



PREVALENCE AND SOCIO-DEMOGRAPHIC RISK FACTORS OF GESTATIONAL DIABETIC MELLITUS AMONG WOMEN ATTENDING ANTENATAL CLINICS AT OBSTETRICS & GYNECOLOGY DEPARTMENT OF PEOPLES MEDICAL COLLEGE HOSPITAL NAWABSHAH, SINDH, PAKISTAN

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ABSTRACT

Background: Gestational Diabetes Mellitus (GDM) is serious consequences for both maternal and neonatal health. The growing number of non-communicable diseases and related risk factors as well as the introduction of new World Health Organization diagnostic criteria for GDM are likely to impact the GDM prevalence in Pakistan.

Aim: To determine the frequency and socio-demographic risk factors of GDM at obstetrics and Gynecology department of Peoples Medical College Hospital (PMCH), Nawabshah, Sindh, Pakistan.

Methods: This cross-sectional study was conducted at the department of obstetrics & Gynecology PMCH, Nawabshah, Pakistan from May 2022 to July 2022. A total of 216 pregnant females of 2nd and 3rd trimester were included. Random blood sugar (RBS) evaluation was done by electronic glucometer. Women whose RBS was ≥ 140 mg/dl, oral glucose tolerance test (OGTT) was done adopting standard protocols. After 1-hour, blood glucose value ≥ 180 mg/dl was labeled as GDM. Association of various socio-demographic characteristics was assessed with GDM applying chi-square test taking $p < 0.05$ as significant.

Results: In a total of 216 pregnant women, the mean age was 26.75 ± 4.9 years. There were 24 (11.1%) women who had $\text{RBS} \geq 140\text{mg/dl}$. These 24 pregnant females with $\text{RBS} \geq 140\text{mg/dl}$ underwent OGTT assessment, and OGTT was positive in 18 (8.3%) females. Age at the time of marriage ($p < 0.001$), third trimester ($p=0.036$), grand multigravida ($p<0.001$), higher BMI ($p<0.001$), poor educational status ($p=0.030$), family history of gestational diabetes ($p=0.023$), occupational status as housewives ($p=0.001$), physical inactivity ($p=0.005$), and middle-income category ($p<0.001$) were found to have significant association with GDM.

Conclusion: The current study revealed the prevalence of GDM as 8.3%. Factors such as marrying at an earlier age, grand multigravida, higher BMI, poor educational status, positive family history of GDM, being a housewife, physical inactivity ($p = 0.005$), and belonging to a middle-income category emerged as significant socio-demographic risk factors of GDM.

Keyword: Body mass index, gestational diabetes mellitus, gravida, oral glucose tolerance test, random blood sugar, socio-demographic.

INTRODUCTION

Gestational Diabetes mellitus (GDM) is a clinical condition because of glucose intolerance leading to hyperglycemia due to inadequate insulin hormone produced by the β - cells of pancreas to regulate glucose homeostasis during pregnancy¹. GDM shares 70% burden of death along with other noncommunicable diseases around the world.² It was estimated that out of every six live births one is affected by GDM, signifying as international public health concern.³

The changes during pregnancy in mother observed usually are raised blood sugar, high cardiac output (CO) and increased respiratory rate; also endocrine hormones like progesterone, estrogen, cortisol and prolactin are increased to deliver healthier and nourished atmosphere for the growing fetus. The biochemical changes results in the deposition of lipids like low level of high-density lipoprotein (HDL), high low-density lipoproteins (LDL) raised serum cholesterol and triglycerides that causes insulin resistance (IR) resulting in metabolic disorder showing central obesity along with high blood glucose level and sometimes hypertension.⁴

Gestational Diabetes mellitus is rising globally with alarming rate and first time observed in 2nd trimester or in 3rd trimester.⁵

In 1882, the Scottish physician J. Matthews Duncan introduced the concept of gestational diabetes mellitus that hyperglycemia can appear during pregnancy and return to normal as the pregnancy is over. Elsie Reed Carrington discovered the term gestational diabetes mellitus in 1957. The W.P.U. Jackson in 1950 stated a positive association of earlier stillbirth & fetal macrosomia in the pregnant women with diabetes mellitus.⁶

