Journal of Nutrition and Food Security
Shahid Sadoughi University of Medical Sciences
School of Public Health
Department of Nutrition
Nutrition & Food Security Research Center

eISSN: 2476-7425 pISSN: 2476-7417 JNFS 2023; 8(3): 433-442 Website: jnfs.ssu.ac.ir

# *Food Security among Pregnant Women and Its Relationship with Body Mass Index in Eastern Iran*

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***ARTICLE INFO***

***ORIGINAL ARTICLE***

***Article history:***
Received: 6 Dec 2021
Revised: 27 Feb 2022
Accepted: 26 Mar 2022

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***ABSTRACT***

**Background:** Food insecurity is recognized as a serious public health problem worldwide. Since pregnant women are among the most vulnerable groups and their food insecurity may cause complications during pregnancy and on their newborns, the aim of this study is to investigate the relationship between food security and body mass index (BMI) of pregnant women in eastern Iran. **Methods:** This cross-sectional study was conducted on 335 pregnant women in 10 health centers in the east of Iran. Participants were selected by random cluster sampling. Data were collected using standard questionnaires including 18-item household food security survey module (HFSSM) designed by the U.S. Department of Agriculture (USDA) and nutritional evaluation forms. **Results:** The mean scores of the HFSSM of all pregnant women were 7.2±4.3. The household food security of pregnant women was significantly related to the occupation of spouses, mother's education, monthly salary, private home, and mother's age ($P$<0.05). There was no significant relationship between food security and BMI ($P$=0.98). **Conclusions:** Based on the results, few people have food security. Pregnancy in older age, lower-income, and education affected the household food security. Appropriate strategies and policies are necessary to combat this problem.

**Keywords:** *Household food security; Pregnant women; Food insecurity; Body mass index*

## Introduction

It is widely accepted that food as a basic need of human being is sustainably provided through food security (Mohammadzadeh *et al.*, 2011). Ensuring food security is one of the goals of

***This paper should be cited as:*** Zadeahmad Z, Charoghchian Khorasani E, Jadgal MS, Kiyani Mask M, Tatari M, , Kasiri N. ***Food Security among Pregnant Women and Its Relationship with Body Mass Index in Eastern Iran.*** *Journal of Nutrition and Food Security (JNFS)*, 2023; 8(3): 433-442.



[ DOI: 10.18502/jnfs.v8i3.13290 ]

human societies in all periods of history and perhaps one of the most important pillars of individual rights and security of man and society (Hosseini, 2018). In addition, food security is included in the priorities of future plans and in the 20-year national vision document (Khaledi and Faryad Ras, 2011). Ensuring sustainable food security is the main task of the government and is considered one of the important axes of human development (Shakouri, 2004). Food security was first introduced in 1973 at the First World Food Conference (Maxwell, 2001). According to the definition provided by the 1996 World Food Summit, food security was defined as "the physical, economic, and social access of all people at all times to sufficient, safe, and nutritious food to meet their nutritional needs and food preferences for a healthy and active life" (World Food Summit, 1996). The FAO states four pillars of food security including availability, access, utilization, and stability (Tey, 2010). In differentiating the concept of food security from hunger, it can be said that food security is a public problem, while hunger is an individual problem (Cohen, 2002).

