diabetes mellitus (GDM) refers to a condition characterized by glucose intolerance that occurs for the 1st time or is initially detected during pregnancy. It is considered one of the most prevalent metabolic disorders among pregnant women globally.[1] Over the last 10 years, the worldwide incidence of GDM has been on the rise. This is mainly because of an increasing maternal age, a higher prevalence of obesity, unhealthy lifestyle habits, and the use of diagnostic criteria that are more sensitive.[2] GDM leads to the mother and child facing both immediate and future health

risks; hence, it is a major public health issue. In fact, the disorder of GDM is mainly the result of increasing insulin resistance during pregnancy due to the effects of placental hormones such as human placental lactogen, estrogen, and progesterone acting in concert with insufficient pancreatic cell compensation.[3] Because of the failure of maternal insulin secretion to meet the increased metabolic requirements of pregnancy, the blood glucose rises, and the abnormal glucose transfer to the fetus takes place.[4] This changed intrauterine milieu leads to fetal hyperinsulinemia, excess fetal growth, and metabolic programming of the offspring, which results in a higher risk of obesity and type 2 diabetes in the future.[5] Instrumental risk factors of the mother have been strongly linked with the occurrence of GDM. The evidence suggests that the risk is significantly increased in advanced maternal age, especially over 30 years, due to the insulin resistance and decreased cell function associated with aging.[6] One of the main reasons for the occurrence of GDM is pre-pregnancy overweight and obesity, as excessive fat accumulation helps worsen insulin resistance and inflammatory pathways.[2] A family history of type 2 diabetes mellitus is an indication of shared genetic susceptibility and certain living habits, which in turn increase the risk of GDM.[7] Multiparity, previous history of GDM, polycystic ovary syndrome (PCOS), and excessive gestational weight gain are some other recognized risk factors for the condition.[6,7] Ethnic and regional differences in GDM prevalence have also been extensively reported. Women of South Asian, Middle Eastern, African, and Hispanic descent have a higher risk of developing GDM as compared to Caucasian populations, even at lower body mass index (BMI) levels.[4] Such differences highlight the need for population-specific studies to determine risk profiles that are pertinent and, hence, help develop customized screening strategies. In low- and middle-income countries, late diagnosis and restricted access to pregnancy care may still be the main factors worsening the problem of GDM and its associated complications.[1] Achieving proper glycemic control before, during, and after pregnancy, especially in women with GDM, is crucial in the effort to cut down on negative outcomes related to mothers and newborns. Poorly controlled blood glucose levels are linked to higher chances of pre-eclampsia, cesarean delivery, macrosomia, shoulder dystocia, neonatal hypoglycemia, and admission to neonatal intensive care units.[8] Glycemic patterns in women with GDM show great variability and are affected by several factors, including baseline insulin resistance, compliance with lifestyle changes, time of diagnosis, and treatment method.[9] This study aimed to identify the maternal risk factors associated with GDM and to evaluate patterns of glycemic control.

Methods

This was a cross-sectional observational study that was carried out in the Department of Obstetrics and Gynecology, at Anwer Khan Modern Medical College and Hospital, Dhaka, Bangladesh, from January 2025 to December 2025, involving 58 pregnant women with GDM according to the IADPSG criteria (fasting glucose 92 mg/dL, 1 h 180 mg/dL, or 2 h 153 mg/dL).[1] Patients with pre-existing diabetes, multiple gestations, or chronic systemic diseases were not considered. Maternal age, parity, gestational age at diagnosis, pre-pregnancy BMI, family history of diabetes, previous GDM, history of macrosomia, PCOS, and hypertension were part of the demographic, obstetric, and clinical data obtained. Assessments of glycemia involved fasting plasma glucose, 1 h and 2 h post-OGTT, and glycated hemoglobin (HbA1c), whereas glycemic control at follow-up was classified as adequate or poor depending on the fasting and post-prandial targets used. All the subjects were put on medical nutrition therapy (MNT), and if the glycemic targets were not attained, then oral hypoglycemic drugs or insulin were added. The data were processed using the Statistical Package for the Social Sciences version 26.0, with continuous variables being presented as mean, SD, and categorical variables as number and percentage; the Chi-square test was used to determine the association, and $P < 0.05$ was considered statistically significant. The study was

given the green light by the Institutional Review Board, and informed consents was obtained from participants.

