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Food Group Intake of Pregnant Jordanian Women Based on the Three Pregnancy Trimesters

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ABSTRACT: Inadequate diets have adverse effects on maternal, fetal, and, possibly, childhood health. This cross-sectional study aimed to examine daily food group intake of pregnant Jordanian women during the three pregnancy trimesters and to compare these to the recommended servings of the five food groups reported by The United States Department of Agriculture and My Plate Plan. A total of 283 pregnant Jordanian women were recruited during their antenatal visits. Data were obtained by interviewer-administered structured questionnaires. Our results showed that 1.1% of participants consumed the recommended number of servings for all five food groups during pregnancy and 10.2% did not consume the minimum number of servings of the five food groups. Nearly half of the participants in the first trimester met the recommended daily servings for three food groups but only approximately two-third of participants met the minimum recommended daily servings for one or two food groups in the second and third trimesters. Consumption of grains and sweets was significantly higher in the third trimester compared with the first and second trimesters. Overall, the majority of pregnant Jordanian women in this study did not consume the recommended number of servings for all five food groups during pregnancy.

Keywords: adequacy, fats, food groups, pregnancy, sweets

INTRODUCTION

Nutrition during pregnancy has a crucial role in the well-being of both the mother and the fetus. Furthermore, nutrition during pregnancy may influence the health of the child later in life (Vioque et al., 2013; D'Souza et al., 2015; Yong et al., 2019). Pregnancy is associated with increased nutritional requirements to meet the demands of both maternal physiological tissue development and fetal growth (Jardí et al., 2019). However, poor nutrition during pregnancy is significantly associated with increased risk of gestational diabetes (Allehdan et al., 2020), excess weight gain during pregnancy (Hill et al., 2019), high infant birth weight, and childhood obesity (Hu et al., 2020).

Identification of optimal nutrition during pregnancy is an important health issue worldwide (Vioque et al., 2013). While diet during pregnancy is commonly assessed by intake of energy, macronutrients, micronutrients, and food groups, there are limited published reports on eating patterns by food groups (Hill et al., 2019; Yong et al., 2019).

In recent years, the focus of nutritional studies during pregnancy has shifted from evaluating single nutrients to evaluating dietary patterns (Hill et al., 2019). This is because nutritional health consequences are often the result of interactions between nutrients and food rather than the effect of individual components. A recent report showed that while dietary patterns high in fruit and vegetables are associated with reduced risk of preterm delivery and childhood allergic diseases, dietary patterns of high energy and saturated- and trans-fats, and refined sugar and sodium are associated with increased risk of preterm delivery, low birth weight, and small gestational aged infants (Yong et al., 2019). Diets high in white

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bread, red and processed meat, French-fried potatoes, fried chicken, and vitamin C-rich drinks may increase the risk of children being overweight and obese at 3 years of age (Yong et al., 2019).

Although evidence supports the importance of maternal nutrition, various studies have shown poor compliance with adequate dietary intake (Jardí et al., 2019). A recent report showed that pregnant women who participated in the Women Infant Children Program had the lowest average daily intake of the following recommended food groups: citrus fruit, dark-green vegetables, whole grains, and plant protein (Hill et al., 2019). In another study, consumption of healthy foods during pregnancy did not meet recommendations, whereas consumption of red and processed meat and sweet food exceeded recommendations (Jardí et al., 2019). A recent report on dietary patterns of pregnant Malaysian women showed that women had a high intake of good protein sources, sugar and carbohydrates during the last month of gestation (Yong et al., 2019). In a study conducted in East Gojjam Zone, Northwest Ethiopia, the authors demonstrated inadequate dietary diversity in about 55% of pregnant women, and micronutrient consumption was inadequate in more than half of the women. Additionally, the dietary groups mainly consumed were legumes, nuts, and seeds (85.5%), followed by starchy staples (64.7%). Non-educated pregnant women were more likely to consume an inadequately diverse diet than those educated to college level or above (Yeneabat et al., 2019).

