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Risk factors of Gestational Diabetes Mellitus Among Saudi Women

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Abstract:

Objective: The aim of this study was to identify the main risk factors of Gestational Diabetes Mellitus among Saudi women.

Methodology: This is a case control laboratory-based study conducted in Wadi Al Dawasir City in Saudi Arabia.600 pregnant women as follows; 300 screened pregnant women as the study group and 300 non screened pregnant women as the control group.Selection Criteria for the screened group: Should be booked at 28 weeks or before that, not known to be diabetic before pregnancy or diagnosed as cases of GDM before 24 weeks. Selection Criteria for the non-screened group: They were not diagnosed before pregnancy as cases of DM or diagnosed during pregnancy as cases of GDM.Screening for GDM: Screening for GDM was a routine using loading dose glucose (LDG) or glucose challenge test (GCT) between 24-28 weeks gestation according to the hospitals protocol. The pregnant women were classified into high risk or low risk according to the following characteristics

Results: Risk factors in the screened mothers with positive LDG result was: family history was identified in 56.1% (23/41) of mothers and it was absent in 43.8% (18/41). The next main risk factor among the mothers with positive LDG results was a history of baby weight 4 kg or more and was found in 9.76% (4/41) followed by history of intrauterine fetal death that was detected in 7.32% (3/41). Only one mother 2.44% (1/41) had past history of gestational diabetes mellitus similar to mothers with history of babies with congenital malformation that was detected in 2.44% (1/41) also. Family history was the main risk factor among mothers with positive LDG results as it was found in 56.1%. Within the 20 mothers with significant oral glucose tolerance test (OGTT) results, 80% (16/20) had risk factors and 20% (4/20) had no risk factors.

Conclusion: Identifying of risk factors is important for screening for GDM but even women with low risk and no risk factors should be screened for GDM.

Introduction:

Pregnancies complicated with GDM present a public health problem of a major proportion. They are generally classified as high risk and require more intensive obstetrical supervision. It is associated with increase in both diabetes and pregnancy related complications[(1)]. It has been reported that 50% of these patients with GDM will become diabetic in 15 years following pregnancy [(2)] especially for those over weight (46.7%) [(3)]. Intrauterine exposure to diabetes conveys a high risk for the development of diabetes and obesity in offspring in excess of risk attributable to genetic factors alone [(4)]. Also they are more liable to develop slowly progressive form of abnormal glucose tolerance in addition to overt diabetes[(5)]. Early clinical recognition of GDM is important because therapy, including medical nutrition therapy (MNT), insulin when necessary, and antepartum fetal surveillance, can reduce the well described GDM-associated prenatal morbidity and mortality[(3)]. Among those factors are reproductive event including a prior

neonate weighing more than 4 kg or a prior neonatal death, congenital anomaly or family history of overt diabetes, clinical finding during pregnancy that include obesity, excessive weight gain, glycosuria, proteinuria and hypertension[6]. Several investigators have examined the efficiency of these risk factors and narrowing the groups to be screened very consistently. These investigators have found these risk factors only in roughly half of the women known to have GDM. That means if risk factors alone determined who was to be screened, half of all cases of GDM would not be detected [6]. Many investigators found that minor abnormalities of glucose metabolism without GDM are significant risk factors for fetal over growth [7].

Although there is less risk of gestational diabetes in low risk women, the prevalence is still high enough to make testing for gestational diabetes worthwhile. Furthermore low risk women with GDM are at equal risk for complications [8]. It was found that over half of all patients who exhibit an abnormal GTT lack the risk factors mentioned above and 35% of all cases of GDM will be miss diagnosed if an arbitrary age cut-off of 30 years used for screening [6]. It is therefore recommended that all pregnant women should be screened for gestational diabetes.

In Saudi Arabia the available data suggests that the incidence of hyperglycemia is high [9,10,11,12]. The high incidence may in turn influence the incidence of gestational diabetes in the population [12]. Also the changing socioeconomic status of Saudi is culminating in the affluence enjoyed by the population could be a factor [9,10]. Also the climatic condition and the general life pattern that favours sedentary lifestyle prevents them exercising. The dietary habits, rich food in carbohydrates and high consumption of dates, the increase prevalence of obesity in addition to genetic factors [10]. All these factors predispose gravid Saudi women to develop diabetes mellitus.

