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The Journal of Maternal-Fetal & Neonatal Medicine

ISSN: 1476-7058 (Print) 1476-4954 (Online) Journal homepage: https://www.tandfonline.com/loi/ijmf20

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To cite this article: Reza Abbasi, Farnush Bakhshimoghaddam & Mohammad Alizadeh (2019): Major dietary patterns in relation to preeclampsia among Iranian pregnant women: a case–control study, The Journal of Maternal-Fetal & Neonatal Medicine, DOI: 10.1080/14767058.2019.1686474

To link to this article: https://doi.org/10.1080/14767058.2019.1686474

THE JOURNAL OF MATERNAL-FETAL & NEONATAL MEDICINE
https://doi.org/10.1080/14767058.2019.1686474

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ORIGINAL ARTICLE

Major dietary patterns in relation to preeclampsia among Iranian pregnant women: a case–control study

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ABSTRACT

Background: Preeclampsia is a pregnancy disorder that increases the risk of prenatal and maternal complications. Therefore, prevention of preeclampsia requires identifying its preventable risk factors such as dietary patterns.

Objective: This study aimed to investigate the relationship between the major dietary patterns and preeclampsia.

Study design: In this case–control study, the dietary patterns of a total of 510 pregnant women were investigated. Data on their dietary intake, sociodemographics, and daily physical activity levels were collected using a 198 item semi-quantitative food frequency questionnaire, a sociodemographic questionnaire, and a physical activity questionnaire, respectively. To identify the major dietary patterns and to model the relationship between dietary patterns and preeclampsia, factor analysis and unconditional logistic regression were employed, respectively. The three major dietary patterns identified were as follows: healthy dietary pattern (i.e. high in fruits, low-fat dairy, dried fruits, nuts, vegetables, fruit juice, liquid oil, and tomatoes), western dietary pattern (i.e. high in red meat, processed meat, fried potatoes, and pickles), and Iranian traditional dietary pattern (i.e. high in eggs, potatoes, and legumes).

Results: After adjustment for confounding factors, we found that with an increase in the healthy dietary pattern score, the odds of preeclampsia were reduced to 87.5% (OR = 0.125, 95%CI: 0.070–0.221, $p < .001$); with an increase in the western dietary pattern score, the odds of preeclampsia were increased 5.99 times (OR = 5.99, 95%CI: 3.414–10.53, $p < .001$); and with an increase in the Iranian traditional dietary pattern score, the odds of preeclampsia were reduced to 81.7% (OR = 0.183, 95%CI: 0.109–0.308, $p < .001$).

Conclusion: The findings showed that the western dietary pattern had a direct relationship and the healthy and Iranian traditional patterns had a reverse relationship with preeclampsia.

ARTICLE HISTORY
Received 25 July 2019
Accepted 25 October 2019

KEYWORDS
Blood pressure; dietary patterns; preeclampsia; pregnant women

Introduction

Preeclampsia is a pregnancy disorder that increases the odds of mortality, prenatal and maternal complications [1]. The incidence of pregnancy-induced hypertension (PIH) in different parts of the world has been reported to be between 2 and 10% [2]. According to the World Health Organization, 16.7% of mortalities among pregnant women in developing countries, 9.1% in Africa, and 25.7% in Latin America are caused by PIH [3]. In Iran, the prevalence of preeclampsia is 5–10% causing 14% of maternal deaths [4]. Preeclampsia risk factors include a history of preeclampsia, prepregnancy diabetes, prepregnancy BMI of over 29, first pregnancy, family history of preeclampsia, twinning, age above 35, black race, and blood pressure over 140 mm Hg at the time of first pregnancy care [5]. Other influential factors include environmental, social, economical, and even seasonal effects [1]. The cause of preeclampsia is not yet known; however, factors such as immunologic, cytotrophoblast, and coagulation disorders and increased vascular response, genetic factors, infections and pathophysiology, such as abnormal placentation, oxidative stress, abnormal endothelial function, and dietary factors are of issue [1]. From a public health perspective, in prevention and management of preeclampsia, we are faced with many challenges. Therefore, prevention of preeclampsia requires

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Supplemental data for this article is available online at https://doi.org/10.1080/14767058.2019.1686474.

identifying its preventable risk factors such as dietary patterns [6].

