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Glycemic Control and Its Effect on Fetomaternal Outcome Among Patients with Hyperglycemia in Pregnancy

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KEYWORDS

Hyperglycemia in pregnancy, glycemic control, gestational diabetes mellitus, fetomaternal outcome.

ABSTRACT:

Background: Hyperglycemia in pregnancy (HIP), including gestational diabetes mellitus and diabetes in pregnancy, is associated with increased maternal and neonatal morbidity. The level of glycemic control plays an important role in determining pregnancy outcomes. Evidence from developing countries remains limited regarding the relationship between glycemic status and fetomaternal complications. This study aimed to evaluate the relationship between glycemic control and fetomaternal outcome among patients with hyperglycemia in pregnancy.

Methods: This cross-sectional analytical study was conducted in the Department of Obstetrics and Gynecology, Bangladesh Institute of Research and Rehabilitation in Diabetes, Endocrine and Metabolic Disorders (BIRDEM), Dhaka, from July 2020 to June 2021. A total of 267 pregnant women with hyperglycemia in pregnancy were included using consecutive sampling. Participants were categorized into acceptable glycemic control and uncontrolled groups based on fasting plasma glucose, postprandial glucose and HbA1c levels. Maternal and neonatal outcomes were compared between groups. Data were analyzed using SPSS version 22.

Results: Among 267 participants, 155 (58.1%) had uncontrolled glycemic status and 112 (41.9%) had acceptable glycemic control. Gestational hypertension (81.5%), urinary tract infection (73.7%) and genital tract infection (77.2%) were significantly higher in the uncontrolled group ($p<0.05$). Neonatal complications including preterm birth (71.6%), low birth weight (72.3%), neonatal jaundice (70.2%), perinatal asphyxia (72.9%), intrauterine death (100%), low APGAR score (94.4%) and NICU admission (72.2%), were significantly more frequent among uncontrolled cases ($p<0.05$).

Conclusion: Poor glycemic control is significantly associated with adverse fetomaternal outcomes. Maintaining optimal glycemic levels during pregnancy is essential to reduce maternal and neonatal complications.

Introduction

Hyperglycemia in pregnancy (HIP) is a common metabolic disorder characterized by impaired glucose tolerance first detected during pregnancy or pre-existing diabetes mellitus diagnosed during gestation. HIP includes both gestational diabetes mellitus (GDM) and diabetes in pregnancy (DIP) and represents a growing public health concern due to its association with adverse maternal and neonatal outcomes [1]. Globally, approximately 16–17% of live births are affected by hyperglycemia in pregnancy, with the highest burden

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observed in low- and middle-income countries where access to adequate antenatal care may be limited [2].

Glycemic control refers to the maintenance of blood glucose levels within recommended ranges in order to minimize complications associated with diabetes. Glycated hemoglobin (HbA1c) is widely considered a reliable indicator of long-term glycemic control, reflecting average blood glucose levels over the previous two to three months [3]. Maintaining optimal glycemic control during pregnancy is crucial because maternal hyperglycemia is associated with increased risks of gestational hypertension, preeclampsia, preterm delivery, polyhydramnios, cesarean delivery and postpartum complications [4]. Poor glycemic control may also adversely affect fetal development, increasing the likelihood of congenital anomalies, macrosomia, neonatal hypoglycemia, hyperbilirubinemia, respiratory distress syndrome, perinatal asphyxia and neonatal intensive care unit (NICU) admission [5,6].

Physiological changes during pregnancy, including increased insulin resistance caused by placental hormones, contribute to alterations in maternal carbohydrate metabolism. Although most pregnant women are able to compensate through increased insulin secretion, failure of this compensatory mechanism results in hyperglycemia [7]. Several maternal risk factors have been identified for the development of HIP, including advanced maternal age, obesity, family history of diabetes, previous history of macrosomia or stillbirth, sedentary lifestyle and multiparity [1]. Increasing maternal age and rising prevalence of obesity among women of reproductive age have contributed to a growing incidence of hyperglycemia in pregnancy worldwide [8].

