

Association between Depression and Food Insecurity in Patients with Diabetes: a cross-sectional study

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Abstract

Background: We sought to determine whether there is a linear trend between different levels of depression and different food security/insecurity situations in patients with diabetes mellitus.

Methods: Two hundred women with diabetes mellitus referred to the diabetic clinic of Shaheed Bahonar, Kerman/ Iran and aged 35-75 years were enrolled randomly in a descriptive-analytic cross-sectional study. The patients completed Beck Depression Inventory-II (BDI-II) and Food Security Questionnaire (HFQ). Pearson's Chi-Square test was carried out to assess whether depressive disorders and household food security/insecurity were related.

Results: There was a significant association between the four-level variable of depressive disorders and the four-level variable of food security/insecurity ($X^2 \geq 29.545$, $p=0.001$). There was a significant association between the two-level variable of depressive disorders and the four-level variable of food security/insecurity ($X^2 \geq 9.878$, $p=0.020$). There was also a significant association between the two-level variable of depressive disorders (normal and depressive diabetic patients) and the two-level variable of food security/insecurity (food secure and insecure diabetic patients) ($X^2 \geq 6.073$, $p=0.014$). About half (47%) of the patients with mild to extreme depression had mild to severe food insecurity. However, two-thirds of the patients in the normal situation were food secure ($p=0.014$).

Conclusion: We found enough evidence to suggest a significant association between household food security/insecurity and depressive disorders. The value of the linear by linear association test for trend was shown to be significant and indicated that household food insecurity tends to rise with values of depressive disorders. Therefore, the more severe the depression, the greater the food insecurity.

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Introduction

Food insecurity is described as the lack of access to adequate, safe, and nutritious foods necessary for an active and healthy life (1). More than 852 million people in the world,

mostly in the developing countries, were suffering from food insecurity. Food insecurity is regarded as a serious public health problem and is associated with chronic health conditions, like diabetes mellitus (DM) disease (2, 3). According to the studies,

the prevalence of food insecurity (4-6) and DM (7-9) in Iranian population are rising up. The prevalence of DM in Iranian adults is estimated at about 8.9% (4). Having an insufficient budget in food-insecure individuals leads to purchase of cheaper and high dense calorie foods which might contribute to obesity, and are linked to the development of chronic illnesses including depression, type 2 DM, and other medical problems (10).

In diabetic patients, food insecurity is affected by poor diabetes management such as poor glycemic control as well as poor dietary and medication adherence (11). In the Seligman et al. study, the prevalence of DM was 10% in individuals with mild food insecurity and 16% in those with severe food insecurity (12). In diabetic patients with food insecurity, feeling powerless over their nutrition and self-caring of their disease can induce feelings of worry and distress and finally depression (12). On the other hand, depressed people may be less able to plan, work, shop and cook for their families (13). Thus, there is a bidirectional cause and can influence the relationship between depression and food insecurity. Depression with a mean prevalence of 3.8%, has been considered at the top of mental disorders in Iran (14).

In previous studies, the association between depression and food security/insecurity has been assessed (15-17), but similar studies in diabetic patients are limited. Thus, this study aimed to find out whether there is a linear trend between different levels of depression and different food security/insecurity situations in patients with DM referred to a diabetic clinic in random time and situation.

Materials and Methods

Two hundred women with DM and the age range of 35-75 years referred to the diabetes clinic of Shaheed Bahonar hospital, Kerman, Iran were randomly enrolled in a descriptive-

analytic cross-sectional study. The selection of patients with DM in the diabetes clinic was based on random times and situations. The researchers enrolled patients at random times between 8-12 am and random locations and circumstances of the clinic. After randomization and before admission, each participant completed a written informed consent. The patients completed Beck Depression Inventory-II (BDI-II) and Food Security Questionnaire through face-to-face interviews.

