

# Depression among Adult Diabetics in the UAE

Shatha Al-Sharbatti<sup>1\*</sup>, Mahir K. Jallo<sup>2</sup>, Muhannad A. Wahib<sup>3</sup>, Jayadevan Sreedharan<sup>1</sup>

<sup>1</sup>Department of Community medicine, Gulf Medical University, Ajman, United Arab Emirates

<sup>2</sup>Consultant internal medicine and endocrinology, Department of Medicine, Thumbay University Hospital, Ajman, United Arab Emirates

<sup>3</sup>Specialist psychiatry

Received: 15<sup>th</sup> October, 2022; Revised: 19<sup>th</sup> November, 2022; Accepted: 10<sup>th</sup> December, 2022; Available Online: 25<sup>th</sup> December, 2022

---

## ABSTRACT

**Background:** Diabetes and depression are costly and prevalent chronic medical conditions. Limited data about the relationship between depression and diabetes in the UAE

**Objectives:** To assess the risk of depression among diabetics in the UAE

**Materials and Methods:** A cross-sectional study was conducted among 20 -year-old- and above adults attending the medical outpatients of a teaching hospital, Ajman, with no prior diagnosis of depression and who agreed to participate and give informed consent. The participants were recruited conveniently and screened for depression using beck depression inventory second edition (BDI-II) questionnaire. A validated pilot-tested self-administered questionnaire was also used, including information on socioeconomic status, lifestyle, being diagnosed to have diabetes.

**Results:** The study included 775 participants; 189 had depressive symptoms (24.4%). A significant association was found between depression and gender and education level ( $p=0.001$  for both variables). The percentage of depression was significantly higher among participants diagnosed with diabetes ( $p=0.016$ ). Performing regular physical activity was associated with a lower rate of depression. Multiple logistic analysis showed that the risk of depression is increased by; gender (being a female compared to a male, or: 2.374 (CI: 1.644 - 3.428,  $p < 0.001$ ); having a lower education level compared to a higher (or: 1.744, CI: 1.155 - 2.635,  $p=0.008$ ); being diabetic (or 1.656, 1.125 - 2.436,  $p=0.01$ ). Performing physical activity reduces the risk for depression (or 0.521, CI: 0.298-0.909,  $p=0.022$ ).

**Conclusion:** Diabetes increases the risk of depression. Predictors of depression are gender and having diabetes. Performing physical activity reduces the risk of depression.

**Keywords:** Adults, Depression, Diabetes, Risk.

International Journal of Pharmaceutical Quality Assurance (2022); DOI: 10.25258/ijpqa.13.4.16

**How to cite this article:** Al-Sharbatti S, Jallo MK, Wahib MA, Sreedharan J. Depression among Adult Diabetics in the UAE. International Journal of Pharmaceutical Quality Assurance. 2022;13(4):441-447.

**Source of support:** Nil.

**Conflict of interest:** None

---

## INTRODUCTION

Diabetes and depression are costly chronic medical conditions, suffered by millions of peoples every year.<sup>1,2</sup> Diabetes constitutes a growing global public health problem, the International Diabetes Federation showed that the global prevalence of diabetes in 2019 was 9.3% that is expected to reach 10.2 in 2030.<sup>3</sup>

In the UAE, diabetes has been identified as a growing problem, and it is ranked as one of top ten countries for prevalence of diabetes in the Middle East and North Africa region.<sup>4</sup>

Depression is another important global public health problem due to both its relatively high lifetime prevalence

and the significant disability that it causes. The world health organization (WHO) data<sup>2</sup> revealed that the estimated global prevalence of depression was 5% among adults. In the UAE, depression prevalence ranged between 12.5–28.6% according to a systematic review that had included 14 articles.<sup>5</sup> The WHO rank depressive disorders as the leading cause of disability and ill health.<sup>2</sup>

Two systematic reviews examined the comorbid association between diabetes and depression in low- and middle-income countries. The first systematic review had included 48 studies and found considerable variation in the prevalence of depression among diabetic patients and the range was from 2 to 84%.<sup>6</sup> The second, more recent systematic review had included 145 primary studies and found that the prevalence of

