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# Perinatal and maternal outcomes of gestational diabetes mellitus in a tertiary hospital

Effect of gestational diabetes mellitus

Abdurrahman Mert[1] Ümmügülsüm Esenkaya[2]

[1]Department of Obstetrics and Gynecology, Aksaray Training and Research Hospital, Aksaray, Türkiye.
[2]Department of Obstetrics and Gynecology, Konya City Hospital, Konya, Türkiye.

## Abstract

**Aim:** This study examines the perinatal and maternal outcomes in pregnant women diagnosed with gestational diabetes mellitus and their newborns.

**Methods:** Our study is a retrospective cohort study. A total of 330 pregnant women underwent an oral glucose tolerance test (OGTT). Two groups were evaluated: the group diagnosed with gestational diabetes mellitus (GDM) after a 75-gram OGTT, comprising 165 pregnant women, and the healthy group with normal test results, also comprising 165 pregnant women. Demographic findings, maternal chronic diseases, delivery methods, and neonatal outcomes were compared between the GDM and control groups. The risk factors of GDM and maternal-fetal outcomes were compared.

**Results:** In the group diagnosed with GDM, multiparity and advanced age were found to be significant risk factors. In the GDM group, the treatment for women with a history of GDM was mostly insulin, while diet and exercise were more commonly used in women without a history of GDM. Maternal complications were more frequently observed in the GDM group. The number of newborns admitted to the neonatal intensive care unit was lower in the control group.

**Conclusion:** As a result of our study, fetal-maternal complications and neonatal intensive care outcomes were found to be higher in GDM. Gestational diabetes mellitus is the most common maternal complication during pregnancy, and its fetal-maternal effects are preventable, making its diagnosis and treatment highly important.

## Keywords

gestational diabetes mellitus, insulin, neonatal intensive care

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**Corresponding Author:** Abdurrahman Mert, Department of Obstetrics and Gynecology, Aksaray Training and Research Hospital, Aksaray, Türkiye.
**Email:** abdurrrrrahman@gmail.com **P.:** +90 539 716 30 32
**Corresponding Author ORCID:** https://orcid.org/0009-0008-1299-0407
**Other Authors ORCID:** Ümmügülsüm Esenkaya, https://orcid.org/0000-0002-7347-2557

## Introduction

Gestational diabetes mellitus (GDM) is characterized by glucose intolerance that develops during pregnancy, impaired pancreatic beta-cell function, and increased insulin resistance. GDM is a common metabolic disorder affecting 14% of pregnancies worldwide and is first diagnosed during pregnancy in women without a history of diabetes.[1] In 2025, the International Diabetes Federation (IDF) reported that 19.7% of babies born to women aged 20-49 were affected by GDM.[2] GDM is associated with both short- and long-term adverse outcomes, including preeclampsia, gestational hypertension, cesarean delivery, preterm birth, macrosomia, neonatal hypoglycemia, and hyperbilirubinemia.[3] In addition to adverse outcomes during pregnancy and childbirth, women with GDM are estimated to be about 8 times more likely to develop type 2 diabetes compared to women who did not have GDM.[4]

The World Health Organization (WHO) and the American Diabetes Association (ADA) recommend screening for fasting plasma glucose or performing a 75 g oral glucose tolerance test (OGTT) between the 24th and 28th weeks of pregnancy.[3] Various diagnostic methods have been used worldwide, contributing to the reported differences in prevalence. According to the IDF 2024 data, the global prevalence of GDM ranges from 2% to 37.6% across continents and countries.[5]

GDM, despite showing negative outcomes for both mother and newborn during and after pregnancy, has, unfortunately, in recent years, led to a challenge to the OGTT, the GDM diagnostic test, in Turkey. The increasing socio-cultural resistance to the OGTT stems largely from misinformation and negative media coverage, which fuel it. According to 2024 IDF data, the prevalence of GDM in Turkey is 10%.[6,7] This ratio brings to mind the possibility that not all pregnant women undergo the OGTT test.

Although there is extensive literature on GDM complications, very few studies have addressed the impact of screening resistance on timely diagnosis and maternal-fetal outcomes.[6] This gap highlights the need to evaluate the results of groups suitable for the OGTT, in which the effects of timely diagnosis and treatment can be observed more accurately. Therefore, the current study aimed to evaluate maternal and neonatal outcomes among women with GDM, compare these findings with the international literature, and highlight the clinical and public health importance of strengthening adherence to screening protocols.

## Materials and Methods

Our study is a retrospective cohort study conducted among 330 pregnant women who presented to a tertiary hospital between January 2021 and January 2023. This study was conducted among pregnant women who agreed to undergo a 75-gram OGTT between 24 and 28 weeks of gestation and who gave birth at the same hospital. 165 pregnant women diagnosed with GDM, and the control group consisted of 165 women with negative OGTT results. These two groups were compared in terms of pregnancy complications, gestational age at delivery, delivery method, birth weight, and neonatal outcomes.