GDM gained broader acknowledgement after John Sullivan in 1961 & 1964 publications. The hyperglycemia generally develops during pregnancy in 13–26 weeks of gestation (2nd trimester) or early 3rd trimester (27–40 weeks) and normalize after end of delivery.⁷

Furthermore, pregnant women diagnosed with GDM has almost 60% chance of developing diabetes type2 (T2DM) within 5 to 15 years after gestational period⁶ and those children showing hyperglycemia in womb; face higher danger for development of obesity and T2DM in their late stage of lifespan.^{8, 9} The risk of T2DM is mainly thought to be due to recurrence of GDM in 30–69% cases after an initial pregnancy affected with GDM.¹⁰

Gestational diabetic women with fasting blood sugar level more than 115 mg/dl remains at a risk of developing complications like pre-eclampsia (9.8%) and 18% may experience caesarean section. According to some studies 17% of women with gestational diabetes mellitus remain on diet-control and 25% need medication¹¹.

The risk factors related to GDM include progressive maternal age, level of education, parity, smoking, nutrition,¹, socioeconomic class, age at marriage, stage of pregnancy, dietary habits sleep, family history of T2DM, ethnicity.¹²

Gestational diabetes mellitus is a condition that can lead to a range of maternal complications, including antepartum hemorrhage, hypertension, and an increased risk of developing diabetes mellitus. In addition, there are various fetal complications associated with gestational diabetes mellitus, such as stillbirth, dystocia, spontaneous abortion, macrosomia, prematurity, and respiratory distress syndrome. Furthermore, children born to mothers with gestational diabetes mellitus have a higher risk of developing cardiovascular disease and metabolic disorders throughout their lives.⁵ However, when evaluated using the International Association of Diabetes in Pregnancy Study Groups (IADPSG) criteria, the prevalence of GDM was found to be higher in certain countries ranging from 17.8% to 41.9%.^{13,14} In a systematic multi-centric research on pregnant women reported the frequency of GDM in 24 countries of Europe; 10.9% (ranging from 8.9%-31.5 %).¹⁵ The other countries as Nigeria 13.5%¹⁶, Ethiopia 12.8%,¹⁷ Turkey 17.6%.¹⁸ and Morocco 10% GDM prevalence was found.¹⁹

On the set criteria about the characteristics of the study population & various methods of diagnosis of gestational diabetes, the universal prevalence of GDM ranging from 1 to 28% in different parts of the world. In Saudi Arabia, the pooled prevalence was 3.6 times higher than in Israel (17.6% versus 4.9%) among the six countries with at least three studies, while in Qatar, Bahrain, Iran & Pakistan, the prevalence was 15.3%, 14.7%, 12.2% and 8.6% respectively. GDM is one of the expensive disease costing US\$1.2 trillion annually worldwide and this value is expected to increase more than US\$2.2 trillion by 2030.²⁰

The other data from different countries shows prevalence of GDM around 14% on average and it varies as in North America (12.6%), Africa (9%), Asia (21%), China (11.91%) as compared to Japan, Korea Thailand was around 8.0%. The literature search explains the progressive age of mother as an independent risk factor for the gestational diabetes mellitus & average age of childbirth over 40 years has been increasing significantly. The incidence of GDM increases with age ranging from 35–50 years.

Worldwide, there is no specific diagnostic tool or recommended criteria for GDM that is universally accepted but in 2013 the WHO approved the criteria of International Diabetes in pregnancy study Group IADPSG 2010 that a women diagnosed early in pregnancy have been classified; compared to who would have been diagnosed with diabetes if hyperglycemia had been noticed outside of the pregnancy, as opposed to women with "usual" GDM.

Material and Methods:

This cross-sectional study was conducted at the department of obstetrics & gynecology, Peoples Medical College Hospital (PMCH), Nawabshah, Sindh, Pakistan, from May 2022 to July 2022 after approval of ethical committee of PUMHS. Informed and written consents were obtained from all study participants. A sample size of 216 was calculated using WHO sample size calculator, taking anticipated proportion of GDM as 16.9%,²¹ with 95% confidence level and 5% margin of error. Inclusion criteria were pregnant females of 2nd and 3rd trimester were analyzed. Known cases of diabetes mellitus or females who had history of GDM were excluded. Females unwilling to be part of this research were also excluded.

