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Nutritional study among adolescent pregnant attending primary health care centers

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***Abstract*---**It was the goal of this study to examine the relationship between pregnant women's consumption of fruits, vegetables, and ultra-processed foods and their nutritional status. Analysis of data from a cohort study of pregnant women enrolled in prenatal care at a primary health care center in the urban area of Al Qyarah, Saudi Arabia Socioeconomic, obstetric, and maternal anthropometric, biochemical, and dietary data will be collected from October 2021 to January 2022. (obtained in the 1st clinical evaluation, between the 16th and 20th week of gestation, performed at the health unit). Serum concentrations of vitamin E, folic acid and beta-carotene, as well as pre-pregnancy body mass (BMI, kg/m2), were used to assess nutritional status. Anemia and vitamin A deficiency were also examined. Only 183 of the 860 pregnant women screened were found to be ineligible for the study, and 171 had subsequently dropped out. As a result, 506 pregnant women were included in the study, with 26% of them being adolescents (under the age of 20) and 44% being primigravidae. 15.4% of pregnant women had anemia, and 10.9% had vitamin A deficiency, both of which were found in the study. According to pre-pregnancy BMI, 10.1% of women were underweight (BMI 18.5 kg/m2), while 30.7% were overweight (BMI 25 kg/m2). Younger age was associated with lower levels of -carotene, vitamin E, and folate in the bloodstream. Higher pre-pregnancy body mass index (BMI) and younger age were also associated with anemia and vitamin A deficiency in pregnant women. -carotene and vitamin A serum concentrations were higher in pregnant women who consumed fruits and vegetables on a daily basis (median; interquartile range in mol/L) than in pregnant women who did not consume these foods on a daily basis. There was no link found between ultra-processed food consumption and any of the biochemical markers studied. Sociodemographic characteristics were found to be associated with nutritional status in the second trimester of pregnancy in the participants in this study. Serum concentrations of -carotene and vitamin A in pregnant women were positively affected by daily consumption of fruits and vegetables. In light of these findings, it is imperative that social

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promotion programs be integrated with healthy eating initiatives in order to improve the well-being of pregnant women.

***Keywords*---**Nutritional, Adolescent, Pregnant, Mosul.

1 Introduction

Over the last few decades, the world has experienced major changes in the population's dietary pattern, which has resulted in an increase in the consumption of highly processed foods and a reduction in foods considered of important nutritional value, such as fruits and vegetables. These changes started in developed countries and today developing countries share the same reality (Popkin, Adair, & Ng, 2012). Dietary changes, together with other social changes that result in a lower level of physical activity (such as urbanization, industrialization and economic development), have a strong impact on the health status of populations and are related to the increase of chronic non-communicable diseases, such as obesity, cardiovascular diseases, type 2 diabetes and some types of cancer(Shetty, 2013). It is a consensus in the literature that maternal nutrition influences pregnancy outcomes for the mother and baby(Marangoni et al., 2016; Nykjaer et al., 2014). Energy consumption before and during pregnancy is an important determinant of gestational weight gain, as both excessive and insufficient gain can have adverse effects on maternal and child health.(Caudill et al., 2020; Poston, Harthoorn, & Van Der Beek, 2011) Excessive weight gain has been associated with macrosomia, childbirth complications, obesity, insulin resistance and metabolic syndrome in children. Insufficient weight gain has been associated with intrauterine growth restriction and low birth weight(Aviram, Hod, & Yogev, 2011; Vargas-Terrones, Nagpal, & Barakat, 2019). In relation to the consumption of micronutrients, maternal deficiency of iron, folic acid, zinc, vitamin B12, has been known for many decades as an important determinant of low birth weight, in addition to being able to harm maternal health(Haider & Bhutta, 2017; Hovdenak & Haram, 2012). Given the importance of food in the gestational period of a woman's life, so that she can meet her own nutritional needs for the maintenance and promotion of her health and that of her baby, epidemiological studies are necessary in order to understand the health and nutrition conditions of women in this important life stage. KOURY (2010)(Koury Filho, 2010) briefly discusses the purposes that lead to studying the nutritional status of women, which is predominantly carried out during the period of pregnancy and postpartum, focusing mainly on outcomes related to the child. In the present study, we highlight the outcomes related to maternal health, seeking to understand the nutritional status and food consumption of pregnant women in Al Qyarah City. In this way, epidemiological studies on health and nutrition conditions of pregnant women in municipalities offer subsidies for planning programs and actions in prenatal care and, consequently, contributing to the improvement of the health conditions of the maternal and child population.

