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Food Insecurity and Preeclampsia: A Case-Control Study

Junaid Bigdeli; MSc[1], Golnaz Ranjbar; PhD[1], Lida Jarahi; PhD[2] , Nayereh Khadem Ghaebi; OB, GYN[3], Davood Soleimani; PhD[4] & Mohammad Safarian; MD, PhD[*1]

[1] *Department of Nutrition, School of Medicine, Mashhad University of Medical Sciences, Mashhad, Iran.*
[2] *Department of Community Medicine, School of Medicine, Mashhad University of Medical Sciences, Mashhad, Iran.*
[3] *Women's Health Research Center, Mashhad University of Medical Sciences, Mashhad, Iran.*
[4] *Department of Nutrition, School of Nutrition Sciences and Food Technology, Kermanshah University of Medical Sciences, Kermanshah, Iran.*

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****Corresponding author:***
safarianm@mums.ac.ir
Department of Nutrition, School of Medicine, Mashhad University of Medical Sciences, Mashhad, Iran.

Postal code: 9177948564
Tel: +9851-38002259

ABSTRACT

Background: Household food insecurity is defined as the limited or uncertain access to adequate and safe food or limited ability to obtain food in a socially acceptable manner. Preeclampsia is a severe case of high-risk pregnancy, which endangers the health of women across the world, especially in developing countries. The current study aimed to use the nutritional deficiencies theory in pathogenesis of preeclampsia and determine the correlation between food insecurity and preeclampsia. **Methods:** This case-control study was conducted on 100 women with preeclampsia and 200 normal pregnant women with the gestational age of 20 weeks. Participants were selected via purposive sampling according to the eligibility criteria. Data were collected using the USDA questionnaire for food insecurity, socioeconomic data, and demographic data through interviews. **Results:** The findings indicated that the frequency of food insecurity was significantly higher in the preeclampsia women than the healthy women (71% vs. 21%; P < 0.001). Logistic regression indicated that the risk of preeclampsia was six times higher among pregnant women in the unsafe food status group than those in safe food status group [odds = 6.4; 95%CI: 3.3-12.4; P < 0.001]. Among the studied variables, socioeconomic status, history of stillbirth, history of preterm delivery, and ethnicity were significantly associated with preeclampsia during pregnancy (P < 0.05). In addition, women with low socioeconomic status were twice at the higher risk of preeclampsia compared to those with favorable socioeconomic status [odds = 2.7; 95%CI: 1.1-6.2; P = 0.01]. **Conclusion:** The current study indicated that the prevalence of food insecurity was high in Iranian women with preeclampsia, especially those with a history of preterm labor, history of stillbirth, low socioeconomic status, or non-Persian

Keywords: *Food insecurity; Preeclampsia; Pregnancy; Nutrition*

Introduction

Attention to maternal health plays a pivotal role in the progress of every society since maintaining the mothers' health is associated with the health of other family members (Yazdanpanahi *et al.*, 2008). Preeclampsia is a severe case of high-risk pregnancy, which

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endangers women's health across the world, especially in the developing countries (Forouhari *et al.*, 2009). Preeclampsia is a specific multi-systemic disorder of pregnancy characterized by proteinuria and high blood pressure during pregnancy (Cheng and Wang, 2009, Cudihy and Lee, 2009). It is a common pregnancy complication and a major cause of mortality and morbidity in pregnant women and their offsprings (Lain and Roberts, 2002).

Preeclampsia affects nearly 5-10% of all pregnancies worldwide. In the developing countries, the prevalence of preeclampsia was estimated up to 16.7%, which is expected to account for 40-60% of maternal mortality in the developing countries (Osungbade and Ige, 2011). The World Health Organization (WHO) estimated that the incidence of preeclampsia is seven times (2.8% of live births) higher in the developing countries compared to the developed countries (Trogstad *et al.*, 2008).