There is very little information available on the role of dietary patterns in etiology of preeclampsia. In Timmermans [7] and Hillesund [8] studies, it was found that *a posteriori* traditional dietary pattern that was high in meat and potatoes increased the risk of preeclampsia while high adherence to the *posteriori* Mediterranean and the *priori* new North European dietary patterns were found to be related to a decrease in the risk of preeclampsia. Although *priori* approaches have high generalizability, they are only defined for certain populations. In contrast, extracting posteriori dietary patterns using factor analysis is pragmatic and atheoretical and can be defined for all populations [9]. Employing epidemiologic methods in the nutrition science has some complexities, and this is due to the fact that dietary factors are closely related to each other, and it is for this same reason that distinguishing between the effects of certain types of foods and certain nutrients on the risk of diseases is difficult. Using food groups may eliminate some of the complexities occurring in data analysis. Nevertheless, distinguishing between the observed relationships among food groups is another problem that can be resolved by an appropriate perspective on dietary patterns and evaluation of their relationship with diseases.

To the best of our knowledge, no study regarding the relationship between dietary patterns and preeclampsia has been conducted in Iran so far. The Iranian society is experiencing transition from a traditional dietary pattern to western or healthy ones. In this transition period, the association between these dietary patterns and their outcomes will be clearly seen. Therefore, we took this as a great opportunity to investigate the relationship between the major dietary patterns and preeclampsia among pregnant women.

Materials and methods

Participants

In this case–control study, based on the pilot study conducted on 60 participants (30 cases and 30 controls) and using the following formula we determined the size of both the case and the control groups to be 113 each. Regarding the design effect of 1.5, a sample size in each group calculated to be 170, that is, a total of 340 participants:

$n=(Z_{1\text{-}\alpha/2}+Z_{1\text{-}\beta})^2\ (S_1{}^2+S_2{}^2)/(\mu_1-\mu_2)^2=113$, $\alpha=0.05$, $\beta=0.10$, S_1 and $S_2=$ Standard deviation of scores of Iranian traditional dietary pattern in controls and cases, respectively, $\mu_1-\mu_2=$ the mean difference between Iranian traditional dietary pattern scores in cases and controls.

However, as larger sample sizes are needed to extract the dietary patterns and to make sure of the adequacy of the sample size in performing factor analysis, 510 participants in total were determined to be sufficient [10–12].

The participants were selected using a stratified sampling method. Moreover, three cities from Lorestan Province (i.e. Khorramabad, Aleshtar, and Noorabad) in Iran were selected as strata. Cities were further subcategorized into three levels consisting of women's hospitals, urban and rural health care centers. Three hospitals, eleven urban and seven rural health care centers were selected using systematic random sampling. Sampling from subcenters of health care centers was conducted using a cluster sampling method. Both cases and controls were selected consecutively from hospitals and health care clusters between August 2015 and August 2016.

The criteria for entering the study were an age of between 18 and 35 and a pregnancy age of above 20 weeks. The criteria for exclusion from the study were a prepregnancy BMI of above 29, birth multiplicity, history of hypertension during previous pregnancies, history of chronic diseases such as diabetes, hypertension, kidney diseases, history of preeclampsia in the mother or sisters, history of dieting, and any stressful incident such as divorce or death of a family member experienced by the pregnant woman. There were no differences between the two groups regarding inclusion and exclusion criteria except for contracting or not contracting preeclampsia. This study was conducted according to the Declaration of Helsinki and approved by the ethics committee of Urmia University of Medical Sciences. Moreover, all the participants completed and signed the written informed consent.

Preeclampsia diagnose

Preeclampsia cases were diagnosed using criteria such as a blood pressure above 140/90, a 24-h proteinuria >300 mg, and a health and hospital record confirmed by a gynecologist in case of hospitalization [1]. Furthermore, it was made sure that controls did not develop preeclampsia throughout their pregnancy.

