Original Article

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Burden of Depression among Patients with Type 2 Diabetes Mellitus in India: A Cross-sectional Study

Epidemiology Section

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ABSTRACT

Introduction: Depression, a leading global cause of disability, shares a bidirectional relationship with Type 2 Diabetes Mellitus (T2DM). Though regional studies exist, pan-India evidence on depression in T2DM is still limited. Considering this unmet need, the current study was designed to determine the prevalence and various components of depression associated as co-morbidity in T2DM patients in India.

Aim: To analyse various components of depression associated as co-morbidity in T2DM patients.

Materials and Methods: A cross-sectional, questionnaire-based survey was conducted between August and December 2024 across 725 private clinics in India. A total of 10,655 patients were enrolled, of whom 10,638 were included in the final analysis. Male and female patients aged 18-year-old and above, diagnosed with type 2 diabetes for over a duration of one year or longer were included in this study. Depression was evaluated using the Patient Health Questionnaire-9 (PHQ-9), and associations with demographics, clinical, and lifestyle factors. Chi-square test was used to find out significance on categorical scales between groups, univariate analysis was applied to investigate the association between symptoms and risks, and two-sided test was used to assess the level of significance.

Results: Overall, 46.4% (n=4931) of patients exhibited depression, while 53.6% (n=5707) had no clinically significant depression based on PHQ-9 score. Subgroup analysis through univariate revealed that depression was significantly associated with age and diabetes duration (p-value <0.001 each). Notably higher prevalence was observed in 18-40 years age group. Conversely, no statistically significant association found between haemoglobin-A1c levels and depression (p-value=0.512). Symptoms of moderate to severe depression in men was minimally higher than women, with no statistically significant difference (p-value=0.345). Additionally, smoking and exercise independently contributed to depression prevalence among diabetic patients (p-value <0.001). On multivariate regression analysis, independent predictors of greater depression severity included younger age, smoking, and longer diabetes duration (p-value <0.001 for all).

Conclusion: This large, pan-India study highlights a substantial burden of depression among patients with T2DM. Younger age, long-standing diabetes, and smoking were independently associated with higher depression rates. Routine depression screening and integrated management should be prioritised as part of comprehensive diabetes care.

Keywords: Co-morbidity, Glycaemic control, Mental disorder, Patient health questionnaire, Smoking

INTRODUCTION

The DM has been a rapidly growing cause of morbidity and mortality all over the world. On a global scale (2021), approximately 537 million people aged 20 to 79 are living with DM, with nearly all of them having T2DM [1]. The burden of T2DM is rising at an alarming rate, especially in South Asian countries such as India. According to recent data from the International Diabetes Federation (IDF), approximately 74.2 million people in India are currently living with T2DM and this number envisioned to surge to 124.9 million by 2045 [2].

Depression, another most prevalent and severe mental illness characterised by sadness, loss of interest or pleasure, low self-worth, loss of sleep or appetite, tiredness, and difficulty concentrating [3], affects more than 300 million people of all ages globally (2017) [4]. Between 1990 and 2019, depression was one of the primary factors impacting disability-adjusted life-years (DALYs) and was the leading cause of death worldwide [5]. In 2017, mental disorders affected 197.3 million people in India, including 45.7 million cases of depression [6].

Depression is closely associated with chronic diseases, such as T2DM, which has been linked to a higher prevalence of depressive symptoms [7]. Depressed subjects have elevated levels of stress hormones, such as, cortisol which make the cells resistant to insulin action resulting in insulin resistance and hyperglycaemia, whereas poor glycaemic control in diabetes influences the Hypothalamic Pituitary Adrenal (HPA) axis, activating the neurobiology of mood disorders resulting in depression [8,9]. According to two meta-analyses diabetic subjects have 24% increased risk of developing depression and depressed adults have 37% higher risk of developing diabetes, which is even higher with the long-term use of antidepressants [10,11].

