A Comparative Study of Investigating the Relationship between the Nutrition, Biochemical Parameters and Demographic Characteristics in Women with and without Gestational Diabetes

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Abstract

Objective: Gestational diabetes mellitus (GDM) is characterized by glucose intolerance during pregnancy. Incidence of gestational diabetes can increase by several factors such as obesity, aging, diet and genetic factors. This study aimed to assess the role of nutrition, biochemical and demographic factors in development of GDM in pregnant women.

Materials and Methods: In this prospective study, pregnant women with and without gestational diabetes mellitus were divided into control and GDM women. At the onset of the study, all subjects were asked to complete a demographic questionnaire. Serum samples were obtained from each woman and the biochemical parameters were measured and then analyzed by GraphPad Prism version 5.

Results: Our results showed a significant relationship between age and BMI with GDM. The level of triglyceride (mg/dl), HOMA Index (mmol/L×μU/mL), FBS (mg/dl), and Insulin (μU/mL) were significantly higher in GDM women compared to the control group. Serum HDL concentration was significantly higher in normal pregnant women compared to patients with GDM. Education level was also higher significantly in control group. The amount of fruits and vegetables consumption was lower in GDM compared to control group significantly. Furthermore, the women who had consummated fruit and vegetables in their diet less likely developed GDM.

Conclusions: This study suggests a strong association between GDM and the consumption of high-calorie foods. Therefore, the use of low-calorie foods such as fruits and vegetables can help reducing the incidence of diabetes in pregnant women.

Keywords: Gestational diabetes mellitus, Pregnancy, Nutrition

Introduction

Gestational diabetes mellitus (GDM) is a metabolic disorder in pregnancy that is characterized by increased insulin resistance (1) and/or decreased insulin secretion (2). Although the etiology of GDM is not completely understood, it is thought that GDM may be due to a non-immune dysfunction of pancreatic β cells (3). There are

several factors that contribute to the development of GDM. The ethnic/racial is one of the main reasons why Asian women are at high risk for GDM compared with other ethnic groups (4). Other factors associated with higher risk for GDM include age older than 25 years, overweight or obesity (body mass index, previous abnormal glucose tolerance, GDM in a previous pregnancy, or a strong family history of diabetes (5). Women with a history of GDM have a higher risk of developing type 2 diabetes later in life (6). The main option for treatment of GDM is the nutritional management (7). Although diet therapy is a cornerstone of the treatment of GDM, there are few studies relating to the association between dietary intake and glycemic status during pregnancy (8,9). This study aimed to investigate the relationship between dietary habits and the risk of GDM in a cohort of pregnant women.

Materials and Methods

This prospective study was reviewed and approved by the Institutional Review Board of Deputy of Research in Mashhad University of Medical Sciences. In each group, 30 women matched in terms of age, weight, height, socioeconomic status and education level were selected as study and control groups.

All pregnant women attended to the Obstetrics and Gynecology clinic of Emam Reza hospital (Mashhad, Iran) were screened with a 50-g oral glucose challenge test (OGCT) at 24-28 weeks of gestational age (as calculated by ultrasound examination). Women with abnormal glucose challenge test (plasma glucose level ≥130 mg/dL but lower than 200 after 1 hour) underwent oral glucose tolerance tests (OGTT) with 100-gr of glucose; blood glucose levels were then measured after 1, 2, and 3 hours. Cut-off values were those proposed by American Diabetes Association: GDM was diagnosed in women who had 2 or more serum glucose concentrations equal or greater than the following criteria: 95 mg/dL (fasting), 180 mg/dL (1 hour), 155 mg/dL (2 hour) and 140 mg/dL (3 hour). Women with abnormal OGTT (two abnormal values out of four plasma glucose levels) were selected as gestational diabetic group. Subjects with normal OGTT were allocated to the normal control group. In each group 30 women were matched together and selected as study and control groups. A standard questionnaire including data about the characteristics, dietary habit, and care provider was completed by the care providers. Names were replaced with unique code numbers, and forms were mailed to the coordinating center for data entry and analysis. In all participants, family history of diabetes mellitus (paternal/maternal), education level (according to their statements) and daily intake of fruits and vegetables and weekly consumption of fish were asked and filled in the questionnaire forms. Body mass index (BMI) was calculated as weight (kg) divided by height squared (m^2). Waist circumference was measured at the top of hipbone using a tape measure.

Biochemical Analysis

Plasma samples were collected and stored at $-20^{°C}$ in the Pharmaceutical Chemistry Department of Mashhad University of Medical Sciences. After all samples were collected, glucose and lipid profile (total, LDL and HDL cholesterol, and triglycerides) were measured by automatic analyzer (BT1500, Italy) and Pars Azmun kits. Glycosylated hemoglobin (HbAlc) (mmol/L) was measured by an automatic analyzer (Toshiba TBA-120FR, Japan). Insulin level was determined by electro-chemiluminescent immunoassay (Bayer ADVIA Centaur CP, Germany).

