Diabetes, Metabolic Syndrome and Obesity

Dovepress

open access to scientific and medical research

Open Access Full Text Article

ORIGINAL RESEARCH

The Prevalence and Determinants of Anxiety and Depressive Symptoms in Patients with Type II Diabetes Mellitus in Mogadishu, Somalia: A Cross-Sectional Study

Nur Adam Mohamed[1], Rahma Yusuf Haji Mohamud[2], Fadumo Hussein Hilowle[2], Yusuf Abdirisak Mohamed[1,3], Hawa Nuradin Mohamed[4]

[1]Mogadishu Somali Turkiye Recep Tayyip Erdogan Training and Research Hospital, Department of Psychiatry and Behavioral Sciences, Mogadishu, Somalia; [2]Mogadishu Somali Turkiye Recep Tayyip Erdogan Training and Research Hospital, Department of Nursing, Mogadishu, Somalia; [3]Lecturer, Faculty of Medicine and Surgery, Somali National University, Mogadishu, Somalia; [4]Mogadishu Somali Turkiye Recep Tayyip Erdogan Training and Research Hospital, Department of Internal Medicine, Mogadishu, Somalia

Correspondence: Nur Adam Mohamed, Mogadishu Somali Turkiye Recep Tayyip Erdogan Training and Research Hospital, Department of Psychiatry and Behavioral Sciences, Mogadishu, Somalia, Email nurmohed01@gmail.com

Purpose: This study aims to determine the prevalence of depression, anxiety, and stress among TIIDM patients in Mogadishu, Somalia, and identify predicting factors, as there is limited research on these disorders in Somalia.

Methods: A hospital-based cross-sectional study was conducted on adult patients with TIIDM from November 2023 to January 2024 at Erdogan Hospital, in the capital city of Somalia. A total of 360 participants were recruited using the systematic sampling technique. Data was collected using questionnaires on sociodemographic, clinical and behavioral characteristics. The depression, anxiety, and stress scale (DASS-21) questionnaire was used to assess symptoms of depression, anxiety, and stress. Bivariate and multivariate logistic regression analyses were performed to identify variables predicted by the outcome variables.

Results: Out of the 360 participants included in this study, 44.7%, 55.0%, and 30.3% had depression, anxiety, and stress symptoms, respectively. A lack of regular exercise (AOR = 1.79; 95% CI: 1.14–2.79) and an illness duration of 4–7 years (AOR = 1.94; 95% CI: 1.16–3.23) were statistically associated with depression. Being female (AOR = 2.07; 95% CI: 1.31–3.28), having ≥9 children (AOR = 1.94; 95% CI: 1.07–3.53), and a lack of regular exercise (AOR = 1.57; 95% CI: 1.01–2.45) were statistically associated with anxiety. A lack of regular exercise (AOR = 2.07; 95% CI: 1.31–3.28), having DM complications (AOR = 2.14; 95% CI: 1.01–4.54), an illness duration of 4–7 years (AOR = 2.22; 95% CI: 1.25–3.94), and DM management non-compliance (AOR = 2.74; 95% CI: 1.20–6.26) were statistically associated with stress.

Conclusions: This study found that TIIDM patients had moderately high rates of depression, anxiety, and stress symptoms, with a lack of physical activity associated with increased odds of depression, anxiety, and stress symptoms. Healthcare workers should screen for psychological symptoms, provide interventions, monitor sedentary patients, and encourage adherence to treatment and physical exercise to reduce mental health burden.

Keywords: type II diabetes mellitus, depression, anxiety, stress, Mogadishu, Somalia

Background

Type II diabetes mellitus (TIIDM) is a prevalent global public health issue with significant medical and financial impacts, ranking as the third-most prevalent disease burden globally.[1] Worldwide, diabetes-related medical expenses accounted for an estimated 850 billion US dollars in 2017.[2] TIIDM, as stated by the American Diabetes Association (ADA) and International Diabetes Federation (IDF), comprises 90–95% of all cases of DM.[3,4] According to IDF estimates, 700 million people worldwide will have DM by 2045, making up 10.9% of the world's population.[3] While there is a lack of official statistics on diabetes prevalence in Somalia, the World Health Organization (WHO) estimated it to be

Received: 23 May 2024
Accepted: 31 August 2024
Published: 14 September 2024

5% in 2016. Furthermore, the WHO classified 22% of Somalia's population as overweight or obese.[5] According to the World Bank's 2021 data, Somalia's diabetes prevalence is 6.5% between the ages of 20 and 79.[6] On top of that, patients with diabetes in Somalia often neglect medical advice, including adhering to strict diabetic diets and medication schedules, resulting in increased diabetes-related complications.[7]

Depression, anxiety, and stress symptoms are common among patients with TIIDM. For instance, several previous studies have reported a prevalence of depression, anxiety, and stress symptoms ranging from 11.5% to 83.1%, 30.5% to 96%, and 12.5% to 78.1%, respectively.[8–12] The prevalence of depression and anxiety among patients with diabetes is almost twice as high as in the general population.[13] Several recent studies have found that there is a complex and bidirectional relationship between depression, anxiety, stress, and chronic diseases, especially among type II diabetes patients.[14,15] For example, chronic diseases like diabetes can negatively impact mood, while mental health disorders like depression can worsen chronic diseases, leading to a vicious cycle of neglect and worsening of the condition. Patients may feel hopeless, struggle to maintain treatment, and experience guilt, exacerbating their mental health concerns.[16]

There is increasing evidence that depression in type II diabetes worsens metabolic and glycemic control, as well as dietary, medication, and physical activity adherence. This increases diabetes complications and disease severity, resulting in higher healthcare expenses and a lower quality of life for patients.[17] A systematic review and meta-analysis of 16 studies discovered an alarmingly substantial link between depression and a higher mortality rate (odds ratio, OR = 1.5) among diabetes patients.[18] According to a recent review in Africa, individuals with TIIDM face various stigmas, including being labeled as HIV-positive, approaching the end of life, and being a burden on resources, which can significantly impact their mental health and highlight the importance of investigating their mental health status.[19]

Despite the fact that 80% of individuals with TIIDM reside in low- and middle-income countries, developed countries conducted the majority of studies on depression, anxiety, and stress symptoms in TIIDM patients.[20] In Africa, there is a scarcity of research on the prevalence and risk factors associated with depression, anxiety, and stress symptoms in individuals with TIIDM. In Somalia, where mental health providers are scarce, identifying factors linked to mental disorders is crucial for targeted screening and monitoring of high-risk patients. This aids in expediting referrals for diagnosis and treatment, alleviating symptoms, and enhancing the mental health and overall quality of life of these patients. Furthermore, to our knowledge, no studies have addressed this issue in Somalia. Similarly, a recent meta-analysis of studies investigating the prevalence of depression among individuals with diabetes mellitus across Africa did not identify any research conducted in Somalia.[21] Therefore, this study aimed to determine the prevalence and associated factors of depression, anxiety, and stress symptoms among patients with TIIDM in Mogadishu, Somalia.