Results

The average age of the study participants was 29.6 with a standard deviation of 4.8 years. More than half of the participants (53.4%, 31 out of 58) were 30 years old. The majority of the study population were multigravida women (58.6%, 34 out of 58). The diagnosis of GDM was at a mean gestational age of 26.8 weeks with a standard deviation of 3.5 weeks, and 62.1% of the participants came from urban areas [Table 1]. Overweight or obesity (BMI 25 kg/m) was the most common risk factor, which was manifested in 60.3% (35 out of 58) of the women. A positive family history of diabetes was experienced by 46.6% (27 out of 58). One out of four (24.1%) had a previous history of GDM, whereas 19.0% (11 out of 58) had PCOS [Table 2]. The mean fasting plasma glucose at diagnosis was 101.8 ± 12.6 mg/dL, whereas the mean 1 h and 2 h OGTT values were 188.4 26.3 mg/dL and 164.7 21.9 mg/dL, respectively. The mean HbA1c level was 5.9 0.6%, which corresponds to mild-to-moderate hyperglycemia at diagnosis [Table 3]. Dietary modification alone was enough to bring the glycemic level back to normal in 41.4% (n = 24) of the women. Oral hypoglycemic agents were used by 31.0% (n = 18), and 27.6% (n = 16) required insulin in addition to MNT [Table 4]. The study found that 67.2% (n = 39) of the patients had achieved adequate glycemic control during the follow-up period. There were, however, 32.8% (n = 19) of patients whose glycemic control remained poor. Post-prandial hyperglycemia (36.2%) was one of the most frequent types of hyperglycemia seen, more so than isolated fasting hyperglycemia (25.9%) [Table 5]. There was a significant difference in the distribution of poor glycemic control between the groups depending on BMI or age. 42.9% of women with a BMI of 25 kg/m had poor glycemic control as against 21.7% of those with a BMI <25 (P = 0.02). More women who were 30 years of age (45.2%) had poor glycemic control as compared to 22.7% of those who were <30 years old (P = 0.03). Having a positive family history of diabetes turned out to be a factor significantly associated with poor control (P = 0.04). Requirement of insulin was one

Table 1: Demographic and obstetric characteristics of the study population (n=58)

Variable	Frequency (%)/mean±SD
Age (years)	29.6±4.8
Age ≥30 years	31 (53.4)
Primigravida	24 (41.4)
Multigravida	34 (58.6)
Gestational age at diagnosis (weeks)	26.8±3.5
Urban residence	36 (62.1)
Rural residence	22 (37.9)

SD: Standard deviation

Table 2: Distribution of maternal risk factors for GDM (n=58)

Risk factor	Frequency (%)
Pre-pregnancy BMI ≥25 kg/m^2	35 (60.3)
Family history of diabetes	27 (46.6)
Previous history of GDM	14 (24.1)
History of macrosomia	9 (15.5)
Polycystic ovary syndrome	11 (19.0)
Hypertension in pregnancy	13 (22.4)

GDM: Gestational diabetes mellitus, BMI: Body mass index

Table 3: Baseline glycemic parameters at diagnosis (n=58)

Glycemic parameter (mg/dL)	Mean±SD
Fasting plasma glucose	101.8±12.6
1-h post-OGTT	188.4±26.3
2-h post-OGTT	164.7±21.9
HbA1c (%)	5.9±0.6

SD: Standard deviation, HbA1c: Glycated hemoglobin

Table 4: Treatment modalities used for glycemic control (n=58)

Treatment modality	Frequency (%)
Medical nutrition therapy (MNT) only	24 (41.4)
MNT+oral hypoglycemic agents	18 (31.0)
MNT+insulin therapy	16 (27.6)

of the variables most strongly associated with poor glycemic control (81.3%, $P < 0.001$) [Table 6].

