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Nutritional status of gestational diabetes of resident's women in eastern province of Saudi Arabia

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Abstract

Background: Recently, gestational diabetes mellitus (GDM) has become a growing health concern among Saudi pregnant women. The prevalence of GDM in KSA reaches 12.5 to 18.7% in 2013.

Purpose: This study attempts to find out the nutritional status of GDM resident's women in the eastern province in Saudi Arabia.

Methods: A cross-sectional study was conducted on pregnant women. Total number (101) of participants were divided into two groups, the control group (CG) was included 49 normal pregnant women, and the experimental group includes 52 gestational diabetes women as gestational diabetes group (GDG). The inclusion criteria were residents' women in Eastern Province in Saudi Arabia, adult, and 2nd to 3rd trimester of pregnancy. The exclusion criteria were women who smoke, have chronic disease or other metabolic disorders, chronic type II diabetes, or taking any medications. Anthropometric measurements were taken. Food consumption pattern, food habits, nutritional intake were collected and analyzed for evaluation of the dietary intake of nutrients.

Results: The results showed the increment of the maternal age, also the initial weight before pregnancy and BMI were higher in GDG than CG. Furthermore, the carbohydrate intake among GDG was increased than RDA by 27.96%, while CG have approximately ideal or recommended intake. The pattern intake from animal and vegetarian source of CG may be healthier than GDG. The daily protein intake was over the recommended intake for both groups. Total iron intake 27.33±3.73 mg/day had been approximately equal to the RDA for GDG, while CG deficit by -4.45±16.39. On the other hand, calcium intake (805.86±176.23 mg/day) was decreased aggressiveness by -9.41±1.62 when compared to AI. Dietary fiber intake may be equal for both groups.

Keywords: gestational, diabetes, dietary intake, BMI, Saudi

Introduction

Gestational diabetes mellitus (GDM); a form of type II diabetes mellitus," is defined as any degree of hyperglycaemia or glucose intolerance with first recognition during pregnancy" (Prutsky *et al*., 2013) [21]. The prevalence of GDM had increased incidence that ranging from 12.5 to 18.7% as reviewed by AL Serehi *et al*., (2015) [2]. Consequently, the prevalence of GDM is also increased among Saudi women, this increment leads to negative consequences on the maternal and neonatal health (Metzger *et al*., 2008) [17]. The major reasons that responsible for the high percentage of GDM in Saudi women are obese and the women who continue being pregnant even at an elderly stage (Eman *et al*., 2015) [9]. The adverse effect resulting from GDM was macrosomia, neonatal hypoglycemia, pre-eclampsia, and cesarean section during labor and preterm delivery (Asemi *et al*., 2014) [4]**.** Several cross-sectional and retrospective studies have shown that the consumption of macronutrient constituents of the diet during pregnancy may predict development of GDM (Zhang and Ning, 2011) [33]. The recent findings of Looman *et al*., (2018) [14] confirmed that a low carbohydrate and high fat and protein intake may increase the risk of GDM, whereas higher fiber intake could decrease the risk of GDM. Also Mercier *et al*., (2018) [16] stated that higher intake of fruits and vegetables may be associated with a lower likelihood of abnormal glucose tolerance (AGT) among women with prior GDM (Mercier *et al*., 2018) [16]. Thus, the dietary counselling is the main strategy in managing GDM (Han *et al*., 2013) [11]. Moreover, NHS-II trial, which analyze the dietary patterns and their association with the risk of GDM development, found a significant relative risk (RR) for GDM development with the increased intake of the western diet and the decreased intake of prudent diet (Zhang *et al*., 2006) [34]. Therefore, the present study aimed to identify the nutritional status of GDM residents' women in the Eastern province in Saudi Arabia.

Subjects and Methods

A cross-sectional study was conducted among gestational diabetes participants aged from 20 to 45 years. GDM cases were recruited after they diagnose under the supervision of consultant in the Obstetrics and Gynecology Clinic of King Fahad University Hospital, Imam Abdulrahman Bin Faisal University, Al-Qatif Central Hospital, Al-Mowasat Hospital, Al-Manaa Hospital, Maternal and Childbirth Hospital and Medical Family Clinic, Eastern Province, KSA, started from January to April 2017. The inclusion criteria were resident in Eastern Province in Saudi Arabia, adult women in 2nd to 3rd trimester of pregnancy. The exclusion criteria were: smoking, having a chronic disease or other metabolic disorders, chronic diabetes mellitus, and if taking any medications.