Methods

Study Design and Setting

From November 2023 to January 2024, patients with TIIDM attending the diabetes consultation clinic at the Mogadishu Somali Turkiye Recep Tayyip Erdogan Research and Training Hospital in Mogadishu, Somalia, participated in a hospital-based cross-sectional study. The study setting was Erdogan Hospital, a public, teaching, and tertiary referral hospital located in Mogadishu, Somalia, established in the 1960s. The hospital continued to serve the public until the start of the civil war in the early 1990s, when it closed due to the collapse of the central government. After an agreement between Somali and Turkish government authorities to renovate and modernize, the hospital officially reopened in January 2015.

Sample Size and sampling Procedure

We used the single population proportion formula to find the right sample size: $n=(z)^2*p*(1-p)/d^2$, where n is the smallest sample size needed, p is the estimated prevalence proportion, z is the standard value for a 95% confidence level, and d is the error margin between the sample and the population (5%). We used a P value of 42.3% for this study, representing the prevalence of depression among type II diabetes patients in eastern Ethiopia.[22] Considering a 10% non-response rate, a total sample size of 360 subjects with TIIDM was required. We used a systematic random sampling technique to select study members from the target population. To determine the sampling interval, we divided the total study population that

had follow-up appointments during the three-month data collection period by the total sample size and then randomly selected the starting point.

Inclusion and Exclusion Criteria

Adult patients (age≥18 years) who had TIIDM for at least six months prior to the data collection date and were visiting the outpatient consultation clinic of the hospital during the study period were included in the study. We used the American Diabetes Association criteria to diagnose diabetes, which states that an individual has diabetes if they have a fasting plasma glucose of ≥126 mg/dL, or a 2-hour plasma glucose of ≥200 mg/dL during an oral glucose tolerance test, or an HbA1C of ≥6.5%, or a random plasma glucose of ≥200 mg/dL in a patient with classic symptoms of hyperglycemia or hyperglycemic crisis.[23] The study excluded patients who were terminally ill or required immediate hospitalization for serious illness, patients with mental illness or psychoactive drug use, patients with other endocrine disorders such as thyroid diseases or chronic glucocorticoid use, patients with any form of cognitive impairment such as dementia or mental retardation, and pregnant or lactating mothers.

Variables of Study and Measurements

Dependent Variable

Status of depression symptoms (yes/no), anxiety symptoms (yes/no) and stress symptoms (yes/no).

Independent Variables

Socio-demographic variables (age in years, gender, marital status, occupational status, educational status, number of children, family size, body mass index (BMI), and average monthly income in US dollars); clinical characteristics (family history of psychiatric illness, family history of DM, presence of **diabetes** complications, number of comorbid medical illness, duration of DM, regular doctor follow up, glycemic control, most recent HbA1c level, current diabetes management, and compliance with diabetes management), and behavioral characteristics (physical activity, cigarette smoking status, and khat chewing status).

Data Collection Tools and Procedures

The data was collected by distributing two sets of self-administered questionnaires, which included sociodemographic, clinical, and behavioral characteristics of the patient, as well as the depression, anxiety, and stress scale (DASS-21) questionnaire.[24] The sociodemographic, clinical, and behavioral characteristics' of participants were collected by using a structured questionnaire that was developed from a literature review.[8,10,17,22] Except for age, all variables were categorical and collected using closed-ended questions.

Depression, anxiety, and stress were assessed by DASS-21. The total number of items is 21, divided into three subscales for depression, anxiety, and stress, each with seven components. Participants are asked if they experienced a specific group of symptoms from each subscale in the previous week, prompting them to select a 4-point Likert scale ranging from "0", indicating "does not apply to me", to '3', indicating "applies to me most of the time". The subscale scores were determined by adding the scores of each item in the subscale, then multiplying by two to align with the original questionnaire version. The DASS Manual eventually classified scores for each subscale as normal, mild, moderate, severe, and extremely severe (Table 1). Additionally, we reviewed patient health records from the hospital

Table 1 The Score Classification of the Depression, Anxiety, and Stress Scale-21 Questionnaire

Domain	Normal	Mild	Moderate	Severe	Extremely Severe
Depression	0–9	10–13	14–20	21–27	≥28
Anxiety	0–7	8–9	10–14	15–19	≥20
Stress	0–14	15–18	19–25	26–33	≥34

system to obtain the most recent HbA1c level and measured the patients' height and weight to determine their BMI. According to the ADA Guidelines, a level of HbA1c <7.0% was defined as good glycemic control, and a level of HbA1c ≥7.0% was considered poor glycemic control.[4,22,25]

Data Management and Statistical Analysis

The study utilized Excel for data entry to ensure accuracy, followed by the Statistical Package for the Social Sciences (SPSS) (Armonk, NY: IBM Corp.), version 26 for descriptive and inferential analysis. The descriptive analysis assessed the socio-demographic, behavioral, clinical characteristics, and DASS-21 score distributions. We performed bivariate and multivariable logistic regression analyses to determine factors associated with the outcome variables. All variables with a p-value of less than 0.25 in bivariate logistic regression were considered candidates and included in the multivariate logistic regression analysis. We used the Hosmer-Lemeshow goodness of fit test to determine the final model's goodness of fit. We considered factors with a p-value less than 0.05 to be statistically significant in multivariate logistic regression and presented the adjusted odds ratio (AOR) with a 95% confidence interval (CI).

Ethical Approval

We conducted the study in compliance with our hospital's regulations, ethical standards, and the Declaration of Helsinki. The Mogadishu Somali Turkiye Recep Tayyip Erdogan Research and Training Hospital's Institutional Review Board (IRB) gave its approval to the study with the reference number MSTH/14299. All subjects with eligibility criteria were explained the study objectives and requested to take part, and before participating in the study, each respondent gave written informed consent and signed it voluntarily without coercion or influence on their decision. Additionally, we informed all individuals about their complete right to participate or withdraw from the study at any moment, the anonymity of the study questionnaires, the confidentiality of the data, and the absence of any individual-specific information.

Results

Socio-Demographic Characteristics of the Patients with type II Diabetes Mellitus

A total of 360 patients with TIIDM participated in the study, resulting in a response rate of 100%. Females constituted the majority (65.6%) of the participants. Most respondents were aged between 50–64 (38.6%) and 35–49 (35.0%) years, with a mean age of 46.7 years and a standard deviation of 12.5 years. The majority was married (67.2%) and had no formal education (58.6%). A large portion was unemployed (61.4%), with the majority earning ≤499 USD monthly (66.1%). Nearly half had family sizes of 6–10 members (49.2%), and the largest group had 5–8 children (45.0%). Most participants had a normal body mass index (40.8%) (Table 2).

Clinical and Behavioral Characteristics of the Patients with type II Diabetes Mellitus

More than half (51.9%) of the participants had a family history of DM, only 11.1% of respondents have a family history of psychiatric illness. The majority of participants (56.4%) report having no comorbid illnesses, while 24.7% have one comorbid illness, and 18.9% have two or more comorbidities. The distribution across different durations of DM shows a relatively balanced spread, with 41.1% having a duration of ≤3 years, 30.6% between 4 and 7 years, and 28.3% ≥8 years. Only 25.8% of participants report regular doctor follow-up. A significant proportion (82.8%) of respondents have poor glycemic control, with an HbA1c level ≥7%, but only 10.6% of respondents indicate the presence of DM complications. The most common diabetes management approach is lifestyle modifications combined with oral medications (63.6%).