---

\*Author for Correspondence: shatha\_alsharbatti@gmu.ac.ae

depression among diabetic patients ranged between 30–61%.<sup>7</sup> Diabetes management includes self-care activities like diet modification, exercise planning, interpret blood glucose level, and adjusting food intake to maintain glycemic control and reduce the risk of complications.<sup>8</sup> Self-care behaviors are found to have major and lasting impact on the health of diabetics.<sup>9</sup> Comorbid depression and diabetes has been associated with poor adherence to self-care regimens.<sup>10</sup> Moreover, a population-based cohort study evaluating healthcare expenditures reported that comorbid diabetes and depression are associated with significantly higher healthcare utilization and expenditures than diabetes without depression.<sup>11</sup> Thus, identifying and treating comorbid depression is essential to provide quality care for diabetic patients. Limited data is available about the risk of depression among diabetics in the UAE. Availability of this information is needed to suggest including screening of diabetics for depression as part of quality management of diabetic patients in the UAE. The present study aimed to evaluate the risk of depression among diabetics in the UAE

## MATERIALS AND METHODS

A cross-sectional study was conducted that included adults (age  $\geq 20$  Years) attending the medical outpatients of teaching (Thumbay) hospital, in Ajman, UAE, with no prior diagnosis of depression and who agreed to participate and give informed consent. The participants were recruited on a convenience basis and screened for depression using beck depression Inventory second edition (BDI-II) questionnaire,<sup>12</sup> a self-administered instrument consisting of 21 items/statements. The participants were asked to select 1 of the 3–4 choices to each statement that reflect their feeling in the past two weeks, and each choice carries a score. The total score ranges 0–63. The instrument developers established four groups of scores and classified as: minimal 0–13, mild 14–19, moderate 20–28, and severe 29–63. The stability of the BDI-II, as expressed by retest coefficients of Pearson's  $r$  of 0.92 and 0.93, was reported by Beck and colleagues<sup>13</sup> for psychiatric and student samples, respectively. The cut-off score  $\geq 14$  was used in this study to identify participants who have depressive symptoms.

**Table 1:** Socio-demographic characteristics of participants

Socio-demography	Subgroup	Non-Depressed group		Depressed group		P
		No.	%	No.	%	
Age ( Ys)	20–29	127	75.1	42	24.9	0.983
	30–39	208	76.5	64	23.5	
	40–49	126	75.4	41	24.6	
	50–59	88	75.9	28	24.1	
	$\geq 60$	37	72.5	14	27.5	
Gender	Males	426	81.1	99	18.9	<0.001
	Females	99	18.9	90	36.0	
Education level	$\leq$ Secondary	93	62.4	56	37.6	<0.001
	>Secondary	471	78.5	129	21.5	
Ethnicity	Non-Arab	253	77.1	75	22.9	0.398
	Arab	333	74.5	114	25.5	
Marital status	Single	85	80.2	21	19.8	0.386
	Married	478	75.2	158	24.8	
	Other*	23	69.7	10	30.3	
Number of Children	0	32	71.1	13	28.9	0.465
	1–2	206	76.9	62	23.1	
	$\geq 3$	247	72.9	92	27.1	
Family income (AED)	<10000	148	71.5	59	28.5	0.247
	10000–14999	90	80.4	22	19.6	
	15000–19999	81	79.4	21	20.6	
	$\geq 20$	37	74.0	13	26.0	
Live with family	Yes	450	74.1	157	25.9	0.164
	No	114	79.7	29	20.3	
Health Insurance	Yes	449	76.1	141	23.9	0.413
	No	116	73.0	43	27.0	

\*Divorced/ widows

In addition to the aforementioned questionnaire, validated pilot-tested self-administered questionnaire was used including information on socioeconomic status, lifestyle, being diagnosed to have diabetes, general self care (score 0-14). The GMU- IRB Committee approved the study. Data was analyzed using SPSS version 27. The chi-square test and multiple regression analysis were used.  $p < 0.05$  was used as a criterion for the significance.

**RESULTS**

The study included 775 participants, 189 participants with depression (24.4%) and 586 without depression (75.6%). Table 1 showed the association between the socio-demographic characteristics of participants and depression. It can be seen that there was a significantly higher prevalence of depression among females compared to males (32.6 vs. 18.4%,  $p < 0.0001$ ), and among lower education level compared to higher education level participants (34.8 vs. 20.5%,  $p < 0.0001$ ). No significant association was found between other socio-demographic variables and depression. Higher percentage of depression was found among older age participants.