Among eligible pregnant females, age, age at the time of marriage, gravidity, educational status, socio-economic status, family history of GDM, occupation, and physical activity status were documented. Body mass index (BMI) was calculated after measuring weight and height. Socio-economic status was labeled as low, medium, and high if monthly family income below 30,000 PKR,

between 30,000 to 60,000 PKR, or above 60,000 PKR, respectively. Random blood sugar (RBS) was assessed by electronic glucometer. The pregnant women who had RBS ≥ 140 mg/dl, the oral glucose challenge test (OGTT) was done by giving 75 mg oral glucose in 200ml water. After 1-hour, women were tested through electronic glucometer, and blood glucose value ≥ 180 mg/dl was labeled as OGTT positive, and these women were deemed having GDM. A special proforma was designed to record study data.

All the data were analyzed using IBM-SPSS Statistics, version 26.0. Qualitative variables were shown as frequency and percentages. Mean and standard deviation were calculated for continuous variables. The prevalence of GDM was determined. Socio-demographic characteristics were stratified with respect to OGTT status, and post-stratification chi-square test was applied taking $p < 0.05$ as significant.

RESULTS

In a total of 216 pregnant women, the mean age was 26.75 ± 4.9 years. There were 104 (48.1%) women who were in 2nd trimester, while remaining 112 (51.9%) were in 3rd trimester. The mean BMI was 27.6 ± 2.81 kg/m². There were 77 (35.6%) women who were illiterate. Family history of GDM was positive in 37 (17.1%) women. Occupation evaluation revealed 207 (95.8%) women were house wives. Socio-economic status was low, and high in 88 (40.7%), and 126 (58.3%) women, respectively. Table-1 is showing details about the characteristics of women analyzed.

Table-1: Characteristics of pregnant females (n=216)

Characteristics	Frequency (%)
Age (years)	18-25
	27 (12.5%)
	26-32
Age at the time of marriage (years)	98 (45.4%)
	33-39
	91 (42.1%)
Age at the time of marriage (years)	18-25
	24 (11.1%)
	26-35
Trimester	152 (70.4%)
	>35
	39 (18.1%)
Gravidity status	2 nd
	104 (48.1%)
	3 rd
Body mass index (kg/m ²)	112 (51.9%)
	Primigravida
	35 (16.2%)
Educational status	Multigravida
	155 (71.8%)
	Grand multigravida
Family history of gestational diabetes mellitus	26 (12.0%)
	<18.5
	1 (0.5%)
Occupation	18.5-24.9
	63 (29.2%)
	25-29.9
Regular physical activity	135 (62.5%)
	≥ 30
	17 (7.9%)
Socio-economic status	Illiterate
	77 (35.6%)
	Primary
Socio-economic status	86 (39.8%)
	Secondary to matriculation
	36 (16.7%)
Socio-economic status	Intermediate or above
	17 (7.9%)
Socio-economic status	House wife
	207 (95.8%)
	Health worker
Socio-economic status	1 (0.5%)
	Government servant
	8 (3.7%)
Socio-economic status	Low
	88 (40.7%)
	Middle
Socio-economic status	126 (58.3%)
	High
	2 (0.9%)

There were 192 (88.9%) women who had RBS below 140mg/dl, and 24 (11.1%) $\geq$ 140mg/dl. Twenty four pregnant females with RBS $\geq$ 140mg/dl underwent OGTT assessment. Out of these 24 women, OGTT was positive in 18 (8.3%) females (table-2).

