



## Research Article

# Prevalence of Gestational Diabetes Mellitus and Associated Risk Factors Among Pregnant Women Attending Antenatal Care in Primary Health Care Centers in Riyadh, Saudi Arabia

Turki Alharbi, Abdelmohsen Albogami, Abdullah Allhuidan, Saleh Alfawaz, Shatha Murad, Mostafa Kofi\*

Family and Community Medicine Department, Prince Sultan Military Medical City, Riyadh, Saudi Arabia

\*Corresponding author: Mostafa Kofi, Family and Community Medicine Department, Prince Sultan Military Medical City, Riyadh, Saudi Arabia.

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### Abstract

**Background:** Pregnancy is a diabetogenic condition, with Gestational Diabetes Mellitus (GDM) developing in 3 to 25% of all pregnancies. GDM has unfavorable short- and long-term consequences for both mothers and their children. We conducted this study aiming to assess the prevalence of gestational diabetes and associated risk factors during pregnancy in Riyadh, Saudi Arabia.

**Methods:** This was a retrospective cross-sectional survey study. GDM diagnosis was based on the universal two-hour 75 g OGTT. GDM cases were defined using the 75 g OGTT with at least one value of plasma glucose concentration equals to or exceeds the thresholds of 92 mg/dl, 180 mg/dl, and 153 mg/dl for fasting one-hour, and 2-hour post glucose, respectively. The data was collected by the study authors from patients' files using a data collection form that included the oral glucose tolerance test results in addition to the participants' socio-demographic data.

**Results:** A total of 384 pregnant women were recruited, the highest percentage (29.7%) of them aged 26 to 30 years old, 35% were overweight and 24.5% were obese, and 72.4% were multi-parity. Based on the 2h OGTT, the prevalence of GDM was 32.6%. The univariate logistic regression analysis showed that old age, low educational level, higher BMI, family history of DM, higher rates of multi-parity, abortions, C-sections, and hypothyroidism were significant risk factors for GDM. On the other hand, there were no significant associations between occupational status, PCOS, preeclampsia, hypertension, asthma, and GDM.

**Conclusion:** GDM diagnosed on basis of the OGTT criteria was very common among pregnant women in Saudi Arabia. Overweight and obesity as well as older age were associated with an increased risk of GDM. Also, low educational level, family history of DM, GDM history, history of abortion, and C-section were all significant risk factors of GDM.

**Keywords:** Gestational diabetes; Pregnancy; Saudi Arabia

### Introduction

Gestational Diabetes Mellitus (GDM) is defined as carbohydrate intolerance of varying severity that begins or is first recognized during pregnancy [1-5]. Pregnancy is a diabetogenic condition, with GDM developing in 3 to 25% of all pregnancies

[6]. A recent review study showed that the prevalence of GDM in Arab Gulf countries is 5.1-37.7 %, which is among the highest in the world, and it is still rising rapidly [7]. As previously stated, the reasons for the wide variation in GDM prevalence are multifaceted: different diagnostic criteria, often-small cohorts to assess the prevalence, and occasionally poorly designed studies [8], in addition to the genetic characteristics and environment of

the population under study, as well as on prevalence of type 2 diabetes mellitus [3,9,10].

GDM has unfavorable short- and long-term consequences for both mothers and their children. GDM is linked to both maternal (hypertension, pre-eclampsia, cesarean section, infection, and polyhydramnios) and fetal (macrosomia, birth trauma, hypoglycemia, hypocalcemia, hypomagnesemia, hyperbilirubinemia, respiratory distress syndrome, polycythemia) morbidities [10-12]. Moreover, women with GDM have elevated risks for type 2 diabetes and cardiovascular problems later in life [13-15]. Offspring of GDM-complicated pregnancies are more likely to develop childhood obesity, impaired glucose tolerance, and a higher cardiovascular risk profile during adolescence and early adulthood [16].

Several studies have linked the rising prevalence of GDM to advanced age, a family history of diabetes, inactive physical activity, obesity, excessive weight gain during pregnancy, and risky behaviors [17-19]. Several studies have also found a link between dietary habits during pregnancy and GDM [20-22].