Food insecurity is a global concern affecting more than 852 million people worldwide, approximately 9 million of which belong to developed countries and the rest to developing countries (Mohammadpour Kaldeh M, 2010). Many studies are available on food security in different parts of the world, including developing countries, and among different segments of society. A study by Maira *et al.* during the perinatal period of immigrant women in Edmonton, Canada, reported that the prevalence of food insecurity was 94% (Quintanilha *et al.*, 2019). The prevalence of food insecurity in the study of Nnakwe *et al.* on pregnant women in rural Nigerian communities was reported to be 90% (Nnakwe, 2018). Food insecurity in 2010 was estimated at 86% among women in Bushehr, Iran (Mohammadpour Kaldeh M, 2010). Identifying people with food insecurity is important, since some households have food insecurity, but have not necessarily experienced hunger (Kolahdooz and Najafi, 2012). In cases, where only the quantity of food is important rather than the quality of food, food insecurity continues (Dolatian *et al.*, September 2018, Yadegari *et al.*, 2017). Some of the most important factors in food insecurity are family size, educational level, employment status, and economic status (Payab *et al.*, 2012). In addition, income is an important factor in food insecurity for families. In low-income families, insufficient income can lead to the inability to provide adequate food for family members (Mohamadpour *et al.*, 2012). Food insecurity in poor families is three times higher than in other people (Nord *et al.*, 2009). Higher-income households with better socioeconomic status have a wider choice of food and could spend a decent portion of their income on food (Payab *et al.*, 2012). In a study by Yadegari *et al.*, labor job and income of less than 40 million Rial showed a significant relationship with food insecurity (Yadegari *et al.*, 2017). Rajizadeh *et al.* introduced low socio-economic status as one of the causes of food insecurity (Rajizadeh *et al.*, 2019).

Food insecurity has adverse consequences for all groups, especially vulnerable groups, including subsequently increased medical costs, disease, etc. (Jadgal *et al.*, 2020). Ramalho *et al.* reported that the prevalence of food insecurity varies between 9% and 87.9% in pregnant women, with the lowest prevalence in developed countries and the highest prevalence in underdeveloped countries (Ramalho *et al.*, 2020). Food quality has a significant impact on fetal and infant health in addition to maternal health. Although the birth of a healthy baby is influenced by various factors such as maternal health status and socio-economic and cultural status, nutritional factors can also play a decisive role (Monafi *et al.*, 2003). Malnutrition in children weakens the immune system and increases the prevalence and severity of infectious diseases and their mortality. It is an important underlying factor in diseases such as gastroenteritis, pneumonia, and other infectious



[ DOI: 10.18502/jnfs.v8i3.13290 ]

diseases. These diseases are one of the leading causes of hospitalization and death among children in developing countries (Borji et al., 2018).

Given that healthy pregnancies and childbearing are among the policies of the maternal health program in the country (Rasty *et al.*, 2015), and also because maternal mortality and neonatal health are the important health indicators, this study aimed to evaluate the food security of pregnant women and its relationship with body mass index (BMI) in eastern Iran.

## Materials and Methods

*Study design and participants:* The present cross-sectional study was conducted in 2019 on pregnant mothers referring to health centers in Torbat Heydarieh. The sample size was estimated to be 335 using the Cochran's formula for calculating sample size. Using two-stage cluster sampling method, first 10 out of 40 urban and rural health centers were randomly selected and then the estimated sample size was distributed in the selected centers according to their population. In the next step, simple random sampling was performed among pregnant mothers according to inclusion criteria, including singleton pregnancy, gestational age equal to or more than 20 weeks, referral for prenatal care, Iranian citizenship, Persian language proficiency, no history of known underlying diseases (such as diabetes, hypertension, and anemia), and other diseases requiring a special diet.

*Measurements:* The data collection tool in this study was a 3-part questionnaire: A) Demographic information. B) The household food security questionnaire (HFSQ): it is one of the questionnaires designed by the U.S. Department of Agriculture (USDA) in 1995 and has been introduced as a valid questionnaire for epidemiological studies. The 18-item questionnaire, which assesses food security status over the past 12 months, was completed during a face-to-face interview with mothers. The 18-item questionnaire was assessed in a study on households in Isfahan and its validity was confirmed (Mohamadpour *et al.*, 2012). The questionnaire options included most of the time, sometimes, etc. with a score range of -1 to 1. The score range of households with food security was 0 to 2, food insecurity without hunger was 3 to 7, and the score range of food insecurity with moderate or severe hunger was 8 to 18 (Mohamadpour et al., 2012).

C) When the pregnant mother referred to the center, height, weight, abdominal circumference (AC), waist circumference (WC), and hip circumference (HC) were measured according to the standard instructions, followed by calculating BMI and waist-to-hip ratio (WHR).

*Ethical Considerations:* The study protocol was approved by the Board of Ethics of Torbat Heydariyeh University of Medical Sciences (IR.THUMS.REC.1397.030).

