

Association of Depression with Glycemic Control in Type 2 Diabetes Mellitus

Anand Bakre¹, Pravin Verma²

¹Associate Professor, Department of general medicine, Prince Medical College, Sikar, Rajasthan, India. ²Associate Professor, Department of Psychiatry, Indira Gandhi Government Medical College, Nagpur, Maharashtra, India

Abstract

Background: Depression is an important psychological comorbidity in type 2 diabetes mellitus (T2DM) and may adversely affect diabetes self-management and glycemic control. The objective is to assess the association between depression and glycemic control among patients with T2DM. **Material and Methods:** This prospective observational study included 50 patients with T2DM at Indira Gandhi Government Medical College, Nagpur, Maharashtra, from February to July 2026. Depression was assessed using the Patient Health Questionnaire-9 (PHQ-9), with a score ≥ 10 indicating clinically significant depressive symptoms. Glycemic control was assessed using HbA1c, and HbA1c $\geq 7\%$ was considered poor glycemic control. Appropriate statistical tests and correlation analysis were performed, with $p < 0.05$ considered statistically significant. **Results:** The mean age of participants was 54.6 ± 9.8 years. Clinically significant depressive symptoms were present in 40.0%, while 72.0% had poor glycemic control. Poor glycemic control was significantly more frequent among patients with depression than among those without clinically significant depressive symptoms (95.0% vs 56.7%, $p = 0.003$). Mean HbA1c increased progressively from $7.18 \pm 0.82\%$ among patients with minimal depressive symptoms to $10.03 \pm 1.21\%$ among those with severe symptoms ($p < 0.001$). PHQ-9 score showed a significant positive correlation with HbA1c ($r = 0.58$, $p < 0.001$). **Conclusion:** Depression was significantly associated with poor glycemic control in patients with T2DM. Incorporating depression screening into routine diabetes care may facilitate comprehensive management of these patients.

Keywords: Type 2 diabetes mellitus; depression; glycemic control; HbA1c; PHQ-9.

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INTRODUCTION

Type 2 diabetes mellitus (T2DM) is a chronic metabolic disorder requiring sustained self-management to achieve adequate glycemic control and prevent complications. Depression is an important psychological comorbidity among patients with T2DM and may adversely influence treatment adherence, lifestyle practices, and metabolic outcomes. Recent evidence has demonstrated a significant relationship between depression and poorer glycemic control in individuals with T2DM.^[1]

The burden of depression among patients with T2DM is particularly relevant in India, where a substantial proportion of affected individuals experience depressive symptoms.^[2] Current diabetes care recommendations emphasize assessment of psychological well-being and screening for depression as part of comprehensive diabetes management.^[3,4] Integrating psychosocial assessment into routine clinical care may therefore facilitate early recognition of depression and improve overall diabetes management.^[5] Recent evidence also suggests that interventions addressing psychological health may improve depressive symptoms and potentially contribute to better glycemic outcomes.^[6] Furthermore, studies from low- and middle-income countries have demonstrated an association between depression and inadequate glycemic control among people living with diabetes.^[7]

Hence, the present study was undertaken to assess the association of depression with glycemic control among patients with T2DM attending a tertiary care hospital in Nagpur, Maharashtra.

MATERIALS AND METHODS

Study design and setting: This prospective observational study was conducted at Indira Gandhi Government Medical College, Nagpur, Maharashtra, over a period of six months, from February 2026 to July 2026. A total of 50 patients with type 2 diabetes mellitus attending the outpatient and/or inpatient services during the study period were enrolled.

Study population: Adult patients with an established diagnosis of T2DM who fulfilled the eligibility criteria and provided informed consent were included. Participants were enrolled consecutively until the required sample size of 50 was achieved.

Address for correspondence: Dr. Pravin Verma, Associate Professor, Department of Psychiatry, Indira Gandhi Government Medical College, Nagpur, Maharashtra, India. E-mail: dranandbakre@gmail.com

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Inclusion criteria

Patients aged ≥ 18 years, diagnosed with T2DM, receiving antidiabetic treatment, and willing to participate in the study were included.

Exclusion criteria

Patients with type 1 diabetes mellitus, gestational diabetes, severe acute medical illness, cognitive impairment interfering with depression assessment, previously diagnosed major psychiatric disorders other than depression, or inability to complete the study questionnaire were excluded.

Data collection: Demographic and clinical information including age, sex, duration of diabetes, treatment received, presence of diabetes-related complications, smoking and alcohol history, and relevant comorbidities was recorded using a structured proforma. Height and weight were measured, and body mass index (BMI) was calculated as weight in kilograms divided by height in metres squared.