Therefore, the primary aim of this study was to examine daily intake of food groups by pregnant Jordanian women, and compare their consumption to the recommended servings of the five food groups reported by The US Department of Agriculture (US Department of Agriculture, 2015) and My Plate Plan (https://www.choosemyplate.gov/resources/MyPlatePlan).

MATERIALS AND METHODS

Study design and participants

This was a cross-sectional observational study designed to examine food groups intake of pregnant Jordanian women compared to consumption of five food groups recommended by the American Dietary Guidelines. The study was conducted between March 2017 and December 2018 at maternity clinics in Jordan University Hospital. Three hundred pregnant Jordanian women were invited to participate in the study, of which 283 agreed. Inclusion criteria included healthy women of Jordanian nationality, pregnant with a single fetus, able to give informed consent and aged 18 years or above at enrollment. Women were excluded from the study if they had severe nausea and/or vomiting, gestational diabetes, preeclampsia, or chronic diseases that require dietary modifications, such as diabetes mellitus, renal and liver diseases, and inflammatory or autoimmune disorders.

Enrolled women were asked to complete an interviewer administrated personal questionnaire, pregnant physical activity questionnaire (PPAQ), and quantitative food frequency questionnaire (FFQ). The gestational age at the time of the study was calculated based on the date of the last menstrual period and ultrasound fetal biometrics performed by obstetricians (Jehan et al., 2010; Skupski et al., 2017).

A written consent form was obtained from all recruited women before enrollment. The study was performed according to the guidelines in the Declaration of Helsinki and the study protocol was approved by the Hashemite University Ethics Committee (1601100/10/13/16/م) and Institutional Review Board of Jordan University Hospital (10/2016/3341).

Data collection

***Socio-demographic data*:** Data about maternal age, pre-pregnancy weight, educational level, monthly income, and smoking status were obtained by an interviewer-administered structured questionnaire.

***Anthropometric assessment*:** Participants' weight and height were measured using standardized techniques and calibrated tools. The participants were weighed without shoes using a Health o meter® Professional Scales (Health o meter® Professional Scales, McCook, IL, USA) to the nearest 0.1 kg, and height was measured without shoes to the nearest 0.1 cm using a wall-mounted plastic height rod. Pre-pregnancy body mass index (BMI) was computed and classified according to World Health Organization guidelines (WHO, 2002).

Physical activity assessment

A semi-quantitative PPAQ was used to determine level of physical activity. It was validated among a sample of 54 pregnant women using 7 days of accelerometer measurements. In the PPAQ, participants were asked to recall the duration of time spent in the current pregnancy trimester participating in 36 types of activities that were grouped into four categories: household/caregiving, occupational, sports/exercise, transportation, and inactivity. These activities were further categorized according to the intensity level in sedentary, light intensity, moderate intensity, and vigorous-intensity activities (Chasan-Taber et al., 2004). In addition, physical activity levels were estimated as min/d. According to the guidelines of the Institute of Medicine for the general adult population, which includes pregnant women, study participants were considered sedentary, low-active, active, or very active (Otten et al., 2006).

Assessment of food groups intake

A validated Arabic language quantitative FFQ that included 117 food items was used to assess food group intake (Allehdan et al., 2019). The FFQ was developed by Tayyem et al. (2020) and validated among a sample of 131 pregnant women using three 24-h dietary recalls. The FFQ assessed usual food group intake over a period of one month. In addition, the FFQ had moderate reproducibility and good relative validity in assessing most food groups intake in pregnant Jordanian women.

A trained dietitian asked participants how often, on average, they had consumed each food item over the past month. For beverages, the questionnaire had 10 frequency selections that ranged from "never" during the past 4 weeks to "≥6/d", whereas for food, the questionnaire had nine frequency selections that ranged from "never" during the past 4 weeks to "≥2/d". The portion sizes of each food item were in standard measuring units (e.g., cups, tablespoons, and teaspoons) or natural units (e.g., 1 apple, 1 egg, a can of soft drink, and 1 cracker). All types of meat, legumes and eggs were grouped in the 'meat and meat alternatives' group. The dairy products group included all types of milk, yogurt, and natural cheeses. Additionally, participants were asked about their supplemental intake, however these results were not shown. The participants were asked to indicate the portion size of food based on three categories: small, medium, and large. Food models, measuring cups, and spoons were used to help participants estimate consumed portion sizes of foods that were not measured using standard measuring units.

