Received: 15 May 2023 | Revised: 27 July 2023 | Accepted: 17 August 2023

DOI: 10.1002/hsr2.1539

ORIGINAL RESEARCH

Health Science Reports Open Access WILEY

The mediating role of quality of life on depression and medication adherence among patients with type 2 diabetes mellitus: A cross-sectional study

Ernest Yorke[1] | Vincent Boima[1] | Vincent Ganu[2] | John Tetteh[3] | Louisa Twumasi[4] | George Ekem-Ferguson[4,5,6] | Irene Kretchy[4] | Christopher C. Mate-Kole[4,6,7]

[1]Department of Medicine & Therapeutics, University of Ghana Medical School, College of Health Sciences, University of Ghana, Accra, Ghana

[2]Department of Medicine and Cardiothoracic Unit, Korle-Bu Teaching Hospital, Accra, Ghana

[3]Department of Community Health, University of Ghana Medical School, College of Health Sciences, University of Ghana, Accra, Ghana

[4]Department of Psychology, University of Ghana, Accra, Ghana

[5]National Cardiothoracic Center, Korle Bu Teaching Hospital, Accra, Ghana

[6]Department of Psychiatry, University of Ghana Medical School, College of Health Sciences, University of Ghana, Accra, Ghana

[7]Center for Ageing Studies, College of Humanities, University of Ghana

Correspondence

Ernest Yorke, Department of Medicine and Therapeutics, School of Medicine and Dentistry, College of Health Sciences, University of Ghana, Legon, Accra, Ghana.
Email: pavlovium@yahoo.com

Funding information

Office of Research, Innovation and Development (ORID) of the University of Ghana Research Grant, Grant/Award Number: Award no. UGRF/13/MCG-002/2019- 2020

Abstract

Background and Aim: Patients living with diabetes mellitus have a high burden of psychological distress such as depression and anxiety as well as impaired quality of life, which may negatively impact their adherence to medications, glucose control, and health-related costs.

This study assessed the impact of quality of life and depression on medication adherence among patients with type 2 diabetes (type 2 diabetes mellitus [T2DM]) in a tertiary care setting in Ghana

Methods: The study was a cross-sectional study involving 238 patients with diabetes aged 18 years and above. Validated tools were used to assess medication adherence, depressive symptoms, and quality of life. Structural Equation Modeling was adopted to examine the mediation effect of quality of life on the relationship between depression and medication adherence among participants.

Results: The mean age of the participants was 58.82 ± 13.49, and 169 (71.0%) out of a total of 238 respondents were females. Depression had a significant direct relationship with the quality of life of respondents [aβ (95% confidence interval, CI) = −0.20 (−0.03, −0.00), $p < 0.05$; −0.21 (−0.41, −0.01) $p < 0.05$, respectively] and indirect relationship with quality of life [aβ (95% CI) = −0.01 (−0.02, −0.004) $p < 0.001$]. Educational status and religion both showed a significant indirect relationship with quality of life [aβ (95% CI) = 0.06 (0.07, 0.12), $p < 0.05$; 0.18 (0.01, 0.35) $p < 0.05$, respectively]. The mediating effect of quality of life on the relationship between depression and medication adherence was significant (Sobel = −3.19, $p < 0.001$).

Conclusion: Depression, medication adherence, and quality of life were higher among older adults with T2DM. Depression was also found to have a strong negative association with both medication adherence and quality of life. Interventions to screen for depression and to improve the quality of life in patients living with

diabetes are also recommended and this should go beyond the provision of standard treatments to explore further the mechanisms of this relationships.

KEYWORDS
depression, medication adherence, quality of life, type 2 diabetes

1 | INTRODUCTION

Diabetes mellitus has reached epidemic proportions globally and in Africa. The current global prevalence is estimated to be 537 million and is projected to reach 783 million by 2045. This will largely be driven by type 2 diabetes with associated complications expected to increase.[1]

Adherence to medications relates to the extent to which patients comply with the prescribed dosing regimen (i.e., the dose and intervals that prescribed medications are supposed to be taken).[2] In chronic conditions such as diabetes, because medications must be taken for a long time, adherence is especially important. The World Health Organization acknowledges medication nonadherence as a widespread problem in chronic conditions.[3] Medication adherence rates in chronic diseases are estimated between 20% and 80%.[3,4] The causes of medication nonadherence are multifactorial, including social, economic, health care system, disease-specific, medication specific, and personal factors.[4] Moreover, patients living with chronic diseases such as diabetes mellitus tend to have a high burden of psychological distress such as depression and anxiety as well as impaired quality of life, which in turn may negatively impact their adherence to medications.[5,6]

The impact of medication nonadherence is manifold. It may be associated with increased morbidity and higher rates of mortality in cardiovascular diseases and diabetes.[7] These ultimately lead to increased health-related costs which impact negatively on the already overburdened resources in developing countries such as Ghana.[8,9] Improved medication adherence is also associated with improved glycaemic control and less hospitalization for newly diagnosed diabetes patients.[10]

This study examined the impact of quality of life and depression on medication adherence among type 2 diabetes patients in a tertiary care setting in Ghana.

Key points

- Patients living with diabetes mellitus have a high burden of psychological distress and impaired quality of life, which may negatively impact their adherence to medications, glucose control, and health-related costs.
- The study found out that depression had a strong negative association with both medication adherence and quality of life.
- Interventions to screen for depression and to improve the quality of life which impact on medication adherence in patients living with diabetes are also recommended. This should go beyond the provision of standard treatments to explore further the mechanisms of this relationships.

2 | MATERIALS AND METHODS

2.1 | Study design and setting

A cross-sectional study was conducted at the National Diabetes Management and Research Center (NDMRC), Korle-Bu Teaching Hospital (KBTH), Accra, Ghana. KBTH is a tertiary referral center located in the capital city of Ghana with 1600 bed capacity and 12 different departments. The NDMRC is the largest Diabetes Center in Ghana and is a national resource center for diabetes care, training, research and offers out-patient services. Patients are received both from within and outside the hospital. The daily outpatient attendance is about 80 persons.

2.2 | Study population

We recruited patients with type 2 diabetes aged 18 years and above attending NDMRC who had been diagnosed as diabetic and on medication for at least 6 months. Acutely ill patients, patients who had known neuropsychiatric illnesses, pregnant women, and those aged less than 18 years were excluded from the study.

2.3 | Sample size calculation

In a recently published study conducted in a similar setting in northern Ghana, the prevalence of medication nonadherence among patients with type 2 diabetes was 15.5%.[11] The minimum sample size calculated using Cochran's formula ($N = z^2p(1\text{-}P)/d^2$) was 201. Where N—minimum sample size; z—Z score at 95% confidence level = 1.96; p—prevalence of medication nonadherence in diabetes (15.5%) and d—level of significance = 0.05. Also, in a systematic review of the epidemiology of depression and diabetes, the prevalence of depression among over 5000 patients with type 2 diabetes was 11.7%.[12] Computing for the minimum sample size using this prevalence is 159. The larger sample size of 201 was chosen. In all, a total of 238 participants were recruited to cater for a 10% nonresponse rate.

