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Sociodemographic characteristics of gestational diabetes mellitus among antenatal women

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Abstract
Background: GDM significantly affects maternal and fetal health, increasing risks of hypertensive disorders, cesarean deliveries, and long-term type 2 diabetes for mothers, and macrosomia, stillbirth, and congenital malformations for infants. Global GDM prevalence ranges from 1% to 28%. Effective management through lifestyle changes and medical treatment can improve outcomes. Risk factors include advanced maternal age, obesity, family history of diabetes, and low socioeconomic status.
Aim of the study: The study aims to measure the sociodemographic characteristics associated with GDM among antenatal women.
Methods: This cross-sectional study was conducted at the Department of Obstetrics and Gynecology, 250 Bed Gaibandha District Hospital, Gaibandha, Bangladesh from July 2023 to December 2023, enrolling 125 pregnant women using purposive sampling. Participants were divided into two groups: 55 with GDM and 70 without. Inclusion criteria included women aged 18+, at 20-23 weeks of gestation, with a singleton pregnancy. Exclusion criteria involved pre-existing diabetes or chronic illnesses. Data were collected via structured questionnaires, following IDF, ADA, and WHO guidelines, including a 75 g OGTT. Physical activity and depressive symptoms were assessed. Statistical analysis used SPSS 26, with significance set at $p \leq 0.05$.
Result: The study compared the socio-demographic and clinical characteristics of 125 antenatal women, including 55 with gestational diabetes mellitus (GDM) and 70 controls. The GDM group was older (mean age 31.85±4.39 vs. 29.52±4.67 years, $p<0.001$) and had a higher family history of diabetes (29.09% vs. 15.71%, $p<0.001$). GDM cases had elevated fasting glucose (101.65±14.72 vs. 79.25±8.34 mg/dL) and systolic blood pressure (117.31±13.05 vs. 113.44±9.52 mmHg). Physical activity was lower, and antenatal depression was higher in the GDM group ($p<0.001$). Other factors showed no significant differences.
Conclusion: This study highlights significant sociodemographic factors linked to gestational diabetes mellitus (GDM) among antenatal women, including age, family history of diabetes, blood glucose levels, and antenatal depression. It emphasizes the importance of early screening and tailored interventions to manage risks, recommending further research on long-term impacts and preventive measures for GDM.

Keywords: Sociodemographic characteristics, gestational age, diabetes mellitus, and antenatal women

Introduction

Gestational diabetes mellitus (GDM), a critical condition affecting maternal and fetal health, is defined as glucose intolerance with onset or first recognition during pregnancy. It usually emerges in the second or third trimester when the pancreas struggles to produce enough insulin to counterbalance pregnancy hormones, leading to elevated blood glucose levels [1]. Diagnosing GDM often involves an oral glucose tolerance test (OGTT), which is carried out between 24 to 28 weeks of pregnancy, a period when insulin resistance naturally increases [2]. GDM impacts metabolic pathways significantly, requiring effective diagnosis and management strategies to mitigate the associated risks for both mother and fetus [3]. The global prevalence of gestational diabetes mellitus (GDM) varies significantly, with estimates ranging from 1% to 28% [4]. According to the 2021 International Diabetes Federation (IDF) Atlas report, the global prevalence of GDM stands at 14%, though this rate varies by region [5]. Furthermore, around 40% of women diagnosed with GDM are at risk of developing type 2 diabetes within ten years after delivery [6]. GDM poses substantial health risks if left untreated, impacting both mothers and infants. Maternal complications include hypertensive disorders, preeclampsia, increased cesarean deliveries, and long-term risks such as type 2 diabetes [7]. Additionally, GDM-associated maternal morbidities such as cardiovascular diseases have lasting implications on