Evidence suggests that the degree of glycemic control significantly influences pregnancy outcomes. Studies have demonstrated that poor glycemic control is associated with increased risk of maternal complications such as urinary tract infection, gestational hypertension and operative delivery, as well as neonatal complications including low birth weight, preterm birth, neonatal jaundice and perinatal mortality [9]. The Hyperglycemia and Adverse Pregnancy Outcome (HAPO) study showed a continuous relationship between maternal glucose levels and adverse perinatal outcomes, emphasizing the importance of strict glycemic monitoring during pregnancy [10].

Despite the growing burden of HIP, limited data are available in Bangladesh regarding the association between maternal glycemic status and fetomaternal outcomes. BIRDEM General Hospital is a tertiary care center where a large number of pregnant women with hyperglycemia receive specialized care. Understanding the relationship between glycemic control and pregnancy outcomes in this population is essential for developing effective management strategies and improving maternal and neonatal health outcomes. Therefore, this study aimed to evaluate the relationship between glycemic control and fetomaternal outcome among patients with hyperglycemia in pregnancy.

Materials & Methods

This cross-sectional analytical study was conducted in the Department of Obstetrics and Gynecology at Bangladesh Institute of Research and Rehabilitation in Diabetes, Endocrine and Metabolic Disorders (BIRDEM), Segunbagicha, Dhaka, Bangladesh. The study was carried out over one year from July 2020 to June 2021. The study population consisted of pregnant women diagnosed with hyperglycemia in pregnancy who were admitted for delivery at BIRDEM General Hospital. A total of 267 women with hyperglycemia in pregnancy, including both gestational diabetes mellitus and diabetes in pregnancy, were included in this study.

Selection Criteria:

Inclusion criteria

- Pregnant women diagnosed with hyperglycemia in pregnancy
- Patients admitted for delivery
- Gestational age ≥28 weeks
- Patients are willing to participate and provide informed consent

Exclusion criteria

- Multiple pregnancy
- Gestational age less than 28 weeks
- Severe co-morbidities such as cardiac failure, hepatic failure, or renal failure
- Clinical vasculopathy, neuropathy and retinopathy
- Proteinuria greater than 2+
- Hemoglobinopathies

Data Collection Procedure

Data were collected using a semi-structured questionnaire and a predesigned data collection sheet. After obtaining informed written consent, eligible participants were enrolled consecutively during admission for delivery. Relevant clinical history, obstetric history and socio-demographic information were obtained through face-to-face interviews and review of hospital records. Clinical examination and laboratory investigations were conducted to determine glycemic status, including fasting blood glucose, two-

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hour postprandial blood glucose and glycated hemoglobin (HbA1c) levels measured just before delivery. Participants were categorized into an acceptable glycemic control group and an uncontrolled glycemic control group according to predefined criteria based on fasting plasma glucose, postprandial glucose and HbA1c levels. Maternal outcomes including gestational hypertension, preeclampsia, premature rupture of membranes, urinary tract infection, genital tract infection, wound infection, postpartum hemorrhage and puerperal pyrexia, were recorded. Fetal and neonatal outcomes including birth weight, gestational age, APGAR score, neonatal jaundice, neonatal hypoglycemia, neonatal sepsis, congenital anomaly, intrauterine death, perinatal asphyxia, NICU admission and neonatal death, were documented during hospital stay and the early puerperium period.

Ethical Consideration

Ethical approval was obtained from the Institutional Review Board of BIRDEM. Written informed consent was obtained from each participant before enrollment. Participants were informed about the objectives, procedures, potential benefits and risks of the study. Confidentiality and anonymity were maintained using unique identification numbers. Participants were assured that refusal or withdrawal would not affect their treatment.

Statistical Analysis

Data were analyzed using Statistical Package for Social Sciences (SPSS) version 22. Descriptive statistics were expressed as frequency and percentage for categorical variables and mean with standard deviation for continuous variables. Chi-square test was applied to determine the association between glycemic control and fetomaternal outcomes. A p-value less than 0.05 was considered statistically significant.

