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Antenatal Risk Factors and Delivery Profiles among Women with Gestational and Pre-Gestational Diabetes

Dr. Nasrin Sultana[1*], Dr. Sayeeda Pervin[1], Dr. Mst. Nargish Khanam[2], Dr. Mst. Mafruha Haque[2], Dr. Nazia Ahmed[2], Dr. Sanjana Rahman[3]

[1]Assistant Professor, Department of Obstetrics and Gynaecology, Dhaka Medical College, Dhaka, Bangladesh
[2]Junior Consultant, Department of Obstetrics and Gynaecology, Dhaka Medical College Hospital, Dhaka, Bangladesh
[3]Registrar, Department of Obstetrics and Gynaecology, Dhaka Medical College Hospital, Dhaka, Bangladesh

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***Corresponding author:** Dr. Nasrin Sultana
Assistant Professor, Department of Obstetrics and Gynaecology, Dhaka Medical College, Dhaka, Bangladesh

Abstract **Original Research Article**

Background: Diabetes in pregnancy, whether pre-gestational or gestational, is associated with significant maternal and perinatal complications. This study aimed to compare maternal and neonatal outcomes among non-diabetic, pre-gestational diabetic, and gestational diabetic pregnancies. ***Methods:*** This prospective cross-sectional observational study was conducted among pregnant women with pre-existing diabetes mellitus (PDM), gestational diabetes mellitus (GDM), and non-diabetic pregnant women from January 2004 to December 2005 in the Department of Obstetrics and Gynaecology at Bangabandhu Sheikh Mujib Medical University (BSMMU). ***Results:*** Family history of diabetes was significantly higher in pre-gestational (80%) and gestational diabetic groups (88%) compared to non-diabetics (0%). Pregnancy complications such as urinary tract infections (26% in pre-GDM, 30% in GDM) and hypertensive disorders were more common among diabetic pregnancies. Preterm delivery occurred more frequently in pre-GDM (18%) and GDM (14%) compared to non-diabetics (4%). Congenital malformations were noted in 4% of pre-GDM and GDM pregnancies. Mean fasting blood glucose and 2-hour postprandial glucose levels were significantly higher in diabetic groups compared to non-diabetic pregnancies ($p<0.001$). Gestational age at delivery was lower in diabetic mothers (35.50 ± 4.08 weeks in pre-GDM and 36.34 ± 4.55 weeks) than in non-diabetic mothers (38.98 ± 1.35 weeks). ***Conclusion:*** Diabetes during pregnancy, both pre-gestational and gestational, is associated with higher maternal and neonatal complications compared to non-diabetic pregnancies. Early diagnosis, effective glycemic control, and multidisciplinary management are essential to improve outcomes.

Keywords: Gestational diabetes, Pre-gestational diabetes, Maternal outcomes, Neonatal outcomes, Pregnancy complications.

INTRODUCTION

Diabetes mellitus is one of the most common medical conditions that complicate pregnancy and is associated with high maternal and perinatal morbidity and mortality. It is broadly divided into pre-gestational diabetes mellitus (PDM), where the diagnosis is established before pregnancy, and gestational diabetes mellitus (GDM), where glucose intolerance is first diagnosed during pregnancy [1, 2]. Both types of diabetes carry an increased risk of poor pregnancy outcomes, but the nature and severity of complications might be different in the two populations. The prevalence of both GDM and PDM has increased worldwide over recent decades due to higher maternal age, obesity, and physical inactivity, and it now constitutes a mounting public health problem, especially in low-income nations such as Bangladesh [3, 4].

GDM affects approximately 3–14% of pregnancies worldwide, varying with the population under study and the cut-point used for diagnosis [1]. GDM is typically asymptomatic and thus becomes a routine screening issue in pregnancy. GDM becomes a cause of serious complications like preeclampsia, macrosomia, shoulder dystocia, neonatal hypoglycemia, and long-term risk of type 2 diabetes in child and mother if undiagnosed or not adequately treated [5]. Pre-gestational diabetes, especially if poorly controlled, has even greater risks like congenital malformations, miscarriage, preterm labor, and long-term complications in the child [6]. Detection and effective control of antenatal risk factors early in pregnancy are therefore

essential to improve maternal and perinatal outcomes in diabetic pregnancy.

Certain antenatal risk factors decide the direction and outcome of pregnancy in diabetic women. These include maternal age, body mass index (BMI), parity, family history of diabetes, previous obstetric history, control of glycemia, and associated comorbidities [7]. Understanding the distribution and impact of these risk factors within different classes of diabetic pregnancies is essential for maximizing antenatal care, tailoring interventions, and planning delivery [8]. Also, the mode of delivery—either vaginal or cesarean section—is typically influenced by the diabetic condition and complications, whereby diabetic pregnancy has a higher rate of cesarean section due to obstetric and fetal factors [9].