Table-2: Prevalence of elevated blood sugar and gestational diabetes mellitus based on random blood sugar and oral glucose tolerance test results (n=216)

Test	Cutt-off Point	Frequency (%)
Random blood sugar (RBS)	<140 mg/dl	192 (88.9%)
	$\geq$ 140 mg/dl	24 (11.1%)
Oral glucose tolerance test for RBS $\geq$ 140 mg/dl)	Positive ($\geq$ 180 mg/dl)	18 (8.3%)

OGTT-positive women were more often aged 33-39 years (44.4%) compared to younger groups, though the p-value of 0.068 suggests this association is near significance but not statistically significant. A significant association exists between age at marriage and OGTT-positive status, with 72.2% of OGTT-positive women marrying at 18-25 years ($p < 0.001$). OGTT-positive women were more frequently in the third trimester (61.1%). The p-value of 0.036 suggests a statistically significant association, indicating that advancing pregnancy stage may be linked to increased glucose levels. Half of OGTT-positive women (50%) were grand multigravida, showing a strong association ($p < 0.001$) between having multiple pregnancies and an elevated risk of gestational diabetes. Higher BMI appears strongly associated with OGTT-positive results, with 61.1% in the 25-29.9 kg/m² category and 38.9% having a BMI $\geq$ 30 kg/m² ($p < 0.001$).

The distribution of education levels among OGTT-positive women showed a significant association ($p = 0.030$). A higher proportion (38.9%) of OGTT-positive women had a family history of gestational diabetes ($p=0.023$). Among OGTT-positive women, 77.7% were housewives, while 22.2% were government servants ($p=0.001$). Regular physical inactivity was reported by 77.8% OGTT-positive women ($p=0.005$). The majority of OGTT-positive women were in the middle-income category (72.2%), with a highly significant p-value (<0.001). Table-3 is showing details about the association of OGTT and various socio-demographic factors studied.

Table-3: Association of oral glucose tolerance test with respect to various socio-demographic characteristics (N=216)

Characteristics		OGTT Positive (n=18)	OGTT Exempted (n=192)	OGTT negative (n=6)	P-value
Age (years)	18-25-27	3 (16.7%)	21 (10.9%)	3	0.068
	26-32-98	7 (38.9%)	89 (46.4%)	2	
	33-39-91	8 (44.4%)	82 (42.7%)	1	
Age at the time of marriage (years)	18-25	13 (72.2%)	8 (4.2%)	4	<0.001
	26-35	1 (5.6%)	150 (78.1%)	1	
	>35	4 (22.2%)	34 (17.7%)	1	
Trimester	2 nd	7 (38.9%)	97 (50.5%)	-	0.036
	3 rd	11 (61.1%)	95 (47.9%)	6	
Gravidity status	Primigravida	2 (11.1%)	32 (16.7%)	1	<0.001
	Multigravida	7 (38.9%)	146 (76.0%)	2	
	Grand multigravida	9 (50.0%)	14 (7.3%)	3	
Body mass index (kg/m ²)	<18.5	-	1 (0.5%)	-	<0.001
	18.5-24.9	-	63 (32.3%)	-	

	25-29.9	11 (61.1%)	120 (62.5%)	4	
	≥30	7 (38.9%)	8 (4.2%)	2	
Educational status	Illiterate	5 (27.8%)	68 (35.4%)	4	0.030
	Primary	5 (27.8%)	79 (41.1%)	2	
	Secondary to matriculation	3 (16.7%)	33 (17.2%)	-	
	Intermediate or above	5 (27.8%)	12 (6.3%)	-	
Family history of gestational diabetes mellitus		7 (38.9%)	30 (15.6%)	-	0.023
Occupation	House wife	14 (77.7%)	187 (97.4%)	6	0.001
	Health worker	-	1 (0.5%)	-	
	Government servant	4 (22.2%)	4 (2.1%)	-	
Regular physical activity		4 (22.2%)	8 (4.2%)	-	0.005
Socio-economic status	Low	3 (16.7%)	84 (43.8%)	1	<0.001
	Middle	13 (72.2%)	108 (56.3%)	5	
	High	2 (11.1%)	-	-	

DISCUSSION

This study was conducted on Two Hundred Sixty pregnant women visited for antenatal checkup in their 2nd or 3rd trimester in Obstetric OPD of PMCH hospital Nawabshah (SBA) Sindh and random blood sugar (RBS) was done by electronic glucometer. Afterward their BMI was calculated after doing weight and height measurements through weighing machine and measuring tape respectively considering exclusion criteria that was known diabetics and first trimester of pregnancy.