*Data analysis:* Statistical analyses were performed using IBM SPSS version 20. Descriptive statistics were used to summarize pregnant women demographics and anthropometric characteristics. Continuous variables were presented as mean and SD, while categorical variables were presented as frequency and percentage. The t-test and ANOVA test were used after establishing a normality hypothesis and Mann-Whitney U and Kruskul Wallis tests for failure to establish a normality hypothesis to compare the mean HFSQ score at different levels of qualitative variables. Tukey post hoc test was used to compare the pairs of two levels of variables. Multivariate linear regressions were used to identify the determinants of HFSQ score. Linearity, normality, and homoscedasticity of data were checked and confirmed to make sure that the prerequisites of generalized linear regression are met. The ANOVA statistical test was used to examine the relationship between food security and BMI. All statistical tests were performed bilaterally with P-value<0.05 considered significant.

## Results

The current cross-sectional study was performed on 335 pregnant women referring to



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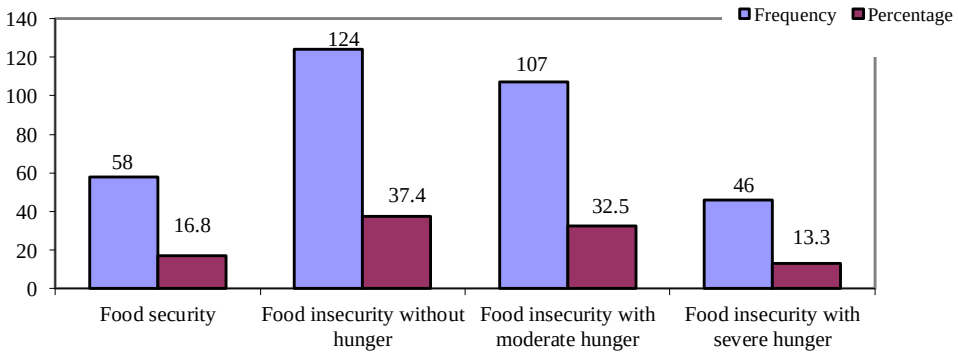
health centers in Torbat Heydarieh. According to the results of demographic information, the mean maternal age was 27.3±6.0 years and the mean paternal age was 32.1±5.5 years. Most of the women in the study (95.1%) were housekeepers and the majority of their spouses were self-employed (55.1%). Moreover, 45.2% of women were illiterate and 45.5% of their spouses had a primary school education level. Most of participants (61.7%) mentioned a monthly salary of over 10 million Rial. In terms of residence status, 71.3% of the participants had a private home. The mean weight of mothers was 66.7±12.4 kg, the mean height of mothers was 157.7±5.8 cm, and the mean BMI of mothers was 26.8±4.9 kg/m$^2$. The mean score of HFSQ obtained by pregnant women was 7.2±4.3. According to the HFSQ classification, summation the score of 18 questions for each person resulted in food security classification into four categories, including complete food security, food insecurity without hunger, food insecurity with moderate hunger, and food insecurity with severe hunger (**Figure 1**).

Comparing the mean scores of food security showed that the studied variables such as health center, mother's education, household monthly income, and private house had a significant relationship with household food security ($P$<0.001). Moreover, mothers with academic education displayed higher food security in comparison to illiterate mothers or those with high school diploma ($P$<0.001). Furthermore, pregnant women in high-income families had more food security than those in low-income families. Pregnant women in families living in a private house showed more food security in comparison to those living in a rented house ($P$<0.001, **Table 1**).

A linear regression model was used to simultaneously investigate factors related to household food security and analyze them. Step wise method was employed to achieve significant variables. The variables such as health centers providing health service to pregnant women, paternal and maternal level of education, monthly income, owning a private house, mother's age, family income, and housing status were determined as the final significant variables in the model. The final model is presented in **Table 3**. The mean score of food insecurity increases annually by 0.15% as a mother gets one year older, indicating that older mothers have lower food security. Food insecurity mean scores in families with monthly income less than 10 million Rials and between 10 and 20 million Rials of were 5.6 and 3.7 scores higher than those families with a monthly salary of more than 20 million Rials , respectively ($P$<0.001). Also, food insecurity mean score of families living in private houses was almost 2.5 scores lower in comparison to families living in rented houses ($P$<0.05). Furthermore, food security mean score of mothers with academic education was 2.8 and 1.5 scores lower in comparison to mothers having a high school diploma and illiterate mothers, respectively (**Table 2**).