Sociodemographic factors

A two-part questionnaire was employed to interview the participants and collect information on their sociodemographic factors such as their place of residence, marital status, education, income, age, gestational age, prepregnancy weight, history of preeclampsia, history of miscarriage, number of childbirths, history of drug use, and history of cardiovascular disease, kidney disease, and diabetes.

Anthropometric measurements and blood pressure

Anthropometric information and blood pressures were extracted from the pregnant mothers' hospital and health records. The prepregnancy weight of each woman had been measured in kilograms using a digital scale (Omron BF508, 0.1–150 kg; OMRON HEALTHCARE Co, Ltd., Kyoto, JAPAN), and it was recorded with a precision of 100 g. The measuring of weight had been carried out with the participants wearing light cloths and no shoes. The participants' height had been measured in a standard condition, that is, without shoes; a measuring tape was used while the person was in a normal condition. Body mass index was calculated by dividing weight in kilogram by the square of height in meters. The recorded blood pressures had been measured using Mercury sphygmomanometers after 10 min of being in a sitting position. Trained persons measured blood pressure twice with the right upper arm being at the heart level. The mean of the two blood pressures was regarded as the actual one.

Assessment of food intake and physical activity measurement

The food intake of the participants was measured using a semi-quantitative food frequency questionnaire (FFQ) containing a list of all food items used (198 items), along with their standard servings. To complete the questionnaires, trained nutritionists interviewed the participants in selected health centers. At the time of interviewing, the average amount of each food item from the FFQ was explained to the participants and they were asked to answer questions on the amount and frequency of consuming each food item on the list over the past year by choosing one of the nine options (ranging from "less than once a month" to "more than six times a day"). Next, the information obtained from the FFQ on all food items of each participant was converted to daily intake in g/day using the directory of home scales, conversion ratios, and the percentage of edibility of food items. The total energy intake for each person was calculated by running Nutritionist IV software which was modified to Iranian foods. The validity and reliability of this questionnaire had been confirmed in previous studies [13]. In this study, we used a stratified physical activity [in accordance with metabolic (MET) equivalents] questionnaire. The questionnaire consisted of nine activity levels ranging from sleeping and resting (METs $= 0.9$) to heavy activity (METs > 6) [14]. This questionnaire, despite being simple, consists of nine categories based on the intensity of physical activities. The categories from top to bottom are 0.9, 1, 1.5, 2, 3, 4, 5, 6, and above 6. The product of this number multiplied by its duration indicated the activity level per unit of time (MET $\times$ time). The number of hours spent on each physical activity is multiplied by the MET of that activity, and then the obtained numbers (MET.H) were added together to calculate MET.H/day.

Statistical analysis

To examine the normality of data distribution, the Kolmogorov–Smirnov test was carried out. Due to the abnormality of distribution, non-parametric tests, namely Kruskal–Wallis, Mann–Whitney *U*, and chi-square were employed and p_{value} and p_{trend} were calculated, when appropriate. Moreover, the data were reported as median, interquartile range and mean values in case of continuous variables and as numeric and percentage values in case of categorical variables.

To determine the dietary patterns, first, 198 food items were stratified into 38 food groups based on nutrient similarities (Supplementary file, Table S1). Furthermore, dietary patterns of all the participants ($n = 510$) were determined by adopting an exploratory factor analysis. In this analysis, in order to create a simple and discriminating matrix, varimax rotation was applied. The number of factors (dietary patterns) was determined based on a screen plot test, eigenvalue of more than one (as Kaiser's Criterion) and the interpretability of factors. Samples adequacy and independency were confirmed by the Kaiser–Meyer–Olkin (KMO) value (KMO $= 0.738$) and Bartlett test ($p < .001$), respectively. Factor analysis, as a statistical method, was employed to extract dietary patterns based on principal component analysis (PCA), as a mathematical one. Food groups with a factor loading of $|\geq 0.2|$ were considered in forming the dietary patterns [15].

