

ORIGINAL ARTICLE

ANXIETY AND DEPRESSION AS PREDICTORS OF GLYCEMIC CONTROL IN PATIENTS WITH TYPE 2 DIABETES MELLITUS

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ABSTRACT:

Introduction: The burden of Diabetes mellitus is becoming a global challenge. More and more research work is being done not only on its treatment and laboratories methods for its early detection, but also on the reasons why the disease is progressing day by day. The objective of present research is to determine the role of anxiety and depression in poor glycemic control.

Objective: The present study aimed to determine anxiety and depression as predictor of glycemic control in adults with type 2 diabetes mellitus.

Methods: This analytical cross-sectional study enrolled 287 adults with confirmed T2DM at the Endocrinology Department, Nishtar Hospital, Multan, between January and October 2025. Depressive and anxious symptom severity was quantified using the PHQ-9 and GAD-7, respectively. Glycemic control was assessed via HbA1c. Data were analyzed using hierarchical multiple linear regression and binary logistic regression in SPSS version 27.0.

Results: A total of 287 subjects were enrolled in the study. Mean PHQ-9 and GAD-7 scores were 10.8 ± 5.4 and 8.6 ± 4.9 , respectively, both falling within the mild-to-moderate severity range. Inverse correlations of moderate magnitude were observed between HbA1c and self-care behaviors ($r = -0.28$, $p < 0.001$) and medication adherence ($r = -0.25$, $p < 0.001$). Mean HbA1c was $8.24 \pm 1.63\%$, with 62.7% exhibiting poor control. Clinically significant depression and anxiety were identified in 34.8% and 27.5%, respectively.

Conclusion: Anxiety and depression are important predictors of diabetes mellitus and the treatment of these psychological disorders decrease the frequency of hyperglycemia.

Keywords: Anxiety; Anxiety; Depression; Diabetes Mellitus, Type 2; Glycated Hemoglobin; Glycemic Control; Self-Management

INTRODUCTION

It is a well-known fact that frequency of diabetes mellitus is increasing throughout the world. It is not only limited to rural or urban areas, rich or poor people, healthy or diseased subjects' males or female persons, young or old individuals but even there is no ethnicity defined for the disease.¹ There are a worldwide concern of this problem and its rapid increase in prevalence. The second problem which is being faced is that there is a clear increase

in the frequency of uncontrolled glucose levels as depicted by the high levels of glycated hemoglobin. The uncontrolled glucose levels are suggested mainly due to noncompliance of the diabetics, poor dietary habits, lack of physical activity, sedentary life style even at work places, anxiety, depression, poverty and illiteracy.² Impairment in glucose is yet another challenge being faced by physicians and diabetologists.^{3,4} When there is impaired glucose tolerance, the persons are more liable to suffer from microvascular complications as retinopathy, neuropathy including peripheral nephropathy. but, on the other hand, macrovascular complications are also not uncommon as diabetic foot, coronary disorders

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and stroke.^{5,6} These devastating effects of diabetes in turn lead to a higher mortality and morbidity worldwide.^{7,8}

The socio-economic conditions of people, globally, is responsible for mental health issues. Constant psychological stress leads to increase in cortisol levels. High levels of cortisol hormone are responsible for a leading cause of diabetes mellitus via gluconeogenesis.^{2,6} Besides, cortisol is an anabolic hormone and is a major cause of adiposity which in turn causes insulin resistance and poor glycemic control. Persistent ongoing emotional strain also increases the sympathetic nervous system involvement and thus leads to release of adrenaline. This further impairs the glucose control in blood.⁷ Disturbed behavioral patterns contribute to anxiety and depression which may result disordered eating, poor sleep hygiene as insomnia, loss of interest in working and unnecessary medications. These all independently can give rise to worsening control of blood glucose levels. These chronic cognitive disorders are associated with a rapid rise in the prevalence of diabetes mellitus throughout the world.^{9,10}

The present study was therefore designed to examine anxiety and depression as independent predictors of HbA1c in a well-characterized T2DM patients, employing hierarchical regression to address the identified gaps in the existing evidence base.

