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Gestational Diabetes Management and Risk Factors

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Abstract

Background: Gestational diabetes mellitus (GDM) is a metabolic condition characterized by glucose intolerance during mid to late stages of pregnancy, resulting in several complications associated with maternal and neonatal health. This study aimed to estimate the prevalence of GDM and identify its associated risk factors and adverse outcomes among pregnant women.

Patients and Methods: A cross-sectional study was conducted involving 380 pregnant women in their second or third trimester. Those women were screened for GDM using a 75 g oral glucose tolerance test (OGTT) between 24 and 34 weeks of pregnancy. Patients' information was collected using designed questionnaires, medical records, laboratory findings, and post-delivery outcomes. Statistical analysis included chi-square tests and odds ratio estimation with a significant level of $p < 0.05$.

Results: GDM was diagnosed in 57 women (prevalence of 15%). Several risk factors associated with GDM were identified, advanced maternal age ($p < 0.001$), physical inactivity (OR = 5.92, $p < 0.001$), family history of GDM (OR = 12.10, $p < 0.001$), personal history of GDM (OR = 2.30, $p = 0.017$), and history of preeclampsia (OR = 4.70, $p < 0.001$). GDM was also found to be associated with higher rates of shoulder dystocia (OR = 5.98, $p < 0.001$), preterm delivery ($p < 0.001$), neonatal hypoglycemia (OR = 2.25, $p = 0.035$), and increased neonatal birthweight ($p = 0.002$).

Conclusion: A significant prevalence of GDM was identified and a substantial correlation with both modifiable and non-modifiable risk factors was observed. These findings underscore the necessity of early GDM screening, lifestyle modifications, and thorough prenatal disease management to mitigate GDM-related complications and improve pregnancy outcomes.

Keywords: Gestational diabetes mellitus, prevalence, risk factors, maternal outcomes, neonatal complications, OGTT.

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INTRODUCTION

Gestational diabetes mellitus (GDM) is a metabolic condition that is recognized as glucose intolerance during the second and third trimesters of pregnancy. The condition is linked with various types of complications for both the mother and the fetus[2]. Maternal GDM is associated with an elevated risk of preeclampsia, cesarean delivery, and the future development of type 2 diabetes mellitus (T2DM)[3]. Fetal complications include macrosomia, neonatal hypoglycemia, shoulder dystocia, and risks of obesity and impaired glucose tolerance[4].

Globally, the prevalence of GDM has increased among women of reproductive age in parallel with the rising rates of obesity and T2DM[5]. The condition affects approximately 14% of pregnancies worldwide[5]; however, the estimation of the prevalence rate may considerably vary regionally due to variations in diagnostic criteria[6]. For instance, the highest regional prevalence has been reported in the Middle East and North Africa (around 28%), followed by South-East Asia (21%) and the Western Pacific (15%)[7]. In contrast, Europe and North America reports were lower in prevalence rates, which ranged from 5% to 10%[8].

There are several risk factors that are associated with the etiology and progression of GDM. Women over the age of 30 years have consistently been associated with a higher risk of developing GDM during pregnancy[9.10]. High body-mass index (BMI) and excessive gestational weight gain were reported among the strongest predictors of glucose intolerance during pregnancy[11]. A positive family history of diabetes was also found to confer an increased risk. Additional lifestyle factors such as physical inactivity, poor dietary patterns, and smoking have been associated with the development of GDM[12]. Studies also showed that women with preexisting polycystic ovary syndrome (PCOS) or a history of GDM in previous pregnancies are also at significantly higher risk[13].

Early diagnosis of GDM is essential for decreasing side effects associated with maternal and fetal health. Effective glycemic control has been shown to reduce the incidence of complications such as preeclampsia, fetal macrosomia, and preterm delivery[14]. Early intervention, including dietary modifications, physical activity, glucose monitoring, and pharmacotherapy, can significantly improve perinatal outcomes[5]. Furthermore, recent studies showed that GDM serves as an important early indicator of long-term metabolic abnormalities. Studies showed that nearly 50% of women with GDM will develop T2DM within 5 years of the initial diagnosis[15.16].

Despite extensive research and publications in GDM, there are still prominent knowledge gaps, specifically in underrepresented communities[17]. Most current findings are from developed countries, whereas less developed regions such as sub-Saharan Africa, South Asia, and Eastern Europe lack comprehensive epidemiological data[18,29]. Additionally, ethnic differences in GDM risk and outcomes have been highlighted by many studies showing that women of South Asian, Middle Eastern, and Pacific Islander descent show disproportionately higher risk[20.21]. These findings point out the need for further research to understand the epidemiology of GDM in different populations[15]. Therefore, the present study aims to determine the prevalence of GDM among Iraqi pregnant women attending antenatal care and to identify key associated risk factors, including demographic, lifestyle, and reproductive characteristics. Findings should provide data to the broader global literature to guide targeted assessment and management efforts for GDM in similar healthcare settings.