Assessment of depression: Depressive symptoms were evaluated using the Patient Health Questionnaire-9 (PHQ-9). The total score ranged from 0 to 27. Scores of 0–4, 5–9, 10–14, 15–19, and 20–27 represented minimal, mild, moderate, moderately severe, and severe depressive symptoms, respectively. A PHQ-9 score ≥ 10 was considered indicative of clinically significant depressive symptoms for the primary analysis.

Assessment of glycemic control: Glycemic control was assessed using glycated hemoglobin (HbA1c) measured during the study evaluation. For the principal categorical analysis, patients were classified as having adequate glycemic control (HbA1c $< 7\%$) or poor glycemic control (HbA1c $\geq 7\%$). HbA1c was also analyzed as a continuous

variable to examine its relationship with PHQ-9 scores.

Outcome measures: The primary outcome was the association between depression and glycemic control. Secondary analyses included the correlation between PHQ-9 score and HbA1c level and comparison of mean HbA1c across different grades of depression severity.

Statistical analysis: Data were entered into Microsoft Excel and analyzed using IBM SPSS Statistics version 29.0. Continuous variables were expressed as mean $\pm$ standard deviation or median with interquartile range, as appropriate, while categorical variables were presented as frequencies and percentages. The independent-samples t test or Mann–Whitney U test was used for continuous variables, while the Chi-square test or Fisher's exact test was used for categorical variables. The relationship between PHQ-9 score and HbA1c was assessed using Pearson or Spearman correlation, depending on data distribution. Multivariable logistic regression was used, where appropriate, to evaluate whether depression was independently associated with poor glycemic control after adjustment for relevant confounding variables. A p-value < 0.05 was considered statistically significant.

RESULTS

A total of 50 patients with type 2 diabetes mellitus were included in the study. The mean age was 54.6 ± 9.8 years, with the majority (40.0%) belonging to the 51–60-year age group. Males constituted 54.0% of the study population. The mean duration of diabetes was 8.1 ± 5.2 years, while the mean BMI was 26.4 ± 3.7 kg/m². The overall mean HbA1c was $8.16 \pm 1.42\%$ [Table 1].

Table 1: Demographic and clinical characteristics of study participants (n=50)

Characteristic	n (%) / Mean $\pm$ SD
Age (years), mean $\pm$ SD	54.6 $\pm$ 9.8
≤ 40 years	5 (10.0)
41–50 years	12 (24.0)
51–60 years	20 (40.0)
> 60 years	13 (26.0)
Sex	
Male	27 (54.0)
Female	23 (46.0)
Duration of diabetes (years), mean $\pm$ SD	8.1 $\pm$ 5.2
< 5 years	15 (30.0)
5–10 years	20 (40.0)
> 10 years	15 (30.0)
BMI (kg/m²), mean $\pm$ SD	26.4 $\pm$ 3.7
Hypertension	24 (48.0)
Diabetes-related complications	18 (36.0)
HbA1c (%), mean $\pm$ SD	8.16 $\pm$ 1.42

Depressive symptoms were assessed using the PHQ-9. The mean PHQ-9 score was 8.9 ± 5.3 . Minimal depressive symptoms were observed in 14 (28.0%) patients, mild symptoms in 16 (32.0%), moderate symptoms in 11 (22.0%),

moderately severe symptoms in 6 (12.0%), and severe symptoms in 3 (6.0%). Using a PHQ-9 score ≥ 10 , 20 patients (40.0%) had clinically significant depressive symptoms [Table 2].

Table 2: Distribution according to depression severity and glycemic control

Parameter	n (%)
PHQ-9 depression severity	
Minimal (0–4)	14 (28.0)
Mild (5–9)	16 (32.0)
Moderate (10–14)	11 (22.0)
Moderately severe (15–19)	6 (12.0)
Severe (20–27)	3 (6.0)

Depression classification	
PHQ-9 <10	30 (60.0)
PHQ-9 ≥10	20 (40.0)
Glycemic control	
HbA1c <7%	14 (28.0)
HbA1c ≥7%	36 (72.0)

Poor glycemic control was observed more frequently among patients with clinically significant depressive symptoms. Of the 20 patients with PHQ-9 scores ≥10, 19 (95.0%) had

HbA1c ≥7%, compared with 17 (56.7%) of the 30 patients without clinically significant depression. This association was statistically significant ($p=0.003$) [Table 3].

Table 3: Association between depression and glycemic control

Depression status	HbA1c <7%, n (%)	HbA1c ≥7%, n (%)	Total	p-value
PHQ-9 <10	13 (43.3)	17 (56.7)	30	
PHQ-9 ≥10	1 (5.0)	19 (95.0)	20	0.003
Total	14 (28.0)	36 (72.0)	50	

Fisher's exact test.

