CASE STUDY

Depression and Associated Factors among Type 2 Diabetics in Karbala City, Iraq: As a Model of Anti-depressant Drugs

Sammar J. Mahan*, Mohammed M. Mahammad

Department of Clinical Pharmacy, College of Pharmacy, Mustansiriyah University, Iraq

Received: 13th April, 2023; Revised: 08th June, 2023; Accepted: 15th August, 2023; Available Online: 25th September, 2023

ABSTRACT

Background: Diabetes mellitus is in the 21st century, it is a very common disease that affects a lot of people. DM and depression symptoms are well-known co-occurring diseases. A person's ability to do everyday things can be affected by depressed symptoms and DM.

Objectives: To find the level of depression symptoms among type 2 diabetics, observe the socio-demographic & disease-related agents that cause depression.

Methods: A cross-sectional study design was used to assess depression in 200 people suffering from type 2 diabetes and 120 healthy participants as a control group. Patients scoring 5 or more were termed depressed. Each participant's verbal informed consent was obtained before the interview. On the questionnaires, no names were written. Depression was correlated with demographic and patient-related disease characteristics using Spearman's rho correlation.

Results: The severe, moderate, and mild depression rates were 7.5, 56, and 29%, respectively and 92.5% of diabetics had depressed symptoms. Among the control group, absences of depressed symptoms and mild depressed symptoms were more common. Diabetics had moderate, moderately severe, and severe depression are all more common than mild depression symptoms. Diabetic patients' median PHQ-9 score (10) was significantly higher than the control group's 8.

Conclusion: Depression is common among diabetes mellitus type 2 patients. Glycemic control is poor & obesity have an impact on it. Endocrinologists should be aware of the elevated risk of depression in this patient population.

Keywords: Depressed symptoms, Risk factors, Type 2 diabetics, Patient Health Questionnaire-9.

International Journal of Drug Delivery Technology (2023); DOI: 10.25258/ijddt.13.3.55

How to cite this article: Mahan SJ, Mahammad MM. Depression and Associated Factors among Type 2 Diabetics in Karbala City, Iraq: As a Model of Anti-depressant Drugs. International Journal of Drug Delivery Technology. 2023;13(3):1125-1130.

Source of support: Nil.

Conflict of interest: None

INTRODUCTION

Type 2 diabetes mellitus is a complex progressive disorder characterized by impaired insulin sensitivity, reduced insulin secretion and progressive failure of pancreatic β- cells.[1] Diabetes is a disease that affects the body's metabolism, characterized by hyperglycemia.[2] It is presently the third most harmful chronic illness to human health. Worldwide. The disease's prevalence is rising globally due to improved living standards, urbanization, industrialization, and an aging population. The WHO indicated that there are approximately 422 million diabetics today. This can be expected to rise to by 2040 to 600 million people.[3]

The overall prevalence of diabetes in Iraq was 2.18%. The rates were greater in urban than rural areas (2.53 and 1.58%, respectively), and in the South, Centre than in Kurdistan (2.30 and 1.43%, respectively). The rates of diabetes increase markedly in the 30 to 49 age group, assumed to indicate the onset of type 2 diabetes. More increases in the rates were seen after age 50, with a prevalence rate of 14.38%.[4]

Depression and diabetes distress are common mental health problems among people with T2DM. Both raise the chances of a patient dying. In chronic conditions like diabetes, depressed symptoms are a common comorbidity[5] Depression can affect anyone, but it is more common in people with type 2 diabetes than those who do not. Previous research has displayed that diabetic patients have twice the rate of depression as the general population.[6] Severe depression can lead to suicide. Depression risk varies by gender, age, income, and education.[7] Around 4% of the world's population suffers from depression symptoms, the second most common cause of impairment. Across the Middle East, > 5% of the population is depressed.[8] For better health outcomes, the role of T2DM psychopathology must be regarded as glycemic control is poor in these individuals compared to people with diabetes alone.[9] Diabetes problems, poor quality of life, and increased mortality.