METHODS

This analytical cross-sectional study was conducted at the Endocrinology Department of Nishtar Hospital, Multan from January to October 2025 after taking approval from the Institutional Review Board and Ethics Committee of Nishtar Medical University (Reference No.: IRB/NMU/2024/1847) and informed consent from every participant. The study

population comprised adult outpatients attending the diabetes clinic for routine follow-up. Eligible participants were individuals aged 18 years or older with a confirmed diagnosis of type 2 diabetes mellitus established, minimum diabetes duration of six months and a stable pharmacological regimen maintained for at least three consecutive months prior to enrolment. Candidates were excluded if they carried a diagnosis of type 1 diabetes, gestational diabetes, or secondary diabetes; had a current psychotic disorder, bipolar affective disorder, or active substance use disorder documented in medical records; scored below 24 on the Mini-Mental State Examination indicating cognitive impairment; experienced an acute illness or systemic infection within the preceding four weeks; underwent any alteration in corticosteroid or psychotropic medication dosage within the preceding eight weeks; or were pregnant at the time of assessment. Sample size was determined on the basis of hierarchical multiple linear regression as the primary analytical strategy. An a priori power estimation assuming medium effect size (Cohen's $f^2 = 0.15$), an alpha level of 0.05, statistical power of 0.95 and 15 predictor variables encompassing demographic, clinical, behavioral and psychological covariates yielded a minimum requirement of 205 participants.⁹ A total of 287 subjects were finally selected.

The primary laboratory investigation done was HbA1c, which gives the blood glucose levels of previous 3 months. However, fasting and two-hour glucose levels were also analyzed to have a recent update of the glucose in blood. The severity and screening of depressive symptoms were primarily done by PHQ-9. While anxiety symptoms were assessed by the GAD-7 questionnaire. MMAS-8 and WHOQOL-BREF tools validated the medication

adherence and quality of life, respectively.

The objective of present research is to determine the role of anxiety and depression in poor glycemic control. The data collection sequence followed a fixed protocol to reduce measurement fatigue and order effects. Upon arrival, eligible patients underwent a brief socio-demographic interview, followed by administration of the psychological instruments in a quiet consultation room. SPSS 27.0 analysed the data. Continuous variables and categorical data were presented as mean $\pm$ SD or median (IQR) and frequencies and percentages. For factors which were associated with glycosylation, basic information of participants, stress and clinical variables Hierarchical multiple linear regression was used. A p-value <0.05 was considered statistically significant.

RESULTS

A total of 287 subjects were enrolled in the study. Baseline demographics and clinical profile of Participants is shown in Table I. Mean PHQ-9 and GAD-7 scores were 10.8 ± 5.4 and 8.6 ± 4.9 , respectively, both falling within the mild-to-moderate severity range. Profile of Glycemic Control, Mental

Health, and Self-Care Measures is shown in Table II. Inverse correlations of moderate magnitude were observed between HbA1c and self-care behaviors ($r = -0.28$, $p < 0.001$) and medication adherence ($r = -0.25$, $p < 0.001$). Pearson correlation coefficients among continuous study variables (Table III) The addition of clinical variables in block two produced a significant increment of 11.6% ($\Delta R^2 = 0.116$, F-change = 12.84, $p < 0.001$), with diabetes duration ($\beta = 0.16$, $p = 0.004$) and insulin-based treatment ($\beta = 0.19$, $p = 0.001$) emerging as significant predictors. Behavioral variables entered at block three contributed an additional 7.9% of explained variance ($\Delta R^2 = 0.079$, F-change = 14.22, $p < 0.001$), with self-care activities ($\beta = -0.21$, $p < 0.001$) and medication adherence ($\beta = -0.18$, $p = 0.002$) inversely associated with HbA1c. Hierarchical Regression Analysis of Predictors of HbA1c ($n = 287$) is described in Table IV. Higher levels of mental stress were examined in relation to poor blood glucose. The assessment evaluated whether depression and anxiety had any relation with HbA1c $\geq 7.0\%$ after correction for relevant factors. (Table V)

Table I Baseline demographics and clinical profile of Participants (n = 287).

