

Innovations

Association of Food Insecurity and Obesity among Household Families: Northern Jordan

Baha'a M. Abu Salma^{1*}, Ali Alshrafat², Alanoud Elmoumani³,
Saif Elmoumani³, Muayyad Bani Hani⁴, Yousef Mograbi

Corresponding Author: [Baha'a M. Abu Salma](#)

Abstract: Food insecurity and obesity are a public health concern. People who experience food insecurity are more likely to suffer from obesity. Economic strains and limited access to healthy food are the main risk factors for obesity among food-insecure people. To evaluate the association between food insecurity and obesity. A cross-sectional study was conducted on (n = 315) people from northern Jordan. Data was collected by structured questionnaire to determine socio-demographic data. The Food Expenditure Share and Household Food Insecurity Access Scale were used to measure food insecurity levels, while body mass index criteria were used to determine the level of obesity. Multiple regression model was used to determine the magnitude and direction of the relationship between food insecurity and obesity. The results of the study found that the mean age of the participants was 50.4 ± 11.7 , and 58.1% of the families had more than six family members with an average monthly income of 338.3 ± 183.4 JD. In addition, the participants are most likely to be obese with an average of BMI 28.7 ± 0.04 , and moderately food insecure levels, according to the results of the food expenditure share and household food insecurity Access Scale categories. Moreover, there are significant positive correlations between food insecurity and obesity; each increase in the level of food insecurity which is represented by food expenditure share and household food insecurity Access Scale, will lead to an increase in body mass index by 0.11 and 0.72 respectively. The results of the study demonstrated that people with household food insecurity are more likely to suffer from obesity, especially among low-to middle-income levels. The current study recommends that policies consider people at risk of food insecurity and obesity to provide them with comprehensive nutritional intervention, and price reduction policies for nutritional food.

Keywords: food insecurity, obesity, food expenditure share, low-middle income, Jordan

1. Introduction

Food insecurity is a condition of social and economic limited access to nutritionally adequate and safe food (US Department of Agriculture, 2016).

Food insecurity affects vulnerable people with various household income levels, single-parent households, low education levels, and large family size (Heerman et al., 2016). However, food insecurity involves both financial instability and anxiety related to access to healthy food. People from insecure families most often consume inexpensive diets with low nutrition-dense and high-calorie diets, which are more affordable and accessible than healthy diets. An unhealthy diet may contribute to malnutrition, obesity, and obesity-related chronic disorders (Popkin and Reardon, 2018; Abu Salma et al., 2024). Moreover, economic constraints in food-insecure families force them to prioritize food quantity over quality, and irregular eating patterns result in obesity and metabolic disorders (Novoa-Sanzana et al., 2024).

Obesity is a public health concern characterized by the accumulation of excessive fat and is considered a risk factor for chronic diseases like diabetes type 2, metabolic syndrome, and cardiovascular disease (Lin X et al., 2021). The estimated prevalence of obesity suggests rising from 38% in 2020 to 50% in 2035 (World Obesity Federation, 2023). However, food insecurity is a key factor contributing to undernutrition and obesity, which trigger poor dietary consumption (Wansink and Shimizu, 2012).

Studies show conflicting results on the link between food insecurity and obesity. The results of a study conducted on data from Hispanic Community Children found that the prevalence of food insecurity among Hispanic Latin youth was 46% with higher body mass index (BMI) (Potochnick et al., 2019). Moreover, a study using data from the National Health Nutrition Examination Survey (NHANES) confirms lack of access to dense food is a leading factor in obesity. In addition, several studies confirm that several factors play a role in the relationship between food insecurity and obesity like the availability of healthy foods, lack of family support system, economic stress, and health insurance (Jones et al., 2018). On the other hand, gender disparity is one of the most common factors affecting food security. Women are more likely to develop food insecurity with higher body mass index (BMI) as women are most likely to prioritize their diet quality to feed their children (Taylor et al., 2021). Researchers suggest socio-demographic nature of low and middle-income countries are more prone to food insecurity with obesity, which affects household access to healthy food (Farrell et al., 2018).

There is contradictory evidence of the relationship between food insecurity and obesity. To the best of our knowledge, the relationship between food insecurity and the incidence of obesity in northern Jordan has not been studied yet. Therefore, the current study hypothesized that there was a relationship between food insecurity and the incidence of obesity. In this

study, we aimed to evaluate the association between food insecurity and obesity in northern Jordan.