Diabetic women, even with improved neonatal and obstetric management, still carry enhanced risks during pregnancy and delivery [10]. In Bangladesh, where healthcare resources are typically limited, and there is limited awareness about managing diabetic pregnancy, data on antenatal risk factors and outcomes of delivery among women with GDM and PDM are still lacking [11]. Determining the antenatal profile and pattern of delivery among diabetic pregnant women is needed to develop evidence-based interventions that can mitigate risks and improve maternal and neonatal health outcomes [12].

This study aimed to compare and evaluate the antenatal risk factors and patterns of delivery in women with gestational and pre-gestational diabetes and non-diabetic controls in two Bangladeshi tertiary hospitals. By comparing socio-demographic factors, obstetric history, glycemic control, pregnancy complications, and mode of delivery, this study aims to obtain valuable information that can be utilized to improve clinical practices and guidelines for the management of diabetic pregnancies in such resource-poor settings.

METHODOLOGY & MATERIALS

This prospective cross-sectional observational study was conducted among pregnant women with pre-existing diabetes mellitus (PDM), gestational diabetes mellitus (GDM), and non-diabetic pregnant women from January 2004 to December 2005 in the Department of Obstetrics and Gynaecology at Bangabandhu Sheikh Mujib Medical University (BSMMU). Cases were collected from BSMMU Hospital and Bangladesh Institute of Research and Rehabilitation in Diabetes, Endocrine and Metabolic Disorders (BIRDEM), Dhaka. A total of 150 pregnant women were enrolled, 50 in each group. Group A included non-diabetic pregnant women (NDM) who had no impaired glucose tolerance before or during pregnancy; Group B included women diagnosed with diabetes mellitus before conception (PDM, type I or II) following standard criteria (Falls 2002); and Group C included women diagnosed with GDM during the present pregnancy.

Inclusion criteria were pregnant women aged 18–40 years, singleton pregnancies, first antenatal visit within 20 weeks of gestation, diagnosis of GDM according to WHO criteria, delivery at BSMMU or BIRDEM, and observation of perinatal complications within the first five days after birth. Exclusion criteria included pregnancies complicated by hypertension, heart disease, renal disease, multiple pregnancies, Rh isoimmunization, and presence of diabetic complications like nephropathy, retinopathy, or angiopathy. Non-compliant patients were also excluded. Ethical approval was obtained from the BSMMU ethical committee, and informed written consent was taken from all participants.

Detailed socio-demographic data, obstetric history, family history, and pregnancy information were recorded. Expected delivery dates were calculated based on the last menstrual period and ultrasonography. Physical examinations including height, weight, and blood pressure measurements were performed. PDM and GDM patients received specialized antepartum care from multidisciplinary teams, emphasizing strict blood sugar control through dietary counseling (2000 kcal diet) and insulin therapy when needed. Obstetric management included close monitoring for complications like preeclampsia and infections, and labor was managed based on diabetic status and gestational age with controlled blood sugar levels using intravenous insulin and glucose during labor. Postpartum monitoring included surveillance for maternal and neonatal complications, with early breastfeeding and neonatal blood glucose monitoring for hypoglycemia. Data were collected using a structured questionnaire and analyzed with SPSS software, applying Chi-square and t-tests for statistical significance.

RESULTS

Table I: Age Distribution (Mean)

Age (years)	Group-A (Non-diabetic)	Group-B (Pre-GDM)	Group-C (GDM)
Mean ± SD	28.34 ± 4.20	29.01 ± 5.03	28.92 ± 5.14
Range	19–36	19–40	20–39

Unpaired Student's t-Test Results:
A vs B → p > 0.05ns, t = 2.719, df = 98
A vs C → p > 0.05ns, t = 0.618, df = 98
B vs C → p > 0.05ns, t = 1.907, df = 98

Table I presents the age distribution among the three study groups. The mean age of Group A (non-diabetic pregnant women) was 28.34 ± 4.20 years, ranging from 19 to 36 years. In Group B (pre-gestational diabetes mellitus patients), the mean age was 29.01 ± 5.03 years, with a range of 19 to 40 years. Group C (gestational diabetes mellitus patients) had a mean age of 28.92 ± 5.14 years, ranging from 20 to 39 years. The mean ages were closely comparable among the groups, indicating no significant difference in age distribution.