Statistical Analysis

All data are presented as mean±standard error of mean (S.E.M). Statistical analysis was performed by using the GraphPad Prism version 5. T-test was used to compare the characteristics between the two groups. *P* value less than 0.05 for the differences between the mean values is considered statistically significant.

Results

The clinical characteristics of study and control groups are presented in Table 1. Our results showed that fasting blood glucose (P<0.05), triglyceride (P<0.05) and insulin concentrations (P<0.001) of women with GDM were higher than normal pregnant women. Women with GDM also had lower HDL concentration compared with control group. There were also no significant differences in the LDL, HbAlc and total cholesterol levels between the control and study groups. Demographic characteristics of GDM and control groups were summarized in Table 2. Women with GDM were older and had greater BMI and waist circumference in compared with control group at the time of diagnosis (P<0.05). Control group had higher education level than the study group. As presented in table 2, the dietary habits of GDM group are different from the control group. Fruit and vegetable consumption by the study group was about twice as controls (2.3 vs. 4.2 servings/day) (P<0.05). But no significant differences were found for consumption of fish and dairy products between the groups.

Discussion

GDM is defined as any degree of glucose intolerance during pregnancy that is recognized during pregnancy (10). Although the etiology of GDM is not completely understood, different studies have shown that insulin sensitivity can be influenced by genetic and environmental factors (11). Age older than 25 years, overweight or obesity, abnormal glucose tolerance, and a previous pregnancy or a strong family history of GDM are among established risk factors for GDM (12). The data of current study showed that age and BMI were higher in study group compared to control group. Previous studies have shown that incidence of GDM in obese women is higher than that of the general obstetric population (13,14). It also has shown that high weight gain during pregnancy and increasing maternal age worsen the risk of developing GDM (15,16). In this study, we tried to better understand the role of dietary habits contribute to GDM. Today, we know that dietary habits play an important role in developing of diabetes. Inappropriate feeding practices and use of high-calorie foods can cause metabolic

Table 1. The biochemical characteristics of GDM and control groups.

Subjects	GDM	Control	*P*
FBS (mg/dl)	95.5 ± 12	87 ± 8.9	<0.05
HDL (mg/dl)	48 ± 9.1	56 ± 13.2	<0.01
Triglyceride (mg/dl)	231.6 ± 32.2	200.5 ± 19.3	<0.05
Total Cholesterol (mg/dl)	227.7 ± 16.4	218.5 ± 18.5	NS
LDL (mg/dl)	131.1 ± 15.1	125.5 ± 17.9	NS
Insulin (µU/mL)	13 ± 2.3	9.67 ± 2.9	<0.01
HbAlc (mmol/L)	5.1 ± 0.8	5.7 ± 0.7	NS
HOMA Index(mmol/L ×µU/mL)	51 ± 9.3	34 ± 5.4	<0.01

NS: Non-significant

Table 2. Demographic characteristics of GDM and control groups.

Subjects	GDM	Control	*P*
Age (year)	25 ± 6.2	30 ± 7.3	<0.05
BMI (kg/m^2)	27 ± 9.2	31 ± 9.8	<0.05
History of macrosomia (≥ 4000 gr)	4%	0%	NS
Anomaly	6.6%	0%	NS
Abortion	33.3%	16%	<0.05
History of GDM	0%	0%	NS
Waist circumference (cm)	107 ± 12.4	104 ± 11.6	NS
Abdominal circumference (cm)	113 ± 11.3	104 ± 10.5	<0.05
Education level (<12)	63%	43%	<0.05
Fish (servings per week)	0.5 ± 0.02	0.5 ± 0.03	NS
Fruit & vegetables (servings per day)	2.3 ± 0.5	4.2 ± 0.7	<0.05
Dairy (servings per day)	2.2 ± 0.2	2.1 ± 0.1	NS

NS: Non-significant

disorders in the body and increase the risk of diabetes (17). These foods consist of high-sugar, high-fat, and high-calorie. The use of proper nutritional diet consisted of fruits and vegetables, can improve GDM by reducing calories. Our results showed that fruit and vegetable consumption is more than twice in normal women compared to GDM group. Green leafy vegetables and fruits containing folic acid, iron, minerals, provitamin A, carotenoids, and high antioxidant and fiber content have low energy density and glycemic load and therefore may provide a more effective combination of nutrients than conventional supplements (18,19). Some studies have suggested that these bioactive components of fruits to be beneficial in insulin sensitivity and/or pancreatic β-cell function by relieving oxidative stress (20). Our results also showed that women with GDM have lower literacy levels than the control group. This is in line with previous studies showed lower level of education in these patients and that this factor could increase the risk of gestational diabetes due to high-calorie food consumption in people with low education and socioeconomic status (21). As a conclusion, this study showed that weight and age are important risk factors of GDM. Thus, low-calorie diet and use of suitable compounds such as fruits and vegetables can play an important role in reducing the risk of GDM and its harmful effects.

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