The criteria for eligibility were fasting blood sugar of more than 126 mg/dl, the disease duration of at least 1 year, consumption of glucose-lowering agents, insulin injection, or both therapies, and diabetes onset age of ≥ 35 years. Patients with metabolic syndrome, suffering from a combination of two metabolic diseases, and severe metabolic failure were excluded.

Food security assessment

The researchers assessed household food insecurity by a 9-item Household Food Insecurity Access Scale (HFIAS). The validity and reliability of the questionnaire had been previously measured (18). The HFIAS had good internal consistency (Cronbach's $\alpha = 0.95$). The questionnaires were completed through face-to-face interviews.

Based on the obtained score, patients were divided into the 4 groups of "Food secure" (score: 0-1), "Mild food insecure" (score: 2-7), "Moderate food insecure" (score: 8-14) and "Severe food insecure" (score: 15-27). Answers were scored as follow (19):

Has never happened or No: 0, has happened once or twice or rarely: 1, has happened 3 to 10 times, or sometimes: 2 and has happened more than 10 times or quite often: 3.

Depression Assessment

BDI-II consisted of 21 items for recognizing depressive perceptions in diabetic patients. Every item had a 0–3 score range. Zero indicated the lack of depressive symptom and score three indicated the severity of depressive symptom for each item. The total score of BDI-II varies between 0–63 and is categorized as follow (19):

Scores 0–10: normal, scores 11–20: mild mood disturbance and borderline clinical depression, scores 21–30: moderate depression and scores 31–63: severe and extreme depression.

The BDI-II-Persian (the translated version) has obtained high internal consistency (Cronbach's $\alpha=0.87$) and acceptable test-retest reliability ($r=0.74$) in a previous study (20).

Statistical Analysis

The sample size was determined through using data indicating that a minimum of 170 patients would be required to identify significant differences and relationships (21). Statistical analysis was performed using SPSS 21 software (IBM Corp. Released 2012. IBM SPSS Statistics for Windows, Version 21.0. Armonk, NY: IBM Corp.). We applied One-way ANOVA to determine significant differences in the mean age and mean duration of diabetes diagnosis among food-secure/insecure groups as well as depressive disorder groups. Chi-Square test was used to determine the relationship between different categories of food security/insecurity and the different levels of depressive disorders. We applied Chi-Square test to determine the relationship between the frequency distribution of the anti-diabetic medications of patients in the studied groups and also for trend tests whether there is a linear trend between

different categories of food security/insecurity and the different levels of depressive disorders. Significance was assumed at $P < 0.05$.

Results

The mean (\pm SD) age of patients was 57.46 ± 7.41 years. The mean (\pm SD) duration of DM diagnosis was 11.17 ± 7.81 years. Fifty-two percent of patients consumed glucose-lowering agents, about 18% received insulin injection and 30% of patients received both therapies.

The prevalence rates of mild, moderate, and severe household food insecurity in patients with DM were 19.5%, 15.0%, and 6.5%, respectively. Fifty-nine percent of patients were household food secure. The prevalence of mild mood disturbance and borderline clinical depression was 41.5%. The prevalence of moderate depression was 21.5% and that of severe and extreme depression was 4.0%. Thirty-three percent of patients with DM were normal. The relationship between different categories of food security/insecurity and the different levels of depressive disorders is shown in tables 1- 3.

Table 1 shows the relationship between the four-level variable of depressive disorders with the four-level variable of food security/insecurity. Pearson's Chi-Square test was carried out to assess whether depressive disorders and household food security/insecurity were related. There was a significant association ($X^2 \geq 29.545$, $p=0.001$). The linear by linear association test is a test for trends. Its value is shown to be significant and indicates that household food insecurity trends to rise with values of depressive disorders ($r=15.717$, $p=0.0001$).

