

Original Article

Assessment of Gestational Diabetes Mellitus Risk Factors in Local Population

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Abstract

Background The gestational diabetes mellitus (GDM) is defined as any degree of glucose intolerance with onset or first recognition during pregnancy. Risk management of GDM should be done at first prenatal visit. As it is the most common metabolic complication of pregnancy, the present study was focused on finding out the risk factors of GDM in local population. **Method** We evaluated the risk factors of GDM in 200 females who were randomly tested for GDM with 75 g Oral glucose tolerance test (OGTT) at 24–28th weeks of pregnancy. A detailed questionnaire was administered in this cross sectional study. **Results** The most commonly observed risk factor was family history DM, 117 patients ($p < 0.001$ and odd ratio as 40.4 [17.4 to 93.6]), obesity, 113 patients ($P < 0.001$, odd ratio as 4.5 [2.2 to 9.2]), pregnancy related stress in 109 ($P < 0.001$, odd ratio as 4.8 [2.4 to 9.5]), anemia in 88 females ($P = 0.003$, odd ratio as 3.5 [1.5 to 8.0]), history of abortions, 76 ($P < 0.001$, odd ratio as 2.9 [1.59 to 5.34]). Furthermore, stress, hypertension, lack of exercise were significantly associated risk factors of GDM. Only 93 females who had fatigue during pregnancy ($P = 0.718$ and odd ratio as 0.88 [0.45 to 1.71]) had association with development of GDM that was statistically insignificant. **Conclusion** The most commonly occurring risk factor of GDM in our population were obesity, family history of diabetes, stress, hypertension and lack of exercise. Unusual association was observed between iron deficiency anemia and GDM.

Keywords

Gestational Diabetes Mellitus, Obesity, Glucose Intolerance, Diabetes Mellitus, Abortion

Introduction

Gestational diabetes Mellitus (GDM) is metabolic disorder in which intolerance to carbohydrates develops in pregnancy resulting in hyperglycemia (Aktun, et al., 2015); (Zheng, Liu, et al., 2013). It affects 1% to 28% of all pregnancies. Gestational diabetes mellitus (GDM) is a widespread medical condition associated with pregnancy. As the prevalence of diabetes and pre-diabetes is increasing in population with increasing age of conception and child bearing, the chances of development of

GDM will also increase (Nielsen et al., 2014). In pregnancy, insulin resistance is increased by 50–60% in order to protect the fetus from deprivation of nutrients.

In consequences certain hormones are secreted from the placenta and they increase fat deposits in the body of mother. To compensate for insulin resistance in GDM, the pancreatic β -cell increase their insulin production by hypertrophy or hyperplasia (Mørkrid et al., 2012).

GDM has poor health prognosis for mother and fetus both in short and long term consequences. Women diagnosed with GDM have higher chances of developing undesirable pregnancy outcomes and there are two folds increased chances of developing type II diabetes in such females rather than those who are non-diabetic during pregnancy. Number of studies has been conducted to show that by the help of therapeutic intervention and lifestyle adaptation, undesirable outcomes of GDM can be minimized and the chances of developing type II diabetes after pregnancy in such females can also be reduced (Nielsen et al., 2014).

According to a study, females with GDM have 6 folds' higher chances of developing type II diabetes in following pregnancy as compared to females who have normal glucose tolerance in pregnancy. The most common risk factors involved in the manifestation of GDM are family history of diabetes, obesity, higher maternal age, previous cesarean section and delivery of a macrosomic baby. The other less associated risk aspects include short stature of mother, less physical activity of mother during pregnancy, multiparity, smoking and excess weight gain in pregnancy. Some socio-economic factors are also considered as contributors in GDM (Erem, Cihangir, et al., 2015).

The objective of the present study is to determine the GDM risk factors and their prevalence in local population and to find out the areas where we need to concentrate with respect to local circumstances.

Methodology

The study was planned by the Pathophysiology Research Unit, the department of Physiology, University of

Karachi and was accomplished in collaboration with Imam Hospital, Karachi. The data collection was started in March 2010 and completed in November 2010. It was a cross sectional study. Among the pregnant females coming to the Gynecology clinic, 200 females were randomly tested for GDM with 75 g Oral glucose tolerance test (OGTT) at 24–28th weeks of pregnancy and they were the part takers. The diagnosis of GDM was made according to the WHO criteria that is if fasting blood sugar (FBS) > 126 mg/dl and two-hour post prandial glucose tolerance (PPGT) > 140 mg/dl, it confirms GDM. Women with any systemic disease and those who were already known case of type 1 and type 2 diabetes were excluded (Aktun et al., 2015).