The aim of this study was to identify the main risk factors of Gestational Diabetes Mellitus among Saudi women.

Methodology:

Study area: The research was conducted in Wadi Al Dawasir City in Saudi Arabia.

Study population: The population number in Wad Al Dawasir is about 80.000 – 120.000. The main health problem in this area is Diabetes Mellitus. Women are rarely allowed for outdoor walk with limited activities.

Sample Size and design: 600 pregnant women as follows of them 300 screened pregnant women as study group and 300 non screened pregnant women as control group.

A sample size was estimated using a sample size derivation. Since the prevalence is 30% thus **p** is 0.3 and **q** is 0.7.

The sample size (n) is determined by using the following formula

$$\mathbf{n = \frac{z^2 pq}{d^2}}$$ where d is 0.05, z is 2.

$n = (2)^2(30)\ (70)/25 = 336$ (This is the minimum sample size)

Selection Criteria for the screened group: Should be booked at 28 weeks or before that, not known to be diabetic before pregnancy or diagnosed as cases of GDM before 24 weeks.

Selection Criteria for the non-screened group: They were not diagnosed before pregnancy as

cases of DM or diagnosed during pregnancy as cases of GDM.

Site of Data Collection: Relevant data was collected from all women by the author himself. For the screened group the information was collected in the Antenatal Clinic of Armed Forces Hospital and Sulayyil Military Clinic .For the non-screened group the information was obtained from the mothers in the Ministery of Health (MOH) hospital.

Screening for GDM: Screening for GDM was a routine using loading dose glucose (LDG) or glucose challenge test (GCT) between 24-28 weeks gestation according to the hospitals protocol. Random Blood Glucose was done in the first visit for all pregnant women booked before 24 weeks (antenatal screening). 100 gm OGTT was done for all cases with blood glucose more than 10 mmol/L.

The pregnant women were classified into high risk or low risk according to the following methods: OGTT It was the main test performed during pregnancy to diagnose gestational diabetes mellitus (GDM), it was 3 hours test using 100 g glucose (4) according to the hospital protocol.

Data Analysis: All collected data were analysis by the SPSS. Probability/t-test was used to assess the significance of the results.

Consent: Consent was obtained from all participants.

Results:

In this descriptive interventional study we screened 300 pregnant women in order to detect the possible risk factors among them.Of the 300 screened pregnant women 22 were less than 20 years old distributed as follows: 95.5% (21/22) were normal and 4.5% (1/22) had GDM. Mothers at the age (20 – 29 years) were 199, 95.5% (190/199) were normal and 4.5% (9/199) proved to have GDM.Among the pregnant screened women in the age group 30 – 39 years 8.6% (6/70) had GDM and 91.4% (64/70) were normal. Of the 9 mothers at 40 years old and above, cases with GDM represent 44.4% (4/9) and 45.6% (5/9) were normal.The number of mothers with GDM increases with the increase of age compared to the normal and the difference between the two groups was statistically significant as Chi square test value = 22.680, df = 3, P. value = .000 which was highly significant. (More details in table 1).

When all cases of GDM (intolerance + GDM) were compared with normal mothers, the mean body mass index of the diabetic group was 29.5122 slightly higher than the mean body mass index of the normal mothers (27.6388). The difference between them is not significant. As T test = 1.491, df = 3 significance = 0.298. (Table 2)

It was found that 9.9% (7/71) primgravidae had LDG result > 7.8 mmol/L compared to 90.1% (64/71) primgravidae with LDG results less than or equal to 7.8 mmol/L. The percentage slightly increased in multiparous (up to 5 children) where 11.4% (21/185) mothers had positive LDG result compared to 88.6% (164/185) multiparous with negative LDG result. 30 (13/44) mothers who had more than 5 children had LDG result more than 7.8 mmol/L compared to 31 (31/44) 70.5% obtained LDG result less than 7.8 mmol/L

Grand multiparous obtained the highest number of positive LDG test 29.5% (13/44) compared to

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primgravidae and multiparous mothers. The difference between the two groups was statistically highly significant as X2 test value = 11.115, df = 2 and P. value = 0.00030. (Table 3)

