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ORIGINAL ARTICLE

Exploring diabetes screening in pregnancy: a comprehensive study at two teaching hospitals in Khyber Pakhtunkhwa, Pakistan

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ABSTRACT

OBJECTIVE: To determine frequency of Gestational Diabetes Mellitus (GDM) among antenatal women visiting two teaching hospitals of Kohat and Peshawar, Pakistan.

METHODS: This cross-sectional study was conducted at Liaqat Memorial Hospital, Kohat and Hayatabad Medical Complex, Peshawar, Pakistan, from December 2022 to May 2023. Participants were selected through non-probability convenient sampling, and antenatal women were included after written informed consent. Oral glucose tolerance test (OGTT) was performed, and GDM was diagnosed, based on International Association of Diabetes and Pregnancy Study Groups criteria. Demographic details and OGTT results were recorded.

RESULTS: In a cohort of 244 antenatal patients (mean age 28.80±5.76 years, 44.3% multigravida), GDM was diagnosed in 27.5%, 18.4%, and 16.4% based on FBS, one-hour OGTT, and two-hour OGTT, respectively. Significant associations were found between GDM and positive family history of DM, and maternal DM across all diagnostic criteria. However, no significant associations were observed with paternal DM, first-degree relatives, or siblings. A previous history of GDM showed a significant association with GDM in current pregnancy. Hypertension exhibited a significant association with GDM across all criteria, while no significant associations were found for BMI, polyhydramnios, or gravidity.

CONCLUSION: GDM frequency was 27.5%, 18.4%, and 16.4% based on FBS, one-hour, and two-hour OGTT. Significantly associated factors included positive family history of DM, maternal DM, hypertension, and a previous GDM history. No significant associations were found with paternal DM, first-degree relatives, siblings, BMI, polyhydramnios, or gravidity. These findings contribute to refining GDM screening and management guidelines in primary and secondary care settings.

KEYWORDS: Blood Glucose (MeSH); Diabetes, Gestational (MeSH); Glucose Tolerance Test (MeSH); Body Mass Index (MeSH); Risk Factors (MeSH); Diabetes Mellitus (MeSH); Hyperglycemia (MeSH); Obesity (MeSH).

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INTRODUCTION

In the 21st century, Diabetes Mellitus (DM) has become a significant global health concern, exacerbated by a parallel increase in hyperglycemia during pregnancy (HIP). [1,2] Between 75% and 90% of HIP cases are attributed to Gestational Diabetes Mellitus (GDM).[3] GDM affects approximately 14.0% of pregnancies worldwide, accounting for over 20 million live births annually, which is approximately one in six pregnancies.[4]

The escalating prevalence of GDM has profound short- and long-term implications on maternal, neonatal, and offspring health. Short-term maternal issues include birth trauma, premature labor, caesarean delivery, miscarriages, stillbirths, and preeclampsia.[5,6] Short-term prenatal and neonatal morbidities include polycythemia, hyperbilirubinemia, hypoglycaemia, birth trauma, and macrosomia.[7] Beyond the immediate challenges during pregnancy, the pervasive impact extends to both maternal and neonatal health. Long-term maternal concerns associated with GDM include Type 2 DM, hypertension, chronic kidney disease, and ischemic heart disease.[8,9] Offspring may experience long-term problems such as obesity, metabolic syndrome, premature start of cardiovascular disease and various autism spectrum disorders.[10,11]

In low- and middle-income countries (LMICs), where pregnancy complications surpass those in high-income nations, GDM screening faces substantial challenges. Many women in LMICs receive inadequate or no screening during pregnancy due to variations in healthcare infrastructure, socio-economic factors, and healthcare policies.[12,13] The exact prevalence of GDM in Pakistan is uncertain, given variable screening tools and diagnostic thresholds, leading to reported frequencies ranging from 8.42% to 35.8% in various studies.[14-17] This lack of screening uniformity highlights the need for further comprehensive investigations. Women with GDM and their families constitute a high-risk group, requiring targeted intervention. The escalating prevalence of GDM and its associated complications emphasizes the critical importance of enhancing screening and management efforts. In Pakistan, there is a dire need for conducting prospective studies on GDM. This study was planned to identify frequency of GDM in our genetically predisposed Asian population, using the globally recognized International Association of Diabetes and Pregnancy Study Groups (IADPGS) criteria.[18] The evidence-based findings of this study will be

helpful to refine local guidelines and enhance GDM screening in primary and secondary care settings across the country.

