



Exploring of Dietary Patterns, and Possible Association with Educational Level, among Jordanian Pregnant Women

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Abstract

Evaluating dietary patterns could provide an overall view of food and nutrient consumed regularly. Better understanding of dietary patterns among pregnant women may be considered an acceptable mean to identify unhealthy dietary practices and the associations with undesirable pregnancy outcomes, which necessitates urgent intervention. This study aimed to determine the dietary patterns followed by Jordanian women during pregnancy in the second and third trimesters and to detect possible association between the dietary patterns and educational level. A total of 286 healthy, pregnant Jordanian women, aged ≥ 18 years with singleton pregnancies, completed the study. Sociodemographic, dietary, and physical activity data were collected using validated questionnaires. Dietary patterns were identified using a Principal Component Analysis. A multinomial logistic regression was used to estimate the effect of education level on dietary intake. Three dietary patterns were identified during the entire duration of pregnancy; 'High-Fat, High-Sugar', 'Fruits and Vegetables', and 'High Protein' which explained about 32% of the variability of the study sample. Dietary patterns adopted by pregnant women during the second and third trimesters, separately, were able to explain about 40% of the variability during each trimester. Educational level showed associations with dietary patterns, in which 'Fruits and Vegetables' and 'Healthy' patterns were remarkably manifested as the preferred pattern of consumption for the highly educated women during their third trimester. Different dietary patterns have been identified among Jordanian pregnant women throughout their pregnancy trimesters. Higher educational level could influence food choices. Fruits and Vegetables' and 'Healthy' patterns were the followed patterns among the highly educated women during their third trimester.



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Introduction

Pregnancy is an important period in human's life and plays an essential role in materno-fetal health and later, on the wellbeing of the children.¹ Moreover, maternal nutrition during pregnancy is a major determinant for pregnancy outcome and, offspring's health outcomes in later life.² Moderate increases in energy, macronutrients, and most of the micronutrient intakes in the second and third pregnancy trimesters are needed for healthy pregnancy outcomes.³ On contrary, excessive weight gain due to unhealthy dietary pattern during pregnancy increases the risk of complications during pregnancy and delivery, such as gestational diabetes, pre-eclampsia, stillbirth and caesarean delivery in addition to postpartum retained maternal weight gain and childhood obesity.⁴ Furthermore, behavioral interventions such as weight awareness and dietary pattern improvement may reduce the risks of pregnancy complications.¹

The study of dietary patterns among pregnant women when compared to single nutrients or foods offers a broader view of food and nutrient consumption. These patterns reflect the overall dietary behavior of the mothers thus enhancing a better understanding of diet-pregnancy interaction.⁵

Various approaches to study the overall diet can be distinguished. Many dietary patterns were reported throughout literature; nevertheless, they vary according to geographical localization. In Iran, most pregnant women followed a traditional Iranian dietary pattern according to a study by Esmailzadeh *et al* (2008).⁶ Paknahad *et al* (2019) identified three major dietary patterns among pregnant women: 'high carbohydrate lower fat', 'High Carbohydrate higher fat' and 'High Fiber'.⁷ On the other hand, in Denmark, other three considerable dietary patterns were recognized: "the Western diet"; being the most commonly pattern followed by pregnant women, the 'Health Conscious diet', while the 'Intermediate diet' incorporated foods of both patterns.⁸ However, in Sweden, the 'Prudent' pattern, i.e. healthy diet, was reported to be the most popular one among pregnant women pursued closely by the 'Western diet'.⁵ The western dietary pattern was distinguished by high intakes of red and processed meat, high-fat dairy, whilst the prudent and health conscious dietary patterns were characterized by a remarkable consumption of fruits and vegetables.^{5,8}

Many factors influence dietary patterns of pregnant women including educational levels, financial status, and age.⁹ Higher educational level may positively affect the dietary pattern among pregnant women, as shown by many studies that correlated a higher adherence rate to healthy dietary style and the higher educational level.^{9,10}

In Jordan, pregnant women were found to be above the median levels of consumption of energy, fat, protein and vitamin C, near the median in their carbohydrate, calcium and vitamin A intakes, and below the median consumptions of folate, iron and zinc as compared to the countries included in the study.¹¹ However, studies related to the dietary patterns adopted by Jordanian pregnant women are rare, if any. Therefore, this study aimed, mainly, to identify the dietary patterns followed by Jordanian pregnant women mainly during the second and third trimesters and during the whole course of pregnancy. Additionally, the study evaluated the possible association between the educational level and the dietary patterns that the women followed during their pregnancy.