Anatomical, physiological, and biochemical normalization of pregnancy is important in terms of perinatal and maternal morbidity and mortality. In this context, we conducted this study to assess the prevalence of gestational diabetes and associated risk factors during pregnancy in Riyadh, Saudi Arabia.

## Methods

This was a retrospective cross-sectional survey study conducted to assess the prevalence and risk factors of gestational diabetes in pregnant women attending antenatal clinics at Al-Wazarat health care center of prince Sultan Military Medical City, Riyadh, Saudi Arabia, during the period from 24-26<sup>+6</sup>

The study population was all pregnant women aged 18 years or more with 24-26<sup>+6</sup> weeks of gestational age and singleton pregnancy, attending antenatal clinics at Al-Wazarat health care center of prince Sultan Military Medical City, Riyadh, Saudi Arabia. Pregnant women who have pre-gestational diabetes type 1 or 2 or multiple gestation or long term medical condition that affects glucose metabolism such as pancreatectomy, acromegaly, hyperthyroidism and pregnant women on long term use of medication that affects glucose metabolism such as steroids and anti-psychotic medication were all excluded. Pregnant women

who fulfilled these inclusion-exclusion criteria were informed to come fasting on their next appointments, and they were called and reminded to complete an overnight fast for 8 h. Screening for GDM was through the universal two-hour 75 g OGTT (oral glucose tolerance test). GDM cases were defined using the 75 g OGTT with at least one value of plasma glucose concentration equals to or exceeds the thresholds of 92 mg/dl, 180 mg/dl, and 153 mg/dl for fasting one-hour, and 2-hour post glucose, respectively.

The data was collected using a data collection form that included the oral glucose tolerance test results in addition to the participants' socio-demographic data that included age, body mass index, history of abortion, multiparity, previous cesarean section, previous history of GDM, chronic condition, family history of DM, and the history of a Polycystic Ovarian Syndrome (PCOS). The data was collected by the study authors from the patients files. The study has been conducted after taking ethical approval from the research ethics committee in Prince Sultan Military Medical City.

## Statistical analysis

Data were analyzed by using Statistical Package for Social Studies (SPSS 22; IBM Corp., New York, NY, USA). Categorical variables were expressed as percentages. Chi square test was used for categorical variables. Univariate logistic regression was used to assess the risk factors associated with GDM in the Saudi pregnant. A p-value <0.05 was considered statistically significant.

## Results

A total of 384 pregnant women participated in the current study, the highest percentage (29.7%) of them were in the age group of 26.30 years old, and more than half (57.4%) of the participants have a university educational level. The data showed that 35% of the female were overweight (BMI 25-29.9 kg/ m<sup>2</sup>), and 24.5% were obese (BMI 30-34.9 kg/ m<sup>2</sup>) the majority (80.3%) were housewives, and 72.4% were multi-parity. A total of 110 (28.6%) of the participated women reported a history of abortion, and most of them (72.9%) underwent C-sections. more than half (57.8%) of the participants have a positive family history of DM, while 17.4% reported a previous history of GDM. Less than 10% of the participated women reported a medical history of PCOS, preeclampsia, hypertension, asthma, and hypothyroidism. Data is shown in Table 1.

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		<b>Number</b>	<b>%</b>
<b>Age</b>	<20	5	1.3
	20-25	69	18.1
	26-30	113	29.7
	31-35	94	24.7
	>35	100	26.2
<b>Educational level</b>	Illiterate	4	1.0
	Primary school	5	1.3
	Intermediate school	18	4.7
	High school	136	35.5
	University degree	220	57.4
<b>Occupational status</b>	Student	8	2.1
	Employed	67	17.6
	house wife	306	80.3
<b>Null parity</b>	Null parity	106	27.6
	Multiparity	278	72.4
<b>Abortions</b>	Yes	110	28.6
	No	274	71.4
<b>C-sections</b>	Yes	104	27.1
	No	280	72.9
<b>Previous GDM</b>	Yes	67	17.4
	No	317	82.6
<b>Family history of DM</b>	Yes	222	57.8
	No	162	42.2
<b>PCOS</b>	Yes	35	9.1
	No	349	90.9
<b>preeclampsia</b>	Yes	11	2.9
	No	373	97.1
<b>Hypertension</b>	Yes	4	1.0
	No	380	99.0
<b>Dyslipidemia</b>	Yes	2	.5
	No	382	99.5
<b>Asthma</b>	Yes	11	2.9
	No	373	97.1
<b>Hypothyroidism</b>	Yes	22	5.7
	No	362	94.3