*Author for Correspondence: noorsammar20@gmail.com

This increases healthcare expenditures more diabetes complications, lower quality of life, and higher risk of morbidity and mortality. They also use more healthcare resources, rising healthcare costs.[10] Depression and diabetes comorbidity leads to higher HbA1c levels, complications, and mortality. Patient satisfaction is also affected by poor provider-patient communication, negative outcome. Thus, accurate depression assessment in diabetics is critical to treatment and may improve diabetes management.[11,12]

Objective

To investigate the prevalence of depression in T2DM patients and the influence of socio-demographic and illness variables.

PARTICIPANTS AND METHODS

Study Design and Participants

From November 2020 to December 2021, A cross-sectional study was carried on 120 healthy control subjects (age 51.04 10.17 years), 66 males and 54 females, and 200 T2DM patients (age 51.46 9.05 years) 93 males and 107 females who attended a private diabetes center, AL-Huja hospital in Karbala, Iraq. All patients are seen regularly at the clinic and are given diabetic medications under the supervision of an endocrinologist consultant. All precautions were taken in the clinical clinic to avoid covid 19 transmission.

Inclusion Criteria

Type 2 DM patients aged (30–65) years, accept and permit the enrollment to the study.

Exclusion Criteria

Patients on anti-depressant drugs or any neurological or psychological disorders. A person with a long-term illness or a long-term mental disorder that prevented participants from answering the interview questions, pregnant, or mental illnesses were not included in this study.

Data Collection

A following information was recorded by researcher for each participant on a data collection sheet designed for the study:

Demographic characteristics

Age, gender, weight, height, social status, educational level, monthly income. Diabetes-related features include disease duration, and the number of diabetes medications are taken. If a patient has hypertension and dyslipidemia, they should have a family history of diabetes.

Questionnaire

To test for depression symptoms, the Arabic version of the 9-state Patient Health Questionnaire (PHQ-9) was employed by the researcher. The PHQ-9 is a multifunctional tool for screening, monitoring, and evaluating the severity of depression; it is short and useful in clinical practice for examining the patient's mental health condition over the course of two weeks. A score is assigned to every of the nine assertions (ranging from 0–3), and the combined scores suggest a diagnosis of depression. Each statement is on a four-point scale: 0 means "not at all," 1 means "a few days," 2 means "more than half the days," and 3 means (nearly every day). A continuous total score ranging from 0 to 27 was calculated using the answer choices.; f the total score is 0 to 4 (no depression), 5 to 9 (mild depression), 10 to 14 (moderate depression), 15 to 19 (moderate-severe depression), 20 to 27 (severe depression).

Ethical Approval

- The College of Pharmacy Scientific and Ethics Committee evaluated and accepted the study proposal and the consent of al Huja Hospital in Iraq, Karbala was achieved.
- Verbal consent was obtained from participants before participation in the study.
- The patient's data kept confidential and did not disclose to unauthorized personnel.

Statistical Analysis

The data were coded using the software SPSS Inc, version 26 of the statistical program for social sciences. Categorical variables were presented as number and percentage. Quantitative variables were initially analyzed for normality distribution Kolmogorov-Smirnov test. Therefore, quantitative variables were described as mean ± standard deviation or median (interquartile range). Comparison of mean values between any two groups was carried out using independent sample t-test or Mann Whitney U test in case of normally distributed or not normally disturbed data, respectively. Association between any two categorical variables was done using the Chi-square test. p-value was considered significant when it is equal or less than 0.05 and highly significant when it is equal or less than 0.001.

RESULTS

Patient Demographics and Disease Characteristics

This study enrolled 200 diabetic patients. The age range was 30 to 65 years with a mean (51.46.6 ± 9.05) year. Males (53.5%), females (46.5). Table 1 mentions the demographic data of the patients and healthy persons enrolled in the study. Age, gender, BMI, marital status, monthly income, and education level did not differ significantly between patients & healthy subjects at a p-value more than 0.05.