Methods

Study Design and Participant

This cross-sectional, observational study aimed to determine the dietary patterns followed by Jordanian women during pregnancy. The methodology of the study was described in detail by Tayyem *et al.* (2014).¹² The study was carried out in Jordan University Hospital from March 2017 to December 2018. Three hundred and ten pregnant Jordanian women were recruited during their antenatal visits at the maternity clinics. Out of the 310 women, 286 were eligible and agreed to be enrolled in the study and complete all the required information. Participants were classified based on their gestational age; 50 pregnant women in the first trimester (9 to 13 weeks of gestation), 96 pregnant women in the second trimester (14 to 26 weeks of gestation), and 137 pregnant women in the third trimester (27 to 36 weeks of gestation). Gestational age was calculated based on the time of last menstruation and ultrasound fetal measurements by her physician.¹³

Eligibility criteria entitled healthy Jordanian pregnant women and aged 18 years or older with singleton pregnancy. However, many women were excluded

if they suffer from complicated pregnancies by gestational preeclampsia, diabetes, hyperemesis gravidarum, inflammatory and autoimmune disorders or any other chronic diseases that require special diets such as renal disease, liver disease, and diabetes.

The study was conducted according to the guidelines in the Declaration of Helsinki. All participants were asked to sign a written consent form before the enrollment in the study.

Data Collection

Women who were eligible for the study were interviewed to complete 3 questionnaires: socio demographic questionnaire, food frequency questionnaire (FFQ), and pregnancy physical activity questionnaire (PPAQ).

Socio-demographic Data

Data about pre-pregnancy bodyweight, maternal age, family income, smoking, and education level were recorded by the dietitian using structured questionnaire.

Dietary Intake Assessment

A validated and reliable Arabic quantitative FFQ was used to assess the intake from all the food groups.¹² In-person interview was accomplished by a trained dietitian to complete the FFQ. The dietitian asked participants how often, on average, they had consumed each food item over the past month. Portion size of each food item was estimated using food models and measuring cups and spoons. In addition, information about food preparation and cooking techniques and the use of dietary supplements were collected. Afterwards, the acquired data from the FFQ were calculated using ESHA Food-Processor software for nutrients' analysis.¹⁴

Physical Activity Data

PPAQ has been developed to evaluate the duration, intensity, and frequency of physical activity performed by pregnant women. This questionnaire has been validated and is considered a reliable tool for the evaluation of physical activity practiced by women during pregnancy.¹⁵ All participants completed the PPAQ during a face-to-face interview. Physical activity level was estimated to adjust for its effect

on the association between educational level and dietary patterns followed by the pregnant women.

Anthropometric Assessment

Weight and height of pregnant women were determined using the standardized methods and tools (Health-O-meter Professional). Pre-pregnancy bodyweight was recorded from the medical files of the pregnant women and for some of them it was self-reported. Pre-pregnancy body mass index (BMI) was calculated and categorized according to WHO guidelines.¹⁶ Pre-pregnancy body weight was measured for the purpose of controlling their effect on the association between educational level and dietary patterns during the pregnancy time.

Statistical Analysis

The data was analyzed using the Statistical Package for the Social Sciences version.²² Dietary patterns were derived using Principal Component Analysis (PCA), form factor analysis. The food items in the FFQ were divided into 23 food groups and items, based on their similarity of nutrient content and culinary usage. These food groups included: fruit juices, sugary drinks, coffee, sweetened tea, banana, orange, apple, vegetables, starchy vegetables, fried potato, olive oil and pickled olives, grains and cereals, dairy products, processed meat, red meats, white meats, traditional and western fast foods eggs, sweets and desserts, falafel, cheese, vegetable oils, and animal fats.

Kaiser-Meyer-Olkin (KMO) test and Bartlett's test of sphericity were performed to assess the appropriateness for using factor analysis for this exercise. The Kaiser-Meyer-Olkin value of >0.600 and Bartlett's test of sphericity <0.001 were selected to evaluate the inter-correlation of factors and sampling adequacy. Factors were taken based on an eigenvalue of >1.25 for screen plot. Varimax rotation was performed to review the relationships between factors and variables. The absolute factor loadings >0.30 were considered for the food groups/items to be considered significant contributor to the pattern. A multinomial logistic regression was used to estimate the effect of education level on dietary intake, in which 4 quartiles were computed for each dietary pattern using the adherence scores, and the lowest quartile was set as the reference value. Two models of adjustment were used to calculate odds

ratio OR and CI. The first model was adjusted for age (continuous) and BMI (continuous), while the second one was adjusted for age (continuous) and BMI (continuous), physical activity level (continuous), and number of pregnancy (categorical).¹⁷ The educational level was divided into 2 categories, the higher level of education was set as the reference category. Diploma and above were considered as higher level of education.

