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Original Article

Assessing the Frequency and Association of Risk Factors with Gestational Diabetes in Women Reporting to a Tertiary Care Hospital using the American Diabetes Association 2023 Criteria

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ABSTRACT

Objective: To assess the frequency of gestational diabetes mellitus (GDM) using latest criteria of American Diabetes Association (ADA) 2023, and to determine the possible association of risk factors with GDM.

Study Design: Comparative cross-sectional study.

Place and Duration of Study: Department of Pathology, Combined Military Hospital Lahore, Pakistan, from Feb to Aug 2023.

Methodology: A total of 281 pregnant women undergoing an Oral Glucose Tolerance Test (OGTT) between 24-28 weeks of gestation were included. Blood samples were obtained following a ten-hour fasting period, 75g of anhydrous glucose was administered and further samples taken one and two hours after oral glucose load. GDM was then diagnosed using latest criteria of ADA 2023.

Results: Among the 281 pregnant women, 72(25.6%) were diagnosed with GDM, whereas 209 had normal glucose tolerance. The mean age of participants was 27.8±4.6 years. Statistically significant differences were observed between females with and without GDM concerning age (p=0.001), prior history of GDM (p=<0.001), familial history of GDM (p=<0.001), BMI exceeding 30 kg/m2 (0.001), and a history of miscarriages (p=0.006). Whereas no statistically significant association of parity (p=0.093), history of macrosomia (p=0.583), preterm delivery (p=0.484), history of hypertension (p=0.250) or socioeconomic status (0.08).

Conclusion: Frequency of GDM according to ADA 2023 criteria was found to be 25.6%. We have highlighted common occurrence of GDM among women aged over 30, those with a history of previous abortions, prior GDM, familial DM, and overweight individuals.

Keywords: American Diabetes Association, Gestational Diabetes Mellitus, Oral Glucose Tolerance Test.

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INTRODUCTION

Gestational diabetes mellitus (GDM) is a type of diabetes, in which females suffer from impaired glucose tolerance due to B-cell dysfunction and thus develop hyperglycemia from 2nd trimester onwards.[1] Due to its increasing prevalence and its connection to adverse pregnancy outcomes in females having GDM and the subsequent development of type 2 diabetes mellitus (T2DM) later in life, GDM has become a significant public health concern.[2,3] GDM correlates with unfavorable fetal outcomes including fetal macrosomia, shoulder dystocia, operative delivery, birth injury, bleeding, heart issues, premature birth, and maternal obstetric issues, such as pre-eclampsia and premature membrane rupture.[4,5]

GDM prevalence in Pakistan varies significantly, ranging from less than 1% to 22.6% in different regions, owing to diverse diagnostic methods, socio-economic conditions, and dietary patterns.[6] Across Asia, the mean prevalence of GDM stands at 11.5%.[7] The global prevalence of GDM has been shown to be 3-10 % of all pregnancies.[8] To standardize GDM diagnosis, WHO endorsed the International Association for Diabetes and Pregnancy Study Group (IADPSG)/American Diabetes Association (ADA) 2010 criteria for GDM, recommending universal screening using the 75g OGTT in its 2013 guideline.[8]

Several risk factors have been linked to GDM including maternal age above 30, overweight, parity, past history of GDM and a family history of diabetes. A BMI between 25.0-29.9 kg/m^2 doubles the risk, while a BMI exceeding 30 kg/m2 increases it sixfold compared to those with normal BMI.[9]

Recently changes to the IADPSG/ADA criteria have been made. Cut offs have also been revised keeping in mind the stringent glucose control necessary in pregnancy to avoid any untoward complication.[10] This OGTT-based study was conducted to determine the latest frequency of GDM in Lahore using latest criteria of ADA 2023/IADPSG and to check association of risk factors with GDM.

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METHODOLOGY

This cross-sectional comparative analysis was conducted at the Pathology Department of Combined Military Hospital Lahore, Pakistan, from February to August 2023. Approval was granted by the Research Institutional Review Board of CMH Lahore (437/2023).

Inclusion Criteria: Pregnant women, regardless of age with 24-28 weeks of gestation were included.