A smaller proportion of respondents use lifestyle modifications combined with insulin (16.1%), or a combination of lifestyle modifications, oral medications, and insulin (11.4%). Non-compliance with diabetes management measures is relatively low, with only 7.8% of respondents reporting no adherence. The majority of the respondents have never smoked (86.7%). Similarly, the majority of the participants have never used khat (87.8%) and do not exercise regularly (61.1%) (Table 3).

Table 2 Socio-Demographic Characteristics of the Patients with Type II Diabetes Mellitus in Mogadishu, Somalia 2024 (n=360)

Variable	Category	Frequency	Percentage
Gender	Female	236	65.6
	Male	124	34.4
Age	Less than 35	69	19.2
	35–49	126	35.0
	50–64	139	38.6
	65 and above	26	7.2
Marital status	Never married	27	7.5
	Married	242	67.2
	Widow/Widower	56	15.6
	Divorced	35	9.7
Education status	No formal education	211	58.6
	Primary school	61	16.9
	Secondary school	52	14.4
	University	36	10.0
Number of children	≤4 children	80	22.2
	5–8 children	162	45.0
	≥9 children	118	32.8
Family size	≤5 members	76	21.1
	6–10 members	177	49.2
	≥11 members	107	29.7
Education status	No formal education	211	58.6
	Primary school	61	16.9
	Secondary school	52	14.4
	University	36	10.0
Occupation status	Employed	139	38.6
	Unemployed	221	61.4
Monthly income	≤499 USD	238	66.1
	500–999 USD	102	28.3
	≥ 1000 USD	20	5.6
BMI	Underweight (<18.5)	22	6.1
	Normal weight (18.5–24.9)	147	40.8
	Overweight (25–29.9)	117	32.5
	Obese (≥30)	74	20.6

Table 3 Clinical and Behavioral Characteristics of the Patients with Type II Diabetes Mellitus in Mogadishu, Somalia 2024 (n=360)

Variable	Category	Frequency	Percentage
Family history of DM	Yes	187	51.9
	No	173	48.1
Family history of psychiatric illness	Yes	40	11.1
	No	320	88.9
Number of comorbid illnesses	None	203	56.4
	One	89	24.7
	Two or more	68	18.9
Duration of DM	≤3 years	148	41.1
	4–7 years	110	30.6
	≥8 years	102	28.3

(*Continued*)

Table 3 (Continued).

Variable	Category	Frequency	Percentage
Regular doctor follow up	Yes	93	25.8
	No	267	74.2
Most recent HbA1c level	Good (<7%)	62	17.2
	Poor (≥7%)	298	82.8
DM complications	No	322	89.4
	Yes	38	10.6
Current diabetes management	Lifestyle modifications	32	8.9
	Lifestyle modifications + oral medications	229	63.6
	Lifestyle modifications + oral medications + insulin	41	11.4
	Lifestyle modifications + insulin"	58	16.1
Diabetes management compliance	No	28	7.8
	Yes	332	92.2
Cigarette smoking status	Current smoker	17	4.7
	Ex-smoker	31	8.6
	Never smoked	312	86.7
Khat chewing status	Current user	10	2.8
	Ex-user	34	9.4
	Never-used	316	87.8
Exercise regularly	Yes	140	38.9
	No	220	61.1

Prevalence of Depression, Anxiety, and Stress

The study findings revealed that 44.7% (95% CI: 39.5–50%), 55% (95% CI: 49.7–60.2%), and 30.3% (95% CI: 25.6–35.3%) of patients with TIIDM in Mogadishu Somalia had depression, anxiety, and stress, respectively (Figure 1).

Factors Associated with Depression Among Patients with Type II Diabetes Mellitus

In the bivariate logistic regression analysis, gender, education status, regular exercise, most recent HbA1c levels, duration of DM were all significantly associated with depression. However, in the multivariate logistic regression analysis, variables such as lack of regular exercise and having duration of DM between 4 and 7 years were significantly associated with depression at a p value of 0.05.

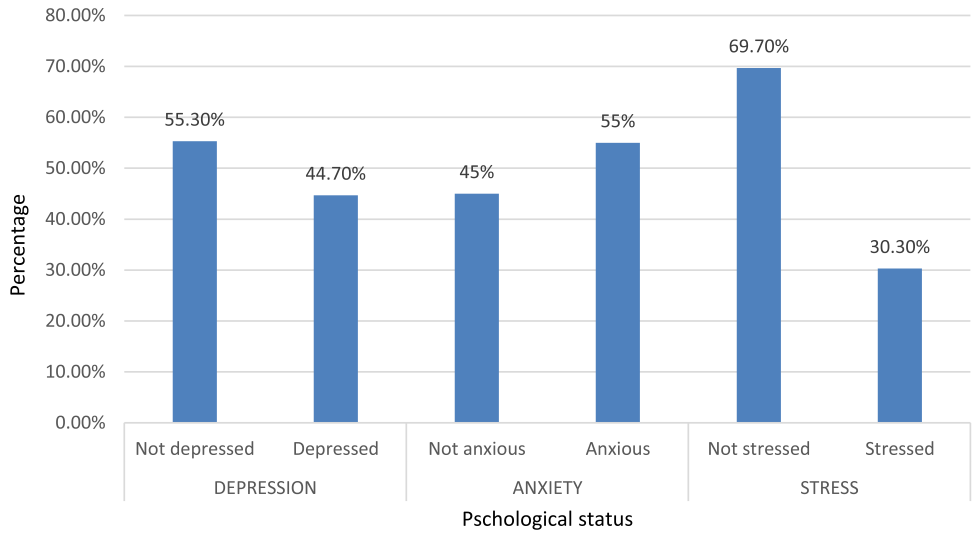

Figure 1 Prevalence of depression, anxiety, and stress symptoms among patients with TIIDM in Somalia.

The study's findings indicated that the participants who do not exercise regularly had 1.79 times higher odds of experiencing depression as compared to those who do exercise regularly (AOR=1.79; 95%CI: 1.14–2.79). Diabetes patients with a duration of DM between 4 to 7 years had 1.94 times higher odds of depression as compared to those with a duration of ≤3 years (AOR=1.94; 95%CI: 1.16–3.23) (Table 4).

Factors Associated with Anxiety Among Patients with Type II Diabetes Mellitus

In the bivariate logistic regression analysis, gender, marital status, number of children, education status, occupation status, monthly income, regular exercise, number of comorbid illnesses, most recent HbA1c levels, and DM treatment compliance were all significantly associated with anxiety. However, in the multivariate logistic regression analysis, variables such as being female, having ≥9 children and a lack of regular exercise were significantly associated with anxiety at a p value of 0.05.