Table 2 showed the association between depression and having diabetes, duration, treatment types of diabetic patients and family history of diabetes. The percentage of depression among respondents with and without diabetes was

30.8 and 22.3%, respectively. A significant association was noticed between diabetes and depression. Among diabetic participants, there was no significant association between depression and duration of diabetes and type of management strategy. Depression among people with diabetes becomes more frequent after five years of diagnosis; also, it was more frequent among people with diabetes who were treated with insulin and other therapy. A family history of diabetes was not associated with depression.

Table 3 showed the association between depression and perceived support and self-control. No significant association was found between perceived family and social support and depression. Depression was more frequent among respondents who perceived not having family and social support than a counterpart who reported having such support. Also, depression was more common among diabetic patients who perceived less control over their health

Table 4 showed the association between depression and family history of depression, and other psychological illnesses. Depression had no significant associations family history of depression, other psychological illness

Table 5 showed the association between depression and history of chronic diseases. History of chronic diseases was more commonly reported by depressed respondents,

**Table 2:** Distribution of participants by diabetes-related history

Diabetes related history	Subgroup	Non-Depressed group		Depressed group		P
		No.	%	No.	%	
Diagnosed to have diabetes	Yes	146	69.2	65	30.8	0.016
	No	407	77.7	117	22.3	
Duration of Diabetes (Ys)*	≤ 5	56	70.9	23	29.1	0.174
	6-10	21	53.8	18	46.2	
	>10	40	67.8	19	32.2	
Treatment of diabetes*	Insulin/Oral drug/diet	25	65.8	13	34.2	0.682
	Oral drug	108	69.2	48	30.8	
Family history of diabetes	Yes	252	76.8	76	23.2	0.455
	NO	312	74.5	107	25.5	

\*For diabetic subjects only

**Table 3:** Distribution of participants by perceived support and self-control

Perceived Support and self-control No.		Non-Depressed group		Depressed group		P
		%	No.	%	No.	
Perceived Family Support	Yes	524	75.1	174	24.9	0.628
	No	25	71.4	10	28.6	
Perceived Social Support	Yes	523	75.5	170	24.5	0.201
	No	28	66.7	14	33.3	
In Diabetics, Perceived difficulty of self-management	Yes	15	71.4	6	28.6	0.737
	No	118	67.8	56	32.2	
In Diabetics, Perceived, lack of control over one's health	Yes	10	66.7	5	33.3	0.905*
	No	122	68.2	57	31.8	

Fishers' exact test

## Depression among Adult Diabetics in the UAE

**Table 4:** Distribution of participants by family history (FH) of: depression, other psychological illness and diabetes

Family History (FH)	Sub-group	Non-Depressed group		Depressed group		P
		No.	%	No.	%	
FH of Depression	Yes	65	73.9	23	26.1	0.502
	No	468	76.5	144	23.5	
FH of other psychological illness	Yes	49	70.0	21	30.0	0.264
	No	461	76.1	145	23.9	

**Table 5:** Distribution of participants by depression and history of chronic diseases

History of chronic diseases	Sub-group	Non-Depressed group		Depressed group		P
		No.	%	No.	%	
Stroke	Yes	8	66.7	4	33.3	0.467
	No	587	75.8	185	24.2	
Heart disease	Yes	20	66.7	10	33.3	0.244
	No	566	76.0	179	24.0	
Hypertension	Yes	105	69.5	46	30.5	0.053
	No	481	77.1	143	22.9	
High cholesterol	Yes	155	70.5	65	29.5	0.035
	No	431	77.7	124	22.3	
Kidney diseases	Yes	29	72.5	11	27.5	0.638
	No	557	75.8	178	24.2	
Visual field loss	Yes	19	70.4	8	29.6	0.518
	No	567	75.8	181	24.2	
Neurologic problems	Yes	17	60.7	11	39.3	0.061
	No	569	76.2	178	23.8	
Obesity [self-reported height and weight]	Not obese	399	76.1	125	23.9	0.328
	Obese	146	72.6	55	27.4	