All pregnant females were asked to respond a planned questionnaire (after an informed consent) that was based on the available literature of risk factors of GDM. The demographic characteristics included in questionnaire were age, level of education, employment status, income and anthropometric measurements for BMI. We stratified maternal age as <35 and ≥ 35 years. BMI (<25, 25-25.9 or ≥ 30 kg/m²) was calculated from height and weight (kg) at that time of presentation in Gynae clinic (Bowers et al., 2011). Patients were considered as obese who had BMI ≥ 25 kg/m² according to the cutoff standards given by Korean society of obesity (Cho et al., 2015). Questionnaire was further divided into conventionally reported risk factors which were divided as modifiable risk factors such as education, obesity during pregnancy or before pregnancy (weight gain <8kg or ≥ 8 kg), dietary patterns, anemia, physical activity in terms of exercise, smoking (non-smokers, smokers and passive smokers), and non-modifiable risk factors such as polycystic ovary, previous macrosomic baby

(Ali, A. D., et al., 2016) , age, hypertension, parity, family history of diabetes, previous miscarriages or abortions, previous GDM history (Aktun et al., 2015); (Erem et al., 2015).

Statistical analysis

Data was entered and analysis in to SPSS version 22. Descriptive statistics were calculating in term of Mean ± SD & proportion analysis with percentages. Odd ratio was also calculated for different parameter of the study participant. History of GDM was the unit of analysis each unit yes/no were calculate and to compare with all demographic categorical variables chi-square test was applied in case if frequency less than 5 then fisher exact test were applied. Finally, p-value <0.05 were taken as significance.

Results

The mean age of the 200 pregnant females was 31.5± 5.7 years, ranging as 20-40 years. Out of these females 53.5% were ≤ 35 years of age. There were 117 females of short height, 66 of tall height and 17 were of average height. In our study 128 females had positive history of GDM (Figure 1). Among all pregnant females with and without GDM following risk factors were present: obesity in 158(79.0%) patients, pregnancy related stress in 148(74%), family history of DM in 132(66%), stress in 132(66%), hypertension 123(61.5%), anemia 122(61%), abortion in 100 (50%) passive smoking 88 (44.0%) and lack of exercise in 60 (30%) patients (table 1). Polycystic ovary was present in 80(40.0%) females and previous delivery of macrosomic baby was present in 79(39.5%) pregnant females.

Figure1: Patients with Positive History of GDM

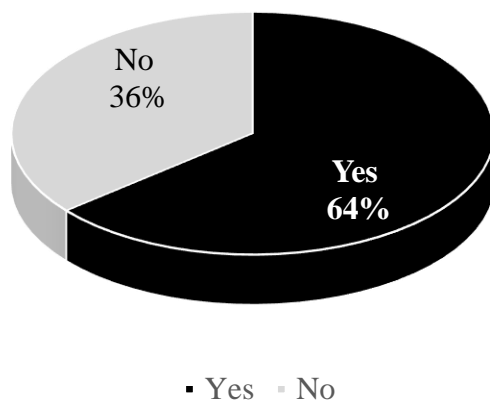


Table 1: Most Commonly Observed Risk Factors of GDM

Demographic Variables	Count	Percentages %
Obesity	158	79.0%
Pregnancy related stress	148	74.0%

Family history of DM (type II)	132	66.0%
Stress	132	66.0%
Hypertension	123	61.5%
Anemia	122	61.0%
History of Abortions	100	50.0%
Passive smoking	88	44.0%
Polycystic ovary	80	40.0%
Previous macrosomic baby	79	39.5%
Lack of Exercise	60	30.0%

Table 2 shows the extent of association of the risk factors in development of GDM. About 117 females with family history of DM were found to have statistically highly significant association with development of GDM $p < 0.001$ and odd ratio as 40.4 [17.4 to 93.6]. Similarly, statistically significant association was observed in risk factors such as in 113 obese patients ($P < 0.001$ and odd ratio as 4.5 [2.2 to 9.2]), 109 patients with pregnancy related stress ($P < 0.001$ and odd ratio as 4.8 [2.4 to 9.5]), 88 anemic females ($P = 0.003$ and odd ratio as 3.5 [1.5 to 8.0]), 76 females with history of abortions ($P < 0.001$ and odd ratio as 2.9 [1.59 to 5.34]), 95 patients with stress ($P = 0.001$ and odd ratio as 2.7 [1.48 to 5.0]), 86 pregnant females with hypertension ($P = 0.028$ and odd ratio as 1.93 [1.0 to 3.49]), 97 females lacking exercise ($P = 0.017$ and odd ratio as 0.474 [0.225 to 0.882]), 49 pregnant females who were passive smoker ($P = 0.030$ and odd ratio as 0.5 [0.2 to 0.9]). Only 93 females who had fatigue during pregnancy ($P = 0.718$ and odd ratio as 0.88 [0.45 to 1.71]) had association with development of GDM that was statistically insignificant. Similarly, history of polycystic ovary and previous delivery of a macrosomic baby didn't show significant association with GDM.