3. Materials and methods

3.1 Study design and participation

A cross-sectional study was conducted on (315) persons between December 2022 and April 2023. Participants were recruited from various areas in Irbid, northern Jordan. Participants who are willing to respond to the questionnaire are included in the study. At enrollment, written informed consent was obtained from the participant. The study was conducted according to the declaration of Helsinki, and the ethical review board at Jerash University approved the study.

3.2 Development of questionnaire

Data was collected by a constructed questionnaire which was formulated and developed based on the World Food Program (WFP, 2019) criteria to measure the level of food security. The questionnaire was modified according to the comments from an experienced researcher at Jerash University. In addition, the result of Cronbach's Alpha coefficient was (0.87) which is considered high and suggests that the questionnaire is reliable.

The research questionnaire included three parts. The first part included socio-demographic characteristics such as age, gender, head of household, educational level, number of family members, average family income, and monthly expenditure on food. The second part included food security indicators.

3.3 Food security indicators:

3.3.1 The Food Expenditure Share (FES):

The Food Expenditure Share (FES) is the proportion of expenditure on food from the total household expenditures. FES is the amount of money spent on food consumption by all family members over the past four weeks. It is widely used as an indicator to measure households' economic vulnerability to food insecurity. The higher the share of households' consumption expenditures on food, the more vulnerable the households are to food insecurity (Antriyandarti et al., 2023).

The household food expenditure is classified according to FAO classification (FAO et al., 2018), 76% of food expenditure share is considered severely food insecure, moderate (50-75.5%). While less than 49.5% consider food secure (Ahmed, 2023, Smith et al., 2006).

3.3.2 Household Food Insecurity Access Scale (HFIAS)

The household food insecurity access scale (HFIAS) is used to determine whether the participants or their households have experienced food insecurity in the last four weeks. Food insecurity access is described in a set of nine questions, which are presented in Table. 1. These questions provide insight into participants' feelings, behavior, attitudes, and perceptions about uncertainty due to a lack of food resources or supply. The participant's responses on whether this condition happened ("yes" with a score of 1 or "no" with a score of 0). The responses to the HFIAS questions are then summed and range from 0 to 9. (Coates et al., 2007). Moreover, the food insecurity status is classified as mild food insecurity (less than 3), moderate (3 - 6), and severe (more than 6 - 9).

3.4 Anthropometrics measurement

3.4.1 Weight and height measurement

The participant's weight and height were measured with light clothes and bare feet by calibrating balance (Charder with a digital weighing scale with a height Rod MS4900). The weight was taken in kilograms to the nearest (0.1kg) while the height was taken in centimeters (cm) to the nearest millimeter (mm). The mean of three consecutive measurements was taken.

The BMI was calculated based on weight in kilograms divided by height in meters square (kg/m^2). The body mass index classification was adopted from the World Health Organization (WHO) guidelines (WHO, 2004): normal (18.5 - 24.9), overweight (25-29.9), obese class I (30-34.9), obese class II (35-39.9), and morbid obesity (more than 40).

3.4 Statistical analysis

Statistical analyses were performed using SPSS version 22 (SPSS statistics for Windows V22, IBM Corp., Armonk, NY, USA). Mean and standard deviation (SD) and percentage were used to evaluate the baseline characteristics of the participants. The data was tested for normality by the Shapiro-Wilk test. A linear regression model was used to determine the degree and magnitude of association between variables. In the model, the dependent variable is the value of BMI (Kg/m^2), and the independent variable is the levels of food insecurity using FES and HFIAS. A p-value of <0.05 was considered statistically significant.

3. Results:

3.1 Socio-demographic, economic, and anthropometric measurements of the participants

Table 2 shows the socio-demographic, economic, and anthropometric measurements of the participants. The results show that the mean age of the participants was 50.4 ± 11.7 , with 54.6% of the participants between the ages (46 and 65 years). For most of the participants, the father was the head of the households 82.9% and 58.1% of the households had more than six family members with an average of 6.1 ± 1.8 , 50.2% of the participants held a diploma or bachelor's degree, and a full-time job 58.7%, with an average monthly income 338.3 ± 183.4 JD. Moreover, 43.8% of the participants are overweight with a mean BMI of 28.7 ± 0.04 .