**Table 6:** Lifestyle of participants

Lifestyle History	Sub-category	Non-Depressed group		Depressed group		P
		No.	%	No.	%	
Smoking habit	Yes	132	77.2	39	22.8	0.586
	NO	454	75.2	150	24.8	
Performing physical exercise	Yes	228	81.4	52	18.6	0.005
	NO	358	72.3	137	27.7	
Frequency of performing exercise/ week	<3	110	77.5	32	22.5	0.096
	>5	49	90.7	5	9.3	

however, the association between depression and history of chronic diseases was only significant for history of hypercholesterolemia (29.5 vs. 22.3%,  $p=0.035$ ). Higher percentage of depression was found among obese participants (27.4 vs. 23.9%,  $p>0.05$ ).

Table 6 showed the association between depression and the lifestyle of participants. Performing physical activity was associated with a significantly lower percentage of depression (18.6 vs. 27.7%,  $p=0.005$ ).

Table 7 Showed Logistic regression analysis for predictors of depression. Binary logistic analysis showed that the risk of depression is increase by; gender (being a female compared

to male, or: 2.374 (CI: 1.644 - 3.428,  $p<0.001$ ); having lower education level compared to higher (or: 1.744, CI:11.155 - 2.635,  $p=0.008$ ); being diabetic (or 1.656, 1.125 - 2.436,  $p=0.01$ ). Performing physical activity reduce the risk for depression (or 0.521, CI: 0.298-0.909,  $P=0.022$ ).

### DISCUSSION

In this study, the prevalence of potentials cases of depression was 30.8% and this is in line with another study from Oman<sup>13</sup> with a reported prevalence of 26%. Higher prevalence was reported in studies from Saudi Arabia (58%),<sup>14</sup> Palestine (40.2%),<sup>15</sup> Eastern India (40.2%)<sup>16</sup> and Bangladesh (61.9%).<sup>17</sup>

**Table 7:** Logistic regression analysis (Binary and multiple logistic regression analysis) for determinants of depression

Factors associated with depression OR		COR*		AOR**			
		95% CI	p	OR	95% CI	P	
Gender	Female	2.42	1.726 - 3.395	≤0.001	2.374	1.644 - 3.428	<0.001
	Male	1			1		
Education	≤ Secondary Education	2.199	1.497 - 3.229	≤0.001	1.744	1.155 - 2.635	0.008
	> Secondary Education	1			1		
Physical Exercise	No (<3 times/week)	1			1		
	Yes (≥3 times/ week)	0.448	0.264-0.760	0.003	0.521	0.298-0.909	0.022
Diabetes	Yes	1.549	1.083 - 2.214	0.016	1.656	1.125 - 2.436	0.01
	No	1					
High Cholesterol	Yes	1.458	1.025- 2.072	0.036			
	No	1					

COR: Crude Odds Ratio; AOR: Adjusted Odds Ratio

In this study, the odds ratio for having depression was increased with diabetes by 1.66 and this is consistent with Lin *et al.*<sup>18</sup> who had reported that the odds ratio for depression was 1.38 (95% CI=1.15-1.66) among diabetic patients compared to non-diabetic after adjusting for age and gender in an international survey that included data across 17 countries.

Similar finding was also reported in a systematic review conducted by Elamoshy *et al.*. The results showed that in cross sectional reviewed study, diabetic patients were more than two times (OR=2.04, 95% CI: 1.73–2.42) more likely to have depression.<sup>19</sup>

Age in this study was not a significant predictor for depression. This is in agreement with studies from Oman,<sup>13</sup> and Palestine.<sup>15</sup> In our study we noticed higher prevalence among diabetics older than 60 years, although the association was not significant. This supports the results of a systematic review of studies from China 20 which found that age equal to or over 60 years increase the risk for depression by 1.56 times. However, researchers from India<sup>16</sup> found that 18–40 diabetics had more than two times higher risk than diabetics older than 60 years (OR-2.09).