2.4 | Sampling technique

A systematic random sampling method was used to recruit patients. Fifteen patients were selected daily for 4 weeks (16 clinic days) using a sampling interval of 3. This was done daily except on weekends until all cases were selected.

2.5 | Outcome measures

2.5.1 | Depression

Depression was measured using the Brief Symptom Inventory Depression subscale (BSI-DS) of the brief symptom inventory (BSI-18). The depression subscale consists of six items from the BSI-18, an 18-item self-report inventory describing three primary dimensions: somatization (SOMA), anxiety (ANX), depression (DEPR), and the Global Scale Global Severity Index (GSI).[13] The items are rated on a 5-point scale ranging from 0 (*not at all*) to 4 (*extremely*). Loneliness, feeling blue, loss of interest, hopelessness about the future, suicidal thoughts, and feelings of worthlessness are rated on the degree of symptoms experienced over the past 2 weeks. The BSI-DS scores were calculated by summing the scores of the six items and dividing them by six to obtain an average rating that ranges between 0 and 4. The subscale cut-off point of 0.28 or higher indicates the presence of depressive symptoms.[13,14] The BSI-DS has good internal consistency, with Cronbach's alpha of 0.87 in a large sample of 2516 nonpatients[15] and an alpha that ranged from 0.82 to 0.87 in patients with Heart failure with and without comorbid renal function.[14]

2.5.2 | Medication adherence

Medication nonadherence was measured using the Medication Adherence Rating Scale (MARS). MARS is a ten-item, self-reported, comprehensive scale developed to measure two aspects of medication nonadherence: the extent or frequency of nonadherence and reasons for nonadherence.[16] For questions 1–6 and 9–10, a no response is indicative of adherence and is coded as 1, while for questions 7 and 8, a yes response is indicative of adherence and is coded as 1. The total MARS score is the sum of 10 items (ranging from 1 to 10), with higher scores indicating better attention.

2.5.3 | Quality of life

The World Health Organization Quality of Life—BREF (WHOQOL-BREF) is a self-report questionnaire that assesses 4 domains of quality of life (QoL): physical health (7 items), psychological health (6 items), social relationships (3 items) and environment (8 items). In addition, 2 items measure overall QoL and general health. Items are scored on a 5-point Likert scale which ranges from 1 to 5, and the raw domain score is the sum of the respective item scores. All domain scores are then normalized to a range of 0–100 by multiplying the mean score by four according to the WHOQOL-BREF scoring manual.[17] The scale demonstrated good internal consistency, with Cronbach alpha of 0.89 for the whole scale and a Cronbach alpha above 0.70 for all domains except social relationships with a Cronbach alpha of 0.53 among Serbian medical students.[18]

2.5.4 | Explanatory variables

The explanatory variables including sociodemographic variables such as age (≥40 years), gender (male or female), educational status, employment status, monthly income (≤GHs 500-GHs 2000+), marital status, and religion were collected using a pretested questionnaire. A self-rated questionnaire was used to assess the level of help patients received from family and friends. Clinical variables such as weight and height were measured with a Seca 740 scale and a stadiometer, respectively, and the body mass index (BMI) was computed using the formula: weight in kilogrammes divided by height in meters squared. The BMI scores were categorized as underweight, normal, overweight, and obese. Blood pressure was measured after a 5 min rest using an automated digital blood pressure monitor (Omron 907XL, pro Healthcare, Inc.), with the patient seated comfortably with a back support and arms resting on a table.

2.5.5 | Statistical analysis

Sociodemographic characteristics were summarized in tables by reporting the proportion and medians. The Skew and kurtosis coupled with the Shapiro–Wilk test were used to check for normality. The Wilcoxon signed rank and Kruskal–Wallis test was used to compare medians depending on the category of the explanatory variable. Quantile regression was used to assess factors associated with the outcomes.

In line with the main objective of the study, the mediation analysis assumed depression as the exposure outcome while QoL and medication adherence were considered as immediate and primary outcomes, respectively. Structural equation modeling (SEM) was used to ascertain the mediation effect of QoL on the relationship between depression and medication adherence among participants. SEM analysis is a form of path analysis to quantify the relationships between multiple variables.[19,20] The Sobel and Monte Carlo test of significance was used to test for significant mediation. STATA software version 16.1 was used to perform all analyses and $p < 0.05$ was deemed significant.

2.5.6 | Ethical considerations

Ethical approval was obtained from College of Health Sciences Ethical and Protocol Review Committee with protocol number (CHS-Et/M.4-P4.1/2020-2021). The study complied with the Helsinki

Declaration on Human Experiments in 1964 (revised in 2000). Participants were fully informed of the nature of the study. They were assured that participation in this study was voluntary and that they are at liberty to withdraw from the study at any time with no consequence. COVID-19 preventive protocols were observed: each research assistant was involved in data collection and respondents were provided with face masks and alcohol-based sanitizers and interviews and procedures were carried out at the prescribed social distance of at least 1 m.

3 | RESULTS

The mean age of the participants was 58.82 ± 13.49 with 169 out of the 258 (71.01%) being females and 69 (29.0%) males. The results (Table 1) showed that 85 (35.86%) of the respondents who were depressed, had good quality of life, or adhered to medications were within 60–69 years of age. Moreover, females were more depressed, have good quality of life, and adhered to medications. Majority of the respondents were married 148 (62.18%), or attained primary/junior high school (JHS) level of education, 112 (47.06%), and were either depressed, had good quality of life, or adhered to medications. In addition, most of the respondents, 120 (50.42%) were in full-time employment (Table 1). A Kruskal–Wallis *H* test showed that there was a statistically significant difference in depression and quality of life scores between the male and female, [$\chi^2 = 11.06$ and 9.32 respectively; $p < 0.001$ each], with a mean depression and quality of life rank score of 42.5, 92 for male and 48.06, 86 for female respectively. Moreover, the Kruskal–Wallis *H* test showed that there was a statistically significant difference in depression scores between the different marital status scores of married, single, widowed, and divorced [$\chi^2 = 14.55$, $p < 0.001$], with a mean depression rank score of 45.29 for married, 48.06 for single, 50.83 for widowed and 49.44 for divorced. In addition, the Kruskal–Wallis *H* test showed that there was a statistically significant difference in QOL scores between the different educational level scores of no formal education through tertiary [$\chi^2 = 8.95$, $p < 0.05$], with a mean quality of life rank score of 88 each for no formal education and SHS/vocational, 86.5 for primary/JHS, and 93.5 for tertiary.

