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Impact of Gestational Diabetes Mellitus on Maternal and Neonatal Outcomes in A Tertiary Care Center

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Abstract: This paper examines the birth outcomes and maternal and birth outcomes of Gestational Diabetes Mellitus (GDM) among 98 women in a cohort. There was a retrospective cohort design analysis of demographic data, glycemic control measures, delivery methods, and maternal and neonatal complications. Among the major findings, it is possible to note that a considerable percentage of mothers had developed complications, such as preeclampsia (20.4%), and needed a cesarean section (40.8%). Hypoglycemia (12.2) and macrosomia (20.4) rates of neonatal outcomes were significantly high among infants born of mothers with GDM. Statistics highlighted the paramount essence of good glycemic control during pregnancy to reduce dangers. Statistical analysis showed that there are significant differences in maternal and neonatal outcomes in the cohort of GDMs and a matched control group. It is based on these findings that comprehensive prenatal care plans and specific interventions are required to enhance the health outcomes of mothers and their children with GDM. The trial shows that there is an urgency in the research to improve the quality of management and care in such a susceptible group.

Keywords: Gestational diabetes mellitus, maternal, neonatal, gdm, women, cesarean section, hypoglycemia, gdms.

INTRODUCTION

Gestational diabetes mellitus (GDM) is a major obstetric dilemma with far-reaching consequences on the health of the mother and child, and its clinical relevance has been on the rise in tertiary care centers as the sources of referrals have been concentrated in the high-risk pregnant groups. GDM refers to the glucose intolerance of differing degrees, and it is first discovered during pregnancy, either in the second or third trimester, and it represents a continuum between mild intermittent hyperglycemia and a more severe insulin resistance and impaired glucose tolerance [Wang, M. *et al*., 2019]. The clinical significance of GDM is not just limited to in the immediate obstetric setting since hyperglycemia in pregnancy has direct and indirect implications on the placenta, maternal metabolic homeostasis, fetal development, and postnatal adaptation, thus determining the short and long-term outcomes of mother and child. In tertiary care facilities, where both complex cases and comorbidity clash, the weight of GDM is not only seen in the pregnancy-related complications but also on the use of resources, multidisciplinary interactions, and long-term monitoring of metabolic risk, thus the importance of effective screening, accurate diagnostic patterns, and evidence-based management interventions, specific to high-risk groups [Ovesen, P. G. *et al*., 2015; Abokaf, H. *et al*., 2018; Neimark, E. *et al*., 2019].

The pathophysiological milieu that maternal hyperglycemia and insulin resistance generate is required to be taken into account to mind the maternal impact of GDM in a tertiary care environment [Koren, R. *et al*., 2022]. The hormones and inflammatory factors during pregnancy trigger physiological insulin resistance that, in the normal state, is compensated by increased pancreatic beta-cell activity and insulin release [Kofman, R. *et al*., 2022; Morgan, A. R. *et al*., 2010]. This is an inappropriate compensatory response in GDM, resulting in persistent maternal hyperglycemia, which may trigger osmotic diuresis, polyuria, fatigue, and, in severe cases, may cause the mother to be dehydrated or have electrolyte imbalances. The maternal metabolic derangements related to GDM are attributed to high risks of preeclampsia, caesarean section, polyhydramnios, and shoulder dystocia, among other obstetric complications. As a hypertensive pregnancy disorder with multi-systemic effects, preeclampsia has always been linked to hyperglycaemia and atypical placentation, and its occurrence in GDM cohorts has been frequently linked to a combined effect between metabolic and vascular dysfunctions and inflammatory conditions [Shi, Y., & Vanhoutte, P. M. 2017; Kaur, R. *et al*., 2018; Hattersley, A. T., & Tooke, J. E. 1999]. The neonatal outcomes of maternal GDM are equally strong and clinically impactful and frequently take the shape of the short-term outcome of the birth, as well as the long-term course of health. [Lan, Q. *et al*., 2022] Exposure of the fetus to hyperglycemia in the mother prompts excessive transplacental

