

The association of food insecurity with diabetes control and self-care in diabetes type 2 patients: A cross-sectional study

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Research

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Abstract

Background

Food insecurity can increase risks of health and nutritional problems, leading to difficulties in self-care and poor glycemic control in diabetic patients. This study assessed food insecurity and its association with diabetes control and self-care in type 2 diabetes patients.

Methods

In this cross sectional study, 148 adults with type 2 diabetes participated. Food insecurity and self-care were determined using the 18-item USDA household food security status questionnaire and self-care (SDSCA) questionnaire. Data were analyzed using logistic and linear regression tests (SPSS 20 software).

Results

Thirty-seven percent of the participants were food-insecure and significantly more likely than food-secure participants to have poor glycemic control ($OR = 3.02$; $CI: 1.45–2.65$). No significant association was found between food-insecurity and overall self-care score.

Conclusion

Food-insecurity was directly associated with poor glycemic control in type 2 diabetes patients. Since economic status was significantly better in the food-secure group, it can be postulated that financial problems will eventually lead to poor glycemic control. Policy strategies to increase access to diabetes-appropriate foods may reduce socioeconomic inequalities in glycemic control.

Introduction

Food insecurity is defined as "limited or unreliable access to adequate and healthy food in terms of nutritional value or limited ability to access acceptable foods in appropriate social ways" (1–3). According to studies in various countries, the percentage of food insecurity in the United States is 14.7%, Canada 10%, Malaysia 50%, Indonesia 11%, the Philippines 35%, Bolivia 70%, Burkina Faso 73%, Finland 5.7%, and Pakistan 43% (3–9). In Iran, an insecurity study based on household costs showed that 20 percent of the population did not have economic access to abdominal satiety, and about 50 percent had problems in meeting their cellular satiety (10).

Limited financial resources among insecure families leads to the purchase of cheaper, higher-calorie foods that are associated with weight gain and susceptibility to chronic diseases, including type 2

diabetes (11–13). The chronic and costly nature of diabetes imposes a heavy financial burden on society, with the cost of health care for a diabetic being about 4.6 times that of a non-diabetic (14). ADA announced in 2003 that after 2000, 1 in 3 Americans would develop diabetes during their lifetime. According to estimates by the World Health Organization (WHO), the prevalence of diabetes in Iran between 1995 and 2000 was about 5.5 to 5.7 percent; reaching 6.8 percent by 2025 (15).

People with food insecurity are at risk for diets that are less varied and of lower quality, insufficient intake of micronutrients, iron deficiency anemia, and low consumption of fruits and vegetables (16–20). Food insecurity also interferes with self-care advice for diabetes (21). Researchers have always reported a relationship between food insecurity and low self-esteem with diabetes control (21–24). Also, diabetic patients with food insecurity have higher HbA1c levels than those with food security (24–28). On the other hand, diabetics with food insecurity are also at risk for hypoglycemia (26).

In a study, it was shown that food insecurity was associated with poor glycemic control and had no significant relationship with self-care behaviors (29). In Iran, the relationship between food insecurity and diabetes has also been studied. In a study in Tehran, there was no significant relationship between food insecurity and blood sugar and lipid profile (30). In another study in newly diagnosed diabetic patients, as well as in a case-control study, a significant and direct relationship between food insecurity and diabetes control was observed (31, 32).

Given the limited studies in Iran and considering the relatively widespread prevalence of food insecurity (26, 33) and the growing prevalence of type 2 diabetes in Iranian society (34), the present study aimed to investigate the status of food insecurity and its association with diabetes control and self-care in patients with type 2 diabetes.

Methods

Study population

This was a cross-sectional study on 148 type 2 diabetic patients between 30 and 65 years old, who had a medical record at Eghlid county Health Center and whose HbA1c level were recorded during the last two weeks. Eghlid is a county in Fars Province in Southwest Iran. Patients were excluded if they any specific diseases (cardiovascular disease and stroke, cancer, acute kidney disease) were present, as well as pregnant and lactating women.

In the period of May to September of 2018, eligible patients were enrolled and the study procedure was explained for them on the phone. They were invited to three community health centers in Eghlid County to complete the questionnaires. Written consent was obtained and demographic questionnaire, food security questionnaire and self-care questionnaire were completed by patients with the supervision of nutritionists. The most recent HbA1c and fasting blood sugar (FBS) abstracted from the medical record and $HbA1c \geq 8.5\%$ was classified as undesirable glycemic control. Weight and height were measured and BMI was calculated.