Discussion

In this study, the average age of mothers was 29.6 4.8 years, and 53.4% of women were aged 30 years. 58.6% of the women were multigravida. Tobias *et al.* reported the mean age of 31.2–5.1 years among women with GDM in a large cohort study, where the risk of GDM increased significantly after 30 years of age.[6] Likewise, Li *et al*., through pooled analyses, found that women aged 30 years had a 1.62.4 fold higher risk of GDM than younger women.[10] The majority of multigravida women in our study is consistent with the work of Zhang and Ning, who reported 61% of multigravidity among GDM cases and suggested that with each successive pregnancy, the metabolic stress accumulates.[7] Before pregnancy, more than half of the women in our study (60.3%) were overweight or obese (BMI 25 kg/m), and almost half (46.6%) had a family history of diabetes. In contrast, Catalano and Shankar, who reported obesity in 55, 65% of women with GDM, pointed out that fatness is the main cause of insulin resistance.[5] Guariguata *et al*. stated that 40–50% of GDM cases worldwide have a positive family history of diabetes, which is consistent with our findings.[2] A history of GDM was reported in 24.1% of our patients, which is in line with the 20–30% recurrence rates reported by Kim *et al*. in longitudinal studies.[11] At the time of diagnosis, the average fasting plasma glucose in our study was 101.8–12.6 mg/dL, with mean 1-h and 2-h OGTT values of 188.4–26.3 mg/dL and 164.7–21.9 mg/dL, respectively. Metzger *et al*. showed in the HAPO study that women who met the GDM criteria had average fasting glucose levels of 95, 105 mg/dL, and 2-h levels were approximately 160, 170 mg/dL.[12] In our study, 41.4% of patients met glycemic targets through MNT only, 31.0% needed oral hypoglycemic drugs, and 27.6% required insulin therapy. According to Crowther *et al*., about 45% of women with GDM were able to adequately control their condition through lifestyle changes only, whereas 20–30% needed insulin treatment.[9] 67.2% of women got their glycemia under control, whereas 32.8% had poor control. Post-prandial hyperglycemia (36.2%) was more common than isolated fasting hyperglycemia (25.9%). Hernandez *et al*. found that post-prandial glucose excursions occurred in 35–40% of GDM patients even when fasting glucose levels were at an acceptable level, thus highlighting post-meal monitoring's clinical relevance.[13] Poor glycemic control was found to be highly associated with BMI ≥25 kg/m (42.9%), age ≥30 years (45.2%), family history of diabetes (44.4%), and insulin administration (81.3%). Hedderson *et al*. revealed that obese women with GDM were nearly twice as likely to have unsatisfactory glycemic control compared to women of normal weight.[14] In the same way, advanced maternal age and the necessity of insulin have been recognized as indicators of more severe insulin resistance and cell dysfunction, which is in agreement with our findings.

Table 5: Glycemic control status during follow-up (n=58)

Glycemic control status	Frequency (%)
Adequate glycemic control	39 (67.2)
Poor glycemic control	19 (32.8)
Fasting hyperglycemia	15 (25.9)
Post-prandial hyperglycemia	21 (36.2)

Table 6: Association between selected risk factors and poor glycemic control (n=58)

Risk factor	Poor control *n* (%)	*P*-value
BMI ≥25 kg/m^2	15/35 (42.9)	0.02
Age ≥30 years	14/31 (45.2)	0.03
Family history of diabetes	12/27 (44.4)	0.04
Insulin requirement	13/16 (81.3)	<0.001

BMI: Body mass index

Limitations of the study

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

Conclusion

This study highlights that GDM is strongly associated with advanced maternal age, pre-pregnancy overweight or obesity, positive family history of diabetes, and adverse glycemic patterns during pregnancy. A substantial proportion of women required pharmacological therapy in addition to lifestyle modification, and nearly one-third failed to achieve optimal glycemic control, with post-prandial hyperglycemia being more prevalent than fasting abnormalities. Poor glycemic control was significantly linked to higher BMI, older age, family history of diabetes, and insulin requirement.

Recommendation

Early identification of women at high risk for GDM through routine antenatal screening, particularly among those with advanced maternal age, elevated BMI, and a family history of diabetes, is strongly recommended. Emphasis should be placed on timely lifestyle counseling, regular monitoring of both fasting and post-prandial glucose levels, and individualized treatment plans to achieve optimal glycemic control.

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How to cite this article: Akhter N, Siddiqua SF, Nasrin S, Risalat S. Risk factors and glycemic control patterns in women with gestational diabetes mellitus. Ann. Int. Med. Den. Res. 2026;12(1):80-84.

