Libyan Journal of Public Health Practices (LJPHP)

Journal homepage:https://journals.uob.edu.ly/LJPHP/index
ISSN (Online) 3008-1467

Research Article

Evaluation of The Association Between Depression and Diabetes Among The Diabetic Patients Treated in Benghazi Diabetic Clinic

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ARTICLE INFO

Article history:
Received 25/10/2025
Revised 1/11/2025,
Accepted 30/12/2025,
Available online December 2025

Keywords:
Concurrent case control study
lifestyle variables
Diabetes
Depression
Binary logistic regression

ABSTRACT

Diabetes and depression have a bidirectional relationship and are prevalent among Libyans. Thus, in this concurrent case-control study, the relationship between depression and diabetes was investigated. The data were collected simultaneously from a total of 112 participants (56 diabetics and 56 controls). The data were collected through a written questionnaire. The binary logistic regression was used to evaluate the relationship between socio-demographic variables, lifestyle variables, depression and diabetes. Marriage was statistically significantly related to diabetes compared to single individuals (P= 0.014; odd ratio= 49.742, 95% CI (2.193 1128.483)). The confidence interval range is very wide. It is an imprecision due to the small sample size. BMI was statistically significantly related to diabetes (P = 0.013; odd ratio = 1.136, 95% CI (1.027 to 1.257)). Eye diseases were statistically significantly related to diabetes compared to "the 'no complications' group". (P= 0.001; odd ratio= 18.196, 95% CI (3.312 to 99.972)). However, the confidence interval is very wide. It is an imprecision due to the small sample size. However, the other variables were not statistically significantly related to diabetes. The research hypothesis was not supported since there is no sufficient evidence for the relationship between depression and diabetes. It is recommended for health educators to encourage diabetic patients, patients with depression, and people without diabetes and depression to follow a healthy lifestyle and to adhere to the depression screening test (diabetic patients and the public).

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1. Introduction

Diabetes is a chronic disorder characterized by high blood glucose levels because of low insulin production or peripheral resistance to insulin, according to the World Health Organization [1].Depression is a low mood status with a loss of happiness or interest in doing activates for at least two weeks which impedes daily activities, according to the World Health Organization [2].

Diabetes is prevalent among Libyans in accordance to the World Bank in 2021, which showed the prevalence of diabetes in Libya was 8.7% for the age of people ranging from 20 to 79 years old [3]. Additionally, depression is also prevalent among Libyans, with a previous study published in 2023 that indicated the prevalence of depression was approximately 24% [4].

Furthermore, the prevalence of depression in Libyan diabetic patients is high and inconsistent based on the different studies conducted in Libya [3,5,6]. According to the study published in 2021, the prevalence of depression in diabetics was 66.5%, while other studies conducted in 2020 and 2024 showed that the prevalence of depression in diabetic patients was 30.5% and 24.7% respectively.[3,5,6]

It is evidenced that the relationship between diabetes and depression is reciprocal.[7] depression patients are at risk of diabetes, since the patients with depression follow an unhealthy lifestyle [7]. Additionally, diabetic patients are at risk of depression, since diabetic patients might be subjected to psychological shock (diabetes diagnosis), complications of diabetes or fear from the complications of the diabetes [8].

Despite the studies published in Lebanon, Iran, and United Kingdom indicating that there is insufficient evidence for a relationship between depression and diabetes,[9-11] other studies were published in the United states of America, Saudi Arabia, Bangladesh, China, and South Korea stating that there is a relationship between depression and diabetes [12-18].

Although many studies around the world have been conducted to evaluate the relationship between depression and diabetes, there are very few published studies conducted in Libya to evaluate the relationship between depression and diabetes. Thus, the study was conducted to evaluate the relationship between depression and diabetes in Libya.

2. Methodology

2.1 Study Design

A concurrent case control study was conducted to evaluate the association only between Depression (risk) and diabetes (outcome). It is a cross-sectional case - control association. The Case control study design was preferred over the cohort study design since it is cheap, not takes much time, and requires a smaller sample size than cohort study within the same statistical power [19].