The findings of this study have shown that the odds of having anxiety among participants who were female were about 2 times higher as compared to those who were male (AOR=2.07; 95%CI: 1.31–3.28). Diabetes patients with nine or more children had 1.94 times higher odds of anxiety as compared to those with four or fewer children (AOR=1.94; 95%CI: 1.07–3.53). Similarly, patients who did not exercise regularly had 1.57 times higher odds of experiencing anxiety than those who did (AOR=1.57; 95%CI: 1.01–2.45) (Table 5).

Factors Associated with Stress Among Patients with Type II Diabetes Mellitus

In the bivariate logistic regression analysis, age, gender, regular exercise, number of comorbid illnesses, DM complications, DM treatment compliance, and duration of DM were all significantly associated with stress. However, in the multivariate logistic regression analysis, variables such as lack of regular exercise, DM complications, DM treatment compliance, and duration of DM between 4 and 7 years were significantly associated with stress at a p value of 0.05.

The results of this study demonstrated that the odds of having stress among participants who do not exercise regularly were 1.92 times higher as compared to those who do exercise regularly (AOR=2.07; 95%CI: 1.31–3.28). Patients with DM complications had 2.14 times higher odds of stress compared to those without complications (AOR=2.14; 95%CI: 1.01–4.54). Similarly, patients who do not comply with diabetes management had 2.74 times higher odds of stress compared to those who do comply (AOR=2.74; 95%CI: 1.20 to 6.26). Likewise, patients with a duration of DM between 4 and 7 years had 2.22 times higher odds of stress compared to those with a duration of ≤3 years (AOR=2.22; 95%CI: 1.25–3.94) (Table 6).

Table 4 Bivariate and Multivariate Logistic Regression of Depressive Symptoms and Associated Factors Among Patients with Type II Diabetes Mellitus in Mogadishu, Somalia 2024 (n=360)

Variable	Category	Depression		COR(95%CI)	AOR(95%CI)	P-value
		Yes	No			
Gender	Female	108(45.7)	128(54.3)	1.13(0.729, 1.73)	0.893(0.549, 1.45)	0.648
	Male	53(42.7)	71(57.3)	1	1	
Educational status	No formal education	86(40.8)	125(59.2)	0.688(0.339, 1.39)	0.636(0.307, 1.32)	0.223
	Primary school	33(54.1)	28(45.9)	1.18(0.517, 2.69)	1.16(0.501, 2.69)	0.726
	Secondary school	24(46.2)	28(53.8)	0.857(0.366, 2.01)	0.879(0.369, 2.09)	0.772
	University	18(50.0)	18(50.0)		1	
Most recent HbA1c level	Yes	34(54.8)	28(45.2)		1	
	No	127(42.6)	171(57.4)	0.612(0.353, 1.06)	0.653(0.366, 1.16)	0.149
Exercise regularly	Yes	52(37.1)	88(62.9)		1	
	No	109(49.5)	111(50.5)	1.66(1.08, 2.56)	1.79(1.14, 2.79)	0.011*
Duration of DM	≤3 years	59(39.9)	89(60.1)		1	
	4–7 years	61(55.5)	49(44.5)	1.88(1.14, 3.09)	1.94(1.16, 3.23)	0.012*
	≥8 years	41(40.2)	61(59.8)	1.01(0.606, 1.69)	1.16(0.680, 1.97)	0.588

Note: *Indicates significance at 5% level.
Abbreviations: COR, Crude odd ratio; AOR, Adjusted odd ratio; 1, reference categories; CI, Confidence interval.

Table 5 Bivariate and Multivariate Logistic Regression of Anxiety Symptoms and Associated Factors Among Patients with Type II Diabetes Mellitus in Mogadishu, Somalia 2024 (n=360)

Variable	Category	Anxiety		COR(95%CI)	AOR(95%CI)	P-Value
		Yes	No			
Gender	Female	144(61.0)	92(39.0)	2.03(1.30, 3.15)	2.07(1.31, 3.28)	0.002*
	Male	54(43.5)	70(56.5)		1	
Number of children	≤4 children	37(46.3)	43(53.8)		1	
	5–8 children	92(56.8)	70(43.2)	1.53(0.892, 2.62)	1.54(0.886, 2.68)	0.125
	≥9 children	69(58.5)	49(41.5)	1.64(0.924, 2.90)	1.94(1.07, 3.53)	0.030*
Exercise regularly	Yes	67(47.9)	73(52.1)		1	
	No	131(59.5)	89(40.5)	1.60(1.05, 2.46)	1.57(1.01, 2.45)	0.046*
Most recent HbA1c level	Good	28(45.2)	34(54.8)		1	
	Poor	170(57.0)	128(43.0)	1.61(0.930, 2.79)	1.62(0.920, 2.87)	0.094

Notes: *Indicates significance at 5% level.
Abbreviations: COR, Crude odd ratio, AOR; Adjusted odd ratio, 1; reference categories; CI, Confidence interval.

Table 6 Bivariate and Multivariate Logistic Regression of Stress Symptoms and Associated Factors Among Patients with Type II Diabetes Mellitus in Mogadishu, Somalia 2024 (n=360)

Variable	Category	Stress		COR(95%CI)	AOR(95%CI)	P-Value
		Yes	No			
Age	Less than 35	18(26.1)	51(73.9)		1	
	35–49	50(39.7)	76(60.3)	1.86(0.978, 3.55)	1.89(0.939, 3.68)	0.075
	50–64	38(27.3)	101(72.7)	1.06(0.554, 2.05)	0.969(0.473, 1.98)	0.931
	65 and above	3(11.5)	23(88.5)	0.370(0.099, 1.38)	0.330(0.082, 1.32)	0.118
Gender	Female	77(32.6)	159(67.4)	1.39(0.857, 2.26)	1.12(0.661, 1.89)	0.675
	Male	32(25.8)	92(74.2)		1	
Number of comorbid illnesses	None	57(28.1)	146(71.9)		1	
	One	26(29.2)	63(70.8)	1.06(0.610, 1.83)	1.01(0.558, 1.81)	0.989
	Two or more	26(38.2)	42(61.80)	1.59(0.890, 2.82)	1.80(0.944, 3.43)	0.074
Exercise regularly	Yes	31(22.1)	109(77.9)		1	
	No	78(35.5)	142(64.5)	1.93(1.19, 3.14)	1.92(1.14, 3.22)	0.015*
DM complications	Yes	92(28.6)	230(71.4)	2.02(1.02, 4.01)	2.14(1.01, 4.54)	0.047*
	No	17(44.7)	21(55.3)		1	
DM treatment compliance	Yes	96(28.9)	236(71.1)		1	
	No	13(46.4)	15(53.6)	2.13(0.977, 4.65)	2.74(1.20, 6.26)	0.017*
Duration of DM	≤3 years	36(24.3)	112(75.7)		1	
	4–7 years	44(40.0)	66(60.0)	2.07(1.21, 3.54)	2.22(1.25, 3.94)	0.007*
	≥8 years	299(28.4)	73(71.6)	1.24(0.698, 2.19)	1.27(0.675, 2.39)	0.457

Note: *Indicates significance at 5% level.
Abbreviations: COR, Crude odd ratio; AOR, Adjusted odd ratio; 1, reference categories; CI, Confidence interval.

