Anthropometric and Dietary Assessment of Gestational Diabetic Women

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Abstract

Background: Gestational diabetes mellitus (GDM) has long term public health significance, as it is strongly correlated with an increased likelihood of both mother and child developing type 2 diabetes in later life. **Aims:** This study aimed at anthropometric and dietary assessment of gestational diabetic women. **Material & Methods:** A case control study was carried out on 90 women with Gestational diabetes mellitus and normoglycemic ones in the Gynecological and obstetrical department in El Shatby hospital, Alexandria, Egypt. Women were interviewed and Body weight, height, biceps, triceps, subscapular, midthigh skin fold thickness were measured. Food frequency questionnaire and twenty four hour recall methods were done, and then Energy and macronutrient intake was obtained using the Egyptian Food Composition Tables. Glycemic index (GI) and load (GL) of consumed diet were finally calculated. **Results:** As women aged 35-39 years had an approximately four times higher risk of GDM than those aged 20-24 years. Multiparty, multi gravity and previous obstetric complication are significantly more evident in cases. Intake of saturated and polyunsaturated fats was higher in cases than controls although the mean total fat intake among gestational diabetic group was significantly lower than controls. Assessment of women nutritional status showed that cases had significantly higher BMI and body fat percentage than controls. **Conclusions:** Findings from this study are strongly suggestive that GDM occurs at higher age, higher parity, and higher BMI and body fat percentage. In addition gestational diabetic women receive in appropriate nutritional advice from their obstetric physicians. Assessitant professor

Key words: Blood glucose, weight gain, nutritional, Pregnancy

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Introduction

Gestational diabetes mellitus (GDM) has been defined as any degree of glucose intolerance with onset or first recognition during pregnancy. Although most cases resolve with delivery, the definition applied whether or not the condition persisted after pregnancy Women with GDM are individuals with a genetic or metabolic predisposition towards diabetes who are incapable of adequately compensating for the diabetogenic effects of pregnancy. Globally the prevalence of GDM ranges from 2% to 12% of all pregnancies, depending on the population studied and the diagnostic tests employed and it is predicted to rise as obesity is becoming prevalent.(1)

A range of factors have been found to increase the risk of developing GDM, including: advanced maternal age, maternal overweight or obesity which are the two most common risk factors. High parity, non-white race/ethnicity, family history of diabetes mellitus, maternal high or low birth weight and polycystic ovarian syndrome are the known non-modifiable risk factors for GDM. Modifiable risk factors are lifestyle related, which include physical inactivity, cigarette smoking, excess maternal weight gain in current pregnancy especially for those who are overweight or obese.(2)

The pathogenesis of GDM has not been clearly explained. The most common theory is that GDM is caused by decreasing insulin sensitivity and increasing anti-insulin hormones that are secreted by the placenta during pregnancy, such as human placental lactogen, prolactin, glucocorticoid, and progesterone .(3)It was suggested that high insulinogenic nutrition represents the key factor in the etiology of GDM. So restriction of high glycemic-index carbohydrate will lead to lower postprandial glucose levels, less insulin requirement and less strain to the B-cells, and therefore may prevent the development of GDM .[4] Dietary fat, however, has been linked with the etiology of insulin resistance and hence with diabetes.

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 especially fatty acid nature of diet and cholesterol.[5] There is still much little data on dietary pattern and nutrient intake in GDM patients in Egypt, which may be highly enlightened by conducting this study.

Materials and Methods

Study design and setting

A case control study was conducted in Gynecological and obstetrical department in El Shatby hospital, Alexandria, Egypt.

Study population, sample size and sampling strategy

Ninety women with Gestational diabetes mellitus and normoglycemic pregnant women (45 cases and 45 controls), aged 20-40 years, between 28-36 gestational weeks, primi or multigravida, singleton pregnancy were included in our study. Diagnosis of GDM was done using 2 hours oral glucose tolerance test according to criteria of American Diabetic Association 2014,[6] with exclusion of pregestational diabetes. All gestational diabetic women and normoglycemic pregnant women with stated inclusion criteria attending outpatient clinic during a period of 6 months were recruited till sample size was completed.