Gestational diabetes mellitus was diagnosed in 36.6% (15/41) mothers with positive LDG test. 12.2% (5/41) mothers were found to have an impaired glucose tolerance test. The remaining 51.2% (21/41) mothers had normal OGTT test. Nearly half of the mothers with positive LDG results were found to have abnormal OGTT (GDM + IOGTT). Mothers with IOGTT were managed as cases of GDM though screening test identified nearly half of mothers with GDM. (Table 4)

About 22% (9/41) women had no risk factors and more than two thirds 78% (37/41) of the mothers with positive LDG result had risk factors. As more than 2/3 of mothers with positive LDG results had risk factors, so risk factors are predictive for diagnosis of GDM. 22% of mothers with positive LDG results would have been missed if screening for GDM was performed for mothers with positive risk factors only. (Table 5)

Table 1: Distribution of mothers with GDM according to their age compared to the normal mothers (N=300)

Age groups	GDM	Normal	Total
Less than 20 years	1 (4.5%)	21 (95.5%)	22 (100%)
20 – 29 years	9 (4.5%)	190 (95.5%)	199 (100%)
30 – 39 years	6 (8.6%)	64 (91.4%)	70 (100%)
40 years & above	4 (44.4%)	5 (45.6%)	9 (100%)
Total	20 (6.7%)	280 (93.3%)	300 (100%)

X2 = 22.680, df = 3 P. value = .000

Table 2: Shows the comparison between the mean of the body mass index (BMI) of cases with GDM and normal mothers (N = 300)

Final diagnosis	N	Mean of MBI	Std deviation	Std error of mean
GDM	20	29.5122	5.4353	1.2154
Normal	280	27.6388	5.4262	3243

T test = 1.491, df = 3 significance = 0.298.

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Table 3: Shows the results of LDG test in relation to parity (number of children has been delivered by the patient (N = 300)

Number of children	Result of LDG test		Total
	7.8 mmol/L or less	More than 7.8 mmol/L	
PG	64 (90.1%)	7 (9.9%)	71 (23.7%)
1 – 5 multiparous	164 (88.6%)	21 (11.4%)	185 (61.7)
>5 (GM)	31 (70.5%)	13 (29.5%)	44 (14.7%)
Total	259 (86.3%)	41 (13.7%)	300 (100%)

X = 11.115 df = 2 P value = 0.00030

Risk factors in the screened mothers with positive LDG result. Family history was identified in 56.1% (23/41) of mothers and it was absent in 43.8% (18/41).

The next main risk factor among the mothers with positive LDG results was a history of baby weight 4 kg or more and was found in 9.76% (4/41) followed by a history of intrauterine fetal death that was detected in 7.32% (3/41). Only one mother 2.44% (1/41) had past history of gestational diabetes mellitus similar to mothers with history of babies with congenital malformation that was detected in 2.44% (1/41) also. Family history was the main risk factor among mothers with positive LDG results as it was found in 56.1%. (Table 6)

Within the 20 mothers with significant OGTT results, 80% (16/20) had risk factors and 20% (4/20) had no risk factors.

In mothers with positive LDG results and negative OGTT, 23.8% (5/21) had no risk factors while 76.2% (16/21) had risk factors. In 41 mothers with positive LDG results 78.0% (32/41) had risk factors.Risk factors used in this study predicted 80% of cases of GDM and 76.2% of those with positive LDG results and normal OGTT. The difference between the two groups was statistically not significant as X2 test value = 0.007, df = 1 P value = 0.9340. As there was no difference between mothers with GDM and those with positive LDG results and normal OGTT, new cases of GDM were expected to be diagnosed among mothers with positive LDG results and normal OGTT, if OGTT was repeated at different gestational age (between 24 to 36 weeks). (Table 7)

There were 20.0% (4/20) mothers with GDM who had no risk factors compared to 23.0% (5/21) mothers with positive LDG results and normal OGTT. About 50.0% (10/20) of cases with GDM had one risk factor compared to 42.9% (9/21) mothers with positive LDG results and normal OGTT. 20.0% (4/20) diabetic mothers had 2 risk factors compared to 33.3% (7/21) mothers with positive LDG results and normal OGTT.

None of the pregnant women with positive LDG results and normal OGTT had 3 or 4 risk factors compared to those with 5% (1/20) diabetic mothers had 3 risk factors and the same number had 4 risk factors.