Discussion

This study assessed the prevalence and factors associated with depression, anxiety, and stress symptoms among patients with TIIDM in Mogadishu, Somalia. Among the 360 participants, 55% exhibited symptoms of anxiety, 44.7% displayed symptoms of depression, and 30.3% showed symptoms of stress. Gender, number of children, diabetes complications, illness duration, regular exercise, and compliance with diabetes management measures were the primary predictors of mental health issues. Being physically active was associated with decreased odds of having depression, anxiety, and stress, while an illness duration of 4–7 years was associated with increased odds of having both depression and stress.

The prevalence of anxiety symptoms in the current study was comparable with studies carried out in Saudi Arabia,[26] Pakistan,[27] and Mexico.[28] Compared to previous studies conducted in Ethiopia,[22] China,[29,30] Saudi Arabia,[10,31] Ecuador,[11] and Bangladesh,[32] this study found a higher prevalence of anxiety symptoms. On the other hand, studies conducted in Iran[9,13,33] and South India[34] revealed a higher prevalence of anxiety symptoms than the current study.

Depression frequently occurs in individuals with chronic diseases such as DM, and it significantly impacts their overall quality of life as well as their occupational, physical, and emotional well-being.[35–38] In this study, we found a relatively high prevalence of depression symptoms among TIIDM patients, which is consistent with research from Ethiopia,[22] South Africa,[39] Saudi Arabia,[40] Turkiye,[41] and China.[30] The increased depression prevalence rates in individuals with DM suggest a significant correlation between the two diseases, as both conditions may share a common cause. Therefore, the presence of DM raises the occurrence or likelihood of future depression, and similarly, the existence of depression enhances the potential risk for future DM.[42]

However, the findings of this study were lower than those of the studies conducted in Iran,[13] Nepal,[43] South India,[34] China,[29] Rwanda,[44] and Tanzania.[45] On the other hand, the findings of the current study were higher than those of the studies performed in southwest Ethiopia,[46] Bangladesh,[32] China,[47] and Sudan.[48] Similarly, the prevalence of depressive symptoms in this study was significantly higher than the global prevalence of depression among TIIDM patients reported in a recent systematic review and meta-analysis.[49] A recent systematic review and meta-analysis from China also reported depression prevalence rates that were lower than those found in the present study.[50]

According to a previous Saudi Arabian study,[31] stress symptoms were present in nearly one-third of the patients with TIIDM, which is in line with the current study. However, several other studies from different countries, like Malaysia,[51] Saudi Arabia,[10] and Ecuador,[11] reported lower prevalence rates of stress symptoms than the findings of the present study. Contrary to our results, other studies reported much higher prevalence rates.[9,12] The various methods used, such as variations in sample size, study design, screening tools, cut-off scores, and participant sociodemographic statuses, may explain the varying prevalence rates found in these studies. Regardless of these differing estimates, patients with TIIDM have well-established higher rates of psychological distress, such as anxiety and depression, compared to the general population.[52]

The general population has a well-established connection between regular physical exercise and anxiety and depression, making it a crucial part of treatment plans for individuals with diabetes.[53,54] In the present study, we found that a lack of regular physical exercise was a significant predictor of depression, anxiety, and stress among TIIDM patients. Studies conducted in Bangladesh,[32] the UK,[55] Iran,[13] Saudi Arabia,[26] and Australia[56] supported this finding. Similarly, a recent systematic review and meta-analysis of the relationship between physical activity and depression found that even below public health guidelines, physical activity improves mental health well-being.[57] Possible mechanisms that play a role in the link between regular exercise and reduced depression and anxiety include endorphin release, thermogenesis activation, mTOR axis activation in some brain areas, and neurotransmitter discharge (like dopamine and serotonin).[58] Therefore, to help manage depressive symptoms, healthcare professionals in Somalia should strongly advocate for the promotion of healthy lifestyles, such as frequent physical activity, among individuals with TIIDM. Furthermore, it is crucial for family members to actively promote higher levels of physical activity in individuals with TIIDM, as family support plays a significant role in ensuring compliance with physical activity recommendations.

This study also revealed that the duration of illness (4–7 years) was a significant predictor of depression and stress. However other studies reported different results, for instance, a Malaysian study found that a diabetes duration of less than 2 years was a significant predictor of depression,[8] while other studies linked an illness duration of more than or equal to 10 years to an increased risk of developing depression.[12,50] On the other hand, several studies found no association between the duration of illness and the psychological symptoms of TIIDM patients.[9,17,32,40] Additionally, we did not find a significant association between the illness duration of ≤3 years and ≥8 years. The most plausible explanation is that patients with shorter illness durations are still getting used to the concept of their condition and its effects on their lives, whereas those with longer illness durations have more time to come to terms with their diagnosis, accept all the associated issues, and adjust their lifestyles to accommodate the disease and its impacts on their quality of life.

This study found no correlation between age groups and the psychological symptoms of diabetes patients, which aligns with prior studies on the topic.[40,48,59] On the other hand, several studies have shown a link between age, especially the elderly, and the psychological symptoms encountered by individuals with diabetes, which contradicts our results.[13,22,26,32,43,50]

Our study revealed higher odds of anxiety symptoms being more prevalent in female diabetes patients compared to their male counterparts, but not depressive symptoms. Several previous studies reported that both depression and anxiety symptoms were more common in female patients than in male participants.[9,32,41] Contrary to our results, multiple studies have shown increased odds of depressive symptoms in female diabetes patients.[13,22,40,50] Similarly, Alzahrani et al[10] discovered that being female was a significant predictor for experiencing sadness, anxiety, and stress. Females have a higher vulnerability to anxiety and depression compared to men due to a variety of reasons, such as genetic predisposition, hormonal influences, environmental conditions, societal expectations, cultural constraints, and stress.[60] However, other studies have found no correlation between gender and symptoms of depression, anxiety, or stress among TIIDM patients.[12,17,43] This study found that patients with nine or more children had higher odds of having anxiety symptoms compared to the other participants, which is comparable to the results reported by Ahangari et al.[9]

Our study revealed that the presence of diabetes complications increased the likelihood of stress among the participants, but it did not have a significant impact on anxiety or depression. However, several studies have documented varying findings. Rehman and Kazmi's study,[61] for instance, found a strong correlation between diabetes-related complications and the presence of depression, anxiety, and stress. In contrast to these findings, Cárdenas et al[6] demonstrated that diabetes-related complications were associated with an increased probability of experiencing anxiety and depression but not stress, whereas Alzahrani et al[10] found no link between diabetes complications and depression, anxiety, or stress.

The study's findings showed no correlation between HbA1c levels and the psychological symptoms of TIIDM, which agrees with the findings of a recent Ecuadorian study.[11] In contrast to our findings, several studies reported varying associations between HbA1c levels and depression, anxiety, and stress. For instance, Alzahrani et al[10] demonstrated a correlation between HbA1c levels and depression, anxiety, and stress, whereas Kaur et al[8] discovered an association between HbA1c levels and anxiety and stress. Similarly, Dehesh et al[13] found an association between HbA1c levels and depression among TIIDM patients.