METHODS

This cross-sectional study was conducted at the outpatient departments of Liaqat Memorial Hospital in Kohat and Hayatabad Medical Complex in Peshawar, Pakistan, spanning from December 2022 to May 2023. The study protocol was approved by the Institutional Ethical Committee (Ethical Committee Number: KIMS-REC/ECC/2022/0, dated: 07/12/2022).

Participants were selected through a non-probability, convenient sampling technique, from the outdoor departments of both the hospitals. Antenatal women, regardless of gestational age or risk factors, were included in the study after providing written informed consent. Women with Type 1 and Type 2 DM and those who were on steroid therapy were excluded.

All eligible study participants were subjected to an oral glucose tolerance test (OGTT) with 75 g of anhydrous glucose powder after an overnight fast. The glucose powder was dissolved in 250–300 ml of water, and pregnant women were asked to consume it within five minutes. Blood was taken aseptically from the ante-cubital vein for estimation of fasting and one- and two-hour post-glucose blood sugar levels. In case of vomiting within 30 minutes of consuming glucose, the OGTT was rescheduled for the next day or the following week. Patients meeting or surpassing the following cutoff levels of IADPGS were identified as having GDM: fasting plasma glucose (FPG) ≥ 92 mg/dl (≥ 5.1 mmol/l), one-hour plasma glucose ≥ 180 mg/dl (≥ 10.0 mmol/l), and two-hour plasma glucose ≥ 153 mg/dl (≥ 8.5 mmol/l) during OGTT.

Demographic information, clinical records, and OGTT results were documented in a standardized form. Data were analyzed using SPSS Version 23. Descriptive statistics were employed to summarize participant characteristics, and inferential statistics, including chi-square tests, were utilized to assess associations between GDM and various variables, as elaborated in subsequent result tables.

Table I: Demographic profile of study participants

Demographic detail		Frequency (n=244)	Percentage
Gravidity	Primigravida	52	21.3
	Multigravida	108	44.3
	Grand multigravida	84	34.4
Pregnancy Trimester	First trimester	36	14.7
	Second trimester	78	32
	Third trimester	130	53.3
Cousin marriage	Yes	84	34.4
	No	160	65.6
Education	Uneducated	173	70.9
	Matric	40	16.4
	Graduate	22	9
	Masters	9	3.7
Working Status	House wives	241	98.8
	Working	3	1.2

RESULTS

Total 244 antenatal patients were screened for GDM. The mean age of study participants was 28.80±5.76 years with mean period of gestation of 28.80±5.76 weeks.

The majority of participants in the study

Table II: Association of hereditary factors and risk of gestational diabetes mellitus

	Fasting Blood Sugar			One-Hour OGTT			Two-Hours OGTT		
	GDM (n=67)	Normal (n=177)	p-value*	GDM (n=45)	Normal (n=199)	p-value*	GDM (n=40)	Normal (n=204)	p-value*
Family history of DM	31 (46.2%)	71 (41.1%)	0.197	26 (57.8%)	76 (38.2%)	0.013	23 (57.5%)	79 (38.7%)	0.022
Maternal DM	26 (38.8%)	43 (24.3%)	0.016	21 (46.7%)	48 (24.1%)	0.003	21 (52.5%)	48 (23.5%)	0.000
Paternal DM	9 (13.4%)	21 (11.9%)	0.423	6 (13,3%)	23 (11.6%)	0.303	7 (15.5%)	24 (11.8%)	0.364
First degree relative	12 (17.9%)	37 (20.9%)	0.339	11(24.4%)	38 (19.1%)	0.268	9 (22.5%)	40 (19.6%)	0.409
Siblings	4 (6%)	14 (7.9%)	0.434	2 (4.4%)	16 (8.0%)	0.319	3 (7.5%)	15 (7.4%)	0.593