The present study reveals the 8.33% prevalence of GDM; in rural and urban areas of Shaheed Benazir Abad, which mainly found in younger age group because of early marriages, economically middle income families; inclined more towards illiteracy with low paid work or unemployment. inadequate nutrition, physical inactivity, overweight, and multigravida. A meta-analysis systemic study included 33 studies with three international databases, showing overall prevalence of GDM around 11.7%. In Saudi Arabia, the pooled prevalence was 3.6 times higher than in Israel (17.6% versus 4.9%) among the six countries with at least three studies, while in Qatar, Bahrain, Iran & Pakistan, the prevalence was 15.3%, 14.7%, 12.2% and 8.6% respectively.²⁰ Different studies were conducted from 2011 to 2018 in different regions of China, showing that the prevalence of GDM varies from 5.12% to 24.24% depending on the characteristics of the participants, such as age and family history, physical inactivity and eating habits, and financial situation.²² A meta-analysis of GDM prevalent studies conducted from 2014 to 2019 reported prevalence of GDM in 24 European countries of 11% (8.9-31.5%).¹⁵ Two other studies in Karachi and Quetta Pakistan found a 17.2% burden of gestational diabetes mellitus.²³ In the year 2021 a study in Quetta Pakistan showed that the recurrence of gestational diabetes is still 29.4 6%, of which 2/3 of them had family history of gestational diabetes.²⁴

The current study results show pregnant female with age group between 18-25 years shows higher frequency n=14(6.5%), those with age group 26-32 years n=1(0.5%) of GDM and 33-39 were of n=3(1.3%) with mean age of all patients is 26.75 years with SD ±4.9 (Table: 4.3) The increased load of GDM in 18-25 years mostly is because of early marriages in younger age especially in India and Pakistan.

Studies have consistently shown that the age of the mother is a significant independent risk factor for gestational diabetes. As the average age of mothers giving birth has increased, the risk of developing gestational diabetes has also risen but different studies shows variation in the age group as in a study

the risk of gestational diabetes increases with maternal age, especially in the age range of 35-50 years, while another study found that the highest prevalence of gestational diabetes among women aged 30-34 years²¹. In Iran, a cross-sectional study of pregnant women diagnosed gestational diabetes using oral glucose tolerance and challenge tests found that the average age of the study group was 27.7 ± 5.7 years⁵, while in Ethiopia, a hospital-based cross-sectional study revealed that the majority of women with gestational diabetes were in the age group of 18-25 years showing more younger group supporting the current study results.

In an American cohort study, maternal age over 40 was associated with twice the risk of developing gestational diabetes compared to the general Southeast Asian population. However, physical activity before and during pregnancy can reduce the risk of gestational diabetes⁷.

A meta-analysis of 24 European countries showed that pregnant women aged ≥ 30 years were 2.14 times more likely to have gestational diabetes compared to those aged 15-29 years¹⁵. Another the study reveals, 57% were in the age 18-25 years, 38% in the of 26-33 years age group, and only 5% were of in the age group of 30 years.²⁵

This study results reveals higher burden of GDM $n=11(5.1\%)$ in 3rd trimester than 2nd trimester $n=7(3.2\%)$ (Table: 4.5). In an Ethiopian cross sectional study the mean gestational age of 27-28 weeks (3rd trimester).² In the a meta-analysis European study of 24 countries there was 1.47-times more GDM risk in the third trimester than second trimester supporting the current study results.¹⁵

The current study results analysis shows GDM frequency more in grand multigravida $n=9(4.2\%)$ than multigravida $n=7(3.2\%)$ and primigravida $n=2(0.9\%)$ (Table 4.6). In an African Ethiopian study the almost one-third of the Parity group were multigravida favoring the study that GDM burden observed more in high parity group.²

This present study also observed the GDM load age at marriages showing higher burden at marriage age 18-25 years ($n=13$; 5.6%) than 26-35 ($n=1$; 0.5% and 36 years above ($n=4$; 1.9%) (Table: 4.7). It was estimated that MODY (maturity onset diabetes in young) patient's account for up to 5% of GDM cases found in routine screening of GDM. MODY should be considered in lean women around 25 years of age, with a positive family history of diabetes in one of the parents.²⁶

In this current study positive family history with GDM found little bit lesser $n=7(3.2\%)$ than $n=11(5.1\%)$ no family history of GDM (Table: 4.9). According to a study conducted in Ethiopia, 76.2% of the pregnancies had no prior history of gestational diabetes.² Another study revealed that amongst those having family history of diabetes, 16% had GDM.