Table II: Past Obstetric History

Past Obstetric History	Group-A (n = 50)		Group-B (n = 50)		Group-C (n = 50)	
	n	%	n	%	n	%
Present	**5**	**10**	**28**	**56**	**22**	**44**
-Congenital anomaly	0	0	2	4	2	4
-History of GDM	0	0	15	30	13	26
-Overweight baby	0	0	1	2	0	0
-Unexplained neonatal death	0	0	2	4	2	4
-Stillbirth	0	0	1	2	1	2
-Abortion	5	10	12	24	10	20
Absent	**45**	**90**	**22**	**44**	**28**	**56**

Chi-square Test: $\chi^2 = 28.18$, df = 10, $P < 0.001$ (Highly significant)

Note: Some women had more than one past obstetric history.

Table II shows the past obstetric history of the study participants. A positive past obstetric history was present in only 10% of Group A (non-diabetic), compared to 56% in Group B (pre-gestational diabetes mellitus) and 44% in Group C (gestational diabetes mellitus). Congenital anomalies were reported in 4% of both Group B and Group C, while no such cases were observed in Group A. A history of gestational diabetes mellitus was found in 30% of Group B and 26% of Group C patients, but none in Group A. Overweight babies were reported in 2% of Group B, with no cases in Group A or Group C. Unexplained neonatal deaths were documented in 4% of both Group B and Group C. Stillbirths were noted in 2% of Group B and Group C, whereas no such outcomes were seen in Group A. Abortions were reported in 10% of Group A, 24% of Group B, and 20% of Group C. Absence of past obstetric complications was more common in Group A (90%) compared to Group B (44%) and Group C (56%).

Table III: Family History of Diabetes Mellitus

Family History	Group A (n=50)		Group B (n=50)		Group C (n=50)	
	n	%	n	%	n	%
Present	**0**	**0**	**40**	**80**	**44**	**88**
- Father	0	0	23	46	23	46
- Mother	0	0	29	58	31	62
- Brother	0	0	2	4	0	0
- Sister	0	0	3	6	2	4
-Grandfather	0	0	0	0	1	2
Absent	**50**	**100**	**10**	**20**	**6**	**12**

Statistical Analysis:

Chi-Square Test: $\chi^2 = 18.01$, df = 8, $P < 0.001$ (Highly significant)

Note: In some cases, a family history of diabetes mellitus was present in more than one family member.

Table III demonstrates the distribution of family history of diabetes mellitus among the study groups. None of the participants in Group A (non-diabetic) had a family history of diabetes, whereas a positive family history was present in 80% of Group B (pre-gestational diabetes mellitus) and 88% of Group C (gestational diabetes mellitus). Among those with a positive family history, the father was affected in 46% of cases in both Group B and Group C. A maternal history of diabetes was found in 58% of Group B and 62% of Group C. Diabetes was present in brothers of 4% of Group B patients but not in Group C, while sisters were affected in 6% of Group B and 4% of Group C. A history of diabetes in the grandfather was noted in 2% of Group C only. Family history of diabetes was completely absent in all participants of Group A, but was absent in only 20% of Group B and 12% of Group C.

Table IV: Present Pregnancy Complications

Complications	Group A (n=50)		Group B (n=50)		Group C (n=50)	
	n	%	n	%	n	%
Present	**14**	**28**	**33**	**66**	**34**	**68**
- Abortion	0	0	2	4	1	2
- UTI	6	12	13	26	15	30
- Polyhydramnios	0	0	5	10	5	10
- Preterm delivery	2	4	9	18	7	14
- Congenital malformation	0	0	2	4	2	4
- PIH/Pre-eclampsia	3	6	6	12	10	20
- Vulvovaginitis	3	6	7	14	5	10
- PROM	0	0	1	2	0	0
- Oligohydramnios	0	0	1	2	0	0
Absent	**36**	**72**	**17**	**34**	**16**	**32**

Statistical Analysis:
Chi-Square Test: $\chi^2 = 16.32$, df = 16, $P < 0.001$ (Highly significant)
Note: Some women had more than one antepartum complication.

Table IV shows the distribution of present pregnancy complications among the study groups. Pregnancy complications were reported in 28% of Group A (non-diabetic), 66% of Group B (pre-gestational diabetes mellitus), and 68% of Group C (gestational diabetes mellitus). Urinary tract infections (UTI) were the most common complication, occurring in 12% of Group A, 26% of Group B, and 30% of Group C. Polyhydramnios was observed in 10% of both diabetic groups (Group B and C), but absent in Group A. Preterm delivery occurred in 4% of Group A, 18% of Group B, and 14% of Group C. Congenital malformations were found in 4% of both Group B and C, while absent in Group A. Pregnancy-induced hypertension (PIH) or pre-eclampsia was noted in 6% of Group A, 12% of Group B, and 20% of Group C. Vulvovaginitis was present in 6% of Group A, 14% of Group B, and 10% of Group C. PROM and oligohydramnios were found only in Group B (2% each). In contrast, 72% of Group A, 34% of Group B, and 32% of Group C had no complications during pregnancy.