2 Materials and Methods

The design of the main study is a cohort of pregnant women enrolled in prenatal care in primary health care in the Rural area of the city of Al Qyarah, from October 2021 to January 2022. According to the number of births in Al Qyarah City registered in the municipality's maternity hospital in 2020, considering 60% of these births were of women residing in the urban area and a coverage of 80% of the family health teams, it was expected to track about 1000 women. During the aforementioned period, a weekly screening was conducted to identify pregnant women enrolled in prenatal care in the municipality through a partnership with the Family Health Strategy, updated with the help of primary care health teams (20 teams). The pregnant women were invited to participate in the study and the inclusion criteria considered were: gestational age less than 20 weeks at the time of screening, having a fixed residence and intending to deliver in the municipality and accepting participation in the research. The phase of home visits for pregnant women who met the inclusion criteria and agreed to participate in the project to apply a socio-demographic and health history questionnaire, took place between February 2021 and January 2022, when the pregnant women found different gestational ages, with a maximum gestational age of 20 weeks, which was the limit to be considered eligible for the study. After completing this questionnaire, the pregnant women were scheduled for the 1st clinical evaluation, performed between the 16th and 20th weeks, based on the date of their last menstrual period. In this evaluation, with the aid of tablets, anthropometric, biochemical and food consumption data were collected together with obstetric ultrasound performed by physicians from the nursing team research, which provided the data that we considered for the definition of gestational age. For the present study, data were used for cross-sectional analysis on food consumption and nutritional status of pregnant women, measured in the first clinical evaluation, with gestational age ranging from 13 to 25 weeks, according to ultrasound data. Figure 3 demonstrates each step performed to obtain the data used in the present study. Participation in the study was voluntary, upon signature of the Free and Informed Consent Term, ensuring complete confidentiality of the information obtained and the main project was approved by the Research Ethics Committee at the University of Mosul. Information on the pregnant women participating in the study was obtained in a personal interview through structured forms for the following socioeconomic, demographic and obstetric variables: age, marital status, education, maternal occupation, lives with a partner/spouse, physical activity, smoking, date of last menstruation and number of pregnancies. The measurement of gestational weight was performed using a portable digital scale, with a capacity of 150 kg and a variation of 0.1 kg, periodically calibrated. To measure height, a portable stadiometer with an accuracy of 0.1 cm was used. All anthropometric measurements followed the WHO recommendations (WHO, 1995), to obtain weight and height, the pregnant women were positioned upright in the center of the equipment, without shoes, heavy clothes and objects on the body, with the feet properly aligned, arms extended along the body, with the head held high, looking at a fixed point at eye level. All measurements were obtained in duplicate and performed by the trained research team. The pre-gestational anthropometric assessment was performed using the Body Mass Index, using the following classification: “Low weight (BMI < 18.5kg/m²); Adequate (BMI ≥18.5 - ≤24.9kg/m²); Overweight (BMI ≥25.0 – ≤29.9kg/m²) and Obesity (≥ 30kg/m²)”. The

pre-gestational weight used was self-reported by the pregnant women at the time of the evaluation. To assess food consumption, the participants answered questions about the frequency of consumption of food groups. Consumption was evaluated according to each food group (meat, offal, dairy products, beans, cereals and pasta, fruits, regional fruits, vegetables, processed foods and sweets, soft drinks and sugary drinks), with the following response options: rarely, 1–3 times/month, 1–3 times/week, 4–6 times/week, 1 time/day, 2–3 times/day, and ≥ 4 times/day. A frequency score of consumption of fruits and vegetables (fruits, vegetables and vegetables) and ultra-processed foods (industrialized foods, sweets, soft drinks and sugary drinks) was constructed, as described in a study for screening risk for micronutrient deficiency in Acrean schoolchildren. Due to the low consumption of vegetables in the population, it was decided to group them in a single group called "vegetables". Subsequently, consumption of fruits and vegetables (FH) was divided into 3 categories: low consumption (including no consumption and consumption less than 3 times/month), intermediate (1 to 6 times/week) and daily consumption (≥1 time/month). /day). The same procedure was adopted for the group of industrialized products and soft drinks, calling this group "ultra-processed products" (UP). To collect venous blood samples, pregnant women were instructed to fast for 8 hours. The main outcome of interest was the nutritional status of pregnant women, characterized by anemia, vitamin A deficiency, and folic acid. Regarding food consumption, based on the distribution of observed consumption frequencies, it was decided to group the categories of low consumption (does not consume or consumes monthly) with intermediate consumption (weekly consumption) for comparison with daily consumption, comparing with sociodemographic and nutritional status variables between daily and non-daily consumers of FH and UP. Continuous variables with normal distribution were described using mean and standard deviation, and when they did not show normal distribution, they were described using medians and their respective interquartile ranges. Categorical variables were described using simple frequency distribution and 95%CI.The association between categorical variables was investigated using Pearson's chi-square test. Comparisons performed with continuous variables were performed using the Mann Whitney test, when they did not present a normal distribution, and by means of analysis of variance (ANOVA, for outcomes with normal distribution). The significance level adopted was $P \leq 0.05$. All analyzes were performed using the statistical package for social Sciences SPSS 26.

