Original Research

Impact of Gestational and Pre-Gestational Diabetes on Maternal Complications and Fetal Outcomes: A Comparative Observational Study at Rangpur Medical College Hospital

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Abstract

Introduction: *Diabetes in pregnancy, including gestational and pre-gestational diabetes, presents significant risks to both maternal and fetal health. Understanding the impact of these conditions on pregnancy outcomes is crucial for developing effective management strategies.*

Methods: *This observational comparative study involved 300 pregnant women at Rangpur Medical College Hospital, divided into three groups: pre-gestational diabetic (Group A), gestational diabetic (Group B), and non-diabetic control (Group C). Data on socio-demographic characteristics, obstetric profiles, mode of delivery, maternal complications, and fetal outcomes were collected and analyzed.*

Result: *The study meticulously analyzed socio-demographic characteristics, revealing no significant differences across the groups. In obstetric profiles, Group A (Pre-Gestational Diabetic) had a notably lower mean gestational age at delivery (36.06 ± 2.71 weeks) compared to Group B (Gestational Diabetic) and Group C (Control), with mean ages of 37.34± 1.12 and 38.46±1.13 weeks, respectively. Maternal complications were significantly higher in Group A at 47%, compared to 25% in Group B and 12% in Group C. Fetal outcomes showed marked variations: Group A had 95% stable births, 5% stillbirths, and 60% of neonates with Apgar scores ≤7 at 5 minutes. In contrast, Group B had 96% stable births, 4% stillbirths, and 27% of neonates with Apgar scores ≤7, while Group C reported 100% stable births and 11% with Apgar scores ≤7. Birth weight distribution indicated 24% of neonates in Group A weighed <2 kg, compared to 5% in Group B and 4% in Group C. NICU admissions were highest in Group A (44%), followed by Group B (29%) and Group C (11%). Perinatal complications like birth asphyxia (38% in Group A, 16% in Group B, 6% in Group C), hypoglycemia (22% in Group A, 10% in Group B, 4% in Group C), and hyperbilirubinemia (16% in Group A, 12% in Group B, 0% in Group C) were also significantly higher in diabetic groups.*

Conclusion: *The presence of gestational or pre-gestational diabetes in mothers significantly impacts fetal outcomes and increases the risk of maternal complications. This study highlights the need for specialized care and vigilant monitoring in pregnancies complicated by diabetes to improve health outcomes for mothers and babies.*

Introduction

Diabetes Mellitus, a complex group of metabolic diseases, is primarily characterized by chronic hyperglycemia resulting from insulin secretion or action defects. This condition is known to cause long-term damage to various organs, including the eyes, kidneys, nerves, heart, and blood vessels[1]. The intersection of diabetes with pregnancy, inherently a diabetogenic state, poses significant challenges in obstetrical care. Globally, the incidence of diabetes-related complications during

pregnancy is on the rise, with gestational diabetes mellitus (GDM) representing a substantial proportion of these cases [2]. Defined by the World Health Organization as carbohydrate intolerance leading to hyperglycemia of varying severity first identified during pregnancy, GDM's prevalence is a growing concern worldwide[3]. In specific regions, such as Saudi Arabia and Bangladesh, the prevalence of pre-gestational diabetes mellitus (Pre-GDM) and GDM is notably high, underscoring the need for focused research in these areas[4,5]. The hormonal changes during pregnancy, particularly the increase in hormones like human placental lactogen and cortisol, exacerbate insulin resistance, a key factor in the development of GDM[6]. Pregestational and gestational diabetes not only share commonalities in insulin resistance but also in genetic susceptibility, further complicating their management and impact on pregnancy[7]. The interplay between Human Leucocytic Antigen G (HLA–G) and Nuclear factor kB (NF- kB) has been identified as a critical factor in the onset of GDM [8]. The degree of maternal hyperglycemia and its timing during pregnancy are crucial determinants of both maternal and fetal outcomes, with early uncontrolled hyperglycemia being particularly detrimental[9]. The implications of GDM extend beyond immediate pregnancy outcomes, encompassing a range of fetal and maternal morbidities and long-term health issues for both the mother and the child. Maternal complications can include conditions like pre-eclampsia and polyhydramnios, while fetal complications range from macrosomia to various metabolic challenges [10]. The risk of congenital anomalies is notably linked to glycemic control during critical early pregnancy stages[11]. Long-standing pregestational diabetes can lead to vascular complications, adversely affecting the uteroplacental unit and potentially leading to intrauterine growth restriction (IUGR) and maternal hypertension[12]. Diabetes also disrupts lipid metabolism, which can have significant implications for fetal development[13]. Furthermore, women with a history of GDM face a heightened risk of developing diabetes in later life, with a substantial recurrence risk in subsequent pregnancies, particularly among high-risk groups [14]. This study is conducted to investigate the maternal and fetal outcomes in pregnancies complicated by pre-gestational and gestational diabetes mellitus. By adopting an observational comparative approach, this research aims to enhance our understanding of the impact of these diabetic conditions on fetal outcomes, with a particular focus on the region of Rangpur. The insights gained from this study are expected to contribute significantly to clinical practice, offering guidance for interventions aimed at improving feto-maternal health outcomes.

