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Comparative Profile of Pregnant Women with and Without Gestational Diabetes Mellitus

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Abstract
Introduction: *Gestational diabetes mellitus (GDM) presents a growing public health concern due to its adverse effects on both mothers and infants. This study aims to identify the sociodemographic, obstetric, and lifestyle factors influencing GDM prevalence and compare the profiles of pregnant women with and without GDM.*
Methods: *This case-control study was conducted at the Combined Military Hospital (CMH), Dhaka, Bangladesh, involving 150 cases (pregnant women with GDM) and 150 controls (pregnant women without GDM), each matched for age. Data collection instruments were pre-tested, and physical activity levels were measured using the Metabolic Equivalent of Task (MET). Differences between cases and controls were analyzed across various sociodemographic and obstetric characteristics.*
Result: *Age distributions were similar, with mean ages of 25.41 ± 2.472 years for cases and 25.21 ± 2.63 years for controls (p=0.484). However, education and income disparities were observed, with 26.67% of cases achieving only a Secondary School Certificate (SSC) education compared to 16.00% of controls. A significant portion of cases (52.67%) fell into the 20,000-39,999-income bracket compared to 36.00% of controls (p<0.01). Physical activity levels were notably lower among cases, with 94.00% of cases reporting low light activity versus only 18.67% of controls (p<0.001). Pre-pregnancy Body Mass Index (BMI) was significantly higher among cases, with 30.67% overweight compared to 8.67% of controls (p<0.001). Family history of diabetes mellitus and polycystic ovary syndrome (PCOS) were not significantly associated with GDM.*
Conclusion: *Pre-pregnancy BMI, physical activity, and socioeconomic status play significant roles in determining GDM risk. Comprehensive education and structured physical activity programs, particularly for women of childbearing age, could help reduce the incidence and complications of GDM.*
Keywords: *Gestational Diabetes Mellitus, Body Mass Index, Physical Activity, Risk Factors*

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I. Introduction

Gestational Diabetes Mellitus (GDM) is an increasingly prevalent condition, affecting pregnant women globally. The worldwide prevalence of GDM has nearly doubled in recent years, highlighting the need for urgent public health interventions. In the United States, the prevalence increased from 4.6% to 8.2% over a ten-year period, with obesity and older maternal age being significant contributors (1). Furthermore, inconsistent diagnostic criteria have resulted in variations in reported prevalence rates across studies (2). Regardless of criteria used, GDM remains a significant public health concern due to its adverse effects on mothers and infants. Women with GDM are at higher risk of developing hypertensive disorders, preeclampsia, and requiring cesarean sections, while their offspring face increased risks of macrosomia, neonatal hypoglycemia, and other complications (3,4). The elevated prevalence and complications underscore the need for early detection and proper management. South Asia, including Bangladesh, is experiencing an upward trend in GDM cases, with cultural, socioeconomic, and lifestyle factors influencing this increase. In Bangladesh, the prevalence of GDM was found to be 35% based on national data, with a significant disparity observed between urban and rural populations (5). In Dhaka slums, the prevalence is lower at 9.3%, illustrating the stark urban-rural divide (6). Similar trends have been noted across the region, such as in the Kashmiri region of India, where urban women had a higher prevalence than rural women, along with a higher incidence in women with a family history of diabetes (7). Cultural beliefs often dictate lifestyle practices, such as diet and exercise, which further complicate adherence to medical advice (8). Moreover, high body fat percentage and low physical activity rates significantly correlate with the risk of developing GDM. Women with GDM often share several risk factors that distinguish them from non-GDM individuals. These include advanced age, higher body mass index (BMI), family history of diabetes, and a prior history of GDM (9,10). In a study by Cypryk et al., GDM patients were older and had a greater tendency towards obesity than non-GDM patients. Other studies corroborate these findings, with pre-pregnancy BMI emerging as a strong predictor (9,11). Family history is also consistently associated with a higher likelihood of developing GDM, with one study reporting a 3.68-fold increase in risk among those with diabetic fathers. Additionally, lifestyle habits like smoking, poor diet, and lack of physical activity exacerbate the risk, while non-white ethnicity and weight gain in early adulthood contribute further (12). However, the management of GDM is complicated by disparities in healthcare access and health literacy. Socioeconomic factors can prevent women from receiving timely screening, and women with lower education levels or non-white ethnicities often remain unaware of their higher risk for developing type 2 diabetes after GDM (13,14). Such barriers reduce participation in diabetes prevention programs. This underscores the need for culturally sensitive interventions that can effectively reach high-risk groups. GDM not only increases the risk of adverse outcomes during pregnancy but also poses long-term health threats. Women with GDM are more likely to develop type 2 diabetes later in life, particularly those requiring insulin therapy, those of Asian descent, and those with high one-hour blood glucose (15). Long-term risks also extend to their children, who are more prone to obesity and diabetes. Notably, women diagnosed with GDM early in pregnancy require stricter surveillance and management due to increased risk of preterm births, preeclampsia, and neonatal respiratory distress (16,17). Early screening has become critical, as adverse cardiometabolic outcomes are more common in those diagnosed before 20 weeks (18). Despite the recognition of several risk factors and adverse outcomes, research gaps persist in understanding the comparative profiles of women with and without GDM, especially in Bangladesh and Dhaka specifically. Ethnic variability in risk factors and outcomes, especially in multi-ethnic societies, remains poorly understood (19). Future research should focus on addressing these gaps and designing culturally appropriate interventions to ensure early detection and minimize complications.