maternal health [8]. For infants, GDM increases risks of spontaneous abortion, macrosomia (large baby), stillbirth, neonatal hypoglycemia, and congenital malformations. Neonates from GDM pregnancies are often large for gestational age, leading to potential complications like shoulder dystocia and birth trauma [6]. Moreover, children born to mothers with GDM face an elevated risk of obesity, type 2 diabetes, and cardiovascular disease later in life, emphasizing the generational health impact of this condition [9]. The influence of sociodemographic factors on GDM incidence is significant, with risk factors including advanced maternal age, obesity, family history of diabetes, and hypertensive disorders [7]. Low socioeconomic status also correlates with higher GDM risk, as disadvantaged women may have limited access to prenatal care, further complicating their pregnancies [10]. Maternal education, parity, and lifestyle habits such as smoking, diet, and physical inactivity are additional contributors [11]. Effective GDM management, encompassing lifestyle interventions, regular monitoring, and, when necessary, medical treatments such as insulin or oral hypoglycemic agents, can significantly improve maternal and neonatal outcomes [12]. Lifestyle modifications, including physical activity and a healthy diet, are crucial preventative measures, as they contribute to improved maternal and fetal health [13]. The study aims to measure the sociodemographic characteristics associated with GDM among antenatal women.

Methodology & Materials

This comprehensive cross-sectional study was rigorously conducted at the Department of Obstetrics and Gynecology, 250 Bed Gaibandha District Hospital, Gaibandha, Bangladesh from July 2023 to December 2023. Employing a purposive sampling strategy, a carefully selected cohort of 125 pregnant women receiving antenatal care was enrolled. The recruitment process adhered to well-defined inclusion and exclusion criteria to maintain clinical relevance and consistency within the study population. The participants were randomly divided into two distinct groups:

- **Case group (n=55):** Comprising pregnant women diagnosed with GDM.
- **Control group (n=70):** Comprising pregnant women who did not meet the diagnostic criteria for GDM.

Inclusion criteria

Women aged 18 years or older, at 20-23 weeks of gestational age, and had a singleton pregnancy.

Exclusion criteria

Pregnant women with a history of pre-existing diabetes mellitus, overt diabetes, chronic illnesses, or were taking medications that could impact glucose metabolism, such as steroids, β-adrenergic agonists, or antipsychotic drugs.

Data collection

A structured, pretested questionnaire was designed and administered to all participants. Initial screening followed the guidelines provided by the International Diabetes Federation (IDF), the American Diabetes Association (ADA), and the World Health Organization (WHO) to rule out pre-existing diabetes [14-16]. Universal screening for GDM was conducted using a 75 g oral glucose tolerance test (OGTT) at 24-28 weeks of gestation. Additionally, participants exhibiting at least one risk factor for GDM (pre-pregnancy BMI ≥30 kg/m², age ≥35 years, history of macrosomia, glycosuria, prior GDM, family history of diabetes, history of adverse pregnancy outcomes, or pregnancy-related complications) were advised to undergo repeat testing at 32-36 weeks if their initial OGTT was negative. The diagnosis of GDM was confirmed by the results of the second test when applicable. To assess physical activity levels, the short form of the International Physical Activity Questionnaire (IPAQ) was utilized, capturing data on routine activities [17]. Antenatal depressive symptoms were evaluated using the Edinburgh Postnatal Depression Scale (EPDS), a tool validated in an urban Ethiopian context [18, 19]. Comprehensive briefings were provided to each participant detailing the study's objectives, aims, and procedures. Written informed consent was obtained before inclusion, ensuring adherence to ethical standards. Baseline demographic and clinical data were collected under strict confidentiality guidelines, with ethical clearance granted by the institutional ethics review board.

Statistical analysis

Data were meticulously organized into tables and figure for enhanced clarity and interpretability. Statistical analyses were performed using SPSS software (version 26). Continuous variables were summarized as mean±standard deviation (SD), while categorical data were presented as frequencies and percentages. To evaluate quantitative variables, an unpaired t-test was employed, and the chi-square test was used for categorical data analysis. A p-value of ≤0.05 was considered statistically significant.

Result

The study analyzed the socio-demographic and clinical characteristics of 125 antenatal women, comparing 55 cases with GDM and 70 controls. The mean age of the case group was higher (31.85±4.39 years) than the control group (29.52±4.67 years), with a significant association observed (p<0.001). Family history of diabetes mellitus was significantly more common in the case group (29.09%) compared to the control group (15.71%, p<0.001) (Table 1). No significant differences were observed in educational level, employment status, or residence. GDM cases had higher fasting (101.65±14.72 vs. 79.25±8.34 mg/dL, p<0.001) and post-OGTT glucose levels, as well as elevated systolic blood pressure (117.31±13.05 vs. 113.44±9.52 mmHg, p<0.001). Hemoglobin levels and parity distribution showed no significant differences (Table 1). 43.64% participants in the case group and 12.86% patients in the control group had the previous incidence of gestational diabetes mellitus (Figure 1). Table 2 shows that physical activity levels were significantly lower among the case group, with a higher proportion reporting low activity (41.82%) compared to the control group (32.86%, p<0.001). Coffee intake was slightly more common in the case group (61.82%). Antenatal depression was significantly higher in the case group (38.18%) in comparison with the control group (17.14%, p<0.001) (Table 2).