Methods

Study Design: This cross-sectional analytical study was conducted in the Department of Obstetrics and Gynecology at Rangpur Medical College Hospital, Rangpur, utilizing a purposive sampling technique.

Study Participants: A total of 300 patients were selected for this observational comparative study, with participants categorized into three distinct groups: Group A (pre-gestational diabetic), Group B (gestational diabetic), and Group C (non-diabetic control), each comprising 100 patients.

Data Collection: A specifically designed questionnaire was employed for data collection, encompassing all relevant parameters under study. This process commenced following proper counseling of the patients, and written consent was obtained from either the patient or her legal guardian.

Inclusion Criteria: The inclusion criteria for the study were a gestational age greater than 28 weeks, diagnosed cases of GDM and Pre-GDM admitted for delivery at Rangpur Medical College Hospital, newly diagnosed cases, and singleton pregnancy.

Exclusion Criteria: The exclusion criteria for mothers with Pre-GDM and GDM included multiple pregnancies, patients with any medical or surgical illness (such as renal disease, liver disease, or endocrine disorder) that could affect blood sugar levels, and non-compliant patients. For control mothers, the exclusion criteria were similar, with the addition of those not willing to participate in the study.

Data Analysis: Data analysis was performed using SPSS software, with statistical significance determined at a p-value of less than 0.05.

Rationale: This methodological approach was designed to ensure a comprehensive and comparative analysis of the maternal and fetal outcomes in pregnancies complicated by pre-gestational and gestational diabetes mellitus, as well as in non-diabetic control cases.

Results

The study involved a comprehensive analysis of 300 participants across three groups: pre-gestational diabetic (Group A), gestational diabetic (Group B), and non-diabetic control (Group C). The baseline socio-demographic characteristics revealed no significant differences in age distribution, education, occupation, socio-economic status, residence, except for a notable family history of diabetes, which was significantly higher in Group A (pre-gestational diabetic) compared to the other groups (p<0.001). Obstetric profiles demonstrated variations in gestational age at delivery, with Group A delivering at a significantly lower mean gestational age (36.06 ± 2.71 weeks) compared to Group B (37.34± 1.12 weeks) and Group C (38.46±1.13 weeks) (p=0.001). Maternal complications were significantly higher in Group A (47%) compared to Group B (25%) and Group C (12%) (p<0.001). Fetal outcomes showed that 5% of Group A experienced stillbirths, and 60% had neonates with Apgar scores ≤7 at 5 minutes, while Group B had 4% stillbirths and 27% with Apgar scores ≤7, and Group C reported no stillbirths and 11% with Apgar scores ≤7 (p<0.001). Birth weight distribution indicated higher percentages of neonates weighing <2 kg in Group A (24%) compared to Group B (5%) and Group C (4%) (p=0.001). NICU admissions were highest in Group A (44%), followed by Group B (29%) and Group C (11%) (p<0.000s). Perinatal complications such as birth asphyxia, hypoglycemia, and hyperbilirubinemia were significantly more prevalent in diabetic groups compared to the control group (p<0.001, p=0.019, p=0.017, respectively). Overall, the study underscores the substantial impact of gestational and pre-gestational diabetes on both maternal and fetal outcomes, emphasizing the need for specialized care and vigilant monitoring in these high-risk pregnancies.