Patients with TIIDM often have additional health conditions such as hypertension, hyperlipidemia, and cardiovascular disease. These comorbidities have a significant impact on the disease's course and contribute to the development of diabetes-related complications.[62] The current study found no significant association between comorbidity and the psychological symptoms of patients with TIIDM. Hossen et al[32] reported similar results. Nevertheless, several previous studies have documented different findings. For example, Alzahrani et al[10] have shown an association between comorbidity, anxiety, and depression, while Kaur et al[8] identified a connection just between comorbidity and stress. In our study, we did not find a correlation between adherence to DM treatment and the likelihood of experiencing depression and anxiety. However, we did observe that not adhering to DM management increased the probability of experiencing stress among the participants. Several studies have reported similar results, demonstrating that inadequate adherence to DM therapy is associated with depression, anxiety, and stress.[10,12]

Strength and Limitation of the Study

This study's main strength is that, to our knowledge, it is the first to investigate the prevalence of depression, anxiety, and stress, as well as their determinant factors, among Somali patients with TIIDM. Understanding and recognizing the risk factors that increase the likelihood of developing mental health issues is critical for preventing and managing such disorders in this population. Second, we enrolled in the study with a sample size that adequately represents the target population. However, this study has certain limitations. First, the instrument used to evaluate symptoms of depression, anxiety, and stress is solely a screening tool and does not serve as a diagnostic instrument. As a result, we examined only the symptoms, not the diseases themselves. Second, although previous studies highlighted the bidirectional association between outcome variables and diabetes due to the study's cross-sectional design, we are unable to identify the causal link between depression, anxiety, stress, and TIIDM. Given the study's limitations, we suggest conducting longitudinal studies to investigate the causal link between psychological symptoms and predictor variables. Additionally, using controls in future studies can help better understand the nature of the association between psychological disorders and TIIDM.

Conclusion

The results of this study showed a moderately high prevalence of depression, anxiety, and stress symptoms in TIIDM patients, suggesting a strong link between diabetes and mental health well-being. These findings highlight the significance of a comprehensive strategy for managing diabetes that incorporates both physical and psychological health support. A lack of regular exercise and an illness duration of 4–7 years were statistically associated with depressive symptoms, whereas being female, having ≥9 children, and a lack of regular exercise were statistically associated with anxiety symptoms. On the other hand, a 4–7 year illness duration, a lack of regular exercise, DM complications, and DM management non-compliance were all statistically associated with stress symptoms. Healthcare workers should prioritize enhancing and spreading health education programs for diabetes patients. Additionally, healthcare providers should be highly concerned with screening, promptly identifying, and offering suitable interventions for psychological symptoms in patients with TIIDM. Healthcare professionals should be vigilant for diabetes patients who exhibit sedentary behavior and non-compliance with their prescription regimen. Their goal should be to motivate and support these patients in maintaining treatment adherence and engaging in physical exercise, with the aim of reducing the mental health burden associated with diabetes.

Abbreviations

TIIDM, Type II Diabetes Mellitus; DASS, Depression, Anxiety and Stress Scale; AOR, Adjusted Odds Ratio; CI, Confidence Interval; DM, Diabetes Mellitus; ADA, American Diabetes Association; IDF, International Diabetes Federation; WHO, World Health Organization; BMI, Body Mass Index.

Data Sharing statement

All data generated or analyzed during this study are included in this published article or are available from the corresponding author upon reasonable request.

Ethics approval and consent to participate

This study was approved by the hospital's ethics review board (MSTH/14299). All methods were carried out in accordance with the Declaration of Helsinki. Written informed consent was obtained from all participants.

Acknowledgments

The authors would like to thank all of the study subjects for their kind participation and our hospital's diabetes consultation unit staff for their warm assistance in collecting data.

Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

Funding

This study received no specific funding from funding agencies or sectors.

Disclosure

The authors reported no conflicts of interest related to this article.

References

1. Xu G, Liu B, Sun Y, et al. Prevalence of diagnosed type 1 and type 2 diabetes among US adults in 2016 and 2017: population based study. *BMJ*. 2018;362(k1497). doi:10.1136/bmj.k1497
2. Cho NH, Shaw JE, Karuranga S, et al. IDF diabetes atlas: Global estimates of diabetes prevalence for 2017 and projections for 2045. *Diabet Res Clin Pract*. 2018;138:271–281. doi:10.1016/j.diabres.2018.02.023

