Prevalence and Risk Factors for Gestational Diabetes Mellitus in Tehran

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Abstract

Objective: To evaluate the prevalence of gestational diabetes mellitus (GDM) and its risk factors in Tehran.

Materials and Methods: From March 2002 to October 2004, screening for GDM was performed on 1804 women in Tehran. All pregnant women were referred for a 50 g oral glucose challenge test (OGCT) between 24th and 28th week of gestation. All subjects with an abnormal GCT (blood glucose level ≥130 mg/dl) underwent an oral glucose tolerance test (OGTT) within 1 week after the abnormal screening test. The prevalence of GDM was estimated.

Results: The glucose challenge test was positive in 38.1% of cases .The prevalence of GDM for the whole cohort was 6.8%. About 78.6% of our population were at medium or high risk for GDM and, therefore, would have been screened.

The rate of GDM was significantly higher in women with a positive family history of diabetes, positive history of GDM, older age, multiparity, pre-pregnancy obesity, greater weight gain during pregnancy, history of infertility, chronic hypertension, history of stillbirth pregnancies and abortion. After logistic regression analysis, GDM diagnosis was significantly correlated with age (P<0.001), pre-pregnancy BMI (P=0.005), family history of diabetes (P<0.001), history of GDM (P=0. 002), chronic hypertension (P<0.001) and glucosuria during current pregnancy (P<0.001).

Conclusion: In populations with medium/ high risks for GDM (like the Iranian) universal screening is recommended to identify women with diabetes mellitus.

Keywords: Gestational diabetes mellitus, Prevalence, Risk factors, Screening

Introduction

Gestational diabetes mellitus (GDM) is defined as any degree of glucose intolerance with onset or first recognition during pregnancy (1). It represents the most common metabolic complication of pregnancy. GDM is associated with maternal and fetal morbidities (2). Therefore, early diagnosis of GDM is essential to reduce maternal and fetal morbidity and to allow subsequent attempts to prevent or delay the onset of type 2 diabetes (3).

Although it is a frequent metabolic alteration during pregnancy, the true prevalence of GDM remains

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Table 1: Clinical characteristics of pregnant women undergoing GCT (n= 1804)

	Mean ± SD
Age (year)	26.9 ± 5.0
Pre-pregnancy weight (kg)	64.3 ± 11.3
Height (cm)	159 ± 55
Pre-pregnancy BMI (kg/m²)	25.3 ± 4.4
Weight gain during pregnancy (kg)	12.3 ± 1.8
	Number (%)
Family history of diabetes	281 (15.6)
Primiparous	1046 (58.0)
History of infertility	94 (5.2)
History of macrosome infant	85 (4.7)
History of chronic hypertension	18 (1.0)
History of stillbirth	47 (2.6)

a matter of controversy. Approximately 7% of all pregnancies are complicated by GDM, resulting in more than 200,000 cases annually. The prevalence may range from 1 to 14% of all pregnancies, depending on the population studied and the diagnostic tests employed (4-5).

Universal screening has been recommended since 1980 (6), while the Fourth Workshop on Gestational Diabetes (1) and, more recently, the American Diabetes Association (7), suggested selective screening for GDM only in women at high risk of glucose intolerance. Due to few studies comparing selective versus universal screening in Iranian populations, this prospective analysis on pregnant women was performed. The main objective of this study was to evaluate the prevalence of GDM in Iranian pregnant women and to determine the frequency of GDM risk factors.

Materials and methods

A prospective study on 1804 Iranian pregnant women was conducted from 2002 to 2004. This cross sectional study was approved by the Ethical Committees of Shahed and Tarbiat Modaress Universities, Tehran, Iran. The participants were drawn from two prenatal clinics in Tehran, after obtaining informed consent for the scientific use of the data. Women who had glucose intolerance before pregnancy or had history of GDM in previous pregnancies with persistent abnormal or undetermined glucose tolerance were not included in the study. All pregnant women were referred for a 50 g oral glucose challenge test (OGCT) between 24th and 28th week of gestation. However, when risk factors such as positive family history of diabetes, age >25 years, pre-pregnancy overweight, personal history of GDM, glucosuria and history of macrosomia were present OGCT was performed at the 14th–18th week of gestation. In the latter group, when the GCT result was negative (GCT−), a further GCT was performed at 24th–28th week of gestation.

The study was performed according to the recommendations for universal screening by the Third International Workshop Conference on Gestational Diabetes (8). According to the ADA recommendations (9) and the conclusion of the Fourth International Workshop Conference on GDM (1), one hour blood Glucose value ≥130 mg/dl was used as the cut-off value of the screening test irrespective of pregnancy age.