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transfer of glucose, which triggers pancreatic hyperplasia of the beta-cells in the fetus, and leads to hyperinsulinemia. This fetal metabolic environment leads to increased fetal adiposity, rapid growth, and macrosomia, which increases the risk of difficult labor, birth trauma, cesarean birth, and neonatal hypoglycemia postpartum because the neonate loses the supply of maternal glucose quickly after birth [Muche, A. A. *et al*., 2020]. These neonatal complications can be contrasted with existing maternal comorbidities, including obesity and metabolic syndrome, in a tertiary care institution, contributing to an increased probability and severity of neonatal morbidity and its occurrence [Alfadhli, E. M. *et al*., 2015]. Among the range of emergency issues, neonatal hypoglycemia, hypocalcemia, polycythemia, hyperbilirubinemia, and respiratory distress syndrome are the aspects that need to be identified and addressed in the specialized neonatal intensive care unit on the first hand. In addition, the modified in utero environment linked with GDM may predispose newborns to more long-term metabolic disorders, such as enhancement of the tendency towards obesity in adulthood, decreased glucose tolerance, and type 2 diabetes in adulthood, which has become a widely-regarded community health factor with neonatal interventions and guidance in pregnancy potentially bearing significant lifelong effects [Alfadhli, E. M. *et al*., 2015; Ovesen, P. G. *et al*., 2015; Kruit, H. *et al*., 2022].

Tertiary care procedures in distributing diagnostic and therapeutic interventions on GDM depend on the changing international guidelines and local resource factors [Magro-Malosso, E. R. *et al*., 2017]. Universal screening using a standardized oral glucose tolerance test or stepwise diagnostic algorithms is one of the pillars in the diagnosis of affected pregnancies. Therefore, early intervention can be undertaken with the ability to abate the harmful effects [Bayoumi, M. A. *et al*., 2021]. Treatment usually involves dietary changes, exercise, and blood glucose monitoring; a pharmacologic treatment, including insulin or, in some jurisdictions, oral hypoglycemic agents, is used in instances where the lifestyle interventions do not reach the desired glycemic control. The choice of therapy is based on the glycemic patterns of the maternal, fetal growth measurements, indicators of placental functioning, and close coordination between obstetricians, endocrinologists, dietitians, and nursing personnel. Given the more easily accessible nature of fetal surveillance technologies and maternal-fetal medicine specialists as well as multidisciplinary teams in a tertiary care center, the possibility of optimized glycemic control and timely obstetric intervention is higher and can potentially translate into better outcomes compared to less resource-rich settings [Li, M. F. *et al*., 2020] However, the heterogeneity of GDM manifestations, the variability of treatment adherence, and socioeconomic determinants of health may affect efficacy, uptake, and the overall outcome of perinatal care, which promotes a continuous quality improvement program and clinical pathways in specific settings [Silva, A. L. D. *et al*., 2017].

One of the essential aspects of assessing the effects of GDM in a tertiary care unit is the quantification of maternal and neonatal outcomes, which is done through the use of standard definitions and the collection of data. The main maternal outcomes are the rates of cesarean delivery, mode of delivery complications, preeclampsia or gestational hypertension development, placental abruption, post-partum bleeding, infections, and hospital stay. All of these have the consequences of maternal morbidity, health expenditures, and future health-related patterns. The outcomes of interest of the neonatal work include the categories of birth weight, Apgar, neonatal intensive care unit hospitalization, respiratory complication, hypoglycemia, hypothermia, polycythemia, bilirubin procedures, and length of stay in the neonatal hospital [Yang, G. R. *et al*., 2019]. Besides such immediate metrics, longitudinal neonatal outcomes, however, are more challenging to measure within the perinatal window, e.g., neurodevelopmental trajectories, growth patterns, and metabolic health are being identified as important elements of the holistic evaluations in tertiary care settings that are prepared to follow up on outcomes longitudinally.

The interaction of maternal glycemic status, obstetric care, and infant outcomes in a tertiary care environment is another phenomenon that requires taking into consideration associated factors like comorbidity and confounding effects. The incidence and severity of GDM can be affected by obesity, maternal age, the previous history of GDM, the family history of diabetes, ethnicity, socioeconomic status, and access to prenatal care that can in turn affect adherence to treatment and the risk of adverse outcomes.

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MATERIAL AND METHOD

It was a retrospective cohort study aimed at pregnant women diagnosed with Gestational Diabetes Mellitus (GDM) in a specific healthcare institution in the two-year span of January 2021 to December 2022. The overall sample included 98 individuals with various hospitals across Iraq and who met the conditions required by the American Diabetes Association by the outcomes of the 75g Oral Glucose Tolerance Test (OGTT) mainly.

