



## Fetal Outcome in Patients with Gestational Diabetes Mellitus

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### ABSTRACT

**Background:** Gestational diabetes mellitus is linked with poor fetal outcomes such as macrosomia, neonatal jaundice, and NICU admission. It is important to know the incidence and predictors of these complications to enhance perinatal care. **Objective:** To determine the frequency of fetal outcomes in patients with gestational diabetes mellitus. **Study Design:** Descriptive cross-sectional study. **Duration and Place of Study:** The study was conducted from August 2024 to January 2025 at the Department of Obstetrics and Gynecology, Ayub Teaching Hospital, Abbottabad. **Methodology:** A total of 116 pregnant women with GDM, aged 18–40 years and with singleton pregnancies beyond 36 weeks of gestation, were enrolled. GDM was diagnosed based on plasma glucose criteria or documented use of antidiabetic medications. Exclusion criteria included major fetal anomalies, maternal complications, or chronic illnesses. Neonatal outcomes assessed included large for gestational age, macrosomia, NICU admission, and neonatal jaundice. **Results:** Among 116 women, LGA was observed in 20.70%, macrosomia in 17.20%, NICU admission in 20.70%, and neonatal jaundice in 10.30%. Maternal age and BMI showed no significant association with any fetal outcomes. Hypertensive mothers had significantly lower rates of LGA ( $p=0.014$ ), while other associations were statistically non-significant. **Conclusion:** GDM is associated with considerable fetal morbidity. Hypertension may modify certain risks such as fetal overgrowth.

### INTRODUCTION

Gestational diabetes mellitus is variable severity glucose intolerance first diagnosed during pregnancy.<sup>1</sup> It typically occurs in the second or third trimester due to hormonal changes that result in insulin resistance.<sup>2</sup> It is among the most prevalent medical issues of pregnancy and is risky for the health of the mother and fetus. Although after pregnancy, the glucose is typically within normal range, the presence of GDM is risky for the development of type 2 diabetes later on for the mother and places the fetus at risk of numerous issues due to the altered intrauterine environment.<sup>3</sup>

One of the most common recorded fetal outcomes of GDM is large for gestational age (LGA).<sup>4</sup> It is operationally defined as neonates with birth weight over the 90th percentile for gestational age.<sup>4</sup> LGA is typically the result of maternal hyperglycemia inducing hyperinsulinemia in the fetus, an efficacious growth stimulus.<sup>5</sup> Excessive fetus growth, more specifically in abdominal circumference, is thus observed.<sup>5</sup> It complicates delivery by causing shoulder dystocia, birth trauma, and the necessity for cesarean section, thus influencing neonatal as well as maternal outcomes.<sup>5</sup>

Macrosomia, a closely related but specific complication, is

defined as birth weight of more than 4,000 to 4,500 grams regardless of gestational age.<sup>6</sup> It is an undisputed consequence of poor glycemic control of pregnant women with GDM. Macrocosmic neonates have increased risk of birth asphyxia, fracture of clavicle, and brachial plexus injuries as secondary outcomes of obstructed labour.<sup>7</sup> Their long-term health is also poor as such neonates have an increased propensity of developing child obesity and metabolic syndrome later in life years, emphasizing the need for early detection and strict glycemic control during pregnancy.<sup>7</sup>

Neonates born of diabetic mothers with GDM have increased risk of NICU admission due to problems such as respiratory distress syndrome, hypoglycemia, and hyperbilirubinemia.<sup>8</sup> Neonatal jaundice is another common finding, more frequently secondary to polycythemia and increased red blood cell turnover secondary to chronic intrauterine hypoxia.<sup>9</sup> The newborn with an immature liver is incapable of clearing the increased bilirubin load, and phototherapy and close monitoring ensue.<sup>9</sup> These findings emphasize the importance of comprehensive antenatal screening, timely intervention, and multidisciplinary care in an effort to prevent unintended fetal outcomes of GDM.

