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Original Article

Pregnancy Outcomes in Women with Diet Control Versus Insulin-Treated GDM

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ABSTRACT

Introduction: Gestational diabetes mellitus (GDM) is a common pregnancy complication associated with increased maternal and neonatal morbidity. While many women achieve adequate glycemic control through dietary modification and lifestyle measures, others require insulin because target glucose levels cannot be maintained with diet alone. The present study aimed to assess maternal and neonatal pregnancy outcomes between women with diet-controlled GDM and those with insulin-treated GDM. **Methods & Materials:** This prospective observational study was conducted in the Department of Obstetrics & Gynaecology, District Sadar Hospital, Rajbari, Bangladesh from January 2025 to December 2025, among 104 pregnant women diagnosed with gestational diabetes mellitus (GDM) who received antenatal care and delivered at the study hospital. Participants were recruited using purposive sampling. Data were analyzed using SPSS version 26.0. **Results:** Among 104 women with GDM, 66 (63.5%) were managed with diet alone and 38 (36.5%) required insulin. Insulin-treated women had significantly higher BMI, earlier GDM diagnosis, and poorer glycemic profiles, including higher fasting glucose, 2-hour OGTT glucose, and HbA1c levels. Induction of labour was significantly more frequent in the insulin group (73.7% vs. 50.0%, p=0.019), while cesarean delivery, LGA, macrosomia, neonatal hypoglycemia, and NICU admission were also more frequent, although these differences were not statistically significant. **Conclusion:** Women with insulin-treated GDM exhibited a greater metabolic burden, reflected by higher BMI, earlier diagnosis, and poorer glycemic control than women managed with diet alone. Insulin-treated pregnancies also had higher frequencies of labour induction, cesarean delivery, LGA, macrosomia, neonatal hypoglycemia, and NICU admission, although most of these differences did not reach statistical significance.

Keywords: *Pregnancy Outcomes, Gestational diabetes mellitus, Diet Control*

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INTRODUCTION

Gestational diabetes mellitus (GDM) is one of the most common metabolic disorders of pregnancy and is characterized by glucose intolerance first recognized during pregnancy. Its clinical importance extends beyond hyperglycemia itself because maternal dysglycemia is associated with adverse maternal, fetal, and neonatal outcomes, including hypertensive disorders, cesarean delivery, preterm birth, excessive fetal growth, neonatal hypoglycemia, and neonatal intensive care admission [1,2]. A systematic review of 156 studies involving 7,506,061 pregnancies found that, even after adjustment for confounding factors, GDM was associated with higher odds of cesarean delivery, preterm birth, macrosomia, and large-for-gestational-age (LGA) birth in studies without insulin use; in studies involving insulin-treated women, GDM remained associated with LGA birth, respiratory distress syndrome, neonatal jaundice, and neonatal intensive care admission [3]. Management of GDM initially focuses on medical nutrition therapy, physical activity, appropriate gestational weight management, and self-monitoring of blood glucose. The 2025 American Diabetes Association (ADA) Standards of Care state that lifestyle intervention may be sufficient for many women, while insulin should be added when glycemic targets are not achieved; insulin remains the preferred pharmacological treatment for GDM. Current treatment targets generally include fasting glucose below 95 mg/dL and either 1-hour postprandial glucose below 140 mg/dL or 2-hour postprandial glucose below 120 mg/dL [4]. Dietary intervention itself can substantially improve metabolic control. A meta-analysis of nine randomized trials involving 884 women found that a low-glycemic-index diet reduced insulin requirement by approximately 23% and lowered newborn birth weight by about 162 g compared with control dietary regimens [1]. Similarly, a Cochrane review concluded that lifestyle interventions can improve glycemic control and may reduce the need for pharmacological treatment in women with GDM [5]. The distinction between diet-controlled and insulin-treated GDM is clinically important because the need for insulin may reflect greater underlying insulin resistance, impaired β-cell compensation, earlier diagnosis, or more severe hyperglycemia rather than simply representing a different treatment choice. In a study of 601 women with GDM, 24.2% required insulin; compared with diet-treated women, insulin-treated women had higher fasting, 1-hour, and 2-hour glucose concentrations, more abnormal oral glucose tolerance test values, lower insulin sensitivity, and higher HbA1c levels. They also had significantly higher rates of LGA infants (28.5% vs. 13.1%) and cesarean delivery (44.1% vs. 27.0%) [6]. However, the findings have not been uniform. In another retrospective cohort of 820 pregnancies, neonatal and obstetric outcomes were largely comparable between diet-only and insulin-treated groups, although insulin-treated women had lower birth weight and gestational age and underwent more labor inductions and planned cesarean deliveries [7]. Another study comparing diet, metformin, and insulin found higher neonatal hypoglycemia and less favorable glycemic measures among insulin-treated women [8]. Importantly, diet-controlled GDM should not automatically be considered low risk. A large Swedish population-based cohort including 14,242 women with GDM reported increased risks of LGA birth, preeclampsia, cesarean delivery, birth trauma, and preterm delivery in both diet- and insulin-treated groups, with most adverse outcomes more frequent among women receiving insulin [9]. Likewise, treatment of mild GDM has been shown to reduce macrosomia, LGA birth, shoulder dystocia, cesarean delivery, and