The clinical features of the diabetic individuals who were included in this investigation are shown in Table 2.

Level of Depression

Diabetes patients were shown to have a high rate of depression in general (92.5%). Mild depression affected 29.0% of the 185 depressed individuals, whereas moderate depression affected 37.5%, moderately severe depression affected 18.5%, severe depression affected 7.5%, and severe depression affected 7.5%.

The diabetic group had more moderate depression, moderately severe depression, and severe depression symptoms than the control group, with a very statistically significant difference (p = 0.0001). as mentioned in Table 3, Figure 1.

As expected, the patient had a significantly higher median PHQ-9 score for depression.[10] compared to the control group (8) at p-value=0.001, as illustrated in Table 4.

Table 1: Assessment of baseline characteristics of T2DM patients compared to that of the control group.

Characteristics N=120		*Control N=200*	*T2DM*	*p-value*
Age (years)	Mean ± SD	51.04 ± 10.17	51.46 ± 9.05	0.703 NS
	≤ 50	50 (41.7)	85 (42.5%)	0.907
	> 50	70 (58.3)	115 (57.5%)	
Gender	Sample size	N%	N%	0.166 NS
	Female	54 (45.0%)	107 (53.5%)	
	Male	66 (55.0%)	93 (46.5%)	
BMI (kg/m^2)	Mean ± SD	29.23 ± 3.41	29.83 ± 3.95	0.170 NS
	Normal Weight	18 (15.0%)	49 (24.5%)	0.103 NS
	Overweight	37 (30.8%)	61 (30.5%)	
	Obesity	65 (54.2%)	90 (45.0%)	
Marital Status	Single	16 (13.3%)	20 (10.0%)	0.361 NS
	Married	104 (86.7%)	180 (90.0%)	
Monthly Income $	≤ 500 $	23 (19.2%)	54 (27.0%)	0.122 NS
	500-1000 $	75 (62.5%)	102 (51.0%)	
	≥ 1000 $	22 (18.3%)	44 (22.0%)	
Education level	Illiterate	20 (16.7%)	42 (21.0%)	0.116 NS
	Primary	32 (26.7%)	70 (35.0%)	
	Secondary	37 (30.8%)	55 (27.5%)	

Data presented as Mean ± SD, N: number of patients, percentage (%), NS: not significant at p >0.05:

Table 2: The clinical features for diabetic individuals

Diabetic features	*Category*	*N=200*	*Percentage*	*p-value*
Glycemic Control	Poor ≥7%	150	75.0	0.001**
	Good<7%	50	25.0	
Family history for DM.	Positive	114	57	0.048 *
	Negative	86	43	
Duration of DM groups	< 1 year	28	14.0	0.001**
	(1–5) year	68	34.0	
	> 5 years	104	52.0	
Diabetes medications no.	One cure	105	52.5	0.001**
	Two cures	77	38.5	
	≥ Two cures	18	9.0	
Hypertension	Yes	47	23.5	0.001**
	No	153	76.5	
Dyslipidemia	Yes	65	32.5	0.001**
	No	135	67.5	
Hypertension and dyslipidemia	Yes	18	9.0	0.001**
	No	182	91.0	

(N):number patients. Percentage (%). * There are statistically significant at p-value ≤0.05, ** (*P-value* ≤ to 0.01) is considered significantly high .SD= standard deviation, DM, diabetes mellitus.

Presenting Symptoms Among Diabetic Patients

Anhedonia and appetite were the most common symptoms in the PHQ-9 depression evaluation scores 25 and 30%, respectively. While suicidal ideation was present in the smallest percentage in 3% of patients, as shown in Figure 2.

Correlation of Depression with Socio-demographic and Clinical Characteristics

Table 5 shows the relationship between depression and numerous socio-demographic and clinical factors.