Although several studies were conducted in this regard, the etiology and pathology of the disease remain unanswered (Jain *et al.*, 2010, Pathak *et al.*, 2004). Several mechanisms have also been proposed to describe the causes of diversity in the pathophysiology of preeclampsia (Ilekis *et al.*, 2007, Lyall and Belfort, 2007, von Dadelszen and Magee, 2008). Maternal diet plays a key role in the etiology of preeclampsia and many nutritional factors were suggested as the potential causes of this syndrome (Xu *et al.*, 2009).

Among the nutritional deficiencies presented in this regard (Sibai *et al.*, 2008), food insecurity is defined as limited or uncertain access to adequate and safe food or limited ability to obtain food in a socially acceptable manner (Bickel *et al.*, 2000). According to literature, the prevalence of food insecurity is nearly 5-8% in the developing countries, while it has been reported as 4-16% in the developed countries (Ronsmans *et al.*, 2006, Villar *et al.*, 2003). Food insecure individuals are at the risk of lower food diversity, lower quality diets, reduced intake of micronutrients, and lower intake of fruits and vegetables (Vozoris and Tarasuk, 2003, Weigel *et al.*, 2007).

Evaluation of food safety is of paramount importance in women since food insecurity in the family is associated with the decreased consumption of fruits and vegetables in women as well as reduced intake of micronutrients in reproductive ages (Kendall *et al.*, 1996, Rose and Oliveira, 1997). Dlamini et al. (Dlamini, 1996) reported that poor socioeconomic status was associated with the risk of preeclampsia in pregnant women in the developing countries. Moreover, Haelterman et al. reported that the risk of preeclampsia was twice higher in pregnant women with poor socioeconomic status compared to those with favorable socioeconomic status (Haelterman *et al.*, 2003). A study conducted in Yazd, Iran, indicated that more than half of the pregnant women were in the mild to severe range of food insecurity and the prevalence of this situation was higher in women with low social economic status and non-native groups (Rajizadeh *et al.*, 2019). Since pregnant women are considered as one of the most vulnerable groups in the community and lack of food safety may cause various complications during pregnancy, prevention of preeclampsia and its complications in pregnant women and their fetus is of particular importance.

Therefore, the current study aimed to determine the correlation between food insecurity and preeclampsia in pregnant women.

Materials and Methods

Participants and study design: This case-control study was conducted on pregnant women with preeclampsia who referred to the department of obstetrics and gynecology at Ghaem Hospital and Imam Reza Hospital in Mashhad, Iran, between winter and summer 2016. The participants were diagnosed with preeclampsia by a gynecologist as follows: systolic blood pressure > 140 mmHg or diastolic blood pressure ≥ 90 mmHg and 24-hour proteinuria ≥ 0.3 g. The ccontrol group consisted of healthy women (after six months of pregnancy) referring to the health centers who were matched with the case group members in a 2:1 ratio in terms of place of residence and age.

Regarding the case group, inclusion criteria were consent to participate in the study, diagnosis with preeclampsia, residence in Mashhad, and age of 18 to 45 years. The exclusion criteria of both groups were presence of pre-pregnancy systemic chronic diseases and use of drugs affecting preeclampsia.

Sample size was estimated using the two proportions formula related to a qualitative attribute from two independent populations and references (Mozayeni *et al.*, 2014) based on the level of food insecurity without starvation. Considering the error of $\alpha = 0.01$ and $\beta = 90$, the sample size of each group was estimated as 100. In order to increase the accuracy and considering availability of the control group, sample size of the control group increased to twice the number of case group members.

In order to access the samples, the required coordination was made with the department of obstetrics and gynecology at Ghaem Hospital and Imam Reza Hospital as well as the health department of Mashhad. The women with preeclampsia who were diagnosed by a gynecologist and referred to the mentioned hospitals enrolled in the study. To select the control group members and match their place of residence, the municipality area, where the case group members resided, was determined. Later, health centers in the determined areas were identified and a list of the pregnant women who were in their third trimester of pregnancy was provided from each health care center. Age grouping was performed to match women in terms of age and from each age group. The required samples were randomly selected from the list of eligible pregnant women provided by the health centers.