3 Results

Table 1 shows the distribution of pregnant women according to socio-demographic and demographic characteristics. We observed a considerable percentage of pregnant women adolescents who took part in the study (26%) and around 8% of pregnant women were 35 years of age or older. The minimum age among the pregnant women studied was 13 years and the maximum age was 40 years (data not shown). Most identified themselves as being brown. The frequency of primigravidae corresponded to almost half of the sample (43.5%) and more than half (55.3%) of the women do not have paid work Table 2 describes the anthropometric and blood pressure characteristics of the study participants. In total, 30.7% of pregnant women reported pre-gestational weight above the adequate weight. According to the lifestyle characteristics presented in Table 3,

few pregnant women reported smoking (4%) and consuming alcoholic beverages (0.6%) during pregnancy. The practice of leisure-time physical activity was reported by only 17% of pregnant women; of these, only 4.5% reported performing 150 minutes or more of leisurely walking practice per week. The proportion of pregnant women who reported not consuming any vitamin or mineral supplement in the second gestational trimester was considerably high (42.5%). For the consumption of illicit drugs, only 2 pregnant women reported having used these substances until that moment of pregnancy (data not shown). Biochemical indicators of the nutritional status of the studied pregnant women Table 4 presents descriptive data of the analyzed biochemical indicators. The prevalence of anemia and vitamin A deficiency corresponded to 15.4% and 10.9%, respectively, being considered a moderate public health problem in this population. In contrast, serum folic acid concentrations were high in the entire study population, with only 2 pregnant women with values lower than 3 ng/ml (an indicator of folic acid deficiency in women of reproductive age according to the WHO technical publication 2015). Association between sociodemographic and anthropometric characteristics of pregnant women, according to vitamin A deficiency (VAD), anemia and serum folate, β-carotene and vitamin E values below the median Tables 5 and 6 present the sociodemographic and anthropometric characteristics according to biochemical indicators of nutritional status in the second trimester of pregnancy. Vitamin A deficiency was positively associated with age below 20 years, being primiparous and having lower BMI pre-median gestational values (Table 5). Regarding the prevalence of anemia, being an adolescent (age below 20 years), having less than 10 years of schooling and having lower median values of pre-gestational BMI were associated with risk for anemia (Table 5). For serum β-carotene concentrations, again, age below 20 years, schooling below 10 years and receiving a family allowance were associated with lower values for this parameter (Table 6). Likewise, for serum folate concentrations, the same variables (age less than 20 years, education less than 10 years and receiving a family allowance) were also associated with values below the median of folate (12.3 ng/mL). Regarding the serum concentration of vitamin E, in addition to the negative association with the variables age younger than 20 years, lower education and lower pre-pregnancy BMI, there was a positive association with the fact that the pregnant woman is not the head of the family (Table 6).

Table 1. Socio-demographic characteristics of pregnant women

Variable	n	%
education		
≤ 9 years	143	28,3
10 - 12 years	277	54,7
> 12 years	67	13,2
Number of children		
primiparous	220	43,5
1 to 2 children	197	38,9
3 or more children	89	17,6

Table 2. Anthropometric characteristics (BMI) and blood pressure of pregnant women

Variable	n	%
Pre-pregnancy BMI (kg/m2)		
Low weight (<18.5)	51	10,1
Adequate (≥18.5 – ≤24.9)	299	59,2
Overweight (≥25.0 – ≤29.9)	120	23,8
Obesity (≥ 30)	35	6,93
No information	1	0,2
Blood Pressure (mmHg)**		
Systolic		
Normal	488	96,4
Borderline	17	3,4
mild arterial hypertension	1	0,2
Diastolic		
Normal	502	99,2
Borderline	4	0,8

**Classification criteria: normal (<130), borderline (130-139), elevated (≥ 140 - ≤ 159) systolic blood pressure; normal (<85) and borderline (85-89) diastolic blood pressure.