A blood glucose level at least 1 point above the ADA reference range, or above the specified values at 0, 1, or 2 hours, was used to diagnose GDM.

Those excluded from the study were: early 18 and over 45 years old, chronic diseases (type 1 and type 2 diabetes, chronic hypertension, autoimmune diseases), multiple pregnancies, and a history of previous cesarean section.

Power analysis was performed with a margin of error of 0.05, a confidence level of 0.95, and an effect size of 0.55. The minimum statistical power required to detect a difference of 3 units was met at 80%, and the study was conducted with an adequate sample size. Power analysis was performed using the GPower 3.1 program. A total sample size of 102, with a minimum of 51 in each group, is sufficient and reflects the total eligible population within the defined time frame.

### *Ethical Approval*

This study was approved by the Ethics Committee of the University of Hamidiye Faculty of Health Science (Date: 06.09.2023, Decision No: 21161).

### *Statistical Analysis*

IBM SPSS 27 software was used for data analysis in the study. Continuous data were presented as mean ± standard deviation, while categorical data were presented as frequency and percentage. For comparisons of categorical variables between groups, Pearson's chi-square test was used for 2 x 2 and R x C tables when the expected count was 5 or greater, or when the proportion of cells with expected counts less than 5 did not exceed 20%. Fisher's exact test was used for 2 x 2 tables in which the proportion of cells with expected counts less than 5 exceeded 20%, and the Fisher-Freeman-Halton test was used for R x C tables. To compare continuous variables between groups, the independent-samples t-test was used for normally distributed variables, and the Mann-Whitney U test for non-normally distributed variables. Statistical significance was accepted as $P < .05$ for all analyses.

### *Reporting Guidelines*

This study was reported in accordance with the STROBE guidelines.

## Results

The demographic and obstetric findings of the pregnant women

**Table 1.** Demographic and Obstetric Findings (*N* = 330)

| | | Control group (*N* = 165) | GDM group (*N* = 165) | *t/Z* | *P** |
|---|---|---|---|---|---|
| Age | x ± SS | 26.28 ± 5.17 | 29.37 ± 5.91 | -5.057 | < .001 |
| Gravida | x ± SS | 2.27 ± 1.47 | 2.67 ± 1.59 | -2.379 | .018 |
| Parity | x ± SS | 0.97 ± 1.18 | 1.37 ± 1.34 | -2.876 | .004 |
| Delivery | Vaginal delivery | 121 (73.3) | 111 (67.3) | 1.451 | .228 |
| | Cesarean | 44 (26.7) | 54 (32.7) | | |
| History of GDM | Yes | 0 (0.0) | 7 (4.2) | -[a] | .015 |
| | No | 165 (100.0) | 158 (95.8) | | |

**Independent samples t-test; aMann-Whitney U test, BMI, Body Mass Indeks; GDM, Gestational Diabetes Mellitus*

**Table 2.** The Distribution of Neonatal Complications of Participants by Group

| | | Control group (*n* = 19) | GDM group (*n* = 27) | $X^2$ | *P** |
|---|---|---|---|---|---|
| | | *n* (%)[a] | | | |
| Neonatal complication | Hypotonic infant | 1 (5.3) | 2 (7.4) | 8.509 | .187 |
| | Intrauterine growth restriction (IUGR) | 0 (0.0) | 1 (3.7) | | |
| | Cardiac | 1 (5.3) | 6 (22.2) | | |
| | Conjunctivitis | 1 (5.3) | 1 (3.7) | | |
| | Neural tube defect (NTD) | 0 (0.0) | 1 (3.7) | | |
| | Respiratory distress | 2 (10.5) | 2 (7.4) | | |
| | Neonatal jaundice | 14 (73.7) | 14 (51.9) | | |

**Fisher Freeman Halton testi, aColumn percentage*

**Table 3.** GDM Treatment Methods and GDM History (*n* = 165)

| | | History of GDM Yes (*n* = 7) | History of GDM None (*n* = 158) | $X^2$ | *P** |
|---|---|---|---|---|---|
| | | *n* (%)[a] | | | |
| GDM treatment method | Diet and exercise | 1 (14.3) | 134 (84.8) | - | < .001 |
| | Insulin | 6 (85.7) | 24 (15.2) | | |

**Fisher Exact testi, aColumn percentage*

are presented in Table 1. The average age of the GDM group was significantly higher than that of the control group (29.37 ± 5.91 versus 26.28 ± 5.17, *P* < .001). Pregnancy (2.67 vs. 2.27, *P* = .018) and the number of deliveries (1.37 vs. 0.97, *P* = .004) were also significantly higher and statistically significant in the GDM group compared to the control group. Mother's advanced age and having had many births are associated with an increased risk of GDM. No significant differences were observed between the groups in body mass index (BMI) or history of low weight. Although the rate of preterm birth was higher in the GDM group (6.1% versus 3.6%), it was not statistically significant. (*P* = .445). Similarly, although the cesarean section rate was higher in the GDM group (32.7% vs. 26.7%), it was not statistically significant. (*P* = .228). A history of GDM is more common in the GDM group. (4.2%, *P* = .015). This indicates that a history of GDM is a significant risk factor.