To estimate food group intake, results from the FFQ was analyzed using Food Processor Nutrition analysis software (version 11.6.0, ESHA's Food Processor SQL, ESHA Research, Salem, OR, USA). Additional data on food consumed in Jordan was obtained from food composition tables and added to the Food Processor Nutrition analysis software (Takruri et al., 2020). The recommended daily servings of each food group were estimated based on maternal age, height, pre-pregnancy body weight, physical activity level, and stage of pregnancy. Accordingly, for our study participants, we estimated the daily recommended servings from each food group based on 1,800 kcal, 2,200 kcal, and 2,400 kcal during the first, second, and third trimesters, respectively, using My Plate Plan and 2015-2020 Dietary Guidelines for Americans (US Department of Agriculture, 2015).

Statistical analysis

Data were analyzed using the Statistical Package for the Social Sciences version 26 (IBM Inc., New York, NY, USA). Data were considered statistically significant at P-value<0.05. Means and standard deviations (SD) were calculated for the continuous variables (maternal age, monthly income, gestational age, pre-pregnancy weight, height, pre-pregnancy BMI, and physical activity). Frequencies and percentages were calculated for categorical variables (pre-pregnancy BMI category, educational level, and smoking status). Means and SD for food group intake estimated from the FFQ were calculated for each pregnancy trimester. The normality of distribution was assessed using the Shapiro-Wilk test. One-way analysis (ANOVA) and Fisher's least significant difference (LSD) post hoc test were used to observe differences across trimesters. The number and percentage of pregnant women who met or consumed less than or more than the recommended number of daily servings of each food group were calculated, and Pearson chi-square (χ^2) test was used to find differences in these results across the three pregnancy trimesters. Additionally, the number and percentage of pregnant women who met any of the minimum recommended daily servings for zero, one or more than one of the American Dietary Guidelines of food groups were determined, and Pearson χ^2 test was used to assess differences in these results across three pregnancy trimesters.

RESULTS

Sociodemographic characteristics of the participants

Two hundred and eighty-three pregnant Jordanian women were recruited in the present study. Fifty, 96, and 137 women were in the first, second, and third trimesters of pregnancy, respectively. The participant's age, monthly income, pre-pregnancy weight, height, pre-pregnancy BMI, smoking status, and physical activity level are shown in Table 1. The mean age was 29.6±5.1 years and the mean gestational age at enrollment was 23.0±8.7 weeks. Overall, 58.3% of participants had normal pre-pregnancy BMI, whereas 4.2% were underweight, 27.9% were overweight and 9.5% were obese. Furthermore, more than half of the participants had at least a diploma degree, and 0.7% of the participants smoked during their pregnancy.

In a previous study, the mean gestational ages of women at enrollment was 9.0±3.1, 20.0±3.7, and 30.0±3.2 weeks in the first, second, and third trimesters of pregnancy, respectively. A large proportion of the participants in the first (68.0%), second (72.9%), and third (63.6%) trimesters of pregnancy had a college degree or above. Furthermore, 50.0%, 61.5%, and 58.1% of participants, respectively, had normal BMIs; 6.3%, 5.2%, and 2.9%, respectively, were underweight; 33.3%, 28.1%, and 26.5%, respectively, were overweight; and 10.4%, 5.2%, and 12.5 %, respectively, were obese (Tayyem et al., 2019).