Several factors, such as female gender, low birth weight, adverse childhood events, lifestyle, obesity, cognitive dysfunction, mobility, migration and globalisation, have been identified to influence the development of co-morbid diabetes and depression through multiple mechanisms [12,13]. In diabetes, depression can exacerbate outcomes as depressed diabetics have poor self-management, rarely adhere to prescribed medications, miss preventive measurements, avoid therapy appointments and skip regular exercise [14]. Moreover, patients with co-morbid depression and T2DM have a higher risk of all-cause and cardiac-related death compared to those without depression [15].

The relationship between DM and depression has been researched in India in a region wise representation [16-20]. However, the Pan-India prevalence is lacking. Therefore, there is a need to generate this data in Indian population. Considering the unmet need, the current study was designed to investigate various components of depression associated as co-morbidity in T2DM patients, to help healthcare practitioners better understand depression in diabetes and design treatments that address both the psychological and metabolic needs of affected patients to improve overall health outcomes.

MATERIALS AND METHODS

This was a questionnaire-based cross-sectional survey conducted between August-December 2024 to investigate various components of depression associated as co-morbidity in T2DM patients. For this study, consulting physicians (qualified as MD in Medicine) with an extensive experience in managing patients with DM were selected from 725 clinical sites (private clinics) across India. Ethical review and approval for the study were granted by the Institutional Ethics Committee for Biomedical and Health Research (IECBH) of Dr. D.Y. Patil Medical College and Hospital, Navi Mumbai (DYP/IECBH/2024/212), under the "Minimal Risk" category, in accordance with the Indian Council of Medical Research (ICMR) Ethical Guidelines (2017). The study was prospectively registered under Clinical Trial Registry of India (CTRI/2024/08/072123).

A total of 10,875 patients who met study eligibility criteria were invited to take part in this study.

Inclusion criteria: Males and females aged ≥18 years, diagnosed with T2DM, receiving medical care for diabetes for at least one year, were able to understand the questionnaire, and patients willing to participate in the study were included in the study.

Exclusion criteria: Patients with physical and/or mental conditions that might interfere with participation, type 1 diabetes, gestational diabetes, Connective Tissue Disease (CTD), ongoing treatment with corticosteroid and antidepressants, were excluded from the study.

Sample size estimation: As this was an observational, cross-sectional and non-interventional survey which did not include a comparison group and so no formal sample-size was calculated. Therefore, based on the enrolment potential, nearly around 10,875 patients from 725 private clinics of Consultant Physicians (i.e., 15 patients per site) were assigned as representative sample across India.

Study Procedure

A predesigned and validated questionnaire was devised by all authors, principal investigators and co-investigator which comprised questions used to gather data on patient's demographics, T2DM-related parameters and glycaemic control. The severity of depression was assessed using the PHQ-9, a widely recognised tool for screening and diagnosing depression [21].

Depression was evaluated using the PHQ-9, and associations with demographics, clinical, and lifestyle factors.

Demographic, lifestyle, and clinical data: Demographic variables included gender, age, height, and weight. The Body Mass Index (BMI) was calculated as weight/height^2 (kg/m^2). Patients were interviewed about their lifestyle including smoking status, physical activities, and emotional status regarding diabetes. The patient's duration of T2DM, associated complications, and the treatment was also recorded. Additionally, available laboratory test results including haemoglobin A1c (HbA1c), Fasting Plasma Glucose (FPG), Post-prandial blood glucose (PPBG) were collected.

Measurement of depression: In accordance with the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition criteria (DSM-5), the PHQ-9, a nine-question depression scale, was utilised for assessing for the prevalence and intensity of signs of depression during the previous two weeks. The nine symptoms were given a value between 0 and 27, where the higher the score, the more severe the symptom. The scores were as follows: "0=not at all", "1=several days", "2=more than half the days", or "3=almost every day". [22] Patient's scores ranged from 0 to 27, helping to screen for the symptoms of no depression (score 0-4), mild depression (score 5-9), moderate depression (score 10-14), moderately severe depression (score 15-19), or severe depression (score 20-27). While scores of ≥ 15 typically indicate the presence of major depression, scores < 5 almost always signifies the absence of depressive disorders. Scores of 5 to 9 predominantly represented patients with either no depression or subthreshold depression [22]. The data was captured digitally with the DocMode online platform and then transferred to Microsoft Excel 2013 for analysis. Before participation, valid informed consent was obtained from each patient.