Variable	Category / Unit	n (%) or Mean $\pm$ SD / Median (IQR)
Age (years)	Continuous	52.4 $\pm$ 9.7
Sex	Male	161 (56.1)
	Female	126 (43.9)
Body mass index (kg/m ²)	Continuous	27.3 $\pm$ 4.1
Education	Primary or below	89 (31.0)
	Secondary	112 (39.0)
	Graduate or above	86 (30.0)
Socioeconomic status	Low	74 (25.8)
	Middle	148 (51.6)
	High	65 (22.6)
Diabetes duration (years)	Continuous	7.2 (4.1–11.3)
Treatment regimen	Oral hypoglycaemics	168 (58.5)
	Insulin $\pm$ oral agents	70 (24.4)
	Combination therapy	49 (17.1)
Hypertension	Present	139 (48.4)
Dyslipidaemia	Present	114 (39.7)
Smoking status	Current/former	67 (23.3)
Family history of diabetes	Present	142 (49.5)
Physical activity (IPAQ)	Low	103 (35.9)
	Moderate	121 (42.2)
	High	63 (21.9)

Table II Profile of Glycemic Control, Mental Health, and Self-Care Measures (n = 287)

Variable	Mean $\pm$ SD / n (%)
HbA1c (%)	8.24 $\pm$ 1.63
HbA1c $\geq$ 7.0% (poor control)	180 (62.7)
Fasting plasma glucose (mg/dL)	156.3 $\pm$ 42.7
Postprandial plasma glucose (mg/dL)	231.8 $\pm$ 58.4
PHQ-9 score	10.8 $\pm$ 5.4
Depression severity	Minimal (0–4): 64 (22.3)
	Mild (5–9): 89 (31.0)
	Moderate (10–14): 71 (24.7)
	Moderately severe (15–19): 38 (13.2)
	Severe (20–27): 25 (8.7)
GAD-7 score	8.6 $\pm$ 4.9
Anxiety severity	Minimal (0–4): 82 (28.6)
	Mild (5–9): 112 (39.0)
	Moderate (10–14): 61 (21.3)
	Severe (15–21): 32 (11.1)
DDS-17 score	2.4 $\pm$ 0.9
MMAS-8 score	5.7 $\pm$ 1.8
SDSCA total score	38.6 $\pm$ 12.3

Table III: Pearson correlation coefficients among continuous study variables (n = 287).

Variable	HbA1c	PHQ-9	GAD-7	DDS-17	SDSCA	MMAS-8	BMI	Duration
HbA1c	1.00							
PHQ-9	0.38	1.00						
GAD-7	0.31	0.52	1.00					
DDS-17	0.33	0.61	0.48	1.00				
SDSCA	-0.28	-0.35	-0.26	-0.30	1.00			
MMAS-8	-0.25	-0.29	-0.22	-0.24	0.41	1.00		
BMI	0.14	0.21	0.17	0.16	-0.12	-0.09	1.00	
Duration	0.19	0.15	0.13	0.18	-0.14	-0.11	0.08	1.00

Table IV: Hierarchical Regression Analysis of Predictors of HbA1c (n = 287)