Table 1. Absolute and Relative Frequency Distribution of Patients with Diabetes in Food Secure/Insecure Groups Based on Groups with Different Levels of Depressive Disorders

Depressive Disorder Groups*	Food Secure	Mild Food Insecure	Moderate Food Insecure	Severe Food Insecure	Total	P. value [†]
Group 1	47 (71.2%)	13 (19.7%)	5 (7.6%)	1 (1.5%)	66 (100.0)	0.001
Group 2	46 (55.4%)	20 (24.1%)	14 (16.9%)	3 (3.6%)	83 (100.0)	
Group 3	21 (48.8%)	6 (14.0%)	10 (23.2%)	6 (14.0%)	43 (100.0)	
Group 4	4 (50.0%)	0 (33.3%)	1 (12.5%)	3 (37.5%)	8 (100.0)	
Total	118 (59.0%)	39 (19.5%)	30 (15.0%)	13 (6.5%)	200 (100.0)	

* Group 1: Normal; Group 2: Mild Mood Disturbance & Borderline Clinical Depression; Group 3: Moderate Depression; Group 4: Severe and Extreme Depression

[†] Pearson Chi-Square as Asymp. Sig. (2-sided).

Table 2 shows the relationship between the two-level variable of depressive disorders with the four-level variable of food security/insecurity. Pearson's Chi-Square test was also carried out to assess whether depressive disorders and household food security/insecurity were related. There was a

significant association ($X^2 \geq 9.878, p=0.020$). The value of the linear by linear association test for trend is shown to be significant and indicates that household food insecurity trends to rise with values of depressive disorders ($r=9.505, p=0.002$).

Table 2. Absolute and Relative Frequency Distribution of Patients with Diabetes in Food Secure/Insecure Groups Based on Two Groups of Normal and Different Levels of Depressive Disorders

Depressive Disorder Groups*	Food Secure	Mild Food Insecure	Moderate Food Insecure	Severe Food Insecure	Total	P. value [†]
Group 1	47 (71.2%)	13 (19.7%)	5 (7.6%)	1 (1.5%)	66 (100.0)	0.020
Group 2	71 (53.0%)	26 (19.4%)	25 (18.7%)	12 (9.0%)	134 (100.0)	
Total	118 (59.0%)	39 (19.5%)	30 (15.0%)	13 (6.5%)	200 (100.0)	

* Group 1: Normal; Group 2: Integrating Patients with Mild Mood Disturbance & Borderline Clinical Depression, Patients with Moderate Depression and Severe and Extreme Depression

[†] Pearson Chi-Square as Asymp. Sig. (2-sided)

Table 3 shows the relationship between the two-level variable of depressive disorders (normal and depressive diabetic patients) with the two-level variable of food security/insecurity (food secure and insecure diabetic patients). Pearson's Chi-Square test was also carried out to assess whether

the association between depressive disorders and household food security/insecurity was related. There was a significant association ($X^2 \geq 6.073, p=0.014$). The value of the linear by linear association test for trend was shown to be significant and indicated that household food insecurity trends to rise with

values of depressive disorders ($r=6.043$, $p=0.014$). About half (47%) of patients with mild to extreme depression were mild to

severe food insecure. However, two-thirds of patients with the normal situation were food secure (Table 3).

Table 3. Absolute and Relative Frequency Distribution of Patients with Diabetes in Food Secure/Insecure Groups Based on Two Groups of Normal and Different Levels of Depressive Disorders

Depressive Disorder Groups*	Food Secure	Mild, Moderate & Severe	Total	P. value [†]
		Food Insecure		
Group 1	47 (71.2%)	19 (28.8%)	66 (100.0)	0.014
Group 2	71 (53.0%)	63 (47.0%)	134 (100.0)	
Total	118 (59.0%)	82 (41.0%)	200 (100.0)	

* Group 1: Normal; Group 2: Integrating Patients with Mild Mood Disturbance & Borderline Clinical Depression, Patients with Moderate Depression and Severe and Extreme Depression

[†] Pearson Chi-Square as Asymp. Sig. (2-sided)

Table 4 shows the mean (\pm SD) of the age and duration of diabetes diagnosis of patients with diabetes among food-secure/insecure groups as well as depressive disorder groups. One-way ANOVA analysis showed a significant difference in the duration of diabetes diagnosis of patients with diabetes

among food-secure/insecure groups ($p=0.009$). Based on Post Hoc tests (Tukey HSD procedure), duration of diabetes diagnosis of patients with diabetes showed significant difference between food secure and mild food insecure groups ($p=0.01$).