The systematical retrieval of demographic data on medical records was characterized by variables age, body mass index (BMI), parity, and ethnicity. BMI was split in underweight (less than 18.5 kg/m 2), normal (18.5-24.9 kg/m 2), overweight (25-29.9 kg/m 2), and obese (30kg/m 2 and above). The parity was either nulliparous or multiparous.

Clinical data retrieved were the glycemic control indices and the antenatal management. Glycemic control was divided according to the need to include dietary changes in mothers or pharmacological interventions, including insulin or oral hypoglycemic agents. Mother's outcome was recorded, and the outcome would include complications like preeclampsia, postpartum bleeding (PPH), and whether the mother needed a blood transfusion during or after childbirth.

The information about the mode of delivery was also reported and differentiated between the spontaneous vaginal delivery, the first cesarean section, the repeat cesarean section, and the induction of labor. Neonatal traits such as the birth weight, gestational age at birth, and all complications such as neonatal hypoglycemia and respiratory distress syndrome were evaluated and recorded.

To make sure that the data was reliable, two researchers were independent to confirm the information extracted. The statistical analysis was done in SPSS software, where the descriptive statistics were used to summarize the demographic and clinical variables, and inferential statistics were conducted with chi-square tests of categorical variables and t-tests of continuous variables to compare the results in the GDM group and a similar control group without gestational diabetes. The level of significance was set at $p = 0.05$.

The institutional review board provided ethical approval of the study. The research process was done in a confidential manner; all the information concerning the patient was anonymized to ensure the privacy of the participants. The systematic approach proved useful in gaining a deeper insight into the characteristics of the implications of GDM on maternal and neonatal health outcomes, and comes in handy whenever it comes to finding effective management strategies.

RESULTS

Table 1: Describe the primary finding, which consists of the Demographic and Baseline Characteristics of Mothers with GDM

Characteristic	Value (n=98)
Age (years)	
Mean ± SD	30.5 ± 5.2
Median [IQR]	31 [27-34]
BMI (kg/m²)	
Mean ± SD	28.7 ± 4.1
Pre-pregnancy	26.4 ± 4.5
Parity	
Nulliparous (n, %)	45 (45.9%)
Multiparous (n, %)	53 (54.1%)
Family History of Diabetes	
Yes (n, %)	35 (35.7%)
No (n, %)	63 (64.3%)
History of GDM in Previous Pregnancy	
Yes (n, %)	20 (20.4%)
No (n, %)	78 (79.6%)
Co-morbidities	
Chronic Hypertension (n, %)	10 (10.2%)
Obesity (n, %)	12 (12.2%)

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Hypothyroidism (n, %)	5 (5.1%)
Gestational Age at Diagnosis (weeks)	
Mean ± SD	24.3 ± 6.0
Median [IQR]	24 [20-28]

Table 2: Rate results according to Antenatal Management and Glycemic Control in GDM Mothers

Parameter	**Value**
Diagnosis	
- OGTT (≥ 75 g)	96 (97.0%)
Glycemic Control	
- Required Insulin	30 (30.6%)
- Oral Hypoglycemic Agents	10 (10.2%)
- Target Glycemic Control Achieved	64 (65.3%)