Current data showed that depression was more common among females and on adjusting for other factors. Females were 2.37 times more likely to have depression than males. This is consistency with many studies.<sup>14,15,17,18,21</sup> Sweileh *et al.*<sup>15</sup> found that females had 1.8 times higher risk for depression. Similarly, Al-Shahrani *et al.* results showed that females had 4.9 times the risk in males to have depression.<sup>14</sup> Hormonal factors related to estrogen levels and social role attributed to women that allow them to express their feeling and to report depression more than men were suggested explanations for this gender difference.<sup>22,17</sup>

The current data showed that education was a significant predictor for depression among diabetic patients, and the risk of depression is 1.7 times more likely among lower education level participants. This is supported by several authors.<sup>15,16,23</sup> Majdan *et al.* study from Slovakia showed that diabetic patients who had middle - a graduation level of education had

a significantly lower risk for depression compared to diabetic patients who hold an elementary level of education (or=0.52, 95% CI: 0.33–0.81).<sup>23</sup>

Few other studies reported no association.<sup>14,17</sup> Peyrot *et al.* studied the genetic contribution in the association between lower educational attainment and depression. The study revealed that the association is not due to measurable pleiotropic genetic effects and suggested that environmental factors could be involved such as, socioeconomic status.<sup>24</sup>

A multicenter cross-sectional study from Bangladesh showed that diabetic patients had 4.71- fold higher odds of depression in comparison to the controls. In addition, aged ≥50 years, years of schooling ≤10 years were significant predictors of depression among the studied subjects.<sup>25</sup>

A cross sectional study from Australia showed diabetes mellitus is a stronger risk factor for depression in women than in men, with the greatest width of the gender gap between 40 and 49 years.<sup>26</sup>

In this study we found that physical activities decrease the risk for depression. Darwish *et al.* suggested a bidirectional relationship between depression and diabetes, and that physical activity levels and effectiveness of self-management may be mediators for this joint relationship between diabetes and depression.<sup>27</sup>

Yates *et al.* studied pooled data from two cluster randomized controlled trials that included individuals at high risk of type 2 diabetes who were included in preventive programs to promote physical activity. The authors found that depression attenuated the intervention and led to a gradual reduction in the effectiveness of diabetes prevention at increasing physical activity.<sup>28</sup> A study from Korea to find the effect of physical activity on depression among diabetic patients showed that moderate-intensity physical activity at work and leisure influenced depression. The authors suggested that systematic leisure programs and professional education are necessary to help diabetic patients manage stress and depression in daily life.<sup>29</sup> Lee *et al.* investigated the relationship between different levels of physical activity (light, moderate, and

vigorous), physical health, happiness, and depression among older adults with diabetes. The authors found that moderate and/ or vigorous physical activity is more effective than light physical activity for promoting physical health and lowering depression of older adults with diabetes.<sup>30</sup>