Each participant was interviewed and age, gravidity, parity, duration of pregnancy, outcome of previous, history of fetal macrosomia (birth weight > 4000 g) and family history of diabetes were noted. Detailed information including pre-pregnancy BMI, weight gain during pregnancy, blood pressure (BP) recordings (hypertension defined as systolic BP ≥ 140 mmHg and diastolic BP ≥ 90 mmHg) were recorded. In all cases, weight and height were measured on the screening day, while pre-pregnancy weight was asked from each woman. The gestational age was estimated by last menstrual period, confirmed or corrected by ultrasonography.

At first all the participants were screened for GDM using blood glucose measurement one hour after eating 50 g glucose. OGCT was performed during the first hours of the day regardless to the time of last meal. One hour after 50 g glucose consumption, plasma glucose concentration (glucose oxidase method) was measured. All subjects with an abnormal GCT (blood glucose level ≥130 mg/dl) underwent an oral glucose tolerance test (OGTT) within 1 week after the abnormal screening test. Women with an abnormal OGCT received a 3 h 100 g OGTT and were classified according to the *Carpenter and Coustan* criteria for GDM. At least two of the four plasma glucose concentrations had to be abnormal for diagnosis of GDM (normal values: 0 h <95 mg/dl, 1 h <180 mg/dl, 2 h <155 mg/dl and 3 h <145 mg/dl). The OGTT was performed in sitting position after an overnight fast of 8 to 14 h while she was on an unrestricted diet and physical activity for at least 3 days. Urine analysis for glucose and protein was performed in all women.

The prevalence of GDM was estimated in all women undergoing GCT (i.e. universal screening). It

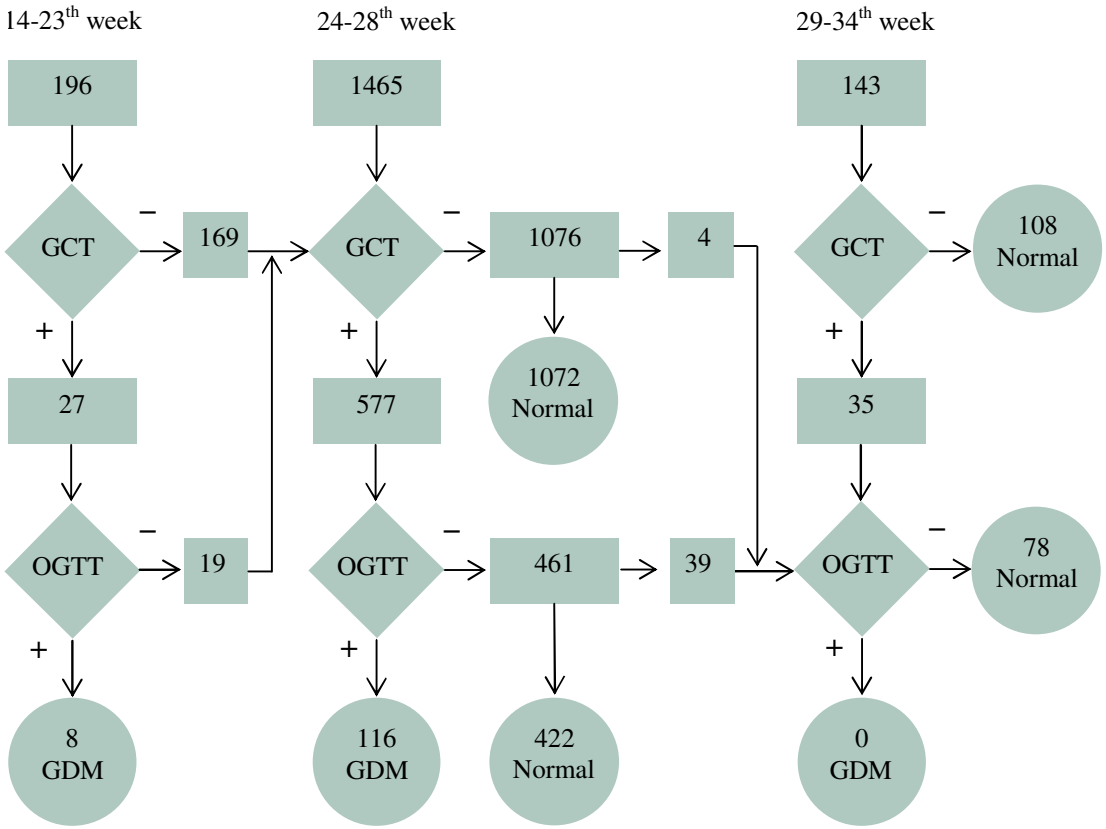

Figure 1: Description of Gestational Diabetes Mellitus screening in the participants

was also estimated in the group of low risk women, defined on the basis of the ADA's recommendations: age <25 years, normal body weight (BMI <25 kg/m^2) and no family history of diabetes.