Exclusion Criteria: Females with overt diabetes mellitus or using medicines impacting glucose metabolism and having a twin pregnancy were excluded.

Using Epi Tools Epidemiological Calculator, a sample size of 157 was initially estimated with an estimated prevalence of Gestational diabetes mellitus of 11.5%.[8] To increase statistical power, total of 300 participants were recruited for the study. Nineteen participants were unable to give samples after oral glucose load, due to vomiting. Finally, data from 281 women was included (Figure).

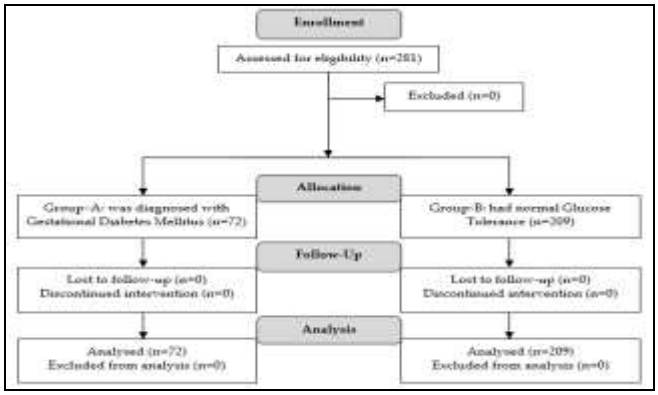

Figure: Patient Flow Diagram (n=281)

Through non-probability consecutive sampling, 281 pregnant women were included, who reported for OGTT at 24-28 weeks of gestation. Each participant provided informed consent. Relevant data including age, family diabetes history, prior GDM history, obstetric background, and parity were gathered through face-to-face interviews. Weight and height of patients was inquired to calculate BMI.

Blood samples were obtained after a ten-hour fast and at 1 and 2 hours post 75g anhydrous glucose intake. The samples were centrifuged immediately and analyzed by the enzymatic (Glucose Oxidase) method on automated Clinical Chemistry Analyzer COBAS C601 (Roche Diagnostics, Switzerland). Standard quality control procedure, using 02 controls in each batch was followed. The Westgaard Rules were strictly adhered to. The fasting plasma glucose (FPG) and plasma glucose levels 1 and 2 hours after glucose load were estimated as recommended by the IADPSG/ADA for one-step diagnosis of GDM according to the new criteria. Patients with 01 reading meeting or exceeding criteria- 5.1mmol/L for FPG, 10mmol/L for 1-hour after glucose load and 8.5 mmol/L for 2-hours after glucose load were classified as GDM.[11]

Statistical Package for Social Sciences (SPSS) version 24 was used for data analysis. Descriptive statistics (mean and standard deviation) were calculated for various parameters like age, BMI, parity, haemoglobin levels and plasma glucose levels, while qualitative variables were expressed as frequency and percentages. The Independent Sample t-test and Pearson Chi-Square test were employed for quantitative and categorical variables' comparison, respectively, between GDM and NGT groups. Association of risk factors with GDM was explored with the Pearson correlation. A significance threshold of $p<0.05$ was adopted for all tests.

RESULTS

A total of 281 pregnant women who came for OGTT for GDM diagnosis were included. Mean age of the participants was 27.8±4.6 years. The age range was from 19 to 40 years. Out of 281 pregnant women, 72(25.6%) were diagnosed as GDM (Group-A) and 209(74.4%) were diagnosed as having normal glucose tolerance (Group-B). A total of 61(21.7%) women were primigravida, while 220(78.3%) were multigravida. Mean Haemoglobin in participants was 11.1 g/dl ±1.5 while it ranged from 6.6 – 14 g/dl. Descriptive statistics of women reporting for OGTT and their Associated Risk factors are presented in Table-I.

Mean age was 30.1±4.9 years in GDM and 26.9±4.1 years in NGT. Mean BMI was 28.1±4.5 kg/m2, in GDM while it was 25.4±4.2 kg/m2, in NGT. The mean glucose (F) was 5.3±0.5mmol/L in females with GDM and 4.6±0.34 mmol/l in females with NGT. The difference across groups was statistically significant (p=0.001) for all the parameters except Haemoglobin (Table-II).