OGTT: oral glucose tolerance test; GDM: Gestational Diabetes Mellitus, DM: Diabetes Mellitus, *Chi Square test

Table III: Comparison of various variables with gestational diabetes mellitus

Variables		GDM diagnosed on FBS level (n=67)	GDM diagnosed on One-Hour OGTT (n=45)	GDM diagnosed on Two-hours OGTT(n=40)
Previous history of GDM	History of GDM present	4 (6%)	2 (4.4%)	4 (10%)
	No GDM history	63 (94%)	43 (95.6%)	36 (90%)
	P value*	0.092	0.381	.015
Body Mass Index (kg/m^2)	Extremely obese	7 (10.4%)	2 (4.4%)	2 (16.7%)
	Obese	19 (28.4%)	16 (35.6%)	11 (13.6%)
	Healthy	27 (40.3%)	17 (37.8%)	17 (18.3%)
	Underweight	14 (20.9%)	10 (22.2%)	10 (17.5%)
	P value*	0.152	0.984	0.916
Hypertension	Hypertension present	9 (13.4%)	8 (17.8%)	6 (15%)
	No hypertension	58 (86.6%)	37 (82.2%)	34 (85%)
	P value*	0.019	0.005	0.041
Polyhydramnios	Polyhydramnios present	4 (6%)	3 (6.7%)	3 (7.5%)
	No polyhydramnios	63 (94%)	42 (93.3%)	37 (92.5%)
	P value*	0.188	0.354	0.458
Gravidity of patient	Primigravida	13 (19.4%)	8 (17.8%)	7 (17.5%)
	Multigravida	28 (41.8%)	17 (37.8%)	15 (37.5%)
	Grand multigravida	26 (38.8%)	20 (44.4%)	17 (45%)
	P value*	0.670	0.293	0.305

OGTT: oral glucose tolerance test; GDM: Gestational Diabetes Mellitus; *Chi Square test; BMI (Asian cut-off) = Healthy: 18.5-22.9, Overweight: 23-27.5, Obese: >27.5

were multigravida [44.3% (n=108)] Approximately 53.3% (n=130) were in the third trimester of pregnancy. Further demographic details of participants are given in Table I.

Applying IADPGS criteria, GDM was diagnosed in 67 (27.5%) participants based on FBS, 45 (18.4%) participants based on one-hour OGTT results, and 40 (16.4%) participants based on two-hour OGTT results. These results show that the most frequent diagnosis of GDM was based on fasting blood sugar, accounting for 67 cases (27.5%). Therefore, the overall frequency of GDM in our study was 27.5%.

Table II displays the association of hereditary factors with the risk of GDM using different diagnostic criteria. A positive family history of DM demonstrated a significant association with GDM diagnosed across two cut-offs, one-hour, and two-hour OGTT results. While, maternal DM exhibited a significant association with at GDM diagnosed across all three criteria points, including FBS, one-hour and two-hour OGTT results. Nevertheless, no significant association was observed between GDM and paternal DM, first-degree relatives, or siblings in this study.

Comparison of various factor with GDM across different diagnostic criteria is presented in Table III. A significant association was found between participants with a previous history of GDM and the frequency of GDM in current pregnancy, specifically diagnosed at Two Hours OGTT (p =0.015). Hypertension exhibited a significant association with GDM, diagnosed across all three criteria points, including FBS, one-hour, and two-hour OGTT results. No significant association was observed for body mass index (BMI), polyhydramnios, or gravidity of patients with the frequency of GDM.

DISCUSSION

In our study, which screened 244 antenatal females using IADPSG criteria, GDM was diagnosed in 27.5%, 18.4%, and 16.4% based on fasting, one-hour, and two-hour OGTT results, respectively. A significant hereditary factor in GDM was the strong association with maternal diabetes (p <0.001), surpassing the impact of diabetes in the father, first-degree relative, and siblings. Further analyses revealed associations between hypertension and GDM. However, polyhydramnios and gravidity categories exhibited no significant associations with diagnosed GDM.