STATISTICAL ANALYSIS

The descriptive statistics were used in accordance with the level of the variable measurements. Representation of continuous variables was expressed by mean and Standard Deviation (SD) whereas the categorical variables were shown with frequency and percentage. For intergroup analysis on metric parameters, Chi-square test was used to find out the significance to the study parameters on the categorical scale between the groups. Univariate analysis was applied to investigate the possible association between depressive symptoms and risk variables including patient's demographic, clinical, and lifestyle characteristics. Those variables which showed significant relationship with the dependent variable in univariate testing were further included in the multivariate logistic regression analysis to identify independent association of the significant variables. The p-value <0.05 was considered as significant. All the data were analysed by using IBM Statistical Package for the Social Sciences (SPSS) Statistics for Windows, Version 28.0. Armonk, NY: IBM Corp (IBM Corp. Released 2019).

Analysis of missing data was performed on available data without imputation. Patients with implausible or incomplete demographic or clinical data entries were excluded from the final dataset. For parameters with partial availability, analyses were restricted to participants with complete information for that variable the extent of missingness was reported in final results.

RESULTS

Out of 10,875 planned sample size 10,655 patients were enrolled based on the eligibility criteria and analysis was performed for 10,638 patients. Seventeen (17) were considered outliers due to protocol deviations and implausible data entries, hence excluded from analysis. The rest of the patients did not pass the eligibility criteria and hence were not enrolled in the study. The demographic and clinical characteristics of study population are reported in [Table/Fig-1].

Variables	Frequency, N (%)
Demographic parameters (N=10638)	
Age (years)	
18 to 40	1835 (17.3)
41 to 64	7105 (66.8)
65 to 74	1321 (12.4)
≥75	377 (03.5)
Gender	
Male	6684 (62.8)
Female	3954 (37.2)
BMI	
<18.5 (Underweight)	671 (06.3)
18.5 - 24.9 (Normal)	5438 (51.1)
25 - 29.9 (Overweight)	3259 (30.7)
≥30 (Obese)	1270 (11.9)
Clinical characteristics (N=10638)	
Diabetes duration (years)	
≤10	7361 (69.2)
>10	3277 (30.8)
Diabetic complications	
Present	6159 (57.9)
Absent	4479 (42.1)
HbA1C (N=5040)*	
<5.7%	241 (04.8)

5.7% to 6.4%	1127 (22.4)
6.5% to 8.5%	2764 (54.8)
8.6% to 10.0%	632 (12.5)
>10.0%	276 (05.5)
FPBG (mg/dL) (N=3014)*	
< 100	134 (04.4)
100 – 125	549 (18.2)
>125	2331 (77.3)
PPBG (mg/dL) (N=2670)*	
Less than 140	227 (08.5)
140 to 199	799 (29.9)
≥200	1644 (61.6)
Lifestyle habits and emotional status (N=10638)	
Smoking status	
Smokers	3416 (32.1)
Non-smokers	7222 (67.9)
Exercise status	
Exercise	7112 (66.9)
Never exercise	3526 (33.1)
Emotional status regarding diabetes (multiple options)	
Angry	4,752 (44.7)
Sad	4896 (46.0)
Scared	3887 (36.5)
Stressed	6639 (62.4)
Emotional status (PHQ-9 score) (N=10638)	
No depression	2358 (22.2)
Mild depression	3349 (31.5)
Moderate depression	3277 (30.8)
Moderately severe depression	1302 (12.2)
Severe depression	352 (03.3)

[Table/Fig-1]: Demographic and clinical characteristics of study population.
*Indicates the number of patients for which the laboratory parameters were available.