Results

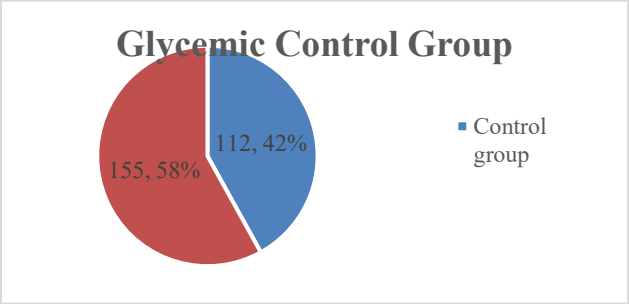

Figure 1: Distribution of study subjects according to glycemic control group (n = 267)

Figure 1 represents the distribution of the respondents according to glycemic control group, where more than half 155 (58.1%), respondents were in the uncontrolled group and 112 (41.95%) respondents were in the acceptable control group.

Table 1: Categorization of the study subjects according to baseline characteristics by group (n = 267)

Variable	Category	Acceptable (n=112)	Uncontrolled (n=155)	p-value
Age	20–30 (low risk)	93 (43.9)	119 (56.1)	0.212
	<20 & >35 (high risk)	19 (34.5)	36 (65.5)	
	Mean ± SD	30.14±4.76	30.37±5.12	0.716
Education	≤ SSC	8 (22.2)	28 (77.8)	0.01
	> SSC	104 (45.0)	127 (55.0)	
Occupation	Unemployed	81 (38.0)	132 (62.0)	0.001
	Employed	31 (57.4)	23 (42.6)	
BMI	Underweight	1 (100.0)	0 (0.0)	0.26
	Normal weight	2 (20.0)	8 (80.0)	
	Overweight	43 (45.7)	51 (54.3)	
	Obese	66 (40.7)	96 (59.3)	
	Mean ± SD	30.74±4.39	31.20±4.04	0.379

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Parity	Primipara	34 (52.3)	31 (47.7)	0.061
	Multipara	78 (38.6)	124 (61.4)	
Previous History of DM	Yes	13 (21.3)	48 (78.7)	0.001
	No	66 (46.4)	75 (53.6)	

Table 1 shows baseline characteristics of the study participants. Mean maternal age was 30.14±4.76 years in the acceptable glycemic control group and 30.37±5.12 years in the uncontrolled group (p=0.716). The majority of the uncontrolled group were educated ≤SSC (77.8%), unemployed (62.0%) and had a previous history of diabetes (78.7%) (p<0.05).

Table 2: Categorization of the respondents according to mode of delivery by glycemic control group (n = 267)

Mode of delivery	Acceptable (n=112)	Uncontrolled (n=155)	P-value
Caesarean section	100 (40.3)	148 (59.7)	0.052
NVD	12 (63.2)	7 (36.8)	

Table 2 describes the distribution of the respondents according to mode of delivery by glycemic control, where the proportion of caesarean section in the uncontrolled group was higher 59.7% and 36.8% had NVD. Among the acceptable glycemic control group, more than half 63.2% had vaginal delivery and 40.3% had caesarean section. This finding was not statistically significant (p = 0.052)

Table 3: Categorization respondents according to maternal complications by glycemic control group (n = 267)

Maternal complications	Category	Acceptable (n=112)	Uncontrolled (n=155)	p-value
Amniotic fluid	Polyhydramnios	6 (30.0)	14 (70.0)	0.332
	Oligohydramnios	12 (35.3)	22 (64.7)	
	Normal	94 (44.1)	119 (55.9)	
PROM	Yes	2 (20.0)	8 (80.0)	0.200
	No	110 (42.8)	147 (57.2)	
Gestational HTN	Yes	5 (18.5)	22 (81.5)	0.012
	No	107 (44.6)	133 (55.4)	
Preeclampsia	Yes	3 (20.0)	12 (80.0)	0.106
	No	109 (43.3)	143 (56.7)	
PPH	Yes	2 (25.0)	6 (75.0)	0.474
	No	110 (42.5)	149 (57.5)	
UTI	Yes	20 (26.3)	56 (73.7)	0.001
	No	92 (48.2)	99 (51.8)	
Infection of genital tract	Yes	18 (22.8)	61 (77.2)	<0.001
	No	94 (50.0)	94 (50.0)	
Hypoglycemia	Yes	13 (29.5)	31 (70.5)	0.068