2.2 Sampling procedure, sample size and power calculation

A Sample size formula to calculate the sample size for a case control study was used. Since the prevalence of depression among Libyans for the time period from 2011 to 2023 was 23.68%,[4] the proportion of the risk (depression) among the controls was 24%. Since the prevalence of depression among Libyan diabetic patients was inconsistent according to the different studies,[3,5,6] the proportion of the risk (depression) among the cases was hypothesized to 50%. The ratio of the cases to controls was assigned as 1:1. Confidence interval was 95%. The 2 sided Alpha was 0.05. The study power was assigned as 0.80. Thus, the sample size was 112 (56 cases and 56 controls). Additionally, the sample size was verified by using the EPI TOOLS [20].

Since randomization in Libya is almost impossible [21], the sampling method in the study was convenient sampling for both cases and controls.

2.3 Study population

56 cases and 56 controls were enrolled in the study. Inclusion criteria for cases include the patients who were diagnosed with diabetes and treated in the Benghazi Diabetic Clinic from February to June 2025 of either gender of any age. Exclusion criteria for cases include patients with normal bereavement, diagnosed with bipolar manic depression, on

antidepressant, diagnosed with delusional disorder, diagnosed with Alzheimer's disease, diagnosed with schizophrenia, diagnosed with end stage renal disease, suffering from chronic pain, diagnosed with cancer, diagnosed with hypothyroidism, taking oral contraceptive, taking steroids, taking antiepileptic medications, and taking beta blockers.

Inclusion criteria for controls include the participants from the University of Benghazi. (Security personnel, staff, and teaching staff) during the time period from February to June 2025 who do not have diabetes. Exclusion criteria for controls include the people with normal bereavement, diagnosed with bipolar manic depression, on antidepressant, diagnosed with delusional disorder, diagnosed with Alzheimer's disease, diagnosed with schizophrenia, diagnosed with end stage renal disease, suffering from chronic pain, diagnosed with cancer, diagnosed with hypothyroidism, taking oral contraceptive, taking steroids, taking antiepileptic medications, and taking beta blockers.

2.4 Data collection and management

A written questionnaire was used to collect the data from the participants in the study. The data were collected from the cases (diabetics) and controls (non-diabetics) for the time period from February to June of 2025. The cases were recruited from Benghazi Diabetic Clinics while controls were recruited from the community (University of Benghazi) to avoid control selection bias. In order to preserve temporality, patients with clinically significant depression (moderate depression or moderately severe depression or severe depression) [22], were asked whether the first episode of depression symptoms before or after the diagnosis of diabetes.

The data collected include:

Sociodemographic data: age, gender, level of education, marital status, employment status, income status, family history of diabetes, and family history of depression.

Lifestyle factors data: physical activity, smoking status, sleep pattern, BMI, and controlled diet status.

Other data diseases status other than diabetes (complications of diabetes), and depression status.

In order to avoid the self-report bias, the height and weight were measured for each participant in the study and the BMI was computed by SPSS before starting data analysis. Then, the BMI was categorized into underweight (BMI is less than 18.5), normal weight (BMI from 18.5 TO 24.99), overweight (BMI from 25 to 29.99), and obesity (BMI is 30 or higher) [23]. Since the subjective measurement of physical activity might lead to recall bias and self-report bias, the physical activity was measured objectively. The Metabolic Equivalent Task was calculated according to the duration, the frequency, and the type of exercise to measure the intensity of physical activity[24]. The participants with zero MET were categorized with the sedentary lifestyle, while participants with 0.1 to 14.99 MET were categorized with light or moderate intensity exercise, and the participants with 15 or higher MET were categorized with the high intensity exercise [25]. The depression symptoms status was measured by the (PHQ9). The depression symptoms status was categorized into five groups (No or minimal depression, mild depression, moderate depression, moderately severe depression, and severe depression) [26]. The range of the scoring of the depression symptoms is from 0 to 27 with 10 or higher as the cutoff of the clinically significant depression (major depressive disorders) [6,14]. Since age, gender, family history of diabetes, and family history of depression are confounders in the study according to a previous study [14], and the biological believable facts, these variables were to be adjusted during data analysis by the binary logistic regression test. Since the restriction technique of adjusting confounders (family history of diabetes and family history of depression) during data collection will interfere with the generalizability, the adjustment of confounders during data analysis was preferred.