In our study, the diagnosis of GDM based on fasting, one-hour, and two-hour OGTT results was 27.5%, 18.4%,

and 16.4%, respectively. A recent systematic review and meta-analysis on GDM prevalence in the Eastern Mediterranean region reported a prevalence of 15.3% for Pakistan.[19] Our results showing 16.4% frequency of GDM at the two-hour OGTT mark corresponds with their results. Local studies in Pakistan display a broad range of GDM prevalence, ranging from 8.42% to 35.8%, across all four provinces[14-17] The primary challenge lies in the diversity of diagnostic criteria applied in these studies. It is essential to utilize current and standardized diagnostic criteria to ensure accurate prevalence estimates of GDM in Pakistan.

Our study identified a positive family history of diabetes and maternal diabetes as significant hereditary factors associated with GDM. Specifically, 46.2%, 57.8%, and 57.5% of GDM cases diagnosed using FBS, one-hour, and two-hour OGTT cutoffs, respectively, reported a positive family history. Other studies in Pakistan have reported varying frequencies of a positive family history of diabetes, ranging from 18.1% to 76%, highlighting the hereditary role of diabetes in a population where consanguinity is prevalent.[15,16,20,21] Importantly, we found a significant association between GDM and maternal history of diabetes, but not with paternal history, other first-degree relatives, or siblings. Pregnancy entails complex hormonal and metabolic changes primarily driven by maternal factors, which may substantially contribute to the development of GDM.

The history of GDM in a previous pregnancy is a significant risk factor for developing GDM in a subsequent pregnancy. In our study, this history was reported in 6%, 4.4%, and 10% of GDM cases diagnosed based on FBS, one-hour, and two-hour OGTT cutoffs, respectively. Other studies have documented similar findings, with a history of GDM in previous pregnancies ranging from 6.8% to 17.1% of current GDM cases. [14,20] These patterns highlight the importance of considering previous pregnancy history when assessing GDM risk and highlight the need for targeted screening and intervention strategies to mitigate recurrence and associated complications

Hypertension was reported 13.4%, 17.8% and 15% in GDM cases, diagnosed on the basis of FBS, one-hour, and two-hour OGTT cutoffs, respectively. Hypertension and GDM may coexist due to shared risk factors like age, previous pregnancy complications, pre-existing type 2 DM, and chronic hypertension. Genetic susceptibility, family history, obesity, dietary patterns, and socioeconomic factors further contribute to the overlap of these conditions. Coexistence of GDM & hypertension elevates the risk of future cardio-metabolic disorders in mothers and adversely affects fetuses and neonates.[22]

In our study, 38.8% of individuals diagnosed with GDM based on the FBS cutoff were categorized as obese or extremely obese. However, no significant difference was observed between various categories of BMI and GDM. One reason for this observation could be the absence of established BMI cutoffs for pregnant women.

Pre-pregnancy obesity and/or overweight have shown a significant association with GDM. [23] Gul B et al.[16] found that 50% of GDM patients had a BMI >30 kg/m^2, and Bibi S, et al.,[20] also demonstrated a significant correlation between GDM and BMI. BMI emerges as a crucial modifiable risk factor that can be targeted to reduce the risk of GDM.

A correlation has been demonstrated between ultrasound parameters such as polyhydramnios and the risk of developing GDM, along with associations with large-for-gestational-age fetuses.[24] However, our study did not find a statistically significant association between GDM and polyhydramnios. Collectively, these findings emphasize the importance of treating GDM as a pre-cardiovascular disease state. The management strategy should focus on identifying and systematically treating cardiovascular risk factors beyond the prevention of type 2 DM.

The main limitation of the present study is the lack of follow-up to record obstetric complications such as preterm birth, macrosomia, and caesarean section in the studied females. Additionally, post-delivery OGTT was not repeated in our investigation.

CONCLUSION

In our study, 27.5% of participants were diagnosed with GDM based on FBS, while 18.4% and 16.4% were diagnosed based on one-hour and two-hour OGTT results, respectively. Significant associations were observed between GDM and a positive family history of diabetes, particularly maternal diabetes. However, no significant associations were found with paternal diabetes, first-degree relatives, siblings, BMI, polyhydramnios, or gravidity. Importantly, participants who had hypertension and a prior history of GDM demonstrated a significant association with the occurrence of GDM.