Table 4. Comparison§ of the Age and Duration of Diabetes Diagnosis of Patients with Type 2 Diabetes among Food Secure/Insecure Groups as well as Depressive Disorder Groups

Food Secure/ Insecure Groups	Food Secure	Mild Food Insecure	Moderate Food Insecure	Severe Food Insecure	Total	Sig. [¶]
Age of Patients	58.20 \pm 6.95	57.03 \pm 7.77	56.14 \pm 8.16	54.75 \pm 8.44	57.46 \pm 7.41	0.289
Duration of Diabetes Diagnosis	12.56 \pm 8.19	7.31 \pm 5.93	9.08 \pm 6.06	11.18 \pm 8.12	11.17 \pm 7.81	0.009 #
Depressive Disorder Groups*	Group 1	Group 2	Group 3	Group 4	Total	Sig. [¶]
Age of Patients	57.56 \pm 7.90	57.52 \pm 6.58	57.40 \pm 7.85	56.14 \pm 10.16	57.46 \pm 7.41	0.971
Duration of Diabetes Diagnosis	10.60 \pm 7.29	11.48 \pm 8.12	10.73 \pm 7.56	14.86 \pm 10.37	11.17 \pm 7.81	0.561

§ One-way ANOVA analyzed the differences (Mean \pm SD) between the age and duration of diabetes diagnosis of patients with type 2 diabetes among the studied groups.

* Group 1: Normal; Group 2: Mild Mood Disturbance & Borderline Clinical Depression; Group 3: Moderate Depression; Group 4: Severe and Extreme Depression

[¶] P value related to the difference among the four studied groups.

Post Hoc Test (Tukey HSD) analyzed the difference of duration of diabetes diagnosis of patients with type 2 diabetes between food secure and mild food insecure groups.

Table 5 shows the absolute and relative frequency distribution of the anti-diabetic medications of patients with diabetes among food-secure/insecure groups as well as depressive disorder groups. Generally, two-fifth of patients (41

patients) in the normal situation received oral hypoglycemic agents. However, higher than half of the patients (58.6%) were food secure that received oral hypoglycemic agents.

Table 5. Comparison§ of the Anti-diabetic Medications of Patients with Type 2 Diabetes among Food Secure/Insecure Groups as well as Depressive Disorder Groups

Food Secure/ Insecure Groups	Food Secure	Mild Food Insecure	Moderate Food Insecure	Severe Food Insecure	Total	Sig. ¶
Oral Hypoglycemic Agents ‡	61 (%58.6)	21 (%20.2)	17 (%16.4)	5 (%4.8)	104 (%100)	
Insulin	28 (%75.7)	4 (%10.8)	4 (%10.8)	1 (%2.7)	37 (%100)	0.220
Oral Hypoglycemic Agents + Insulin	38 (%64.4)	6 (%10.1)	8 (%13.6)	7 (%11.9)	59 (%100)	
Depressive Disorder Groups *	Group 1	Group 2	Group 3	Group 4	Total	Sig. ¶
Oral hypoglycemic Agents	41 (%39.4)	38 (%36.5)	21 (%20.2)	4 (%3.9)	104 (%100)	
Insulin	5 (%13.6)	17 (%45.9)	13 (%35.1)	2 (%5.4)	37 (%100)	0.150
Oral hypoglycemic Agents + Insulin	16 (%27.1)	27 (%45.8)	14 (%23.7)	2 (%3.4)	59 (%100)	

§ Chi-Square analyzed the differences (absolute and relative frequency distribution) between the anti-diabetic medications of patients with type 2 diabetes in studied groups.

