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Original Article

Association between depression with glycemic control and its complications in type 2 diabetes

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ABSTRACT

Aims: This study aims to determine the association between depression with glycemic control (HbA1c) and its complications.
Materials and methods: This was a cross-sectional study that included 514 diabetic patients. The patients were randomly selected from among all type 2 diabetes patients referred to health and medical centers in Khorramabad town (Iran). Two questionnaires used for data collection. The first questionnaire included demographic information, diabetes and its complications and the second questionnaire was Beck Depression Inventory (BDI-II) which was used to assess depression. The stata software version 14 was used for data analysis. Then, for evaluate the association between depression with glycemic contol and its complications, Univariate and multiple logistic regression analysis were employed.
Results: The prevalence of depression in diabetic patients under study was 46.3% and for female and male was 49.6 and 36.8%; respectively. The results showed that 48.6% of diabetic patients did not have appropriate glycemic control status (HbA1c > 8). There was no significant association between glycemic control expressed as HbA1c levels and depression (OR: 1.11, 95% CI: 0.87–1.57). By contrast, sex (OR: 2.03, CI 95%: 1.03–3.99), residence (OR: 1.92, 95% CI: 1.28–2.91) and sexual complications (OR: 5.54, 95% CI: 1.07–27.87) have a significant statistical association with depression.
Conclusion: The study highlights the high prevalence of depression in diabetic patients. However, there was no significant association between depression and glycemic control. The implementation of mental health screening for rapid diagnosis and timely treatment of depression seems essential in diabetic patients.

1. Introduction

Diabetes is the most common metabolic disease in the world which characterized by hyperglycemia with disturbances of carbohydrate, protein, and fat metabolism [1]. The global prevalence of diabetes has almost doubled in adults over the past two decades, so that from 4.7% in 1980 to 8.5% in 2014 has reached. It is estimated the number of diabetic patients will reach over 336 million in 2030, which is more than double the number in 2000. In 2015, it is estimated that 1.6 million deaths occurred directly from diabetes [2–5]. The results of a systematic review and meta-analysis study

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has showed that prevalence of diabetes in Iran is 3.41% so that the highest and the lowest prevalence rates were 18.6% and 1.3%, respectively [6]. Also, studies in this field also show that the prevalence of diabetes over the age of 30 years in Iran is 7.3% and the current cost of diabetes care and disability has exceeded $ 233 million annually [7]. Diabetes is one of the chronic diseases with many complications, these complications can be short-term (such as hypoglycemia) and long-term (such as kidney failure, stroke, blindness and leg amputation) which significantly affects the physical performance, quality of life and work efficiency of the individuals. Also, the risk of premature in diabetic patients is significantly higher and have a shorter life expectancy [8–11].

Today, depression is one of the main causes of disability in the world and in terms of global burden of diseases, has won fourth place. Lifetime prevalence of depression in men and women have been reported 15% and 25%; respectively [12]. On the other hand, this complication (depression) is one of the most common psychiatric disorders in diabetic patients which can have adverse effects on the quality of life of these patients. The various studies have suggested that co-morbidity diabetes and depression are relatively common [13–16]. For example, a meta-analysis study has shown that the prevalence of depression in diabetic patients is twice that of the general population [14]. Systematic reviews studies have also shown that the risk of depression in diabetic patients is significantly higher than non-diabetics [15,16]. Comorbid depression with diabetes can be exacerbate the complications and symptoms in diabetic patients. Previous epidemiological studies emphasize the bidirectional association between the two diseases, so that diabetics compared with non-diabetic suffer 2 times more than the symptoms and complications of diabetes [17,18]. The association between these two diseases is largely due to stress and anxiety and complications of the disease [19]. Also, people with depression are more prone to unhealthy lifestyle and, as a result, diabetes is likely to develop [20]. On the other hands, symptoms of depression can interfere in compliance of medication and self-care regimens (such as appropriate diet and physical activity) by diabetic patients, as a result it may cause increased health care and medical costs, progression of the disease and reduced the patient's quality of life [10,17,21]. Studies have also shown that there is a significant association between depression in diabetics with endothelial diseases, heart disease, erectile dysfunction, obesity, amputation, cognitive decline, and attention deficit and concentration [22–24].

Despite the documented interconnections, there is a meaningful gap in the literature regarding the determination of the association between depression with diabetes and its complications in diabetic patients. Therefore, according to the above explanation and also the importance of type 2 diabetes as a major public health problem and depression as an exacerbating factor for this disease, the present study was designed to determine the prevalence of depression in type 2 diabetes patients and also the association between depression with glycemic control (HbA1c) and its complications in order to provide timely treatment and reduce disease burden.