Increased incidence of GDM was noted in multipara women. Known risk factors of GDM like family history of diabetes, previous history of GDM, history of miscarriages and intrauterine deaths and hypertension were present in 38.0%, 16.4%. 33.1% and 10.3% of the study participants respectively.

Table-I: Risk Factors associated with Gestational Diabetes Mellitus in Participants (n=281)

Risk factors	Categories	n(%)
Previous history of GDM	Yes	46(16.4%)
	No	235(83.6%)
Family history of GDM	Yes	107(38.1%)
	No	174(61.9%)
BMI (kg/m2)	>30	59(21.0%)
	25-29.9	105(38.0%)
	<25	110(41.0%)
Weight of baby (History of Macrosomia)	>4.0 kg	9(3.2%)
	<4.0 kg	272(96.8%)
Parity	Primipara	61(21.7%)
	Multipara	207(73.6%)
	Grandmultipara	13(4.7%)
Age	>35 years	30(10.7%)
	<35 years	251(89.3%)
History of premature baby	Yes	15(5.3%)
	No	266(94.7%)
History of miscarriages	Yes	93(33.1%)
	No	188(66.9%)
History of hypertension and proteinuria	Yes	29(10.3%)
	No	252(89.7%)
Socioeconomic status	>50000	67(5.0%)
	25000-50000	200(71.2%)
	<25000	14(23.8%)
Treatment for infertility	Yes	13(4.5%)
	No	268(95.5%)

**GDM: Gestational Diabetes Mellitus*

Table-II: Comparison of Quantitative Parameters across Groups (n=281)

Parameters		Mean±SD	*p*-value
Age in years	Group-A	30.0±4.9	0.001
	Group-B	26.9±4.1	
BMI kg/m2	Group-A	28.0±4.5	0.001
	Group-B	25.4±4.2	
Haemoglobin (g/dl)	Group-A	11.0±1.7	0.739
	Group-B	11.1±1.4	
Glucose (F) (mmol/L)	Group-A	5.35±0.50	0.001
	Group-B	4.60±0.34	
Glucose (1-hr) (mmol/L)	Group-A	9.4±1.9	0.001
	Group-B	6.8±1.1	
Glucose (2-hr) (mmol/L)	Group-A	7.7±1.7	0.001
	Group-B	5.9±1.0	

Comparison of risk factors between females with GDM and NGT is presented in Table-III. Statistically significant difference was noted between females with and without GDM with regard to age, previous history of GDM, family history of GDM, increase BMI above 30 kg/m2 and History of miscarriages. Whereas no statistically significant association of parity, history of macrosomia, preterm delivery, history of hypertension or socioeconomic status with GDM was noted.

DISCUSSION

GDM is one of the most common metabolic issues during gestation. Females diagnosed with GDM have to undergo vigilant glucose monitoring, additional clinic visits and regular obstetric scrutiny. Mothers face a heightened risk of developing metabolic disruptions and diabetes mellitus. A global surge in GDM prevalence and related risk factors has been observed. Our study also revealed an increase frequency of GDM among pregnant females and association of many risk factors among females with GDM.

Table-III: Comparison of Risk factors in Pregnant females across Groups (n=281)

Risk factors	Categories	Group-A (n=72) n(%)	Group-B (n=209) n(%)	*p*-value
Age	>35 years	16(53%)	14(47%)	0.01
	<35 years	56(22%)	195(78%)	
Previous history of GDM	Yes	24(52%)	22(48%)	<0.001
	No	48(20%)	187(80%)	
Family history of GDM	Yes	41(38%)	66(62%)	<0.001
	No	31(18%)	143(82%)	
BMI	>30	27(46%)	32(54%)	<0.001
	25-29.9	26(25%)	79(75%)	
	<25	16(15%)	94(85%)	
Weight of baby (History of macrosomia)	>4.0 kg	02(22%)	07(78%)	0.583
	<4.0 kg	70(26%)	202(74%)	
Parity	Primipara	15(25%)	46(75%)	0.093
	Multipara	51(25%)	156(75%)	
	Grandmultipara	06(46%)	7(54%)	
History of premature baby	Yes	05(33%)	10(67%)	0.484
	No	67(25%)	199(75%)	
History of miscarriages	Yes	33(35%)	60(65%)	0.006
	No	39(21%)	149(79%)	
History of hypertension and proteinuria	Yes	10(34%)	19(66%)	0.250
	No	62(25%)	190(75%)	
Socioeconomic status	>50000	23(34%)	44(66%)	0.08
	25000-50000	46(23%)	154(77%)	
	<25000	03(31%)	11(69%)	
Treatment for infertility	Yes	1(08%)	11(92%)	0.140
	No	71(26%)	197(74%)	