Table 2: Association of Risk Factors with GDM

Risk Factors		History of GDM		P-Value	Odd Ratio [CI]
		Yes	No		
		Count	Count		
Family History of DM	Yes	117(58.5%)	15(7.5%)	<0.001*	40.4 [17.4 to 93.6]
	No	11(5.5%)	57(28.5%)		
Obesity	Yes	113(56.5%)	45(22.5%)	<0.001*	4.5 [2.2 to 9.2]
	No	15(7.5%)	27(13.5%)		
Pregnancy Related Stress	Yes	109(54.5%)	39(19.5%)	<0.001*	4.8 [2.4 to 9.5]
	No	19(9.5%)	33(16.5%)		
Anemic	Yes	88(44%)	34(17%)	0.003*	3.5 [1.5 to 8.0]
	No	40(20%)	38(19%)		
History of Abortion	Yes	76(38%)	24(12%)	<0.001*	2.9 [1.59 to 5.34]
	No	52(26%)	48(24%)		
Stress	Yes	95(47.5%)	37(18.5%)	0.001*	2.7 [1.48 to 5.0]
	No	33(16.5%)	35(17.5%)		

Hypertension	Yes	86(43%)	37(18.5%)	0.028*	1.93[1.0 to 3.49]
	No	42(21%)	35(17.5%)		
Lack of Exercise	Yes	31(15.5%)	29(14.5%)	0.017*	0.47[0.22 to 0.88]
	No	97(48.5%)	43(21.5%)		

Discussion

The study was conducted to appraise the risk factors of GDM in our population. The assessment was based on the risk factors which were evaluated from different researches conducted worldwide. In our study one of the most important risk factor strongly associated with GDM was family history (FHD) of GDM it has the higher odds ratio. According to previous research studies the reported literature also strongly correlates with family history of diabetes mellitus and development of GDM (Rajput et al., 2014); (Somani, B. L., et al.,2012). It is considered that chances of GDM are two times higher in those pregnant females who have family history of DM as compared to those who first degree relative are non-diabetic and there is statistically significant association among both (Erem et al., 2015). In a study conducted in UAE, the family history of DM was found to be strongly correlated prognosticator of GDM (Ali et al., 2016). Our study results are also consistent with the reported literature as there was a highly significant association between FHD and GDM. Obesity was also found to be another key predictor of GDM in our study because majority of the pregnant females were obese and their BMI in pregnancy was $\geq 25\text{kg/m}^2$ and there was highly statistically significant association in obesity and GDM. In a systematic review, American College of Obstetrics and Gynecologists suggested that those pregnant females who are overweight, must be screened for GDM as it is one of the important clinical risk factor for development of GDM pregnant women having BMI between $25\text{-}30\text{kg/m}^2$ fall in category of high risk group (Nielsen et al.,

2014). A number of met-analyses have also shown that weight gain before pregnancy is an integral risk factor of GDM. Out of 70 studies, one study reported that women with $\text{BMI} \geq 25\text{kg/m}^2$ have two times higher odds of developing GDM while females who are moderately obese and morbidly obese have 3 and 5 times higher odds of developing GDM respectively (Kim, 2014). Literature from Africa also reported that a $\text{BMI} > 30$ possess 3 times higher threat of GDM (Macaulay et al.,2014). Our study results are also supported with reported literature as we saw that obesity has 4 folds' higher odds as a risk factor of GDM (odd ratio[OR], 4.5; 95% [CI],2.2 to 9.2).

Stress is also another important risk factor of GDM. In a cross sectional study that was conducted on pregnant females who were in 20-30 weeks of conception, it was observed that in 75 g OGTT fasting glucose levels were increased in females who had pregnancy related stress, depression and anxiety and it was a significant association (Horsch et al., 2016). One of the studies from Bangladesh reported that stress leading to depression is a significant risk factor of GDM and there exists a strong affiliation. The prevalence of depression among expected females was 18.32% and this rate was higher in women with GDM, 25.92% as compared to non GDM females thus proving that women with history of depression are highly prone to the development of GDM (Natasha et al., 2015). In our study similar results are proved showing to have a positive significant association with GDM between pregnancy related stress and GDM as the odds of pregnancy related stress are