The study population reveals GDM prevalence in illiterate women $n=5(2.3\%)$, $n=5(2.3\%)$ with primary literacy, $n=3(1.4\%)$ with secondary level literacy, and $n=5$ 2.3% in highly literate individuals (Table 4.10) showing around 6.4% GDM load in less educated study population. In an international study, 2% were illiterate, while 96% had studied up to the college level. Out of the literate women, 51% had diabetes.

This study results also showed that the majority of pregnant females $n=14(6.5\%)$ are housewives, while the rest were government servants $n=4$ (1.9%) (Table 4.11). These findings are consistent with an international study that reported that 72% of women with hyperglycemia were housewives.²⁵

This study shows that almost $n=14(6.5\%)$ pregnant women with sedentary life style and only $n=4$ (1.9%) are doing mild physical activity. (Table :4.12). In an African cross sectional study reported less physical activity in the study group.² In another study 62% of the pregnant women who were having sedentary life diagnosed to be having diabetes;²⁵ while the other study compared to no physical activity, pre-pregnancy or early pregnancy physical activity was associated with 30% and 21% reduced risk of GDM. Engaging in >90 min/week of leisure time PA before pregnancy was associated with 46% decreased odds of GDM.²⁶

The study results show that most of pregnant female are belonging to middle income class $n=13$, (6.0%), low income class includes $n=3(1.4\%)$ while only $n=2(0.9\%)$ are belonging to high class status

socioeconomically. (Table:4.13). This was supported by the study related sociodemographic factors that most of the GDM women; about more than 2/3rd were and half of them were belonging to low - middle socio-economic group.⁴

The current study results reveals overweight pregnant women exposed to GDM more n=11(5.1%) than obese n=7(3.2%). (Table: 4.14) which is mostly because of lack of physical activity or sedentary life style and low education .In the meta analysis of 24 countries of Europe it was shown that there was higher risk of 6.79- fold in obese and 2.29-fold in overweight women than normal weight pregnant women so favoring the study to higher BMI and GDM ¹⁵

In another Ethiopian cross sectional study 44.8% with history of overweight/obesity.²The other study shows about 18% were overweight and 4% were obese. About 41% of overweight women were having diabetes²⁵

According to current study almost all OGTT positive diagnosed with GDM (n=18; 8.33%) are having irregular sleep pattern (Table: 4.15) but higher in those with 6 hours duration of sleep=15(6.9%).In a study conducted in Japan found the effects of sleep duration on glucose metabolism and the risk of GDM and when compared to normal mothers ; found that the average duration sleep ranging from 7 to less than 10 hours (reference group), women getting less than 5 hours or ≥ 10 h sleep ,revealed significantly raised RBS level and was associated to an higher risk1.31-fold and 1.21 respectively.²⁷

Study Limitation: As due to scarce resource this study is one centered study on limited sample size; it is therefore recommended to conduct this research study on multicenter health care institution and on large sample size.

Conclusion:

The current study revealed the prevalence of GDM as 8.3%. Factors such as marrying at an earlier age, grand multigravida, higher BMI, poor educational status, positive family history of GDM, being a housewife, physical inactivity (p = 0.005), and belonging to a middle-income category emerged as significant socio-demographic risk factors of GDM. These findings underscore the importance of targeted screening and tailored interventions for high-risk groups, particularly among women with these characteristics, to effectively manage and reduce the risk of GDM during pregnancy.

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Authors Contribution:

NNS: Data collection, drafting, responsible for data's integrity, approved for publication.

RAM: Data collection, drafting, responsible for data's integrity, approved for publication.

NAS: Conception, design, proof reading, critical revision, approved for publication.

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