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<b>BMI</b>	Underweight <18.5	6	1.6
	Normal	98	25.6
	Overweight 25-29.9	134	35.0
	Obese class I 30-34.9	94	24.5
	Obese class II 35.0-39.9	36	9.4
	Obese class III >40	15	3.9

**Table 1:** Characteristics of the participants (n=384).

The current study results showed that, based on the 2h OGTT, the prevalence of GDM was 32.6%, as shown in Table 2.

	Number	Prevalence (%)
GDM	125	32.6

**Table 2:** Prevalence of GDM among the pregnant women.

The characteristics of the participants by the GDM status are shown in Table 3. There was a statistically significant ( $P < 0.001$ ) difference between the GDM cases and the non-GDM in terms of age, where the highest proportion of GDM cases were older than the non-GDM ones. Similarly, the two groups differed significantly ( $P < 0.001$ ) by educational level and BMI, and it was noticed that the prevalence of obesity was higher among GDM cases. In addition, family history of DM and previous history of GDM were more frequently reported among the GDM cases at 68% vs. 52.9%, and 32.8% vs. 10%, respectively. moreover, higher rates of multi-parity, abortions, C-sections, and hypothyroidism were reported among the GDM cases at 83.2%, 35.2%, 40.8%, and 11.2% compared to 67.2%, 25.5%, 20.5%, and 3.1% in the non-GDM cases, respectively, with significant P-values ( $< 0.05$ ). On the other hand, there were no significant differences between the two groups in terms of PCOS, preeclampsia, hypertension, and dyslipidemia, where all p values were  $> 0.05$ .

		GDM(n=125)		Non GDM(n=259)		P value
		Number	%	Number	%	
<b>Age</b>	<20	1	.8	4	1.6	0.001*
	20-25	12	9.6	57	22.3	
	26-30	32	25.6	81	31.6	
	31-35	32	25.6	62	24.2	
	>35	48	38.4	52	20.3	

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<b>Educational level</b>	Illiterate	4	3.2	0	0	<0.001*
	Primary school	5	4.0	0	0	
	Intermediate school	6	4.8	12	4.6	
	High school	46	37.1	90	34.7	
	University degree	63	50.8	157	60.6	
<b>Occupational status</b>	Student	2	1.6	6	2.3	0.212
	Employed	28	22.4	39	15.2	
	house wife	95	76.0	211	82.4	
<b>Null parity</b>	Null parity	21	16.8	85	32.8	0.001*
	Multiparity	104	83.2	174	67.2	
<b>Abortions</b>	Yes	44	35.2	66	25.5	0.048*
	No	81	64.8	193	74.5	
<b>C-sections</b>	Yes	51	40.8	53	20.5	<0.001*
	No	74	59.2	206	79.5	
<b>Previous GDM</b>	Yes	41	32.8	26	10.0	<0.001*
	No	84	67.2	233	90.0	
<b>Family history of DM</b>	Yes	85	68.0	137	52.9	0.005*
	No	40	32.0	122	47.1	
<b>PCOS</b>	Yes	15	12.0	20	7.7	0.172
	No	110	88.0	239	92.3	
<b>preeclampsia</b>	Yes	3	2.4	8	3.1	0.705
	No	122	97.6	251	96.9	

