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Original Article

Gestational Diabetes-Mellitus and it's Associated Risk-Factors Among Women at an Antenatal Clinic at a Tertiary-Care Hospital Of Rawalpindi

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ABSTRACT

Objective: To determine the frequency of GDM and its associated risk factors at an antenatal outpatient department at Fauji Foundation Hospital in Rawalpindi.

Study Design: Cross sectional study.

Place and Duration of Study: Gynecology and Obstetrics outpatient department Fauji Foundation Hospital, Rawalpindi, Pakistan Nov 2021 to May 2022.

Methodology: Our study was done on 330 gravid females (gestational age between 24-30 weeks) aged 20-45 years who were selected by purposive sampling. Women with pre diagnosed diabetes mellitus type II and depression were excluded from the study. Fasting blood glucose sample of participants was taken at their 24-30 weeks visit followed by the OGTT according to the modified International Association of Diabetes and Pregnancy Study Groups (IADPSG) criteria. BMI, MUAC and blood pressure were taken at their booking antenatal visit. International physical activity questionnaire (IPAQ) was used for history of physical exercise during pregnancy. MDDS scoring was used for dietary diversity.

Results: The mean age of the sample at time of study was 31.95 (SD±6.34) years. A total of 330 pregnant women participated, of which 47(14.2 %) were GDM positive. GDM was positively associated (p<0.05) with BMI greater than 30, MUAC greater than 28 cm, no exercise, antenatal depression, familial history of GDM and DM, pregnancy induced hypertension (PIH) in current pregnancy, past account of pregnancy with GDM, and bad obstetrics history.

Conclusion: The positive predictors of GDM were familial GDM, low physical activity and obesity. Incorporating healthy life style and dietary modifications along with regular screening during pregnancy are recommended.

Keywords: BMI, Exercise, Gestational Diabetes Mellitus. Mid Upper Arm Circumference, Obesity.

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INTRODUCTION

GDM is explained as an intolerance to the carbohydrates resulting due to a chronic state of insulin resistance in the body that develops during pregnancy. Usually Gestational Diabetes Mellitus is diagnosed during the second trimester of gestation as a consequence of the human placental hormone which has an adverse effect on the glucose metabolism giving rise to feto maternal morbidity plus mortality. Few of the complications of GDM include lifelong risk of maternal diabetes, macrosomia, excessive birth weight, preterm birth, hypo glycaemia in baby (due to the maternal excessive insulin levels still in circulation), shoulder dystocia, birth trauma during delivery, hypocalcemia, hyperbilirubinemia, hypomagnesemia, respiratory distress syndrome, polycythemia in the neonate. Approximately 87.5 % of the women who present with diabetes in pregnancy have gestational diabetes mellitus that may not optimize after delivery.[1,2]

Around the world, GDM affects around 15.0% of the gravid women, 75% of whom are in the developing countries.[2] Prevalence of GDM fluctuates globally from 10.1% in Eastern and Southeastern Asia) to 13.61% reported in Africa.[2] This is due to different screening parameters, diagnostic criteria, as well as the differences in ethnic composition. A prevalence of 24.2% was seen in South East Asia. India, reports a prevalence from 3 to 35%.[2] Conflicting results have been seen in few studies conducted in Pakistan, with a prevalence of 23.9% in area of Islamabad, 17.2% in KPK, 13.2% in Sindh, 11.4% in Punjab.[3]

In Pakistan, GDM remains largely unexplored and no satisfactory data is available about the overall prevalence of the disease and it's associated risk factors. Since GDM results in adverse feto maternal outcomes and around 70% women diagnosed with GDM further develop DM type II.[4-6] Therefore it is essential to collect base line local data so that evidence

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based recommendations can be made in order to better manage GDM and it's complications.[7,8] This study was done to know the frequency of GDM both in women with and without family history of GDM as well as to know the risk factors pertaining to their lifestyle, anthropometric and demographic

METHODOLOGY

This cross sectional study was done on 330 gravid females selected by purposive sampling technique over a period of 7 months (November 2021 till May 2022). ERB approval certificate was issued from ethical review board (IERB) (No FF/FUMC/215-120/Phy/21 dated 15 April 21) , Foundation University Medical College Rawalpindi, Pakistan. Sample size was calculated by WHO sample size calculator, keeping CI at 95 %, Margin of error at 5%, Standard prevalence of GDM as per reference study was kept at 23.9% 3 and adjusting for non-response rate of 5%.

Inclusion Criteria: Pregnant women (24-30 weeks of gestation) between 20-45 years attending AN clinic were included in the study

Exclusion Criteria: Women with pre diagnosed type II diabetes or hypertension, known depression and those diagnosed with any type of cancer, were excluded.