Source of Support: Nil, **Conflict of Interest:** None declared

Received: 07-Jan-2026; **Revised:** 03-Feb-2026; **Acceptance:** 20-Feb-2026; **Published:** 10-Mar-2026

Original Research Article

https://doi.org/10.53339/aimdr.2026.12.1.14
E-ISSN: 2395-2822 | P-ISSN: 2395-2814

Effect of controlled hypotensive anesthesia on intraoperative blood loss and surgical field visibility in micro-ear surgery

Md. Nurullah, Md. Jashim Uddin, Rafiz Abyaz

Department of Anesthesiology, Ibn Sina Medical College and Hospital, Dhaka, Bangladesh

Address for correspondence: Dr. Md. Nurullah, Department of Anesthesiology, Ibn Sina Medical College and Hospital, Dhaka, Bangladesh. E-mail: dr.nurullah973@gmail.com

Abstract

Background: Micro-ear surgery demands an immaculate surgical field, yet conventional anesthesia often leads to capillary ooze that obscures delicate structures. Controlled hypotensive anesthesia (CHA) is a strategy to mitigate this by reducing mean arterial pressure, but its comparative effectiveness in micro-ear surgery requires further validation.

Objective: To compare the effect of CHA versus normotensive anesthesia on intraoperative blood loss and surgical field visibility in patients undergoing micro-ear surgery.

Methods: A case-control study was conducted at Ibn Sina Medical College and Hospital, Dhaka, Bangladesh, from January 2023 to December 2024. A total of 80 patients were selected via purposive sampling: 40 cases received CHA, and 40 controls received standard normotensive anesthesia. Intraoperative blood loss was measured volumetrically. Surgical field visibility was assessed by the blinded primary surgeon using the 6-point scale at regular intervals. Data were analyzed using the Statistical Package for the Social Sciences version 23.0.

Results: The CHA group ($n = 40$) demonstrated significantly lower mean intraoperative blood loss (47.8 ± 10.5 mL) compared to the control group (101.2 ± 20.3 mL; $P < 0.001$). Surgical field visibility was superior in the CHA group, with 72.5% of cases rated as excellent/good versus 7.5% in controls ($P < 0.001$). No significant difference in surgery duration or major complications was observed between the groups.

Conclusion: CHA significantly reduces blood loss and improves surgical field visibility in micro-ear surgery without increasing operative time or major complications. It is a recommended technique for optimizing surgical conditions in these delicate procedures.

Keywords: Blood loss, controlled hypotension, ear surgery, hypotensive anesthesia, mastoidectomy, tympanoplasty

Introduction

Microsurgery of the ear, encompassing procedures such as tympanoplasty and mastoidectomy, represents a pinnacle of surgical precision, demanding exceptional visualization within a confined and anatomically complex field.[1] Optimal surgical outcomes are inextricably linked to the clarity of the operative field; even minimal bleeding can obscure critical structures, such as the ossicular chain, tympanic membrane remnants, and the facial nerve, potentially prolonging surgery, compromising graft viability, and increasing the risk of iatrogenic injury.[2,3] Consequently, the pursuit of a bloodless field is a paramount concern for otologic surgeons. In conventional anesthetic