3.2 Participants' food security status

3.2.1 Participants' food security status Based on FES

Table 3 and Figure 1 show the participants' status of food insecurity according to the FES. The results show that the households belong to the category of moderately food insecure (MFI) with an average of 66.6%. Furthermore, nearly 60% of the participants had moderate food insecurity, 22% had severe food insecurity, and 18% had food-secure households.

3.2.2 Participants' food security status Based on HFIAS

The results of the HFIAS are shown in Table 4 and Figure 2. Shows the participants' food security status. The results indicated that the total of responses of the participants to the HFIAS questions was 3.79, which means that these households belong to the category of moderate food insecurity Status. This result confirms the result obtained from the FES indicator. The two indicators revealed that the level of food security of the investigated participants' is moderate.

3.3 The relationship between food insecurity status and BMI:

Linear regression analysis was applied to assess the contribution of food security status on BMI as an indicator of the prevalence of obesity. Among different regression models, a multiple regression model in which food security was resembled by FES (%), and HFIAS as an independent variable, and body mass index or BMI (Kg/m^2) resembled obesity as the dependent variable. The dependency on the model was assured by introducing both the level of FES (%) and HFIAS of the respondents as independent variables. The data of all variables were tested for normality and the results indicated a normal distribution for data included in the model. The coefficient of determination of the model as well as the F-value were high enough in the model to be dependable and the independent variables reliably predicted the

dependent variable. Table 5. Correlation between food insecurity represented by FES (%) and HFIAS, and body mass index. As shown in Table 5, more than 16% of the variation in the dependent variable (BMI) is explained or can be predicted by the impact of the independent variables.

The results are presented in Table 5. Shows that the predicted value of BMI when FES and HFIAS variables are 0 is 28.42, and 31.3 respectively. The results also revealed that all the independent variables have with significant impact on the dependent variable (BMI) ($P < 0.05$). Among the independent variables, the FES and HFIAS have with positive relation with BMI. This means that each increase in the level of FES and HFIAS will lead to an increase in BMI by 0.11 and 0.72 respectively. These results confirm the fact that the increase in food insecurity status will lead to an increase in BMI, which resembles obesity.

4. Discussion:

The relationship between obesity and food security is complex and multifactorial. Both food security and obesity are relevant among medium and low- and low-income countries. However, the results of the study found that most of the participants fall within the low-income level, which subjects them to limited access to healthy and high-quality food. While healthy foods are expensive and cannot be affordable by low-income families, low-income families struggle with their limited resources and purchase inexpensive, unhealthy energy-dense diets containing refined sugar and fat to meet their calories and prevent hunger (Kowaleski-Jones et al., 2019). Moreover, overconsumption of unhealthy energy-dense and low-nutritional-quality diets has been linked to obesity (Popkin and Reardon, 2018).

In this study, the participants' obesity was assessed by BMI, which found that a higher proportion of the participants had a BMI higher than 25, which is indicative of overweight. This observation is consistent with (World Obesity Federation, 2023) which reported that the prevalence of obesity is rising globally among low and middle-income families. Moreover, the food insecurity levels were assessed by FES and HFIAS. Results indicated that the participants' households experienced moderate food insecurity. Food insecurity is crucial as it often leads to consuming unhealthy cheap foods, which contributes to obesity (Darmon and Drewnowski, 2015). Our study suggests that households with higher expenditure on food are more prone to food insecurity because they are directing the largest proportion of their income towards providing food for their members, so they are very sensitive to food availability. On the other hand, food-insecure families prioritize food quantity over quality to meet their calories from fast food restaurants. However,

frequent consumption of poor nutrients, high fat, high-refined sugar, and high-dense calories leads to obesity (Powell and Nguyen, 2013). Additionally, food insecure families are most likely to adapt to a shortage of food by skipping meals or eating less while they may overeat when food is available. Cycling from overconsumption and deprivation of food may lead to hyperglycemia, metabolic and hormonal changes that promote fat storage (Drewnowski, 2009).

A recent study has suggested that low-income families may suffer from stress, anxiety, and depression due to low wages and inability to access food, which, can lead to emotional eating of high-refined sugar and fat that contribute to an increase in the risk of obesity and metabolic disorder (Chiu et al., 2024). Moreover, stress among food-insecure families may lead to overconsumption of hyper-palatable fast food as comfort food, which induces metabolic disorders and hormonal changes (Kaiser et al., 2022).