BSF was performed on all 330 women at 24-30 weeks visit followed by OGTT . However 11 women did not return for the OGTT test after two hours so their BSF value was taken into account for diagnosis of GDM by the modified IADPSG (International Association of the Diabetes and Pregnancy Study Groups) diagnostic criteria i.e BSF equal to or >92 mg/dL and/or OGTT at 2 hours : >153 mg/dL as a cut off for GDM diagnosis.4

Structured, validated, adapted and pre tested questionnaire was used after informed consent of participants. Their sociodemographic information was taken. Both modifiable risk factors for GDM for example obesity, BMI, dietary diversity, drug usage, exercise habits and blood pressure during pregnancy as well as the non modifiable risk factors which included family history of GDM and DM and prior obstetrics history was taken. Dietary diversity was assessed by using the minimum dietary diversity measurement tool. It contains a list of 10 food groups (starchy staples, pulses, nuts and seeds, dairy, eggs, poultry, meat and fish, vegetables, other vitamin-A rich vegetables and fruits, other vegetables and fruits). The minimum dietary diversity score (MDDS) was dichotomized on the basis of whether or not women have consumed the list of food groups the previous day The MDDS equal to 5 or more was labelled as adequate dietary diversity. Physical exercise was taken into account as vigorous, moderate or mild exercise as per the criteria used in the international physical activity questionnaire (IPAQ). Vigorous physical activities that take a lot of effort like heavy lifting, digging, aerobics, or fast bicycling. Moderate physical activities are those that take moderate physical effort and make one breathe somewhat harder than normal, like carrying light loads, brisk walk for 10 min at a time. Mild physical exercise include walk at regular pace for at least 10 minutes at a time

Past obstetrics history which included the history of macrosomic babies, C/sections, still births, miscarriages , past account of GDM along with familial history of GDM and DM was taken. Participants' BSF and booking weight were recorded from their hospital forms while their current weight was taken on a digital weight scale. Their height was calculated without their shoes on a height scale (floor type ZT-120 EVERICH, China) and BMI was measured The mid-upper arm circumference (MUAC) measurement was taken with a measuring tape. MUAC of ≥28 cm was considered overweight.4 The systolic blood pressure (SBP) and diastolic blood pressure (DBP) was measured in mmHg (two readings with a gap of 10 min). Hypertension was labelled if the systolic and diastolic blood pressures was greater than or equal to 150 mmHg and 100 mmHg, respectively.

Statistical package for Social Sciences (SPSS) version 21 was used for data analysis. Frequencies were calculated for qualitative variables which included BSF, OGTT, MUAC ,BMI, physical activity (IPAQ low, moderate, vigorous), dietary diversity. Mean±SD was calculated for the quantitative variables which included age and gestation week. GDM was analyzed by Chi square among stratified age groups, BMI and MUAC values, level of physical activity and dietary diversity. *p*-value of less than 0.05 was taken as significant.

RESULTS

Out of 330 pregnant women, 47(14.2%) had GDM. Mean age was 31.95±6.34 years. For the age groups of GDM ,the sample size was homogenous. 31(65.95%) women lived in urban areas. Total house hold monthly income of 19(40.4%) was more than 30k PKR. GDM was significantly associated with obesity

i.e 37(78.7%) had MUAC >28 cm and 32(68.0%) had BMI >30. In the GDM group, history of no physical exercise was given by 34(72.3%). Previous poor obstetric history including macrosomic babies was reported by 30(81.1%) and c/sections by 35(74.4%) Gestational hypertension reported by 30(63.8%). previous GDM by 29(61.70%), familial DM 39(82.9%) and familial GDM by 40(85.10%) showing a strong positive association with familial history.

Participants were asked about their sociodemographic and obesity related variables , including the BMI and MUAC. Table-I shows the data related to these variables. Results were significant (*p*-value<0.05) for family history of GDM and DM type 2. BMI greater than 30 and MUAC greater than 28 cm were found in 15(97%) and 10(6.2%) of the GDM participants respectively which were significant (*p*-value<0.05).