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	No	99 (44.4)	124 (55.6)	
Wound infection	Yes	1 (12.5)	7 (87.5)	0.144
	No	111 (42.9)	148 (57.1)	
Puerperal pyrexia	Yes	3 (23.1)	10 (76.9)	0.249
	No	109 (42.9)	145 (57.1)	

Table 3 shows that maternal complications were higher in the uncontrolled group, including gestational hypertension (81.5%), urinary tract infection (73.7%) and genital tract infection (77.2%), which were statistically significant ($p<0.05$).

Table 4: Categorization of the respondents according to fetal complications by glycemic control group (n=267)

Fetal complications	Category	Acceptable (n=112)	Uncontrolled (n=155)	p-value
Type of baby	Preterm	25 (28.4)	63 (71.6)	0.003
	Term	87 (48.4)	92 (51.4)	
Birth weight	<2.5 kg	18 (27.7)	47 (72.3)	0.006
	2.5–4.0 kg	92 (47.9)	100 (52.1)	
	>4.0 kg	2 (20.0)	8 (80.0)	
APGAR score	≤7	1 (5.6)	17 (94.4)	0.001
	>7	111 (44.6)	138 (55.4)	
Neonatal jaundice	Yes	31 (29.8)	73 (70.2)	0.001
	No	81 (49.7)	82 (50.3)	
Intra uterine death	Yes	0 (0.0)	8 (100.0)	0.023
	No	112 (43.2)	147 (56.8)	
Neonatal sepsis	Yes	4 (36.4)	7 (63.6)	0.766
	No	108 (42.2)	148 (57.8)	
Congenital anomaly	Yes	1 (14.3)	6 (85.7)	0.245
	No	111 (42.7)	149 (57.3)	
Hypoglycemia	Yes	16 (33.3)	32 (66.7)	0.182
	No	96 (43.8)	123 (56.2)	
Perinatal asphyxia	Yes	16 (27.1)	43 (72.9)	0.009
	No	96 (46.2)	112 (53.8)	
NICU admission	Yes	25 (27.8)	65 (72.2)	0.001
	No	87 (49.2)	90 (50.8)	
Neonatal death	Yes	0 (0.0)	1 (100.0)	1.00
	No	112 (42.1)	154 (57.9)	

Table 4 shows fetal and neonatal complications were significantly higher in uncontrolled group including preterm birth (71.6%), birth weight <2.5kg (72.3%), APGAR score ≤7 (94.4%), neonatal jaundice (70.2%),

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intrauterine death (100%), perinatal asphyxia (72.9%) and NICU admission (72.2%) ($p<0.05$).

Discussion

This cross-sectional analytical study evaluated the relationship between glycemic control and fetomaternal outcome among pregnant women with hyperglycemia in pregnancy admitted at a tertiary care hospital in Bangladesh. Among 267 participants, 58.1% had uncontrolled glycemic status and 41.9% had acceptable glycemic control. This finding differs from Banerjee et al., who reported that 79.5% of gestational diabetes patients had acceptable glycemic control and 20.5% had uncontrolled glycemic status, suggesting possible differences in population characteristics, clinical practices, or healthcare accessibility [11].

The mean maternal age in the acceptable glycemic control and uncontrolled groups was 30.14±4.76 and 30.37±5.12 years, respectively, which is consistent with previous findings suggesting that increasing maternal age is associated with a higher risk of impaired glucose tolerance during pregnancy. Meena et al. reported that women aged more than 30 years had a higher prevalence of poor glycemic control, highlighting the influence of age-related metabolic changes on insulin sensitivity [12]. Similarly, Buhary et al. reported a mean age of 33.43±6.63 years among pregnant women with hyperglycemia, supporting the similarity of maternal age distribution observed in the present study [13].