**BMI: Body Mass Index, GDM: Gestational Diabetes Mellitus*

Overall frequency of GDM in our study was 25.6%. Although this figure slightly surpasses the prevalence reported by Asian and African studies, the trend is consistent with increasing prevalence of diabetes and GDM in the country. A study conducted in the province of KPK, recruiting 190 patients has reported a frequency of GDM to be 26.3%.[7] A Lahore-based study reported the prevalence of GDM to be 13.5 % in 2022 among 217 studied women.[11] According to a large study by Riaz M *et al.,* from Pakistan, which included 11430 pregnant women, GDM was found in 1349(11.8%) pregnant women.[12] A recent study from Balochistan has reported GDM frequency to be 35.8% among 530 pregnant women.[4] Nhidza *et al.,* reported a prevalence of 6.7% in 150 Zimbabwean pregnant women.[1] A systematic review involving 6525 pregnant females from 10 studies, from Ethiopia, showed prevalence of 12.04%, while a study from India reported the incidence of GDM to be 14.8% among

pregnant women.[13,14] A United States-based study, recruiting 589,605 pregnant females over 15 years from 2005-2019 has shown that the prevalence of GDM has increased continuously, and it was 8-8.9% in year 2020.[15] Another study involving 37357 females in United states, in 2016, reported prevalence of GDM to be 8.2%, showing an increase of 78% in 10 years.[16]

Guidelines by the Royal College of Gynecology and Obstetrics have documented that females with less than 25 years of age, have a low risk of developing GDM. In our study, out of 30 women above 35 years of age, 16(53%) of the females were found to be having GDM. In one study, females above 30 years constituted 64% of GDM patients.[9] This has been corroborated by other studies, as well.[7,16] In contrast, one research from Africa showed that increased woman's age is not a risk factor for GDM.[1]

In our study, obesity was associated with the development of GDM. About 46 % of the women with BMI more than 30 kg/m2 and 32 % of the women with BMI more than 25 kg/m2 were diagnosed as having GDM. The results are similar to a study by Sharma *et al.,* which showed that GDM is more common in overweight and obese women.[17] In a Pakistani study, 23% of women diagnosed as having GDM were found to be obese.[11]

In our study 52% of the women with previous history of GDM were diagnosed as having GDM again in the current pregnant. This is in line with multiple local and international studies.[7,18]

No significant association of GDM with macrosomia was found in our study. Although a local study reported reported a positive correlation between the two variables.[7]

A strong heritability is associated with GDM. In our study, majority of women (57%) with GDM had a positive family history of DM. The findings correspond to study by Zakir *et al.,* in which majority of women with GDM had a positive family history.[9] Monod *et al.,* reported that a family history of T2DM was associated with GDM.[19] Multiple studies have reached the same conclusion.[7,20]

LIMITATIONS OF STUDY

There were some limitations of this study. It was a single center study. Although a large number of patients were recruited, but still a multicenter study across Pakistan would be better. As it was a cross-sectional study, causation could not be established.

The authors also strongly suggest the use of OGTT preferably 75g according to the latest criteria for further researches to be carried out in the same field of study.

CONCLUSION

Frequency of GDM according to ADA 2023 criteria was found to be 25.6%. We have highlighted common occurrence of GDM among women aged over 30, those with a history of previous abortions, prior GDM, familial DM, and overweight individuals.

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Authors' Contribution

Following authors have made substantial contributions to the manuscript as under:

NUK & AS: Data acquisition, data analysis, critical review, approval of the final version to be published.

MS & MZR: Study design, data interpretation, drafting the manuscript, critical review, approval of the final version to be published.

HA: Conception, data acquisition, drafting the manuscript, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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