Measurements: Pre-pregnancy body mass index (BMI) was obtained from the medical records of the participants. Accordingly, the BMI $\leq$ 18.5 kg/m^2, BMI 18.5-24.9 kg/m^2, BMI 25-29.9 kg/m^2, and BMI $\geq$ 30 kg/m^2 were defined as low weight, normal weight, overweight, and obese, respectively (Barba *et al.*, 2004). All participants signed written informed consents to enter the study. Data were collected using a general information questionnaire containing demographic and socioeconomic information. Moreover, food security status was measured using the USDA 18-item food security questionnaire.

Data on the socioeconomic status of the participants were collected via interviews and the socioeconomic status questionnaire. In addition, the results of a valid and reliable questionnaire, applied in a previous study (Garmaroudi and Moradi, 2010), were used to assess the socioeconomic status and its association with various health outcomes. The variables determining the socioeconomic status of the households in this questionnaire included household education level, education level of the spouse, residential property, residential housing infrastructure, and social welfare (e.g., possession of a car and personal computer), which were rated based on the participants' responses. The maximum score of the questionnaire was 48. Based on the respondent's mean score as well as the first and third quadrants, participants were divided into four levels of poor, moderate, favorable, and excellent according to the socioeconomic status of the household.

Food Insecurity: In the current research, the USDA questionnaire was administered to assess food security, which consisted of 18 items to evaluate the food security status of the households during 12 months. The questionnaire was validated for the Iranian population in a previous study (Ramakrishnan, 2004). To evaluate the responses, the positive responses (Often True, Sometimes True, Almost Every Month, and Number of Months) were interpreted as Yes and coded as one, while the negative responses (Only One/two months) were interpreted as No. In addition, the unanswered questions were coded as zero. Table 1 shows the assigned codes used to assess the status of food security (Ramesh *et al.*, 2010).

The questionnaires were evaluated based on food security and food insecurity (3 $\geq$ Yes) in terms of marginal food security (Yes: 1-2). In its classification, the USDA has categorized marginal food security in the food security group. However, Laraia demonstrated that economic variables were correlated with social marginal food security and food insecurity (Laraia *et al.*, 2006). In the present study, we examined the food security of the borde. According to the 18-item USDA food security status questionnaire, food security was classified into four groups of food secure, food insecure without starvation, food insecure with moderate starvation, and food insecure with severe starvation. Regarding food insecurity with severe starvation, all households with children had low food intake to the extent that their children experienced hunger. In some other households with children, this occurs at an earlier stage of severity. In the households with and without children, adults repeatedly experience more extensive reduction in their food intake. In our research, the participants were divided into two groups of food secure and food insecure. The scoring range of food security was 0-18 based on the number of positive responses (food secure: 0-2, food insecure: 3-18) (Bickel *et al.*, 2000).

Ethical considerations: This study was derived from a master's thesis approved by the Ethics Committee of Mashhad University of Medical Sciences (IR.MUMS.fm.REC.1395.359). Before data collection, written informed consents were obtained from all participants.

Data analysis: Data analysis was performed in SPSS version 16. Median and quadruple range were reported to describe the quantitative variables and Mann-Whitney U test was used to compare the quantitative variables between the two groups. As for the qualitative variables, frequency tables were drawn and Chi-square test was used. In order to evaluate the correlation between food insecurity and preeclampsia, multivariate logistic regression analysis was carried out by adjusting the confounding variables. The food security status of each household was determined based on their score. In all statistical analyses, P-value of less than 0.05 was significant.