Among newborns, birth weight in the control group was 3374.13 ± 438.27 g and in the GDM group was 3398.02 ± 521.06 g, with no statistically significant difference (*P* = .68). Apgar score 1st minute: No significant difference was observed between the groups, while Apgar score 5th minute was close to the significance level, but no statistical difference was observed.

The frequency and types of neonatal complications in the GDM and control groups are summarized in Table 2.

Neonatal complications were observed in 46 newborns. Although 27 of these were from the GDM group and 19 from the control group, the difference was not statistically significant. (*P* = .187). The most common complication in both groups was neonatal jaundice (73.7% in the control group versus 51.9% in the GDM group). Cardiac complications were more frequent in the GDM group compared to the control group (22.2% vs. 5.3%, respectively). Hypotonia, conjunctivitis, respiratory distress, neural tube defects, and other complications were observed at low rates in both groups.

In the GDM group, women with a history of GDM were significantly more likely to require insulin treatment compared to those without such a history (85.7% vs. 15.2%, *P* < .001). In contrast, it was predominantly used in women without GDM in their dietary and exercise history (84.8%) (Table 3).

The detailed data are provided in Supplementary Table 1.

## Discussion

Our study has yielded multifaceted results regarding maternal, fetal, neonatal, and treatment aspects. The results obtained have been evaluated against the literature.

### *Maternal Results and Risk Factors*

In our study, the average age of women with GDM was found to be higher than that of women without GDM. Advanced maternal age has also been identified as a significant risk factor in studies from France, Portugal, and Palau.[7-9] Advanced maternal age is associated with a decrease in beta-cell function, which plays a role in impaired glucose tolerance during pregnancy, and an increase in insulin resistance. Therefore, the risk of GDM increases as gestational age advances. The frequency of GDM was significantly higher among women who had given birth more than once in our study. This also supports the evidence from Canada and Saudi Arabia that the number of births increases the risk of GDM.[10,11] The underlying mechanisms of insulin resistance associated with parity in pregnancy are largely unknown, complex, and likely reflect a variety of factors such as placental hormones, lifestyle changes, and genetic and epigenetic contributions.[12]

In multiparous women, the increase in the GDM ratio appears to correlate with increasing body weight and age.[13,14]

Additionally, a history of GDM was more common in the GDM group. Although there was no statistically significant difference in our study, cesarean delivery was more common in the GDM group (32.7% vs. 26.7%) compared to the control group (*P* = .228). This rate was lower than those reported in India, Portugal, and Palau, but closer to the French cohort.[7-9,15] Different outcomes in cesarean rates may stem from variations in country-specific obstetric practices, beyond obstetric history. While cesarean sections are

performed more frequently in some healthcare systems, other countries encourage vaginal birth. This situation also reveals that cesarean rates vary widely among countries worldwide. GDM primarily increases the risk of cesarean section by causing fetal macrosomia. Maternal hyperglycemia leads to a predisposition to dystocia and birth trauma. It should not be forgotten that timely GDM diagnosis and effective treatment reduce these potential risks that can develop secondary to hyperglycemia.

*Neonatal Outcomes*

Although GDM is more frequently observed in the GDM group in the literature on its association with preterm birth, statistical significance was observed only in the study by Kumari et al.[8,10,11,15] The lower rates observed in our cohort compared to some studies may explain part of the differences in the risk of preterm birth, including the number of pregnant women included in the studies, differences in inclusion criteria, and fundamental differences in maternal obesity, hypertension, and other comorbidities between populations. The low rate of preterm birth in our area may be associated with closer prenatal monitoring and earlier intervention. Maternal hyperglycemia can alter placental function by increasing the release of inflammatory cytokines, which can trigger premature birth.