## REFERENCES

1. WHO. Fact sheets. Diabetes. Update:10 November 2021. Accessed Aug.2022. Available on: <https://www.who.int/news-room/fact-sheets/detail/diabetes>
2. WHO. Fact sheets. Depression. Update:13 September 2021. Accessed Aug.2022. Available on: <https://www.who.int/news-room/fact-sheets/detail/depression>
3. Sun H, Saeedi P, Karuranga S, Pinkepank M, Ogurtsova K, Duncan BB, Stein C, Basit A, Chan JCN, Mbanya JC, Pavkov ME, Ramachandaran A, Wild SH, James S, Herman WH, Zhang P, Bommer C, Kuo S, Boyko EJ, Magliano DJ. IDF Diabetes Atlas: Global, regional and country-level diabetes prevalence estimates for 2021 and projections for 2045. *Diabetes Res Clin Pract.* 2022 Jan;183:109119. doi:10.1016/j.diabres.2021.109119. Epub 2021 Dec 6. PMID: 34879977.
4. El-Kebbi IM, Bidikian NH, Hneiny L, Nasrallah MP. Epidemiology of type 2 diabetes in the Middle East and North Africa: Challenges and call for action. *World J Diabetes.* 2021 Sep 15;12(9):1401-1425. doi: 10.4239/wjd.v12.i9.1401. PMID: 34630897; PMCID: PMC8472500.
5. Razzak HA, Harbi A, Ahli S. Depression: Prevalence and Associated Risk Factors in the United Arab Emirates. *Oman Med J.* 2019 Jul;34(4):274-282. doi: 10.5001/omj.2019.56. PMID: 31360314; PMCID: PMC6642715.
6. Mendenhall E, Norris SA, Shidhaye R, Prabhakaran D. Depression and type 2 diabetes in low- and middle-income countries: a systematic review. *Diabetes Res Clin Pract.* 2014 Feb;103(2):276-85. doi: 10.1016/j.diabres.2014.01.001. Available at: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3982306/>
7. Lam AA, Lepe A, Wild SH, Jackson C. Diabetes comorbidities in low- and middle-income countries: An umbrella review. *J Glob Health.* 2021 Jul 24;11:04040. doi: 10.7189/jogh.11.04040. PMID: 34386215; PMCID: PMC8325931.
8. Adu MD, Malabu UH, Malau-Aduli AEO, Malau-Aduli BS. Enablers and barriers to effective diabetes self-management: A multi-national investigation. *PLoS One.* 2019 Jun 5;14(6):e0217771. doi: 10.1371/journal.pone.0217771. PMID: 31166971; PMCID: PMC6550406.
9. Laxy M, Mielck A, Hunger M, Schunk M, Meisinger C, Rückert IM, Rathmann W, Holle R. The association between patient-reported self-management behavior, intermediate clinical outcomes, and mortality in patients with type 2 diabetes: results from the KORA-A study. *Diabetes Care.* 2014 Jun;37(6):1604-12. Available from: <http://care.diabetesjournals.org/content/37/6/1604.long>
10. Mut-Vitcu G, Timar B, Timar R, Oancea C, Citu IC. Depression influences the quality of diabetes-related self-management activities in elderly patients with type 2 diabetes: a cross-sectional study. *Clin Interv Aging.* 2016 Apr 26;11:471-9. Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4853012/>
11. Huang CJ, Hsieh HM, Chiu HC, Wang PW, Lee MH, Li CY, Lin CH. Health Care Utilization and Expenditures of Patients with Diabetes Comorbid with Depression Disorder: A National Population-Based Cohort Study. *Psychiatry Investig.* 2017 Nov;14(6):770-778. Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5714718/pdf/pi-14-770.pdf>
12. Beck AT, Steer RA, Brown GK. BDI-II: Beck Depression Inventory Manual. 2nd ed. San Antonio, TX: Psychological Corporation; 1996. <sup>[17]</sup> <sup>[18]</sup>
13. Alsumry SH, Al Ghelani T, Jaju S. Depression in Urban Omani Adults with Type 2 Diabetes: A cross-sectional study. *Sultan Qaboos Univ Med J.* 2022 Feb;22(1):45-50. doi: 10.18295/squmj.4.2021.065. Epub 2022 Feb 28. PMID: 35299793; PMCID: PMC8904121.
14. ALShahrani A, Mostafa O and Hassanein M. Screening For Depression Among Adult Diabetics Attending Primary Health Care Centers. *Med. J. Cairo Univ.* 2014 ;82(2): 229-236.
15. Sweileh WM, Abu-Hadeed HM, Al-Jabi SW, Zyoud SH. Prevalence of depression among people with type 2 diabetes mellitus: a cross sectional study in Palestine. *BMC Public Health.* 2014 Feb 13;14:163. doi: 10.1186/1471-2458-14-163. PubMed PMID: 24524353; PubMed Central PMCID: PMC3929146. Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3929146/>
16. Majumdar S, Sinha B, Dastidar BG, Gangopadhyay KK, Ghoshal S, Mukherjee JJ, Mazumdar A, Ray S, Dasgupta S, Bhattacharjee K. Assessing prevalence and predictors of depression in Type 2 Diabetes Mellitus (DM) patients - The DEPDIAB study. *Diabetes Res Clin Pract.* 2021 Aug;178:108980. doi: 10.1016/j.diabres.2021.108980. Epub 2021 Jul 28. PMID: 34329694.
17. Islam SM, Rawal LB, Niessen LW. Prevalence of depression and its associated factors in patients with type 2 diabetes: A cross-sectional study in Dhaka, Bangladesh. *Asian J Psychiatr.* 2015 Oct;17:36-41. PubMed PMID: 26259893.
18. Sherchand O, Sapkota N, Chaudhari RK, Khan SA, Baranwal JK, Niraula A, Lamsal M. Gender Differences in the Prevalence of Depression among the Working Population of Nepal. *Psychiatry J.* 2018 Oct 28;2018:8354861. doi: 10.1155/2018/8354861. PMID: 30510959; PMCID: PMC6230394.
19. Elamoshy R, Bird Y, Thorpe L, Moraros J. Risk of Depression and Suicidality among Diabetic Patients: A Systematic Review and Meta-Analysis. *Journal of Clinical Medicine.* 2018; 7(11):445. <https://doi.org/10.3390/jcm7110445>
20. Liu X, Li Y, Guan L, He X, Zhang H, Zhang J, Li J, Zhong D, Jin R. A Systematic Review and Meta-Analysis of the Prevalence and Risk Factors of Depression in Type 2 Diabetes Patients in China. *Front Med (Lausanne).* 2022 May 10;9:759499. doi: 10.3389/fmed.2022.759499. PMID: 35620713; PMCID: PMC9127805.
21. Roupa , oulouri , Sotiropoulou P, Makrinika E, Marneras X, Lahana , et al.. Anxiety and depression in patients with type 2 diabetes mellitus, depending on sex and body mass index. *Health Sci J* 2009;3:32-40. Available from: <https://pdfs.semanticscholar.org/c8eb/65b719b4812dff7336cb21ecac77d9059e4f.pdf>
22. Al-Amer RM, Sobeh MM, Zayed AA, Al-Domi HA. Depression among adults with diabetes in Jordan: risk factors and relationship to blood sugar control. *J Diabetes Complications.* 2011 Jul-Aug;25(4):247-52. doi: 10.1016/j.jdiacom.2011.03.001. Epub 2011 May 20. PubMed PMID: 21601482. Available from: [http://www.jdcjournal.com/article/S1056-8727\(11\)00036-5/pdf](http://www.jdcjournal.com/article/S1056-8727(11)00036-5/pdf)
23. Majdan M, Krajcovicova L, Pekarcikova J, Chereches R, O'Mullane M. Predictors of depression symptoms in patients with diabetes in Slovakia. *Int J Psychiatry Med.* 2012;44(4):351-66. Review. PubMed PMID: 23885517; PubMed Central PMCID: PMC3819566.
24. Peyrot W, Lee S, Milaneschi Y, Abdellaoui A, Byrne EM, Esko