2. Materials and Methods

This study was a cross-sectional study that aimed to of evaluation the prevalence of depression in type 2 diabetes patients and also the association between depression with glycemic control and its complications was designed. The population under study consisted of 532 diabetic patients who were randomly selected from among all type 2 diabetes patients identified by health and medical centers until 2016 in Khorramabad town (Capital of Lorestan province in Iran). Inclusion criteria consisted of age over 30 years old and a history of at least one year of diabetes.

In this study, two questionnaires were used for data collection. The first questionnaire includes demographic information (such as age, gender, marital status, place of residence, education, occupation, insurance coverage, etc.) and information about diabetes and its complications (such as duration of disease, type of treatment, HbA1c, BMI, daily activity, cardiovascular disease, retinopathy, neuropathy, renal disease, diabetic foot, number com and, etc.). To measure blood glucose in patients, HbA1C that the best indicator for measuring glucose in the last 3 months, was measured. For this purpose, 2 CC of venous blood was taken from each patient, than was poured inside the tub contains anticoagulant and analyzed by chromatographic-spectrophotometric method. In the present study, glycemic control expressed as HbA1c levels.

The second questionnaire that used to measure depression in patients, was Beck Depression Inventory (BDI-II) [25]. The BDI-II has been standardized in Iranian population and its validity and reliability has already been done [26]. The questionnaire consists of 21 questions and each question has 4 answers and a score of 0–3. In each question, scores 0 and 3 indicate the absence of disorder and the most severe disorder, respectively. The minimum and maximum score of the questionnaire is 0 and 63. In BDI-II questionnaire, the Scores 0–13, 14–19, 20–28, and 29–63 indicate minimal, mild, moderate and severe depression respectively. Also, in order to analyze the logistic regression, patients with moderate and severe depression were considered as depressed people. After obtaining informed consent and explaining the research objectives for the participants, data collection was conducted. Than the relevant data were entered into the stata14 for analysis. In descriptive analyzes, mean and standard deviation were used for quantitative variables, and number and relative frequency were used for qualitative variables. Also, for evaluate the association between depression with glycemic control and its complications, Univariate and multiple logistic regression analysis were employed. Finally, the crude and adjusted OR with 95% confidence interval (CI) were calculated. Also P-Value <0.05 was considered as a significant level.

3. Results

In the present study, of the 532 patients selected for study, 514 people participated in the study. The number of women and men were 381 (74.1%) and 133 (25.5%); respectively. The most of the patients were over the age of 50 years. In terms of employment, 79.2% were employed and the rest were unemployed. Also, 85.2% of them were married. The results of this study showed that 26.1% of patients have favorable blood glucose control status (HbA1c < 6.5), however, 48.6% of them did not have appropriate blood glucose control status (HbA1c > 8). The overall prevalence of depression in diabetic patients under study was 46.3% and also its prevalence in women and men were 49.6 and 36.8%; respectively. Table 1 shows the other demographic and clinical characteristic of population under study. Table 2 shows the association between demographic and clinical characteristics with severity of depression in diabetic patients. As it can be seen, only sex, occupation and residence had a significant association with severity of depression (P-Value <0.05).

Table 3 shows the results of Univariate logistic regression model. The Univariate logistic regression model was performed to determine the association between depression with glycemic control and its complications. In order not to ignore any important variables, the first significance level for α error was set at 0.2. The results of this analysis showed that variables of age, number of complications, duration of diabetes, sex, occupation, education level, residence, cardiovascular disease, retinopathy, renal disease, neuropathy, sexual complications have a significant statistical association with depression ($P < 0.2$). For example, the odds of occurrence of depression in diabetic men was 1.69 (CI 95%: 1.12–2.53) times higher than diabetic women (Table 3).

Table 1
Demographic and clinical characteristics of patients under study.