Dietary patterns were obtained based on the consumed food items in these factors. The factor score of each individual for dietary pattern was calculated in that pattern. To determine the relationship between the dietary patterns scores and preeclampsia, an unconditional logistic regression analysis was

Table 1. Sociodemographic and anthropometric factors in preeclampsia and control groups.

Characteristics	Cases ($n = 170$)		Controls ($n = 340$)		p^a
Age (y)	24	8	26	6	.043
BMI (kg/m^2)	27	1.5	25.9	2.3	<.001
Weight (kg)	71	10	68	7	<.001
Gestational age (weeks)	35	5	26	6	<.001
Number of child births	1	2	2	1	<.001
Energy intake (kcal/d)	1664	439	1698	357	.71
Physical activity (MET.h/d)	33.7	9.8	36.8	6.7	<.001
Residence [*n* (%)]					<.001
Urban	130	76.5	303	89.1	
Rural	40	23.5	37	10.9	
Level of income[b] [*n* (%)]					<.001
<USD85 per month	3	1.8	50	14.7	
USD85–285 per month	126	74.1	246	72.4	
>USD285 per month	41	24.1	44	12.9	
Level of education[b] [*n* (%)]					<.001
University	30	17.7	89	26.2	
High school	109	64.1	127	37.4	
Secondary school and less	31	18.2	124	36.4	
Nulliparous/Multiparous [*n* (%)]					<.001
Nulliparous	70	41.2	54	15.9	
Multiparous	100	58.8	286	84.1	
History of miscarriage [*n* (%)]					<.001
Yes	10	6	72	21	
No	160	94	268	79	
History of drug use					.097
Yes	6	3.5	23	6.8	
No	164	96.5	317	93.2	
Differences in physical activities prior to pregnancy as opposed to during the pregnancy					.057
Yes	3	1.8	17	5	
No	167	98.2	323	95	

[a]p values were computed by the Mann–Whitney's test for continuous variables and by chi-square for categorical variables.
[b]p_{trend} <.001 for level of income, and p_{trend} =.157 for level of education.

performed. Factor scores of dietary patterns and preeclampsia were determined to be the independent and dependent variables, respectively. Three models were used including crude; adjusted for BMI; and adjusted for BMI, age, gestational age, level of physical activity, number of childbirths, history of miscarriage, drug use, and differences in physical activities prior to pregnancy as opposed to during the pregnancy. To identify confounding variables, we evaluated the relationship between descriptive and sociodemographic variables with preeclampsia using univariate analysis including chi-square and Mann–Whitney U statistical tests. Variables who showed $p < .25$ in univariate analysis, were entered into the multivariate modeling such as simple or binary logistic regression [16,17]. The obtained data were analyzed using SPSS software, version 21; the two-sided significance level was considered lower than.05.

Results

A comparison between the sociodemographic and anthropometric factors in the preeclampsia and control groups revealed that the median of BMI ($p < .001$), weight ($p < .001$), and gestational age ($p < .001$) were higher in the case group, and the median of age ($p < .043$), number of childbirths ($p < .001$), and physical activity ($p < .001$) were lower in the case group, as opposed to the control group. Residence in rural areas, low level of income, moderate level of education, and nulliparous pregnancy were significantly higher in the case group; however, the history of miscarriage was lower in the case group ($p < .001$). There were no significant differences found between the two groups ($p > .05$) in terms of calorie intake, history of drug use, and differences in physical activities prior to pregnancy as opposed to during the pregnancy (Table 1). The association between extracted dietary patterns and rural/urban residence, level of income, and education has been outlined in Table S2 in the Supplementary file.

Using factor analysis in this study, we identified three major dietary patterns. These dietary patterns explained 27.94 of the total variance. In the healthy dietary pattern, the consumption of fruits, low-fat dairy, dried fruits, nuts, vegetables, fruit juice, liquid oil, tomatoes, butter, and honey was higher and, on the contrary, the consumption of broth, refined grains, and solid oils was lower. The western dietary pattern had a high factor loading for red meat, processed meat, fried potatoes, pickles, sweets, pizza, and a low factor loading for vegetables. In the Iranian traditional dietary pattern, high consumption of eggs, potatoes, legumes, high-fat dairy, tea and a low consumption of olives, snacks, beverages, and poultry was observed (Table 2).