II. Methods

A case-control study was conducted to investigate the relationship between physical activity levels and the prevalence of gestational diabetes mellitus (GDM) in pregnant women. The research included a group of cases consisting of pregnant women diagnosed with GDM and a control group of pregnant women without GDM, both within 20 to 28 weeks of gestation. Each control was matched for age within ±2 years of a corresponding case. The study period was from July to December 2020, with protocol development starting in September and pre-testing of data collection instruments in October. Data collection took place in November, followed by processing and analysis in December. The final report was completed in February 2021. The study was conducted at the Combined Military Hospital (CMH) Dhaka, a tertiary care hospital that provides comprehensive clinical and diagnostic services. Pre-testing of the survey questionnaire was performed at Kurmitola General Hospital, Dhaka.

Cases were defined as pregnant women aged 20 to 28 weeks of gestation who were previously diagnosed with GDM by a specialist physician. The controls were healthy pregnant women within the same gestational age range and without a GDM diagnosis. All participants provided informed consent to participate. Exclusion criteria included pre-existing diabetes and severe illness. The sample size comprised 150 cases and 150 controls.

Physical activity levels were measured using the Metabolic Equivalent of Task (MET) method, which determines exercise intensity as a ratio of working metabolic rate to resting metabolic rate. Activities were categorized based on MET values into sedentary (≤1.5 METs), light (1.5-3.0 METs), moderate (3.0-6.0 METs), and vigorous (>6.0 METs) levels. Weekly physical activity scores were calculated by multiplying the MET values by the duration of each activity for every day of the week.

III. Results

Table 1: Distribution of sociodemographic characteristics among the participants (N=300)

Variables	Case (n=150)		Control (n=150)		P-Value
	n	%	n	%	
Age					
19-22	16	10.67%	23	15.33%	0.459
23-26	85	56.67%	78	52.00%	
27-30	49	32.67%	49	32.67%	
Mean±SD	25.41 ± 2.472		25.21 ± 2.63		0.484
Educational Status					

SSC	40	26.67%	24	16.00%	0.1
HSC	70	46.67%	76	50.67%	
Graduate	20	13.33%	30	20.00%	
Post Graduate	20	13.33%	20	13.33%	
Residence					
Rural	21	14.00%	14	9.33%	0.208
Urban	129	86.00%	136	90.67%	
Type of Family					
Nuclear	130	86.67%	134	89.33%	0.477
Joint	20	13.33%	16	10.67%	
Income of Participant					
20000-39999	79	52.67%	54	36.00%	**<0.01**
40000-59999	41	27.33%	36	24.00%	
60000 and above	30	20.00%	60	40.00%	

The distribution of age among participants shows that the largest age group for both cases and controls was between 23 and 26 years, accounting for 56.67% of cases and 52.00% of controls, with no significant age difference between the groups (p=0.484). Educational status varied across the groups; a higher percentage of cases had completed Secondary School Certificate (SSC) at 26.67% compared to 16.00% of controls, whereas controls had a higher percentage of graduates at 20.00% compared to 13.33% of cases, though these differences were not statistically significant (p=0.1). In terms of residence, the majority of both groups lived in urban areas, with 86.00% of cases and 90.67% of controls, indicating no significant rural versus urban distribution (p=0.208). Family types were also similar, with the majority living in nuclear families—86.67% of cases and 89.33% of controls (p=0.477). A notable difference emerged in the income levels between the groups; 52.67% of cases earned between 20,000 and 39,999 compared to 36.00% of controls, and a significantly higher percentage of controls (40.00%) had an income of 60,000 and above, compared to 20.00% of cases, with this income discrepancy reaching statistical significance (p<0.01).