2.5 Data analysis

The SPSS software version 25 was used to analyze the data. First, the data were entered in

the Excel sheet. Secondly, the data were uploaded to the SPSS. Then, the data cleaning was performed on the SPSS to ensure the accuracy of the results in the study. After that, the descriptive analysis was performed by cross tabulation between the diabetes status variable (outcome) and the independent variables (socioeconomic variables, lifestyle variables, diseases status other than diabetes variable, and depression status variable) to calculate the counts and the percentages. The cross tabulation was performed since all the independent variables and dependent variable were categorical variables. In order to be included in the cross tabulation test, the BMI was recoded into the categorical variable by the SPSS. Additionally, the prevalence of clinically significant depression (major depression disorder) was calculated for both cases and controls. Furthermore, the onset of clinically significant depression (major depression disorder) for the diabetic patients (cases) was calculated according to the cutoff of the depression symptoms, which is 10 or higher. Since the dependent variable (diabetes status) is a dichotomous variable and the independent variables are multiple, the binary logistic regression was used to perform the inferential analysis in the study. The binary logistic regression was preferred over the chi square test since the binary logistic regression can control confounders in the study (age, gender, and the family history of diabetes), and it can calculate the odd ratio of the polychotomous variables. The assumptions for the binary logistic regression (normalcy) were tested before proceeding with the inferential analysis. The data of the study met the assumptions. All the categorical variables were recoded as dummy variables (dummy coding). As a part of the binary logistic regression, the odd ratio was calculated to evaluate whether there is a relationship between each independent variable and a dependent variable. The statistically significant results were to be for P values of less than 0.05 and with the confidence interval ranges do not pass through 1. Finally, the cross tabulation between depression status and the .socioeconomic variables, lifestyle factors, disease status other than diabetes were performed for controls to access the prevalence of depression in controls according to these factors

2.6 Ethical considerations, methods to obtaining informed consent

An approval was obtained from the Benghazi Diabetic Clinic to collect data from the diabetic patients treated in the clinic.

The ethical considerations to engage participants in the study were followed, which include voluntary participation of participants, informed consent from the Participants to participate in the study, Anonymity, and confidentiality.

Additionally, all information taken from the references has been paraphrased to avoid plagiarism.

2.7 Pretest or pilot study

In order to verify that the (PHQ9) questionnaire was valid and reliable according to the culture of the community, a pilot study was conducted in January of 2025. The Patient Health Questionnaire 9 was valid and reliable. The Cronbach Alpha Correlation coefficient was 0.658. Since the Cronbach correlation coefficient is greater than 0.60 [27], the (PHQ9) is reliable. The other parts of the questionnaire in the study were valid since they were taken from the validated questionnaire of a previous study [6].

3. Results and Discussion

According to the socio-demographic characteristics, most controls (50%) were categorized within 35 to less than 55 years old group while most cases (50%) were categorized within 55 years or older group. It is logical since people with 45 years old and older are at high risk of type 2 diabetes [28]. However, the inferential analysis indicated that there is insufficient evidence for a relationship between age 35 years old to less than 55 years old group, and 55 years old or older group and diabetes compared to age group less than 35 year old (p values= 0.997, 0.530 respectively) which is in disagreement with a study in Bangladesh [14], which showed the statistical significant association between age groups and diabetes.

Additionally, most of the controls (71.4%) and most cases (67.9%) were female. Also, inferential analysis showed that there is insufficient evidence for the relationship between gender and diabetes (p value= 0.150), which is in agreement with a study in Bangladesh [14].

Furthermore, most of the controls (62.5%) were categorized with undergraduate degrees, while most cases (30.4%) were categorized with primary or middle school as their highest level of education. It is logical since a high level of education decreases the risk of disease according to the general knowledge about the topic[29]. However, the inferential analysis indicated that there is insufficient evidence for a relationship between educational levels and diabetes compared to illiterate (p values= 1, 0.999, 0.999, 0.998), which is not in agreement with a study in Bangladesh [14].

Moreover, most of the controls (57.1%) were singles while most cases (67.9%) were married. At the same time, the inferential analysis stated that there is a relationship between marriage and diabetes compared to single individuals group (p value= 0.014, odd ratio= 49.742, 95% CI 2.193 to 1128.483), which is consistent with another study [14]. However, the confidence interval range is very wide. It is an imprecision due to the small sample size.