<b>Hypertension</b>	Yes	1	.8	3	1.2	0.746
	No	124	99.2	256	98.8	
<b>Dyslipidemia</b>	Yes			2	.8	0.325
	No	125	100.0	257	99.2	
<b>Asthma</b>	Yes	5	4.0	6	2.3	0.354
	No	120	96.0	253	97.7	
<b>Hypothyroidism</b>	Yes	14	11.2	8	3.1	0.001*
	No	111	88.8	251	96.9	
<b>BMI</b>	Underweight <18.5			6	2.3	<0.001*
	Normal	14	11.2	84	32.6	
	Overweight 25 - 29.9	47	37.6	87	33.7	
	Obese class I 30 - 34.9	42	33.6	52	20.2	
	Obese class II 35.0 - 39.9	15	12.0	21	8.1	
	Obese class III >40	7	5.6	8	3.1	
*Significant p value						

**Table 3:** Characteristics of the participants by GDM status.

The univariate logistic regression for the risk factors associated with GDM in Saudi pregnant women is shown in Table 4. Old age was a significant risk factor for GDM with subjects aged 31-35 years have more than two folds risk (OR: 2.42, 95% CI (1.16-5.05), and a p-value of 0.018), and those aged >35 years having more than four folds risk (OR: 4.33, 95%CI (2.12-8.86), and a P-value of <0.001), compared to those aged ≤25 years old. Compared to subjects with a university degree, those with intermediate school or a less educational level were at more than three folds (OR=3.12), 95% CI (1.38-7.03) risk of GDM, with a significant P-value of 0.006. The results showed that history of

abortion, c-section, previous GDM, and family history of DM are significant risk factors of GDM with OR (95% CI) of 1.59 (1.00-2.25), 2.68 (1.68-4.27), 4.37 (2.52-7.59), and 1.89 (1.21-2.96), respectively, with all P values less than 0.05. Hypothyroidism was also shown to be a risk factor with an OR of 3.96, 95% CI (1.61-9.70), and a p-value of 0.001. For the BMI, it was also a significant risk factor, as when compared with those with BMI ≤25 kg/m<sup>2</sup>, overweight females, obese class 1, obese class 2, and obese class 3 pregnant females have 3.47, 5.19, 4.59, and 5.62 folds increased risk of GDM, with highly significant P values.

		Odds ratio	95 CI %		P value
			Lower	Upper	
Age	≤25**	1.00			
	26-30	1.85	0.90	3.83	0.095
	31-35	2.42	1.16	5.05	0.018*
	>35	4.33	2.12	8.86	<0.001*
Educational level	Intermediate school or less	3.12	1.38	7.03	0.006*
	High school	1.27	0.80	2.02	0.303
	University degree**	1.00			
Occupational status	student**	1.00			
	Employed	2.15	0.40	11.47	0.369
	house wife	1.35	0.27	6.82	0.716
Null parity	Null parity**	1.00			
	Multiparity	2.42	1.42	4.13	0.001*
Abortions		1.59	1.00	2.52	0.048*
C-sections		2.68	1.68	4.27	<0.001*
Previous GDM		4.37	2.52	7.59	<0.001*
Family history of DM		1.89	1.21	2.96	0.005*
PCOS		1.63	0.80	3.30	0.172
Preeclampsia		0.77	0.20	2.96	0.705
Hypertension		0.69	0.07	6.68	0.746
Asthma		1.76	0.53	5.87	0.354
Hypothyroidism		3.96	1.61	9.70	0.001*
BMI	<25**	1.00			
	Overweight 25.5-29.9	3.47	1.79	6.76	<0.001*
	Obese class I 30-34.9	5.19	2.59	10.40	<0.001*
	Obese class II 35.0-39.9	4.59	1.92	10.96	0.001*
	Obese class III >40	5.62	1.76	17.95	0.004*

\*Significant p value; \*\* used as a reference

**Table 4:** Univariate logistic regression for the risk factors associated with GDM in the Saudi pregnant women.

## Discussion

We set out this cross-sectional study to assess the prevalence of GDM and its risk factors among Saudi pregnant women. The results revealed an overall GDM prevalence of 32.6%, and old age, obesity, low educational level, family history of DM, previous history of GDM, history of abortion, and C-section were all significant risk factors of GDM [23].