The results further showed that there was a statistically significant difference in depression and GSI scores between the different employment status scores for full-time, unemployed, and retired [$\chi^2 = 10.36$, 7.80, and 7.28, $p < 0.001$]. There was a statistically significant difference in QoL score between the different religions of Christian and Islam [$\chi^2 = 5.67$, $p < 0.05$], with a mean quality of life rank score of 87 for Christian and 93 for Islam. Moreover, there was a statistically significant difference in quality-of-life scores for the support received from friends with scores of none, 1–2, and 3 or more [$\chi^2 = 13.78$, $p < 0.001$], with a mean quality of life rank score of 87 for none, 83 for 1–2 and 93 for 3 and above. Finally, there was a statistically significant difference in depression score between the different systolic pressure scores [$\chi^2 = 7.54$, $p < 0.05$], with a mean systolic rank score of 50.83 for ≤119 mmHg, 48.06 for 120–139 mmHg and 45.29 for 140 mmHg and above. Further details are set out in Table 1.

From Table 2, it was found that being within 60–69 years old and 70 years plus were significantly positively related to the quality of life as compared to age groups of less or equal to 39 years [aβ (95% confidence interval, CI) = 0.08 (0.00, 0.15) $p < 0.05$; 0.08 (0.00, 0.16) $p < 0.05$, respectively]. Moreover, being female and single were positively related to depression as compared to male and married [aβ (95% CI) = 0.13 (0.05, 0.20), $p < 0.001$; 0.13 (0.02, 0.23) $p < 0.05$, respectively]. The study further found that being unemployed had a negative statistically significant relationship with quality of life as compared to respondents who were in full-time employment [aβ (95% CI) = −0.11 (−0.16, −0.05) $p < 0.001$]. Receiving help from at least three (3) friends was significantly negatively related to medication adherence as compared to receiving no help from friends [aβ (95% CI) = −0.08 (−0.15, −0.01) $p < 0.05$].

The hypothesized mediating effects of QoL on the relationships between depression and medication adherence are presented in the structural equation model displayed in Figure 1. The domains of QoL include physical, psychological, social, and environmental. Through these domains, the indirect effect of depression on medication adherence increased with a regression coefficient of 0.024, 0.014, 0.13, and 0.14, respectively (model χ^2 was 314.94, $p < 0.000$). Meanwhile, the direct effect of depression on medication adherence showed a decreased regression coefficient of 0.017 (Figure 1).

The results in Table 3 showed that depression and help from friends had a statistically significant negative direct relationship with the quality of life of respondents [aβ (95% CI) = −0.20 (−0.03, −0.00) $p < 0.05$; −0.21 (−0.41, −0.01) $p < 0.05$, respectively]. It was further found that depression had a statistically significant negative indirect relationship with quality of life [aβ (95% CI) = −0.01 (−0.02, −0.004) $p < 0.001$]. On the other hand, educational status and religion both showed a statistically significant positive indirect relationship with quality of life [aβ (95% CI) = 0.06 (0.07, 0.12) $p < 0.05$; 0.18 (0.01, 0.35) $p < 0.05$, respectively]. Overall, depression was found to have a statistically significant negative relationship with quality of life [aβ (95% CI) = −0.03 (−0.05, −0.01), $p < 0.001$].

In addition, the results also showed that the mediating effect of quality of life on the relationship between depression and medication adherence was negatively statistically significant (Sobel = −3.19, $p < 0.001$). Furthermore, the Monte Carlo test showed a greater negative significant value of −3.16 and $p < 0.001$ of the mediating effect of quality of life on the relationship between depression and medication adherence.

4 | DISCUSSION

This study sought to assess the medication role of quality of life on the association between depression and medication adherence among type 2 diabetes patients in Ghana. The findings revealed statistically significant median differences in the relationship between sociodemographic factors such as sex, marital status, employment,

TABLE 1 Demographic characteristics and the median difference of psychological domain, quality of life, and medication adherence.

Variable	Frequency	Depression	Quality of life	Medication adherence
	n (%)	Median (LQ, UQ)	Median (LQ, UQ)	Median (LQ, UQ)
Overall		48.05 (42.52, 56.36)	88 (80, 95)	9 (8, 10)
Age				
40–49	53 (22.36)	48.06 (42.52, 53.59)	89 (82, 97)	9 (8, 10)
50–59	52 (21.94)	48.06 (42.52, 59.13)	87 (75, 95)	9 (8, 10)
60–69	85 (35.86)	48.05 (42.52, 56.36)	87 (79, 94)	9 (7, 10)
70+	47 (19.83)	48.06 (42.52, 56.36)	90 (82, 99)	9 (8, 10)
Test statistic		0.27	5.52	3.56
Sex				
Male	69 (28.99)	42.5 (42.52, 50.83)	92 (85, 98)	9 (8, 9)
Female	169 (71.01)	48.06 (42.52, 59.13)	86 (79, 94)	9 (7, 10)
Test statistic		11.06***	9.32***	0.07
Marital status				
Married	148 (62.18)	45.29 (42.52, 53.59)	89 (81.5, 95.5)	9 (8, 10)
Single	33 (13.87)	48.06 (42.52, 61.90)	86 (79, 94)	9 (8, 10)
Widowed	45 (18.91)	50.83 (42.52, 59.13)	85 (79, 92)	9 (8, 10)
Divorced	12 (5.04)	49.44 (45.29, 60.52)	90.5 (81.5, 95)	9 (8, 10)
Test statistic		14.55***	3.96	1.10
Educational level				
No formal education	25 (10.50)	45.29 (42.52, 50.83)	88 (79, 95)	9 (8, 10)
Primary/JHS	112 (47.06)	49.44 (42.52, 59.13)	86.5 (78, 93)	9 (8, 10)
SHS/vocational	75 (31.51)	45.29 (42.5, 53.59)	88 (81, 96)	9 (8, 10)
Tertiary	26 (10.92)	48.06 (42.52, 53.59)	93.5 (88, 99)	9 (8, 10)
Test statistic		6.72	8.95*	1.97
Employment				
Full time	120 (50.42)	48.06 (42.52, 56.36)	88 (80.5, 95.5)	9 (8, 10)
Unemployed	66 (27.73)	48.06 (42.52, 59.13)	86 (79, 94)	9 (8, 10)
Retired	52 (21.85)	42.52 (42.52, 50.83)	89.5 (80.5, 95)	9 (7, 9)
Test statistic		10.36***	1.67	1.87
Monthly income				
less than 500	77 (28.33)	48.06 (42.52, 59.13)	86 (79, 93)	9 (8, 10)
500–900	31 (23.48)	45.29 (42.52, 59.13)	87 (80, 95)	9 (8, 10)
1000–1999	16 (12.12)	48.06 (42.52, 59.13)	91.5 (87, 98)	9 (6, 10)
2000+	8 (6.06)	48.06 (42.52, 53.59)	94.5 (90.5, 97.5)	9 (8, 9.5)
Test statistic		2.05	9.40	1.64
Religion				
Christian	213 (89.50)	48.06 (42.52, 56.36)	87 (79, 95)	9 (8, 10)
Islam	25 (10.50)	48.06 (42.52, 53.59)	93 (90, 98)	9 (8, 10)
Test statistic		0.001	5.67*	0.23

(Continues)

TABLE 1 (Continued)