Table 2: Distribution of obstetric characteristics among the participants (N=300)

Variables	Case (n=150)		Control (n=150)		P-Value
	n	%	n	%	
Gravida					
Primigravida	91	60.67%	90	60.00%	0.906
Multigravida	59	39.33%	60	40.00%	
Age at first pregnancy					
19-22	30	20.00%	44	29.33%	0.091
23-26	119	79.33%	103	68.67%	
27-30	1	0.67%	3	2.00%	
Mean±SD	23.65 ± 1.321		23.37 ± 1.508		0.081
Bad Obstetric History					
No	136	90.67%	131	87.33%	0.225
Abortion	5	3.33%	9	6.00%	
Miscarriage	7	4.67%	10	6.67%	
Preterm Labour	2	1.33%	0	0.00%	

The data reveal that the majority of participants were primigravida, accounting for 60.67% of cases and 60.00% of controls, showing no significant difference between the two groups (p=0.906). When considering age at first pregnancy, the largest proportion of cases and controls fell in the 23-26 age group, representing 79.33% of cases and 68.67% of controls, which was not statistically significant (p=0.091). The mean age at first pregnancy was similar for both cases (23.65 ± 1.321) and controls (23.37 ± 1.508), with no significant difference between the groups (p=0.081). Most participants did not report a bad obstetric history, with 90.67% of cases and 87.33% of controls having none. Differences in the specific types of adverse obstetric histories were also statistically insignificant. Cases with a history of abortion comprised 3.33%, while controls accounted for 6.00%. Miscarriages occurred in 4.67% of cases and 6.67% of controls. Only two cases reported preterm labor, compared to none in the control group.

Table 3: Distribution of physical activity of the participants via MET score among the participants (N=300)

Variables	Case (n=150)		Control (n=150)		P-Value
	n	%	n	%	
Sedentary physical activity					
Low	90	60.00%	70	46.67%	**0.021**
High	60	40.00%	80	53.33%	
Light physical activity					
Low	141	94.00%	28	18.67%	**<0.001**
High	9	6.00%	122	81.33%	
Moderate physical activity					
Low	90	60.00%	72	48.00%	**0.037**
High	60	40.00%	78	52.00%	
Total physical activity					
Low	145	96.67%	27	18.00%	**<0.001**
High	5	3.33%	123	82.00%	

In terms of sedentary activity, 60.00% of cases engaged in low sedentary activity compared to 46.67% of controls, while 40.00% of cases and 53.33% of controls exhibited high sedentary activity (p=0.021). This indicates a higher tendency for low sedentary activity among women with GDM. A stark contrast emerged in light physical activity levels, where 94.00% of cases engaged in low light physical activity compared to only 18.67% of controls, while a significantly higher proportion of controls (81.33%) engaged in high light physical activity versus 6.00% of cases (p<0.001). This trend is consistent for moderate physical activity, where 60.00% of cases participated in low levels, compared to 48.00% of controls. Conversely, 40.00% of cases reported high moderate physical activity compared to 52.00% of controls (p=0.037). These differences are even more pronounced in the overall physical activity category, where 96.67% of cases had low total physical activity compared to 18.00% of controls, and only 3.33% of cases had high total activity versus 82.00% of controls (p<0.001).

Table 4: Distribution of pre-pregnancy BMI among the participants (N=300)

Pre-Pregnancy BMI	Case (n=150)		Control (n=150)		P-Value
	n	%	n	%	
Normal	104	69.33%	137	91.33%	**<0.001**
Overweight	46	30.67%	13	8.67%	

In the normal BMI category, 69.33% of cases and 91.33% of controls had a normal pre-pregnancy BMI. Conversely, the percentage of participants classified as overweight was markedly higher among cases, with 30.67% compared to only 8.67% among controls. This difference in pre-pregnancy BMI distribution was statistically significant (p<0.001), indicating a strong association between being overweight before pregnancy and the development of GDM.

Table 5: Distribution of findings related to risk factors of gestational diabetes mellitus of the participants (N=300)

Variables	Case (n=150)		Control (n=150)		P-Value
	n	%	n	%	
Family history of DM	29	19.33%	42	28.00%	0.077
History of Dyslipidaemia	4	2.67%	1	0.67%	0.176
History of Polycystic Ovary	11	7.33%	16	10.67%	0.313

Table 5 reveals the distribution of findings related to risk factors for gestational diabetes mellitus (GDM) among the participants. Although some differences were noted between women with GDM (cases) and those without (controls), none were statistically significant. A family history of diabetes mellitus was observed in 19.33% of cases compared to 28.00% of controls (p=0.077). The prevalence of dyslipidemia was slightly higher among cases, with 2.67% versus 0.67% of controls (p=0.176). Additionally, a history of polycystic ovary syndrome (PCOS) was found in 7.33% of cases compared to 10.67% of controls (p=0.313).