GDM poses a risk of developing type 2 diabetes in the next decade with an estimated 50% probability [24]. Therefore, it is recommended that gestational diabetes research should be performed with OGTT whether there is a risk or not [25]. The

current study data revealed a far higher prevalence of GDM compared to previous studies in which the GDM prevalence ranged from Turkey 8.4-17.8% [26-28], and china at 8.1%. Though, the current estimated GDM prevalence is considered within the prevalence range estimated in Asia at 0.7 to 51.0% [29-31]. In a recent systematic review and meta-analysis study about GDM prevalence in Asia, the pooled GDM prevalence was reported to be 11.5%, and Saudi Arabia was amongst the highest GDM prevalent countries at 22.9% [30]. Such wide disparity in GDM prevalence rates could be attributed to ethnic differences, diagnostic criteria, screening strategies, and population characteristics [30].



For GDM risk factors, Multiparity, a previous history of GDM, congenital anomalies, stillbirth, abortion, preterm delivery, macrosomia, PCOS, age  $\geq 25$ , BMI  $\geq 25$ , and a family history of diabetes were reported [30]. Previous studies showed that females with a history of previous GDM have 3.5 times odds more likely to develop GDM compare to those without a history of previous GDM, our finding showed a higher odd at 4.37 [32,33]. However, another study reported a higher odds ratio at 9.71 (Crude OR), and 5.82 (adjusted OR) [34]. Women with PCOS are more likely to develop GDM, as PCOS is a common cause of insulin resistance [35,36], which is supported by our findings.

For the BMI, Najafi F, et al. in their meta-analysis showed that the incidence of GDM has a direct relationship with the pre-pregnancy BMI. The crude and adjusted ORs of developing GDM were 3.22 and 3.98 in the obese women compared with the women with normal BMI [21]. Although pre-gestational weight was not available in this study, other studies in Egypt, Ghana, and South Africa that looked at obesity using BMI found a significant link between obesity and GDM [20,37,38]. Similarly, Nelson SM, et al. [38] reported that pre-pregnancy BMI was more strongly associated with the risk of GDM in a review and meta-analysis study. Excessive gestational weight gain, particularly between early and mid-pregnancy, was positively associated with GDM risk [39-41].

In regards to age as a risk factor for GDM, a recent systematic review and meta-analysis study showed a linear relationship between GDM and maternal age (P trend  $< 0.001$ ), and it was reported that, for each one year increase in maternal age from 18 years, GDM risk for the overall population, Asian, and Europid increased by 7.90%, 12.74%, and 6.52%, respectively [42]. Such a positive association between GDM and age was reported in many studies [43-46]. These findings indicate that the incidence of GDM increases with maternal age and that the high frequency of GDM may be due to maternal age. Our findings corroborated earlier research, indicating that pregnancy is better planned before the age of 35 and that GDM screening procedures for older pregnant women should be improved.

Thyroid disease, including hypothyroidism and hyperthyroidism, has been linked to an increased risk of insulin resistance [47,48], which is consistent with our findings in terms of hypothyroidism, but we did not address hyperthyroidism. Thyroid hormone is important in maintaining insulin secretion and glucose homeostasis [49]. Pregnancy caused significant and complex changes in maternal thyroid hormone, and the inability to respond to these physiological changes resulting in thyroid dysfunction. Thyroid disease has an independent effect on GDM and may be used to predict the presence of GDM in early pregnancy, according to this study.

The current study has some limitations including the small sample size and that the sample was taken from only one institution, therefore the results cannot be generalized to the whole kingdom, the retrospective design, height, and weight before conception were not provided, therefore we could not assess the BMI before pregnancy. We hope our study may provide a new perspective on GDM in Saudi Arabia and facilitate further research to improve public health.

## Conclusion

In conclusion, GDM diagnosed on basis of the OGTT criteria was very common among pregnant women in Saudi Arabia. Overweight and obesity as well as older age were associated with an increased risk of GDM. In addition, low educational level, family history of DM, previous history of GDM, history of abortion, and C-section were all significant risk factors of GDM. This shows that pregnancy should be planned before the age of 35, and that weight loss may be more advantageous for women in their 30s and early 40s who are at risk of developing GDM. Weight-controlling public health actions taken before and throughout pregnancy may have an impact on future GDM prevention strategies. Health education is important to control a healthy diet and life style during pregnancy.

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