Variable		Number (%)
Sex	Female	381 (74.1)
	Male	133 (25.9)
Age (Year)	<40	62 (12.1)
	40–50	139 (27.0)
	50–60	162 (31.5)
	>60	151 (29.4)
Occupation	Unemployed	407 (79.2)
	Employed	107 (20.8)
Marital Status	Single	76 (14.8)
	Married	438 (85.2)
Education Level (Year)	Illiterate	342 (66.5)
	<5 year	101 (19.7)
	>5 year	71 (13.8)
Residence	Rural	328 (63.8)
	Urban	186 (36.2)
Duration of diabetes	<5	290 (56.4)
	5–10 years	156 (30.4)
	>5	68 (13.2)
HbA1c	>6.5	134 (26.1)
	6.5–8	130 (25.3)
	>8	250 (48.6)
History of Depression	Yes	83 (16.1)
	No	431 (83.9)
Depression in Women	Yes	189 (49.6)
	No	192 (50.4)
Depression in Men	Yes	49 (36.8)
	No	84 (63.2)
General Depression	Yes	238 (46.3)
	No	276 (53.7)

After Univariate logistic regression analysis, in order to eliminate potential confounding variables, we introduced all the significant variables in Univariate logistic regression analysis ($P < 0.2$) simultaneously into a multiple logistic regression model. In the multiple logistic regression model, using the stepwise method (backward stepwise) and after adjusting for the confounding variables, significant statistical association was found between depression with variables of sex, residence and sexual complications (**$P < 0.05$**). Table 4 shows the results of multiple logistic regression model (see Table 4).

4. Discussion

This study was designed with two objectives [1]: to determine the prevalence of depression in type 2 diabetes patients [2] assessment of the association between depression with glycemic control and its complications. The results of our study showed that 26.1% of patients have favorable blood glucose control status (HbA1c < 6.5), however, 48.6% of them did not have appropriate blood glucose control status (HbA1c > 8). The overall prevalence of depression in diabetic patients under study was 46.3% and also its prevalence in women and men were 49.6 and 36.8%; respectively. Also, the results of the multiple logistic regression analysis showed that variables of sex, residence and sexual complications have a significant statistical association with depression ($P < 0.05$).

The results of this study showed that the overall prevalence of depression in diabetic patients under study was 46.3%. In Iran, various studies have been conducted on the prevalence of depression in type 2 diabetic patients which have reported different estimates of depression in these patients [27–31]. A systematic review and Meta – analysis study bay Sayehmiri et al. showed that the prevalence of depression in type 2 diabetic patients in Iran is 54.8% (Cl 95%: 43.5%–66.1%) [32].Generally, the prevalence of depression in diabetic patients depending on geographical region and racial differences is different in the world, for example, this rate in United States and Pakistan was reported 8.3% and 50%; respectively [33,34]. Also, in some other systematic review and Meta – analysis studies, the prevalence of depression was reported 24%–33%. It can be said that prevalence of depression

Table 2
The association between demographic and clinical characteristics with severity of depression in diabetic patients.

Variable	Depression					
	Minimal	Mild	Moderate	Severe	Total	P-Value
Sex						**0.025**
Female	66 (17.32)	126 (33.07)	147 (38.58)	42 (11.02)	381 (100)	
Male	37 (27.82)	47 (35.34)	40 (30.08)	9 (6.77)	133 (100)	
Age (year)						
<40	13 (20.97)	25 (40.32)	18 (29.03)	6 (9.68)	62 (100)	0.508
40–50	29 (20.86)	36 (25.90)	58 (41.73)	16 (11.51)	139 (100)	
50–60	31 (19.14)	54 (33.33)	63 (38.89)	14 (8.64)	162 (100)	
>60	30 (19.87)	58 (38.41)	48 (31.79)	15 (9.93)	151 (100)	
Occupation						
Unemployed	75 (19.43)	135 (33.17)	149 (36.61)	48 (11.79)	407 (100)	**0.022**
Employed	28 (26.17)	38 (35.51)	38 (35.51)	3 (2.80)	107 (100)	
Marital Status						
Single	16 (21.05)	23 (30.26)	24 (31.58)	13 (17.11)	76 (100)	0.135
Married	87 (19.86)	150 (34.25)	163 (37.21)	38 (8.68)	438 (100)	
Education						
Illiterate	71 (20.76)	124 (36.26)	112 (32.75)	35 (10.23)	342 (100)	0.254
<5	16 (15.84)	30 (29.70)	44 (43.56)	11 (10.89)	101 (100)	
>5	16 (22.54)	19 (26.76)	31 (43.66)	5 (7.04)	71 (100)	
Residence						
Rural	77 (23.48)	120 (36.59)	109 (33.23)	22 (6.71)	328 (100)	0.001
Urban	26 (13.98)	53 (28.49)	78 (41.94)	29 (15.59)	186 (100)	
Duration of Diabetes						
<5	56 (19.31)	110 (37.93)	93 (32.07)	31 (10.69)	290 (100)	0.226
5–10	34 (21.79)	43 (27.56)	64 (41.03)	15 (9.62)	156 (100)	
>10	13 (19.12)	20 (29.41)	30 (44.12)	5 (7.35)	68 (100)	
HbA1C						
>6.5	27 (20.15)	49 (36.57)	43 (32.09)	15 (11.19)	134 (100)	0.941
6.5–8	27 (20.77)	42 (32.31)	49 (37.69)	12 (9.23)	130 (100)	
>8	49 (19.60)	82 (32.80)	95 (38.00)	24 (9.60)	250 (100)	

Table 3
The Association Between Depression with Glycemic Control and Its complications by Univariate Logistic Regression Model.