3. Saeedi P, Petersohn I, Salpea P, et al. Global and regional diabetes prevalence estimates for 2019 and projections for 2030 and 2045: Results from the international diabetes federation diabetes atlas, 9th edition. *Diabet Res Clin Pract*. 2019;157:107843. doi:10.1016/j.diabres.2019.107843
4. ElSayed NA, Aleppo G, Aroda VR, et al. 6. Glycemic targets: Standards of care in diabetes-2023. *Diabetes Care*. 2023;46(Suppl 1):S97–S110. doi:10.2337/dc23-S006
5. World Health Organization. *Diabetes Somalia 2016 Country Profile*. Geneva: WHO; 2016.
6. The World Bank. *Diabetes Prevalence (% of Population Ages 20 to 79)*. Somalia: The World Bank; 2021.
7. Mohamed MH, Farah MA, Ali MA, Mohamed NA, Hassan AM. Knowledge, attitude and practice on common diabetic patients among diabetic complications at Egyptian hospital in Mogadishu, Somalia. *J Biosci Med*. 2021;9(9):87–99. doi:10.4236/jbm.2021.99008
8. Kaur G, Tee GH, Ariaratnam S, Krishnapillai AS, China K. Depression, anxiety and stress symptoms among diabetics in Malaysia: A cross sectional study in an urban primary care setting. *BMC Fam Pract*. 2013;14:69. doi:10.1186/1471-2296-14-69
9. Ahangari H, Moasheri B, Norouzi E, Shayesteh M. The prevalence of stress, anxiety and depression in patients with type 2 diabetes and their association with demographic factors. *Health Edu Health Promotion*. 2016;4(3):13–22.
10. Alzahrani A, Alghamdi A, Alqarni T, Alshareef R, Alzahrani A. Prevalence and predictors of depression, anxiety, and stress symptoms among patients with type II diabetes attending primary healthcare centers in the western region of Saudi Arabia: A cross-sectional study. *Int J Ment Health Syst*. 2019;13:48. doi:10.1186/s13033-019-0307-6
11. Cárdenas L, Cabezas MDC, Muñoz A, Proaño JL, Miño C, Aguirre N. Prevalence and risk factors of depression, anxiety, and stress in an Ecuadorian outpatient population with type II diabetes mellitus: A cross-sectional study (STROBE). *Medicine*. 2022;101(39):e30697. doi:10.1097/MD.0000000000030697
12. Abualhamael SA, Baig M, Alghamdi W, Gazzaz ZJ, Al-Hayani M, Bazi A. Quality of life, stress, anxiety and depression and associated factors among people with type 2 diabetes mellitus in western region Saudi Arabia. *Front Psychiatry*. 2024;14:1282249. doi:10.3389/fpsyt.2023.1282249
13. Dehesh T, Dehesh P, Shojaei S. Prevalence and associated factors of anxiety and depression among patients with type 2 diabetes in Kerman, Southern Iran. *Diabetes Metab Syndr Obes*. 2020;13:1509–1517. doi:10.2147/DMSO.S249385
14. Scott KM, Lim C, Al-Hamzawi A, et al. Association of mental disorders with subsequent chronic physical conditions: World mental health surveys from 17 countries. *JAMA Psychiatry*. 2016;73(2):150–158. doi:10.1001/jamapsychiatry.2015.2688
15. Atlantis E, Ghassem Pour S, Girosi F. Incremental predictive value of screening for anxiety and depression beyond current type 2 diabetes risk models: A prospective cohort study. *BMJ Open*. 2018;8(1):e018255. doi:10.1136/bmjopen-2017-018255
16. Herrera PA, Campos-Romero S, Szabo W, Martínez P, Guajardo V, Rojas G. Understanding the relationship between depression and chronic diseases such as diabetes and hypertension: A grounded theory study. *Int J Environ Res Public Health*. 2021;18(22):12130. PMID: 34831886; PMCID: PMC8618720. doi:10.3390/ijerph182212130
17. Tran NMH, Nguyen QNL, Vo TH, Le TTA, Ngo NH. Depression among patients with type 2 diabetes mellitus: Prevalence and associated factors in Hue City, Vietnam. *Diabetes Metab Syndr Obes*. 2021;14:505–513. doi:10.2147/DMSO.S289988
18. van Dooren FE, Nefs G, Schram MT, Verhey FR, Denollet J, Pouwer F. Depression and risk of mortality in people with diabetes mellitus: A systematic review and meta-analysis. *PLoS One*. 2013;8(3):e57058. doi:10.1371/journal.pone.0057058
19. Akyirem S, Ekpor E. Experience of stigma among persons with type 2 diabetes in Africa: A systematic review. *Int Health*. 2024;16(3):231–239. PMID: 37366652; PMCID: PMC11062194. doi:10.1093/inthealth/ihad045
20. Mendenhall E, Norris SA, Shidhaye R, Prabhakaran D. Depression and type 2 diabetes in low- and middle-income countries: A systematic review. *Diabet Res Clin Pract*. 2014;103(2):276–285. doi:10.1016/j.diabres.2014.01.001
21. Ogunsakin RE, Olugbara OO, Moyo S, Israel C. Meta-analysis of studies on depression prevalence among diabetes mellitus patients in Africa. *Heliyon*. 2021;7(5):e07085. PMID: 34095580; PMCID: PMC8165422. doi:10.1016/j.heliyon.2021.e07085
22. Nigussie K, Sertsu A, Ayana GM, et al. Determinants of depression and anxiety among type 2 diabetes patients in governments' hospitals at Harari regional state, Eastern Ethiopia: A multi-center cross-sectional study. *BMC Psychiatry*. 2023;23(1):13. doi:10.1186/s12888-022-04494-x
23. ElSayed NA, Aleppo G, Aroda VR, et al.; on behalf of the American Diabetes Association. 2. Classification and diagnosis of diabetes: Standards of care in diabetes-2023. *Diabetes Care*. 2023; 46(Suppl 1): S19–S40. PMID: 36507649; PMCID: PMC9810477. doi:10.2337/dc23-ad08
24. Lovibond PF, Lovibond SH. The structure of negative emotional states: comparison of the depression anxiety stress scales (DASS) with the beck depression and anxiety inventories. *Behav Res Ther*. 1995;33(3):335–343. doi:10.1016/0005-7967(94)00075-Ua
25. Boye KS, Thieu VT, Lage MJ, Miller H, Paczkowski R. The association between sustained HbA1c control and long-term complications among individuals with type 2 diabetes: A retrospective study. *Adv Ther*. 2022;39(5):2208–2221. doi:10.1007/s12325-022-02106-4
26. AlBekairy A, AbuRuz S, Alsabani B, et al. Exploring factors associated with depression and anxiety among hospitalized patients with type 2 diabetes mellitus. *Med Princ Pract*. 2017;26(6):547–553. doi:10.1159/000484929
27. Khuwaja AK, Lalani S, Dhanani R, Azam IS, Rafique G, White F. Anxiety and depression among outpatients with type 2 diabetes: A multi-centre study of prevalence and associated factors. *Diabetol Metab Syndr*. 2010;2:72. doi:10.1186/1758-5996-2-72
28. Tovilla-Zárate C, Juárez-Rojop I, Peralta Jimenez Y, et al. Prevalence of anxiety and depression among outpatients with type 2 diabetes in the Mexican population. *PLoS One*. 2012;7(5):e36887. doi:10.1371/journal.pone.0036887
29. Sun N, Lou P, Shang Y, et al. Prevalence and determinants of depressive and anxiety symptoms in adults with type 2 diabetes in China: A cross-sectional study. *BMJ Open*. 2016;6(8):e012540. doi:10.1136/bmjopen-2016-012540
30. Wen Y, Han X, Sun M, et al.. The anxiety and depression status and related influencing factors in patients with type 2 diabetes: Why should we care. *J Radiat Res Appl Sci*. 2023;16(1):100495. doi:10.1016/j.jrras.2022.100495
31. Aljohani AA, Al-Namlah SS, Fallatah AN, Al-Sharif SS, Khayat FM, Almaghrabi RY. Depression, anxiety, and stress among type II among diabetic patients in Al-Madinah, Saudi Arabia. *Pharmacophore*. 2022;13(3–2022):106–112. doi:10.51847/jxdYXjDhWe
32. Hossen MT, Shuvo SD, Mazumdar S, et al. Determinants of anxiety and depression among type 2 diabetes mellitus patients: A hospital-based study in Bangladesh amid the COVID-19 pandemic. *Glob Ment Health*. 2024;11:e13. doi:10.1017/gmh.2024.8
33. Namjoo S, Mirzaei M, Foroughan M, Harouni GG, Aboubakri O. Prevalence and determinants of depression, anxiety and stress among the Iranian older people with type 2 diabetes. *J Ren Inj Prev*. 2022. doi:10.34172/jrip.2022.10
34. Subramanian P, Prabhu V, Ramachandran AS, Kumar JS. A cross-sectional study to determine the prevalence and predictors of depression and anxiety in type 2 diabetes patients in South India. *Int J Nutr Pharmacol Neurol Dis*. 2024;14(1):111–117. doi:10.4103/ijnpnd.ijnpnd_83_23