Questionnaires

A demographic questionnaire was used to collect general demographic information, including age, sex, ethnicity, education, and employment status. Household economic status was determined using a questionnaire including 9-item home appliances and was classified owning less than 3-item as poor economic level, 4 to 6-item as moderate economic level, and more than 7-item as wealthy economic level.

The 18-item USDA household food security questionnaire was used to assess food security over the past 12 months (35). This questionnaire has been validated during previous studies in Iran (36). Rating of 18-item USDA household food security status questionnaire was a below: positive rate to answers "often true", "sometimes true", "almost every month", "some months", and "yes" and zero score to responses "not true", "does not know or refused", "only 1 or 2 months", and "no". Finally, scores 0–2 were categorized as food secure, scores 3–7 as food insecure without hunger, scores 8–12 as food insecure with moderate hunger, and scores 13 and higher as food insecure with severe hunger.

Collecting self-care behaviors was assessed using the Summary of Diabetes Self Care Activities (SDSCA) with 14 questions that assesses patients' self-care quality in the last seven days (37). Questions include diet: 5 questions, exercise: 2 questions, blood sugar control: 2 questions, foot care: 5 questions, and regular medications: 1 question. To score the questionnaire, for each question of self-care behaviors, one point was considered per day if it was done and zero points were considered if it was not done. The highest score in this tool is 98, which indicates the highest quality of self-management. The validity and reliability of this questionnaire have been studied by Anbari et al (38).

Weight was measured using a Seca scale with an accuracy of 100 g with minimal coverage and no shoes, and height was measured by a tape without shoes with an accuracy of 0.1 cm by a nutritionist. BMI was calculated by dividing weight (in kilograms) by height squared (in square meters).

Statistical analyses

All analyzes were performed using SPSS version 20 and the significance level was considered to be 0.05. The relationship of food quality and self-care with food security was tested by linear regression analysis. Logistic regression was used to investigate the association between glycemic control and food security with a 95% confidence interval.

Results

Of the 155 eligible patients, 148 subjects completed the interviews. Findings of the food insecurity prevalence in diabetic participants are given in **Table 1**. According to this table, 63% of households had food security, 23.9% had food insecurity without hunger, 10.2% had insecurity with moderate hunger, and 2.9% had insecurity with severe hunger. The majority of patients with good control had food security (72.8%) and the majority of patients with poor diabetes control had some degrees of food insecurity (53.8%).

Table 1. Food security among at type 2 diabetes patients according to glycemic control status

Table 2 shows the characteristics of participants according to food security status. According to the table, there was a significant relationship between food security and marital status, so that the percentage of married people was higher in the food secure group than in insecure group. There was also a significant association between food security and economic status, education, HbA1c, and body mass index, with a higher percentage of poor, sub-diploma, patients with uncontrolled diabetes ($HbA1c \geq 8.5\%$) and overweight and obese patients in the food insecure group compared with the secure group. Weight, body mass index, fasting blood sugar and HbA1c were also significantly higher in the food insecure group than in the secure group.

Table 2- patients' characteristics according to food security status

Table 3 shows the mean values of self-care subscales in food secure and food insecure groups. Following a healthy diet and doing regular physical activity was significantly higher in the food secure group than in the food insecure group. However, the overall self-care score was not significantly different between the two groups.

Table 4 shows the relationship between poor glycemic control ($HbA1c \geq 8.5\%$) and food insecurity using logistics regression tests. With increasing degrees of food insecurity, the probability of poor glycemic control increased. In the crude model, poor glycemic control had a significant direct association with moderate and severe insecurity (OR: 1.15; CI: 0.74-1.35 and OR: 2.30; CI: 0.62–2.63; respectively). However, after adjustment for confounders, only the association between severe insecurity and poor glycemic control remained significant (OR: 3.02; CI: 1.45-2.65).

Table 5 shows the relationship between self-care and food insecurity with HbA1c using linear regression. After adjustment for confounders, it was observed that self-care has a significant inverse relationship with HbA1c levels ($P= 0.016$) and food insecurity had a direct relationship with HbA1c levels ($P= 0.009$). That is HbA1c decrease by 0.68 units given a unit increment in self-care score, and increased by 0.41 units given a unit increment in self-care score.