MATERIALS AND METHODS

The present study is a cross-sectional investigation that included a total of 380 pregnant women in their second or third trimester at the time of their visit to the Department of Gynecology and Obstetrics at the Baghdad and the Bint Al-Huda Teaching Hospitals, Baghdad city, between September 2023 and April 2025. Eligible participants were women aged 18–45 years with a singleton pregnancy in the second or third trimester. In accordance with the standard definition of gestational diabetes as glucose intolerance first recognized during pregnancy, women with known type 1 or type 2 diabetes before pregnancy were excluded. Additional exclusion criteria included multiple gestation (twin or higher-order pregnancies), chronic endocrine disorders, or those who refused to join the study. The study protocol was approved by the institutional ethics committee at Baghdad College of Medicine, Iraq, and all participants provided written informed consent.

Patients' information was collected following the use of a standardized questionnaire, clinical examinations,

and medical records. The questionnaire collected information on sociodemographic characteristics, obstetric history, and lifestyle factors. Pregnant women were also asked to provide information regarding known risk factors for GDM, family or personal history of diabetes or previous incidents of GDM. Clinical data were extracted from antenatal records and laboratory reports. After delivery, maternal and neonatal outcome data were collected from delivery records, such as gestational age at delivery, mode of delivery, birth weight, and neonatal complications (such as neonatal hypoglycemia or hyperbilirubinemia).

After the initial assessment, all participants underwent GDM screening in the mid-second to early third trimester (between 24- and 34-weeks' gestation). Screening was performed using a one-step 75 g oral glucose tolerance test (OGTT). Following an overnight fast of 8–14 hours, venous blood samples were drawn for fasting plasma glucose, after which each woman consumed a 75 g anhydrous glucose solution (within 5 minutes). Blood samples were then collected at 1 hour and 2 hours post-glucose ingestion to measure plasma glucose levels. GDM was diagnosed according to the International Association of Diabetes and Pregnancy Study Groups (IADPSG) criteria[22]. Patients were categorized as having GDM if plasma glucose readings surpassed the threshold. The diagnostic cut-off values for GDM after a 75 g OGTT were fasting glucose ≥ 92 mg/dL, 1-hour glucose ≥ 180 mg/dL, or 2-hour glucose ≥ 153 mg/dL. Among the 380 screened participants, 57 were diagnosed with GDM based on the OGTT results. The remaining 323 pregnant women showed normal glucose tolerance (forming the non-GDM group).

Data collection and analysis were performed on the Statistical Package for Social Sciences (SPSS, Version 28, IBM Corp, USA). Descriptive statistics were presented as frequency and percentages (%). Continuous variables were expressed as means ± standard deviations (S.D). For bivariate comparisons between the GDM and non-GDM groups, the chi-square (χ^2) test was used to assess differences in categorical variables, while t-test for independent samples was used to assess differences between continues variables. To assess the risk factors associated with GDM, odds ratios (OR) and the 95% confidence intervals (95% CI) were calculated. A p-value of < 0.05 was considered statistically significant for all tests.

RESULTS

Among the 380 pregnant women included in the study, 57 women were diagnosed with GDM, showing a prevalence rate of 15%. Women with GDM were significantly older than those without GDM (mean age 33.5 ± 3.21 years vs. 27.36 ± 4.54 years, $p < 0.001$; Table 1). Regarding lifestyle factors, physical inactivity was far more common in the GDM group (86% of women with GDM vs. 37.2% of those without GDM; OR 5.92, $p < 0.001$; Table 4). Several medical and obstetric history factors were also associated with GDM. A family history of GDM was reported in 58% of the GDM group compared to 16.4% of the non-GDM group (OR 12.10, $p < 0.001$; Table 4). Likewise, women with a prior pregnancy affected by GDM had higher odds of GDM recurrence in the current pregnancy (24.5% had a personal history of GDM vs. 12.4% of non-GDM women; OR 2.30, $p = 0.017$; Table 4). Additionally, a history of preeclampsia was significantly more prevalent in the GDM group (43.9% vs. 14.2%; OR 4.70, $p < 0.001$; Table 4).