Out of total enrolled patients around 46.4% met the criteria for depression {moderate 3277 (30.8%); moderately severe 1302 (12.2%); severe 352 (3.3%)}, remaining 5707 (53.6%) of patients had no clinically significant depression {no depression 2358 (22.2%); mild depression 3349 (31.5%)}.

A subgroup analysis was conducted through univariate model to understand impacts of depression on T2DM patients based on their demographic - clinical profile, and lifestyle habits and the results are depicted in [Table/Fig-2]. The study findings revealed the statistically significant association between age groups and depression (p-value <0.001), there was high prevalence observed in age group between 18-40 years compared to other age groups. Severity of depression was mild-to-moderate in young patients (18-40 years) whereas patients ≥65 years of age were having severe depression.

Overall mean score of PHQ-9 representing symptoms of moderate to severe depression in men was minimally higher (n=3130/6684; 46.8%) than women (n=1801/3954; 45.6%), hence the difference was statistically non-significant (p-value=0.345). There was a significant association found between disease duration and depression (p-value <0.001). The prevalence of moderate to severe depressive symptoms was higher in those had a history of disease >10 years (n=1566/3277; 47.8%) compared to ≤10 years (n=3365/7361; 45.6%). However, there was no significant association found between depression along with levels of HbA1c (p-value=0.512), and presence or absence of diabetic complications (i.e., neuropathy, nephropathy and retinopathy) (p-value=0.680). Lifestyle habits like smoking and exercise in diabetic patients also conferred substantial prevalence of depression independently (p-value <0.001). Those who exercised had less severe depression but who never exercised had all grades of depression. Further, more non-smokers had no depression compared to smokers.

Following the univariate findings, a multivariate regression analysis was added to the study to evaluate whether the variables identified as significant in univariate analysis continued to show an independent relationship with PHQ-9 scores when adjusted for other influencing factors [Table/Fig-3].

Variables	Study population, N (%) (n=10,638)	Emotional Status (PHQ-9 Score), N (%)					p-value
		No depression (0-4) (n=2358)	Mild depression (5-9) (n=3349)	Moderate depression (10-14) (n=3277)	Moderately severe depression (15-19) (n=1302)	Severe depression (20-27) (n=352)	
Age groups							
18 to 40 years	1835 (17.3)	228 (12.4)	692 (37.7)	608 (33.1)	266 (14.5)	41 (02.2)	*<0.001
41 to 64 years	7105 (66.8)	1661 (23.4)	2189 (30.8)	2204 (31.0)	844 (11.9)	207 (02.9)	
≥65 years	1321 (12.4)	363 (27.5)	319 (24.1)	395 (29.9)	160 (12.1)	84 (06.4)	
≥75 years	377 (03.5)	106 (28.1)	149 (39.5)	70 (18.6)	32 (08.5)	20 (05.3)	
Gender							
Male	6684 (62.8)	1480 (22.1)	2074 (31.0)	2084 (31.2)	811 (12.1)	235 (03.5)	0.345
Female	3954 (37.2)	878 (22.2)	1275 (32.2)	1193 (30.2)	491 (12.4)	117 (03.0)	
BMI							
<18.5 (Underweight)	671 (06.3)	150 (06.4)	214 (06.4)	221 (06.7)	66 (05.1)	20 (05.7)	0.408
18.5 - 24.9 (Normal)	5438 (51.1)	1205 (51.1)	1710 (51.1)	1652 (50.4)	700 (53.8)	170 (48.3)	
25 - 29.9 (Overweight)	3259 (30.6)	713 (30.2)	1012 (30.2)	1015 (31.0)	403 (31.0)	116 (33.0)	
≥30 (Obese)	1270 (11.9)	290 (12.3)	413 (12.3)	389 (11.9)	133 (10.2)	46 (13.1)	
Exercise routine							
Exercise	7112 (66.9)	1524 (21.4)	2304 (32.4)	2241 (31.5)	838 (11.8)	205 (02.9)	*<0.001
Never exercise	3526 (33.1)	834 (23.7)	1045 (29.6)	1036 (29.4)	464 (13.2)	147 (04.2)	
Smoking status							
Smoker	3416 (32.1)	626 (18.3)	1023 (29.9)	1179 (34.5)	455 (13.3)	133 (03.9)	*<0.001
Non-Smoker	7222 (67.9)	1732 (24.0)	2326 (32.2)	2098 (29.1)	847 (11.7)	219 (03.0)	
Diabetes duration							
≤10 years	7361 (69.2)	1591 (21.6)	2405 (32.7)	2255 (30.6)	916 (12.4)	194 (02.6)	*<0.001
>10 years	3277 (30.8)	767 (23.4)	944 (28.8)	1022 (31.2)	386 (11.8)	158 (04.8)	