Discussion

In this sample of Iranian adults with type 2 diabetes, 37% of patients were food-insecure. The majority of patients with well-controlled diabetes were food-secure and the majority of patients with poor glycemic control had some degrees of food insecurity. On the other hand, there was a significant association between food insecurity and glycemic control. As food insecurity increased, the likelihood of poor glycemic control increased. This association with sever insecurity remained significant after adjustment for confounding factors. In this study, although food security was not significantly associated with overall self-care scores, “following a healthy diet” and “doing regular physical activity” behaviors were significantly higher in the food secure group than in the food insecure group. There was also a significant

inverse association between self-care and HbA1c, as well as a positive association between food insecurity and HbA1c.

Findings on the prevalence of food insecurity in diabetic patients referred to Eghlid health center showed that 37% of households had food insecurity. In a cross-sectional study in Shiraz on 135 newly diagnosed diabetic patients, the prevalence of food insecurity was 66.7% (32). In a study in Canada, the relationship between food insecurity and diabetes was examined and the results showed that food insecurity was more prevalent among diabetics than non-diabetics (9.3% vs. 6.8%) (39). A study by Mohammad Aria et al. showed that the prevalence of food insecurity was 85.3% in diabetics and 67.1% in non-diabetics (31). It seems that the reason for the difference in the prevalence of food insecurity in different studies is due to differences in the population in terms of geographical, socio-economic and cultural conditions as well as food habits.

With increasing food insecurity, the probability of poor glycemic control increased. Other studies in this field have also reported a significant association between food insecurity and decreased glycemic control (40–43). Adults with food insecurity provide most of their diet through high-calorie and low-nutrient foods, which diabetic patients are recommended to avoid, such as refined carbohydrates, added sugar and fat. These foods are cheaper than balanced calorie foods such as fruits, vegetables, and dairy products (44, 45). People with food insecurity are at risk of diets with less variety, lower quality, lack of micronutrients, and low intake of fruits and vegetables, which can lead to poor glycemic control in diabetics.

In self-care scales, following a healthy diet and doing regular exercise was significantly higher among food secure group than food insecure group, but the overall self-care score was not significantly different between the groups. In some studies, there was no association between food insecurity and diabetes self-care (29, 46). While in some other studies, there was a significant relationship between food insecurity and lack of self-care behaviors (22, 27, 47).

In the present study, self-care was inversely related to HbA1c and food insecurity was directly associated with HbA1c. Similar results were found in some other studies (48). Improving self-care behaviors is the first step in helping patients better control their disease. It also emphasizes the design and strengthening of interventions related to self-care behaviors and helps caregivers to better control the patient and reduces the associated complications.

One of the weaknesses of this study is the cross-sectional design of the present study, so we will not be able to interpret the results of this study in the form of a causal relationship. The use of self-administered questionnaires is another weakness of this study, and therefore the actual behaviors of patients may not be reported. In this study, we could control for important confounders. Also, using the USDA food security questionnaire, which is one of the best options for measuring household food security, is another strength of this study.

Conclusion

Results of the present study showed that food-insecurity has a direct association with poor glycemic control in type 2 diabetes patients. On the other hand, food-secure group had higher scores of following healthy diet and physical activity. Since economic status was significantly better in the food-secure group, it can be postulated that financial problems will eventually lead to non-compliance with the recommendations and therefore poor glycemic control. Policy strategies to increase access to diabetes-appropriate foods may reduce socioeconomic inequalities in glycemic control.

Abbreviations

ADA

American Dietetic Association

WHO

World Health Organization

USDA

United States Department of Agriculture

FBS

fasting blood sugar

BMI

Body Mass Index

HbA1C

Hemoglobin A1C

Declarations

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

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Contributions

MM and AA-J designed and conceived the research. MM recruited participants and collected data. AD analyzed the data and interpreted the results. MM, AA-J and AD drafted the manuscript. All authors read and approved the final manuscript.