Variable	Frequency	Depression	Quality of life	Medication adherence
Help from friends				
None	107 (47.14)	48.06 (42.52, 59.13)	87 (79, 93)	9 (8, 10)
1–2	63 (27.75)	48.06 (42.52, 53.59)	83 (79, 95)	9 (7, 10)
3+	57 (25.11)	48.06 (42.52, 53.59)	93 (86, 97)	8 (8, 9)
Test statistic		1.88	13.78***	3.09
Help from family				
None	107 (47.14)	48.06 (42.52, 59.13)	87 (79, 93)	9 (8, 10)
1–2	63 (27.75)	48.06 (42.52, 53.59)	83 (79, 95)	9 (7(10)
3+	57 (25.11)	48.06 (42.52, 53.59)	93 (86, 97)	8 (8, 9)
Test statistic				
BMI				
Underweight	2 (1.31)	45.29 (42.52, 48.06)	86 (79, 93)	9 (9, 9)
Normal	47 (30.72)	42.52 (42.52, 53.59)	92 (83, 96)	9 (8, 10)
Overweight	53 (34.64)	48.06 (42.52, 56.36)	90 (81, 95)	9 (8, 10)
Obesity	51 (33.33)	45.29 (42.52, 53.59)	88 (83, 95)	9 (8, 10)
Test statistic		3.16	1.51	1.42
Systolic				
≤119	45 (19.82)	50.83 (42.52, 56.36)	87 (79, 95)	8 (7, 10)
120–139	88 (38.77)	48.06 (42.52, 59.13)	88 (79, 94.5)	9 (7, 10)
140+	94 (41.41)	45.29 (42.52, 50.83)	90 (84, 95)	9 (8, 10)
Test statistic		7.54*	3.20	4.58
Diastolic				
≤80	114 (50.22)	48.06 (42.52, 56.36)	88.5 (80, 95)	9 (8, 10)
80–89	59 (25.99)	45.29 (42.52, 56.36)	89 (83, 94)	9 (7, 10)
90+	54 (23.79)	45.29 (42.52, 53.59)	88 (81, 95)	9 (8, 10)
Test statistic		2.39	0.01	0.39

Note: p value notation: *$p < 0.05$, ***$p < 0.001$.

Abbreviations: BMI, body mass index; GSI, global severity index; JHS, junior high school; QoL, quality of life; ref, reference category; SHS, senior high school.

systolic blood pressure, and depression among type 2 diabetes patients. This finding is congruent with a study that also found marital status to be correlated with depression among type 2 diabetes patients.[21]

Sociodemographic factors such as sex, educational level, religion, and help from friends also showed a statistically significant relationship with QoL. This finding is partially conforms with a study that found statistically significant median differences in sex and educational level but insignificant means for moral and social support (help from others).[22] However, the change in demographic factors such as age, monthly income, help from family, BMI, and diastolic BP was not statistically significant for both depression and QOL. This is not consistent with other studies that indicate that age, poor economic status,[23] help from family,[24] BMI, and diastolic BP are associated with depression among type 2 diabetes mellitus (T2DM) patients. Surprisingly, the current study found no significant differences in all sociodemographic factors and medication adherence among type 2 diabetes patients. This is parallel to other studies which found statistically significant mean differences in some sociodemographic factors and medication adherence among T2DM patients[25,26]

4.1 | Factors associated with depression, quality of life, and medication adherence

Various factors have been associated with depression, quality of life, and medication adherence among type 2 diabetes patients. Quite surprisingly, our study found that being between 60 and 69 years old

TABLE 2 Quantile regression showing factors associated with depression, quality of life, and medication adherence.

Variable	Depression	QoL	Medication adherence
	aβ [95% CI]	aβ [95% CI]	aβ [95% CI]
Age			
≤39	**Ref**	**ref**	**ref**
50–59	0.03 [−0.05, 0.11]	0.04 [−0.03, 0.12]	0.01 [−0.08, 0.09]
60–69	0.03 [−0.06, 0.13]	0.08 [0.00, 0.15]*	−0.01 [−0.10, 0.08]
70+	−0.05 [−0.17, 0.06]	0.08 [0.00, 0.16]*	0.01 [−0.09, 0.11]
Sex			
Male	**Ref**	**ref**	**ref**
Female	0.13 [0.05, 0.20]***	−0.02 [−0.05, 0.02]	−0.02 [−0.08, 0.05]
Marital status			
Married	**Ref**	**ref**	**ref**
Single	0.13 [0.02, 0.23]*	0.02 [−0.04, 0.08]	0.01 [−0.09, 0.10]
Widowed	0.02 [−0.06–0.11]	0.02 [−0.02, 0.06]	0.02 [−0.05, 0.09]
Divorced	0.07 [−0.07–0.20]	−0.02 [−0.08, 0.05]	0.00 [−0.19, 0.20]
Educational level			
No formal education	**Ref**	**ref**	**ref**
Primary/**JHS**	0.03 [−0.05, 0.11]	−0.03 [−0.11, 0.05]	−0.08 [−0.17, 0.00]
SHS/vocational	0.01 [−0.08, 0.10]	0.03 [−0.04, 0.10]	−0.01 [−0.09, 0.09]
Tertiary	0.09 [−0.05, 0.24]	0.07 [−0.01, 0.14]	−0.01 [−0.10, 0.09]
Employment			
Full time	**Ref**	**ref**	**ref**
Unemployed	0.06 [−0.02, 0.13]	−0.11 [−0.16, −0.05]***	0.03 [−0.04, 0.00]
Retired	0.01 [−0.09, 0.09]	−0.03 [−0.08, 0.02]	0.03 [−0.05, 0.11]
Religion			
Christian	**Ref**	**ref**	**ref**
Islam	0.07 [−0.01, 0.15]	−0.03 [−0.08, 0.02]	0.07 [−0.02, 0.15]
Help from friends			
None	**ref**	**ref**	**ref**
1–2	−0.03 [−0.09, 0.03]	0.02 [−0.03, 0.07]	−0.2 [−0.09, 0.05]
3+	−0.01 [0.08, 0.06]	−0.01 [−0.05, 0.03]	−0.08 [−0.15, −0.01]*
BMI			
Underweight	**ref**	**ref**	**ref**
Normal	0.11 [−0.06, 0.28]	−0.01 [−0.15, 0.12]	−0.01 [−0.10, 0.08]
Overweight	0.16 [−0.01, 032]	−0.01 [−0.14, 0.12]	−0.02 [−0.11, 0.07]
Obesity	0.13 [−0.04, 0.31]	−0.03 [−0.16, 0.11]	−0.02 [−0.12, 0.08]
Systolic			
≤119	**ref**	**ref**	**ref**
120–129	0.07 [−0.02, 0.16]	−0.01 [−0.06, 0.04]	0.01 [−0.07, 0.01]
130+	−0.001 [−0.10, 0.09]	−0.02 [−0.16, 0.11]	0.06 [−0.04, 0.15]

(Continues)

TABLE 2 (Continued)

Variable	Depression	QoL	Medication adherence
Diastolic			
≤80	**ref**	**ref**	**ref**
81–89	−0.03 [−0.12, 0.05]	0.01 [−0.03, 0.05]	−0.04 [−0.12, 0.03]
90+	−0.03 [−0.11, 0.05]	0.01 [−0.04, 0.06]	−0.01 [−0.09, 0.07]

Note: p value notation: $^{*}p < 0.05$, $^{***}p < 0.001$.

