



Contents lists available at ScienceDirect

Diabetes & Metabolic Syndrome: Clinical Research & Reviews

journal homepage: www.elsevier.com/locate/dsx



Original Article

Risk factors of gestational diabetes mellitus using results of a prospective population-based study in Iranian pregnant women

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ARTICLE INFO

Article history:
Available online xxx

Keywords:

Gestational diabetes mellitus
International association of diabetes and pregnancy study groups
Cross-sectional study
Risk factors

ABSTRACT

Aims: Early identification of at-risk groups is an important step in preventing gestational diabetes and its subsequent side effects. This study aimed to evaluate the risk factors of gestational diabetes based on the International Association of Diabetes and Pregnancy Study Groups criteria in Ahvaz.

Material and Methods: In a cross-sectional case control study, 520 pregnant women involving life after gestational diabetes Ahvaz cohort study (LAGAs) were investigated for risk factors of gestational diabetes mellitus.

Result: The prevalence of overweight and obesity were 40% and 25.8% in the GDM group and in 35.8% and 16.2% in the control group respectively ($p = 0.002$). According to NCEP-ATP III criteria, 16.9% of women with GDM and 6.9% of mothers in the control group had metabolic syndrome in first visit of pregnancy ($p < 0.001$). Logistic regression showed that there is a significant relationship between maternal age [OR = 1.05 (95% CI, 1.01–1.10)] ($p = 0.01$), previous GDM [OR = 5.60 (95% CI, 2.21–14.18)] ($p = 0.001$), positive family history of diabetes [OR = 1.86 (95% CI, 1.19–2.94)] ($p = 0.006$), pre-pregnancy BMI [OR = 1.05 (95% CI, 1.007–1.11)] ($p = 0.04$) and metabolic syndrome in first visit of pregnancy [OR = 2.34 (95% CI, 1.038–5.30)] ($p = 0.04$) with GDM.

Conclusion: Factors including maternal age, previous GDM, family history of diabetes, pre-pregnancy BMI reported in previous studies around the world. A significant association between metabolic syndrome in the first visit of pregnancy and GDM is novel finding of this study. Therefore screening of pre-pregnancy metabolic syndrome in women at risk of gestational diabetes is recommended.

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1. Introduction

The considerable increase in diabetes worldwide is one of the health problems. By 2030, the rate of diabetes is expected to double twice the current level of about 552 million people. This also includes pregnant women [1]. Increasing trend of diabetes emphasizes the importance of identifying related risk factors. Gestational diabetes is the most important predictor of diabetes in the future [2]. This disorder occurs when the maximum insulin secretion in the pregnant mother's body cannot overcome insulin resistance in her body [3]. The metabolic changes are made during pregnancy in order to supply fuel and nutrients for mother and fetus. The intolerance to glucose and gestational diabetes occurs

when pancreatic function is not enough to overcome insulin resistance due to pregnancy. So, people who are prone to diabetes will go ahead [4]. Following such an occurrence, both mother and fetus are both subjected to hyperglycemia which itself causes damage such as an increase in blood pressure, maternal toxicity and a drop in blood sugar [3]. Gestational diabetes has long been known to be a major risk factor for embryo. Further, gestational diabetes is associated with an increase in obstetrics complications such as weight gain and complications during and after delivery [1–6]. Mothers with gestational diabetes also have a higher risk of developing type 2 diabetes in the future [7]. Infertility and maternal complications include preeclampsia, eclampsia and forced cesarean section, while neonatal outcomes include macrosomia, birth defects, postpartum hypoglycemia, and increased bilirubin and respiratory distress syndrome [8]. The risk factors related to gestational diabetes are maternal age, pre-pregnancy BMI, history of diabetes among relatives, history of gestational

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diabetes in previous pregnancies [1–11]. Additionally, the increased reproductive age of women, reduced physical activity and adaptation to modern lifestyles may also be associated with an increased prevalence of gestational diabetes [1–13].

The incidence of GDM is rising. Increasing shift in its potential risk factors including obesity and diabetes type 2, advanced mother age in pregnancy and the application of new criteria for diagnosis of GDM are potential causes of this pattern [14,15].

In 2008, a major study known as HAPO, was conducted in nine countries. This study showed that there is a significant association between glucose intolerance less than those levels that are diagnosed as gestational diabetes, and adverse outcomes. This research and similar research have led to a greater need for a more sensitive definition of gestational diabetes [11–13]. In 2010, the International Association for Diabetes and Pregnancy (IADPSG) proposed new criteria for diagnosis of gestational diabetes. Based on these criteria lower thresholds and single abnormal value required for diagnosis of gestational diabetes and a higher incidence of GDM was reported in many studies [1–18].

In many studies, the risk factors of gestational diabetes mellitus are reported based on previous criteria (Glucose challenge test 50 g and oral glucose tolerance test 100 g). This study aimed to evaluate the risk factors of gestational diabetes mellitus based on new diagnostic criteria of the International Association for Diabetes and Pregnancy in Ahvaz.