A study conducted by Ejaz Z et al. reported that among patients with gestational diabetes mellitus, the observed frequencies of adverse fetal outcomes were as follows: large for gestational age in 14.54% of cases, macrosomia in 12.71%, NICU admissions in 16.4%, and neonatal jaundice in 8.2% of neonates.<sup>10</sup>

Despite the recognized issues of gestational diabetes mellitus on the outcomes of fetuses, little local information on Abbottabad is available to guide clinical practice. The variation in dietary habits, access to care, and awareness level of Abbottabad may affect the prevalence of GDM as well as neonatal outcomes of the disease. The conduct of the study within Abbottabad is relevant in an effort to provide information on the local burden and pattern of fetal outcomes of GDM. The findings may be employed in developing specific screening strategy and improving perinatal care at the local scene.

## METHODOLOGY

This descriptive study was conducted over a six-month period from August 2024 to January 2025 following ethical approval at the Department of Obstetrics and Gynaecology, Ayub Teaching Hospital, Abbottabad. A total of 116 pregnant women were enrolled. The sample size was calculated using WHO sample size software with a 95% confidence level, 5% margin of error, and an expected frequency of neonatal jaundice of 8.2% among women diagnosed with gestational diabetes mellitus.<sup>10</sup>

Women aged 18 to 40 years, with a singleton pregnancy confirmed on ultrasound, and a gestational age greater than 36 weeks based on the last menstrual period, were included. A diagnosis of gestational diabetes mellitus was established if any of the following were present: fasting plasma glucose level above 92 mg/dL, a one-hour post-75g oral glucose tolerance test (OGTT) result greater than 180 mg/dL, a two-hour post-OGTT result above 153 mg/dL, or documented use of antidiabetic medications during pregnancy. Women were excluded if they had major fetal anomalies detected on ultrasound, significant maternal complications such as preeclampsia or placental abruption, a history of substance use including alcohol or tobacco, or chronic medical conditions such as autoimmune diseases.

Upon enrollment, informed written consent was obtained, and detailed demographic and clinical information was recorded. Following delivery, neonates were assessed for specific outcomes. Large for gestational age was defined as a birth weight exceeding the 90th percentile for gestational age, measured using a calibrated weighing machine. Macrosomia was considered present if the birth weight was greater than 4.5 kilograms. NICU admission was recorded for neonates requiring intensive care support due to fetal distress, determined by clinical signs such as abnormal heart rate patterns or meconium-stained liquor. Neonatal jaundice was identified by visible yellow discoloration of the skin and sclera, and confirmed with total serum bilirubin levels exceeding 15 mg/dL.

All data were recorded on a predesigned proforma. Statistical analysis was conducted using IBM SPSS version 26. Quantitative variables were analyzed using means and standard deviations. Categorical variables were expressed as frequencies and percentages. Stratification was applied

based on maternal and clinical characteristics to examine differences in fetal outcomes. Post-stratification chi-square testing was performed, with a p-value  $\leq 0.05$  considered statistically significant.

## RESULTS

The study included 116 patients with gestational diabetes mellitus with a mean age of  $29.99 \pm 4.70$  years and gestational age of  $37.55 \pm 1.07$  weeks, having a mean parity of  $2.86 \pm 1.42$  and BMI of  $27.01 \pm 3.32$  kg/m<sup>2</sup> (as shown in Table 1). The majority of participants were from rural areas (64.7%), had primary education (29.3%), belonged to middle socioeconomic status (36.2%), were normotensive (75.9%), and had no renal disease (95.7%) (as shown in Table 1).

**Table 1**  
*Patient Demographics (n=116)*

Demographics	Mean $\pm$ SD	
Age (years)	29.99 $\pm$ 4.70	
Gestational Age (weeks)	37.55 $\pm$ 1.07	
Parity	2.86 $\pm$ 1.42	
BMI (kg/m <sup>2</sup> )	27.01 $\pm$ 3.32	
Residential Status	Rural n (%)	75 (64.7%)
	Urban n (%)	41 (35.3%)
Education Level	Uneducated n (%)	24 (20.7%)
	Primary n (%)	34 (29.3%)
	Secondary n (%)	27 (23.3%)
	Higher n (%)	31 (26.7%)
Socioeconomic Status	Poor n (%)	41 (35.3%)
	Middle n (%)	42 (36.2%)
	Rich n (%)	33 (28.4%)
Hypertension	Yes n (%)	28 (24.1%)
	No n (%)	88 (75.9%)
Renal Disease	Yes n (%)	5 (4.3%)
	No n (%)	111 (95.7%)

Regarding fetal outcomes, large for gestational age occurred in 20.70% of cases, macrosomia in 17.20%, NICU admission in 20.70%, and neonatal jaundice in 10.30% of infants (as shown in Table 2).