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preeclampsia compared with usual care, demonstrating that the degree of glycemic control has direct implications for pregnancy outcomes [10]. The present study aimed to assess maternal and neonatal pregnancy outcomes between diet-controlled and insulin-treated GDM.

METHODS & MATERIALS

This prospective observational study was conducted in the Department of Obstetrics & Gynaecology, District Sadar Hospital, Rajbari, Bangladesh from January 2025 to December 2025, among 104 pregnant women diagnosed with gestational diabetes mellitus (GDM) who received antenatal care and delivered at the study hospital. Participants were recruited using purposive sampling. The women were categorized into two groups according to their GDM management: diet-controlled GDM, comprising women who achieved recommended glycemic targets with medical nutrition therapy and lifestyle modification alone, and insulin-treated GDM, comprising women who required insulin because adequate glycemic control was not achieved with dietary management. Maternal demographic and clinical characteristics, gestational age at diagnosis, BMI, previous GDM, family history of diabetes, fasting and post-load glucose levels, HbA1c, and treatment details were recorded. Maternal outcomes including gestational hypertension, preeclampsia, preterm delivery, induction of labour, mode of delivery, postpartum hemorrhage, and duration of hospital stay were assessed, while neonatal outcomes included birth weight, macrosomia, large-for-gestational-age status, small-for-gestational-age status, Apgar score, neonatal hypoglycemia, respiratory distress, neonatal jaundice, birth trauma, NICU admission, and perinatal death. Data were analyzed using SPSS version 26.0. Categorical variables were expressed as frequencies and percentages and compared using Pearson's chi-square test. Continuous variables were expressed as mean ± standard deviation. A p-value <0.05 was considered statistically significant. Ethical approval was obtained from the appropriate institutional ethics committee, and informed consent was obtained from all participants before enrollment.

RESULTS

The diet-control group comprised 66 (63.5%) women and the insulin-treated group 38 (36.5%). Women aged ≥35 years were more common in the insulin group (23.7% vs. 12.1%), but this difference was not significant (p=0.061). Most participants were urban residents and housewives in both groups, with no significant differences in residence, education, or occupation (*Table I*).

Table I

Sociodemographic characteristics of women with GDM according to treatment group (*n*=104).