Experimental design

The study was conducted on 101 participants. 49 normal pregnant women were included as a control group, and 52 GDM women were case group. The following variables at the first clinic visit were systematically recorded: weight in the initially of pregnancy and current weight, height; and BMI was calculated [BMI = body weight (kg)/ height (m^2)] (WHO, 2016) [30].

Questionnaire

A validated and reliable questionnaire was designed for collecting data related to socioeconomic status, health history, food habits, and nutritional intake). The dietary intake was evaluated by 24-hour recall food questionnaire which was conducted for three times (two weekdays and a weekend day), which was filled for each participant. Nutritive values of the consumed foods were evaluated by using Saudi composition table at computerized software Nutritionist Program (Musaiger, 2006) [19].

Ethical consideration

All participants were provided with formal consent information about the procedure of the study, and their rights and duties.

Statistical Analysis

The collected data was statistically analyzed to find out the frequency distribution of non-parametric variables, also mean value, standard deviations (SD) for parametric variables. Significant differences (P-value) by (independent sample test), and Chi^2 test for verifying differences between studied groups were set by using Statistical Package of Social Science program (SPSS version 23). The significance levels were tested at $p < 0.05$. All obtained results were tabulated to obtain the results (SPSS, 2015) [23].

Results and Discussion

The prevalence of GDM and pre-GDM in the Saudi pregnant population is among the highest in the world. The conditions are associated with high maternal and neonatal morbidities and mortalities (Wahabi *et al*., 2017) [27]. Therefore, the present study was designed to analyze the nutritional status of Saudi Eastern women infected with gestational diabetes mellitus.

The results of the current study showed the increment of the maternal age among Saudi women, as illustrated in table (1). The trimester of pregnancy differs significantly (P-value <0.05) between both groups, and most of the participants in both groups were in the third trimester when compared to the percent of the second trimester. The education level differs significantly (P-value <0.05), while most of the participants in both groups had a universal education. Regarding to smoking, there are 55.8% of gestational diabetic group exposure to negative smoking compared to 38% of the control group while did not differ significantly. The family income, occupation, and living state did not differ significantly. Also, the age, or the first pregnancy' age and the duration between pregnancies were not statistically differ significantly. Moreover, the Saudi study of Wahabi *et al*., (2013) [29] recognized some risk factors for the development of GDM, including an increase in maternal age and obesity. ADA proved that major risk factors for GDM include older age in pregnancy and a family history of diabetes (ADA, 2004) [3]. Another study of Zhu *et al*., (2013) [38] showed that both age and week of pregnancy have independent associations with fasting blood glucose (FPG) as mentioned by Tobias *et al*., (2012) [6]. Furthermore, the study of Marchi *et al*., (2015) [15] ascertains that obesity is associated with the development of type II diabetes mellitus and GDM due to the increased peripheral resistance to insulin, and it is a risk factor for many maternal adverse outcomes, including increased Cesarean section delivery, hypertensive disorders in pregnancy, macrosomia, and perinatal mortality.

The table (2) clarified information related to the history of pregnancy. As shown in the table below, the three times of being pregnant are alike among the two groups. The GDG had a high rate of infecting with gestational diabetes during the previous pregnancy, which is statistically significant than CG. In addition, a family history of diabetes was more prevalent among GDG by 82.7% vs. 60% of CG.

The anthropometric indices from table (3) showed that the initial weight before pregnancy and BMI were higher in GDG than CG but did not differ significantly. At the same trend, the actual weight has slight increase in GDG than CG, and means value were 72.16±14.71 and 74.12±12.42, for CG and GDG respectively. These findings are consistent with previous studies from Saudi Arabia and other parts of the world of diabetes in pregnant subjects (Wahabi *et al*., 2014) [26]. Similarly, the findings of Catalano and Ehrenberg, (2006) [8] illustrate that obese women have much more insulin resistant as compared with normal weight women; hence increased insulin resistance may be relevant to the development of preeclampsia in obese women and women developing GDM.