In addition to that, 58.9% of controls and 33.9% of cases were governmental employee. Also, the inferential analysis showed that there is insufficient evidence for a relationship between the employment status with different categories and diabetes compared to unemployed group (p values= 0.806, 0.397, 0.999, 0.236), This is inconsistent with the Bangladeshi study [14]. Also, most controls (53.6%) earned income between 1000 to less than 3000 Libyan Dinar, while most cases (30.4%) earned income between 500 to less than 1000 Libyan Dinar. Further, the inferential analysis proved that the income levels were not related to diabetes compared to income less than 500 Libyan Dinar (p value= 0.168, 0.736, 0.373), which agrees with another study [14].Finally, the percentage of controls (35.7%) to have a family history of diabetes was higher than the percentage of cases (26.8%) to have a family history of diabetes, which is not in agreement with the general knowledge about the topic [30]. Besides, the inferential analysis indicated that the family history of diabetes was not related to diabetes (p value=0.453). Since the sampling procedure in the study was convenient sampling, it might be the characteristics of the sample in the study were different from the general population. Thus, the study could be subjected to the selection bias.

Based on the lifestyle factors, most controls (75%) and cases (92.9%) were nonsmoker. On the other hand, 5.4% of cases and 17.9% of controls were active smokers. Further, the inferential analysis revealed that smoking status with different categories was not related to diabetes compared to non-smokers (p values=1, 0.999, 1, 0.097). It is rational since diabetic patients are usually recommended by their doctors to stop smoking in order to increase their insulin sensitivity.[1]. However, the results are not in agreement with a previous study published in Bangladesh [14].

Additionally, most controls (60.7%) and cases (49.1%) were categorized as a controlled diet sometimes. On the other hand, 14.5% of cases and 8.9% of controls adhered to a controlled diet. At the same time, the inferential analysis stated that the controlled diet status with different categories was not related to diabetes compared to “not controlled diet” group (p values= 0.336, 0.728).It is justifiable, since doctors usually recommend diabetic patients to adhere to a controlled diet to control blood glucose level to decrease the risk of complications of diabetes [1].

Furthermore, most controls (53.6%) and cases (39.3%) suffered from sleeping disturbance sometimes. On the other side, the high percentage of the cases (33.9%) and controls (25%) suffered from sleeping disturbance. Besides, the inferential analysis indicated that the sleeping disturbance status with different categories was not related to diabetes compared to “no sleeping disturbance” group (p values=0.392, 0.734). It is sensible since the prevalence of sleep issues among Libyans is very high, whether for diabetic or non-diabetics, according to a previous study published in Libya [31].

Moreover, most of the controls (39.3%) were overweight while most cases (53.6%) were obese. In addition to that, the inferential analysis indicated that the BMI was related to diabetes (p value=0.013, odd ratio= 1.136, 95% CI= 1.027 to 1.257). It is logical for the highest percentage of diabetic patients to be obese, since there is a bidirectional relationship between obesity and diabetes [32]. Also, it is logical for the high percentage of non-diabetic Libyans to be overweight, since most Libyans follow an unhealthy lifestyle [33]. The results are in agreement with a previous study published in Bangladesh [14].

Finally, most of the controls (41.1%) and cases (58.9%) adhered to light or moderate intensity exercise. In addition to that, the percentages of cases and controls which adhered to the high intensity exercise were 1.8% and 17.9% respectively. Further, the inferential analysis stated that the physical activity with the different categories was not related to diabetes compared to the sedentary lifestyle (p values= 0.736, 0.111, 0.495). It is rational for diabetic patients to adhere to moderate intensity exercise as it is a part of the lifestyle modification that is recommended by doctors for diabetic patients.[1] Also, it is justifiable that the lowest percentage of cases adhere to high intensity exercise, since it is recommended for diabetic patients by doctors to avoid the high intensity exercise especially if the blood glucose level is not controlled [34].

As stated by the disease status other than diabetes, most controls (87.5%) and cases (44.6%) were categorized with “no diseases”. group Further, most cases were diagnosed with eye diseases (21.4%) while a very low percentage of controls (3.6%) were diagnosed with eye diseases. At the same time, the inferential analysis indicated that eye diseases were related to diabetes (p value= 0.001, odd ratio = 18.196, 95% = 3.312 to 99.972), which is in agreement with a previous study published in Bangladesh [14]. Odd ratio indicated that diabetes is related to eye diseases. It is sensible since diabetes causes retinopathy according to the general knowledge about the topic.[1] However, the confidence interval range is wide. It is an imprecision due to the small sample size