[ DOI: 10.18502/jnfs.v8i3.13290 ]

**Figure 1.** Household food security status.

**Table 1.** Comparing the mean±SD score of food security based on demographic variables.

| Demographic variables | Categories | N | Mean | P-value[a] |
|---|---|---|---|---|
| Type of health center | Rural | 178 | 7.5±4.4 | 0.12 |
| | Urban – Rural | 157 | 6.8±4-2 | |
| Number of family members | 2 | 98 | 6.5±4.4 | 0.13 |
| | 3 | 139 | 7.0±4.0 | |
| | 4 | 75 | 7.9±4.1 | |
| | 5 | 23 | 7.4±5.4 | |
| Husband's education | Illiterate and elementary school | 134 | 7.3±4.6 | 0.41 |
| | High school and diploma | 182 | 6.7±3.9 | |
| | Academic education | 19 | 8.2±3.8 | |
| Mother's education | Illiterate and elementary school | 151 | 8.5±4.4 | <0.001 |
| | High school and diploma | 166 | 6.1±3.8 | |
| | Academic education | 18 | 4.9±3.6 | |
| Husband's occupation | Employee | 17 | 8.5±4.8 | 0.89 |
| | Self-employment | 110 | 6.9±3.9 | |
| | Worker | 111 | 7.0±4.4 | |
| | Unemployed | 11 | 6.8±5.6 | |
| | Farmer | 86 | 7.1±4.2 | |
| Mother's occupation | Housekeeper | 328 | 7.2±4.3 | 0.1 |
| | Employed | 7 | 4.4±2.5 | |
| Monthly salary (Rial) | <10 Million | 212 | 8.1±4.1 | <0.001 |
| | 10-20 Million | 97 | 6.2±4.2 | |
| | 20< Million | 26 | 0.6±0.6 | |
| Housing status | Private | 246 | 6.3±3.8 | <0.001 |
| | Rental | 75 | 9.7±4.6 | |
| Type of centers | Urban | 54 | 6.2±3.6 | 0.29 |
| | Rural | 20 | 7.2±3.4 | |
| Weight status | Thin | 17 | 7.1±3.8 | 0.98 |
| | Normal | 117 | 7.1±4.3 | |
| | Overweight | 93 | 7.2±4.4 | |
| | Fat | 102 | 7.0±4.4 | |

[a]: Independent two sample t-test.

**Table 2.** Results of multiple linear regression analysis of the relationship between food security score and population variables.

| Demographic variables | Categories | Coefficient | Std. Error | P-value |
|---|---|---|---|---|
| Salary | <10 million Rial | 5.6 | 0.8 | <0.001 |
| | 10-20 million Rial | 3.7 | 0.8 | <0.001 |
| | 20< million Rial | 0.0 | 0.0 | . |
| Housing status | Private | -2.30 | 0.510 | <0.001 |
| | Rental | 0.0 | 0.0 | . |
| Mother's education | Illiterate and elementary school | -2.8 | 0.9 | .003 |
| | High school and diploma | -1.4 | 0.4 | <0.001 |
| | Academic education | 0.0 | | . |
| | Age-wife | 0.1 | 0.03 | <0.001 |

## Discussion

According to the FAO report in 2019, 26.4% of the world's population (2 billion people) have experienced moderate to severe food insecurity.



[ DOI: 10.18502/jnfs.v8i3.13290 ]

Food insecurity increased from 2011-2018 in middle-income countries experiencing economic depression and inflation. Food insecurity in West Asia was 73.7 million in 2014 and 80.2 million in 2018 (World Health Organization, 2019).