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Tables

Table 1. Food security among at type 2 diabetes patients according to glycemic control status

*p	glycemic control status			Food security status
	Total	HbA ₁ C≥8.5%	HbA ₁ C<8.5%	
	(Poor glycemic control)	(glycemic control)		
0.010	92 (63)	25 (46.2)	67 (72.8)	Secure
	35 (23.9)	20 (37)	15 (16.3)	Insecure without starvation
	15 (10.2)	7 (12.9)	8 (8.6)	Insecure whit moderate starvation
	4 (2.9)	2 (3.9)	2 (2.3)	Insecure whit severe starvation

* Chi-square test

Table 2- patients' characteristics according to food security status

P*	Food security status			Characteristics
	Total	Food insecurity	Food security	
0.223	45.82±9.9	43±9	47±10	Age, mean±SD
				Sex, n (%)
0.517	70 (47.9)	24 (44.4)	46 (50)	Male
	76 (52.1)	30 (55.6)	46 950)	Female
				Race, n (%)
0.211	125 (85.6)	48 (88.8)	77 (83.7)	Fars
	21 (14.4)	6 (11.2)	15 (16.3)	Turkish and lorish
				Education, n (%)
0.040	61(41.7)	29 (53.8)	32 (34.7)	<High school
	85 (58.3)	25 (46.2)	60 (65.3)	>High school
				Economic status n (%)
	42 (28.8)	26 (48.2)	16 (17.4)	Poor
0.000	70 (47.9)	22 (40.7)	48 (52.2)	Moderate
	34 (23.3)	(1/11) 6	(4/30) 28	wealthy
				Marital status, n (%)
0.048	127 (87)	42 (77.8)	85 (92.4)	Married
	19 (13)	12 (22.2)	7 (7.6)	Single, divorced, widow
				Employment status, n (%)
0.180	70 (47.9)	25 (46.3)	45 (48.9)	Employed
	76 (52.1)	29 (53.7)	47(51.1)	Unemployed
				Home ownership, n (%)
0.634	102 (69.9)	39 (72.2)	63 (68.5)	Personal
	44 (30.1)	54 (27.8)	29 (31.5)	Rental
0.000	74 (52-119)	82.5 (63-108)	70/50 (66-86)	Weight, mean±SD
0.089	166.69±10.3	171.72±10.5	163.74±9.17	Height, mean±SD
				BMI status, n (%)
	8 (5.5)	2 (3.9)	6 (6.5)	Underweight

0.030	52 (35.6)	6 (11)	46 (50)	Normal weight
	61 (41.8)	27 (50)	34 (37)	Overweight
	25 (17.1)	19 (35.1)	6 (6.5)	Obese
0.199	17.32±97.85	17.32±96.82	16.69±99.31	Waist circumference, mean±SD
0.010	179 (126-321)	198.5 (127-325)	168 (128-282)	FBS, mean±SD
				Glycemic control, n (%)
0.020	91 (62.3)	23 (42.6)	68 (73.9)	HbA ₁ C<8.5%
	55 (37.7)	31 (57.4)	24 (26.1)	HbA ₁ C≥8.5%

*Chi-square test

Table 3 .Association between food insecurity and diabetes self-care

SD± Mean				
P*	Total	Food insecurity	Food security	Characteristics
0.027	13.9±4.4	11.8±5.2	15.2±3.6	Follow a healthy diet
0.365	3.3±3.2	4.1±2.4	2.9±3.5	Blood sugar monitoring
0.073	5.07±2.6	5.51±2.1	5.89±1.35	Medication adherence
0.040	5.02±3.5	4.82±3.9	5.9±4.6	Exercise
0.106	6.1±3.8	5.9±4.1	6.1±4.3	Foot care
0.681	34.5±16.5	30.43±13.6	36.58±11.7	Total score

* Independent sample t test

Table 4. Association between food insecurity and poor glycemic control at type 2 diabetes patients

Fully adjusted *			Unadjusted			Characteristics
P	OR	95%CI	P	OR	95%CI	
0.237	1	0.428-0.762	0.069	1	0.241-0.352	Food security (Reference)
0.098	0.619	1.037-1.117	0.149	1.004	0.562-1.021	Mild Food insecurity
0.112	2.09	1.241-1.374	0.043	1.150	0.741-1.352	Moderate Food insecurity
0.009	3.02	1.453-2.659	0.001	2.309	0.620-2.630	Severe Food insecurity

Logistic regression

* age, BMI, Marital status, Economic status

Table 5. Association of food insecurity and diabetes self-care with HbA₁c

P-value*	95%CI	Beta	
0.016	0.97-1.47	0.684	Self-care score
0.009	0.81-1.56	0.41	Food insecurity

* Linear regression