Data collection

Sociodemographic data (age, age of mirage, family size, number of children, education, and occupation, and place of residence (urban/rural) were collected by interviewing pregnant women using a predesigned questionnaire. In addition, family history of diabetes and obesity, obstetric history and physical activity pattern were included.

Anthropometric and blood pressure measurements

All measurements were carried out according to criteria described by Gibson (2005).[7] Body weight, height, biceps, triceps, subscapular, midthigh skin fold thickness were measured. Then Body fat percentage(%) was estimated through Wilomore & Behnke and siri equations .[8]

Dietary intake assessment:

Food consumption pattern was assessed using food frequency questionnaire. [9] Pregnant women of cases and control groups were asked about the consumption (amount and frequency) of different food items. In addition, detailed list of food and beverages intake in previous twenty four hours was interviewed and amount taken was determined by use of household measures. Energy and macronutrient intake was obtained using the Egyptian Food Composition Tables.[10] Fats were analysed into Fatty acids (saturated, monounsataurated, polyunsaturated fats) and cholesterol content.[11] Percent of energy derived from macronutrients and from different fatty acids was calculated. Finally, Glycemic index (GI) and load (GL) of consumed diet were calculated according to the following formula guided by international tables of GI and GL 2002.[12]

$$GI(\%) = \Sigma(\text{carbohydrate content of each food item (g)} \times GI) / \text{total amount of carbohydrate in meal (g)};$$

$$GL\ (g) = \Sigma(\text{carbohydrate content of each food item (g)} \times GI) / 100.$$ [13]

Statistical analysis

Data analysis was performed using the SPSS software version 16. For descriptive statistics mean and stander deviation were used. For analysis of numeric data One sample kolmogorov-smirnov test and Mann-Whitney test were used. To test the association between 2 categorical variables, Pearson's chi square test, Mont Carlo exact test and fisher exact test were used. Finally, multiple stepwise logistic regression was used to predict a dependent variable on the basis of continuous and/or categorical independents and to determine the effect size of the independent variables on the dependent. The impact of predictor variables is usually explained in terms of odds ratio (OR) which mean the amount of increased risk at the exposed groups relative to the reference one.

Ethical considerations

There were no conflicts of interest. This work received no specific grant from any funding agency in the public, commercial or not-for-profit sectors. This study was conducted according to the guidelines laid down for medical research involving human subjects and was approved by ethics committee of High Institute of Public Health, Alexandria University , Egypt. All measurement were taken and kept confidential. Women were informed about the objective of the study and they had the right to accept or refuse to participate in the study.

Results

The study included 90 pregnant women (with gestational diabetes and normoglycemic) with similar socio-economic background. Two thirds of controls aged from 20- <30 years, while 60% of cases aged 30-40 years. As women aged 35-39 years had an approximately four times higher risk of GDM than those aged 20-24 years. Family history of diabetes mellitus was significantly higher (55. 6%) in cases mainly among first degree relatives (92%). Multiparty, multi gravity and previous obstetric complication are significantly more evident in cases. Focusing in food consumption pattern of studied sample, cases were consuming more full fat dairy products, fish, whole grains, fruits and vegetables but less refined grains and potato and significantly less sweets.

The studies showed that mean total fat intake among gestational diabetic group (41±24.4g/day) was significantly lower than controls (50±23.3g/day) while intake of saturated and polyunsaturated fats were higher in cases than controls. Mean cholesterol intake among cases (268.9±351.2mg) was higher than among controls (243.5±236.3mg). Finally it was found that the mean carbohydrate intake among cases (172±78.8g/day) was significantly lower than that among controls (208g/day), and the mean GI and GL were also lower in them. (Table1, figure 1&2)

Assessment of women nutritional status showed that cases had significantly higher BMI and body fat percentage than controls. (Table2) Mean systolic and diastolic Blood pressure was significantly higher in cases than controls.