Depression was found to be substantially connected with BMI at a very weak level (r=0.181, *p-value*=0.010) and weakly correlated with poor glycemic control patients (HbA1c ≥ 7) at a highly significant level (r=0.207, *p-value*=0.003). In contrast to patients age (p=0.547), gender (p=0.705), social status (p=0.540), an education degree (p=0.931), monthly income (p=0.599), family history (p=0.534), duration of DM (p=0.323), and hypertension exist (p=0.924), dyslipidemia (p=0.995), and both hypertension and dyslipidemia present (p=0.369). We found no significant correlation between depression and the remaining characteristics were investigated by using Spearman correlation analysis. Depression was found to be significantly correlated at a very weak level with BMI ((r=0.147, p-value=0.037) and weakly correlated with poor glycemic control patients at a highly significant level (HbA1c≥7) (r=o.255,p -value= 0.001). A highly significant weak positive correlation of depression with HbA1c (r=220, p-value=0.002), in contrast. We found no significant correlation between depression and patients' age (p=0.536), gender (p=0.662), marital status (p=0.813), education level (p=0.671), monthly income (p=0.387), family history (p=0.701), duration of DM (p=0.189), and presence of hypertension, dyslipidemia, or both in the remaining characteristics.

Table 3: Levels of depression between diabetic and control group

Level of depression	*Healthy Control N=120*			*DM patients N=200*			*p-value*
	N (%)	*Median*	*IQR*	*N (%)*	*Median*	*IQR*	
No depression	18 (15.0%)	2.50	(1–4)	15 (7.5%)	2.00	(1–4)	0.0001***
Mild depression	61 (50.8%)	7.00	(6–8)	58 (29.0%)	8.00	(7–9)	
Moderate depression	28 (23.3%)	10.0	(10–12)	75 (37.5%)	10.0	(10–13)	
Moderately severe depression	12 (10.0%)	15	(15–16.5)	37 (18.5%)	17	(16–18)	
Severe depression	1.00 (0.80%)	20	-	15 (7.5%)	21	(21–23)	
Asses of depression	Mild depression			Moderate depression			

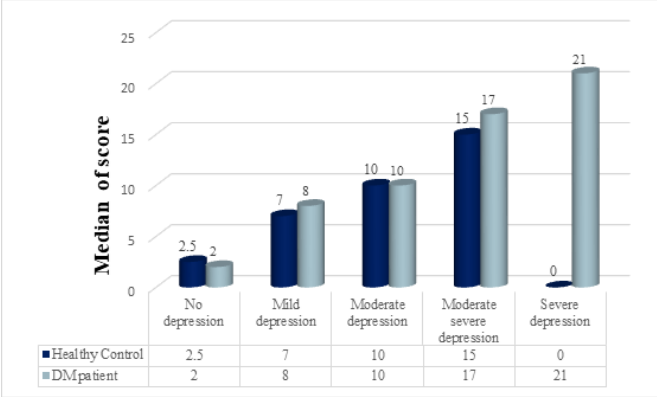

Figure 1: Levels of depression in patients and control group

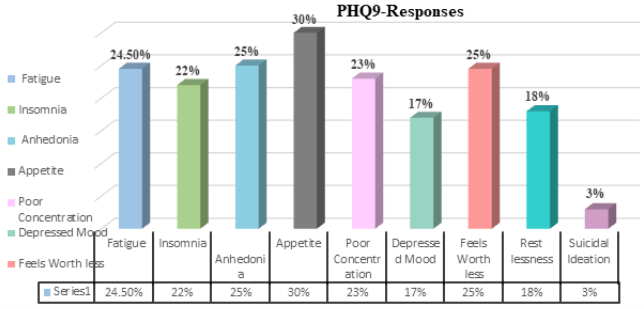

Figure 2: Presenting symptoms among diabetic patients

Table 4: Median PHQ-9 score for participants

Variables	*Healthy Control N=120*	*DM patients n=200*	*p-value*
	Median (IQR)	*Median (IQR)*	
PHQ-9 score	8 (6 – 10)	10(8– 15)	0.001**
Asses of depression	Mild depression	Moderate depression	