practice, maintaining normotension is standard. However, this often fails to address the challenge of capillary ooze from the highly vascularized temporal bone mucosa and bone itself. This bleeding is primarily influenced by local capillary pressure, which is directly related to mean arterial pressure (MAP).[4] As a result, surgeons frequently encounter a suboptimal visual field, resorting to repeated suctioning and the use of vasoconstrictors, which can be temporizing and may have systemic implications.[5] To address this persistent challenge, controlled hypotensive anesthesia (CHA) has been advocated as an integral technique in various surgical specialties, including orthognathic, spinal, and endoscopic sinus surgery.[6,7] The principle involves the deliberate, pharmacological reduction of a patient's MAP to a predetermined target range, typically 20–30% below baseline or an absolute MAP of 50–65 mmHg, during the critical phases of surgery, thereby decreasing capillary hydrostatic pressure and surgical bleeding.[8] The intended benefit in otology is a drier operative field, theoretically enhancing surgical precision and efficiency. Recent studies within the last quinquennium have provided renewed evidence supporting the utility of CHA. A 2020 systematic review highlighted its efficacy in reducing blood loss across multiple surgical disciplines, though it called for more procedure-specific data.[9] Specifically in otology, emerging research continues to explore this paradigm. A 2021 prospective study demonstrated significantly improved surgical field scores in functional endoscopic sinus surgery using CHA, a finding relevant to similarly mucosal, confined surgical sites.[10] Furthermore, a 2022 randomized controlled trial focusing on tympanoplasty reported a nearly 50% reduction in measured blood loss and superior surgeon-rated visibility with deliberate hypotension.[3,4] Despite this growing body of international literature, the adoption and standardized evaluation of CHA in micro-ear surgery within specific institutional contexts, such as in Bangladesh, remain less documented. Local factors, including patient demographics, prevalent pathology, and anesthetic protocols, may influence outcomes and safety profiles. While the benefits for surgical visibility are compelling, the technique necessitates careful physiological consideration, particularly regarding end-organ perfusion, underscoring the need for meticulous patient selection and vigilant intraoperative monitoring.[11-14] Therefore, while CHA is theoretically beneficial and supported by contemporaneous international studies, there is a need for localized, robust clinical data to inform evidence-based practice in our setting. This study aims to contribute to this knowledge gap by evaluating the specific effect of CHA on intraoperative blood loss and surgical field visibility in patients undergoing micro-ear surgery at a tertiary care center in Dhaka, Bangladesh. The hypothesis is that the application of CHA will result in a statistically significant reduction in blood loss and a clinically meaningful improvement in the quality of the surgical field compared to standard normotensive anesthesia.

Methodology

This case–control study was conducted in the Department of Anesthesiology at Ibn Sina Medical College and Hospital, Dhaka, Bangladesh, between January 2023 and December 2024. The study population comprised 80 patients undergoing elective micro-ear surgery (tympanoplasty or cortical mastoidectomy), divided into a case group ($n = 40$) receiving CHA and a control group ($n = 40$) receiving normotensive anesthesia. A purposive sampling technique was employed.

Inclusion and exclusion criteria

Patients aged 18–60 years with an American Society of Anesthesiologists (ASA) physical status of I or II were included. Exclusion criteria comprised significant cardiovascular, renal, or hepatic disease, uncontrolled hypertension, cerebrovascular disease, severe anemia (hemoglobin <10 g/dL), coagulopathy, and use of medications affecting hemodynamic stability.

Study procedure

In the case group, controlled hypotension was induced post-intubation to maintain a MAP

of 55–65 mmHg using a titrated infusion of nitroglycerine. The control group maintained a MAP within 20% of the pre-induction baseline. For all patients, intraoperative blood loss was calculated quantitatively by measuring suction canister fluid and weighing surgical gauze. The primary surgeon, blinded to the patient's group and MAP, assessed the surgical field visibility every 30 min using the validated from 6-point scoring scale (1 = excellent, 6 = massive bleeding).

Data collection and analysis

Demographic, hemodynamic, and surgical data were recorded on a structured case record form. Data analysis was performed using IBM Statistical Package for the Social Sciences Statistics version 23.0. Continuous variables were expressed as mean ± standard deviation and compared using independent sample t-tests. The ordinal from scale data were analyzed using the Mann–Whitney U test. Categorical data were presented as frequencies and percentages, compared using the Chi-square or Fisher's exact test. $P < 0.05$ was considered statistically significant.

Results

A total of 80 patients completed the study: 40 cases receiving CHA and 40 controls. The baseline demographic and clinical characteristics of the two groups were comparable, with no statistically significant differences in age, gender distribution, ASA physical status, or type of surgical procedure performed (all $P > 0.05$) [Table 1].

The targeted hemodynamic intervention was successfully achieved. The mean intraoperative MAP in the CHA group was 60.2 ± 3.8 mmHg, which was significantly lower than the 84.1 ± 4.9 mmHg recorded in the control group ($P < 0.001$). The mean heart rate was also significantly lower in the CHA group [Table 2].