The study of Metzger *et al*., (2007) [18] stated that the association between dietary patterns and GDM risk appears to be mediated by BMI. Also, Zhang and Ning, (2011) [33] confirmed that dietary components include macronutrients and micronutrients were associated with GDM risk, in parallel the study of Saldana *et al*., (2004) [22], they mentioned that macronutrient components of the diet in mid-pregnancy may predict incidence or recurrence of GDM. Regarding table 4, estimated energy requirements (EER) and macronutrient intake were differed significantly between pregnant subject and gestational diabetic cases. Total energy intake was deficit by -48.21 in CG than -26.89% in GDG when compared with EER. In contrast, the carbohydrate intake was increased than RDA (175 g/day) by 27.96%, while CG have approximately ideal or recommended intake. Similarly, in the Nurses' Health Study II of Bowers *et al*., (2012) [6], they stated that replacement of 5% of energy from carbohydrates with total fat slightly increased the risk of GDM. On the other hand, a low-carbohydrate dietary pattern tends to have a relatively higher intake of fat and protein to compensate energy requirements, as found in the present study that the major capacity of energy was dense from fat sources, while the pattern intake from animal and vegetarian source of CG may be healthier than GDG.

The major capacity of energy was dense from fat sources, while the pattern intake from animal and vegetarian source of

CG may be healthier than GDG, as 2/3 of fat intake from plant sources by 59.16±10.36 g/day compared to approximately equal portions for the animal and vegan sources for GDG, the mean values were 57.33±12.44 and 45.90±7.66, respectively. At the same lime, the findings of Saldana *et al*., (2004) [22] stated that total fat intake was significantly higher among women with than among those without GDM. Moreover, a recent prospective study that considered the correlation of nutrients showed that higher intake of fat and lower intake of carbohydrates may be associated with increased risk of GDM and impaired glucose tolerance as mentioned by Saldana *et al*., (2004) [22]. Also, Bowers *et al*., (2012) [6] illustrated that higher intakes of animal fat and animal protein were associated with increased risk of GDM, whereas higher intake of vegetable protein was associated with lower risk. Theoretically, the findings of Bao *et al*., (2013) [5] proved that long-term adherence to low-carbohydrate dietary patterns, particularly those that are mainly based on animal foods, may have detrimental effects on the GDM risk because they result in an increase in animal fat intakes and a decrease in the consumption of whole grains, dietary fiber, fruits, and vegetables.

For dietary protein, the daily intake was over the recommended intake for both groups, the mean values were 111.67±22.68 and 131.06±24.27 g/day compared to RDA that 71 g/day. Furthermore, Brandsch *et al*., (2006) [7] investigated that an animal protein compared with a vegetable protein rich meal cause higher plasma concentrations of branched chain amino acids, which have been positively linked to the development of insulin resistance and incident diabetes. Furthermore, heme iron have been associated with β-cell damage, oxidative stress, and insulin resistance as well as incident GDM (Zhang *et al*., 2006) [34].

Dietary fiber intake may be equal in both groups (13.91±2.81and 13.39±10.92) for CG and GDG respectively, however, it was decreased drastically than adequate intake for pregnancy (28 g/day). At the same line, Zhang *et al*., (2006) [34] concluded that pregravid consumption of dietary fiber was significantly and inversely associated with GDM risk. Moreover, Zhang, (2010) [35] confirmed that the combination of high glycemic load and a low fiber diet was associated with a 2.15-fold increased risk of GDM compared with the reciprocal diet.

The micronutrient intake for pregnant women's was indicated in table (5). The findings showed no significant difference in terms of dietary intakes of vitamin C, thiamin, and riboflavin between both groups, moreover their consumption may meet the RDA of pregnancy. In addition, a prospective study of pregnant women showed that lower maternal level of ascorbic acid was found to be associated with a 3.1-times increased risk for GDM compared with higher intakes (Zhang *et al*., 2004) [35] and vitamin D concentrations in early pregnancy were significantly associated with increased GDM risk (Zhang *et al*., 2008) [37]. Also, Hamer and Chida, (2007) [10] reported that both plasma ascorbic acid concentrations and dietary vitamin C intake were inversely associated with GDM risk, hence, vitamin C might prevent metabolic deterioration by opposing free radicals and improving systemic oxidative stress.