Table 1: Socio-demographic and clinical profiles of the study cohort (N=125)

Variables	Case group (n=55)		Control group (n=70)		P-value
	n	%	n	%	
	Mean±SD		Mean±SD		
Age (years)					
<25	17	30.91	20	28.57	<0.001
25-29	20	36.36	26	37.14	
30-34	11	20	16	22.86	
≥35	7	12.73	8	11.43	
Mean±SD	31.85±4.39		29.52±4.67		
Educational level					
No formal education	11	20	11	15.71	0.069
Primary education	12	21.82	16	22.86	
Secondary education and above	32	58.18	43	61.43	
Employment status					
Unemployed	36	65.45	47	67.14	0.009
Employed	19	34.55	23	32.86	
Residence					
Urban	42	76.36	57	81.43	0.232
Rural	13	23.64	13	18.57	
Family history of DM					
No	39	70.91	59	84.29	<0.001
Yes	16	29.09	11	15.71	
Parity					
Nullipara	26	47.27	32	45.71	0.058
Primipara	14	25.45	17	24.29	
Multipara	15	27.27	21	30	
Hemoglobin (g/dl)					
Normal (Hb ≥11 g/dl)	44	80	61	87.14	0.184
Anemia (Hb <11 g/dl)	11	20	9	12.86	
Blood glucose level (mg/dL)					
Fasting blood glucose	101.65±14.72		79.25±8.34		<0.001
1-h blood glucose (OGTT)	165.79±26.17		139.44±20.09		
2-h blood glucose (OGTT)	140.58±21.38		118.83±15.29		
Blood pressure					
Systolic blood pressure (mmHg)	117.31±13.05		113.44±9.52		<0.001
Diastolic blood pressure (mmHg)	76.08±10.03		73.66±7.58		

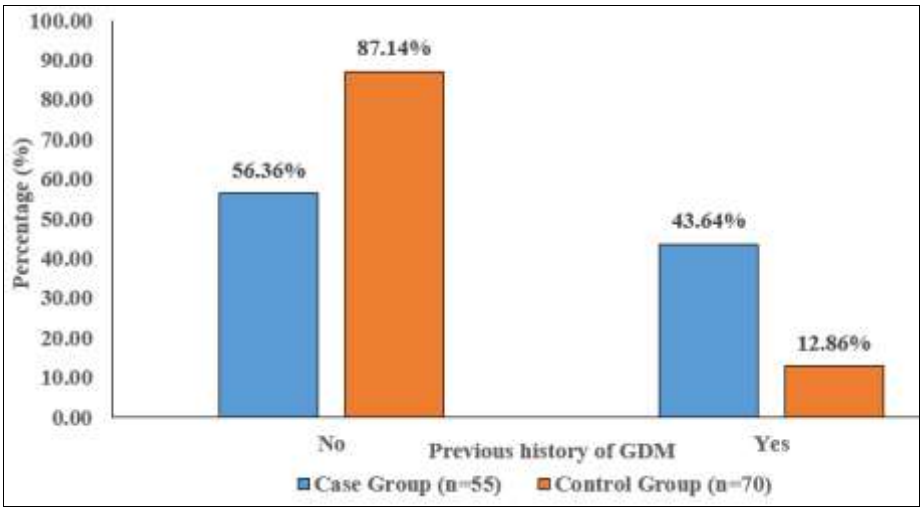

Fig 1: Previous incidence of gestational diabetes mellitus among study participants (N=125)

Table 2: Behavioral and lifestyle attributes of study participants (N=125)

Variables	Case Group (n=55)		Control Group (n=70)		P-value
	n	%	n	%	
Level of physical activity					
High	11	20.00	17	24.29	<0.001
Moderate	21	38.18	30	42.86	
Low	23	41.82	23	32.86	
Coffee intake					
No	21	38.18	39	55.71	0.343
Yes	34	61.82	31	44.29	
Antenatal depression					
No	34	61.82	58	82.86	<0.001
Yes	21	38.18	12	17.14	