Mann Whitney U test, IQR: interquartile range

DISCUSSION

Diabetes is a metabolic condition that has medical and economic implications. The Arab globe will have the second-highest proportion of DM patients in 2030.[10] In this study, the control group had higher levels of no depression and mild depression than the diabetic patients. Compared to the control group, moderate, moderately severe, and severe depression are higher in diabetic patients. Surprisingly noticed. Mild depression (50.8%) was high percentage and moderate depression (34.2%) among the control group; the findings of this study were validated by a survey done in Baghdad, Iraq, which revealed a high prevalence of mild depression (46.7%) and moderate depression (34.2%) among the control group.[13] That's because prior decades' exposure of Iraqi people to wars, sanctions, and violence was blamed for the link between mental and post-traumatic stress disorders. None of the control groups have severe depression in contrast to what al Hamzawi *et al.* discovered in their study concerning the prevalence of severe depression in Iraqi general people (46%).[14]

Table 5: Correlation of median PHQ-9 scores with demographic data disease characteristics in diabetic patients

Characters	*Correlation Coefficient, r*	*p-value*
Demographic Data		
Age, years	0.043	$0.547^{N.S}$
Gender	-0.027	$0.705^{N.S}$
BMI	0.181	0.010*
Glycemic control	0.207	0.003**
Marital Status	0.044	$0.540^{N.S}$
Education level	-0.006	$0.931^{N.S}$
Monthly income IQ	-0.037	$0.599^{N.S}$
Diabetes-related characteristics		
Family history of diabetes	-0.044	$0.534^{N.S}$
Duration of DM	0.070	0.323^{NS}
Number of diabetes medications	0.057	$0.426^{N.S}$
Hypertension	0.007	$0.924^{N.S}$
Dyslipidemia	0.001	$0.995^{N.S}$
Both Hypertension & Dyslipidemia	-0.064	0.369^{NS}

***Correlation** is significant at the p-value ≤0.05 level. ** Correlation is highly significant at the p-value≤0.01. NS: Correlation is not significant at the p-value>0.05.

A total of 185 diabetic patients (92.5%) reported having some levels of depression, mostly moderate, accounting for almost 56% of all depressed patients. Severe depression symptoms were only in 7.5% of diabetics. The prevalence of moderate depression among diabetes patients was determined to be 29%. The finding of this study is in line with Alhunayni,[15] and an Iranian study,[16] Tanzanian study was 22.1%[17] in this research, the prevalence of severe depression in diabetes patients was 7.5%, which is similar with previous results indicating (6.5%) of diabetic patients are likely to have severe depression (Derek Sharpour *et al.*,2015),[18] as well as a Saudi Arabian study by A Alhunayni.[15]

The prevalence of severe depression in diabetic patients was 7.5% in this study, which is consistent with the findings of other studies that (6.5%) of diabetic patients are likely while the findings of this study contradict those of Bahaty in India, where diabetes patients were 60% depressed,[19] another study was done by Mohammed Khan.[20]

The prevalence of depression varies significantly between research, which is explained by environmental, cultural, ethnic, and social factors. This study found that more than half of T2DM patients had major depression. Diabetes patients had a considerably higher median PHQ-9 score than the control group, indicating that depression was more prevalent among diabetics than non-diabetics. According to a recent study by Bahetyin indea results, depression was shown to be much more common in T2DM patients (63%) than in controls (48%).[19] Also in line with Derek Hshanpour's study.[18] Anhedonia and appetite were the most prevalent symptoms in the patients, according to the PHQ-9 depression evaluation score 25 and 30%, respectively, while suicidal ideation was present in the smallest percent in the current study 3%. Suicidal ideation

was common among depressed people and, compared to other studies was 9.9%.[21]