Laboratory measurements in the third trimester demonstrated markedly higher glycemic values in the GDM group. Mean fasting plasma glucose in women with GDM was 136.1 ± 42.4 mg/dL, compared to 77.6 ± 6.9 mg/dL in those without GDM ($p < 0.001$; Table 2). Similarly, HbA1c levels were elevated in the GDM group (7.3% vs. 5.2% in non-GDM, $p < 0.001$). Findings from the OGTT test showed that the 1-hour post-load glucose was 205 ± 20.4 mg/dL in the GDM group versus 125.9 ± 10.7 mg/dL in non-GDM. The 2-hour glucose was 166.5 ± 16.7 mg/dL vs. 98.2 ± 8.1 mg/dL (both $p < 0.001$; Table 2). These findings confirm that women diagnosed with GDM had substantially poorer glycemic control and higher glucose levels on screening tests than their non-GDM counterparts.

Gestational diabetes was furthermore associated with several adverse pregnancy and neonatal outcomes. The incidence of shoulder dystocia was significantly higher in the GDM-affected pregnancies (42.1% vs. 10.8% in non-GDM; OR 5.98, $p < 0.001$; Table 4). Women with GDM also experienced a greater rate of preterm delivery compared to those without GDM (29.8% vs. 6.5%, $p < 0.001$). Neonatal complications were more frequent in the GDM group. Neonatal hypoglycemia occurred in 19.3% of infants born to mothers with GDM, versus 10.2% of infants of non-GDM mothers (OR 2.25, $p = 0.035$; Table 3). In addition, infants of the GDM group had a significantly higher mean birth weight than those of the non-GDM group (3305 ± 504.8 g vs. 3127 ± 390.6 g, $p = 0.002$).

Table 1. Demographic, Lifestyle, and Clinical Characteristics of Pregnant Women Diagnosed with Gestational Diabetes Mellitus

Demographic variables		GDM group (n=57)	Non-GDM group (n=323)	P value
Age (Mean±SD)		33.5±3.21	27.36±4.54	< 0.001*
BMI (kg/m²) (Mean±SD)		24.1±2.3	23.5±3.9	0.260
Age groups	<21 years	9(15.7%)	67(20.7%)	0.637
	21-40 years	36(63.1%)	185(57.3%)	
	>40 years	12(21%)	71(22%)	
Occupation	Employed	14(24.5%)	112(34.6%)	0.167
	Housewife	35(61.4%)	185(57.2%)	
	Private worker	8(14%)	26(8%)	
Educational level	Illiterate	9(15.7%)	41(12.6%)	0.725
	Primary or secondary school	16(28%)	76(23.5%)	
	High school	13(22.8%)	94(29.1%)	
	College or higher	19(33.3%)	112(34.6%)	
Smoking status	Non-smokers	54(94.7%)	296(91.7%)	0.424
	Smokers	3(5.3%)	27(8.3%)	
Lifestyle	Physically active	8(14%)	203(62.8%)	< 0.001*
	Physically inactive	49(86%)	120(37.2%)	
Familial History of GDM	Positive	33(58%)	53(16.4%)	< 0.001*
	Negative	24(42%)	270(83.6%)	
Personal history of GDM	Positive	14(24.5%)	40(12.4%)	0.015*
	Negative	43(75.5%)	283(87.6%)	
Parity	1	10(17.5%)	35(10.8%)	0.416
	2	12(21.1%)	74(22.9%)	
	3	14(24.6%)	105(32.5%)	
	4	8(14%)	50(15.5%)	
	5	5(8.8%)	33(10.2%)	
	> 5	8(14%)	26(8%)	
History of Preeclampsia	Positive	25(43.9%)	46(14.2%)	< 0.001*
	Negative	32(56.1%)	277(85.8%)	
Current time of diagnosis with GDM	2nd trimester	54(95%)	0(0%)	-
	3rd trimester	3(5%)	0(0%)	

*Significant difference

Table 2. Laboratory findings at third trimester of pregnancy

Laboratory findings		GDM group (n=57)	Non-GDM group (n=323)	P value
Fasting glucose (mg/dL)		136.1±42.4	77.6±6.9	< 0.001*
HbA1C		7.3±2.8	5.2±1.3	< 0.001*
75g oral glucose tolerance test (OGTT) (mg/dL)	1-hour	205±20.4	125.9±10.7	< 0.001*
	2-hour	166.5±16.7	98.2±8.1	

*Significant difference

Table 3. Maternal and neonatal findings at the time of delivery.