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The number of risk factors was more among mothers with GDM compared to mothers with positive LDG results and normal OGTT. The difference between the two groups was not significant as X2 test value = 2.959, df = 9, P value = 0.5647. (Table 8)

Table 4: The final result of oral glucose tolerance test OGTT for all mothers with LDG test more than 7.8 mmol/L (N = 41)

Final diagnose	Frequency	Percent
Gestational Diabetes Mellitus (GDM	15	36.6%
Impaired Oral Glucose Tolerance Test	5	12.2%
Normal OGTT	21	51.2%
Total	41	100%

Table 5: Number of cases with risk factors and those without risk factors among mothers with LDG result more than 7.8 mmol/L (N = 41)

Cases with LDG result >7.8 mmol/L	**No. of cases**
Mothers with no risk factors	9 (22%)
Cases with risk factors	32 (78%)
Total	**41 (100%)**

Table 6: Distributions and types of risk factors among mothers with positive LDG results (N = 41)

Types of risk factors	**Risk factors present**	**Absent factors**	**Total**
Past history of GDM	1 (2.44%)	40 (97.56%)	41 (100 %)
Family history of DM	23 (56.10%)	18 (43.80%)	
History of baby WT 4 kg or more	4 (9.76%)	73 (90.24%)	
History of babies with CMF	1 (2.44%)	40 (97.56%)	
History of IUFD	3 (7.32%)	38 (92.68%)	

Table 7: Mother with risk factors comparing cases of GDM to mothers with positive LDG

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results and normal OGTT (N = 41)

Risk factors	Mothers with GDM	Mothers with positive LDG results and normal OGTT	Total
Cases with no risk factors	4 (20.0%)	5 (23.8%)	**9 (22.0%)**
Cases with risk factors	16 (80.0%)	16 (76.2%)	**32 (78.0%)**
Total	**20 (6.7%)**	**21 (100%)**	**41 (100%)**

X^2 = 0.007 df = 1 P value = 0.9340

Table 8: Distribution of cases of GDM according to the numbers of risk factors compared to those with positive LDG results and normal OGTT (N = 41)

No. of risk factors	GDM	Normal	Total
No risk factors	4 (20.0%)	5 (23.8%)	9 (22.0%)
Cases with one risk factor	10 (50.0%)	9 (42.9%)	19 (46.3%)
Cases with two risk factors	4 (20.0%)	7 (33.3%)	11 (26.8%)
Cases with three risk factors	1 (5.0%)	0 (0.0%)	1 (2.4%)
Cases with four risk factors	1 (5.0%)	0 (0.0%)	1 (2.4%)
Total	**20.0 (100%)**	**21 (100%)**	**41 (100%)**

X^2 = 2.959, df = 9 P value = 0.5647

Discussion:

A total of 300 women were screened antenatally for gestational diabetes mellitus in order to detect the risk factor for developing gestational diabetes among Saudi women.

The hospital protocol adopted a random blood sugar 11.1 mmol/L is diagnostic for diabetes mellitus even in pregnant women. Screening in the first visit using 50 oral glucose should be done for all pregnant women with random blood glucose more than 8 mmol/L.

All mothers who had positive LDG results [13] were subjected to oral glucose tolerance test (OGTT) by using 100 gm oral glucose. 15 mothers (36.6%) had two or more abnormal results which were diagnostic for GDM, 5 mothers 12.2% had only one abnormal result suggestive of intolerance oral glucose tolerance test (IOGTT). The remaining 21, (51.2%) mothers had normal oral glucose

tolerance test and their final diagnosis was abnormal LDG results and normal OGTT. Patients with single abnormal value IOGTT results behaved like cases of GDM and were significantly different from mothers with normal OGTT [14]. There was no difference in the early insulin secretion (insulinogenic index), total insulin secretion (mean insulin level) and fasting insulin concentrations (haemostasis models) during oral glucose tolerance test between those with IOGTT and those with GDM [15]. Mothers with IOGTT were regarded as pathogenic finding and the patients were treated similarly to the patients with gestational diabetes mellitus [15].

The body mass index is a strong predictive means for positive LDG results. More patients with GDM could be diagnosed if OGTT was repeated to those with positive LDG results up to 36 weeks. Our results are similar to other studies in which obesity influences LDG results [1]. Increase in body mass index is associated with increased incidence of GDM [37, 38] even in low risk population [2].