As well, total iron intake had been approximately equal to the RDA for GDG at 27.33±3.73 mg/day, while CG had lower intake 25.79±4.42 and deficit by -4.45±16.39, although there is no significant differ between groups regarding iron and phosphorus intake. On the other hand, calcium intake (805.86±176.23 mg/day) was decreased aggressively by -9.41±1.62 when compared to AI, while CG differs significantly at (P-value < 0.001) and had the recommended intake (1019±32.56 mg/day). Furthermore, the studied groups had the RDA of phosphorus intake that did not differ significantly between them. These findings state the hypothesis of Osorio-Yáñez *et al*., (2017) [20] who proved that higher dietary Ca intake was inversely associated with GDM risk. Moreover, the study of Krige *et al*., (2018) [13] stated that the dietary intake of these women was not optimal, and the same findings of Joseph *et al*., (2018) [12] indicated a deficit in the intake of, iron, calcium, thiamine, and riboflavin among GDM women.

Table 1: Characteristic data of participants among both control and gestational diabetes groups

Variables		CG		GDG		P-Value	Sig.
		No	%	No	%		
Trimester	Second trimester	10	20	23	44.2	8.33	0.04*
	Third trimester	39	78	29	55.8		
Presence of smoker at home "Negative Smoking"	Yes	19	38	29	55.8	3.97	0.13
	No	30	60	23	44.2		
Education level	Illiteracy	1	2	1	1.9	12.29	0.03*
	Primary School	2	4	2	3.8		
	Preparatory School	0	0	7	13.5		
	Secondary School	11	22	16	30.8		
	University	36	72	24	46.2		
	Post graduate	0	0	2	3.8		
Occupation	House wife	32	64	34	65.4	2.05	0.56
	Retired	0	0	1	1.9		
	Employee	15	30	16	30.8		
	Other	3	6	1	1.9		
Living state	Rented house	6	12	6	11.5	0.90	0.82
	Rent apartment	22	44	27	51.9		
	Owned house	12	24	9	17.3		
	Owned apartment	10	20	10	19.2		
Kinship of Parents	Yes	23	46	19	36.5	1.76	0.41

	No	27	54	3	61.5		
Family Income	Less than 5.000	9	18	9	17.3	1.98	0.57
	5.000 to 10.000	26	52	33	63.5		
	10.000 to 15.000	13	26	8	15.4		
	More than 15.000	2	4	2	3.8		

CG= Control group; GDG= Gestational diabetes group; %: percentage; Sig: significance. *= (Value ≤ 0.05); **= (Value ≤ 0.01); ***= (Value ≤ 0.001).

Table 2: Baseline pregnancy history data among participants in Control and Gestational Diabetes Groups.

History of pregnancy							
Variables		**CG**		**GDG**		**P-value**	**Sig.**
		No	**%**	**No**	**%**		
First pregnancy	Yes	14	28	10	19.2	3.10	0.376
	No	35	70	41	78.8		
Time becomes pregnant	Second	7	14	10	19.2	2.96	0.39
	Third	9	18	14	26.9		
	More than 3	18	36	18	34.6		
Complication during the previous pregnancy	Yes	7	14	9	17.3	2.19	0.33
	No	27	54	33	63.5		
Gestational diabetes during previous pregnancy	Yes	2	4	10	19.2	5.72	0.05*
	No	37	74	33	63.5		
History of obesity in the family	Yes	9	18	10	19.2	0.25	0.87
	No	41	82	42	80.8		
History of diabetes in the family	Yes	30	60	43	82.7	6.45	0.01*
	No	20	40	9	17.3		
History of chronic disease in the family	Yes	29	58	39	75	3.31	0.06
	No	21	42	13	25		
feeding the baby	Natural	5	10	12	23.1	5.37	0.14
	Artificial	6	12	7	13.5		
	Natural and artificial	20	40	23	44.2		

CG= Control group; GDG= Gestational diabetes group; %: percentage; Sig: significance. *= (Value ≤ 0.05); **= (Value ≤ 0.01); ***= (Value ≤ 0.001).