Socio-demographic factors such as education and employment status also showed an association with glycemic control. In the present study, the majority of respondents in the uncontrolled group were educated below the SSC level (77.8%) and unemployed (62.0%). Lower educational status may influence awareness regarding antenatal care, diet and lifestyle modification, contributing to poor glycemic control. Meena et al. also observed that a considerable proportion of women with gestational diabetes were unemployed, indicating socioeconomic factors may influence disease management [12].

Parity and previous history of diabetes showed a statistically significant association with glycemic control. In this study, 78.7% of women in the uncontrolled group had a previous history of diabetes compared to 21.3% in the acceptable glycemic control group. Multiparity was also more common in the uncontrolled group. Similar findings were reported by Meena et al. indicating increased risk of hyperglycemia among multiparous women and those with a previous history of metabolic disorders [12].

Body mass index showed no statistically significant difference between groups, although mean BMI was slightly higher in the uncontrolled group (31.2±4.04 kg/m2) compared to the acceptable control group (30.74±4.39 kg/m2). Catalano et al. reported that obesity increases the risk of gestational diabetes and adverse pregnancy outcomes, particularly when glycemic targets are not achieved [14]. Langer et al. demonstrated that obese women with poor glycemic control had higher rates of adverse pregnancy outcomes compared to normal weight women, supporting the clinical importance of maintaining optimal glucose levels during pregnancy [15].

Mode of delivery was not significantly different between groups, although caesarean section was more common among women with uncontrolled glycemic status (59.7%). Kapustin et al. reported increased frequency of operative delivery among women with poorly controlled diabetes, suggesting hyperglycemia may influence obstetric decision-making due to increased risk of complications [16].

Maternal complications such as gestational hypertension, urinary tract infection and genital tract infection were significantly higher in the uncontrolled glycemic group. Similar findings were reported by Nkume et al., who found increased prevalence of urinary tract infection among individuals with poor glycemic control, suggesting impaired immunity associated with hyperglycemia increases susceptibility to infection [17]. However, Yefet et al. reported no difference in gestational hypertension between controlled and uncontrolled groups, indicating possible influence of population variation and sample size differences [18].

Fetal and neonatal complications were significantly associated with poor glycemic control. Preterm birth, low birth weight, neonatal jaundice, intrauterine death, perinatal asphyxia, low APGAR score and NICU admission were significantly higher among the uncontrolled group. Banerjee et al. demonstrated a higher incidence of congenital anomalies and adverse neonatal outcomes among uncontrolled gestational diabetes cases, emphasizing the importance of maintaining optimal glucose levels throughout pregnancy [11].

Perinatal asphyxia was significantly higher in the uncontrolled group (72.9%) compared to the acceptable glycemic control group (27.1%). Similar findings were observed by Banerjee et al. where the incidence of birth asphyxia was higher in the uncontrolled group, suggesting that persistent hyperglycemia contributes to placental insufficiency and fetal hypoxia [11].

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Overall, findings of the present study demonstrate that uncontrolled glycemic status significantly increases risk of adverse maternal and neonatal outcomes. Maintaining appropriate glycemic control through diet, insulin therapy and regular monitoring is essential to reduce complications and improve pregnancy outcomes.

Limitations of the study

The study had several limitations. The sample size was relatively small and the study was conducted within a short period of time. The consecutive sampling technique was used, which may introduce selection bias and limit the generalizability of the findings.

Conclusion

Adverse fetomaternal outcomes are more pronounced among patients with uncontrolled glycemic status compared to those with acceptable glycemic control. Poor glycemic control during pregnancy is an independent risk factor for complications such as gestational hypertension, urinary tract infection, genital tract infection, preterm birth, low birth weight, neonatal jaundice, intrauterine death, perinatal asphyxia, low APGAR score and NICU admission. Maintaining optimal glycemic control during pregnancy is essential to improve maternal and neonatal outcomes.

Conflicts of interest: There are no conflicts of interest.

Ethical Approval: This study approved by the institutional ethical review committee.

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