Table-I: Sociodemographic & Anthropometric Variables of the Participants (n=330)

Variables	NonGDM n = 283	GDM n = 47	*p*-value
Participant's age (yrs)			
20 to 29	131(97%)	14(9.7%)	0.17
30 to 39	115(85.2%)	20(14.8%)	
40 to 45	37(74%)	13(26%)	
Residence			
Urban	171(84.7%)	31(15.3%)	0.471
Rural	112(87.5%)	16(12.5%)	
Family History of Diabetes Type II			
Yes	108(73.5%)	39(26.5%)	<0.001
No	175(95.6%)	8(4.4%)	
Family History of Gestational Diabetes Mellitus			
Yes	43(51.8%)	40(48.2%)	<0.001
No	240(97.2%)	7(2.8%)	
Body Mass Index at			
Booking visit<30	139(90.3%)	15(9.7%)	0.029
Equal or greater than 30	144(81.8%)	32(18.2%)	
Equal or greater than 28 cm			
MUAC*	151(93.8%)	10(6.2%)	<0.001
<28 cm	132(78.1%)	37(21.9%)	

**Mid Upper Arm Circumference*

Table-II shows their lifestyle factored including exercise habits, dietary choices, history of antenatal depression and their current blood pressure which is indicative of PIH. There were 34(25.8%) participants who didn't do any exercise in the GDM group Similarly antenatal depression was present in 20(30.3%) of the GDM participants and concurrent PIH was present in 30(49.2%) which were significant(*p*-value <0.001) in the GDM group.

Table-III shows the past obstetrics history of the study participants. Results were significant (*p*-value<0.05) for the GDM group which showed that out of participants with GDM , 30(81.1%) had macrosomia baby in any of the previous pregnancies. Similarly 22 (41.5%) had prior preterm birth,9(50%) had prior still birth, 35(30.2%) had prior C sections, 21(21.4%) had prior miscarriages ,9(75%) had prior congenital anomalies and 29(65.9%) had GDM in any of previous pregnancies.

Table-II: Behavioral and life style Characteristics of the Participants n=330

Variables	NonGDM n = 283	GDM n = 47	*p*-value
Level of exercise			
No exercise	98(74.2%)	34(25.8%)	<0.001
Mild	154(93.3%)	11(6.7%)	
Moderate	31 (93.9%)	2 (6.1%)	
Dietary diversity			
Adequate	106(80.9%)	25(19.1%)	0.53
Inadequate	177(88.9%)	22(11.1%)	
Antenatal Depression			
Present	46 (69.7%)	20 (30.3%)	<0.001
Absent	237(89.8%)	27 (10.2%)	
Substance Abuse			
Yes	14(93.3%)	1(6.6%)	0.390
No	269(85.3%)	46(0.1%)	
Blood pressure			
Hypertensive (equal or >150/100mm Hg)	31(50.8%)	30(49.2%)	<0.001
Normotensive (<150/100 mm Hg)	252(93.7%)	17(6.3%)	

Table-III. Prior Obstetrics History of the Study Participants n=330

Variables	NonGDM n=283 (85.8)	GDM n=47 (14.2)	*p*-value
Prior Macrosomic Baby			
Yes	7(18.9%)	30(81.1%)	<0.001
No	276(94.2%)	17(5.8%)	
Prior Preterm Birth			
Yes	31(58.5%)	22 (41.5%)	<0.001
No	252(91%)	25(9%)	
Prior Still Births			
Yes	9(50%)	9(50%)	<0.001
No	274(87.8%)	38(12.2%)	
Prior Caeserian Sections			
Yes	81(69.8%)	35(30.2%)	<0.001
No	202 (94.4%)	12(5.6%)	
Prior Miscarriages			
Yes	77(78.6%)	21(21.4%)	0.015
No	206(88.8%)	26(11.2%)	
Prior Congenital Anomalies			
Yes	3(25%)	9(75%)	0.001
No	280(88.1%)	38(11.9%)	
Gestational Diabetes Mellitus in Prior Pregnancies			
Yes	15(34.1%)	29(65.9%)	<0.001
No	268(93.7%)	18(6.3%)	

DISCUSSION

Our study was conducted on 330 pregnant women, the frequency was found out to be 14.2%.

Around the world, more than one criteria are used for the diagnosis of GDM due to the different cultural prevalence of GDM. Our study used the IADPSG diagnostic criteria,[5-7] to find out the prevalence of GDM and it's associated risk factors.

In our study, the non modifiable risk factors were previous poor obstetrics history including macrosomic babies, as reported by 30(81.1%) and c/sections by 35(74.4%), previous pregnancy with GDM by 29 (61.70%), antenatal depression(69.70%), positive familial account of DM 39(82.9%) and familial GDM was reported by 40(85.10%). However, no association of GDM was discovered in our study with the total number of pregnancies, maternal age, dietary diversity and substance abuse. Since gestational diabetes mellitus results from insulin resistance due to the pancreatic beta cells dysfunction, if left unaddressed, it can result in a multitude of adverse obstetrics outcomes including DM II, gestational HTN, pre eclampsia in the mother and macrosomia, miscarriage, poly hydramnios, still birth, premature rupture of membranes, preterm labour , congenital anomalies in the fetus.[7,8]

