Title: Are Nutritional Habits Equally Associated with the Risk of Gestational Diabetes and Gestational Glucose Intolerance?

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Abstract

Objective. The aim of this study is to investigate the relationships between the nutritional characteristics of pregnant women and the risk of GDM and Gestational Glucose Intolerance (GGIT). **Materials and Methods.** Women were investigated for GDM during the 24th to 28th weeks of pregnancy. According to the two-step diagnostic approach, women with normal glucose tolerance (normal), those with only 1 high glucose value (GGIT) and those with at least 2 high values (GDM) in OGTT were included in the study. There was 60 pregnant women in each group, the mean age: 31.6±5.4 years (19-46 years). Demographic and clinical characteristics of the participants were questioned and 3-day food consumptions were evaluated with BEBIS program. **Results.** The mean weight, BMI and daily fiber intake in GDM group were significantly higher than the normal group. In the GDM and GGIT groups, the mean age, weight, daily carbohydrate (CHO) and protein intakes, and family history of diabetes were higher than those with normal group. In the GDM group, daily fat intake was also significantly higher than the normal and GGIT groups. According to the separate models of logistic regression analysis; the age; daily protein, CHO and fat consumptions; having the first pregnancy and higher pre-pregnancy BMI (>25 kg/m^2) were associated with increased likelihood of GDM. Similarly, the age, daily protein consumption, history of giving birth to a macrosomic baby and current smoking were positively linked with the risk of GGIT. **Conclusion.** Women's nutritional habits (excessive CHO, fat and especially protein consumptions), phenotypic characteristics, family history of diabetes and poor obstetric history are similarly related to the risk of developing GDM and GGIT. Our results showed that in all, particularly in high-risk women who are planning pregnancy a special attention should be given to general health and balanced diet starting from pre-pregnancy.

Background and Objective. Gestational diabetes mellitus (GDM) and gestational glucose intolerance (GGIT) are currently defined as glucose intolerance of variable severity with onset during late pregnancy. Dietary counseling has long been recommended for women who develop GDM. However, studies of the association between dietary factors and the risk of development of GDM are limited. The aim of this study is to investigate the relationships between the nutritional characteristics of pregnant women and the risk of GDM and GGIT and compare the two categories.

Materials and Methods. Women were investigated for GDM during the 24th to 28th weeks of pregnancy. According to the two-step diagnostic approach, women with normal glucose tolerance (NGT), those with only one high glucose value (GGIT) and those with at least two high values (GDM) in oral glucose tolerance test (OGTT) were included in the study. There were 60 pregnant women in each group, the mean age of 31.6±5.4 years (min.-max. 19-46 years). The demographic and clinical characteristics of the participants were questioned, and

a three-day (two nonconsecutive weekdays and one weekend day) food consumption diary was evaluated through the BEBIS program.

Results. The mean age, daily energy intake, macronutrient (carbohydrate [CHO], protein, fat, and cholesterol) consumptions, and family history of diabetes in the GDM and GGIT groups were significantly higher than in the NGT group (p=0.007 for age, and p=0.001 for the rest). In the GGIT (but not in the GDM) group, the mean pre-pregnancy BMI and daily fiber consumption were higher than the NGT group (p<0.001). The average daily energy consumption was higher in the GDM group than in the GGIT group (p=0.026). fasting lipid profile and mean weight gain adjusted for gestational weeks was not different between the groups (Table 1).