As indicated by depression status, most cases (50%) and controls (38.2%) were mild depressant. At the same time, 23.6% of controls and 22% of cases were suffered from moderate depression. Additionally, 5.5% of controls and 4% of cases were suffered from moderately severe depression. Furthermore, 7.3% of controls and 4% of cases were suffered from severe depression. See table 1. Notably, the differences in the percentages between the cases and controls according to the depression status were very small. Thus, the inferential analysis indicated that the depression status with the different categories was not related to diabetes compared to no or minimal depression (p values=0.121, 0.752, 0.883, 0.915), which is in agreement with other studies published in Lebanon, Iran, and United Kingdom [9-11]. However, the findings are in disagreement with the general knowledge about the topic and the previous studies published in the United States of America, Saudi Arabia, Bangladesh, China, and South Korea [12-18]. See table 2 for further information. Since the sample used for analyzing the relationship between depression and diabetes was 100, thus there were missing data as the total sample size was 112. As the depression variable was string when it is uploaded from excel to spss, the missing data were handled through treating blanks as user missing values when the variable is automatically recoded to numeric variable.

As stated by the major depression disorder (clinically significant depression), the prevalence was a little bit higher for controls (36.4%) than for cases (30%). See figure 1.

According to the onset of major depression disorder (clinically significant depression), most diabetic patients (86.7%) were exposed to the first episode of depression symptoms after the diagnosis of diabetes. See figure 2. It is logical since people might be shocked from the diagnosis of diabetes or it might be due to the psychological stress from the possibility of the occurrence of diabetic complications which might lead to depression for diabetic patients [8].

Since the analysis indicated that there is no relationship between depression and diabetes, the reasons about that were evaluated by performing cross tabulation between independent variables and depression for controls (non-diabetics). The analysis indicated that a high percentage of controls were categorized as a very low income level, to be with a Low level of education, to be married (marital conflicts), to be a governmental employee (workplace conflicts), and to follow an unhealthy life style (passive smoking, sleeping disturbance, uncontrolled diet, overweight, and obesity) therefore, depression is also prevalent among non-diabetics (controls).

For diabetic patients, almost half (44.6%) of them did not have any diabetic complications. Thus, this is considered other reason why there is insufficient evidence for the relationship between depression and diabetes.

Table1. Depression categories distribution for cases and controls

Variable		Cases		Controls	
		N	%	N	%
Depression status	No or Minimal depression	10	20%	14	25.5%
	Mild depression	25	50%	21	38.2%
	Moderate depression	11	22%	13	23.6%
	Moderately severe depression	2	4%	3	5.5%
	Severe depression	2	4%	4	7.3%

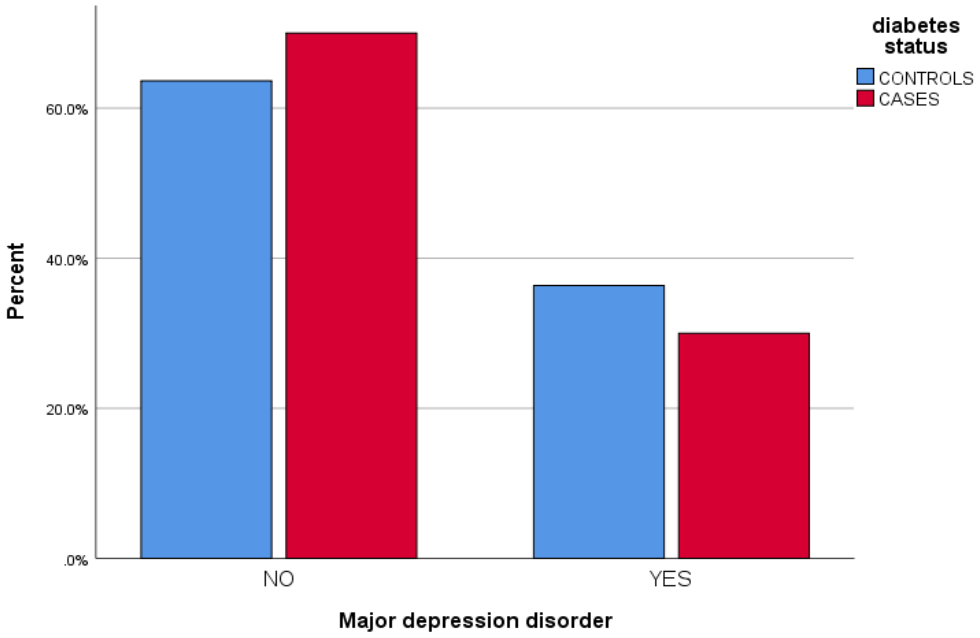


Figure1. Bar chart shows the percentages of Major Depression disorder among cases and controls