The rates of selected potential risk factors were calculated for women with and without GDM. Chi-square tests were performed to test statistical significance. To assess the independent effect of each individual risk factor attributed to GDM, multiple logistic regressions were applied. The adjusted odds ratio (OR) and the 95% confidence interval (C.I) were derived from the coefficient of the logistic model and its standard error. All *P*-values were two-tailed, and the selected significance level was 0.05. All statistical analyses were performed using SPSS version 11.5 for Windows (SPSS Inc., Chicago, IL).

Results

During the study period a total of 1804 Iranian women (mean age 26.9±5.0 years; range: 16–43 years) were referred to selected prenatal care clinics. A positive history of diabetes in first degree relatives was reported in 15.6% of cases. Pre-pregnancy body weight and BMI were 64.3 ±11.3 kg (range 40-125 kg) and 25.3±4.4 kg/m^2 (range 14.1–48.1 kg/m^2), respectively. Weight gain during pregnancy at the day of screening test averaged 12.3±1.8 kg (range 1–32 kg) (Table 1).

GCT was performed early in pregnancy (14th–23th weeks) in 196 (10.9%) women, while in 143 (7.9%) women it was performed later than the 28th week and in 1465 (81.2%) between the 24th and 28th week; the mean gestational age for GCT was 25.8±2.6 week.

A positive GCT was found in 639 women (35.4%); including women tested earlier and later in pregnancy. Twenty seven of the 196 women tested earlier in pregnancy had a positive GCT (13.8%). OGTT was done for this group of women and 8 (29.6%) women had GDM. The remaining women (negative GCT) had a repeat GCT at 24th–28th week of gestation and the result was positive in another 48 (24.4%) cases; therefore, the total number of women with positive GCT in the group that was

Table 2: Prevalence of the risk factors

Risk factors	All Cases = 1804	GDM = 124
Age (year) *		
<30	1362 (75.5%)	58 (4.3%)
30-35	330 (18.3%)	37 (11.2%)
>35	112 (6.2%)	29 (25.8%)
Pre-pregnancy BMI (kg/m²) *		
<25	1136 (63.0%)	50 (4.4%)
25-28	355 (19.7%)	27 (7.6%)
≥29	313 (17.3%)	47 (15.0%)
Family history for DM *		
Negative	1520 (84.3%)	71 (4.7%)
Positive	284 (15.7%)	53 (18.6%)
Parity *		
0	1046 (58.0%)	45 (4.3%)
≥1	758 (42.0%)	79 (10.4%)
Weight gain (kg) **		
<10	378 (21.0%)	10 (2.6%)
≥10	1427 (79.0%)	114 (7.9%)
Glucosuria during current pregnancy *		
Negative	1767 (97.9%)	114 (6.5%)
Positive	37 (2.1%)	10 (27%)
History of chronic hypertension *		
Negative	1786 (99.0%)	117 (6.6%)
Positive	18 (1.0%)	7 (38.9%)
History of GDM ***		
Negative	1713 (95.0%)	75 (4.4%)
Positive	91 (5.0%)	49 (53.8%)

* P<0.001, ** P=0.008, *** P<0.0001

screened earlier in pregnancy was 74 (29.6%).

OGTT was performed in 577 women with positive GCT results. GDM was diagnosed in 116 (20.1%) cases (Figure 1). Considering the 8 women with positive OGTT (diagnosed by early screening in 24 weeks), the total number of women with GDM increased to 124 cases. The estimated prevalence of GDM for the whole cohort was 6.8% (124 out of 1804 pregnant women).

According to the ADA recommendations a group of women (n=379) was identified as low risk. In this group, 60 women had positive GCT, and 14 met the criteria for GDM, accounting for a prevalence of 16.1% and 3.8%, respectively. This confirmed much lower figures in low risk women (P<0.001) as compared with the entire cohort.

The prevalence of GDM according to each risk factor is reported (Table 2). GDM was more prevalent in women with positive family history of diabetes (P<0.001), positive history of GDM in previous pregnancies (P<0.001), greater weight gain (P=0.008), chronic hypertension (P<0.0001) and glucosuria during current pregnancy (P<0.001). Also the results indicated that GDM was more prevalent in women with history of infertility (12.6% vs. 4.5%), macrosomia (23.5% vs. 7.7%), stillbirth (17% vs. 6.1%) and abortion in previous pregnancies (17% vs. 6.1%). There was no relationship between height and GDM.

To establish the independence of these variables a multivariate analysis was performed using a multiple logistic regression model. GDM was significantly and independently associated with age (P<0.001), pre-pregnancy BMI (P=0.005); history of GDM (P=0.002); family history of diabetes (P<0.001); history of chronic hypertension (P<0.001) and glucosuria during current pregnancy (P<0.001) (Table 3). Figure 1, describes Gestational Diabetes Mellitus screening in the participants.