Results

The characteristics of the Participants

As described in a previous study by Tayyem *et al.* (2019)¹¹ on the same sample, the mean gestational ages of the 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. The lowest body weight and BMI at enrollment was documented in pregnant women at the first trimester as compared with women in the second and third trimesters. Additionally, a large percentage of participants 68%, 79.2%, and 63.6% had college degree and above in the first, second and third trimesters of pregnancy, respectively. Regarding the physical activity, Tayyem *et al.* (2019)¹¹ showed that the time spent (minutes of moderate and vigorous activity/ day) in physical activity was 58.9 ± 10.8 , 67.7 ± 8.5 , 56.3 ± 4.7 in the first, second and third trimesters of pregnancy, respectively, for the study sample.

Dietary patterns during the whole pregnancy period Three factors were identified to describe the dietary patterns of the Jordanian pregnant women as shown in table 1. Collectively these factors explained 32.3% of the variability within the sample with KMO of 0.730. Food items with loadings of >0.3 on a factor were considered to have a strong association with that factor. The three factors were named according to the food item loadings as 'High-Fat, High-Sugar', 'Fruits and Vegetables', and 'High Protein'. The 'High-Fat, High-Sugar' dietary pattern was loaded by fried potato, starchy vegetables, Falafel, olive oil, sweetened tea, sugar and sweets, processed meats and vegetable oils, while 'Fruits and Vegetables' pattern consisted of a plenty of bananas, apples, oranges, vegetables, fruit juices, and sugary drinks. On the other hand, 'High Protein' pattern was marked by red and white meats, dairy products, cheese, egg, grains and cereals and vegetable oils.

Dietary Patterns during the Second Trimester of Pregnancy

In this trimester four factors were recognized to describe the dietary patterns of the Jordanian pregnant women as depicted in table 1. These four factors explained 40.1% of the variability within the enrolled pregnant women with KMO of 0.597. The four factors were named according to the food item loadings as 'Fast Foods', 'Traditional Jordanian' 'Fruits and Vegetables', and 'High-Fat, High Sugar'. White and red meat, cheese, dairy products, banana, olive oil, egg, and vegetables showed high loadings in 'Traditional Jordanian' pattern. Whilst fried potato, sweetened tea, starchy vegetables, olive oil, vegetable oils, falafel and sugar and sweets were heavily loaded in 'High Fat, High Sugar' pattern.

Dietary Patterns During the Third Trimester of Pregnancy

Four factors were detected to define the dietary patterns of the Jordanian pregnant women in their third trimester as shown in table 1. These four factors explained 41.13% of the variability within the sample with KMO of 0.738. As shown in table 1, food items with loadings of >0.3 on a factor were considered to have a strong association with that factor and represented in bold. The four factors were named according to the food item loadings as 'High-Fat, High-Sugar', 'Fruits and Vegetables', 'High-Protein' and 'Healthy'. These three dietary patterns: 'High-Fat, High-Sugar', 'Fruits and Vegetables', and 'Healthy' were similar the patterns of the second trimester. However, 'High-Protein, High Sugar' dietary pattern was loaded with fruit juices, sugary drinks, red meats, white meats, dairy products, and sugar and sweets.

Association between Educational Level and Dietary Patterns during Pregnancy

The results which are presented in table 2 show that adherence of pregnant women to "Fruits and Vegetables" pattern or "Healthy" pattern was significant in educated women. About 50-60% of the highly educated pregnant women showed adherence to 'Fruits and Vegetable' and/or 'Healthy' patterns in the third trimester (the significant odds range was from 0.39 to 0.51). No dietary pattern was spotted to relate the educational level to the whole pregnancy and the second trimester (data not shown).

Table 1: Factor loading matrix for the identified dietary patterns among the Jordanian pregnant women during their second, third and whole pregnancy period

Food Groups	Whole pregnancy period			Second trimester			Third trimester				
	High-Fat, High-Sugar	Fruits and Vegetables	High-Protein	Fast Foods	Fruits and Vegetable	High-Fat, High-Sugar	Traditional Jordanian	High-Fat, High-Sugar	Fruits and Vegetables	High-Protein, High Sugar	Healthy
Fried Potato	.731					.737		.811			
Starchy Vegetables	.622			.330		.592		.601	.327		.367
Falafel	.611					.343		.646			
Olive Oil	.541					.425	.327	.471			.458
Sweetened Tea	.505					.685		.459			
Sugar and Sweets	.481			.396		.336		.471			.550
Processed Meat	.409							.595			
Banana		.621		-.303	.453		.511		.671		
Apple		.596			.797				.591		
Orange		.571			.704				.499		.371
Vegetables		.551			.362	.396	.435		.484		.494
Fruit Juices		.479			.683				.363		
Sugary Drinks		-.394		.237	-.311						.361
Red Meats			.633				.585				.508
White Meats			.561				.671				.710
Dairy Products		.358	.552				.567		.304		.345
Cheese			.474				.599				.448
Vegetable Oil	.436		.441	.308		.388		.438			.484
Egg			.309	-.586							.201
Coffee				.585			.525				.593
Fast Foods				.488				.553			-.315
Grain and Cereals			.358	.567					.435		
Animal Fat				.409					.327		