Table 1. Clinical and nutritional features of the study groups

Parameter	NGT (n=60)	GDM (n=60)	GGIT (n=60)	p-value*
Age, year	29.8 (5.1)	32.4 (5.6)	32.7 (5.3)	***0.007***^{a,b}
Pre-pregnancy BMI, kg/m^2	24.8 (5.1)	28.5 (5.2)	26.5 (4.9)	***0.00***^{a,b}
Gestational weight gains, kg**	8.9 (10.0)	7.8 (4.8)	9.5 (5.5)	0.253
Family history of DM, n (%)	24 (40.0)	19 (68.3)	43 (71.7)	***0.001***^{a,b}
Energy, kcal/day	1719 (232)	2124 (368)	1936 (417)	***0.001***^{a,b,c}
CHO intake, g/day	174.7 (43.3)	228.0 (55.7)	205.7 (72.5)	***0.001***^{a,b}
Protein intake, g/day	64.4 (14.2)	82.3 (14.0)	78.3 (15.4)	***0.001***^{a,b}
Fat intake, g/day	81.3 (16.6)	95.7 (22.1)	86.5 (19.0)	***0.001***^{a,b}
Fiber intake, g/day	22.2 (5.8)	26.4 (5.6)	81.7 (20.6)	***0.001***^{b}
Cholesterol intake, mg/day	311.3 (115.3)	443 (149.9)	402.2 (127.1)	***0.001***^{a,b}

Data are shown as mean (SD) unless otherwise indicated. *p-value for One-way ANOVA (except that family history of DM for Pearson Chi-Square, gestational weight gains for Kruskal Wallis), **Gestational weight gain is adjusted for gestational week. [a]NGT vs GGIT, [b]NGT vs GDM, [c]GGIT vs GDM. (NGT, normal glucose tolerance; GDM, gestational diabetes mellitus; GGIT, gestational glucose intolerance; BMI, body mass index; DM, diabetes mellitus; CHO, carbohydrate)

According to the separate models of logistic regression analysis; the age; daily protein, CHO and fat consumptions; having the first pregnancy and higher pre-pregnancy BMI (>25 kg/m2) were associated with increased likelihood of GDM. Similarly, the age, daily protein consumption, history of giving birth to a macrosomic baby and current smoking were positively linked with the risk of GGIT (Table 2).

Table 2. Factors associated with gestational diabetes mellitus and gestational glucose intolerance (Backward stepwise logistic regression analysis)

	Gestational Diabetes Mellitus			Gestational Glucose Intolerance		
	Parameter	**p**	**OR, 95% CI**	**Parameter**	**p**	**OR, 95% CI**
Step 12	Age	0.011	1.14, 1.03-1.26	Age	0.050	1.13, 1.00-1.26
	Current smoking	0.050	6.64, 1.00-44.46	Pre-pregnancy BMI >25 kg/m^2	0.002	5.40, 1.80-16.24
	Macrosomic baby	0.049	11.74, 1.01-136.03	First pregnancy	0.049	3.51, 1.00-12.47

	Protein intake	<0.001	1.07, 1.03-1.11	Protein intake	0.018	1.07, 1.01-1.13
	-	-	-	CHO intake	0.008	1.02, 1.01-1.03
	-	-	-	Fat intake	0.040	1.03, 1.00-1.07
Variables entered on step 1: Age, first pregnancy, live birth, spontaneous abortion, stillbirth, macrosomic baby, pre-pregnancy body mass index, weight gains during pregnancy, family history for diabetes, current smoking; nutritional (energy, carbohydrate, protein, fat, fiber, and polyunsaturated fat) intake.						

Discussion: Women's nutritional habits (excessive CHO, fat, and especially protein consumption), phenotypic characteristics, family history of diabetes, and poor obstetric history are similar in terms of the risk of developing GDM and GGIT. The most striking result of this study is that high protein intake has been shown to be a risk factor for both GDM and GGIT. It emphasizes the need to raise awareness in pregnant women today, as protein-rich nutrition is becoming more and more popular.

Our study has some limitations. First, there was a limited number of participants in each study group. Secondly, we were unable to obtain a food consumption history before pregnancy. Our results are based on a 3-day food intake diary during late pregnancy. However, to our knowledge, this is one of the few studies to compare GDM and GIGT through the link between food consumption habits and developing these entities. Of course, we are aware that we cannot generalize our study results. Therefore, prospective studies involving more women are warranted to clarify these findings.

Conclusion: Our results revealed that women who are planning a pregnancy, in particular, those at high-risk for GDM, special attention should be given to general health and a balanced diet starting from pre-pregnancy.

Keywords: Gestational diabetes mellitus, gestational glucose intolerance, nutrition and oral glucose tolerance test.

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