‡ Patients received Oral Hypoglycemic Agents including glibenclamide, metformin, and pioglitazone alone or a combination of them.

* Group 1: Normal; Group 2: Mild Mood Disturbance & Borderline Clinical Depression; Group 3: Moderate Depression; Group 4: Severe and Extreme Depression

¶ Pearson Chi-Square as Asymp. Sig. (2-sided)

Discussion

According to our findings, the prevalence of food insecurity in diabetic patients was 41%. Also, the prevalence of mild-to-severe depression in the participants was 67%.

In the study of Montgomery et al., 33.3% of individuals with DM had food insecurity (13). Results of two studies in Iran showed a high prevalence of food insecurity (22-24). In the study of Payab and colleagues, the prevalence rates of food insecurity and depression were 50.2% and 51.4%, respectively (25). In another previous study, 68.3% of diabetic patients were located in an insecure food group (26). In another study

conducted on patients with diabetes in Iran, the prevalence rates of food insecurity and depression were 66.7% and 43.7%, respectively (4). The prevalence rates of depression in patients with DM have been 78% (27), 53% (4), and 64% (28) in the conducted studies in Iran. The finding of studies have shown that the odds of depression were twice in patients with DM compared with participants without DM (29). A meta-analysis of 16 studies that examined the risk of depression in those with diabetes showed that both relative risk (RR) and hazard ratio (HR) were significant at 1.27 and 1.23, respectively (30). Changes in the brain (structural, functional, and neurochemical) may increase the risk of depression in people with DM

(31). Hyperglycemia may lead to low mood by reducing hippocampal integrity, neurogenesis, and neuroplasticity resulting in hippocampal atrophy (32)

In our study, there was a significant association between food insecurity and depression. A large body of evidence has suggested that food insecurity is significantly associated with depression, especially in diabetes (13). Our findings are consistent with prior reports that have shown a direct association between food insecurity and psychological distress in the general population (33, 34) and among adults with poorly controlled diabetes (35). Also, Silverman and colleagues have reported a positive significant association between food insecurity and depression in people with DM and prediabetes (36). Parallel to our finding, in another study, a significant positive relationship between food insecurity and depression has been reported (25).

Diet may play an important role in the relationship between food insecurity and depression. Consumption of high-fat, poor nutrients, and high-caloric foods is greater in people with food insecurity (37). These foods are high in trans fatty acids and sugar that elevate the risk of depression (38, 39). Concerns about lack of access to enough food and safe food increase the mental burden and subsequently increase the risk of depression. Our results indicated that household food insecurity trends to rise with scores of depressive disorders. There is a bilateral relationship between food insecurity and depression and DM (34, 36). Food habits, controlling blood sugar, and self-management in depressed peoples are usually different from the others (40). Depression increases the risk of food insecurity and DM.

The number of patients in the normal situation that received insulin and insulin plus oral hypoglycemic agents was lower than the number of patients with food security that received

these medications. We concluded that the effect of household food insecurity in patients receiving insulin and insulin plus oral hypoglycemic agents may influence a greater probability for the incidence of depressive disorders.

However, based on the design of our study, we did not have any special limitations in our research. However, in future studies, the researchers can enroll more patients with diabetes mellitus for face to face interview approach.

Conclusion

We found enough evidence to suggest a significant association between household food security/insecurity and depressive disorders. The value of the linear by linear association test for trend was shown to be significant and indicated that household food insecurity trends to rise with values of depressive disorders. Therefore, the more severe the depression, the greater the food insecurity. About half of the patients with mild to extreme depression were mild to severe food insecure. However, two-thirds of the patients in the normal situation were food secure.

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Conflict of Interest

There is no potential conflict of interest relevant to this article.

Consent for publication and Ethical approval

The review panels and ethics committees of Deputy of Research, Kerman University of Medical Sciences approved the protocol (Approval ID: IR.KMU.REC.1398.537). The

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