Results

According to the information in **Table 1** and considering that the two groups were matched, the median and quadruple range of age had no significant differences between the patients with preeclampsia and healthy participants ($P = 0.32$). Moreover, no significant differences were observed between groups in terms of their number of successful pregnancies, age at first pregnancy, number of children, number of family members, and number of children aged less than 18 years. However, the study groups were significantly different in terms of pre-pregnancy BMI and total number of pregnancies ($P < 0.05$) since the rate of these parameters was higher in the preeclampsia group compared to the control group. No significant differences were found between the food secure and insecure groups in terms of the median and quadruple range of age and pre-pregnancy BMI. However, the number of successful pregnancies, age at first pregnancy, total number of pregnancies, number of children, number of family members, and number of children aged less than 18 years were significantly different ($P < 0.05$).

Table 2 shows the results of tests for the qualitative variables between the preeclampsia and healthy participants. Accordingly, pre-pregnancy BMI, history of stillbirth, history of preterm labor, history of preeclampsia, family history of preeclampsia in the first-degree relatives (mother and sister), pre-pregnancy smoking habits, performing pre-pregnancy physical exercise, ethnicity, socioeconomic status, and food security were significantly different between the study groups ($P < 0.05$). Mann-Whitney U test was used to compare ranking of the qualitative variables. The results indicated that the frequency of food insecurity was 71% in the pregnant women with preeclampsia and 21% in the control group members.

As it can be seen from **Table 3**, the variables that affected preeclampsia and food insecurity ($P < 0.01$) were considered as the quantitative and qualitative confounding variables. However, the history of preeclampsia and pre-pregnancy smoking habits were considered as the influential factors in this regard; they were eliminated due to the lack of data in the control group. Multivariate logistic regression was applied using the significant variables regarding preeclampsia and food security (total number of pregnancies, history of stillbirth, history of preterm labor, ethnicity, and socioeconomic status). Moreover, the study variables had a significant correlation with preeclampsia and food insecurity ($P < 0.001$; odds ratio = 6.4).

Table 1. Median and interquartile range of some demographic characteristics ::in quantitative variables in study groups

Variables	Median (Interquartile range) Case	Control	P-value [a]	Median (Interquartile range) Safe	Unsafe	P-value [a]
Age (y)	32 (11)	30 (10)	0.32	32 (10)	32 (10)	0.18
Pre-pregnancy body mass index (kg/m^2)	26 (7.6)	24 (6.0)	0.06	25.2 (6.2)	24.7 (8.2)	0.88
Successful pregnancy	1 (2)	1 (2)	0.19	1 (1)	1 (2)	< 0.001
Age at first pregnancy (y)	23 (8.0)	24 (6.0)	0.11	24 (6.0)	21.5 (7.5)	0.03
Total number of pregnancies	3 (3)	2 (2)	0.03	2 (2.0)	3 (2.2)	0.003
Number of children	1 (2)	1 (2)	0.28	1 (1)	1 (2)	< 0.001
Number of family members	3 (2)	3 (2)	0.26	3 (1)	3 (2)	< 0.001
Number of family member food board	3 (2)	3 (2)	0.32	3 (1)	3 (2)	< 0.001
Number of children < 18 years	1 (2)	1 (2)	0.27	1 (1)	3 (2)	< 0.001