The primary outcome, intraoperative blood loss, was markedly reduced in the CHA group. The mean blood loss was 47.8 ± 10.5 mL in the case group, compared to 101.2 ± 20.3 mL in the control group, representing a 52.8% reduction ($P < 0.001$) [Table 3].

Surgical field visibility, as rated by the blinded surgeon using the from scale, was significantly superior in the CHA cohort. Assessments in the CHA group were predominantly (72.5%) rated as "Excellent" or "Good" (from scores 1 to 2) [Table 4].

Table 1: Baseline demographic and clinical characteristics

Characteristic	CHA group (*n*=40) (%)	Control group (*n*=40) (%)	*P*-value
Age (years), mean±SD	35.1±9.8	36.4±10.2	0.561
Male gender, *n* (%)	24 (60.0)	22 (55.0)	0.648
ASA I, *n* (%)	33 (82.5)	31 (77.5)	0.782
Tympanoplasty, *n* (%)	25 (62.5)	23 (57.5)	0.651
Mastoidectomy, *n* (%)	15 (37.5)	17 (42.5)	0.651

Data analyzed using an independent t-test (age) and a Chi-square test (categorical variables). ASA: American Society of Anesthesiologists, CHA: Controlled hypotensive anesthesia

Table 2: Intraoperative hemodynamic parameters

Parameter	CHA group (*n*=40)	Control group (*n*=40)	*P*-value
Mean arterial pressure (mmHg)	60.2±3.8	84.1±4.9	<0.001
Heart rate (beats/min)	67.8±6.5	75.4±7.9	<0.001

Data analyzed using an independent t-test. CHA: Controlled hypotensive anesthesia

Table 3: Primary and secondary surgical outcomes

Outcome measure	CHA group (*n*=40)	Control group (*n*=40)	*P*-value
	Mean±SD		
Blood loss (mL)	47.8±10.5	101.2±20.3	<0.001
Surgery duration (min)	115.3±22.7	120.8±26.1	0.312
Irrigation fluid (mL)	130.5±28.4	215.8±50.6	<0.001

Data analyzed using an independent t-test. SD: Standard deviation, CHA: Controlled hypotensive anesthesia

Table 4: Distribution of surgical field visibility (from scale)

From scale score	Description	CHA group, *n* (%)	Control group, *n* (%)
1	Excellent (No bleeding)	10 (25.0)	0 (0.0)
2	Good (Minimal)	19 (47.5)	3 (7.5)
3	Adequate (Slight)	9 (22.5)	10 (25.0)
4	Moderate (Bleeding)	2 (5.0)	15 (37.5)
5	Severe (Bleeding)	0 (0.0)	9 (22.5)
6	Massive (Bleeding)	0 (0.0)	3 (7.5)

Overall distribution compared using the Mann-Whitney U test, $P<0.001$. CHA: Controlled hypotensive anesthesia

In contrast, only 7.5% of assessments in the control group achieved these top ratings, with the majority (67.5%) falling into the "Poor" category (from scores 4 to 6). The duration of surgery was statistically similar between the groups. However, the volume of irrigation fluid used was significantly lower in the CHA group. Regarding safety, no major adverse events (e.g., organ hypoperfusion or cardiac ischemia) were recorded [Table 5].

The incidence of transient, correctable hypotension was 15.0% in the CHA group and 0% in controls, a non-significant difference ($P = 0.053$). Conversely, intraoperative hypertension occurred in 2.5% of CHA cases versus 12.5% of controls [Table 6].

Discussion

The findings of this case–control study demonstrate that the application of CHA during micro-ear surgery significantly reduces intraoperative blood loss and markedly improves surgical field visibility compared to standard normotensive anesthesia. This aligns with the core physiological principle that reducing MAP lowers capillary hydrostatic pressure, thereby attenuating surgical bleeding.[8] The magnitude of benefit observed, a reduction in blood loss exceeding 50%, is consistent with the established efficacy of this technique across various surgical disciplines requiring a clear operative field.[9] The superior quality of the surgical field, quantitatively demonstrated through the validated

Table 5: Categorized surgical field quality

Field quality category	From score	CHA group (*n*=40)	Control group (*n*=40)	*P*-value
		n (%)		
Excellent/Good	1–2	29 (72.5)	3 (7.5)	<0.001
Adequate	3	9 (22.5)	10 (25.0)	0.796
Poor	4–6	2 (5.0)	27 (67.5)	<0.001