Food groups' intake

Table 2 presents the mean food group intake of all par-

Table 1. Participants characteristics

Variables	Participants (n=283)
Maternal age (year)	29.6±5.1
Monthly income (Jordanian dinars)	594.5±330.1
Gestational age (week)	23.0±8.7
Body weight (kg) at enrollment	71.4±13.3
Pre-pregnancy weight (kg)	63.9±11.3
Height (cm)	161.7±5.9
Pre-pregnancy BMI (kg/m^2)	24.4±4.0
Physical activity level (min of moderate and vigorous activity/d)	60.6±4.13
Pregnancy trimester	
First	50 (17.7)
Second	96 (33.9)
Third	137 (48.4)
Pre-pregnancy BMI category	
Under weight (<18.5 kg/m^2)	12 (4.2)
Normal (18.5~24.9 kg/m^2)	165 (58.3)
Overweight (25.0~29.9 kg/m^2)	79 (27.9)
Obese (>30.0 kg/m^2)	27 (9.5)
Education level	
Illiterate	2 (0.7)
Primary	22 (7.8)
High school degree	62 (21.9)
Diploma and above	197 (69.6)
Smoking during pregnancy	2 (0.7)
Physical activity category	
Sedentary	137 (48.4)
Low active	51 (18.0)
Active	75 (26.5)
Very active	20 (7.1)

Data are presented as mean±SD or number of participants [n (%)].
Body mass index (BMI) categories according to World Health Organization classification (WHO, 2002).
Physical activity categories based on IOM guidelines (Otten et al., 2006).

ticipants, as derived from the FFQ across the three pregnancy trimesters. Our results showed no significant differences between the three pregnancy trimesters for consumption of fruit, vegetables, meat and meat alternatives, dairy products, fats, oils, and nuts. However, the mean intake of grains (overall, 8.9±3.3 ounces/d) and was significantly higher in the third trimester compared with the first and second trimesters (P=0.026). Similarly, the mean intake sweets was significantly higher in the third trimesters (3.9±3.1 servings/d) compared with the first trimesters (P=0.009).

The numbers and percentages of participants who reported intake of the five food groups above or below those recommended by the American Dietary Guidelines during pregnancy are presented in Table 3. In the first trimester, 80.0%, 74.0%, and 62.0% of participants consumed the American Dietary Guideline recommended daily servings for fruits, grains, and vegetables, respectively. Approximately 26.0% and 12.0% of participants met the American Dietary Guideline recommended daily servings for dairy products and meats and meat alternatives, respectively. Daily servings of grains were in line with the American Dietary Guidelines for 64.6% and 60.6% of participants in the second and third trimesters, respectively, and daily servings of fruits for 57.3% and 58.4% of participants in the second and third trimesters, respectively.

Data for participants who consumed less than the recommended daily servings for each food group are shown in Table 3. While fruit intake was inadequate for 42.7% and 41.6% of participants in the second and third trimesters, respectively, it was only inadequate for 20.0% of participants in the first trimester (P=0.010). Likewise, vegetable intake was inadequate for 67.7% and 63.5% of participants in the second and third trimesters, respectively, compared with only 38.0% of participantsin the first trimester (P=0.001). There was a high prevalence of inadequate intake of meat and meat alternatives in all three trimesters (first, 88.0%; second, 95.8%; third, 89.8 %) (P=0.036).

The results also showed that only 1.1% of participants consumed the recommended number of servings for all five food groups during pregnancy, and 10.2% of participants did not consume the minimum number of daily servings for any of the five food groups (Table 4). Furthermore, nearly half of participants in the first trimester (42.0%) met the recommended daily servings for

Table 2. Mean daily intake of food groups among 283 pregnant Jordanian women

Food group	All participants (n=283)	First trimester (n=50)	Second trimester (n=96)	Third trimester (n=137)	P-value
Fruits (cups)	2.7±1.7	2.6±1.5	2.5±1.6	2.9±1.8	0.783
Vegetables (cups)	2.9±1.3	3.0±0.4	2.7±1.0	2.9±1.5	0.397
Grains (ounces)	8.9±3.3	8.3±3.3^b	8.3±2.9^b	9.4±3.4^a	0.026*
Meat, meat products, and legumes (ounces)	3.8±1.7	3.6±1.6	3.6±1.3	4.1±1.9	0.073
Dairy products (cups)	2.2±1.3	2.2±1.4	2.0±1.1	2.3±0.3	0.254
Fats, oils, and nuts (servings)	13.6±5.0	13.2±4.7	13.4±4.1	14.0±5.7	0.605
Sweets (servings)	3.6±3.1	2.8±2.0^b	3.6±3.3^a	3.9±3.1^a	0.009*

Data are presented as mean±standard deviation.
Means within the same row with different letters (a,b) are significantly different at *P<0.05.