Table 3: Anthropometric measurements of pregnancy and gestational diabetes participants

Variables	**CG Mean±(SD)**	**GDG Mean±(SD)**	**P-value**	**Sig.**
Age	30.14 (6.03)	32.17 (5.77)	1.72	0.087
First pregnancy age	24.92 (5.06)	23.96 (7.39)	-0.76	0.448
Duration between pregnancy	2.03 (1.77)	2.48 (1.61)	1.36	0.176
Pre-pregnancy weight	62.92 (13.47)	65.42 (11.91)	0.99	0.32
Actual weight	72.16 (14.71)	74.12 (12.42)	0.75	0.46
Height	157.46 (6.54)	160.73 (9.63)	1.99	0.04*
BMI	25.5 (6.01)	25.48 (5.09)	0.05	0.96

CG: control group; GDG: gestational diabetes group; BMI: body mass index; Sig: significance. *= (P-Value ≤ 0.05); **= (P-Value ≤ 0.01); ***= (P-Value ≤ 0.001)

Table 4: Macronut1rients intake of pregnant and gestational diabetes participants

Variables	**CG Mean ±(SD)**	**GDG Mean ±(SD)**	**Sig.**
Energy (Kcal/day)	1450.43 (79.87)	2047.22 (42.26)	0.000
Lower % EER	- 48.21(5.48)	-26.89 (1.87)	0.001
Carbohydrate (g/day)	172.74(40.08)	233.94 (40.20)	0.000
%RDA (175g/d)	-1.71(0.45)	27.96 (4.08)	0.021
Fiber (g/day)	13.91 (2.81)	13.39 (10.92)	0.768
Lower %AI (28g/d)	-53.57(7.57)	-52.18 (8.99)	0.150
Animal fat (g/day)	28.13 (6.21)	57.33 (12.44)	0.000
Plant fat (g/day)	59.16 (10.36)	45.90 (7.66)	0.000
Total fat (g/day)	82.05 (11.30)	142.73 (22.03)	0.000
Animal protein (g/day)	49.91 (14.63)	55.60 (14.38)	0.066
Vegan protein (g/day)	40.63 (6.93)	39.84 (7.18)	0.592
Total protein (g/day)	111.67 (22.68)	131.06 (24.27)	0.000
Higher %RDA (71g/d)	57.28 (10.95)	84.60 (14.18)	0.000

EER: Estimated energy requirements; RDA: Recommended dietary allowances; AI: Adequate intake; BMI: body mass index; CG: control group; GDG: gestational diabetes group; Sig: significance. *= (P-Value ≤ 0.05); **= (P-Value ≤ 0.01); ***= (P-Value ≤ 0.001).

Table 5: Micronutrient intake of pregnant and gestational diabetes participants.

	CG	GDG	Sig.
Vitamin C (mg/day)	85.87 (11.65)	88.62 (10.65)	74.97
%RDA (85 mg/d)	1.02 (0.53)	4.25 (0.36)	74.97
Riboflavin (mg/day)	1.43 (0.28)	1.53 (0.30)	0.10
%RDA (1.4 mg/d)	2.14 (0.69)	9.28 (1.96)	0.09
Thiamine (mg/day)	1.65 (0.96)	1.56 (0.03)	0.68
%RDA (1.4 mg/d)	17.85 (4.38)	11.42 (3.79)	0.75
Total iron (mg/day)	25.79 (4.42)	27.33 (3.73)	0.07
%RDA (27mg/d)	-4.45 (0.39)	1.22 (0.81)	0.07
Phosphorus (mg/day)	970.49 (39.03)	791.64 (12.59)	0.27
%RDA (700 mg/d)	38.64 (1.43)	13.09 (1.51)	0.27
Calcium (mg/day)	1019 (32.56)	805.86 (22.23)	0.000
%AI (1000mg/d)	1.91 (0.25)	-19.41 (1.62)	0.000

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