Mothers with positive LDG results "78% (32/41)" had risk factors, so risk factors are predictive for abnormal LDG results. Risk factors were studied in all screened mothers with abnormal LDG results. The main risk factor among the screened mothers with positive LDG results is positive family history of diabetes mellitus as it was present in the history of 56.1% (23/41) followed by history of baby weighing 4 kg or more 9.76% (4/41). History of intrauterine fatal death was present in 7.32% (3/41). Past history of GDM and history of babies with congenital abnormalities were equally distributed as each of them presented by 2.44% (1/41). The of this study results are similar to other studies in Kuwait as they found the main risk factor was family history of diabetes mellitus, but they had more patients with past history of GDM [11]. Also similar to other studies in Saudi Arabia [9], Mexico [18] and China [16].

Risk factors were found in 80% (16/20) mothers with GDM compared to 76.2% (16/21) mothers with positive LDG results and normal OGTT. There is no statistical difference between them P value = 0.9340. Risk factors are predictive for GDM, so 23.8% (9/41) mothers with positive LDG results and 20% (4/20) mothers with GDM would have been missed if screening for GDM was done only for mothers with risk factors. This result is less than that found by other researchers [6] as they found that 50% of mothers with GDM had no risk factors and their recommendation was screening for all pregnant women based on that study. In screening pregnant women with no risk factors in Singapore 35.6% had positive screening higher than our results and 22.2% of them had GDM. The overall incidence of GDM is 8.3 % [1] they recommended universal screening. A study in Australian pregnant women with low risk factors reported the incidence of GDM was 8.7 less than our results [2] and they recommended universal screening for GDM. Good maternal and perinatal outcome cannot be achieved without early detection and treatment of mothers with GDM. One third of pregnant women with GDM have been overlooked [19] if screening for GDM was done only for mothers with risk factors. Universal screening for GDM increases the sensitivity test for screening [6] and it improves pregnancy outcome compared to selective screening [19]. Universal screening for GDM is recommended.

When studying the number of risk factors. 50% of diabetic mothers (10/20) had one risk factor compared to 42.9% mothers with normal OGTT (9/21). Two risk factors were more among

mothers with normal OGTT 33.3% (7/21) and all mothers with more than 2 risk factors were all diabetic. There is no statistical difference P value = 0.5647. So more diabetic mothers expected to be diagnosed among mothers with normal OGTT if OGTT is repeated after a month time and up to 36 weeks gestation [20, 21, 22].

Risk factors were more among mothers with positive LDG results and normal OGTT "76.1% (16/21)" compared to mothers with negative LDG results "42.5% (110/259)". The difference is statistically highly significant P value = 0.0058. As 23.8% (5/21) mothers with positive LDG results and normal OGTT had no risk factors, they would have been missed if screening was done only for mothers with risk factors. Diabetic mothers from low risk group or those with no risk factors run the same complications as high risk group and the prevalence of GDM is still high so screening test for all pregnant women is the solution [1,2,19].

Risk factors for GDM were compared between the screened and the non-screened mothers and were found to be similar in history of babies 4 kg or more P value = 1.000, history of intrauterine fetal death P value = 0.153 and the number of mothers with past history of GDM P value 0.560. They are different in history of babies with congenital malformations which was more among the screened mothers 3.3% (10/300) compared to 1.0% (3/300) of the non-screened mothers P value = 0.050. The two studied groups were also different in the number of mothers with family history of diabetes mellitus with higher percentage among the screened mothers 43.7% (131/300) compared to 20.0% (60/300) of the non-screened mothers. The difference is statistically highly significant P value = 0.00. Screening help identification of mothers at risk to develop GDM (6).

On studying the distribution of the risk factors in the whole area of the study it was found that the main risk factor was family history of diabetes mellitus which was found in 31.8% (191/600) mothers followed by history of big baby (4 kg or more) and past history of intrauterine fetal death which were found in 6.7% (40/600) and 4.2% (25/600) respectively. Past history of GDM "2.0% (12/600)" and history of babies with congenital malformations "2.2% (13/600)" were equally distributed in the mothers.

We recommend screening for GDM in high risk women but even women with low risk and no risk factors should be also screened for GDM.

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