**Table 2**  
*Frequency of Fetal Outcomes in Patients with Gestational Diabetes Mellitus*

Fetal Outcomes	Frequency	% age	
Large for Gestational Age	Yes	24	20.70%
	No	92	79.30%
	Total	116	100%
Macrosomia	Yes	20	17.20%
	No	96	82.80%
	Total	116	100%
NICU Admission	Yes	24	20.70%
	No	92	79.30%
	Total	116	100%
Neonatal Jaundice	Yes	12	10.30%
	No	104	89.70%
	Total	116	100%

When examining associations between maternal factors and fetal outcomes, maternal age showed no significant association with any fetal outcome, with similar rates of large for gestational age in mothers  $\leq 30$  years (20.6%) versus  $>30$  years (20.8%,  $p=0.987$ ), macrosomia rates of 14.3% versus 20.8% ( $p=0.358$ ), NICU admission rates of 25.4% versus 15.1% ( $p=0.172$ ), and neonatal jaundice rates of 12.7% versus 7.5% ( $p=0.542$ ) (as shown in Table 3). BMI categories also showed no significant differences,

with large for gestational age occurring in 16.0% of mothers with BMI  $\leq 25$  kg/m<sup>2</sup> versus 24.2% in those with BMI  $>25$  kg/m<sup>2</sup> ( $p=0.278$ ), macrosomia in 16.0% versus 18.2% ( $p=0.758$ ), NICU admission in 18.0% versus 22.7% ( $p=0.534$ ), and neonatal jaundice in 10.0% versus 10.6% ( $p=1.000$ ) (as shown in Table III). Hypertensive mothers showed a significantly lower rate of large for gestational age compared to normotensive mothers (3.6% versus 26.1%,  $p=0.014$ ), while macrosomia rates were higher but not statistically significant (28.6% versus 13.6%,  $p=0.068$ ), NICU admission rates were similar (17.9%

versus 21.6%,  $p=0.793$ ), and neonatal jaundice rates were comparable (14.3% versus 9.1%,  $p=0.480$ ) (as shown in Table III). Mothers with renal disease showed no cases of large for gestational age or NICU admission compared to 21.6% in those without renal disease (both  $p=0.366$ ), had higher macrosomia rates (40.0% versus 16.2%,  $p=0.205$ ), and no cases of neonatal jaundice compared to 10.8% in mothers without renal disease ( $p=0.656$ ), though none of these differences reached statistical significance due to the small sample size of mothers with renal disease ( $n=5$ ) (as shown in Table 3).

**Table 3***Association of Fetal Outcomes with Maternal Factors*

Maternal Factors	Large for Gestational Age		p-value	Macrosomia		p-value	NICU Admission		p-value	Neonatal Jaundice		p-value	
	Yes n(%)	No n(%)		Yes n(%)	No n(%)		Yes n(%)	No n(%)		Yes n(%)	No n(%)		
Age (years)	$\leq 30$	13 (20.6%)	50 (79.4%)	0.987	9 (14.3%)	54 (85.7%)	0.358	16 (25.4%)	47 (74.6%)	0.172	8 (12.7%)	55 (87.3%)	0.542*
	$>30$	11 (20.8%)	42 (79.2%)		11 (20.8%)	42 (79.2%)		8 (15.1%)	45 (84.9%)		4 (7.5%)	49 (92.5%)	
BMI (Kg/m <sup>2</sup> )	$\leq 25$	8 (16.0%)	42 (84.0%)	0.278	8 (16.0%)	42 (84.0%)	0.758	9 (18.0%)	41 (82.0%)	0.534	5 (10.0%)	45 (90.0%)	1.000*
	$>25$	16 (24.2%)	50 (75.8%)		12 (18.2%)	54 (81.8%)		15 (22.7%)	51 (77.3%)		7 (10.6%)	59 (89.4%)	
Hypertension	Yes	1 (3.6%)	27 (96.4%)	0.014*	8 (28.6%)	20 (71.4%)	0.068	5 (17.9%)	23 (82.1%)	0.793*	4 (14.3%)	24 (85.7%)	0.480*
	No	23 (26.1%)	65 (73.9%)		12 (13.6%)	76 (86.4%)		19 (21.6%)	69 (78.4%)		8 (9.1%)	80 (90.9%)	
Renal Disease	Yes	0 (0.0%)	5 (100.0%)	0.366*	2 (40.0%)	3 (60.0%)	0.205*	0 (0.0%)	5 (100.0%)	0.366*	0 (0.0%)	5 (100.0%)	0.656*
	No	24 (21.6%)	87 (78.4%)		18 (16.2%)	93 (83.8%)		24 (21.6%)	87 (78.4%)		12 (10.8%)	99 (89.2%)	