Variable		OR[a]	95% CI[b]	P-Value
Age (Year)		0.97	0.97–1.002	**0.108**
BMI		0.99	0.98–1.01	0.655
HbA1c		1.11	0.78–1.57	0.566
Number of Complications		1.73	1.33–2.24	**0.001**
Duration of Diabetes		1.03	0.99–1.06	**0.109**
Sex	Female	Reference	–	**0.011**
	Male	1.69	1.12–2.53	
Occupation	Employed	Reference	–	**0.064**
	Unemployed	1.51	0.98–2.33	
Marital Status	Single	Reference	–	0.652
	Married	0.89	0.55–1.45	
Education Level (Year)	Illiterate	Reference	–	–
	<5 year	1.58	1.02–2.48	**0.043**
	>5 year	1.36	0.82–2.28	0.23
Residence	Rural	Reference	–	**0.001**
	Urban	2.04	1.41–2.93	
Cardiovascular Disease	No	Reference	–	**0.057**
	Yes	1.83	0.98–1.42	
Retinopathy	No	Reference	–	**0.014**
	Yes	2.14	1.17–3.95	
Renal Disease	No	Reference	–	**0.012**
	Yes	2.32	1.21–4.46	
Neuropathy	No	Reference	–	**0.074**
	Yes	1.82	0.94–3.52	
Diabetic Foot	No	Reference	–	0.569
	Yes	1.29	0.54–3.09	
Sexual Complications	No	Reference	–	**0.005**
	Yes	6.12	1.75–21.41	
Physical Activity	No	Reference	–	0.570
	Yes	0.69	0.18–2.58	

[a] **OR:** Odds Ratio.
[b] **CI:** Confidence Interval.

Table 4
The association between depression with glycemic control and its complications by multiple logistic regression model.

Variable		OR[a]	95% CI[b]	P-Value
Age (Year)		0.98	0.98–1.02	0.837
Number of Complications		1.12	0.42–2.99	0.830
Duration of Diabetes		1.01	0.97–1.05	0.530
Sex	Female	Reference	–	**0.040**
	Male	2.03	1.03–3.99	
Occupation	Employed	Reference	–	0.850
	Unemployed	1.07	0.52–2.19	
Education Level (Year)	Illiterate	Reference	–	–
	<5 year	1.53	0.91–2.54	0.100
	>5 year	1.16	0.61–2.22	0.650
Residence	Rural	Reference	–	**0.002**
	Urban	1.92	1.28–2.91	
Cardiovascular Disease	No	Reference	–	0.660
	Yes	1.32	0.39–4.45	
Retinopathy	No	Reference	–	0.220
	Yes	2.18	0.62–7.66	
Renal Disease	No	Reference	–	0.240
	Yes	2.07	0.62–6.94	
Neuropathy	No	Reference	–	0.970
	Yes	1.02	0.29–3.50	
Sexual Complications	No	Reference	–	**0.040**
	Yes	5.54	1.07–27.87	

[a] **OR:** Odds Ratio.
[b] **CI:** Confidence Interval.

in diabetic patients in Iran is higher than developed countries which this difference can be explained by the difference in the provision of health care and the lack of follow up of these patients in Iran in relation to the developed countries [14,35]. On the other hands, it may also be due to different instruments which is used to measure depression. So, it seems that implementation of screening programs and regular psychiatrist visits is essential for the early diagnosis of mental disorders, especially depression in Iranian diabetic patients.

In this study, the prevalence of depression in diabetic women (46.9%) was higher than diabetic men (36.8%). This finding was consistent with the studies conducted in this regard [27–31,36]. For example, a systematic review and Meta – analysis study in Iran showed that the prevalence of depression in men and women is 32.2% (Cl 95%: 16.3%–48.1%) and 60% (Cl 95%: 46.4%–73.3%); respectively [32]. The results of other study by Mirzaei et al.

indicated that the prevalence of depression in diabetic women is higher than diabetic men [36]. Also, the rate in the western countries was reported 28.2% and 18% in females and males, respectively [17,35]. The higher prevalence of depression in women can be attributed to different factors of social, cultural, biological and hormonal [37]. So, special attention should be paid to diabetic patients, especially female sex. Of course, it should be noted that most of the participants in our study were women.