The recent economic crisis and the rapid rise in food prices may also lead to food insecurity over time (Behzadifar *et al.*, 2016). Therefore, the present study investigated food security of pregnant women in Torbat Heydarieh. According to the results, the mean score of the HFSQ of all pregnant women was 7.2±4.3. The prevalence of food security among participants was 16.8% and the prevalence of food insecurity was 83.2%, so that food insecurity without hunger, food insecurity with moderate hunger, and food insecurity with severe hunger were 37.4, 32.5, and 13.3%, respectively. The prevalence rate of food insecurity in the present study is consistent with the studies of Maira and Nnakwe (Nnakwe, 2018, Quintanilha *et al.*, 2019). Maira *et al.* studied immigrant pregnant mothers in Canada and Nnakwe and also examined pregnant mothers in rural Nigerian communities. The reason for this consistency can be attributed to the fact that nearly 60% of the households were also rural in the present study. Reportedly, 86% of women in Bushehr, Iran, in 2010 had food insecurity, which is similar to the results of the present study (Mohammadpour Kaldeh M, 2010). These results are inconsistent with other national studies (Barzegar *et al.*, 2019, Fathi Beyranvand *et al.*, 2019, Hojaji *et al.*, 2015, Kazemi *et al.*, 2018, Rajizadeh *et al.*, 2019, Sharifi *et al.*, 2018, Yadegari *et al.*, 2017).

In some international studies, food insecurity was lower than the present study. In some international studies, food insecurity was lower than the present study. The prevalence of food insecurity in pregnant women was 24% in North Carolina, 46.4% in East Ogan, 75.5% in Gambela (Ethiopia) and 45.1% in Colombo (Fernandes *et al.*, 2018, Laraia *et al.*, 2010, Nigatu *et al.*, 2018, Oluwafolahan O *et al.*, 2014). Differences between the results of the present study and other studies can be attributed to cultural, social, economic differences, and the development status of communities (Hojaji *et al.*, 2015).

In the present study, no significant relationship was observed between food security and BMI of pregnant women. Perhaps this lack of relationship is due to the fact that pregnant women with gestational age of over 20 weeks were generally examined and women were not examined separately by month of pregnancy, and women in the last months of pregnancy usually have a higher BMI than the first months of pregnancy.

In the present study, a significant relationship was found between food insecurity of pregnant women and their age, so that food insecurity increased by 0.15% as the mother became one year older; therefore, older mothers had lower food security. In the studies by Fernandes *et al.* and Oliveira *et al.*, food insecurity also increased with age, in line with the present study (Fernandes *et al.*, 2018, Oliveira *et al.*, 2017). The mean maternal age was higher in households with food insecurity (food insecurity with moderate or severe hunger) compared to those with complete food security. It can be said that the number of children and the size of family also increase with age, thus affecting the quality and quantity of food (Mortazavi *et al.*, 2017).

However, Rajizadeh *et al.*, Nnakwe and Laraia *et al.* reported an inverse correlation between food insecurity and age, so that food insecurity was higher in young pregnant women (Laraia *et al.*, 2010, Nnakwe, 2018, Rajizadeh *et al.*, 2019). In studies by Fathi Beyranvand *et al.* and Sharifi *et al.*, there was no significant relationship between maternal age and food insecurity (Fathi Beyranvand *et al.*, 2019, Sharifi *et al.*, 2018).

In the current study, moreover, no significant relationship was observed between the number of family members and food insecurity, which is in line with the results obtained from Barzegar's study conducted in Zanjan (Barzegar *et al.*, 2019). However, this result is not consistent with studies by Sharifi, Yadegari, Tenaw, Fernandes, and Laraia's (Fernandes *et al.*, 2018, Laraia *et al.*,





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2010, Sharifi *et al.*, 2018, Tenaw *et al.*, 2018, Yadegari *et al.*, 2017), in which such a significant relationship was reported between the number of family members and food insecurity. The presence of a child in the family increases costs (such as education, school costs, clothing, and health care), and reduces the budget and share of food costs, resulting in food insecurity. In addition, food sources are shared among more people and each person has less access to food with the increase in the number of family members (Sajjadian *et al.*, 2018).