Household food insecurity and physical activity are interrelated. The current study found that people in food insecure families are less likely to engage in physical activity. Children in food-insecure families are more likely to stay at home and less engagement in physical activity than those with food-secure, because of limited access to recreation sites (To QG et al., 2014). The expense of recreation places and transportation limit their participation in physical activity. Furthermore, children with food insecurity have a higher consumption of fat, refined sugar, and low vegetable intake and are less engaged in physical activity (Fram et al., 2015). Moreover, food insecure persons with a higher prevalence of obesity are highly exposed to advertising and marketing for unhealthy food products, and sedentary activities like television shows and video gaming (Eisenberg et al., 2021).

In conclusion, food insecurity and obesity are interrelated. Food insecure people with obesity face socio-demographic and economic challenges in accessing healthy foods and adopting physical activity. Food insecurity is associated with an increasing incidence of obesity among low- to moderate-income people, which limits their ability to access healthy food. Therefore, the current study recommends that policies consider people at risk of food insecurity and obesity to provide them with comprehensive nutritional intervention, and price reduction policies for nutritional food.

Affiliations of the authors:

^{1*} Dept. of Nutrition and Food Sciences, Faculty of Agriculture, Jerash University, Jerash

²Climate Change, Sustainable Agriculture and Food Security Program (CCSAFS), Faculty of Agriculture, Jerash University.

³Faculty of Medicine, University of Jordan, Amman

³Faculty of Medicine, University of Jordan, Amman

¹Dept. of Plant production and protection, Faculty of Agriculture, Jerash University, Jerash

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Table 1: Food Insecurity Experience Scale (FIES) Module.

Question No.	Question: During the last 30 days (12 months) was there a time when, because of lack of money or other resources:	Answer	
		Yes	No
1	Did you or any of your household members were worried you would not have enough food to eat?		
2	Did you or any of your household members were unable to eat your preferred food?		
3	Did you or any of your household members eat only limited kinds of foods?		
4	Did you or any of your household members eat a small portion of a meal because there was not enough food due to insufficient resources?		
5	Any of your household members had to skip a meal.		
6	Did you or your household eat some foods you did not want to eat?		
7	Were there ever you or any of your household members experienced no food at your household?		
8	Did you or your household ever sleep at night		

	hungry?		
9	Did you or any of your householdmembers go without eating for a whole day and night because of a lack of resources?		

Table2. Socio-demographic, economic, and anthropometric characteristics of the participants

Variables	N= 315	Percentage
Age (years)	50.4 ± 11.7	
< 30	12	3.8%
30- 45	90	28.6%
46 – 65	172	54.6%
≥ 66	41	13%
Gender		
Male	164	52.1%
Female	164	46.3%
Head of the family		
Father	261	82.9%
Mother	44	14%
Husband	10	3.1%
Number of family members		
Mean ± SD	6.1 ± 1.8	
< 3	6	1.9%
3-6	126	40%
Less than 6	183	58.1%
Level of education		
Illiterate	66	21%
Less than secondary school	77	24.4%
Diploma or Bachelor	158	50.2%
Higher education	14	4.4%

Occupation		
Full-time job	185	58.7%
No job	62	19.7%
Retired	68	21.6%
Weight (kg)	80.3 ± 13.2	
Height (cm)	167.2 ± 10	
BMI (kg/m²)		
Mean ± SD	28.7 ± 0.04	
Healthy Weight: <24.999	65	20.6%
Overweight: 25-29.9	138	43.8%
Obese class I: 30 – 34.9	85	27%
Obese classII: 35 – 39.9	22	7%
Morbid obesity: > 40	5	1.6%
Income (JD/ month)		
Mean ± SD	338.3 ± 183.4	
< 400 JD	317	75.3%
400 – 599.9 JD	67	15.9%
≥ 600 JD	37	8.8%
Expenditure on food	201 ± 60.1	
FES (%)	66.6 ± 16.1 %	

BMI: Body mass index; FSH: Food Expenditure Share

Table 3: Sample distribution according to food security status Based on FES calculations.