It's been reported that diabetes is linked to an elevated risk of certain mental illnesses. A higher incidence of diabetes-related suicidal ideation and attempts than in the overall population. However, little research has been dedicated to understanding suicidality in people with diabetes. The depression was weakly correlated with poor glycemic control patients (HbA1c≥7) at high significant level. These results are supported by similar findings among people with diabetes. in meta-analyses and systematic reviews of diabetes patients, depression was shown to be modestly linked with glycemic status.[22] Unlike earlier studies that found no link between poor glycemic control and depression.[23] Higher depressive symptoms were associated with higher HbA1c. The results are similar to those of prior research.[24] In addition to many study reports,[25] also, this study confirms it.[26] Depression was found to be significantly correlated with BMI at a very weak level; our findings suggest a link between depression and higher BMI. The major depression group had a significantly higher BMI ≥ 30 kg/m^2. Similar findings in previous studies support these findings.[26] Hypertension is the most significant risk factor for cardiovascular morbidity and mortality; therefore, we evaluated the correlation of depression with the presence of hypertension we not find any significant correlations between them.[27]

CONCLUSION

This study showed a high prevalence of depression in patients with T2DM. The risk factors for depression were obesity and poor glycemic control. Depression and diabetes are causally related and deserve attention from clinicians to ensure better management.

ACKNOWLEDGMENT

The researcher would like to thank all of the patients and personnel who helped him perform this study.

REFERENCES

1. Sazan DS, Kassim JS, Ansam NH. Comparative study between Metformin, Glibenclamide and their combination in newly diagnosed diabetic (type II) patients in Hawler City. Al Mustansiriyah Journal of Pharmaceutical Sciences. 2012 Dec 1;12(2):61-74.
2. American Diabetes Association. Diagnosis and Classification of Diabetes Mellitus. Diabetes Care 2014; 37 (Suppl. 1): S81–S90.
3. Dong G, Qu L, Gong X, Pang B, Yan W, Wei J. Effect of social factors and the natural environment on the etiology and pathogenesis of diabetes mellitus. International journal of endocrinology. 2019 Jun 25;2019.
4. Kasim AA, Mohammed MM. Biochemical Evaluation of Some Liver Enzymes in Type 2 Diabetes Mellitus Iraqi Patients. Al Mustansiriyah Journal of Pharmaceutical Sciences. 2012 Dec 1;12(2):107-14.
5. Owens-Gary MD, Zhang X, Jawanda S, Bullard KM, Allweiss P, Smith BD. The importance of addressing depression and diabetes distress in adults with type 2 diabetes. Journal of general internal medicine. 2019 Feb;34(2):320-4.
6. Tran, N. M. H., Nguyen, Q. N. L., Vo, T. H., Anh Le, T. T., & Ngo, N. H. (2021). Depression among patients with type 2 diabetes mellitus: Prevalence and associated factors in Hue City, Vietnam. Diabetes, Metabolic Syndrome and Obesity: Targets and Therapy, 14, 505–513.18.
7. van den Bosch M, Meyer-Lindenberg A. Environmental Exposures and Depression: Biological Mechanisms and Epidemiological Evidence. Annual Review of Public Health. 2019;40(1):239-259.
8. Friedrich M. Depression Is the Leading Cause of Disability Around the World. JAMA. 2017;317(15):1517.
9. 9.Sunny AK, Khanal VK, Sah RB, Ghimire A. Depression among people living with type 2 diabetes in an urbanizing community of Nepal. PloS One. 2019 Jun 10;14(6): e0218119.
10. van Dijk SE, Adriaanse MC, van der Zwaan L, Bosmans JE, van Marwijk HW, van Tulder MW, Terwee CB. Measurement properties of depression questionnaires in patients with diabetes: a systematic review. Quality of Life Research. 2018 Jun;27(6):1415-30.
11. Khamseh ME, Baradaran HR, Javanbakht A, Mirghorbani M, Yadollahi Z, Malek M. Comparison of the CES-D and PHQ-9 depression scales in people with type 2 diabetes in Tehran, Iran. BMC Psychiatry. 2011 Apr 16; 11:61.
12. Grey M. Coping and Psychosocial Adjustment in Mothers of Young Children with Type 1Diabetes. Children's health care: journal of the Association for the Care of Children's Health. 2009;38(2):91-106.
13. Faik N, Kadhim DJ, Al-auqbi TF. Depression among Type 2 Diabetics Attending the National Diabetes Center. 2019;65(9):86–91.
14. Ali Obaid Al-Hamzawi, Ronny Bruffaerts, Evelyn J. Bromet, Abdulzahra Mohammed AL Khafaji, Ronald C. Kessler. The epidemiology of major depressive episodes in the Iraqi general population. PLoS One 2015; 10(7): e0131937. Published online 2015 Jul 31.
15. Alhunayni NM, Mohamed AE, Hammad SM. Prevalence of Depression among Type-II Diabetic Patients Attending the Diabetic Clinic at Arar National Guard Primary Health Care Center, Saudi Arabia. Psychiatry J. 2020 Jun 19; 2020:9174818.
16. Z N, M K. The Prevalence of Depression in Patients with Diabetes Mellitus Type II in the Shahid Rahimi Hospital of Khorramabad, Iran. Epidemiol Open Access. 2016;6(3).
17. Khan ZD, Lutale J, Moledina SM. Prevalence of Depression and Associated Factors among Diabetic Patients in an Outpatient Diabetes Clinic. Psychiatry J. 2019 Jan 15; 2019:2083196.
18. Derakhshanpour F, Vakili MA, Farsinia M, Mirkarimi K. Depression and quality of life in patients with type 2 diabetes. Iran Red Crescent Med J. 2015;17(5).
19. Bahety P, Agarwal G, Khandelwal D, Dutta D, Kalra S, Taparia P, *et al.* Occurrence and predictors of depression and poor quality of life among patients with Type-2 diabetes: A Northern India perspective. Indian J Endocrinol Metab. 2017;21(4): 564-569.
20. Khan MA, Sultan SM, Nazli R, Akhtar T, Khan MA, Sher N, Aslam H. Depression among patients with type-II diabetes mellitus. J Coll Physicians Surg Pak. 2014 Oct;24(10):770-1.
21. Khan ZD, Lutale J, Moledina SM. Prevalence of Depression and Associated Factors among Diabetic Patients in an Outpatient Diabetes Clinic. Psychiatry J. 2019 Jan 15; 2019:2083196.
22. Lustman PJ, Clouse RE. Depression in diabetic patients: the