Abbreviations: aβ, adjusted coefficient estimate; BMI, body mass index; CI, confidence interval; JHS, junior high school; QoL, quality of life; ref, reference category; SHS, senior high school.

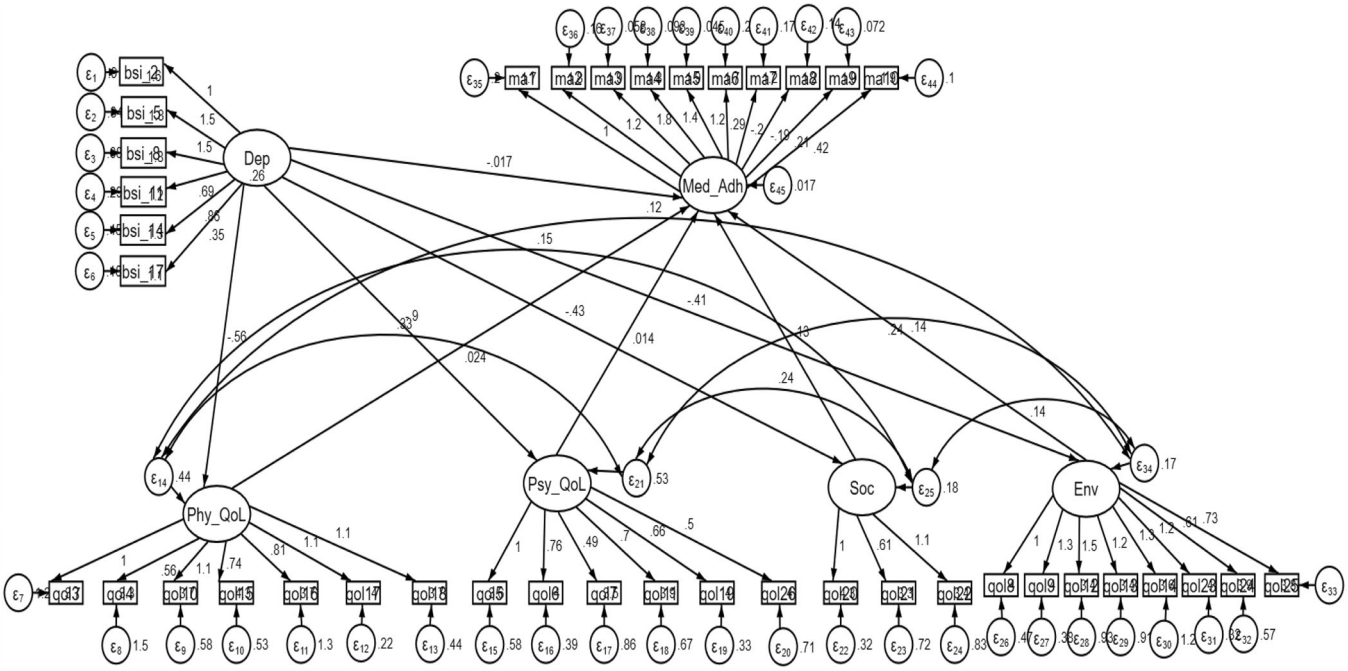

FIGURE 1 Path analysis showing the mediating effect of quality of life on the relationship between depression and medication adherence. *Dep: Depression; Med-Adh: Medication Adherence; Phy: Physical; Psy: Psychological; Env: Environmental; Soc: Social; QoL: Quality of Life.*

and 70 years plus was significantly positively related to quality of life among T2DM as compared to age groups of less or equal to 39 years. This implies that as patients with T2DM grew older, their quality of life significantly improves. This finding is inconsistent with other studies which found that older age, poor glycaemic control, longer duration of diabetes, insulin usage, obesity, and having diabetes-related complications were significant negative predictors of QoL.[27] Similarly, another study by Gebremedhin et al.[26] also found an inverse association among age, disease duration, and fasting glucose level, and all levels of QoL among patients. These variations may be because older patients may not be burdened with family responsibilities or aspire for better career opportunities compared to younger patients who have large responsibilities of building families and having career aspirations in addition to their health conditions. Their inability to actively perform these functions may trigger sequelae of depressive symptoms that affect their quality of life. Again, there may be other confounding variables such as access to social support networks, resilience, and coping that may influence that association which was not explored in the current study.[28]

Moreover, being female and single were positively related to depression as compared to male and married. This implies that being female and single increases depression among T2DM patients. This finding is consistent with another study that found that depression was high among females[29] and singles.[30] Similarly, Akpalu et al.[31] also found in their study among Ghanaian patients with T2DM that female gender, being unmarried, frequent intake of alcohol, previous smoking status, and insulin use were associated with increased odds of depression. The findings of the current study, however, are incongruent with another study among T2DM patients in Qatar which found that male patients were at higher risk for developing depression when compared to females.[32] Asefa[33] and colleagues also reported that being male and single was associated with increased

TABLE 3 Direct, indirect, and total effects of QoL on the relationship between depression and medication adherence.

Endogenous variable	Exogenous	Effect size		
		Direct	Indirect	Total
Quality of life		aβ [95% CI]	aβ [95% CI]	
	Depression	−0.20 [−0.03, -0.00]*	−0.01 [−0.02, −0.004]**	−0.03 [−0.05, −0.01]**
	Age	−0.03 [−0.19, 0.13]	−0.001 [−0.04, 0.03]	−0.04 [−0.20, 0.13]
	Sex	0.10 [−0.30, 0.49]	−0.07 [−0.16, 0.02]	0.03 [−0.38, 0.43]
	Marital status	−0.01 [−0.19, 0.17]	0.002 [−0.36, 0.04]	−0.01 [−0.19, 0.17]
	Education	−0.13 [−0.35, 0.08]	0.06 [0.07, 0.12]*	−0.07 [−0.29, 0.15]
	Employment	0.10 [−0.05, 0.26]	−0.02 [−0.05, 0.02]	0.09 [−0.07, 0.24]
	Religion	0.13 [−0.56, 0.83]	0.18 [0.01, 0.35]*	0.31 [−0.40, 1.02]
	Help from	−0.21 [−0.41, -0.01]*	0.01 [−0.03, 0.06]	−0.20 [−0.40, 0.01]
	BMI	0.09 [−0.12, 0.30]	−0.003 [−0.05, 0.04]	0.08 [−0.13, 0.30]
	Systolic BP	−0.08 [−0.36, 0.20]	0.06 [−0.01, 0.13]	−0.02 [−0.30, 0.26]
	Diastolic BP	−0.06 [0.31, 0.19]	−0.04 [−0.10, 0.04]	−0.10 [−0.36, 0.15]
Test of significance				
Sobel	−3.19**			
Monte Carlo	−3.16**			

Note: p value notation: *$p < 0.05$, **$p < 0.01$.