Data analyzed using the Chi-square test. CHA: Controlled hypotensive anesthesia

Table 6: Intraoperative adverse events

Adverse event	CHA group (*n*=40)	Control group (*n*=40)	*P*-value
	n (%)		
Transient hypotension*	6 (15.0)	0 (0.0)	0.053
Bradycardia (<50 bpm)	1 (2.5)	0 (0.0)	1.000
Hypertension**	1 (2.5)	5 (12.5)	0.198

*MAP <55 mmHg for >2 min, responsive to intervention. *Sustained MAP >20% above baseline. Data analyzed using Fisher's exact test. MAP: Mean arterial pressure, CHA: Controlled hypotensive anesthesia

From scale, is the most critical clinical outcome. A clear field is indispensable in micro-ear surgery for the safe identification and manipulation of delicate structures such as the ossicular chain and the facial nerve.[2] The stark contrast in visibility ratings, where the majority of CHA cases were rated optimal versus the majority of controls rated suboptimal, provides robust evidence supporting CHA's role in facilitating surgical precision. This finding is corroborated by recent otology-specific research confirming improved surgeon-rated conditions with deliberate hypotension.[4] The concomitant significant reduction in irrigation fluid use in the CHA group further objectively supports the subjective assessment of a drier field.[15] Importantly, these significant advantages were achieved without increasing the duration of surgery. This indicates that the time invested in achieving and maintaining controlled hypotension is offset by the efficiency gained from operating in a clearer field, a net balance previously noted in similar contexts.[6] Regarding safety, the protocol used in this study, involving strict hemodynamic

targets in carefully selected patients, proved to be well-tolerated. The absence of major adverse events reinforces the conclusion from recent analyses that CHA can be safely implemented in otologic surgery with appropriate monitoring.[11,16] The transient hypotensive episodes in the CHA group were readily managed, whereas the occurrence of hypertension in some control patients highlights that normotension itself can be challenging to maintain under surgical stress. This study has certain limitations. Its case–control design, while pragmatic, carries inherent risks of selection and confounding bias compared to a randomized trial. The use of purposive sampling and a single-center setting may affect the generalizability of the findings. Furthermore, the assessment of the surgical field, though performed by a blinded surgeon, remains subjective. Future randomized controlled trials with larger, multicentric cohorts and perhaps objective measures of field clarity (e.g., through image analysis) would strengthen the evidence base.[17] This study provides compelling evidence that CHA is a highly effective and safe technique for optimizing surgical conditions in micro-ear procedures. By significantly reducing blood loss and improving field visibility without prolonging surgery or compromising patient safety, CHA should be considered a valuable component of the anesthetic and surgical strategy for tympanoplasty and mastoidectomy. Its adoption can enhance surgical precision and potentially contribute to improved patient outcomes.

Limitations

The study limitations include its non-randomized case–control design, which may introduce selection bias. The purposive sampling from a single center limits generalizability. Furthermore, the primary assessment of surgical field quality, though conducted by a blinded surgeon, remains a subjective measure, lacking objective quantification.

Conclusion

This study concludes that CHA is an effective and safe technique for micro-ear surgery. It significantly reduces intraoperative blood loss and provides a superior surgical field visibility compared to normotensive anesthesia, without increasing operative time or major complications. Therefore, its adoption is recommended to optimize surgical conditions and enhance precision during delicate tympanoplasty and mastoidectomy procedures.

Recommendation

CHA should be adopted for micro-ear surgeries to optimize the surgical field. Future multi-center randomized trials with objective field assessment are recommended to strengthen the evidence. Anesthesiologists and surgeons should receive training in this technique.

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How to cite this article: Nurullah M, Uddin MJ, Abyaz R. Effect of controlled hypotensive anesthesia on intraoperative blood loss and surgical field visibility in micro-ear surgery. Ann. Int. Med. Den. Res. 2026;12(1):85-90.

Source of Support: Nil, **Conflict of Interest:** None declared

Received: 05-Jan-2026; **Revised:** 04-Feb-2026;
Acceptance: 22-Feb-2026; **Published:** 10-Mar-2026