The median and mean rank of healthy and Iranian traditional dietary patterns scores were significantly lower among the cases ($p < .001$). This is while in western dietary pattern, they were higher among cases than the controls ($p < .001$) (Table 3).

As seen in Table 4, employing an unconditional logistic regression, we used three models of analysis.

Table 2. Factor loading matrix[a] for dietary patterns explored by factor analysis[b].

Food groups	Healthy diet	Western diet	Iranian traditional diet
Fruit	0.730		
Low-fat dairy products	0.688	−0.303	
Dried fruit	0.638		
Chowders	−0.561		
Solid oils	−0.514		
Nuts	0.495		
Other vegetables	0.481	0.336	
Fruit juice	0.475		0.320
Refined grains	−0.472	0.396	0.263
Fish	−0.472		
Green leafy vegetables	0.448		
Canned fruits	0.404		0.222
Salt	0.329	0.208	
Liquid oil	0.299		−0.254
Mayonnaise	0.299		0.258
Tomatoes	0.281	−0.262	
Butter	0.251		
Honey	0.235		
Spices			
Processed meat		0.639	
Red meat		0.548	−0.311
Sweets and desserts	0.352	0.520	
Fried potato		0.479	
Pickles		0.433	
Pizza		0.382	
Orange vegetables		−0.234	
Eggs			0.466
Cooked potato	−0.265		0.448
Legumes		−0.405	0.443
Olives	0.244		−0.440
Salty snacks			−0.423
High-fat dairy products			0.396
Beverage			−0.338
Cabbage vegetables			−0.258
Tea			
Viscera			
Poultry			
Sugar			

[a]Values <0.2 were excluded.
[b]Bartlett's test of sphericity <0.001; Kaiser−Meyer−Olkin = 0.738; total variance = 27.94%.

In the crude model, only the extracted dietary patterns scores were entered. This model could accurately predict up to 79.2% of cases developing or not developing preeclampsia. In the second model, dietary patterns scores and BMI were entered. This model could accurately predict up to 83.7% of cases of developing or not developing preeclampsia. In the third model, the dietary patterns scores, BMI, age, gestational age, level of physical activity, number of childbirths, history of miscarriage, drug use, and differences in physical activities prior to pregnancy as opposed to during the pregnancy were entered. This model could accurately predict up to 93.9% of cases of developing or not developing preeclampsia. After adjustment for the confounding factors, with an increase in the healthy dietary pattern score, the odds of preeclampsia were reduced to 87.5% (OR = 0.125, 95%CI: 0.070–0.221, $p < .001$); with an increase in the western dietary pattern score, the odds of preeclampsia were increased 5.99 times (OR = 5.99, 95%CI: 3.414–10.53, $p < .001$); and with an increase in the Iranian traditional dietary pattern score, the odds of preeclampsia were reduced to 81.7% (OR = 0.183, 95%CI: 0.109–0.308, $p < .001$). Similar results were observed using the categorical analyses (tertiles of dietary patterns) (Table S3 in Supplementary file). The association between extracted dietary patterns and food groups has been outlined in Table S4 in supplementary file.

Discussion

In this case–control study, the relationship between major dietary patterns and preeclampsia was investigated. Based on the results of factor analysis, three major dietary patterns were extracted: healthy, western and Iranian traditional dietary patterns. In the previous studies conducted in Iran, the dietary patterns that were extracted were similar to our dietary patterns [18,19].

Considering various studies, it can be said that there are two dietary patterns, that is, the healthy and the western patterns, which are common between different countries and societies. Although the naming of these patterns are slightly different and in some societies, a third pattern specific to those regions has

Table 3. Comparison of median and mean rank of factor scores of dietary patterns in preeclampsia and control groups.