Category	Number	Percentage in Sample (%)	Food Spending Status Rating	Food Expenditure Share (FES): (%)	Food Security Status
1	69	22%	Too high	More than 76%	Severely Food Insecure

2	189	60%	Medium	50% - 75.5%	Moderately Food Insecure
3	57	18%	Acceptable	Less than 49.5%	Food Secure
Total	315	100.0%			

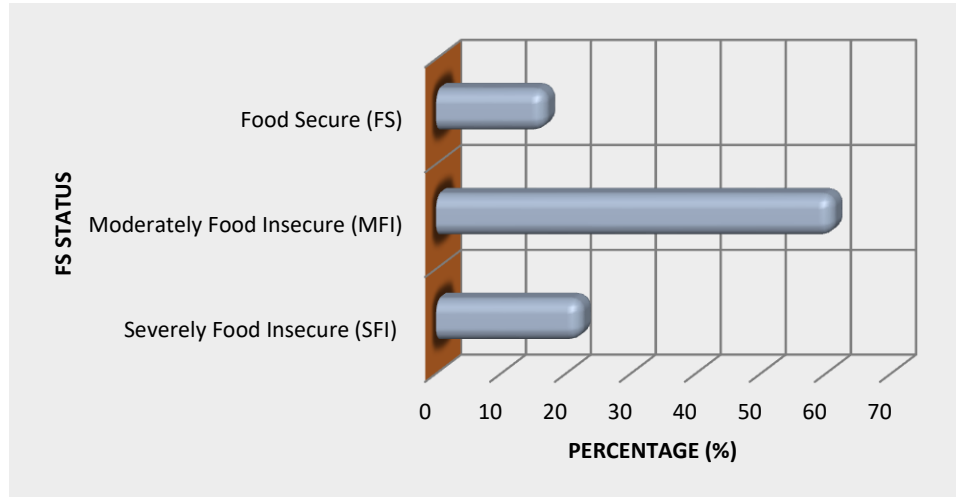


Figure 1: Sample distribution according to FI status based on FES.

Table 4: Sample distribution according to food security status Based on FIES calculations.

Category	Number	Percentage in Sample (%)	Total Scores for Questions Answers	Food Insecurity Status
1	141	45.50%	0 – 3	Mild
2	134	41.60%	3.01 – 6	Moderate
3	40	12.90%	6.01– 8	Severe
Total	310	100.0%		

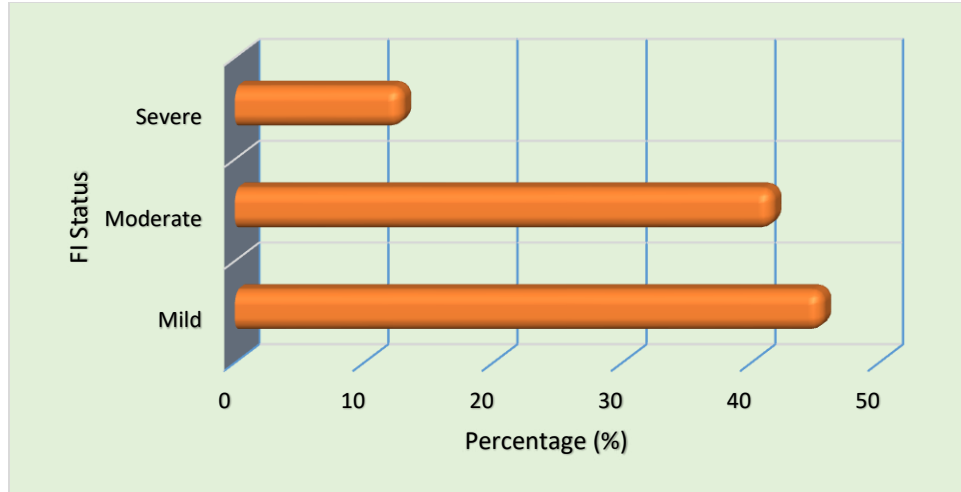


Figure 2: Sample distribution according to FI status based on FIES.

Table 5. Correlation between food insecurity represented by FSH and body mass index

Model		B	R Square	F	P- value
	(Constant)	28.42			
	FES (%)	0.11	0.16	83.4	0.000
	(Constant)	31.3			
	HFIAS	0.72	0.16	79.4	0.00

Predictors: (Constant), Weight (Kg), FES (%), Height (Cm)