relationship between mood and glycemic control. J Diabetes Complications. 2005 Mar-Apr;19(2):113-22.
23. Akpalu J, Yorke E, Ainuson-Quampah J, Balogun W, Yeboah K. Depression and glycaemic control among type 2 diabetes patients: a cross-sectional study in a tertiary healthcare facility in Ghana. BMC Psychiatry. 2018 Nov 6;18(1):357.
24. Wagner JA, Abbott GL, Heapy A, Yong L. Depressive symptoms and diabetes control in African Americans. J Immigr Minor Health. 2009 Feb;11(1):66-70.
25. Richardson LK, Egede LE, Mueller M, Echols CL, Gebregziabher Longitudinal effects of depression on glycemic control in veterans with Type 2 diabetes. Gen Hosp Psychiatry. 2008 Nov-Dec;30(6):509-14.
26. Katon W, von Korff M, Ciechanowski P, Russo J, Lin E, Simon G, Ludman E, Walker E, Bush T, Young B. Behavioral and clinical factors associated with depression among individuals with diabetes. Diabetes Care. 2004 Apr;27(4):914-20.
27. Abdulaali AR, Abdulridha MK, Arif IS, Al-Turfi HH. Effect of Vitamin D3 Supplement on Biochemical Markers and Blood Pressure Reading in Hypertensive patients as A secondary Prevention. Al Mustansiriyah Journal of Pharmaceutical Sciences. 2018 Dec 1;18(2):24-32.