Abbreviations: aβ, adjusted coefficient estimate; BMI, body mass index.

odds of depression among DM patients whereas Mushtaque et al.[34] found no significant association between depression, gender, and marital status. These differences can be attributed to the assessment tools used and the different populations assessed.

Unsurprisingly, our study further found that being unemployed had a negative statistically significant relationship with quality of life as compared to respondents who were in full-time employment. This is consistent with another study which found that females, patients above 75 years old, and those who are in low socioeconomic income, unemployed, and widowed had lower QOL.[22] Having diabetes and being unemployed may trigger some psychosocial challenges, especially among younger adults, which can affect your QOL. The inability to afford medical bills because of financial difficulties may affect treatment adherence and ultimately increase the risk of complications and reduced QOL.

Receiving help from at least three (3) friends was significantly negatively related with medication adherence as compared with receiving no help from friends. This finding supports findings from another study that reported that social support presented a positive effect on medication adherence, and that support utilization and the subscale of social support exhibited a significantly strong influence on medication adherence in patients with T2DM. Although medication adherence was influenced by multiple factors, this finding confirmed that social support must be recognized as a core element in interventions aimed at improving the management of patients with T2DM.[35] Contrary to this, in a related study in Ghana, Ekem-Ferguson[24] and colleagues found that T2DM patients received social support from family and significant others but not friends. Social Support buffered the relationship between depression and T2DM, which indirectly have an association with medication adherence.[24]

4.2 | Mediating role (direct, indirect, and total effects) of QoL on the relationship between depression and medication adherence

The study found that depression had both direct and indirect effects on medication adherence. The indirect effect of depression on medication adherence showed an increase in the regression model, while the direct effect of depression on medication adherence showed a decrease in the regression model. Interestingly, this implies that the indirect effect of depression leads to an improvement in medication adherence, whereas the direct effect has a negative impact on medication adherence. This finding is in line with other studies that have found that depression contributes negatively to medication adherence among patients with T2DM.[5,36] Similarly, in a study to assess the impact of incident depression on medication adherence in patients with T2DM, Lunghi et al.[37] found that depression was associated with nonadherence to antidiabetic medications after accounting for baseline adherence and other confounders. Loss of interest in activity, forgetfulness, and low energy levels which are associated with depression could explain these findings.

The results showed that help from friends had a statistically significant negative direct relationship with the quality of life of respondents. It was further found that depression had a statistically significant negative indirect relationship with quality of life. Overall, depression was found to have a statistically significant negative relationship with quality of life. This finding is not surprising as it is consistent with findings from a systematic review that reported a negative association between depressive symptoms and at least one aspect of quality of life in people with diabetes.[38] Diabetic individuals with depressive symptoms also had a severely lower diabetes-specific quality of life. Generic and domain-specific quality of life were found to be mildly to moderately lower in the presence of depressive symptoms.[39] Another study also observed that depression was the major factor that decreased the quality of life in patients with diabetes.[40]

On the other hand, educational status and religion both showed a statistically significant positive indirect relationship with the quality of life of T2DM patients. This finding is consistent with other studies which report similar findings that patients with higher levels of education may have an appreciable knowledge of their health and are more likely to follow through on their medication regimen and self-care behaviors hence the improved QOL.[41,42] Similarly, religiosity or spirituality has been reported to be a valuable tool for coping with chronic illness conditions and has been associated with positive health outcomes. In line with our finding, a study performed on Iranian patients with T2DM revealed a positive association between the components of health-related QOL and spirituality, with patients who have higher levels of spiritual well-being showing better QOL.[43]

In addition, the results also showed that quality of life played a mediating role and had a negative relationship with both depression and medication adherence. Thus, quality of life significantly reduced the effect of depression on medication adherence, which may improve treatment outcomes. Previous studies have investigated the potential factors affecting depression and medication adherence among type 2 diabetes patients and reported the need for an intervention to improve quality of life beyond the provision of standard treatments and explore further the mechanisms of this relationship.

Seligowski[44] and colleagues explored the relationship between the fear of hypoglycemia and psychological well-being in veterans with type 2 diabetes. Using the mediation effect of specific health-related quality of life (HRQoL), they found significant indirect effects on the relationship between depressive symptoms and diabetes quality of life and between anxiety symptoms and diabetes quality of life. However, the mediating role of QoL on depression and medication adherence has scarcely been explored. Our finding is therefore novel, hence the need to explore further the mechanisms through which these associations operate in future studies.

4.3 | Limitations

The current study was a cross-sectional study, hence may not draw conclusions based on cause-and-effect relationships. Again, there may be other factors associated with depression, medication adherence, and quality of life such as resilience, coping, self-care behaviors, and self-efficacy, which were not explored in the current study and may have improved our model to better explain the mediators.

4.4 | Implications and future directions

The higher prevalence of depression and medication nonadherence among older T2DM patients calls for a change in the approach to managing these patients. Clinicians should consider routinely screening for psychological disorders and distress among these group of patients. Patients must be educated to recognize early, the symptomatology of these conditions and seek timeous treatment. Policy makers must be engaged to support these initiatives and also provide the necessary resources to support these initiatives.

We recommend that future researchers should consider the use of Online Photovoice (OPV) as a qualitative or part of a mixed method approach to conduct research on the same or similar topics to explore the interrelationships between depression, medication adherence, physical health, psychological health, social support, and other environmental factors among persons living with T2DM.[45–47] OPV is emerging as one of the most recent and effective innovative qualitative research methods. It gives opportunities to the participants to express their own experience with as little manipulation as possible, compared to traditional quantitative methods. Educators can also use OPV for experiential activities to increase group and organizational synergy and improve the mental and psychological health of T2DM patients.[45–47]

5 | CONCLUSION

In this study, we showed that depression, medication adherence, and quality of life were high among older adults with T2DM and poorer for younger adults. Again, depression was found to have a strong negative association with both medication adherence and quality of life. There is a need for thorough screening for early detection and management of depressive symptoms as part of protocols for the management of diabetes, particularly among younger adults. Quality of life was seen as a mediating factor that improved the rate of medication adherence among T2DM patients with depression. There is a need for an intervention to improve the quality of life in patients with diabetes beyond the provision of the standard treatment and explore further the mechanisms of this relationship.