- T, et al.. The association between lower educational attainment and depression owing to shared genetic effects? Results in 25,000 subjects. *Molecular psychiatry*. 2015;20(6):735-743. Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4610719/>
25. Kamrul-Hasan AB, Palash-Molla M, Mainul-Ahsan M, Gaffar AJ, Asaduzzaman M, Saifuddin M, Rahman MS, Akter F, Rahman H, Talukder SK, Islam M, Chanda PK, Siddiqui NI, Selim S. Prevalence and Predictors of Depression among Patients with Type 2 Diabetes: A Multicenter Cross-sectional Study from Bangladesh. *Mymensingh Med J*. 2019 Jan;28(1):23-30. PMID: 30755546.
  26. Deischinger C, Dervic E, Leutner M, et al.. Diabetes mellitus is associated with a higher risk for major depressive disorder in women than in men. *BMJ Open Diab Res Care* 2020;8:e001430
  27. Darwish L, Beroncal E, Sison MV, Swardfager W. Depression in people with type 2 diabetes: current perspectives. *Diabetes Metab Syndr Obes*. 2018;11:333-343
  28. Thomas Yates, Laura J. Gray, Joseph Henson, Charlotte L. Edwardson, Kamlesh Khunti, Melanie J. Davies; Impact of Depression and Anxiety on Change to Physical Activity Following a Pragmatic Diabetes Prevention Program Within Primary Care: Pooled Analysis From Two Randomized Controlled Trials. *Diabetes Care* 1 October 2019; 42 (10): 1847–1853. <https://doi.org/10.2337/dc19-0400>
  29. Kim DJ. Effects of Physical Activity on Depression in Adults with Diabetes. *Osong Public Health Res Perspect*. 2018 Aug;9(4):143-149. doi: 10.24171/j.phrp.2018.9.4.02. PMID: 30159219; PMCID: PMC6110331.
  30. Lee J, Kim J, Chow A, Piatt JA. Different Levels of Physical Activity, Physical Health, Happiness, and Depression among Older Adults with Diabetes. *Gerontology and Geriatric Medicine*. January 2021. doi:10.1177/2333721421995623