Table 1: Distribution of baseline socio-demographic characteristics among the participants (N=300)

Variables	Group A n (%)	Group B n (%)	Group C n (%)	P value
Age (in year)				
<25	4 (4%)	16 (16%)	18 (18%)	
25-29	65 (65%)	59 (59%)	59 (59%)	0.06
≥30	31 (31%)	25 (25%)	23 (23%)	
Mean±SD	28.62±2.11	27.90± 2.04	27.56± 2.65	0.06
Education				
Illiterate	8 (8%)	8 (8%)	15 (15%)	
Below SSC	55 (55%)	59 (59%)	41 (41%)	
SSC	23 (23%)	22 (22%)	23 (23%)	0.86
HSC	9 (9%)	9 (9%)	20 (20%)	
Graduate and above	5 (5%)	2 (2%)	1 (1%)	
Occupation				
Housewife	84 (84%)	80 (80%)	88 (88%)	
Service Holder	6 (6%)	4 (4%)	4 (4%)	0.86
Day Laborer	8 (8%)	11 (11%)	5 (5%)	
Others	2 (2%)	5 (5%)	3 (3%)	
Socio-economic status				
Lower	47 (47%)	48 (48%)	60 (60%)	
Middle	41 (41%)	40 (40%)	32 (32%)	0.36
Higher	12 (12%)	12 (12%)	8 (8%)	
Residence				
Rural	72 (72%)	72 (72%)	83 (83%)	0.46
Urban	28 (28%)	28 (28%)	17 (17%)	
Family history				
Present	71 (71%)	65 (65%)	11 (11%)	<0.001
Absent	29 (29%)	35 (35%)	89 (89%)	

Discussion

The baseline socio-demographic characteristics of the 300 participants in this study, spanning across Group A (Pre-Gestational Diabetic), Group B (Gestational Diabetic), and Group C (Control), revealed no significant differences in age, education, occupation, socio-economic status, and residence. This aligns with the findings of Jubrael et al., who reported that gestational diabetes mellitus (GDM) prevalence is influenced by factors such as older age, obesity, higher parity, and history of recurrent miscarriage, rather than by basic socio-demographic factors[15].

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

Variables	Group A	Group B	Group C	P value
	n (%)	n (%)	n (%)	
Parity				
Primi-parous	27 (27)	12 (12%)	20 (20%)	0.20
Multi-parous	73 (73)	88 (88%)	80 (80%)	
Gestationam Age Delivery (week)				
28-32	16 (16)	3 (3)	0 (0)	0.04
33-36	29 (29)	20 (20)	7 (7)	
<36	55 (55)	77 (77)	93 (93)	
Mean±SD	**36.06 ± 2.71**	**37.34± 1.12**	**38.46±1.13**	0.00
Past obstetric history				
H/O GDM	38 (38)	18 (18)	8 (8)	0.00
H/O HTN	18 (18)	8 (8)	10 (10)	0.26
H/O congenital anomaly baby	10 (10)	2 (2)	0 (0)	0.02
H/O macrosomia	8 (8)	2 (2)	0 (0)	0.06
H/O IUFD	14 (14)	2 (2)	0 (0)	0.01
H/O stillbirth	2 (2)	0 (0)	0 (0)	0.36
H/O abortion	20 (20)	6 (6)	4 (4)	0.01
ANC				
Regular	77 (77)	64 (64)	56 (56)	0.04
Irregular	19 (19)	31 (31)	36 (36)	
None	4 (4)	5 (5)	8 (8)	

The lack of significant differences in these basic socio-demographic characteristics in our study suggests that the impact of gestational and pre-gestational diabetes on pregnancy outcomes may be more strongly influenced by clinical factors than by socio-demographic ones. The obstetric profile showed a higher prevalence of pre-gestational and gestational diabetes in multiparous women, which is consistent with the literature indicating that higher parity is a risk factor for GDM[15].

Table 3: Distribution of mode of delivery among the participants (N=300)

Mode of Delivery	Group A	Group B	Group C	P value
	n (%)	n (%)	n (%)	
Normal Vaginal Delivery	38 (38)	48 (48)	80 (80)	<0.001
Cesarean Section	62 (62)	52 (52)	20 (20)	

Table 4: Distribution of presence of maternal complication among the participants (N=300)

Maternal Complications	Group A	Group B	Group C	P value
	n (%)	n (%)	n (%)	
Present	47 (47)	25 (25)	12 (12)	<0.001
Absent	62 (62)	75 (75)	88 (88)	

Table 5: Distribution of fetal outcome among the participants (N=300)