Discussion

The time of screening was generally between the 24th and 28th week of gestation; if the woman had any risk factors for diabetes, GCT was done earlier. Considering the high prevalence of risk factors in the studied population, the number of women examined earlier than 24 weeks was lower than expected. This suggests the necessity of putting stress on the importance of GDM risk factors. In addition, the screening test was performed on a number of women who came to the clinics after the 28th week of gestation. This was mainly due to personal reasons. It has been reported that a repeat test of glucose tolerance later in pregnancy enables diagnosis of GDM in women with negative test results earlier in pregnancy (10).

The study indicated that GCT was positive in 35.4% of cases, while the prevalence of GDM was 6.8%. Previous studies have reported prevalence of GDM to be between 1 and 16% with wide-ranging differences between countries (11). Moreover, within the same country, the prevalence of GDM varies in relation to ethnicity (12-13), the screening methods and the diagnostic criteria used (14). The prevalence of an abnormal GCT (35.4%) in present study was slightly higher than reported for most populations (2,12). There is general consensus that the prevalence of GDM is increasing. The prevalence in our study according to *Carpenter and Coustan* criteria falls within the reported range (1–15%) in the literature (7, 15-16). There is one study from Iran which reported prevalence of GDM to be 4.8% using NDDG criteria (17).

Table 3: Risk factors of GDM

Variables	Odds Ratio	95% Confidence interval	P-Value
History of GDM	12.01	3.99 - 36.18	<0.001
History of chronic hypertension	5.07	1.71 - 15.02	<0.001
Glucosuria during current pregnancy	3.91	1.70 - 8.97	<0.001
History of macrosomia	3.44	2.02 - 5.84	0.001
History of stillbirth	2.20	1.01 - 4.80	0.001
Family history of diabetes	2.16	1.43 - 13.9	0.043
History of preterm delivery	2.09	0.85 - 5.10	0.095
History of Infertility	1.54	0.82 - 2.89	0.099
BMI ≥ 27	1.33	0.95 - 1.87	0.174
Age ≥ 25	1.08	0.78 - 1.49	0.638
History of abortion	1.05	0.68 - 1.62	0.833

Unlike the other studies which reported that GDM tends to occur more frequently in women who are short (18,19), the present study did not show any association between height of the studied women and prevalence of GDM. Age above 25 is an important risk factor for development of GDM (1, 2, 18-23). In present study, the prevalence of GDM steadily increased with advancing age. On multiple logistic regression analysis parity was not found to affect GDM prevalence significantly. Increased parity is often associated with other diabetic risk factors like increasing age, body weight and abdominal fat deposition (18, 21). Family history of diabetes has a strong correlation with occurrence of GDM (1, 22). A higher prevalence of GDM in women with family history of diabetes mellitus was found.

The prevalence of GDM is also affected by previous pregnancy outcome. Naylor et al. found glucose intolerance in 14.5% of women who had adverse obstetric outcomes (24). In our study the prevalence of GDM was increased in women with positive history of abortion. The women with positive history of macrosomia in previous pregnancies were found to have more GDM in the current pregnancy. Macrosomia complicates 20–30% of pregnancies with GDM (2). Women with positive history of macrosomia belong to high risk category for GDM and should undergo OGCT as soon as possible after conception.

Glucose intolerance is relatively common during pregnancy and should be evaluated after proper risk assessment. A significantly higher prevalence of GDM is found in women who are aged, multiparous, hypertensive or have higher body mass index, glucosuria during current pregnancy, previous history of GDM or birth of a large baby and history of diabetes mellitus in a first degree relative. Thus, it can be argued that an OGTT should be considered in all pregnant women with such factors irrespective of a negative GCT.

In this study the GDM prevalence in pregnant women at low-risk for GDM was estimated according to the ADA recommendations. In disagreement with other studies (10-12), this group included 45 women with a very low risk of gestational diabetes. This would provide evidence for an acceptable performance of the universal approach, since it would miss 3.8% of GDM in a low-risk population. Also some considerations are worthnoting. Larijani et al demonstrated that, in comparison to universal screening, the selective approach allows only a 3.9% financial saving (17). In the present population, about 78.6% of the women were at medium/high risk for GDM, showing an accepted indication for screening. Under such circumstances, universal screening is likely to attract some women who would not opt for targeted screening thus decreasing the risk of undiagnosed diabetes in pregnancy. The 3.9% saving that may be generated by selective screening in our experience can be easily offset by financial loss due to unforeseen complications of a diabetic pregnancy.

At present, universal screening remains a good instrument to identify women with diabetes mellitus at least in populations with medium/high risks for GDM (like the Iranian population).

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There exists no conflict of interest to declare.

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