Table V: Gestational Age at Delivery

Gestational Age (weeks)	Group A (n=50)	Group B (n=48)	Group C (n=49)
Mean ± SD	38.98 ± 1.35	35.50 ± 4.08	36.34 ± 4.55
Range	35–41	35–39	35–40

Statistical Analysis (Unpaired Student's t-test):
A vs B = p>0.05 (NS), t=2.719, df = 98
A vs C = p>0.05 (NS), t=0.618, df = 98
B vs C = p>0.05 (NS), t=1.907, df = 98
Key: NS = Not Significant

Table V presents the distribution of gestational age at delivery among the three groups. The mean gestational age was 38.98 ± 1.35 weeks in Group A (non-diabetic), 35.50 ± 4.08 weeks in Group B (pre-gestational diabetes mellitus), and 36.34 ± 4.55 weeks in Group C (gestational diabetes mellitus). The range of gestational age was 35–41 weeks for Group A, 35–39 weeks for Group B, and 35–40 weeks for Group C. It was observed that women in the diabetic groups (Group B and Group C) tended to deliver earlier compared to non-diabetic women.

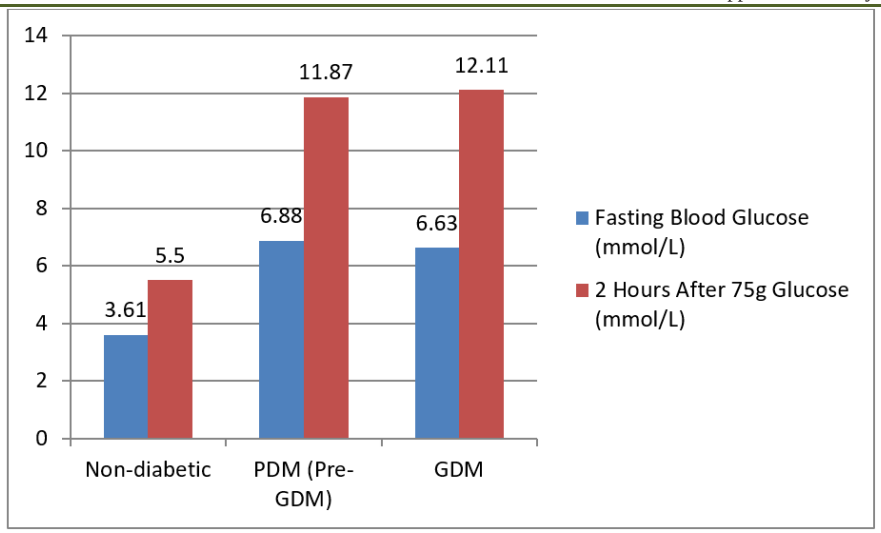

Figure 1: Glucose Tolerance Test in Different Groups of Patients

Significant difference in fasting and 2 hr glucose between diabetic and non-diabetic groups ($P < 0.001$)

No significant difference between PDM and GDM groups ($p > 0.10$).

Figure 1 shows that mean value of blood glucose level of fasting and 2 hours after 75 gm glucose of non diabetic patient were 3.61mmol/L and 5.5mmol/L respectively. There is significant ($P<0.001$) difference between fasting blood glucose level of diabetic and non-diabetic group of patients. But no significant (>0.10ns) difference was found between diabetic groups. Fasting blood glucose levels were 6.88mmol/L and 6.63mmol/l. and 2 hour after 75 gm glucose levels were 11.87 mmol/L and 12.11mmol/L in the patients of pre gestational and gestational diabetes mellitus respectively. The unpaired student's t test shows that there is significant ($P<0.001$) difference in 2 hr after 75 gm glucose between diabetic and non-diabetic group, but no (>0.10ns) significant difference between pre-gestational and gestational diabetic group.

DISCUSSION

Maternal and perinatal outcomes in this study were compared among pregnant women who were non-diabetic, pre-gestational diabetic, and gestational diabetic. There were noted clinical differences between the groups based on the results.

The age at mean in maternal years was no different between the groups, as had also been reported by Naher *et al.*, whereby there had again been no varied ages for diabetic compared to non-diabetic pregnancy [13]. The obstetric history before now differed considerably, with the condition having previous complication as a common factor, having a rate higher in diabetic cases (56% for gestational and 44% for pre-gestational), once again agreeing with what was reported by Sultana *et al.*, [14].