Block / Predictor	B	SE B	β	95% CI for B	p-value	ΔR^2	R ² (cumulative)
Block 1: Demographics						0.058	0.058
Age	0.008	0.006	0.048	-0.004 to 0.020	0.182		
Sex (female)	-0.12	0.17	-0.036	-0.45 to 0.21	0.473		
Education	-0.09	0.08	-0.054	-0.25 to 0.07	0.271		
Socioeconomic status	-0.14	0.09	-0.076	-0.32 to 0.04	0.124		
Block 2: Clinical						0.116	0.174
BMI	0.031	0.015	0.078	0.002 to 0.060	0.038		
Diabetes duration	0.042	0.014	0.161	0.015 to 0.069	0.004		
Insulin-based therapy	0.68	0.19	0.192	0.31 to 1.05	0.001		
Comorbidity score	0.09	0.06	0.071	-0.03 to 0.21	0.134		
Block 3: Behavioral						0.079	0.253
SDSCA score	-0.024	0.005	-0.213	-0.034 to -0.014	<0.001		
MMAS-8 score	-0.14	0.045	-0.182	-0.23 to -0.05	0.002		
Physical activity	-0.08	0.05	-0.067	-0.18 to 0.02	0.118		
Block 4: Psychological						0.108	0.369
PHQ-9 score	0.072	0.013	0.241	0.047 to 0.097	<0.001		
GAD-7 score	0.058	0.014	0.178	0.031 to 0.085	0.002		

Table V: Relationship Between Emotional Stress and Poor Blood Glucose (n = 287)

Predictor category	Adjusted OR	95% CI	p-value
Depression (PHQ-9)			
Minimal (0–4)	1.00 (reference)	—	—
Mild (5–9)	1.38	0.74–2.57	0.312
Moderate (10–14)	2.41	1.28–4.53	0.006
Moderately severe / Severe (≥ 15)	3.67	1.82–7.41	<0.001
Anxiety (GAD-7)			
Minimal (0–4)	1.00 (reference)	—	—
Mild (5–9)	1.22	0.68–2.19	0.508
Moderate (10–14)	1.94	1.05–3.58	0.034
Severe (15–21)	2.86	1.41–5.79	0.003
Covariates in the model			
Diabetes duration (per year)	1.06	1.02–1.10	0.004
Insulin-based therapy	1.83	1.04–3.22	0.036
MMAS-8 (per unit)	0.78	0.67–0.91	0.002
SDSCA (per unit)	0.94	0.92–0.97	<0.001

DISCUSSION

The burden of Diabetes mellitus is becoming a global challenge. More and more research work is being done not only on its treatment and laboratories methods for its early detection, but also on the reasons why the disease is progressing day by day. This modern era has a lot to do in its progression. Unemployment is one of the greatest reasons. This leads to anxiety and depression and which are a major cause of the emerging disease.⁶

The psychological disorders have proved to have a poor outcome in controlling a worldwide disease, diabetes mellitus. Our study indicated a consistent pattern with the findings of previous studies in which it was demonstrated that emotional stress as anxiety and depression were a major cause of developing impairment in glucose control of the blood in the human body in Pakistan.^{11,12}

However, our studies reported that the patients of psychological disorders had also poor cognitive behaviors which was inconsistent with some of the previous studies.^{9,13} This difference of observation might be due to the fact that our study subjects were not well educated. Unlike some of the existing literature.^{12,14}, our study deducted an opposite trend in the percentages and frequencies of diabetes in emotionally compromised patients, suggesting the difference in the study setting areas and study participants/population. Exactly in line with a prior research article.¹⁵ our study also revealed that hormonal changes and poor care of one's own care i.e. self-care may lead to worsening of the diabetic complications. The outcome of the current study was comparable with another particularly with respect to the fact in which it was seen that the diabetic control was good with the patients who were cooperative

and showed good compliance.^{16,17} Our present study results were in agreement and supported previous work evidence that if the underlying cause of developing high blood glucose is well treated, the patient can be saved from the devastating effects of the deadly syndrome and its complications.¹⁸

CONCLUSION

Anxiety and depression are important predictors of diabetes mellitus and the treatment of these psychological disorders decrease the frequency of hyperglycemia.

DECLARATION OF INTEREST: The authors declare no conflict of interest.

AUTHORS CONTRIBUTIONS:

G.F: Conceptualization, literature review, data collection, data analysis, write up, proofreading and final editing of manuscript.

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