Sociodemographic characteristic	Diet control (n=66)	Insulin-treated (n=38)	p-value*
Age group (years)			0.061
<25	12 (18.2%)	4 (10.5%)	
25–29	24 (36.4%)	10 (26.3%)	
30–34	22 (33.3%)	15 (39.5%)	
≥35	8 (12.1%)	9 (23.7%)	
Residence			0.412
Urban	43 (65.2%)	23 (60.5%)	
Rural	23 (34.8%)	15 (39.5%)	
Educational level			0.538
Primary or below	15 (22.7%)	10 (26.3%)	
Secondary	28 (42.4%)	13 (34.2%)	
Higher secondary	13 (19.7%)	9 (23.7%)	
Graduate and above	10 (15.2%)	6 (15.8%)	
Occupation			0.634
Housewife	48 (72.7%)	29 (76.3%)	
Service	11 (16.7%)	5 (13.2%)	
Other	7 (10.6%)	4 (10.5%)	

**Chi-square test.*

BMI category differed significantly between groups (p=0.048), with overweight/obesity more frequent among insulin-treated women. Previous GDM and family history of diabetes were also more common in the insulin group, although not significantly. Earlier diagnosis of GDM was significantly more frequent among insulin-treated women (p=0.002) (*Table II*).

Table II
Clinical and obstetric characteristics of women with GDM according to treatment group (*n*=104).

Clinical characteristic	Diet control (n=66)	Insulin treated (n=38)	p-value*
BMI category (kg/m²)			0.048
<23	10 (15.2%)	2 (5.3%)	
23–24.9	17 (25.8%)	8 (21.1%)	
25–29.9	31 (47.0%)	20 (52.6%)	
≥30	8 (12.1%)	8 (21.1%)	
Parity			0.316
Primigravida	31 (47.0%)	14 (36.8%)	
Multigravida	35 (53.0%)	24 (63.2%)	
Previous GDM			0.071
No	59 (89.4%)	29 (76.3%)	
Yes	7 (10.6%)	9 (23.7%)	
Family history of diabetes mellitus			0.198
No	48 (72.7%)	23 (60.5%)	
Yes	18 (27.3%)	15 (39.5%)	
Gestational age at GDM diagnosis			0.002
≤24 weeks	11 (16.7%)	12 (31.6%)	
25–28 weeks	29 (43.9%)	18 (47.4%)	
>28 weeks	26 (39.4%)	8 (21.1%)	
Previous macrosomic baby			0.276
No	62 (93.9%)	33 (86.8%)	
Yes	4 (6.1%)	5 (13.2%)	
Mode of GDM diagnosis			0.118
Routine antenatal screening	51 (77.3%)	25 (65.8%)	
Symptom/risk-based testing	15 (22.7%)	13 (34.2%)	

**Chi-square test.*

Insulin-treated women had significantly higher fasting glucose, 2-hour OGTT glucose, and HbA1c at diagnosis (all p≤0.002). Two or more abnormal OGTT values were more frequent in the insulin group (52.6% vs. 27.3%, p=0.010), and third-trimester HbA1c ≥5.5% was also more common (47.4% vs. 27.3%, p=0.006) (*Table III*).

Table III
Glycemic characteristics of women with GDM according to treatment group (*n*=104).

Glycemic characteristic	Diet control (n=66)	Insulin treated (n=38)	p-value*
Fasting plasma glucose at diagnosis (mg/dL)			<0.001
<95	31 (47.0%)	7 (18.4%)	
95–104	25 (37.9%)	15 (39.5%)	
≥105	10 (15.2%)	16 (42.1%)	
2-hour OGTT glucose (mg/dL)			<0.001
<140	14 (21.2%)	3 (7.9%)	
140–159	34 (51.5%)	12 (31.6%)	
≥160	18 (27.3%)	23 (60.5%)	
Number of abnormal OGTT values			0.010
One	48 (72.7%)	18 (47.4%)	
Two or more	18 (27.3%)	20 (52.6%)	
HbA1c at diagnosis			0.002
<5.5%	39 (59.1%)	14 (36.8%)	
5.5–5.9%	22 (33.3%)	15 (39.5%)	
≥6.0%	5 (7.6%)	9 (23.7%)	
Third-trimester HbA1c			0.006
<5.5%	48 (72.7%)	20 (52.6%)	
≥5.5%	18 (27.3%)	18 (47.4%)	
Time from GDM diagnosis to delivery			<0.001
<8 weeks	13 (19.7%)	3 (7.9%)	
8–12 weeks	32 (48.5%)	12 (31.6%)	
>12 weeks	21 (31.8%)	23 (60.5%)	
Insulin dose at delivery			-
<20 U/day	-	9 (23.7%)	
20–39 U/day	-	22 (57.9%)	
≥40 U/day	-	7 (18.4%)	