4.8 times higher in GDM diagnosed females as compared to those who are not under stress. This pregnancy related stress could be due to previous history of miscarriage or fear of delivering baby for the first time. Similarly, the odds of stress other than pregnancy related are also 2.7 times higher in our population. There can be number of factors contributing in this stress like relations with the husband, in laws and financial instability or work place pressure. Another important finding in our study was the presence of anemia as a risk factor of GDM, although the literature suggests that there is an inverse relationship between anemia and GDM but we found direct association and it was significant. One of the prospective study that was conducted to find the association between iron intake and hemoglobin in pregnancy and the risk of GDM suggested that higher serum iron levels in pregnancy, greater are the chances of GDM (Helin et al., 2012). In a systematic review and Meta –analysis it was reported that risk of GDM is significantly higher in pregnant females who have elevated heme iron and serum ferritin levels (Fu, Shimin, et al., 2016). Another reported literature suggested that iron deficiency anemia serves as a good marker for decreasing prevalence of GDM (Lao & Ho, 2004). Thus we might need to work on larger sample size to prove our hypothesis in consistent with reported literature and find out the reasons of inverse relationship in our population.

Another significant association that we found in our study was abortion and the odds of developing GDM in those females who had abortions were 2.9 folds higher. In some of the studies it was reported that frequent abortions increases the risk of GDM and suggested that those women who had 3 or more abortions have higher chances of developing GDM but this association

didn't gain significance {SSH, 2011 #39; Hedderson, 2008 #52}. In a cross sectional study from Nigeria, the relative risk of recurrent pregnancy loss was reported as 1.58 (Fawole et al., 2014). In another study past history of abortion as a risk factor of GDM was evaluated and it reported that out of 723 GDM diagnosed females, 23.7% had history of abortions and it was a significant association on the basis of O'Sullivan's criteria (ACOG guidelines) but overall it was insignificant association (Somani et al., 2012). Hypertension (HTN) was another significant risk factor in our results and our results were comparable to reported literature as one of the study from China and rural west India reported HTN as a significant risk factor of GDM (Dave et al., 2014) and the odd ratio of increased systolic blood pressure was 1.31 ($P < 0.001$), this result was consistent with odd ratio of HTN thin our study which was 1.93 ($P = 0.028$) (Leng et al., 2015). In another literature it was reported that about 8% of pregnancies are accompanied by preeclampsia and gestational hypertension and it is observed that such females develop insulin resistance during gestation period resulting in GDM (Feig et al., 2013). In a study that measured blood pressure before and in early pregnancy to establish the risk of GDM, it was reported that pregnant females with prehypertension tend to have less chances of GDM (odd ratio [OR] 1.56) while expected females with hypertension had 2 times higher odds of developing GDM (Hedderson & Ferrara, 2008).

Lack of exercise or less physical activity was inversely associated with GDM in our study that is lesser the physical activity, higher are the chances of GDM and this was a significant association. Thus we can infer that in our population pregnant females need to focus on exercise or moderate physical

activity in order to protect themselves from GDM. The internationally published literature also supported this hypothesis and reported that those pregnant females who follow the regimen of exercise during gestation period are protected from GDM and its other outcomes. Women with GDM have higher chances of delivering macrosomic baby, cesarean section and preterm birth but with the help of exercise all these adverse outcomes can be controlled. Adequate physical activity also results in maintaining BMI thus contributing in other way to combat the risk factor of GDM (C. Wang et al., 2015). Another study from New York also reported that physical activity in relaxation timings could serve as a defensive factor from GDM thus life style modification in terms of introducing moderate physical activity during pregnancy can save from GDM and other complications (Hod et al., 2015); (Leppänen et al., 2014).

In gestational diabetes mellitus females of our study fatigue was also found as a risk factor of GDM but there was no significant association and the odd ratio was very small. In one of the study fatigue and lack of energy were considered as obstacles for preventing GDM as fatigue could lead to lack of exercise and lethargy (Han, Shanshan et al., 2015). The other risk factors of GDM found in our study that were not significantly associated with GDM but consistent with reported literature were, previous delivery of a macrosomic baby, polycystic ovary, passive smoking and age ≥ 35 years (Cho et al., 2015); (Cupul-Uicab et al., 2012); (Hayes et al., 2013); (Kirke et al., 2014); (Y. Wang et al., 2013).

Conclusion

According to our results of study on the assessment of risk factors of GDM in local

population we found that the major risk factors in our population are family history of diabetes mellitus, obesity, stress, pregnancy related stress, abortions, hypertension and lack of exercise. While the unusual association of iron deficiency anemia as a risk factor of GDM suggests that we need to work on larger sample size in order to confirm this trend in our local population.

Conflict of Interest

The authors declare no conflict of interest.

Acknowledgment

N/A

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