\*Fischer Exact Test

**DISCUSSION**

The present study investigated outcomes of fetus in 116 gestational diabetes mellitus cases, revealing significant information on prevalence and associations of neonatal undesirable complications. The general incidence of fetal impairments were high, with 20.7% of neonates being large for gestational age and 20.7% being admitted in NICU, and 17.2% of neonates having macrosomia and 10.3% having neonatal jaundice. The outcomes were in sync with the pathophysiological rationale of maternal hyperglycemia inducing fetal hyperinsulinemia with consequent increased fetal growth and metabolic disturbances. The incidence of large for gestational age and macrosomia was high on account of the Pedersen hypothesis of maternal glucose passing through placenta, inducing an impetus for insulin output and consequent fat deposition and organomegaly. The high admission rate of NICU can be attributed to higher surveillance and intervention requirements of neonates born of diabetic mothers due to hypoglycemia, respiratory distress, and metabolic instability. Neonatal jaundice, being less common, is the result of polycythemia secondary to chronic intrauterine hypoxia and delayed enzymatic development of the liver in these neonates. Intriguingly, the study showed an unexpected finding of hypertensive mothers having very smaller numbers of babies large for gestational age as compared to normotensives, explainable through placental sufficiency with hypertension causing intrauterine growth restriction overriding diabetic effect of promoting growth. The non-existence of associations of maternal age, BMI with fetomaternal outcomes points towards glycemic control and management of diabetes as possibly overriding demographic predictors of fetomaternal outcomes.

Our study results demonstrate both concordance and variance with existing literature on gestational diabetes

mellitus outcomes. The mean maternal age in our cohort ( $29.99 \pm 4.70$  years) closely aligns with Akhter & Karim<sup>11</sup> (29.5 years) and Kumar V, et al.<sup>12</sup> ( $28 \pm 4.4$  years), while being slightly younger than Qadir SY, et al.<sup>13</sup> (32.3 years) and Jani SK, et al.<sup>14</sup> (31.5 years). This consistency across different populations suggests that GDM commonly affects women in their late twenties to early thirties, reflecting the peak reproductive years when metabolic stress is most likely to unmask glucose intolerance. The macrosomia rate in our study (17.20%) was substantially lower than reported in several comparative studies. Qadir SY, et al.<sup>13</sup> and Katke RD, et al.<sup>15</sup> both reported macrosomia rates of 36%, while Jani SK, et al.<sup>14</sup> found 10.5% macrosomia ( $>4$ kg) with an additional 18.2% of infants weighing  $>4$ kg, collectively suggesting higher rates of fetal overgrowth. This discrepancy may reflect differences in diagnostic criteria for macrosomia, with some studies using  $>4$ kg while others use  $>3.5$ kg cutoffs, as well as variations in glycemic control achieved through different management protocols. Our lower macrosomia rate might indicate better glucose management or earlier intervention in our population.