Table 2: Association between educational levels and dietary patterns in the third trimester

Variables	Q1	Q2	Q3	Q4
Crude OR and CI[#]				
High-Fat, High-Sugar	1	0.87 (0.42 – 1.85)	1.07 (0.52 – 2.20)	1.09 (0.53 – 2.25)
Fruits and Vegetables	1	0.84 (0.42 – 1.69)	0.41 (0.19 – 0.88)	0.67 (0.33 – 1.38)
High-Protein, High Sugar	1	1.09 (0.54 – 2.19)	0.54 (0.25 – 1.16)	0.87 (0.43 – 1.79)
Healthy	1	0.72 (0.36 – 1.47)	0.51 (0.24 – 1.04)	0.74 (0.36 – 1.50)
Adjusted OR and CI Model 1*				
High-Fat, High-Sugar	1	0.95 (0.43 – 2.07)	1.03 (0.48 – 2.24)	1.18 (0.55 – 2.54)
Fruits and Vegetables	1	0.90 (0.43 – 2.00)	0.39 (0.17 – 0.87)	0.69 (0.32 – 1.47)
High-Protein, High Sugar	1	1.01 (0.48 – 2.12)	0.55 (0.25 – 1.24)	0.84 (0.39 – 1.81)
Healthy	1	0.72 (0.34 – 1.55)	0.43 (0.19 – 0.97)	0.66 (0.31 – 1.42)
Adjusted OR and CI Model 2**				
High-Fat, High-Sugar	1	1.02 (0.46 – 2.29)	0.97 (0.44 – 2.16)	1.08 (0.49 – 2.39)
Fruits and Vegetables	1	0.96 (0.44 – 2.08)	0.41 (0.18 – 0.93)	0.78 (0.36 – 1.71)
High-Protein, High Sugar	1	0.77 (0.35 – 1.68)	0.48 (0.21 – 1.11)	0.70 (0.31 – 1.57)
Healthy	1	0.66 (0.30 – 1.44)	0.41 (0.18 – 0.93)	0.66 (0.30 – 1.47)

OR and CI: odd ratio and confidence interval

* Adjusted for age and BMI

** Adjusted for age, BMI, physical activity and number of pregnancies

Discussion

This study aimed to identify the major dietary patterns consumed by Jordanian pregnant women during the second and third trimesters as well as the whole course of pregnancy and their association with educational level. Dietary patterns are expected to offer a better evaluation of dietary intake as explained by Borge *et al* (2017).¹⁸ Our findings revealed that different dietary patterns were adopted by Jordanian pregnant women in the different trimesters, where the main shared dietary patterns in the identified factors were 'Fruits and Vegetables' and 'High-Fat, High-Sugar' dietary patterns. In addition, a third dietary pattern named as 'High-Protein' pattern was identified all over pregnancy. The presence of three different dietary patterns could be attributed to the differences in attitudes, beliefs and backgrounds among pregnant women. Moreover, dietary modification is recommended for the management of nausea and vomiting during

pregnancy with reduction in fatty foods and fresh vegetables that cause delayed gastric emptying.¹⁹ When we compare the dietary patterns of pregnant women during the second and third trimesters, further distinct differences were revealed which could be attributed to maternal gastro intestinal symptoms such as gastroesophageal reflux and constipation that are managed initially by lifestyle and dietary modification.²⁰ These differences can be summarized by the presence of 'Traditional Jordanian', among women in the second trimester, a pattern that reflects the usual items consumed by typical Jordanians including eggs, olive oil, white and red meats, cheese, dairy products, banana and vegetables.^{21,22} On the other hand, 'Healthy' pattern of consumption was apparent during the third trimester which could be explained by the mechanical pressure of the gravid uterus in addition to the gastroesophageal reflux, therefore women avoid certain foods that may aggravate their discomfort.