Table 3. The number and percentage of pregnant women meeting the American Dietary Guideline recommended food group daily servings (n=283)

	Fruits (cups)	Vegetables (cups)	Grains (ounces)	Meat and meat alternatives (ounces)	Dairy (cups)
First trimester (n=50)					
Recommended daily servings[1)]	1.5	2.5	6	5	3
Consuming less than recommended serving	10 (20.0)	19 (38.0)	13 (26.0)	44 (88.0)	37 (74.0)
Meeting & consuming more than the recommended daily serving	40 (80.0)	31 (62.0)	37 (74.0)	6 (12.0)	13 (26.0)
Second trimester (n=96)					
Recommended daily servings[2)]	2	3	7	6	3
Consuming less than recommended serving	41 (42.7)	65 (67.7)	34 (35.4)	92 (95.8)	79 (82.3)
Meeting & consuming more than the recommended daily serving	55 (57.3)	31 (32.3)	62 (64.6)	4 (4.2)	17 (17.7)
Third trimester (n=137)					
Recommended daily servings[3)]	2	3	8	6.5	3
Consuming less than recommended serving	57 (41.6)	87 (63.5)	54 (39.4)	123 (89.8)	105 (76.6)
Meeting & consuming more than the recommended daily serving	80 (58.4)	50 (36.5)	83 (60.6)	14 (10.2)	32 (23.4)
P-value	0.010*	0.001*	0.176	0.036*	0.247

Data are presented as number of participants [n (%)].
Food group amounts are presented based on the mean of maternal age, pre-pregnancy body weight, height, and physical activity and pregnancy trimester of participants and are equivalent to [1)]1,800, [2)]2,200, and [3)]2,400 calories a day.
P-values calculated by Pearson chi-square (χ^2) to find the difference between trimesters.
*$P<0.05$ was considered statistically significant.

Table 4. Number and proportion of pregnant women meeting any of the minimum recommended daily servings for none, one, or more than one of the American Dietary Guidelines of food groups

Number of food group recommendations met	All participants (n=283)	First trimester (n=50)	Second trimester (n=96)	Third trimester (n=137)	*P*-value
0-inadequate intake	29 (10.2)	0 (0)	13 (13.5)	16 (11.7)	0.028*
1	80 (28.3)	7 (14.0)	28 (29.2)	45 (32.8)	0.078
2	84 (29.7)	15 (30.0)	32 (33.3)	37 (27.0)	0.565
3	56 (19.8)	21 (42.0)	16 (16.7)	19 (13.9)	<0.001*
4	31 (11.0)	7 (14.0)	6 (6.3)	18 (13.1)	0.135
5-adequate intake	3 (1.1)	0 (0)	1 (1.0)	2 (1.5)	0.689

Data are presented as number of participants [n (%)].
P-values calculated by Pearson chi-square (χ^2) to find difference between trimesters.
*$P<0.05$ was considered statistically significant.

three food groups ($P<0.001$), and approximately two-third of participants met the minimum recommended daily servings for one or two food groups in the second and third trimesters of pregnancy (Table 4).

DISCUSSION

The main aim of this study was to assess adequacy of intake of five food groups among pregnant Jordanian women. Two hundred and eighty-three pregnant women were recruited. Participants had a mean age was 29.6±5.1 years, and approximately 60% had a normal pre-pregnancy BMI and 70% had at least a diploma degree. Furthermore, participants had a mean daily physical activity level (min of moderate and vigorous activity) of 61 min; however, 48.4% of participants exhibited sedentary behaviour during their pregnancy.

Our results showed that while the intake of fruit, vegetables, and dairy products were comparable between the three trimesters, there was a significant increase in consumption of grains during the third trimester compared with the first and second trimesters. This could be attributed to the higher energy and total carbohydrate intake of our study participants in the third trimester compared with the first and second trimesters, as previously reported by Tayyem et al. (2019). Our results are in agreement with Huybregts et al. (2009) who reported that the mean intake of cereals is higher in the third trimester [+45.2 g; 95% CI: −0.5; 90.9] compared with the first and second trimesters. However, in this study, this change didn't reach statistical significance ($P=0.052$) and

the authors attributed the increase in cereal intake to higher energy consumption.