Table 1: Dietary assessment of the studied sample

Macronutrient Intake	Group				Z	P
	Case (n=45)		Control (n=45)			
	Mean	SD	Mean	SD		
Energy (kcal/day)	1306.30	540.65	1520.40	547.26	1.9	0.054
Protein (g/day)	61.2	28.4	58.6	25.2	0.6	0.545
Fat (g/day)	41.5	24.4	50.5	23.3	2.3	0.023*
Saturated fat	48.5	96.8	29.1	24.3	0.4	0.663
Polyunsaturated fat	18.2	21.5	17.5	14.9	0.9	0.345
Monounsaturated fat	34.1	42.1	34.6	30.1	1.2	0.231
Poly UF/Sat Fat ratio	0.78	0.68	1.03	1.23	0.68	0.494
Cholesterol (mg)	268.9	351.2	243.5	236.3	0.3	0.732
CHO (g/day)	172.0	78.8	208.0	80.8	2.3	0.019*
Nutrient density(%kcal)						
Protein	19.08	7.44	15.37	4.33	2.5	0.011*
Fat	28.03	8.17	29.68	8.78	0.88	0.377
CHO	52.89	11.79	54.95	10.74	0.67	0.506
Insulinogenic nature of diet						
Meal glycemic index (%)	55.2	12.2	58.7	12.1	1.2	0.225
Meal glycemic load (gm)	100.1	63.0	125.6	66.2	2.4	0.018*

Z: Mann-Whitney test for two independent samples

* P < 0.05 (significant)

Z: Mann-Whitney test

* P < 0.05 (significant)