A: Mann-Whiteny U test

Table 2. Correlation of qualitative variables in study groups

Variables	Case N (%)	Control N (%)	P-value	Security N (%)	Insecurity N (%)	P-value
Age (y)						
>20	2 (2.0)	4 (2.0)	0.99[a]	4 (2.1)	2 (1.8)	0.28[a]
20-24	16 (16.0)	29 (14.5)		28 (15.0)	17 (15.0)	
25-29	23 (23.0)	49 (24.5)		50 (26.7)	22 (19.5)	
30-34	24 (24.0)	49 (24.5)		44 (23.5)	29 (25.7)	
≥35	35 (35.0)	69 (34.5)		61 (32.6)	43 (38.1)	
Pre-pregnancy weight status						
Underweight	2 (2.2)	6 (3.2)	0.07[a]	6 (3.4)	2 (2.0)	0.72[a]
Normal	40 (44.0)	90 (48.4)		79 (44.9)	51 (50.5)	
Overweight	21 (23.1)	61 (32.8)		61 (34.7)	21 (20.8)	
Obese	28 (30.8)	29 (15.6)		30 (17.0)	27 (26.7)	
Successful pregnancies						
None	36 (36.0)	76 (38.0)	0.19[a]	82 (43.9)	30 (26.5)	< 0.001[a]
One	24 (24.0)	67 (33.5)		59 (31.6)	32 (28.3)	
Two/more	40 (40.0)	57 (28.5)		46 (24.6)	51 (45.1)	
Total number of pregnancies						
One	25 (25.0)	63 (31.5)	0.06[a]	62 (33.2)	26 (23.0)	0.008[a]
Two	23 (23.0)	57 (28.5)		54 (28.9)	26 (23.0)	
Three/more	52 (52.0)	80 (40.0)		71 (38.0)	61 (54.0)	
History of stillbirth	17 (17.0)	4 (2.0)	< 0.001[b]	9 (4.8)	12 (10.6)	0.05[b]
History of abortion	33 (33.0)	55 (27.5)	0.32[b]	60 (32.1)	28 (24.8)	0.17[b]
History of preterm labor	16 (16.0)	1 (0.5)	< 0.001[b]	6 (3.2)	11 (9.7)	0.01[b]
History of preeclampsia	21 (21.0)	0 (0)	< 0.001[b]	7 (3.7)	14 (12.4)	0.004[b]
Family history of preeclampsia	5 (5;0)	0 (0)	< 0.001[b]	3 (1.6)	2 (1.8)	0.91[b]
Pre- pregnancy smoking habits	11 (11.0)	0 (0)	< 0.001[b]	4 (2.1)	7 (6.2)	0.07[b]
Pre-pregnancy physical exercise	11 (11.0)	0 (0)	0.02[b]	10 (5.3)	7 (6.2)	0.758[b]
Number of children						
None	36 (36.0)	75 (37.5)	0.31[a]	79 (42.2)	32 (28.3)	<0.001[a]
One	26 (26.0)	67 (33.5)		62 (33.2)	31 (27.4)	
More	38 (38.0)	58 (29.0)		46 (24.6)	50 (44.2)	
Number of family members			0.73[b]			0.003[b]
Two	37 (37.0)	78 (39.0)		84 (44.9)	31 (27.4)	
More	63 (63.0)	122 (60.5)		103 (55.1)	82 (72.6)	

Table 2. Correlation of qualitative variables in study groups

Variables	Case N (%)	Control N (%)	P-value	Security N (%)	Insecurity N (%)	P-value
Number of family member food board			0.73[b]			0.003[b]
Two	37 (37.0)	78 (39.0)		84 (44.9)	31 (27.4)	
More	63 (63.0)	122 (61.0)		103 (55.1)	82 (72.6)	
Number of children < 18 Years			0.29[a]			< 0.001[a]
None	36 (36.0)	78 (39.0)		83 (44.4)	31 (27.4)	
One	28 (28.0)	66 (33.0)		59 (31.6)	35 (31.0)	
More	36 (36.0)	56 (28.0)		45 (24.1)	47 (41.6)	
Ethnicity			< 0.001[b]			< 0.001[b]
Persian	74 (74.0)	192 (96.0)		179 (95.7)	87 (77.0)	
Non-Persian	26 (26.0)	8 (4.0)		8 (4.3)	26 (23.0)	
Socioeconomic status						
Poor	47 (47.0)	30 (15.0)	< 0.001[a]	23 (12.3)	54 (47.8)	< 0.001[a]
Average	30 (30.0)	60 (30.0)		51 (27.3)	39 (34.5)	
Good	15 (15.0)	57 (28.5)		60 (32.1)	12 (10.6)	
Excellent	8 (8.0)	53 (26.5)		53 (28.3)	8 (7.1)	
Food security status						
Security	29 (29.0)	158 (79.0)	< 0.001[b]	-	-	-
Insecurity	71 (71.0)	42 (21.0)				