In this study, on the other hand, women with academic education were shown to be less threaten with the danger of food insecurity than those who were illiterate or had a diploma. Academically educated mothers had significantly higher food security. Results of studies on pregnant women by Fathi Beyranvand in Khorramabad, Barzegar in Zanjan, Sharifi in Ilam, Nnakwe in rural communities of Nigeria, Tenaw in Ethiopia, Jemal in Almaty, Fernandes in Brazil, and Laraia in North Carolina were consistent with the present study (Barzegar *et al.*, 2019, Fathi Beyranvand *et al.*, 2019, Fernandes *et al.*, 2018, Kemal and Mukemil, 2019, Laraia *et al.*, 2010, Nnakwe, 2018, Sharifi *et al.*, 2018, Tenaw *et al.*, 2018). People with low levels of education have more limited job opportunities and, consequently, their ability to earn money and food costs reduces (Payab *et al.*, 2012). Jemal *et al.* showed that dietary diversity is higher in academically educated mothers than mothers with primary school education (Kemal and Mukemil, 2019). Food diversity can also be affected by the socio-economic status of the household, so that food diversity in households with higher socio-economic status is better than those with lower socio-economic status (Arimond and Ruel, 2004, Murakami *et al.*, 2009). Nigatu *et al.* found that food insecurity is higher in pregnant women with lower dietary diversity (Nigatu *et al.*, 2018).

In the current study, families with low-economic status displayed higher food insecurity, in other words, there was higher food security in families with more than 20 million Rials income in comparison to families with 10 million Rails income and families with an income between 10 to 20 million Rails. This finding is consistent with the results reported by the others (Fernandes *et al.*, 2018, Kazemi *et al.*, 2018, Laraia *et al.*, 2010, Mortazavi *et al.*, 2017, Sharifi *et al.*, 2018, Tenaw *et al.*, 2018, Yadegari *et al.*, 2017).

In this research, no significant relationship was observed between food insecurity and husband's unemployment, but in the studies performed by Yadegari, Sharifi, Kazemi, Sajadian, and Pasdar, unemployment of head of household was reported as a risk factor for food insecurity (Kazemi *et al.*, 2018, Pasdar *et al.*, 2019, Sajjadian *et al.*, 2018, Sharifi *et al.*, 2018, Yadegari *et al.*, 2017).

Food insecurity in the present study was lower in households living in private homes, which is consistent with the findings of the study by Sajjadian (Sajjadian *et al.*, 2018). It could be due to the fact that having a private home prevents people from paying for mortgages and rent, and thus they have more access to food.

## Conclusions

Overall, the results of the current study showed that a small percentage of people have food security. Low education and old age of pregnant mothers, father's unemployment, low income, and lack of private housing were some of the food security-related factors. Due to the fact that unfavorable nutritional status during pregnancy is associated with adverse consequences such as fetal growth restriction and preterm delivery, it is necessary to evaluate food security during pregnancy. In addition, the rise in commodity prices, especially in households with an income close to the poverty line, can lead to food insecurity. Therefore, it is recommended to reduce the prevalence of food insecurity in high-risk households by appropriate policies to improve the socio-economic status of households and provide facilities. Further research is suggested on food security status based on different age groups and nutritional issues, such as dietary patterns, anthropometric indices, and clinical manifestations. This study is the first attempt to examine the relationship between food security and



[ DOI: 10.18502/jnfs.v8i3.13290 ]

BMI in eastern Iran. One of the limitations of this study is that it was conducted on women in comprehensive health centers, where there are fewer opportunities for working mothers or students to participate in this study due to the working hours of in these centers. Another limitation of the study is that the information was completed as a self-report, which may be accompanied by a percentage of error.

## Acknowledgement

This study was funded by Torbat Heydarieh University of Medical Sciences with a code of ethics of IR.THUMS.REC.1397.030.

## Conflicts of interest

The authors declare no conflict of interest.

## Authors' contributions

Study concept and design: Zadeahmad Z and Kasiri N. Data collection: Jadgal MS and Kiyani Mask M. Analysis and interpretation of data: Tatari M. Manuscript preparation: Charoghchian Khorasani, E.

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