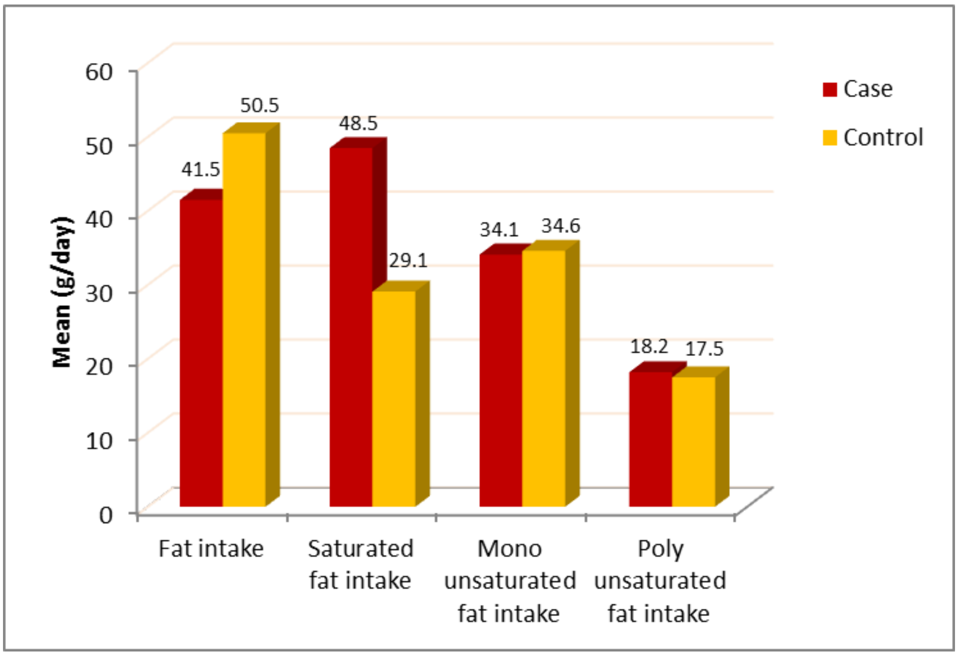

Figure (1): The distribution of studied sample by fat and fat subtypes intake

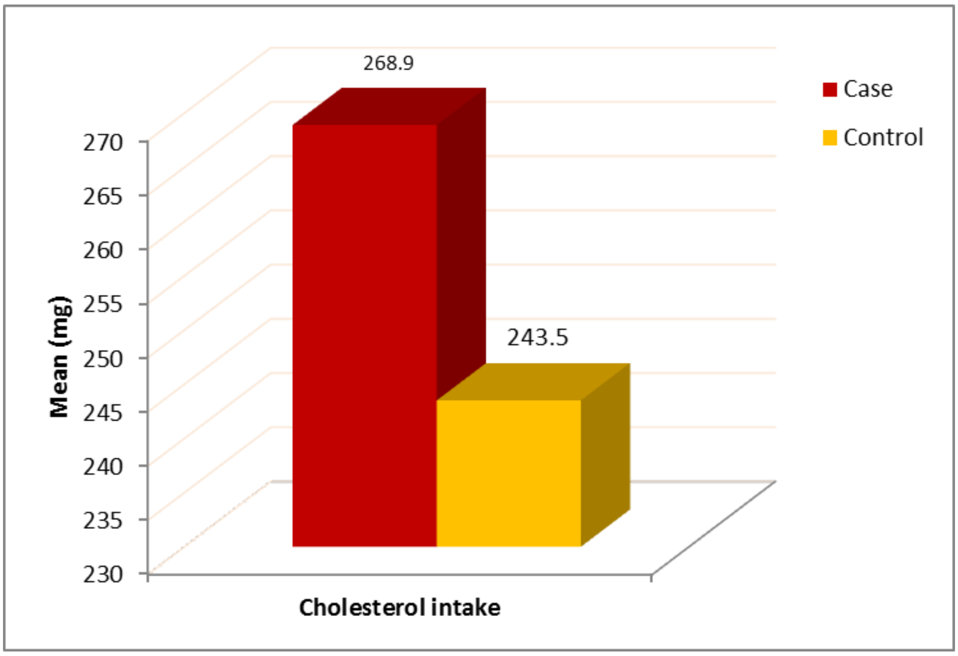

Figure (2): The distribution of studied sample by cholesterol intake

Table 2: Anthropometric assessment of the studied sample

Variable	Group				T	P
	Case (n=45)		Control (n=45)			
	Mean	SD	Mean	SD		
Age (years)	31.6	4.9	26.9	4.9	t=4.4	0.000*
BMI (kg/m^2)	38.3	24.4	30.6	4.8	2.1	0.039*
Biceps skin fold thickness (mm)	19.8	6.4	16.0	4.9	3.2	0.002*
Triceps skin fold thickness (mm)	23.7	5.4	20.1	4.8	3.3	0.002*
Sub scapular skin fold thickness (mm)	26.9	6.2	22.4	5.4	3.6	0.000*
Mid-thigh skin fold thickness (mm)	29.6	5.6	24.8	5.4	4.2	0.000*
Sum of skin fold thickness (cm)	100.0	20.2	83.4	18.5	4.1	0.000*
Body fat percentage (%)	31.8	3.2	29.2	3.0	3.9	0.000*

t: independent samples t-test

* P < 0.05 (significant)

Logistic regression risk factors for gestational diabetes

Table 3 shows that the dependent variable is GDM. The covariates that were finally retained in the model were Pre pregnancy weight, previous obstetric complications, Gravidity and Family history of DM. As evident from the table, it was found that all were significant risk factors for having gestational diabetes.

As regards prepregnancy weight, it was found that increase in prepregnancy weight 1 kg was associated with 7% increased risk for gestational diabetes. The table also revealed that those with previous obstetric complications were 8 times more likely to have gestational diabetes. Regarding gravidity, it was found that with increasing gravidity, there was 70% more risk getting gestational diabetes. Finally, it was clear that those with family history of gestational diabetes were 26 times more likely to have gestational diabetes.

Table 3: Multiple logistic regression analysis for the potential risk factors of gestational diabetes among studied sample

Variables	GDM		
	OR	95% CI	P value
Pre pregnancy weight	1.077	1.012-1.146	.019
Previous obstetric complications	8.460	1.463-48.906	.017
Gravidity	1.701	1.275-2.270	.000
Family history of DM	26.875	5.791-45.9	.000

Discussion

GDM is associated with an increase in maternal and neonatal complications of pregnancy. It was reported that age was strongly and positively associated with risk of GDM.The mean age among our study cases was significantly higher than that among controls (Table 2). This was similar to mean age of GDM women in government maternity units in Bahrain 2010,(14) Turkey 2008,(15)Korea 2005,(16) United kingdom 2005,(17) and Iran 2005.(18)

Family history of diabetes increases the risk of women to have gestational diabetes (Table 3). It was clear that cases with family history of GDM were 26 times more likely to have GDM. Similar finding was reported by González-Clemente et al. (2006) (19) and Keshavarz et al 2005. (20) Multiparity, multi gravity and previous obstetric complication were significantly more evident in cases. Regarding gravidity, it was found that with increasing gravidity, there was 70% more risk getting gestational diabetes (Table 3). The possible explanation for this is that multiparty, multi gravity and previous obstetric complication are closely linked to two other factors, increase in age and BMI. A study in Riyadh, Saudi Arabia by Al-Rowaily et al (2010)(21) was in agreement with ours.