Furthermore, the intake of sweets was lowest in the first trimester compared with the second and third trimesters. This could be due to a generalized increase in chemosensitivity in early pregnancy that makes the intake of sweets not appealing or acceptable to pregnant women (Kölble et al., 2001). In addition, the number of servings of fruit and vegetables consumed was within the recommendations. However, during all three trimesters, the consumption of grains was 2～3 servings/d higher than the recommendations, and the consumption of meat and dairy groups was lower than the recommended daily servings of 1.5～3.0 and 0.7～1.0 serving(s)/d, respectively (data not shown). While no recommendations are available for the appropriate number of servings of fat, the amount consumed by our study participants could be considered high and unhealthy (13.2～14.0 servings/d and 66～70 g/d). Consistent with our findings, Cuervo et al. (2014) demonstrated that pregnant women did not achieve recommended levels of consumption of protein, cereals, dairy products, salad, and vegetables. A study by Qureshi and Khan (2015) reported significantly lower consumption of vegetables, grains, and poultry groups by pregnant Pakistani women compared with those recommended by the USDA. In this study, the mean daily fruit, vegetable, dairy, and poultry consumption were reported as 0.82, 0.97, 1.34, and 0.79, respectively (Qureshi and Khan, 2015).

In the present study, over 75% of participants consumed less than the recommended servings of meats and meat alternatives and dairy products; however, at least 30% of participants consumed adequate or excess amounts of fruits, vegetables and grains. Consistent with our findings, Jardí et al. (2019) reported that despite adequate access and availability of food among pregnant women in Spain, consumption of some food groups (e.g. fruit and vegetables, dairy products, poultry, fish, eggs, salted cereals, legumes, and nuts) was below the recommended amounts. In another study from the UK, only 3.5% of women consumed the recommended amounts of all four food groups assessed, and 15.3% of the women did not consume the lowest amounts of foods for any of these groups (Fowler et al., 2012).

Several studies have investigated reasons for insufficient consumption of the recommended servings (Yang et al., 2017; Jardí et al., 2019; Yong et al., 2019). Yang et al. (2017) showed that participants with high balanced pattern scores were more likely to be better educated, wealthier, 25～29 years old at the time of delivery, working outside, and living in urban areas. Similarly, Yong et al. (2019) reported an association between ethnicity, waist circumference, and education with specific dietary patterns before and throughout pregnancy, in which the education was positively associated with healthy dietary patterns. In this study, age was considered one of the most determinant factors of diet, and older age was associated with a higher level of education. Furthermore, the authors showed that older women consumed greater amounts of vegetables, salted cereals, nuts, and legumes, and lesser amounts of red and processed meat and sweet cereals than younger women. In addition, women of a lower social class or with only primary schooling consumed greater amounts of sweet cereals than women with a more extensive educational background (Jardí et al., 2019). Similar findings were reported by Rodríguez-Bernal et al. (2013), who showed that less education and a younger age were associated with lower consumption of vegetables and n-3 fatty acids but higher consumption of protein and trans-fatty acids.

Limitations of our study include small sample sizes, that it was conducted at a single center, and there are errors associated with the FFQ technique (e.g. over or underestimating of nutrient intake and recall bias). However, to reduce recall and estimation errors, we used a validated FFQ containing food groups culturally adapted to pregnant Jordanian women in addition to food models and measuring tools to accurately estimate portion sizes. Furthermore, a trained nutritionist conducted in-person interviews to collect all the required data and to minimize missing data.

In conclusion, the majority of pregnant Jordanian women did not consume the recommended number of servings for all the five food groups during pregnancy. Furthermore, approximately 10% of women did not consume the minimum number of servings of any of the five food groups. Maternal factors such as age, social class, and education strongly influence dietary practice.

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AUTHOR DISCLOSURE STATEMENT

The authors declare no conflict of interest.

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