[a]: Mann-Whitney U test; [b]: Chi-square test

Table 3. Multivariate logistic regression analysis to control quantitative and qualitative confounding variables

Variables		B	SE[a]	P-value.	Odds	95% CI Lower	95% CI Upper
Food security status	Security	Reference					
	Insecurity	1.86	0.33	< 0.001	6.4	3.3	12.4
Total number of pregnancies	Three/more	Reference					
	Two	0.28	0.40	0.87	1.3	0.6	2.8
	One	0.54	0.39	0.16	1.7	0.8	3.7
History of stillbirth	No	Reference					
	Yes	1.58	0.75	0.03	4.8	1.1	21.1
History of preterm labor	No	Reference					
	Yes	3.36	1.17	0.004	29.1	2.8	292.3
Ethnicity	Persian	Reference					
	Non-Persian	1.56	0.50	0.002	4.7	1.7	12.7
Socioeconomic status	Good/Excellent	Reference					
	Moderate	0.32	0.39	0.41	1.3	0.6	2.9
	Low	1.00	0.42	0.01	2.7	1.1	6.2

[a]: standard error

Discussion

The findings of this research indicated a significant correlation between food insecurity and preeclampsia as an influential factor. Moreover, the risk of preeclampsia in the individuals with food insecurity was six times higher compared to the food secure participants.

In a study, Hajji et al. evaluated family food insecurity and its association with some pregnancy complications, reporting significant correlations between food insecurity, diabetes, and hypertension during pregnancy (Hojaji *et al.*, 2015). Furthermore, Seligman et al. investigated the association of food insecurity with chronic diseases in low-income adults, denoting that food insecurity was associated with hypertension and diabetes (Seligman *et al.*, 2010).

In another research, Laraia et al. determined the correlation between household food insecurity and pregnancy complications, observing that among various pregnancy complications, only diabetes was associated with household insecurity, while it had no correlation with pregnancy and anemia (Laraia *et al.*, 2010).

Background reasons such as low socioeconomic status and the subsequent food insecurity may lead to lower levels of food intake, reduced dietary diversity, and intake of high-calorie foods with low nutritious contents (Brantsæter *et al.*, 2009, Longo-Mbenza *et al.*, 2008, Ødegård *et al.*, 2000, Torjusen *et al.*, 2014). Discrepancy among the findings of various studies in this regard can be due to different prevalence of pregnancy complications and socioeconomic levels in various populations, which may influence family food insecurity and complications during pregnancy.

Adults living in food insecure households eat less than half a serving of fruits, vegetables, and dairy weekly and have lower intake levels of micronutrients (e.g., group B vitamins, magnesium, iron, zinc, and calcium) (Dixon *et al.*, 2001, Lee and Frongillo, 2001, Tarasuk and Beaton, 1999). This food pattern is likely to increase the risk of chronic diseases and complications during pregnancy (Klesges *et al.*, 2001, Vozoris and Tarasuk, 2003).

The correlation between dietary nutrition components and preeclampsia was investigated in several case-control and cohort studies and the risk of preeclampsia was associated with the intake of high-calorie foods, sugary drinks, polyunsaturated fatty acids, and trans fatty acids. However, the high intake of milk and appropriate intake of vitamin D were associated with the reduced risk of preeclampsia (Bodnar *et al.*, 2007, Chavarro *et al.*, 2011, Clausen *et al.*, 2001, Haugen *et al.*, 2009, Oken *et al.*, 2007, Olafsdottir *et al.*, 2006).

Several epidemiological studies also indicated that consumption of fruits, vegetables, and dietary fiber was associated with the reduced risk of preeclampsia (Brantsæter *et al.*, 2009, Longo-Mbenza *et al.*, 2008, Qiu *et al.*, 2008, Torjusen *et al.*, 2014), which affect preeclampsia through anti-inflammatory mechanisms (North *et al.*, 2009). Moreover, recent findings denoted that deficiency in magnesium, vitamins A, vitamin C, folic acid, and calcium may increase the risk of preeclampsia (Bodnar *et al.*, 2006, Hofmeyr *et al.*, 2014, Jain *et al.*, 2010, Wen *et al.*, 2008).