Variables		GDM group (n=57)	Non-GDM group (n=323)	P value
Shoulder dystocia	Yes	24(42.1%)	35(10.8%)	< 0.001*
	No	33(57.9%)	288(89.2%)	
Delivery	Preterm	17(29.8%)	21(6.5%)	< 0.001*
	At term	36(63.2%)	291(90.1%)	
	Post-term	4(7%)	11(3.4%)	
Neonatal birthweight (g) (Mean±SD)		3305±504.8	3127±390.6	0.002*
Neonatal hypoglycaemia	Yes	11(19.3%)	33(10.2%)	0.031*
	No	43(80.7%)	290(89.9)	
Neonatal hyperbilirubinaemia	Yes	8(14%)	24(7.4%)	0.098
	No	49(86%)	299(92.6%)	

*Significant difference

Table 4. Odds ratios for statistically significant risk factors associated with gestational diabetes mellitus.

Factors	OR	95% CI	P value
Lifestyle	5.9208	3.1364 - 11.1773	< 0.001*
Familial History of GDM	12.0991	6.9075 - 21.1923	< 0.001*
Personal history of GDM	2.3035	1.1577 - 4.5834	0.017*
History of Preeclampsia	4.7045	2.5583 - 8.6511	< 0.001*
Shoulder dystocia	5.9844	3.1805 - 11.2603	< 0.001*
Neonatal hypoglycaemia	2.2481	1.0579 - 4.7773	0.035*

*Significant difference

DISCUSSION:

Findings from the current analysis showed that 15% of our sample population of pregnant women were suffering from GDM. The finding aligns with recent global estimations from multiple studies and highlights the substantial burden posed by hyperglycemia in pregnancy[20,23]. The International Diabetes Federation reported a worldwide GDM prevalence of approximately 14%[7]. However, reports indicated that GDM prevalence can vary across different geographic regions[24]. Studies based in European countries reported lower rates[25], compared to the reported higher prevalence of GDM in Asia, Africa, and the Middle East[26]. Indeed, parts of Southeast Asia report that GDM rates exceed 20%[27]. The Middle East and North Africa (MENA) regions show some of the highest rates globally[28]. Such regional differences exhibit variations in population risk profiles (e.g., ethnicity, obesity rates, maternal age), screening practices, and diagnostic criteria[7]. The observed 15% prevalence in the current analysis thus aligns with the upper limits of the reported global prevalence and emphasizes that GDM is a significant public health issue in this population. The finding also suggests that risk factors prevalent in this region, such as higher maternal age and a sedentary lifestyle, may cause a higher risk similar to what has been reported in South Asia and the MENA region.

Our study identified advanced maternal age as a significant risk factor for GDM. Women of higher age brackets had markedly greater odds of GDM, consistent with extensive evidence that advancing maternal age is a strong independent predictor of gestational hyperglycemia[29]. Biologically, older pregnant women tend to have reduced insulin sensitivity and α-cell reserve[30]. Those women were also reported to often carry more adiposity and comorbidities, which can all contribute to higher GDM risk[31]. Recent large studies echo our findings. For example, a Chinese study found that women aged ≥30 had significantly higher incidence of GDM, with maternal age emerging as one of the most important risk factors in multivariable models[13]. Similarly, other international studies have reaffirmed the age effect on GDM[29,32,33]. These studies point to a steady increase in GDM risk with each advancing maternal age group. Our results also showed that a personal history of GDM in a previous pregnancy is a potent risk factor[34]. These results are consistent with those of previous studies, which showed women with history of GDM have a greatly elevated likelihood of recurrence in subsequent pregnancies, with some studies reporting recurrence rates on the order of 20% or higher[35]. This could be attributed to

persistent underlying risk factors (such as chronic insulin resistance or beta-cell dysfunction) that carry over between pregnancies[36].

Another notable finding in our study was the association between a history of preeclampsia and GDM. Although there is very limited information in the literature regarding this association, it is still biologically plausible and has been observed in some analyses[37,38]. Both GDM and preeclampsia share common pathological pathways that are manifested through developing signs of insulin resistance, endothelial dysfunction, and chronic inflammation[39]. Women who experienced preeclamptic pregnancies may have underlying metabolic syndrome traits that predispose them to GDM in a subsequent gestation[40]. Moreover, GDM itself increases the risk of developing hypertensive disorders in pregnancy, such as preeclampsia, suggesting a valid link between dysglycemia and placental vascular dysfunction[13,41]. The overlap of these metabolic conditions in our subjects highlights the significant importance of a woman's reproductive history in signaling an elevated baseline risk for future gestational complications. Clinicians should therefore take careful notes of such history and consider enhanced surveillance and preventative strategies in these patients.