These insights emphasize the importance of targeted screening and intervention strategies, particularly for women with a positive family history of DM and previous GDM, to mitigate the risk of recurrence and associated complications. This comprehensive analysis of diverse factors influencing GDM provides valuable data for refining screening and management guidelines in both primary and secondary healthcare settings.

REFERENCES

1. Sun H, Saeedi P, Karuranga S, Pinkepank M, Ogurtsova K, Duncan BB, et al. IDF Diabetes Atlas: Global, regional and country-level diabetes prevalence estimates for 2021 and projections for 2045. Diabetes Res Clin Pract 2022;183:109119. https://doi.org/10.1016/j.diabres.2021.109119.
2. Hod M, Kapur A, Sacks DA, Hadar E, Agarwal M, Di Renzo GC, et al. The International Federation of Gynecology and Obstetrics (FIGO) Initiative on gestational diabetes mellitus: A pragmatic guide for diagnosis, management, and care. Int J Gynaecol Obstet 2015;131 (Suppl 3):S173-211. https://doi.org/10.1016/S0020-7292(15)30033-3.
3. International Diabetes Federation.

What is Diabetes? in: IDF Diabetes Atlas 10th ed 2021. (Online): Accessed On: June 06, 2023. Available from URL: https://diabetesatlas.org/idfawp/resourcefiles/2021/07/IDF_Atlas_10th_Edition_2021.pdf