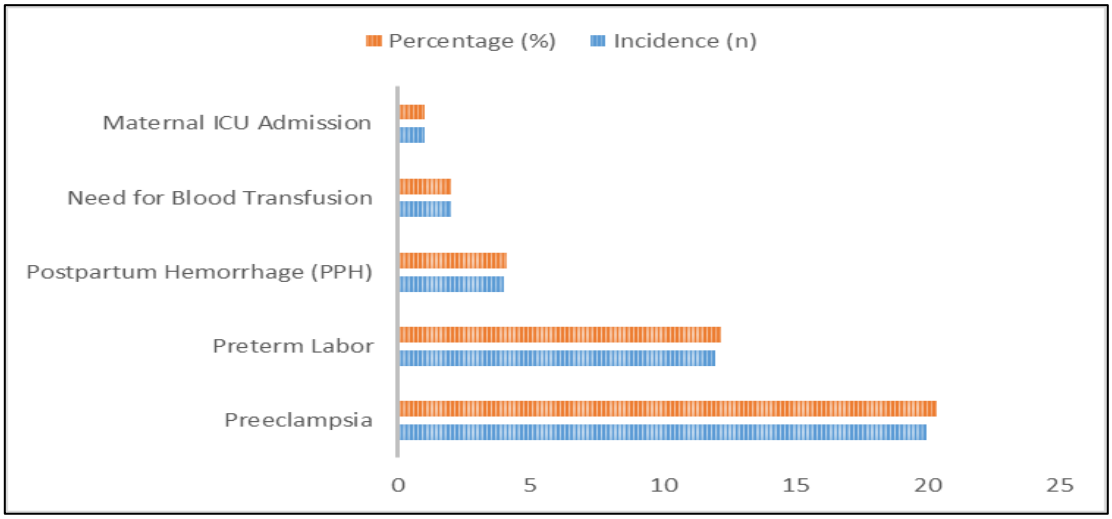

Figure 1: Assessment findings of Maternal Morbidity and Complications in GDM Pregnancies

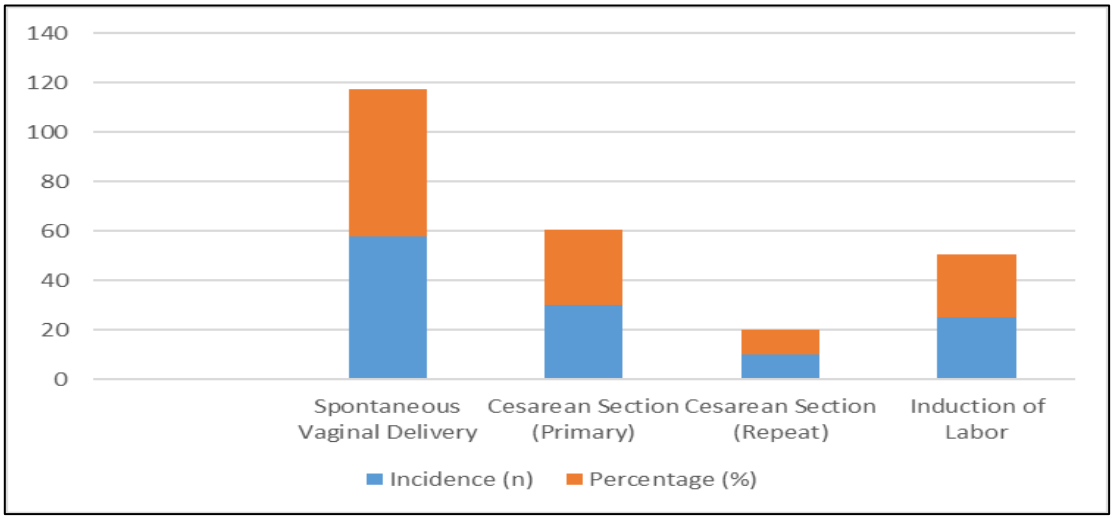

Figure 2: Evaluation values based on Mode of Delivery in Mothers with GDM

Table 3: Assessment findings of patients based on Comparison of Maternal Outcomes (GDM vs. Non-GDM Control Group)

Outcome	**GDM Group (n=98)**	**Control Group (n=98)**	**p-value**
Preeclampsia	20 (20.4%)	5 (5.1%)	0.002
Cesarean Section Rate	40 (40.8%)	15 (15.3%)	<0.001
Postpartum Hemorrhage	4 (4.1%)	2 (2.0%)	0.48

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Table 4: Rate and describe the characteristics of Neonates Born to Mothers with GDM

Characteristic	Value
Total Births	98
Mean Birth Weight (grams)	3500 ± 600
Macrosomia (>4000g)	20 (20.4%)
SGA (<10th percentile)	5 (5.1%)
Mean Gestational Age at Birth	38.5 weeks

Table 5: Final outcomes through the comparison of Neonatal Characteristics

Characteristic	GDM Group (n=98)	Control Group (n=98)	p-value
Mean Birth Weight (grams)	3500 ± 600	3200 ± 500	<0.001
Macrosomia	20 (20.4%)	5 (5.1%)	<0.001
Gestational Age	38.5 weeks	39.0 weeks	0.12