	Healthy dietary pattern scores			Western dietary pattern scores			Iranian traditional dietary pattern scores		
Group	Median	Interquartile range	Mean rank	Median	Interquartile range	Mean rank	Median	Interquartile range	Mean rank
Case	−0.47	−0.07	142.40	0.44	1.8	325.69	−0.49	1.52	201.36
Control	0.46	0.83	312.05	−0.38	1.1	220.40	0.27	1.31	282.57
p[a]	<.001			<.001			<.001		

[a]p values were computed by the Mann–Whitney test.

Table 4. Preeclampsia across factor scores of dietary patterns.

Dietary patterns	Models	B	SE	OR	95% CI	p
Healthy DP	[a]Models 1	−2.1	0.2	0.129	0.86, 0.194	<.001
	[b]Models 2	−2.08	0.22	0.125	0.081, 0.193	<.001
	[c]Models 3	−2.08	0.292	0.125	0.070, 0.221	<.001
Western DP	Models 1	1.48	0.18	4.42	3.09, 6.31	<.001
	Models 2	1.47	0.185	4.37	3.04, 6.28	<.001
	Models 3	1.79	0.287	5.99	3.414, 10.53	<.001
Iranian traditional DP	Models 1	−1.26	0.17	0.281	0.200, 0.395	<.001
	Models 2	−1.34	0.185	0.261	0.182, 0.375	<.001
	Models 3	−1.69	0.265	0.183	0.109, 0.308	<.001

DP: dietary pattern.
[a]Model 1: crude.
[b]Model 2: adjusted for BMI.
[c]Model 3: adjusted for BMI, age, gestational age, physical activity, parity, history of miscarriage, drug use and differences in physical activities prior to pregnancy as opposed to during the pregnancy.

been identified as the traditional dietary pattern (consistent with our study), the food contents of most dietary patterns mainly follow these two patterns.

In this study, before and after controlling the confounding factors, the odds ratio of preeclampsia was significantly higher with the western dietary pattern and lower with the healthy and Iranian traditional patterns. In our study, the healthy dietary pattern was rich in fruits and vegetables. In a study conducted by Hillesund et al. [8] in Norway, a relationship between adherence to the new North European dietary pattern (containing whole bran bread, barley, fruits, vegetables, potatoes, fish and other seafood, meat, milk, yogurt, and water) and a lower risk of preeclampsia were found [8]. In a cohort study performed in the Netherlands, a relationship was found between PIH among pregnant women with high adherence to the traditional dietary pattern (i.e. high in meat and potatoes) and among those with low adherence to the Mediterranean dietary patterns [7]. A clinical trial showed that a dietary pattern emphasizing the consumption of fruits, vegetables, low-fat dairy products, legumes, poultry, and fish and that contained lower amounts of fat, red meat, and sugary beverages led to a significant control of blood pressure [20]. In a study by Borgen et al. [21], the findings supported food recommendations that emphasized an increase in the consumption of fruits and a decrease in the consumption of sugary beverages during pregnancy. A study performed in central Africa with different cultural, social, and economical conditions reported that the risk of preeclampsia were higher in women who had low intakes of vegetables as opposed to those who consumed vegetables frequently [22]. In another study conducted in the USA, the protective effect of dietary fibers against the development of preeclampsia was reported [23]. In the study conducted by Brantsaeter et al. [24] following a dietary pattern rich in vegetables, vegetarian foods and oils reduced the risk of preeclampsia, and dietary patterns rich in processed meats increased the risk. In a case–control study, Paknahad et al. [25] did not observe any difference between energy, vitamin C and D intakes of the two groups under the study. However, zinc, calcium, riboflavin, and protein intakes in pregnant women with hypertension, compared to healthy pregnant women, were lower [25]. In the study by Sharma et al. the risk of preeclampsia was lowered by lycopene antioxidant content of tomatoes [26]. All the mentioned studies put an emphasis on the importance of a healthy diet that included fruits, vegetables, legumes, and poultry during pregnancy in order to prevent the risk of PIH and preeclampsia, and they are all consistent with our study to a large extent. Several mechanisms have shown the biological effect of a dietary pattern rich in fruits and vegetable on reducing the risk of preeclampsia. Fruits and vegetables prevent preeclampsia due to their high contents of micronutrients, such as minerals, antioxidants, vitamins, and dietary fibers. Consuming vegetables reduces the risk of hyperhomocysteinemia which itself is a risk factor for preeclampsia [27].