Discussion

This study aimed to identify the sociodemographic characteristics associated with gestational diabetes mellitus (GDM) among antenatal women, employing updated international diagnostic criteria. The overall prevalence of GDM observed in this study was 44.00%, which is notably higher compared to findings from Rwanda (8.3%), Tanzania (5.9%), Egypt (8%), and Nigeria (8.6%) [20-23]. The primary reason for this elevated prevalence could be attributed to the use of lower cut-off values for fasting plasma glucose (FPG) and oral glucose tolerance tests (OGTT) in the updated diagnostic standards. Conversely, these results align more closely with the study by Adams *et al*. (2017) in South Africa, which reported a prevalence of 25.8% using similar diagnostic criteria [24]. These findings underscore that variations in GDM prevalence may be influenced not only by differing diagnostic protocols but also by specific population characteristics [23-25]. Factors such as increased GDM screening, lifestyle changes, and the growing rates of overweight and obesity likely contribute to these statistics [26]. The present study identified significant associations between employment status, family history of diabetes mellitus (DM), blood glucose levels, and blood pressure. These outcomes are consistent with the study by Muche *et al*. (2019) in Northwest Ethiopia, which highlighted similar associations [27]. Although pre-gestational weight data was not available in this study, other research, including studies from Egypt (2018), Ghana (2015), and South Africa (2018), demonstrated a significant link between obesity (as measured by BMI) and GDM [28-30]. A review and meta-analysis conducted by Nelson SM *et al*. (2010) also indicated that higher pre-pregnancy BMI was strongly associated with an increased risk of GDM [31]. This relationship can be explained by reduced insulin sensitivity in obese pregnancies, which elevates blood glucose levels [31, 32]. Sedentary behavior contributing to weight gain perpetuates a cycle that adversely affects glucose metabolism. The ongoing rise in obesity as a public health issue suggests that GDM rates could continue to climb in the future. Moreover, pregnant women with a history of GDM were more likely to develop the condition again during subsequent pregnancies. This observation aligns with studies conducted in Egypt (2018) and Nigeria (2014), as well as a systematic review by Catherine Kim *et al*. (2007) [30, 33, 34]. Low levels of physical activity were also identified as a risk factor for developing GDM when compared to higher levels of activity during pregnancy. This result is supported by findings from a 2018 study in Vietnam and a meta-analysis by Tobias *et al*. (2011) [35, 36]. Enhanced physical activity during pregnancy has been shown to reduce blood glucose levels by preventing excessive weight gain and improving insulin sensitivity [35, 37]. Women experiencing antenatal depression were found to have a higher prevalence of GDM compared to those without depressive symptoms. This association is corroborated by research such as the study by Morrison *et al*. (2016), which identified antenatal depression as a risk factor for GDM [38]. The bidirectional relationship between depression and GDM may be explained by shared psychosocial and physiological factors [39]. Depressed pregnant women are more prone to adopting unhealthy behaviors, including a sedentary lifestyle, which increases the risk of developing GDM [40]. Additionally, depression-induced changes in cortisol levels can exert hyperglycemic effects [41, 42].

Limitations of the study

This study has several limitations. The unavailability of pre-gestational weight data may limit the understanding of obesity's role in GDM development. The study design did not allow for tracking long-term postpartum outcomes, which could provide insights into the recurrence of GDM. Self-reported data on physical activity and depression may introduce recall bias, affecting the accuracy of these associations. The sample may also not be representative of all regions, limiting the generalizability of the findings.

Conclusion and Recommendations

This study provides valuable insights into the sociodemographic characteristics associated with gestational diabetes mellitus (GDM) among antenatal women. The findings highlight significant differences in age, family history of diabetes, blood glucose levels, and antenatal depression between those diagnosed with GDM and those without. These results underscore the importance of early screening and targeted interventions to manage risk factors effectively. Enhanced awareness and tailored prenatal care strategies could contribute to better maternal and fetal outcomes, particularly in high-risk groups. Further research is recommended to explore long-term impacts and preventive measures for GDM.

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Conflict of interest

None declared

Ethical approval

The study was approved by the Institutional Ethics Committee.

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