Table 3 – Lifestyle characteristics of pregnant women enrolled in prenatal care at primary care

Varables	n	%
Smoking during pregnancy		
No	486	96,0
Yes	20	3,9
Consumption of alcoholic beverages in the last 3 months		
No	465	91,9
Yes, once or twice	33	6,5
yes, monthly	5	0,9
yes, weekly	3	0,6
Leisure walking practice		
No	420	83,0
Yes	86	17,0
Use of supplements		
No	215	42,5
Yes	291	57,5

Table 4. Biochemical indicators of the nutritional status of pregnant women in the second gestational trimester

Variables	descriptive values	
Anemia (%, 95%CI)	14,7	(12,3;18,9)
Vitamin A deficiency (%, 95%CI)	10,9	(8,3;14,0)
Hemoglobin, mg/dL (mean, SD)	12,1	(1,3)
Folic Acid, ng/mL, (median, IQ25-75)	12,2	(8,7; 18,0)
Vitamin A, µmol/L (median, IQ25-75)	1,8	(1,0; 2,6)

Beta carotene, nmol/L (median, IQ25-75)	0,4	(0,2; 0,8)
Vitamin E, µmol/L (median, IQ25-75)	21,0	(15,5; 28,9)

SD: standard deviation; IQ: interquartile range; 95%CI: 95% confidence interval.

Table 5 – Socio-demographic and anthropometric characteristics of pregnant women enrolled in prenatal care in primary care according to vitamin A deficiency and anemia

Socio-demographic and anthropometric characteristics	Vit A n (%)	*P*	Anemia n (%)	*P*
Age				
<20 year	19 (17,0)		24 (22,4)	
≥20 year	34 (9,2)	**0,034**	52 (13,5)	**0,038**
Education				
< 10 years	20 (14,5)		29 (21,3)	
≥10 years	32 (9,4)	0,108	46 (13,6)	**0,037**
Primiparous				
Yes	30 (14,1)		36 (17,3)	
No	24 (8,5)	**0,047**	40 (14,1)	0,340
pre-pregnancy BMI				
	21,6 (19,1;23,3)	**0,003**	21,2 (18,9;24,5)	**0,003**

Pearson's Chi-square (x2) (for comparison between proportions) and Mann-Whitney test (for comparison between two independent continuous variables).

Table 6 – Socio-demographic and anthropometric characteristics of pregnant women enrolled in prenatal care in primary care, according to serum folate, β-carotene and vitamin E concentrations below the median

Socio-demographic and anthropometric characteristics	Folate (below median) n (%)	*P*	B-carotene (below the median) n (%)	*P*	Vitamin E (below median) n (%)	*P*
Age						
<20	74 (56,5)		69 (59,1)		76 (60,2)	
>=20	169 (48,4)	**0,033**	170 (48,1)	**0.34**	169 (44,4)	**0.05**
Education						
< 10 years	78 (56,5)		85 (61,6)		78 (59,9)	
≥10 years	155 (46,3)	**0,043**	153 (45,3)	**0.05**	147 (41,6)	**0.05**
Primiparous						
Yes	103 (48,7)		104 (48,8)		109 (51,2)	
No	143 (51,2)	0,524	141 (50,0)	0,796	139 (49,1)	0,650
pre-pregnancy BMI						
	23,0 (20,5;25,8)	0,964	23,2 (20,8;25,9)	**0,021**	22,5 (20,2;25,2)	**0,028**

Pearson's Chi-square (x2) test (for comparison between proportions) and Mann-Whitney test (for comparison between two independent continuous variables). Median values of serum concentrations: Folate = 12.44 ng/mL, β-carotene = 0.47 μmol/L and vitamin E = 21.05 μmol/L. BMI: Kg/m2