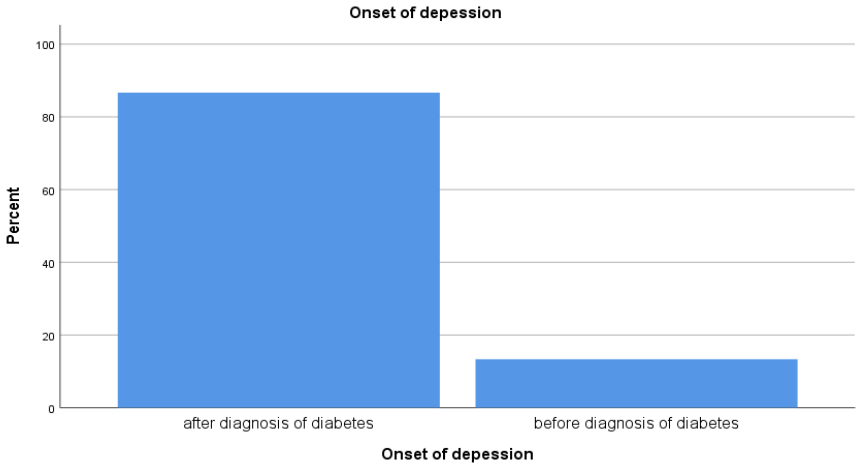


Figure2. Bar chart shows the onset of depression among the diabetic patients (cases)

Table2. The key inferential analysis tools to access the relationship between depression and the diabetes status by using binary logistic regression.

Statistical tools	*P value*	Odd ratio	95% CI	
			Lower	Upper
No or minimal depression (reference)	0.304			
Mild depression	0.121	2.567	0.779	8.461
Moderate depression	0.752	0.786	0.177	3.501
Moderately severe depression	0.883	0.824	0.063	10.700
Severe depression	0.915	0.876	0.077	9.977

4. Conclusion and Recommendations

The study indicated that there is insufficient evidence for the relationship between independent variables (socioeconomic variables, lifestyle variables, complications of diabetes, and depression) and diabetes except for the relationship between independents variables (marriage, BMI, and eye diseases) and diabetes which were statistically significant.

It is recommended to conduct further studies on the same topic, since the study is one of a very few studies that have already been

conducted in Libya to evaluate the relationship between depression and diabetes.
It is recommended for conducting sensitivity or matching analyses in a future study.
Additionally, it is recommended for health educators to encourage the Libyan people to adhere to a healthy lifestyle which includes smoking cessation, to sleep well, to adhere to a healthy diet, and to decrease weight. Moreover, health educators should recommend Libyan people starting from the age of thirties to adhere to the screening test for depression.
Furthermore, it is recommended for health educators to encourage diabetic patients to follow a healthy lifestyle which includes sleeping well, to adhering to a controlled diet, and to decrease weight in order to control the blood glucose level and to prevent depression.
In addition to that, it is recommended for health educators to encourage diabetic patients to adhere to the depression screening test.
Finally, it is recommended for health educators to encourage patients with the depression but not diabetic yet to follow a healthy lifestyle in order to relief the depression symptoms and to decrease the risk of diabetes.

5. Limitations of the study

Since randomization is almost impossible in Libya due to many factors, including lack of a strong database in Libya, the sampling procedure was convenient sampling (participants not randomly selected), which might lead to the study being subjected to selection bias. The selection bias is clear in the study for the percentage of the family history of diabetes, which is higher for controls than cases. Additionally, the selections bias is clear in the study, since the percentage of major depression disorder is higher in controls than in diabetics
For controls, it might be possible for some of them to have diabetes, but they were not to be diagnosed with diabetes (subclinical cases).
The Patient Health Questionnaire 9 is used for the screening of depression and to measure the severity of depression symptoms, but it is not used for diagnosis of clinical depression.
Finally, the diabetic complications were to be self-reported by the participants, which might lead to the study being subjected to the self-report bias.

Acknowledgment

We are very thankful and fully appreciate the management for Benghazi Diabetic Clinic and the faculty of Public Health for their approval and cooperation during the time of the study.

Conflict of Interest

No conflict of interest was declared by Authors.

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