The modifiable risk factors in our study were maternal obesity before conception (BMI recorded at booking visit), sedentary life style, physical activity level and blood pressure during pregnancy. Reportedly, 37(78.7%) women had MUAC greater > 28 cm and 32(68.0%) had BMI greater than 30 which signifies obesity. Figure-2 depicts the breakdown of cases BMI wise noted at each participant's booking visit , showing that majority of cases in both GDM and non GDM groups had increased BMI. However different studies suggest the BMI alone is not a correct indicator of diagnosis of obesity during pregnancy mainly because of various cut off levels being used for grading obesity in different trimesters. Therefore we also included the MUAC in our study to augment the findings of BMI. The MUAC cut off level to detect obesity in the females is 27.9 cm and males is 27.7 cm.[8,9] The precision level of the MUAC for identification of overweight or obesity is high in both the sexes.[10] GDM and Obesity have major repercussions for both the mother and the fetus.[11] Desoye *et al*., state that excessive nutritional supply towards the developing baby due to insulin resistance coupled with eating habits of mother, obesity and increasing weight towards last trimester of pregnancy is associated with the advanced risks of fetal adverse metabolic conditions, fetal hyperglycemia as well as risk of neonatal malnutrition after birth.[12,13]

Thirty four (72.3%) of the participants with GDM gave history of no physical exercise during their pregnancy , 23.4% had mild exercise and 4.2% had moderate physical exercise. Few studies have shown that regular exercise decreases postpartum weight retention. Ehrlich SF *et al.*, reported mild exercise as preventive factor against GDM.[14] comparable results have been reported by another study implying that mild physical activity effectively reduced the odds of developing GDM.[15]

In our study , 20 out of 47(42.5 %) GDM positive women had antenatal depression which also contributes to chronically increased serum cortisol levels thereby aggravating insulin resistance. Studies have revealed that prenatal physical activity also tends to reduce the ante natal and post natal depression symptoms.[16]

Among the women diagnosed with GDM, 65.95% resided in urban areas which showed higher urban prevalence. A rural environment exposes the individual to inhale purer air and pollution free environment along with intake of organic, unprocessed, pure & healthier diet imply a protective effect on a person's mental health especially in pregnancy when the body is already in a state of physiological stress, thus also alleviating state of stress as well as depression.

Notably 30(63.8%) women reported having gestational hypertension (PIH) along with GDM. While blood pressure during pregnancy can be controlled by modifying dietary habits and keeping an active lifestyle, developing PIH with concurrent GDM further aggravates GDM. Few studies show that the oxidative stress underlying the hypertension disorders during gestation (PIH) and consequent pre-eclampsia directly results in inadequate and insufficient utero placental blood perfusion leading to calcifications, placental infarcts and fibrin deposits resulting in hypoxemia in placenta, that leads to the systemic cascade of inflammatory response activation in the mother .In pre eclampsia, this may cause kidney inflammation and result in proteinuria.[17] The urinary excretion of the 8-oxo Guo (a proteinuria marker) is seen at pronounced levels in preeclamptic state. The oxidative stress becomes considerably worse due to excess insulin production in concurrent GDM, markedly at the cellular level hampering the cells to

transport glucose from blood towards tissues which further aggravates insulin resistance.[18,19]

In the 22(46.8%) out of 47 GDM women having inadequate dietary diversity it was observed that these women taking un equal foods from the 3 main food groups (i.e carbohydrates, fats, proteins) had more tendency to develop GDM concurrently with PIH. Excessive intake of high carb foods and trans fatty acids were also predictors for developing PIH as well as GDM.[20] Out of 47 GDM women, only 1(2.12%) gave history of huqqa smoking. Studies suggest that women who have been smoking before or during pregnancy have a significantly higher risk of GDM thus requiring insulin therapy.[21] Passive smoking also equally exposes women to the adverse effects of nicotine in pregnancy leading to an increased possibility of getting GDM among non smoker gravid females.[22] Masalin S. *et al.*, states that smoking decreases offspring weight if the female continues smoking after the 1st trimester.[23]

Implementing lifestyle and healthy dietary changes reducing salt and sugar intake, regular walk can significantly decrease HTN and GDM. The findings of our study can provide guidelines for the improvement of overall management of GDM.

LIMITATIONS OF STUDY

Our study was carried out in a single center. A multicenter study performed on larger sample size can better guide us to develop guidelines for better management of GDM.

CONCLUSION

The modifiable risk factors for GDM included obesity and sedentary lifestyle with no physical activity, whereas the non modifiable risk factors were positive familial account of GDM and poor obstetrics history including GDM in prior pregnancy. The overall frequency of GDM was found out to be 14.2%

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Authors' Contribution

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

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

QJ & SA: Data acquisition, data analysis, approval of the final version to be published.

FAR: Critical review, concept, 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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