2. Method

In a case control cross-sectional study, women who participated in the cohort of Ahvaz Gestational Diabetes Mellitus were enrolled in this study. Details of the cohort study reported previously [19–21]. Briefly, the cohort study started in March 2015 in Ahvaz city. Ahvaz as the capital of Khuzestan is located in southwestern Iran and has a high incidence of GDM according to IADPSG criteria (29.9%) [22], low rate of postpartum glucose testing [23] and high rate of postpartum hyperglycemia and dyslipidemia and metabolic syndrome after GD [19–21]. This population-based prospective cohort study investigated the metabolic outcomes of GDM in mothers and their offspring compared with healthy women during pregnancy and followed them for 2 years after delivery.

Initial assessment for plasma glucose level was performed in the first trimester using fasting plasma glucose (FPG) test. Women with normal glucose underwent a 75-g OGTT between 24 and 32 weeks of gestation, and one elevated value of ≥ 92 for fasting or ≥ 180 and ≥ 153 mg/dl for 1-h and 2-h plasma glucose level was considered as GDM based on IADPSG criteria. Women in the control group were selected randomly in the same setting.

Medical and health profile records were used for pre-pregnancy body weight and lipid profile. Anthropometric measurements including weight, height, waist circumference, blood pressure and hip circumference measured at baseline visit during pregnancy.

Weight and blood pressure measurements repeated at each pregnancy visit and recorded. Interviewer-administered questionnaires were used to collect the following data: socio-demographic features, pregnancy outcomes, medical and obstetric history, potential risk factors of GDM and metabolic syndrome.

Body mass index (BMI) < 25 kg/m² was considered normal. BMI 25–29.9 kg/m² and ≥ 30 kg/m² were considered as overweight and obesity, respectively. Metabolic syndrome in first visit of pregnancy was defined by the National Cholesterol Education Program Adult Treatment Panel (NCEP ATP III) criteria, as having any three of five of the following disorders including waist circumference ≥ 88 cm, triglycerides ≥ 150 mg/dl, HDL-cholesterol < 50 mg/dl (or treatment for dyslipidemia), FPG first visit of pregnancy ≥ 100 mg/dl and blood pressure $\geq 130/85$ mmHg or having treatment for hypertension [24].

Among of 520 pregnant women under cover of 25 health centers in Ahvaz who participated in cohort study, 260 women with gestational diabetes and 260 healthy women were compared for identifying risk factors of gestational diabetes mellitus

Independent sample t- tests, χ^2 and Fisher exact test analysis were performed as appropriate; univariate and backward multivariate logistic regression were used to assess risk factors of gestational diabetes mellitus. We used SPSS (version 22) for data analysis.

3. Results

The results of the study showed that the average age of patients in the GDM group was 29.72 ± 5.34 years and the control group was 28.23 ± 5.46 years ($P = 0.002$). The mean of gestational age at delivery in the GDM group was significantly lower than that of the control group. Based on Pre-pregnancy BMI, the prevalence of overweight or obesity was 65.8% in the GDM group and in 52% the control group. Of women with gestational diabetes 19.2% required insulin or metformin for control of hyperglycemia. There were 33 mothers (17.2%) from the GDM group and 6 (3%) from the control group with history of previous GDM ($p = 0.001$). also 117 mothers (45%) from the GDM group and 66 (25.4%) from the control group had a family history of diabetes ($p = 0.001$). more details presented in Tables 1 and 2.

According to NCEP-ATP III criteria, 44 patients (16.9%) of the GDM group and 18 (6.9%) in the control group had metabolic syndrome in first visit of pregnancy ($p < 0.001$). also we found significant difference between two groups in the results of metabolic syndrome components including hypertension ($p = 0.04$), elevated TG ($p = 0.03$), fasting blood sugar ($p < 0.001$) and waist circumference (and BMI ≥ 30) ($p < 0.001$) except HDL < 50 ($p = 0.38$), showed in Fig. 1. Results of univariate and multivariate logistic regression analysis are shown in Table 3.

There is a significant relationship between maternal age, previous GDM, positive family history of diabetes, pre-pregnancy BMI and metabolic syndrome in first visit of pregnancy with GDM.

Table 1
Patient's characterizations in control and GDM Groups.

Characteristics	Control Group (N = 260)		GDM Group (N = 260)		P-value
	Mean	SD	Mean	SD	
Age (years)	28.23	5.46	29.72	5.34	0.002
FBS first visit pregnancy (g/dL)	78.97	6.85	93.39	11.40	<0.001
Gestational age at delivery	39.65	0.94	39.12	1.29	<0.001
Systolic BP pregnancy (mmHg)	110.90	10.04	112.28	15.84	0.23
Diastolic BP (mmHg)	68.92	9.44	68.84	11.69	0.93
Pre-pregnancy BMI	25.40	4.51	27.21	4.52	<0.001
Birth Weight (g)	3255.76	451.36	3317.82	530.11	0.15

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