4. Discussions

In the present study, sociodemographic characteristics were associated with nutritional status in the second trimester of pregnancy in women enrolled in prenatal care in primary health care in Al Qyara City. Anemia and vitamin A deficiency were observed in 15.4 % and 10.9 % of the pregnant women studied, respectively. Serum concentrations below the median of β-carotene, vitamin E and folate were associated with younger age (< 20 years), lower schooling (< 10 years). Anemia and vitamin A deficiency were also associated with younger age, lower education and lower pre-pregnancy BMI. Pregnant women with daily consumption of fruits and vegetables had higher serum concentrations of β-carotene and vitamin A when compared to pregnant women without daily consumption of these foods. There was no association between consumption of ultra-processed products and the biochemical indicators evaluated. The socio-demographic profile of the pregnant women studied was similar to that observed in other studies(Hotz et al., 2012; Strobel, Tinz, & Biesalski, 2007; Vioque et al., 2013). The level of education of the pregnant women in the present study was also similar to that observed in a previous study carried out in basic health units in a city in the interior of the state of São Paulo, where 21.05% of the pregnant women had less than 8 years of schooling(Malta et al., 2021). Regarding the pre-gestational nutritional status of the pregnant women in the present study, 31% started their pregnancy overweight or obese. Similar results were found in studies carried out in the cities of Viamão and Botucatu: 28% and 34% of pregnant women, respectively, were overweight at the beginning of pregnancy(Vitolo, Boscaini, & Bortolini, 2006). Pre-pregnancy BMI has been associated with adverse pregnancy outcomes. A recent study conducted with more than 90,000 Japanese women observed that women with higher prepregnancy BMI values were two to three times more likely to develop pregnancy-induced hypertension, two to six times more likely to develop gestational diabetes, two to four times more likely to have a macrosomic baby, up to two and a half times more likely to have cesarean delivery and also to have postpartum cesarean hemorrhage(Enomoto et al., 2016). Another important factor related to gestational nutritional status is regular physical activity. In our study, only 17% of the pregnant women reported walking during leisure time; of these, few reported reaching at least 150 minutes of walking per week – values below this cut-off point are used by the WHO to classify physical inactivity(Organization, 2002). The type of physical activity during pregnancy, frequency and duration is still the scene of much discussion in the literature. However, some authors recommend the regular practice of physical activity during pregnancy, depending on the pre-gestational conditioning of the woman and with follow-up, as they suggest that it can be a stimulus for a change in lifestyle, with positive effects on women's health(Artal & O'Toole, 2003). Regarding the occurrence of anemia in pregnancy, there are still few representative studies on Brazilian pregnant women for more accurate estimates of the prevalence of anemia at the national level or by regions. The WHO estimates that in developed countries the prevalence of anemia among pregnant

women is 23% and in developing countries it is 52% (WHO, 2001). In Brazil, some cross-sectional studies in small samples found prevalence between 16 and 50%, depending on the region, gestational age and socioeconomic level(Ferreira, Moura, & Cabral Júnior, 2008). The Ministry of Health recommends screening for anemia at the first prenatal consultation and indicates the necessary procedures, depending on the hemoglobin values. There is only no indication of iron supplementation, if the pregnant woman has a hemoglobin value greater than 11 mg/dl and does not have risk factors (diet low in iron, vitamins or minerals; blood loss due to surgery or injury; serious illness or (such as cancer, diabetes, kidney disease, rheumatoid arthritis, AIDS, inflammatory bowel disease, liver disease, heart failure, and thyroid disease; long-term infections; family history of inherited anemia such as thalassemia and sickle cell anemia). In the case of folic acid, there are no recommendations for serum dosages, only the strategy of prophylactic supplementation is adopted. However, there are two sources of recommendations from the Ministry of Health and they differ from each other. In the Low-Risk Prenatal Care Notebooks, supplementation of 5 mg of folic acid per day is recommended, at least 3 months before pregnancy and during the first gestational trimester. In the National Iron Supplementation Program, which uses the same recommendation indicated by the WHO, it suggests 400 μg, but 30 days before conception and daily until the end of pregnancy. However, the serum levels of folic acid found in the present study raise an important question that is already discussed in the international literature. We found 2 pregnant women with deficiency of this vitamin, but with a serum value very close to the cut-off point; the other participants showed relatively high values. Folic acid supplementation aims to prevent neural tube defects in the baby and megaloblastic anemia in women of childbearing age and in early pregnancy (WHO, 2015). However, there is still no consensus on a maximum serum value that would be safe for maternal and child health. The median and interquartile ranges for folic acid found in the present study were even lower than the values found in a cohort study with Canadian pregnant women (median: 22.47mg/ml; IQ25: 21.60mg/mL - IQ75: 23.80 mg/mL), considering the measurement of serum folic acid between 12 and 16 weeks(Plumptre et al., 2015). There is extensive debate in the literature about high levels of serum folate and its health implications, as much of it is not metabolized by the human body. Studies attribute these high concentrations of unmetabolized folic acid to synthetic folate, which is consumed through supplementation and food fortification. And they point to an association between unmetabolized folic acid with asthma, peripheral insulin resistance, obesity, respiratory tract infections in children and cancer risk in animals(Whitrow, Moore, Rumbold, & Davies, 2009; Yajnik et al., 2008).

5 Conclusion

Sociodemographic characteristics were found to be associated with second-trimester nutritional status in the current study's participants. Serum concentrations of -carotene and vitamin A in pregnant women were positively affected by daily consumption of fruits and vegetables. In light of these findings, it is imperative that social promotion programs be integrated with healthy eating initiatives in order to improve the well-being of pregnant women.

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Declarations

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