Looking at neonatal outcomes, although there was no statistically significant difference between the groups, neonatal complications were more frequent in the GDM group. The most common complication in both groups was neonatal jaundice, consistent with reports from Portugal and India.[7,15]

Hyperbilirubinemia in infants of diabetic mothers; Maternal hyperglycemia → fetal hyperglycemia/hyperinsulinemia; relative hypoxia develops with increased oxygen consumption and/or placental restriction. This leads to polycythemia; as the erythrocyte mass increases, bilirubin production after hemolysis increases.[16]

After hyperbilirubinemia, cardiac anomalies are the second most common issue in the GDM group. This observation is supported by evidence that fetal hyperinsulinemia has anabolic effects on the myocardium, leading to septal hypertrophy and structural abnormalities. On the other hand, the picture is a bit different regarding structural (congenital) heart anomalies: The increased risk is particularly evident in pre-gestational diabetes, and the mechanism is more closely linked to hyperglycemia during the early stages of organogenesis.[17]

Macrosomia was observed in 9% of our GDM cases, which is more than the studies reported (4.1%) in Palau.9 This rate showed no statistical difference between the groups compared to the non-GDM group. Average birth weights indicate that GDM increases fetal macrosomia in India and Sydney, whereas the Portuguese study did not show a statistically significant difference in macrosomia.[7,15,18] The different results in the literature may also be related to variations in the number of patients included in the studies, ethnic-genetic factors affecting fetal development, dietary habits, and maternal BMI values.

Although Ye, W. et al. reported increased neonatal admissions in GDM pregnancies in their meta-analysis, our neonatal admissions did not differ statistically despite significant differences between groups. Although this inconsistency is considered, given that the studies included in the meta-analysis span 30 years and 32.1% of the studies show a low or moderate risk of bias, the sample size of our study may also be a contributing factor. Additionally, differences in hospital admission policies across a wide range of countries and a very diverse patient population can affect admissions to the Neonatal Intensive Care Unit. While admission decisions can be made more easily in environments with higher neonatal intensive care unit capacity, only serious cases are accepted in environments with limited resources. This variability demonstrates how healthcare infrastructure affects reported neonatal outcomes.[17]

*Treatment Approaches*

In our study, 18% of women with GDM used insulin for blood sugar control; this rate is consistent with international reports, which range from 12% to 28%.[9,11,15,19] While insulin needs were observed at a much higher rate (85.7%) in women with a history of GDM, diet and exercise (84.8%) remained the primary management strategy in those without a history of GDM. These findings highlight the cumulative metabolic risk associated with a history of GDM and emphasize the importance of careful monitoring and timely initiation of medication in high-risk subgroups.

*Clinical and Public Health Impacts*

What is concerning in Turkey in recent years is the increasing socio-cultural resistance to the OGTT, which hinders timely diagnosis and management. Unlike in many Western countries with high screening compliance, misinformation and negative media coverage in Turkey have led to increased rejection rates.[6,20] These socio-cultural changes in recent years indicate an urgent need for public health interventions. As seen in our study, maternal and fetal risks in mothers with GDM who undergo selected, timely screening, follow-up, and treatment can be minimized.

## Limitations

Retrospective, being a single-center study. This situation prevents the study from reflecting the region and the country as a whole. Since women who refused the OGTT were not included in the study, this could underestimate the true frequency and potential outcomes of GDM in the population. Finally, long-term maternal and neonatal outcomes have not been evaluated, which has prevented conclusions from being drawn about the lasting effects of GDM on mothers and newborns.

## Conclusion

This study once again emphasizes the clinical importance of screening, follow-up, and treatment for GDM, particularly in communities where there is resistance to OGTT screening, for the health of both mother and fetus. Our findings indicate that prenatal care and timely treatment can significantly mitigate these adverse outcomes. Clinically, it is important to screen women with significant risk factors, such as advanced maternal age, multiple pregnancies, and a history of gestational diabetes, earlier. Because maternal and newborn health is a fundamental criterion for countries' health policies, OGTT is of critical importance from a public health perspective. A detailed discussion of resistance to OGTT is needed, including its causes and the necessary regulations to address them.

## Declarations

***Animal and Human Rights Statement***

*All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Declaration of Helsinki and its later amendments, or comparable ethical standards.*

***Informed Consent***

*The requirement for informed consent was waived by the Ethics Committee due to the retrospective nature of the study.*

### Data Availability

*The datasets used and/or analyzed during the current study are not publicly available due to patient privacy reasons, but are available from the corresponding author on reasonable request.*

### Conflict of Interest

*The authors declare no conflict of interest.*

### Funding

*None.*

### Author Contributions (CRediT Taxonomy)

*Conceptualization: A.M., Ü.E.*
*Methodology: A.M., Ü.E.*
*Formal analysis: Ü.E.*
*Investigation: A.M., Ü.E.*
*Data curation: A.M.*
*Writing – original draft: A.M.*
*Writing – review & editing: A.M., Ü.E.*
*Supervision: Ü.E.*

### AI Usage Disclosure

*The authors declare that no AI-assisted technologies were used.*

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### Abbreviations

*ADA: American diabetes association*
*BMI: Body mass index*
*GDM: Gestational diabetes mellitus*
*IDF: International diabetes federation*
*OGTT: Oral glucose tolerance test*
*STROBE: Strengthening the reporting of observational studies in epidemiology*
*WHO: World health organization*

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