35. Li H, Ge S, Greene B, Dunbar-Jacob J. Depression in the context of chronic diseases in the United States and China. *Int J Nurs Sci*. 2018;6 (1):117–122. doi:10.1016/j.ijnss.2018.11.007
36. Mohamed NA, Eraslan A, Kose S. The impact of anxiety and depression on the quality of life of hemodialysis patients in a sample from Somalia. *BMC Psychiatry*. 2023;23(1):825. doi:10.1186/s12888-023-05312-8
37. Huang D, Wang J, Fang H, Fu Y, Lou J. Longitudinal association of chronic diseases with depressive symptoms in middle-aged and older adults in China: Mediation by functional limitations, social interaction, and life satisfaction. *J Glob Health*. 2023;13:04119. doi:10.7189/jogh.13.04119
38. Kose S, Mohamed NA. The interplay of anxiety, depression, sleep quality, and socioeconomic factors in Somali hemodialysis patients. *Brain Sci*. 2024;14(2):144. doi:10.3390/brainsci14020144
39. Ramkisson S, Pillay BJ, Sartorius B. Anxiety, depression and psychological well-being in a cohort of South African adults with type 2 diabetes mellitus. *S Afr J Psychiatr*. 2016;22(1):935. doi:10.4102/sajpsychiatry.v22i1.935
40. Khiro MAK, Alshahrani AAS, Jabali SHY, Alyahya YAM, Alamri MM. Prevalence of depression among diabetic patients attending the armed forces hospital, Southern Region, Saudi Arabia: A prospective cross-sectional study. *J Family Med Prim Care*. 2024;13(1):323–329. doi:10.4103/jfmpc.jfmpc_1174_23
41. Sisman P, Polat I, Aydemir E, et al. How the COVID-19 outbreak affected patients with diabetes mellitus?. *Int J Diabetes Dev Ctries*. 2022;42 (1):53–61. doi:10.1007/s13410-021-00992-y
42. Bădescu SV, Tătaru C, Kobylinska L, et al.. The association between diabetes mellitus and depression. *J Med Life*. 2016;9(2):120.
43. Sharma K, Dhungana G, Adhikari S, Bista Pandey A, Sharma M. Depression and anxiety among patients with type II diabetes mellitus in Chitwan Medical College teaching hospital, Nepal. *Nurs Res Pract*. 2021;2021:8846915. doi:10.1155/2021/8846915
44. Mukeshimana M, Chironda G. Depression and associated factors among the patients with type 2 diabetes in Rwanda. *Ethiop J Health Sci*. 2019;29 (6):709–718. doi:10.4314/ejhs.v29i6.7
45. Mussa MR, Iseselo MK, Tarimo EAM. Depression and its associated factors among patients with diabetes: a cross-sectional survey at Mnazi Mmoja Referral Hospital in Zanzibar, Tanzania. *PLoS One*. 2023;18(4):e0284566. doi:10.1371/journal.pone.0284566
46. Geleta B, Dingata S, Emanu M, Kebede E, Eba L, Abera K. Prevalence of depression and associated factors among type 2 diabetes patients attending hospitals in Ilu AbaBor and Bunno Bedelle Zones, South West Ethiopia, 2020: A cross sectional study. *J Depress Anxiety*. 2021;9:388.
47. Maimaitituerxun R, Chen W, Xiang J, et al. Prevalence of comorbid depression and associated factors among hospitalized patients with type 2 diabetes mellitus in Hunan. *China BMC Psychiatry*. 2023;23(1):158. doi:10.1186/s12888-023-04657-4
48. Omar SM, Musa IR, Idrees MB, Adam I. Prevalence of depression and associated factors among patients with type 2 diabetes mellitus in eastern Sudan. *BMC Psychiatry*. 2021;21(1):336. doi:10.1186/s12888-021-03357-1
49. Khaledi M, Haghighatdoost F, Feizi A, Aminorroaya A. The prevalence of comorbid depression in patients with type 2 diabetes: An updated systematic review and meta-analysis on huge number of observational studies. *Acta Diabetol*. 2019;56(6):631–650. doi:10.1007/s00592-019-01295-9
50. Liu X, Li Y, Guan L, et al. A systematic review and meta-analysis of the prevalence and risk factors of depression in type 2 diabetes patients in China. *Front Med*. 2022;9:759499. doi:10.3389/fmed.2022.759499
51. Nini Shuhaida MH, Siti Suhaila MY, Azidah KA, Norhayati NM, Nani D, Juliawati M. Depression, anxiety, stress and socio-demographic factors for poor glycaemic control in patients with type II diabetes. *J Taibah Univ Med Sci*. 2019;14(3):268–276. doi:10.1016/j.jtumed.2019.03.002
52. Snoek FJ, Bremmer MA, Hermanns N. Constructs of depression and distress in diabetes: Time for an appraisal. *Lancet Diabetes Endocrinol*. 2015;3(6):450–460. doi:10.1016/S2213-8587(15)00135-7
53. Schuch FB, Vancampfort D. Physical activity, exercise, and mental disorders: It is time to move on. *Trends Psychiatry Psychother*. 2021;43 (3):177–184. doi:10.47626/2237-6089-2021-0237
54. Pascoe M, Bailey AP, Craike M, et al. Physical activity and exercise in youth mental health promotion: A scoping review. *BMJ Open Sport Exerc Med*. 2020;6(1):e000677. doi:10.1136/bmjsem-2019-000677
55. Kandola AA, Osborn DPJ, Stubbs B, Choi KW, Hayes JF. Individual and combined associations between cardiorespiratory fitness and grip strength with common mental disorders: A prospective cohort study in the UK Biobank. *BMC Med*. 2020;18(1):303. doi:10.1186/s12916-020-01782-9
56. Nanayakkara N, Pease A, Ranasinha S, et al. Depression and diabetes distress in adults with type 2 diabetes: results from the Australian National Diabetes Audit (ANDA) 2016. *Sci Rep*. 2018;8(1):7846. doi:10.1038/s41598-018-26138-5
57. Pearce M, Garcia L, Abbas A, et al. Association between physical activity and risk of depression. *A Sys Rev Meta-anal JAMA Psychi*. 2022;79 (6):550–559. doi:10.1001/jamapsychiatry.2022.0609
58. Silva LRB, Seguro CS, de Oliveira CGA, et al. Physical inactivity is associated with increased levels of anxiety, depression, and stress in brazilians during the COVID-19 pandemic: A cross-sectional study. *Front Psychiatry*. 2020;11:565291. doi:10.3389/fpsyt.2020.565291
59. Paudel S, Khanal SP, Gautam S, Chalise A, Koirala TN, Marahatta SB. Anxiety and depression among people with type 2 diabetes visiting diabetes clinics of Pokhara Metropolitan, Nepal: A cross-sectional study. *BMJ Open*. 2023;13(1):e064490. doi:10.1136/bmjopen-2022-064490
60. Kuehner C. Why is depression more common among women than among men?. *Lancet Psychiatry*. 2017;4(2):146–158. doi:10.1016/S2215-0366(16)30263-2
61. Rehman A, Kazmi SF. Prevalence and level of depression, anxiety and stress among patients with type-2 diabetes mellitus. *Ann Pak Inst Med Sci*. 2015;11(2):81–86.
62. García-Rivera EJ, Ruiz-Serrano K, Miranda EI, et al. Prevalence and co-prevalence of comorbidities among patients with type 2 diabetes mellitus living in Puerto Rico. *J Multimorb Comorb*. 2024;14:26335565231224570. doi:10.1177/26335565231224570