In line with our findings, many studies showed different dietary patterns among pregnant women.^{8,23-26} Arkkola *et al* (2008) identified seven factors: 'Healthy', 'Fast Foods', 'Traditional bread', 'Traditional meat', 'Coffee', 'Alcohol and 'Butter' patterns.²⁴ The authors attributed the identification of seven dietary patterns compared to an earlier cohort study²³ that showed only two important dietary patterns, 'healthy' and 'traditional', to the fact that people's eating habits vary very rapidly at present than ever before. This is probably due to the availability of varied choices of food products in the markets, in addition to the different eating styles and habits especially during pregnancy. Another study by Knudsen recognized two major dietary patterns in pregnant women in Denmark.⁸ The first pattern was characterized by red and processed meat, 'high-fat dairy', while vegetables, fruits, poultry, and fish marked the second pattern. Furthermore, women were classified into three classes according to their diet: the 'Western diet' consumers had high consumption of foods of the first dietary pattern, the second class favored foods of the second pattern and was classified as the 'Health Conscious', and the third one had eaten foods of both patterns and was classified as the 'Intermediate'.⁸ Another study conducted on Brazilian pregnant women showed that four dietary patterns were identified among those women, "traditional Brazilian", "snacks", "coffee" and "healthy" patterns, in which greater commitment to "healthy" and "traditional Brazilian" patterns were inversely associated with weight gain.²⁶ The significant disparities in dietary patterns among pregnant women could be due to pregnancy-related aversion and craving of certain food items that could drive the intake toward a specific and distinct pattern of consumption. Furthermore, food choices may be derived by the levels of health awareness and perception.

Regarding the effect of educational level on the adherence to specific dietary pattern, our results showed that about 50-60% of the highly educated pregnant women adhered to 'Fruits and Vegetable' dietary pattern and 'Healthy' pattern during their third trimester. Yet, the whole pregnancy and the second trimester did not show any association with any dietary pattern. Our findings correlated with many studies which revealed that higher education was associated with more adherences to healthy dietary patterns.^{24, 27-28} Olmedo-Requena *et al* (2014)

showed that Spanish pregnant women with higher educational level and higher social class were more committed to the Mediterranean diet ($P < 0.001$).²⁸ Another study reported that the consumption of a 'Health Conscious' diet was positively associated with increasing education and age.⁹ Studies, also, reported the association between low adherence to a 'Healthy' diet and Mediterranean diet and lower level of education (primary, secondary).^{27,29} Additionally, it has been found that maternal total vegetable consumption was positively associated with maternal education, household income, and breastfeeding duration¹⁰ as indicated in our study findings. Englund-Ögge *et al* (2014) documented that the highest scores for the Western pattern were found among women who were younger, smokers, overweight, and had less years of formal education.⁵ All these studies confirm that higher education of the pregnant women could be associated with better understanding to the benefits of healthy diet for the fetus and for the mother now and in later life. Additionally, sometimes better education may provide more financial abilities to purchase more healthy foods and have a variety of choices. In a study in Bangladesh by Shamim,¹¹ women who completed secondary or higher level of education were 2.5 times more likely to have diet diversity score than the functionally illiterate women, which was reflected by an adjusted

OR (95% CI) of 2.58 (1.27-5.24, $P < .001$).

The main limitation of this study was the possible errors inherited with FFQ technique related to possible overestimating or underestimating of nutrients intake as well as recall bias. However, to reduce the recall and estimation errors, a validate FFQ containing foods culturally adapted to Jordanian pregnant women along with food models and measuring tools for accurate estimation of portion sizes were used. Further, a trained nutritionist conducted in-person interviews to collect all the required data and to minimize missing data. Another limitation of the present study could be our inability to identify the dietary patterns during the first trimester due to its low KMO values (less than 0.4), however, this is an expected result because most of the pregnant women do not have a specified dietary pattern due to vomiting, morning sickness, anorexia and nausea and other pregnancy symptoms and signs.³⁰ Also, the small sample size in this trimester

could be another factor. We acknowledge that pregnancy and neonatal outcomes were not studied. In conclusion, food choices and patterns of consumption of pregnant women could be derived by their level of education and health perception particularly in the third trimester. Different dietary patterns have been itemized during the second and third trimesters, in which 'Fruits and Vegetable' as well as 'Healthy' patterns were the main patterns followed by pregnant women with higher educational levels.

Ethical Approval

The study was conducted in accordance with the ethical standards of the responsible committee on human experimentation and with the Helsinki declaration of 1975. The proposal was approved

by the Hashemite University Ethics Committee (1601100/10/13/16/1₂) and Institutional Review Board of Jordan University Hospital (10/2016/3341).

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Conflict of interest

The authors declare that they have no conflict of interests.

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