**Chi-square test.*

Induction of labour was significantly more frequent among insulin-treated women (73.7% vs. 50.0%, p=0.019). Cesarean delivery was also more common in the insulin group (52.6% vs. 34.8%), although the difference was not statistically significant (p=0.085). Other maternal complications showed no significant between-group differences (*Table IV*).

Table IV
Maternal and obstetric outcomes according to GDM treatment group (*n*=104).

Maternal/obstetric outcome	Diet control (n=66)	Insulin-treated (n=38)	p-value*
Gestational hypertension	6 (9.1%)	4 (10.5%)	0.807
Preeclampsia	3 (4.5%)	4 (10.5%)	0.250
Preterm delivery (<37 weeks)	7 (10.6%)	6 (15.8%)	0.439
Induction of labour	33 (50.0%)	28 (73.7%)	0.019
Spontaneous vaginal delivery	35 (53.0%)	14 (36.8%)	0.108
Assisted vaginal delivery	8 (12.1%)	4 (10.5%)	0.805
Cesarean delivery	23 (34.8%)	20 (52.6%)	0.085
Emergency cesarean delivery	15 (22.7%)	10 (26.3%)	0.684
Planned cesarean delivery	8 (12.1%)	10 (26.3%)	0.074
Postpartum hemorrhage	4 (6.1%)	3 (7.9%)	0.702
Maternal length of stay >3 days	9 (13.6%)	9 (23.7%)	0.190

**Chi-square test.*

Birth weight ≥4000 g and LGA were more frequent among infants of insulin-treated women (15.8% vs. 9.1% and 26.3% vs. 13.6%, respectively), although neither difference was statistically significant. Neonatal hypoglycemia and NICU admission were also more common in the insulin group (21.1% vs. 10.6% and 15.8% vs. 9.1%, respectively). Other neonatal outcomes were comparable between groups (*Table V*).

Table V
Neonatal outcomes according to maternal GDM treatment group (*n*=104).

Neonatal outcome	Diet control (n=66)	Insulin treated (n=38)	p-value*
Birth weight			0.118
<2500 g	5 (7.6%)	3 (7.9%)	
2500–3999 g	55 (83.3%)	29 (76.3%)	
≥4000 g	6 (9.1%)	6 (15.8%)	
Others			
Large for gestational age	9 (13.6%)	10 (26.3%)	0.112
Small for gestational age	6 (9.1%)	3 (7.9%)	0.843
5-minute Apgar score <7	2 (3.0%)	2 (5.3%)	0.610
Neonatal hypoglycemia	7 (10.6%)	8 (21.1%)	0.157
Respiratory distress	3 (4.5%)	3 (7.9%)	0.487
NICU admission	6 (9.1%)	6 (15.8%)	0.309
Neonatal jaundice requiring treatment	5 (7.6%)	5 (13.2%)	0.350
Birth trauma	2 (3.0%)	2 (5.3%)	0.610
Perinatal death	0 (0.0%)	1 (2.6%)	0.193