AUTHOR CONTRIBUTIONS

Ernest Yorke: Conceptualization; Data curation; Formal analysis; Funding acquisition; Investigation; Methodology; Project administration; Resources; Supervision; Validation; Visualization; Writing—original draft; Writing—review & editing. **Vincent Boima**: Conceptualization; Data curation; Formal analysis; Investigation; Methodology; Project administration; Resources; Supervision; Writing—review & editing. **Vincent Ganu**: Conceptualization; Data curation; Funding

acquisition; Investigation; Methodology; Resources; Supervision; Validation; Visualization; Writing—review & editing. **John Tetteh**: Data curation; Formal analysis; Funding acquisition; Investigation; Methodology; Project administration; Software; Validation; Visualization; Writing—review & editing. **Louisa Twumasi**: Data curation; Formal analysis; Funding acquisition; Investigation; Methodology; Project administration; Resources; Supervision; Validation; Visualization; Writing—review & editing. **George Ekem-Ferguson**: Data curation; Formal analysis; Investigation; Methodology; Project administration; Resources; Supervision; Validation; Visualization; Writing—review & editing. **Irene Kretchy**: Data curation; Funding acquisition; Investigation; Methodology; Project administration; Resources; Supervision; Validation; Visualization; Writing—review & editing. **Christopher C Mate-Kole**: Conceptualization; Data curation; Funding acquisition; Investigation; Methodology; Project administration; Resources; Supervision; Validation; Visualization; Writing—review & editing.

ACKNOWLEDGMENTS

We are exceedingly indebted to all participants who made time to participate in this study. The study could not have been accomplished without their participation. This work was supported by the Mid-career grant from Office of Research, Innovation and Development (ORID) and the University of Ghana (Award no. UGRF/13/MCG-002/2019-2020).

CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest.

DATA AVAILABILITY STATEMENT

The data used to support the findings of this study are available from the corresponding author upon request.

TRANSPARENCY STATEMENT

The lead author Ernest Yorke affirms that this manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned (and, if relevant, registered) have been explained.

ORCID

Ernest Yorke http://orcid.org/0000-0003-4257-7492
George Ekem-Ferguson http://orcid.org/0000-0002-9293-6812

REFERENCES

1. Sun H, Saeedi P, Karuranga S, et al. IDF diabetes Atlas: global, regional and country-level diabetes prevalence estimates for 2021 and projections for 2045. *Diabetes Res Clin Pract*. 2022;183:109119. doi:10.1016/j.diabres.2021.109119
2. Cramer JA, Roy A, Burrell A, et al. Medication compliance and persistence: terminology and definitions. *Value Health*. 2008;11(1):44-47. doi:10.1111/j.1524-4733.2007.00213.x
3. Organization WH. *Adherence to long-term therapies: evidence for action*. World Health Organization; 2003.
4. DiMatteo MR. Variations in patients' adherence to medical recommendations: a quantitative review of 50 years of research. *Med Care*. 2004;42(3):200-209. doi:10.1097/01.mlr.0000114908.90348.f9
5. Gonzalez JS, Peyrot M, McCarl LA, et al. Depression and diabetes treatment nonadherence: a meta-analysis. *Diabetes Care*. 2008;31(12):2398-2403. doi:10.2337/dc08-1341
6. Gonzalez Heredia T, González-Ramírez LP, Hernández-Corona DM, Maciel-Hernández EA. Anxious depression in patients with type 2 diabetes mellitus and its relationship with medication adherence and glycemic control. *Global Public Health*. 2021;16(3):460-468. doi:10.1080/17441692.2020.1810735
7. McGinnis BD, Olson KL, Delate TM, Stolcpart RS. Statin adherence and mortality in patients enrolled in a secondary prevention program. *Am J Manag Care*. 2009;15(10):689-695.
8. Rasmussen JN, Chong A, Alter DA. Relationship between adherence to evidence-based pharmacotherapy and long-term mortality after acute myocardial infarction. *JAMA*. 2007;297(2):177-186. doi:10.1001/jama.297.2.177
9. Ho PM, Magid DJ, Masoudi FA, McClure DL, Rumsfeld JS. Adherence to cardioprotective medications and mortality among patients with diabetes and ischemic heart disease. *BMC Cardiovasc Disord*. 2006;6(1):48. doi:10.1186/1471-2261-6-48
10. Lin L-K, Sun Y, Heng BH, Chew DEK, Chong P-N. Medication adherence and glycemic control among newly diagnosed diabetes patients. *BMJ Open Diabetes Res Care*. 2017;5(1):e000429. doi:10.1136/bmjdrc-2017-000429
11. Afaya RA, Bam V, Azongo TB, et al. Medication adherence and self-care behaviours among patients with type 2 diabetes mellitus in Ghana. *PLoS One*. 2020;15(8):e0237710. doi:10.1371/journal.pone.0237710
12. Golden SH. Examining a bidirectional association between depressive symptoms and diabetes. *JAMA*. 2008;299(23):2751-2759. doi:10.1001/jama.299.23.2751
13. Derogatis L. *Brief Symptom Inventory (BSI): administration, scoring, and procedures manual*. National Computer Systems. In.: Inc; 1993.
14. Khalil AA, Hall LA, Moser DK, Lennie TA, Frazier SK. The psychometric properties of the brief symptom inventory depression and anxiety subscales in patients with heart failure and with or without renal dysfunction. *Arch Psychiatr Nurs*. 2011;25(6):419-429. doi:10.1016/j.apnu.2010.12.005
15. Franke GH, Jaeger S, Glaesmer H, Barkmann C, Petrowski K, Braehler E. Psychometric analysis of the brief symptom inventory 18 (BSI-18) in a representative German sample. *BMC Med Res Methodol*. 2017;17:14. doi:10.1186/s12874-016-0283-3
16. Thompson K, Kulkarni J, Sergejew AA. Reliability and validity of a new Medication Adherence Rating Scale (MARS) for the psychoses. *Schizophr Res*. 2000;42(3):241-247. doi:10.1016/s0920-9964(99)00130-9
17. Group W. The development of the World Health Organization quality of life assessment instrument (the WHOQOL). *Quality of life assessment: International perspectives. edn*. Springer; 1994:41-57.
18. Ilić I, Šipetić-Grujičić S, Grujičić J, Živanović Mačužić I, Kocić S, Ilić M. Psychometric properties of the world health organization's quality of life (WHOQOL-BREF) questionnaire in medical students. *Medicina*. 2019;55(12):772. doi:10.3390/medicina55120772
19. Fan Y, Chen J, Shirkey G, et al. Applications of structural equation modeling (SEM) in ecological studies: an updated review. *Ecol Process*. 2016;5(1):19. doi:10.1186/s13717-016-0063-3
20. Ringle CM, Sarstedt M, Mitchell R, Gudergan SP. Partial least squares structural equation modeling in HRM research. *Int J Hum Resour Manag*. 2020;31(12):1617-1643. doi:10.1080/09585192.2017.1416655
21. Zanchetta FC, Trevisan DD, Apolinario PP, Silva JB, Lima MHM. Clinical and sociodemographic variables associated with diabetes-