Mean prepregnancy weight in our study was significantly higher in cases than controls. American diabetes association (2013)(22) that prepregnancy overweight and obesity account for a high proportion of GDM. In addition, Mean body fat percentage and mean BMI were significantly higher in our study cases than that of controls (Table 2) and this was in agreement with a study by Gonalez-Clemente et al (2006),(19) Thomas et al (2006) in United Kingdom(17) and Yelmez et al (2010)(15) Beside placental hormones which play big role in insulin resistance in GDM, it was reported that Adiponectin which is negatively correlated with BMI and accordingly is lower in obese has insulin sensitizing effect.(23)

Ying H et al (2006) in China(24) reported that Fat intake in GDM group was significantly higher than that in normal pregnant women, while carbohydrate and protein intake in GDM group was not significantly different. It was concluded that high dietary fat, high SFA and low PUFA may be one of the high-risk factors triggering GDM. This was inconsistent with our study findings where the mean total fat intake among cases was lower significantly than controls, while saturated, polyunsaturated fats and dietary cholesterol were higher in cases than controls. This may be attributed to the fact that most Gestational diabetic women who attended obstetric outpatient clinic in El-Shatby Hospital had received incomplete dietary advice before their referral which focused on importance of decreasing total fat intake only but not on different types of fats (Table 1).

A study by Gonalez et al (2007)(19) in Spain was held to investigate the relation between cholesterol intake and GDM and concluded that cholesterol intake is independently associated with GDM and that it could be involved in its pathogenesis. This is consistent with findings of our study (Table 1) as mean cholesterol intake among cases was higher than controls in spite of dietary advice received before their referral.

The established Dietary Reference Intake for carbohydrates during pregnancy is 175 g per day(25) which is consistent with our study, as it was clear that after prelimenary dietary advice given to our cases, the mean carbohydrate intake among cases was significantly lower in cases (172±78 g/day)than controls (208±80 g/day).

The glycaemic index (GI) is a means to categorize the distinctly different glycaemic impact of specific carbohydrate foods. Moses et al (2006)[26] and Middleton et al (2008)[4] in Australia found that the consumption of the low-GI diet led to a reduction in risk of the women having large-for-gestational-age infants. Zhang C et al (2006)[27] reported that the consumption of high-glycaemic load diets with low fibre contents before pregnancy doubled the risk of developing GDM when pregnants during 8 years of follow-up. In our study (Table 1) mean meal glycemic index and mean meal glycemic load was lower in gestational diabetic women than normoglycemic pregnant women after receiving general dietary advice from their obstetric physicans.

Concerning protein intake, it was evident mean total protein intake among cases (61.2g/day) was slightly higher than among controls (58.6±25.2), which is similar to study by Ying H et al (2006) in China[28] who reported that protein intake in GDM group was not significantly different compared with NP group.

Several research studies have focused on use of energy-restricted diets during pregnancy. Hypocaloric diets (<1,200 calories per day) in obese women with gestational diabetes have been shown to result in ketonemia ; elevations in plasma free fatty acids causing more insulin resistance and fatty liver. It was clear in our study that the minimum energy intake among cases (779 kcal) was lower than that of controls (981.5kcal),this could be attributed to improper dietary advice or the fact that some of gestational diabetic patients tend to under eat to decrease the dose of insulin, not aware that hypocaloric diets will result in ketonemia.

Conclusion & recommendations

In conclusion GDM occurs at higher age, multiparty, multi gravity, and higher BMI and body fat percentage. Saturated fat and cholesterol intake was high in GDM women. In addition gestational diabetic women receive in appropriate nutritional advice from their obstetric physicians.

It is recommended that a structured program that emphasizes life style changes should include nutrition education to physicians of family health units and obstetricians who deal with gestational diabetic patients. Individualized meal plan and dietary counseling by nutritionist is mandatory for GDM patients. Preconceptional weight control must be encouraged as prepregnancy overweight and obesity are leading factors to gestational diabetes. Finally, Community based programmes for prevention of obesity should be considered to decrease risk of GDM incidence.

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