Vegetables are rich in micronutrients such as phytochemicals, antioxidants, vitamins and minerals, and fiber, while processed foods contain sugars, salt, and saturated fatty acids. None of these dietary components is responsible for the positive results in the cases mentioned earlier. Overall, the interactions between many high-quality dietary components play a key role in disease prevention (Brantsæter *et al.*, 2009).

To date, clinical trials extensively investigated the correlation between dietary supplements and preeclampsia, while further research is urgently required on the diet of pregnant women during pregnancy. The findings in this regard indicated that absorption of nutrients through diet may have more beneficial health effects compared to supplementation (Lichtenstein and Russell, 2005).

Findings indicated the significant correlation of poor socioeconomic status as a risk factor with the prediction of preeclampsia. Furthermore, the probability of developing preeclampsia was twice higher in individuals with low socioeconomic levels compared to those with favorable socioeconomic status. It is also notable that socioeconomic status was determined as a major risk factor for obesity, hypertension, metabolic syndrome, and cardiovascular diseases (Langenberg *et al.*, 2003, Loucks *et al.*, 2007, Mackenbach *et al.*, 2000, Vargas *et al.*, 2000). In addition, it may be associated with the increased risk of preeclampsia.

In this regard, Dlamini et al. reported that poor socioeconomic status was associated with the risk of preeclampsia in pregnant women in the developing countries (Dlamini, 1996). Moreover, Haelterman et al. reported that the risk of preeclampsia was twice higher in pregnant women with poor socioeconomic status compared to those with favorable socioeconomic status (Haelterman *et al.*, 2003). Another study in Mexico also proposed similar results (Cerón-Mireles *et al.*, 2001). Our findings are inconsistent with the research by Gudmundsson et al., who reported that the risk of preeclampsia was not significantly correlated with the low socioeconomic level in women; it is also notable that the mentioned study was conducted in the developing countries (Gudmundsson *et al.*, 1997). Low socioeconomic status is considered to be a major risk factor for preeclampsia and poor socioeconomic status is associated with various nutritional issues, reduced prenatal care, and inappropriate health status (Ramesh *et al.*, 2014).

The main strength of the current research was that all data were obtained by conducting interviews with the participants. In the cases where no appropriate place or time could be set with the participant for the interviews, data collection was performed via phone calls. Since questions in the food security questionnaire could not be answered properly through phone calls, they might have been affected by the unfavorable conditions while answering the questions. Another strength of the study was its case-control design; although several studies investigated the correlation between diet and preeclampsia, this was the first study to evaluate diet from the perspective of food insecurity.

One of the limitations of this study was that its sampling was limited to two hospitals in Mashhad city over a limited period of time. Furthermore, the non-blindness of the study procedure and possible effects of the confounding variables (e.g., employment status of the pregnant women, stress during pregnancy) could have affected the study outcomes.

Conclusion

After adjusting the confounding factors, findings of the study indicated that living in food insecure households was associated with the risk of preeclampsia during pregnancy. Considering the influential factors in this regard, preventive measures must be taken into account to provide practical solutions to the relevant organizations and prevent food insecurity in households. Since socioeconomic status was observed as the most important determinant of food insecurity, appropriate strategies should be adopted to improve the socioeconomic status of households and provide the required facilities to reduce the prevalence of food insecurity in high-risk households.

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Authors' contributions

Bigdeli J and Safarian M initially conceptualized and designed the study. Rangbar G, Jarahi L, Khadem Ghaebi N, and Soleimani D upgraded the protocol design and contributed to obtaining initial funding. The manuscript was written by Bigdeli J and reviewed by all members.Jarahi L was responsible for design optimizing and statistical analysis. All authors read and approved the final manuscript.

Conflicts of interest

None declared.

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