In the resent study, despite the high prevalence of depression in diabetic women, after adjusting for the confounding variables, we saw odds of occurrence of depression in diabetic men was 2.03 (CI 95%: 1.03–3.99) times higher than diabetic women. This finding was not in line with the results of some other studies in this field, because these showed that there is no relationship between the sex of diabetic patients and the occurrence of depression [12,38–40]. On the other hands, the some studies showed that there is significant association between sex and depression in diabetic patients. For example Robert D et al. showed that odds of depression in diabetic women higher than men (OR: 1.31; CI 95%: 1.01–1.59) [41]. Perhaps one of the reasons for the higher risk of depression in diabetic men due to the behavioral and cultural characteristics of men in Iran, especially in Lorestan province, because men are less concerned about their health and less are looking for different screening and health tests such as depression and psychological tests than women, as a result, despite the lower prevalence of depression due to lack of early detection, the risk for them is higher. Of course, that most of the participants were women in this study which can be effective on the results.

In the multiple logistic regression analysis, there was no significant association between glycemic control expressed as HbA1c levels and depression (OR: 1.11, 95% CI: 0.87–1.57). This finding has been supported by various studies in this regard [12,42–44]. For example, a study by Hala Ahmadieh et al. in Lebanon showed no significant relationship between HbA1c levels and depression ($P = 0.843$) [40]. In contrast, some studies showed the opposite results [39,45,46]. A meta-analysis study on 24 studies in this field indicated that there is a significant relationship between HbA1c levels and depression [45]. However, the results of present research showed that 48.6% of patients did not have appropriate glycemic control status (HbA1c > 8) and also the prevalence of depression in this group was higher than other groups with lower HbA1c. Generally, many studies have supported the idea that depression in diabetic patients can be associated with weak self-care behaviors, insufficient control of glycemic and reduced physical function and as a result increase in HbA1c [47–49]. Therefore, attention to the relationship between HbA1c levels and depression can be important in diabetic patients.

This study showed there is significant association between sexual complications and depression in diabetic patients (OR: 5.54, 95% CI: 1.07–27.87). This finding was consistent with the findings of studies conducted in this field [50–52]. The study of Sayuk GS et al. showed 71.1% of diabetic patients have insufficient sexual dysfunction and also patients with high blood sugar had a higher ratio of this disorder [50]. In other study in this regard demonstrated Sexual disorders in diabetic patients have a direct relationship with the occurrence of depression in these patients [53]. So, our study confirms the necessity of assessment routine of sexual function and regular psychiatrist visits for diagnosis of mood disorders in type 2 diabetic patients, because co-morbidity of diabetes with depression can have a synergistic effect on the patient's sexual function.

Also, in this study, there is significant association between residence and depression in diabetic patients (OR: 1.92, 95% CI: 1.28–2.91). A study in Lebanon revealed that the effect of depression varies depending on the place of residence and occupation of diabetics [40]. Also Probst et al. demonstrated that the prevalence of depression in rural areas is higher than in urban areas which can be due to inappropriate health status, poverty and inadequate access to health services [54]. These studies were not in line with the results of our studies, because in our study, odds of depression in urban diabetic patients was higher than in rural areas. Perhaps one of the most important reasons is solidarity, unity, more sincere social relations, less stress, and deep religious beliefs in the rural environment. In general, it can be said that socioeconomic status has a significant impact on the behavior of diabetic patients and the incidence of depression [55,56].

5. Limitations

One of the limitations that can be noted is the cross-sectional nature of the study, because temporality assumption (occurrence of an independent variable before the dependent variable) has not been regarded [57,58]. Additionally, complications of diabetes were extracted from patient's medical records without performing detailed examinations to diagnose these complications, which can be associated with bias.

6. Conclusion

In conclusion, the study highlights the high prevalence of depression (46.3%) in diabetic patients in Lorestan province (Iran). However, there was no significant association between depression and glycemic control but sex, residence and sexual complications have a significant statistical association with depression in diabetic patients. Given that the high prevalence of depression and its effect on management and control of complications of diabetes, the implementation of psychological screening such as depression for rapid diagnosis and timely treatment of depression seems essential in diabetic patients.

Author statements

Ethical approval

This research was approved by the Deputy of Research and Ethics Committee of Lorestan University of Medical Sciences, Khorramabad, Iran.

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Competing interests

The authors declare no conflict of interest regarding publication of this article.

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