Current findings also emphasized the role of lifestyle in predicting risks of developing GDM. Physical inactivity was strongly associated with GDM in our study population. Sedentary lifestyle is a known contributor to higher weight gain and glucose dysregulation[42]. Recent evidence and reviews have highlighted that low physical activity before or during pregnancy significantly increases GDM risk[43]. Muscle activity is essential for glucose uptake, and analyses indicate that women with limited exercise activities can develop higher insulin resistance[44]. Based on these observations, physical activity can be considered as a modifiable risk factor that can be improved, unlike age or genetics, which cannot be adjusted through lifestyle changes[45,46]. The high prevalence of physical inactivity in some regions may partly explain the rising GDM rates[47]. Thus, current results support efforts to increase preconception and antenatal physical activity as a means to curb GDM incidence.

In addition to lifestyle, current analysis showed that women with a family history of GDM had higher odds of developing GDM. The findings suggest that both genetic susceptibility and shared environment can be recognized as risk factors to influence GDM development. A study described a significant likelihood of having a first-degree relative with diabetes and an increased risk of GDM[48]. Similarly, women with a personal history of GDM have a higher risk of recurrent GDM in the following pregnancies higher likelihood of developing type 2 diabetes in the next five years. , which was also correlated positively with other factors such as age, pre-pregnancy BMI, and OGTT levels[49]. Our findings align with those reports, underlining the need to consider a detailed family history in early antenatal assessments. Most recent studies identify overweight/obesity as one of the important factors that can predict GDM risk, in addition to excessive gestational weight gain, which could further exacerbate that risk[50,51]. Indeed, studies based in the MENA region have attributed the high GDM burden partly to the prevalence of above-normal BMI and physical inactivity in that population[28]. Thus, even though our study focused on age, inactivity, and medical history, these factors likely acted in concert with underlying nutritional and weight-related factors. Taken together, current results and the broader literature generate a consistent picture that shows that modifiable lifestyle factors (physical inactivity, unhealthy diet leading to obesity) and inherent factors (maternal age, family or personal history) jointly determine GDM risk. Interventions targeting these modifiable factors could substantially reduce GDM occurrence, a notion supported by trials showing lifestyle modification can lower GDM incidence in high-risk women[52].

Data from clinical studies showed that providing the appropriate clinical management for cases with GDM has direct consequences on perinatal outcomes[53]. GDM is well known to increase the likelihood of adverse maternal and neonatal outcomes if not adequately controlled. Consistent with other research, our sample population of women with GDM faces elevated risks of complications such as macrosomia and shoulder dystocia in affected pregnancies[54]. Hyperglycemia drives fetal overgrowth, leading to macrosomia, which in turn raises the risk of shoulder dystocia and birth trauma[55]. There are also maternal risks of preeclampsia and cesarean sections[56]. Furthermore, neonatal hypoglycemia is a well-recognized complication in children born to mothers with diabetes[57]. Due to fetal hyperinsulinemia secondary to maternal hyperglycemia, neonates can experience a sudden drop in blood sugar after birth[58]. This condition is serious as it can lead to seizures and long-term neurodevelopmental impairment

if left unmanaged throughout pregnancy[59]. Clinical trials have shown that treatment of GDM, through strict diet, glucose monitoring, and medications can significantly reduce the incidence of macrosomia, shoulder dystocia, and neonatal metabolic complications[60]. It is important, therefore, to provide prompt GDM management at the earliest possible time to reduce birth complications and future health issues to the delivered child. This can be achieved through providing nutritional therapy, lifestyle modification, and pharmacotherapy when needed.

CONCLUSION

A notable GDM prevalence of 15% was observed among the pregnant women enrolled in this study. The result underscores the increasing concern of hyperglycemia in pregnancy within this population. Significant risk factors for GDM included advanced maternal age, physical inactivity, a family history of GDM, previous GDM, and a history of preeclampsia. The condition was also found to be associated with adverse maternal and neonatal outcomes, which included preterm delivery, shoulder dystocia, neonatal hypoglycemia, and increased birthweight. These findings are consistent with recent studies and highlight the critical need for early risk estimation, proper screening, and timely intervention.

Ethics Statement and Conflict of Interest Disclosures

Financial support and sponsorship: All authors have declared that no financial support was received from any organization for the submitted work.

Ethics Consideration: The authors declare that all the procedures and experiments of this study respect the ethical standards in the Helsinki Declaration of 1975, as revised in 2008(5), as well as the national laws. Written informed consent was provided by the patient participant in this study.

This study was approved by the Institutional Research Board and Ethics Committee.

Conflict of interest: No known conflict of interest correlated with this publication.

Availability of data and materials: The data used and/ or analyzed throughout this study are available from the corresponding authors upon reasonable request.

Competing interests: The authors declared that they have no competing interests.

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