IV. Discussion

This study's investigation into the epidemiological characteristics of gestational diabetes mellitus (GDM) reveals intricate interplays between sociodemographic, obstetric, and lifestyle factors that align closely with findings from previous research. In our study, the mean age of cases was 25.41 ± 2.472 years, while the controls had a similar mean age of 25.21 ± 2.63 years. The similarity in age distributions is consistent with the global understanding that GDM can occur across all age groups but increases slightly with maternal age. Freinkel et al. noted that women with GDM were older and heavier than those without, while Thachappilly et al. reported a mean age of 26.24 years for GDM cases versus 23.77 years for non-GDM controls, with older women having a higher prevalence of GDM (20,21). In our study, 26.67% of GDM cases had a Secondary School Certificate (SSC) education level compared to 16.00% of controls. Education level appeared to influence GDM incidence, where fewer educated women developed GDM, reflecting the findings by Wu et al., who noted that higher educational attainment correlates with better health outcomes (22). Higher education may translate into improved health literacy and access to resources, which facilitate healthier lifestyle choices and adherence to GDM management protocols. Our study also highlighted significant disparities in income levels between GDM cases and controls. While 52.67% of GDM cases had incomes in the 20,000-39,999 bracket, only 36.00% of controls were in this income group. Conversely, 40.00% of controls had incomes over 60,000 compared to just 20.00% of cases ($p<0.01$). This suggests that lower socioeconomic status is a risk factor for GDM, potentially due to reduced access to quality healthcare and nutritious food options (23). These results align with findings from AlGhamdi and Allugmani, which reported that economic constraints significantly impact the management and outcomes of GDM (24). In terms of physical activity, our findings underscore a crucial point of intervention. In our study, 94.00% of GDM cases reported low light physical activity, compared to just 18.67% of controls, while 81.33% of controls engaged in high light activity, contrasting with only 6.00% of cases ($p<0.001$). Similar trends were noted in moderate activity levels. This observation is supported by Mørkrid et al., who reported that less physical activity was associated with higher incidences of GDM (25). Gao et al. also highlighted that moderate physical activity notably decreased abnormal plasma glucose levels, especially in overweight or obese women, emphasizing the role of lifestyle modification in managing or preventing GDM (26). Pre-pregnancy BMI analysis showed that only 69.33% of cases had a normal BMI versus 91.33% of controls. Meanwhile, 30.67% of cases were overweight compared to 8.67% of controls ($p<0.001$). This is corroborated by extensive research, including Nagalingam and Murugaraj, and Kouhkan et al., who found that higher pre-pregnancy BMI significantly increases GDM risk (27,28). Singh et al. quantified these risk increases, reporting that each 1 kg/m^2 increase in BMI raises the risk of GDM by 8% (29). Interestingly, our study did not find a significant association between GDM and a family history of diabetes mellitus (19.33% of cases versus 28.00% of controls, $p=0.077$), contrary to findings by Lewandowska, who identified family history as a notable risk factor with a 3.68-fold increase in GDM risk (10). This discrepancy might be due to population-specific genetic factors or lifestyle differences that modulate the impact of genetic predisposition on GDM. These findings suggest that addressing modifiable risk factors such as BMI, physical activity, and socioeconomic disparities could substantially reduce the incidence of GDM. Tailored educational programs targeting women of childbearing age, particularly in lower socio-economic groups, could be beneficial. Public health policies should also consider structured physical activity programs as part of prenatal care to mitigate GDM risk, particularly for those identified as high-risk due to obesity.

Limitations of The Study

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

V. Conclusion

This study highlights significant sociodemographic, obstetric, and lifestyle factors that influence the prevalence of gestational diabetes mellitus (GDM). Our findings underscore the critical role of pre-pregnancy BMI, physical activity, and socioeconomic status in modulating GDM risk. While family history was not a significant determinant in this cohort, the results emphasize the importance of comprehensive, individualized preventive strategies. Addressing modifiable risk factors through targeted educational programs and structured physical activity initiatives could significantly reduce the incidence and complications of GDM, ultimately improving maternal and neonatal outcomes.

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