Family history of diabetes was very prevalent among diabetics (80% in pre-GDM and 88% in GDM) compared to non-diabetics (0%), highlighting the role of genetic susceptibility, as also suggested by Sumit and Sarker *et al.*, [15]. Mothers were the most common affected relatives, as per Alberico *et al.*, findings, which emphasized the mother's role in diabetic risk during pregnancy [16].

Diabetic mothers had a much higher rate of complications during pregnancy (66% in pre-GDM and 68% in GDM) compared to non-diabetic mothers (28%). Urinary tract infection was the largest rate of complication (26% in pre-GDM and 30% in GDM), followed by PIH/pre-eclampsia (12% and 20%, respectively). The finding is consistent with Akter *et al.*, who reported that diabetic pregnancy had a greater risk of hypertensive disorders and infection [17].

Preterm delivery rates were much higher among diabetic groups (18% in pre-GDM and 14% in GDM) compared to the non-diabetic group (4%). This is consistent with the work of Diboun *et al.*, where they depicted the interaction between diabetes and preterm birth [18]. Polyhydramnios was experienced by 10% of diabetic groups but was absent among the non-diabetic group, consistent with findings of Nouhjah *et al.*, [19].

Congenital malformations occurred in 4% of GDM and non-GDM pregnancies but not in diabetic pregnancies, validating the result of Suborna *et al.*, which showed the direct correlation of rising maternal HbA1c with congenital abnormalities [20].

As for gestational age at delivery, the mean was significantly lower among diabetic groups (35.50 ± 4.08 weeks for pre-GDM and 36.34 ± 4.55 weeks for GDM)

compared to non-diabetics (38.98 ± 1.35 weeks). This is consistent with Zhang *et al.,* findings that diabetes increased the likelihood of premature deliveries [21].

We also obtained blood glucose levels in our research. The fasting blood glucose levels were 6.88 mmol/L in pre-GDM and 6.63 mmol/L in GDM, while the levels were 3.61 mmol/L in non-diabetic pregnancy. The post-glucose levels at 2 hours were also found to be highly significant in diabetic groups (11.87 mmol/L and 12.11 mmol/L) compared to non-diabetics (5.5 mmol/L). These were statistically significant (P<0.001) between diabetic and non-diabetic but not significantly different between the two diabetic groups (>0.10). These findings are consistent with the research of Gracelyn and Saranya, who stressed that hyperglycemia stays equally in GDM and pre-GDM groups [22].

The higher rate of complications and adverse outcomes with diabetic pregnancies seen in this study is supported by previous studies. For example, Rahman *et al.,* emphasized that uncontrol of glycemic leads to adverse outcomes such as infection, hypertension, and birth defects [23]. Furthermore, studies conducted by Lassi *et al.,* and Pathirana *et al.,* indicated that maternal hyperglycemia significantly increases the incidence of adverse cardiovascular and metabolic outcomes among offspring [24, 25].

Surprisingly, though both pre-GDM and GDM groups had similar blood glucose profiles, pre-GDM was moderately more associated with higher rates of earlier deliveries and complications, consistent with Malaza *et al.,* who documented poorer outcomes for pre-GDM compared to GDM [26].

Overall, this study affirms the findings of Santos *et al.,* and Bianchi *et al.,* that gestational or pre-gestational diabetes significantly worsens maternal and fetal outcomes, and therefore early screening, severe glycemic control, and pregnancy management by a multidisciplinary team are imperative [27, 28].

Limitations of the study

This study was conducted in a limited number of patients from selected tertiary care hospitals, which may not represent the general population. The sample size, though adequate for preliminary observations, was relatively small. Furthermore, we could not assess long-term maternal and neonatal outcomes beyond the immediate perinatal period. Glycemic control measures during pregnancy and their impact on outcomes were not uniformly evaluated. Future studies with larger multicenter cohorts and longer follow-up periods are recommended to validate and expand upon these findings.

CONCLUSION

Both pre-gestational and gestational diabetes mellitus are associated with increased maternal complications, such as urinary tract infections, hypertensive disorders, and preterm deliveries, as well as adverse neonatal outcomes, including congenital malformations and early deliveries. Compared to non-diabetic pregnancies, diabetic pregnancies showed significantly higher fasting and postprandial blood glucose levels and more pregnancy-related complications. These findings highlight the critical need for early screening, proper antenatal care, and strict glycemic control to improve maternal and perinatal outcomes in diabetic pregnancies.

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