4. Wang H, Li N, Chivese T, Werfalli M, Sun H, Yuen L, et al. IDF Diabetes Atlas: Estimation of Global and Regional Gestational Diabetes Mellitus Prevalence for 2021 by International Association of Diabetes in Pregnancy Study Group's Criteria. Diabetes Res Clin Pract 2022;183:109050. https://doi.org/10.1016/j.diabres.2021.109050.
5. Metzger BE, Lowe LP, Dyer AR, Trimble ER, Chaovarindr U, Coustan DR, et al. Hyperglycemia and adverse pregnancy outcomes. N Engl J Med 2008;358(19):1991-2002. https://doi.org/10.1056/NEJMoa0707943
6. Vounzoulaki E, Khunti K, Abner SC, Tan BK, Davies MJ, Gillies CL. Progression to type 2 diabetes in women with a known history of gestational diabetes: systematic review and meta-analysis. BMJ 2020;369:m1361. https://doi.org/10.1136/bmj.m1361
7. Inoue H, Ishikawa K, Takeda K, Kobayashi A, Kurita K, Kumagai J, et al. Postpartum risk of diabetes and predictive factors for glucose intolerance in East Asian women with gestational diabetes. Diabetes Res Clin Pract 2018;140:1-8. https://doi.org/10.1016/j.diabres.2018.03.031
8. Kramer CK, Campbell S, Retnakaran R. Gestational diabetes and the risk of cardiovascular disease in women: a systematic review and meta-analysis. Diabetologia 2019;62(6):905-14. https://doi.org/10.1007/s00125-019-4840-2
9. Daly B, Toulis KA, Thomas N, Gokhale K, Martin J, Webber J, et al. Increased risk of ischemic heart disease, hypertension, and type 2 diabetes in women with previous gestational diabetes mellitus, a target group in general practice for preventive interventions: a population-based cohort study. PLoS Med 2018;15(1):e1002488. https://doi.org/10.1371/journal.pmed.1002488. Erratum in: PLoS Med 2019;16(7):e1002881.
10. Yu Y, Arah OA, Liew Z, Cnattingius S, Olsen J, Sørensen HT, et al. Maternal diabetes during pregnancy and early onset of cardiovascular disease in offspring: population based cohort study with 40 years of follow-up. BMJ 2019;367. https://doi.org/10.1136/bmj.l6398.
11. Kong L, Nilsson IA, Brismar K, Gissler M, Lavebratt C. Associations of different types of maternal diabetes and body mass index with offspring psychiatric disorders. JAMA Netw Open 2020;3(2):e1920787. https://doi.org/10.1001/jamanetworkopen.2019.20787
12. Zhu Y, Zhang C. Prevalence of gestational diabetes and risk of progression to type 2 diabetes: a global perspective. Curr Diab Rep 2016;16(1):7. https://doi.org/10.1007/s11892-015-0699-x.
13. Tatem, A.J., Campbell, J., Guerra-Arias, M. et al. Mapping for maternal and newborn health: the distributions of women of childbearing age, pregnancies and births. Int J Health Geogr 2014;13:2. https://doi.org/10.1186/1476-072X-13-2
14. Riaz M, Nawaz A, Masood SN, Fawwad A, Basit A, Shera AS. Frequency of gestational diabetes mellitus using DIPSI criteria, a study from Pakistan. Clin Epidemiol Glob Health 2019;7(2):218-21. https://doi.org/10.1016/j.cegh.2018.06.003
15. Atta J, Das K, Yousfani ZA, Yousfani S, Bala M, Aftab S. Frequency of gestational diabetes mellitus in pregnant women: a cross-sectional study. Ann Romanian Soc Cell Biol 2022;26(01):472-9. http://annalsofrscb.ro/index.php/journal/article/view/10819
16. Gul B, Mehboob S, Qayuom S, Daud M. The prevalence of gestational diabetes in women of child bearing age belonging to KPK. Khyber J Med Sci 2021;14(4):244.
17. Latif M, AyazSB, Anwar M, Manzoor M, Aamir M, Bokhari SARS, Ahmad M. Frequency of gestational diabetes mellitus in pregnant women reporting to a public sector tertiary care hospital of Quetta. Pak Armed Forces Med J 2022;72(6):2095-8. https://doi.org/10.51253/pafmj.v72i6.4073
18. International Association of Diabetes and Pregnancy Study Groups Consensus Panel, Metzger BE, Gabbe SG, Persson B, Buchanan TA, Catalano PA, et al. International association of diabetes and pregnancy study groups recommendations on the diagnosis and classification of hyperglycemia in pregnancy. Diabetes Care 2010;33:676-82. https://doi.org/10.2337/dc09-1848
19. Badakhsh M, Daneshi F, Abavisani M, Rafiemanesh H, Bouya S, Sheyback M, Rezaie Keikhaie K, Balouchi A. Prevalence of gestational diabetes mellitus in Eastern Mediterranean region: a systematic review and meta-analysis. Endocrine 2019;65(3):505-14. https://doi.org/10.1007/s12020-019-02026-4.
20. Bibi S, Saleem U, Mahsood N. The frequency of gestational diabetes mellitus and associated risk factors at Khyber teaching hospital Peshawar. J Postgrad Med Inst 2015;29(1):43-6.
21. Khan N, Farooq N, Batool A, Altaf A. Frequency of gestational diabetes mellitus and associated risk factors. Rawal Med J 2018;43(3):459-61.
22. Jiang L, Tang K, Magee LA, von Dadelszen P, Ekeroma A, Li X, et.al. A global view of hypertensive disorders and diabetes mellitus during pregnancy. Nat Rev Endocrinol 2022;18(12):760-75. https://doi.org/10.1038/s41574-022-00734-y.
23. Lewandowska M. Gestational Diabetes Mellitus (GDM) Risk for

Declared Family History of Diabetes, in Combination with BMI Categories. Int J Environ Res Public Health 2021;18(13):6936. https://doi.org/10.3390/ijerph1813 6936.

24. Afzal S, Sultana S, Shadab W, Khan MNA. Obstetric ultrasonography as a screening tool for the diagnosis of GDM: Detection of raised AFI and large for gestational age fetus. Isra Med J 2022;14(2):68-71. https://doi.org/10.55282/imj.oa1335

AUTHORS' CONTRIBUTION

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

FG: Concept and study design, acquisition of data, drafting the manuscript, approval of the final version to be published

RM: Acquisition of data, drafting the manuscript, approval of the final version to be published

SB: Analysis and interpretation of data, critical review, approval of the final version to be published

RS: Concept and study design, acquisition of data, critical review, 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.

CONFLICT OF INTEREST

Authors declared no conflict of interest, whether financial or otherwise, that could influence the integrity, objectivity, or validity of their research work.

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DATA SHARING STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request

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