The western dietary pattern due to its high content of simple sugars, refined grains, saturated fatty acids and its low content of antioxidants, minerals, and vitamins increased the risk of preeclampsia by oxidative stress, insulin resistance, and metabolic syndrome [28]. The high chance of contracting preeclampsia with the western dietary pattern could be related to the food combination in this pattern, especially saturated fatty acids, which affect the rise of blood pressure [28].

In this study, the Iranian traditional dietary pattern consisted of high consumption of eggs, potatoes, legumes, high-fat dairy, tea and low consumption of olives, snacks, beverages, and poultry, which had a protective effect against preeclampsia. Previous studies have emphasized the direct relationship between high consumption of high-fat dairy, due to their saturated fatty acids content, and low consumption of olives, fruits, and vegetables, due to their antioxidant properties, minerals, and vitamins, on one hand, and metabolic syndrome on the other hand [29,30]. Considering these reasons, despite the protective effect of the Iranian traditional dietary pattern against preeclampsia, this dietary pattern is not recommended. The Iranian traditional dietary pattern is not considered a desirable pattern since it contains food items that were found to be associated with the prevalence of chronic diseases [31].

Unlike the above studies, in a study in Brazil, researchers did not find any relationship between the dietary pattern and changes in blood pressure during pregnancy and postpartum. The reason behind this result might be that only healthy pregnant women were examined and women with hypertension or preeclampsia were excluded. Researchers raised a hypothesis that due to hemodynamic compatibility in healthy pregnant women, blood pressure was not disturbed even by powerful mechanisms such as dietary patterns [32].

The advantage of the present study was using FFQ validated specifically for the population of our study and in which Iranian local foods and combined foods were included making responding to the questions easier for the participants. Moreover, evaluation and checking the control group until the end of pregnancy in terms of preeclampsia development and using hospital records and confirmation by gynecologists in diagnosing preeclampsia were among the advantages of the present study.

The present study had several limitations as well. First, we excluded women with most of the known risk factors for preeclampsia; however, some variables were different between cases and controls. If we were adding these variables into inclusion or exclusion criteria, we would have missed many of the controls and representative sample. We adjusted the effect of these covariates in model 3 of our analysis. Second, the food patterns were evaluated only based on the food intake of the individuals; while in evaluating food intakes, attention should also be paid to eating behaviors such as patterns, time, and the number of snacks and meals. Third, in evaluation of food intakes using FFQ, errors such as errors of measurement including low reporting and over reporting exist. Moreover, the long and time consuming FFQ could have an impact on the study accuracy. Finally, the factor analysis method could not specify how many servings of foods one should consume to get the required health benefits.

The three dietary patterns, namely healthy, western, and Iranian traditional dietary patterns were identified based on exploratory factor analysis. After adjustment for confounding factors, with an increase in healthy and Iranian traditional dietary patterns scores, the odds ratio of preeclampsia was lowered significantly. Moreover, with an increase in western dietary pattern scores, the odds ratio of preeclampsia was increased significantly. In general, a significant relationship existed between the dietary patterns, anthropometric indices, physical activity, and sociodemographic characteristics on one hand, and preeclampsia on the other. Proving the observed relationships in this cross-sectional study through clinical trials and prospective studies seems necessary.

Acknowledgments

This manuscript is extracted from a master's thesis in nutrition and is supported by Urmia University of Medical Sciences. The authors would like to express their gratitude toward Farzad Ebrahimzadeh for the statistical data analysis and Parastu Dorrimanesh for English editing of the manuscript.

Disclosure statement

No potential conflict of interest was reported by the authors.

Funding

This study was supported by Urmia University of Medical Sciences.

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