Large for gestational age occurred in 20.70% of our cases, which, while not directly comparable due to different reporting metrics in other studies, appears consistent with the overall pattern of fetal overgrowth complications. Phalle & Gokhale<sup>16</sup> reported that Mediterranean diet intervention reduced LGA rates from 3.9% to 0.8%, suggesting that dietary modifications can significantly impact fetal growth patterns. The variation in LGA rates across studies likely reflects differences in maternal glycemic control, adherence to treatment protocols, and timing of intervention initiation. Neonatal jaundice affected 10.30% of infants in our cohort, which was considerably lower than the 18% reported by Qadir SY, et al.<sup>13</sup> and the 31.5% hyperbilirubinemia rate found by

Akhter & Karim.<sup>11</sup> This substantial difference may be attributed to variations in neonatal care protocols, timing of delivery, or maternal glucose control during the peripartum period. Interestingly, Phalle & Gokhale<sup>16</sup> noted that Ramadan fasting increased neonatal hyperbilirubinemia to 22.8%, highlighting how maternal dietary patterns can influence neonatal outcomes. NICU admission rates in our study (20.70%) were comparable to Kumar V, et al.<sup>12</sup> who reported 18% NICU admissions, suggesting consistency in the need for specialized neonatal care across different populations with GDM. This similarity indicates that despite variations in specific complications, the overall burden of neonatal morbidity requiring intensive care remains relatively constant.

Our finding that maternal age showed no significant association with fetal outcomes contrasts with the general obstetric literature where advanced maternal age is typically associated with increased complications. However, this may reflect the fact that GDM itself represents a high-risk condition where additional maternal factors may have less discriminatory power. The lack of significant association between BMI categories and fetal outcomes in our study differs from Kumar V, et al.<sup>12</sup> who found higher BMI (28.8 vs 25 kg/m<sup>2</sup>) in their GDM cohort, suggesting that pre-pregnancy BMI may be more predictive than BMI at delivery. The significantly lower rate of large for gestational age in hypertensive mothers (3.6% versus 26.1%,  $p=0.014$ ) in our study presents an interesting paradox, as hypertension typically compounds the risks associated with GDM. This unexpected finding might be explained by more intensive monitoring and tighter glycemic control in mothers with comorbid hypertension, or by the growth-restricting effects of hypertensive disorders counteracting the growth-promoting effects of hyperglycemia. This contrasts with other studies where hypertensive disorders generally amplified adverse outcomes.

These findings emphasize the multifaceted interplay of maternal metabolic condition with fetal growth in gestational diabetes mellitus and advocate individualized management approaches that consider numerous maternal risk variables simultaneously. The pathophysiologic mechanisms of these findings emphasize the overriding importance of optimal glycemia care during all of pregnancy, given that controlled gestational diabetes remains capable of causing severe fetal morbidity. The

unexpected protection afforded by maternal hypertension on macrosomia is in need of further research and may guide accounts of the double burden of cardiovascular and metabolic disease during pregnancy. Prospective research would be desirable in ascertaining modifiable risk variables and informing focused interventions capable of reducing the enormous burden of adverse fetal outcomes within the high-risk group, particularly with consideration of the rising global prevalence of gestational diabetes mellitus.

A number of limitations must be noted in the interpretation of these results. It was a single-center study conducted in a single institution, and it may limit generalizability of findings to other populations and health care settings with diverse patient populations, management approaches, and availability of resources. The relatively small sample size, more importantly for some of the subgroups such as mothers with renal disease ( $n=5$ ), may have decreased statistical power in identifying important associations and increased the likelihood of type II error. The cross-sectional study design prevented consideration of time-related associations and causality between maternal variables and fetal outcomes. Additionally, relevant confounding variables such as glycemic control variables, timing of diagnosis, modality of treatment, maternal compliance with medical and dietary interventions, and duration of exposure to diabetes were not controlled for in the analysis and may have had an impact on the associations and outcomes noticed.

## CONCLUSION

Our study concluded that gestational diabetes mellitus is not only present with high frequencies of undesirable fetal outcomes, but large for gestational age, macrosomia, and NICU admission were the most prevalent of these problems among affected pregnancies. The study indicated that maternal hypertension had a highly significant protective association with large for gestational age neonates, while other maternal variables like age, BMI, and kidney disease had no statistically significant associations with fetal outcomes.

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