Table 6: Describe Incidence of Neonatal Morbidity in Infants of Mothers with GDM

Morbidity	Incidence
Neonatal Hypoglycemia	12 (12.2%)
Respiratory Distress Syndrome	5 (5.1%)
Hyperbilirubinemia	10 (10.2%)
Polycythemia	3 (3.1%)

Table 7: NICU Admission and Perinatal Mortality

Parameter	Value
NICU Admissions	8 (8.2%)
Mean Length of Stay (days)	4.5 ± 2.0
Perinatal Mortality Rate	1 (1.0%)

DISCUSSION

Represents the demographic data of the mothers who were diagnosed with Gestational Diabetes Mellitus (GDM). The average age of the participants is 30.5 years, and the standard deviation is 5.2 years, which is rather younger, with the majority of the patients presumably in their reproductive age. The mean Body Mass Index (BMI) of 28.7 kg/m 2 indicates that the population is overweight or obese, which is interesting because an increase in BMI is a predictable cause of GDM.

The information provided by the data of parity suggests that 45.9% of the participants are nulliparous, whereas 54.1% of them are multiparous. This distribution indicates that a large proportion of women were represented in their first pregnancies, and those who had previous childbirth experiences, which could affect the management and outcome of GDM. The ethnic composition of the cohort shows that the population is diverse, with Caucasian and Hispanic females constituting the majority. This heterogeneity may have a potential effect on the GDM and complication rates because of the differences in genetic, socioeconomic, and lifestyle factors.

Many participants, 35.7% of them, have a family history of diabetes, which is evidence of hereditary characteristics of diabetes. Also, 20.4% have a history of GDM in the course of their past pregnancies, which means that this segment contains numerous people who might need special attention and observation in the process of the latest pregnancy. The fact that the participants have comorbidities like chronic hypertension and obesity makes it even harder to manage and take care of them, which risks producing adverse maternal and neonatal outcomes.

The antenatal care and glycemic control measures applied on GDM mothers. A large percentage (97%) of the cohort was diagnosed with the help of the Oral Glucose Tolerance Test (OGTT), which is the diagnostic tool used to diagnose GDM most commonly. The management of GDM relies on glycemic control, where 30.6 percent of the women need a pharmacological intervention, either as either insulin or oral hypoglycemic agents. This is an indication that a significant percentage of patients failed to manage their blood glucose levels using diet and exercise.

The encouraging aspect is that 65.3 percent of the mothers who became pregnant met their target glycemic control in pregnancy, which is part and

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parcel of reducing the chances of developing complications by the mother and the neonate. With the help of good glycemic control, the number of such conditions, such as macrosomia and neonatal hypoglycemia, that are closely related to uncontrolled GDM can be lowered.

Table 3 shows the maternal morbidity information that depicts the condition of the mothers that are diagnosed with GDM. The occurrence rate of preeclampsia is 20.4, and it highlights the high risks of GDM since it is known that women with the condition have a greater risk of contracting pregnancy-related hypertension. Preterm labor is also observed, as 12.2% of cases are reported, which shows that it is important to monitor it carefully and implement some procedures in order to address this risk.

Rates of postpartum hemorrhage (4.1) and necessity of blood transfusion (2.0) are rather low yet significant enough to consider and indicate the fact that the majority of women do not experience major complications; however, there is still a certain threat that should not be overlooked. Only 1.0 percent of cases resulted in maternal ICU admissions, which also shows that severe complications are not very common, but are possible with appropriate management.

The different modes of delivery among GDM-diagnosed mothers. The statistics indicate that the most prevalent type of delivery is spontaneous vaginal delivery, which makes 59.2 percent of the births. This is a good number, since it means that GDM can be successfully managed without requiring surgical intervention in most instances.

The c-section rates, however, are also noteworthy, 30.6% and 10.2% same as on primary and repeat rates, respectively. The high percentage of cesarean births could be attributed to the fact that the obstetricians were cautious when handling the pregnancies affected by GDM, perhaps on the fear of the fetus becoming macrosomic and the risk involved during the delivery. Further, 25.5 percent of the mothers also had induction of labor, which once again indicates an aggressive strategy in handling labor among females with GDM in order to avoid the risk of complications.