Mean HbA1c progressively increased with increasing severity of depressive symptoms, from $7.18 \pm 0.82\%$ among patients with minimal symptoms to $10.03 \pm 1.21\%$ among those with severe depressive symptoms. The difference across depression severity categories was statistically

significant ($p<0.001$). PHQ-9 score also showed a significant positive correlation with HbA1c ($r=0.58$, $p<0.001$), indicating worsening glycemic control with increasing depressive symptom severity [Table 4].

Table 4: Relationship between depression severity and HbA1c

PHQ-9 category	n	HbA1c (%), Mean ± SD
Minimal	14	7.18 ± 0.82
Mild	16	7.71 ± 1.03
Moderate	11	8.62 ± 1.17
Moderately severe	6	9.28 ± 1.24
Severe	3	10.03 ± 1.21
Overall	50	8.16 ± 1.42
ANOVA p-value		<0.001
PHQ-9 score vs HbA1c, Pearson r		0.58 ($p<0.001$)

Overall, 40.0% of patients had clinically significant depressive symptoms and 72.0% had poor glycemic control. Depression was significantly associated with poor glycemic control, and increasing depression severity was accompanied by progressively higher HbA1c levels.

DISCUSSION

The present prospective study evaluated the association between depression and glycemic control among 50 patients with type 2 diabetes mellitus. Clinically significant depressive symptoms (PHQ-9 ≥10) were observed in 40.0% of participants, while 72.0% had poor glycemic control (HbA1c ≥7%). Patients with depression showed a substantially greater frequency of poor glycemic control than those without clinically significant depressive symptoms (95.0% vs 56.7%, $p=0.003$).

The considerable burden of depressive symptoms observed in the present study is consistent with recent evidence demonstrating that depression is an important comorbidity among patients with diabetes. Yang et al. reported a substantial prevalence of depression among individuals with diabetes and identified several demographic and disease-related factors contributing to its occurrence.^[8] These findings emphasize the importance of psychological assessment as part of routine diabetes care.

The association between psychological health and diabetes outcomes may be influenced by multiple behavioral and clinical pathways. Cooper et al. demonstrated that integrated

approaches addressing both depression and diabetes can improve psychological outcomes and aspects of diabetes management.^[9] Similarly, longitudinal evidence reported by Gillett et al. indicated an association between major depressive disorder and glycemic outcomes among individuals with T2DM.^[10] Depression may interfere with medication adherence, dietary practices, physical activity, self-monitoring, and motivation for long-term disease management, thereby contributing to poorer glycemic control.

In the present study, mean HbA1c increased progressively with depression severity, from $7.18 \pm 0.82\%$ in patients with minimal depressive symptoms to $10.03 \pm 1.21\%$ among those with severe symptoms ($p<0.001$). Digital and behavioral interventions targeting depression have also demonstrated potential benefits in patients with T2DM, supporting the relevance of addressing psychological well-being alongside conventional diabetes treatment.^[11]

A significant positive correlation was observed between PHQ-9 score and HbA1c ($r=0.58$, $p<0.001$), suggesting that increasing depressive symptom severity was associated with worsening glycemic control. Qian et al. similarly demonstrated an important relationship between depressive symptoms, diabetes-related distress, and glycemic control, suggesting that diabetes distress may partly mediate this association.^[12]

The PHQ-9 provided a simple standardized approach for identifying clinically relevant depressive symptoms. Evidence from systematic evaluation has supported its usefulness as a screening instrument for major depression across clinical settings.^[13] Its applicability among patients with T2DM has also

been demonstrated in diabetes clinics, supporting its use for identifying patients who may require further psychological assessment.^[14]

Indian evidence has consistently highlighted depression as an important but frequently under-recognized comorbidity of diabetes. A systematic review from an Indian perspective demonstrated a considerable burden of depression among patients with diabetes and emphasized its potential implications for diabetes management.^[15] Similarly, Thour et al. reported clinically relevant depressive symptoms among Indian patients with diabetes using the PHQ-9.^[16] The present findings add to this evidence by demonstrating a significant association between depressive symptom severity and HbA1c in patients attending a tertiary care institution in Maharashtra.

The study had certain limitations. The relatively small sample size and single-centre design limit the generalizability of the findings. Depression was assessed using a screening questionnaire rather than a structured psychiatric diagnostic interview. Furthermore, although the study was prospective in data collection, the observed association does not establish a causal relationship between depression and poor glycemic control. Larger multicentric longitudinal studies are required to clarify the temporal relationship between depression and glycemic outcomes.

CONCLUSION

Depressive symptoms were common among patients with type 2 diabetes mellitus and were significantly associated with poor glycemic control. Increasing PHQ-9 scores were associated with progressively higher HbA1c levels. Routine screening for depression, together with appropriate psychological assessment and management, may therefore be useful as part of comprehensive diabetes care.

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Conflicts of interest

There are no conflicts of interest.

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