related distress in patients with type 2 diabetes mellitus. *Einstein (São Paulo)*. 2016;14:346-351. doi:10.1590/S1679-45082016AO3709
22. Alsuwayt S, Almesned M, Alhajri S, Alomari N, Alhadlaq R, Alotaibi A. Quality of life among type II diabetic patients attending the primary health centers of King Saud Medical City in Riyadh, Saudi Arabia. *J Family Med Prim Care*. 2021;10(8):3040. doi:10.4103/jfmpc.jfmpc_175_21
23. 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
24. Ekem-Ferguson G, Tetteh J, Udofia EA, et al. Second edition in 2020 of the HSI journal volume 1 issue 2 publication. *Health Sci Invest J*. 2020;1(2):93-104. doi:10.46829/hsijournal.2020.12.1.2.93-104
25. Tusa BS, Alemayehu M, Weldesenbet AB, Kebede SA, Dagne GA. Prevalence of depression and associated factors among diabetes patients in East shewa, Ethiopia: Bayesian approach. *Depress Res Treat*. 2020;2020:1-11. doi:10.1155/2020/4071575
26. Gebremedhin T, Workicho A, Angaw DA. Health-related quality of life and its associated factors among adult patients with type II diabetes attending Mizan Tepi University Teaching Hospital, Southwest Ethiopia. *BMJ Open Diabetes Res Care*. 2019;7(1):e000577. doi:10.1136/bmjdrc-2018-000577
27. Gebremariam GT, Biratu S, Alemayehu M, et al. Health-related quality of life of patients with type 2 diabetes mellitus at a tertiary care hospital in Ethiopia. *PLoS One*. 2022;17(2):e0264199. doi:10.1371/journal.pone.0264199
28. Ozbay F, Johnson DC, Dimoulas E, Morgan Iii C, Charney D, Southwick S: Social support and resilience to stress: from neurobiology to clinical practice. *Psychiatry (Edgmont)* 2007, 4(5):35.
29. Kant R, Yadav P, Barnwal S, Dhiman V, Abraham B, Gawande K. Prevalence and predictors of depression in type 2 diabetes mellitus. *J Educ Health Promot*. 2021;10:352. doi:10.4103/jehp.jehp_1507_20
30. Dogra S, MacIntosh L, O'Neill C, et al. The association of physical activity with depression and stress among post-secondary school students: a systematic review. *Ment Health Phys Act*. 2018;14:146-156. doi:10.1016/j.mhpa.2017.11.001
31. Akpalu J, Yawson AE, Osei-Poku F, et al. Stroke outcome and determinants among patients with and without diabetes in a tertiary hospital in Ghana. *Stroke Res Treat*. 2018;2018:1-9. doi:10.1155/2018/7521351
32. Ismail M, Seif MH, Metwally N, et al. Prevalence and determinants of depression among patients with type 2 diabetes mellitus attending family medicine clinics in Qatar. *Am J Med Open*. 2023;9:100014. doi:10.1016/j.ajmo.2022.100014
33. Asefa A, Zewudie A, Henok A, Mamo Y, Nigussie T. Depression and its associated factors among diabetes mellitus patients attending selected hospitals in Southwest Ethiopia: a cross-sectional study. *Psychiatry J*. 2020;2020:1-8. doi:10.1155/2020/6486030
34. Mushtaque A, Gulati R, Hossain MM, Azmi SA. Prevalence of depression in patients of type 2 diabetes mellitus: A cross sectional study in a tertiary care centre. *Diabetes Metab Syndr*. 2016;10(4):238-241. doi:10.1016/j.dsx.2016.06.016
35. Gu L, Wu S, Zhao S, et al. Association of social support and medication adherence in Chinese patients with type 2 diabetes mellitus. *Int J Environ Res Public Health*. 2017;14(12):1522. doi:10.3390/ijerph14121522
36. Rotella F, Mannucci E. Depression as a risk factor for diabetes: a meta-analysis of longitudinal studies. *J Clin Psychiatry*. 2013;74(1):31-37. doi:10.4088/jcp.12r07922
37. Lunghi C, Zongo A, Moisan J, Grégoire J-P, Guénette L. The impact of incident depression on medication adherence in patients with type 2 diabetes. *Diabetes Metab*. 2017;43(6):521-528. doi:10.1016/j.diabet.2017.07.003
38. Nouwen A, Winkley K, Twisk J, et al. Consortium EDiDR Type 2 diabetes mellitus as a risk factor for the onset of depression: a systematic review and meta-analysis. *Diabetologia*. 2010;53:2480-2486. doi:10.1007/s00125-010-1874-x
39. Schram M, Baan C, Pouwer F. Depression and quality of life in patients with diabetes: a systematic review from the European depression in diabetes (EDID) research consortium. *Curr Diabetes Rev*. 2009;5(2):112-119. doi:10.2174/157339909788166828
40. Juárez-Rojop IE, Fortuny-Falconi CM, González-Castro TB, et al. Association between reduced quality of life and depression in patients with type 2 diabetes mellitus: a cohort study in a Mexican population. *Neuropsychiatr Dis Treat*. 2018;14:2511-2518. doi:10.2147/ndt.s167622
41. Al-Aboudi IS, Hassali MA, Shafie AA. Knowledge, attitudes, and quality of life of type 2 diabetes patients in Riyadh, Saudi Arabia. *J Pharm Bioallied Sci*. 2016;8(3):195-202. doi:10.4103/0975-7406.171683
42. Tamornpark R, Utsaha S, Apidechkul T, Panklang D, Yeemard F, Srichan P. Quality of life and factors associated with a good quality of life among diabetes mellitus patients in northern Thailand. *Health Qual Life Outcomes*. 2022;20(1):81. doi:10.1186/s12955-022-01986-y
43. Jafari N, Farajzadegan Z, Loghmani A, Majlesi M, Jafari N. Spiritual well-being and quality of life of Iranian adults with type 2 diabetes. *Evid Based Complement Alternat Med*. 2014;2014:1-8. doi:10.1155/2014/619028
44. Seligowski AV, Pless Kaiser AP, Niles BL, Mori DL, King LA, King DW. Sleep quality as a potential mediator between psychological distress and diabetes quality of life in veterans with type 2 diabetes. *J Clin Psychol*. 2013;69(10):1121-1131. doi:10.1002/jclp.21866
45. Doyumğaç I, Tanhan A, Kiymaz MS. Understanding the most important facilitators and barriers for online education during COVID-19 through online photovoice methodology. *Int J High Educ*. 2020;10(1):166-190.
46. Tanhan A. COVID-19 Sürecinde Online Seslifoto (OSF) Yöntemiyle Biyopsikososyal Manevi ve Ekonomik Meseleleri ve Genel İyi Oluş Düzeyini Ele Almak: OSF'nin Türkçeye Uyarlanması. *J Turk Stud*. 2020;15(4):1029-1086. doi:10.7827/TurkishStudies.44451
47. Tanhan A, Strack RW. Online photovoice to explore and advocate for Muslim biopsychosocial spiritual wellbeing and issues: ecological systems theory and ally development. *Curr Psychol*. 2020;39(6):2010-2025. doi:10.1007/s12144-020-00692-6

How to cite this article: Yorke E, Boima V, Ganu V, et al. The mediating role of quality of life on depression and medication adherence among patients with type 2 diabetes mellitus: a cross-sectional study. *Health Sci Rep*. 2023;6:e1539. doi:10.1002/hsr2.1539