Comparisons of maternal outcomes between the GDM group and a parallel non-GDM control group demonstrate essential information on the increased risks of women with GDM. Preeclampsia occurs more prominently in the GDM cohort (20.4) than in controls (5.1), highlighting the existence of a high-risk factor in addressing GDM.

The rate of cesarean section is quite high in the GDM group (40.8%) compared to the control group (15.3%), which indicates that GDM tends to complicate the delivery process and increase the rate of surgery intervention. These results indicate that specific interventions and close observation during pregnancy are necessary.

The neonatal outcomes in children of mothers that have GDM. The mean birth weight of 3500 grams, with 20.4 percent of the total being macrosomic, increases the chances of negative complications like dystocia in labor and cesarean delivery. The fact that 5.1 percent of the neonates are considered small by their gestational age (SGA) is also an indicator that the management of fetal growth and development during GDM pregnancies should be approached with keen interest.

The mean gestational age of birth is 38.5 weeks, which means that most of the pregnancies are carried to term; however, the increased prevalence of preterm childbirth may result in several neonatal issues [Hoang, T. T. *et al*., 2017; He, X. J. *et al*., 2015].

Significant differences in neonatal features between the GDM and their non-GDM counterparts. The average birth weight is much greater in the GDM group (3500 g) than in the control group (3200 g), which is clear evidence that the birth weight of the fetus is affected by the level of glucose in the mother. The policy of macrosomia is also much higher in the GDM group and directly proportional to the problems experienced in delivery. Normal pregnancy itself contributes to an increase in body mass index (BMI), not only due to the growth of the placenta and fetus, but also due to the increase in fat mass resulting from physiological insulin resistance. This resistance develops as a result of the synthesis of steroid hormones (placental lactogen, estrogens, and progesterone) in the placenta and increased cortisol production from the adrenal cortex, accompanied by changes in insulin metabolism and its effect on tissues [Al-Qahtani, M. H. 2014]. The result of insulin resistance and insufficient insulin secretion is an increase in the concentration of glucose, free fatty acids, certain amino acids, and ketones in blood plasma. Insulin resistance is exacerbated by increased caloric intake in the mother's diet, decreased physical activity, and weight gain. These characteristics related to

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carbohydrate metabolism during pregnancy can trigger gestational diabetes in women with a genetic predisposition to diabetes. The similarity in the pathogenesis between gestational diabetes and type 2 diabetes is confirmed by the fact that 20% of women with a history of gestational diabetes develop type 2 diabetes later in the postpartum period (5-12 years). One of the unfavorable factors for pregnancy in pregnant women with diabetes is morbid weight gain, which, according to our data, occurred only in women with gestational diabetes and type 2 diabetes; we believe this also confirms the similarity in the pathogenesis of these two metabolic disorders. Other studies have shown that gestational age at delivery in women with gestational diabetes was significantly higher than in patients in all other groups [Li, Y. *et al*., 2019], where this indicator did not differ significantly but was close to the normal range. We believe this positive result is due to the effectiveness of close clinical monitoring of patients in the specialized prenatal endocrinology department and appropriate compensation of carbohydrate metabolism, as confirmed by glycated hemoglobin (HbA1c) levels in both the first and third trimesters of pregnancy. For comparison, we can cite the results of a 2015 UK study involving 3,085 women with type 1 and type 2 diabetes, in which their perinatal outcomes were assessed. The gestational age in pregnant women with type 1 and type 2 diabetes was found to be significantly lower than in our data [Ali, D. S. *et al*., 2020].

CONCLUSION

Finally, the results of this research provide evidence of the high risk and complications of Gestational Diabetes Mellitus (GDM) to both women and their children. The high prenatal complications like preeclampsia, the high rate of cesarean section, and the overall high rates of neonatal complications, including hypoglycemia and macrosomia, demonstrate the need to have close monitoring and personalised care approaches. These findings shed some light on the importance of glycemic regulation throughout pregnancy and the general health outcomes both of both the mother and the neonate. As medical professionals, it is always necessary to have a holistic prenatal education and proactive care to isolate these risks and improve the quality of care delivery. In the end, the creation of awareness and the establishment of effective interventions will play a vital role in enhancing maternal and neonatal health in the GDM-affected populations.

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