**Chi-square test.*

DISCUSSION

In this study, 36.5% of women with GDM required insulin treatment, while 63.5% were controlled with diet alone. The insulin-treated group showed a less favorable metabolic profile, with higher BMI, earlier GDM diagnosis, and greater glycemic abnormalities. Benhalima et al., in a cohort of 601 women, reported insulin use in 24.2% and similarly found that insulin-treated women were diagnosed earlier, had higher fasting and post-load glucose values, more abnormal OGTT values, and higher HbA1c than diet-treated women [6]. Likewise, Eleftheriades et al. found that higher maternal BMI and fasting glucose were significant predictors of insulin requirement, with baseline glucose >98 mg/dL and BMI 26–31 kg/m² substantially increasing the likelihood of insulin therapy [11]. The present findings therefore suggest that insulin use largely identified women with greater underlying metabolic severity rather than representing treatment-related risk itself. Regarding baseline clinical characteristics, women requiring insulin in this study had more frequent overweight/obesity, previous GDM, and family history of diabetes, although only BMI category reached statistical significance. Benhalima et al. found previous GDM in 21.5% of insulin-treated versus 10.4% of diet-treated women and also reported more multiparity and earlier diagnosis in the insulin group [6]. Tamagawa et al. further demonstrated that BMI ≥25 kg/m², family history of diabetes, and higher fasting, 1-hour, and 2-hour glucose values were significant predictors of subsequent insulin therapy [12]. The glycemic differences were particularly pronounced. Fasting glucose ≥105 mg/dL occurred in 42.1% of insulin-treated women versus 15.2% of diet-controlled women, while ≥2 abnormal OGTT values occurred in 52.6% versus 27.3%, respectively. Benhalima et al. reported higher fasting glucose (97.6 vs. 87.7 mg/dL), 2-hour glucose (185.2 vs. 175.0 mg/dL), and more frequent three or four abnormal OGTT values among insulin-treated women [6]. For maternal outcomes, induction of labour was significantly more frequent with insulin treatment (73.7% vs. 50.0%), while cesarean delivery was also higher (52.6% vs. 34.8%). Koning et al., in 820 GDM pregnancies, similarly found more labour induction and planned cesarean delivery among insulin-treated women, although many perinatal complications were otherwise comparable [7]. Benhalima et al. reported an even greater difference in cesarean delivery, 44.1% versus 27.0% in insulin- and diet-treated women, respectively [6]. Valgeirsdóttir et al., using Swedish population data involving 14,242 women with GDM, also found higher risks of cesarean delivery, preterm birth, and hypertensive complications among insulin-treated women, while emphasizing that diet-treated GDM should not automatically be regarded as low risk [13]. In neonatal outcomes, LGA was observed in 26.3% of insulin-treated versus 13.6% of diet-controlled pregnancies, while macrosomia occurred in 15.8% versus 9.1%. Benhalima et al. found LGA rates of 28.5% and 13.1%, respectively, and macrosomia rates of 12.6% and 7.3%, closely paralleling the direction of the present findings [6]. Conversely, Koning et al. found no significant difference in LGA or macrosomia between treatment groups, illustrating that neonatal growth outcomes may vary across populations [7]. Neonatal hypoglycemia was also more frequent in the present insulin group (21.1% vs. 10.6%), although not significantly. Voormolen et al.,

however, reported similar mild and severe hypoglycemia rates in insulin- and diet-treated pregnancies, indicating that hypoglycemia may remain an important neonatal concern regardless of treatment modality [14].

LIMITATIONS

The study was conducted in a single hospital with a small sample size. So, the results may not represent the whole community. As an observational study, potential confounding factors could not be completely excluded, particularly factors influencing the decision to initiate insulin therapy. In addition, the analysis focused primarily on pregnancy and early neonatal outcomes, without assessing longer-term maternal and child outcomes.

CONCLUSION

This study demonstrated that women with insulin-treated GDM had greater metabolic disturbance, including higher BMI, earlier diagnosis, and poorer glycemic profiles, than those achieving control with diet alone. Insulin-treated pregnancies also showed higher rates of labour induction, cesarean delivery, LGA, macrosomia, neonatal hypoglycemia, and NICU admission, although several differences in maternal and neonatal outcomes were not statistically significant.

RECOMMENDATION

Women with insulin-treated GDM should receive closer antenatal and neonatal monitoring because of their greater metabolic burden and higher frequency of adverse pregnancy outcomes. Early diagnosis, regular glucose monitoring, timely dietary intervention, and appropriate initiation of insulin may help improve maternal and neonatal outcomes. Further studies with larger samples are recommended to confirm these associations.

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CONFLICT OF INTEREST

None declared

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