Variables	Group A	Group B	Group C	P value
	n (%)	n (%)	n (%)	
Fetal Outcome				
Stable birth	95 (95)	96 (96)	100 (100)	0.34
Still birth	5 (5)	4 (4)	0 (0)	
Apgar score at 5 min				
≤ 7	60 (60)	27 (27)	11 (11)	<0.00
≥ 7	40 (40)	73 (73)	89 (89)	
Birth weight of neonate (kg)				
<2	24 (24)	5 (5)	4 (4)	
2-4	76 (76)	84 (84)	93 (93)	0.00
>4	0 (0)	11 (11)	3 (3)	
Need for NICU				
No	56 (56)	71 (71)	89 (89)	<0.00
Yes	44 (44)	29 (29)	11 (11)	
Perinatal Complications				
Birth asphyxia	38 (38)	16 (16)	6 (6)	<0.00
Hypoglycemia	22 (22)	10 (10)	4 (4)	0.01
Hyperbilirubinemia	16 (16)	12 (12)	0 (0)	0.01
Congenital anomaly	2 (2)	0 (0)	0 (0)	0.75
Perinatal Death	4 (4)	2 (2)	0 (0)	0.56

The gestational age at delivery was significantly different among the groups, with Group A having a lower mean gestational age. This finding is crucial as it suggests that pre-gestational diabetes may lead to earlier deliveries, a factor that can impact neonatal outcomes. A significant history of GDM, hypertension, and other obstetric complications was noted in Group A, aligning with the findings of Sofiah et al., who observed that GDM mothers often have a history of pregnancy-induced hypertension and macrosomia[16]. The higher incidence of past obstetric complications in Group A highlights the need for careful monitoring and management in pregnancies complicated by pre-gestational diabetes. The mode of delivery also varied significantly across the groups, with a higher rate of cesarean sections in the diabetic groups, especially in Group A. This is in line with the

general trend observed in diabetic pregnancies, where the rate of cesarean delivery is often higher due to various obstetric complications[16]. Our study found significant variations in maternal complications across the groups, with Group A (Pre-Gestational Diabetic) experiencing the highest rate of complications (47%), followed by Group B (Gestational Diabetic) at 25%, and Group C (Control) at 12%. This trend is consistent with the literature, which indicates that gestational diabetes mellitus (GDM) is associated with a higher risk of adverse maternal outcomes [17]. The elevated risk in pre-gestational diabetic patients underscores the need for heightened surveillance and management in this group. The incidence of stable births was high across all groups, with a slightly lower rate in the diabetic groups. This finding aligns with the general understanding that while GDM increases the risk of complications, effective management can lead to favorable outcomes[18]. The occurrence of stillbirths, although not statistically significant, was higher in the diabetic groups, echoing the findings of Jin et al., who reported an association between high blood pressure in early pregnancy and adverse outcomes such as stillbirth[19]. The Apgar scores at 5 minutes post-delivery revealed a higher percentage of neonates in the diabetic groups with scores ≤7, indicating a need for immediate medical attention. This is in line with the literature, which suggests that GDM can impact neonatal health, necessitating closer monitoring and intervention [18]. The birth weight distribution showed a higher percentage of neonates weighing <2 kg in Group A, while Group B had a higher percentage of neonates weighing >4 kg. These findings highlight the diverse impact of diabetes on fetal growth, with GDM often leading to larger babies due to hyperglycemia [19]. NICU admissions were highest in Group A, followed by Group B and Group C, indicating more severe neonatal complications in diabetic pregnancies. This is supported by the study of Glick et al., which discusses the increased risk of adverse fetal outcomes, including the need for NICU care, in pregnancies complicated by diabetes [20]. In terms of perinatal complications, birth asphyxia, hypoglycemia, and hyperbilirubinemia were more prevalent in the diabetic groups, especially Group A. These complications are well-documented in the literature as common issues in diabetic pregnancies[18].

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.

Conclusion

This study's analysis of 300 pregnant women reveals a clear impact of gestational and pre-gestational diabetes on fetal outcomes and maternal complications. Notably, mothers with pre-gestational diabetes (Group A) experienced the highest rate of complications, followed by those with gestational diabetes (Group B), and the control group (Group C). This trend highlights the increased risk and need for specialized care in diabetic pregnancies. Significant differences were observed in fetal outcomes, particularly in birth weight variations and the necessity for NICU admission, with diabetic groups showing greater adverse outcomes. Although the increase in stillbirths in diabetic groups was not statistically significant, it aligns with known risks associated with diabetes in pregnancy. The study emphasizes the importance of early detection and proactive management of diabetes in pregnancy to mitigate risks and improve health outcomes for both mothers and babies. It underscores the need for targeted interventions and vigilant monitoring in managing pregnancies complicated by diabetes, reinforcing the critical role of specialized care in these scenarios.

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Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

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