HbA1c classification (N=5040)							
< 5.7%	241 (04.8)	42 (17.4)	84 (34.9)	81 (33.6)	31 (12.9)	03 (01.2)	0.512
5.7% to 6.4%	1127 (22.4)	252 (22.4)	361 (32.0)	339 (30.1)	135 (12.0)	40 (03.5)	
6.5% to 8.5%	2764 (54.8)	644 (23.3)	843 (30.5)	831 (30.1)	340 (12.3)	106 (03.8)	
8.6% to 10.0%	632 (12.5)	135 (21.4)	192 (30.4)	187 (29.6)	93 (14.7)	25 (04.0)	
>10.0%	276 (05.5)	63 (22.8)	88 (31.9)	78 (28.3)	39 (14.1)	08 (02.9)	
Diabetes complications							
Present	6159 (57.9)	1368 (22.2)	1929 (31.3)	1884 (30.6)	762 (12.4)	216 (03.5)	0.680
Absent	4479 (42.1)	990 (22.1)	1420 (31.7)	1393 (31.1)	540 (12.1)	136 (03.0)	

[Table/Fig-2]: Univariate analysis of PHQ-9 Score with variables.
By Chi-square test, p<0.05, *Significant
Note: Due to the unavailability of FPBG and PPBG values in several patients, their correlation with PHQ-9 scores could not be assessed.

Variable	Coefficient (β)	p-value	Confidence Interval (CI-95%) (Lower-Upper)
Age group	-00.48	*<0.001	-0.65 – -0.31
Exercise	00.19	0.084	-0.03 – 0.41
Smoking	00.88	*<0.001	0.66 – 1.10
Diabetes duration	00.53	*<0.001	0.29 – 0.77

[Table/Fig-3]: Multivariate regression analysis.
*Significant

Younger individuals with diabetes exhibited comparatively higher PHQ-9 scores, reflecting a greater tendency toward depressive symptoms. Those with a longer duration of diabetes and individuals who smoked also showed higher depression scores, suggesting that both prolonged illness and smoking habits may adversely affect mental wellbeing. In contrast, older adults reported slightly lower depression levels. Although regular exercise showed a marginally positive trend, the difference was not statistically significant. Overall, younger age, smoking, and longer duration of diabetes emerged as factors associated with greater depressive symptom severity.

DISCUSSION

Depressive symptoms impede diabetes care tasks and negatively influence health status furthermore these depression symptoms not only can't be identified by the patients, but also can't be recognised by care providers, hence, leading to under-treatment [23,24]. This study analysed the prevalence of depression in 10,638 T2DM patients Pan-India. The study reported the prevalence of depression as 46.4% among T2DM patients.

In comparison with these previously published studies in [Table/Fig-4] [16-20], the aim was to investigate prevalence rates of depression among T2DM patients in Pan-India with considerably larger sample size, represents a significant strength of current study. Secondly, PHQ-9 ≥10 criteria used in the present study provided more precise prevalence of depression [22].

To understand impacts of depression on T2DM patients based on their demographic-clinical profile, and lifestyle habits a subgroup analysis was conducted. A study by Baker MM et al., with 706 patients found that patients diagnosed with T2DM before age 40 years had significantly higher levels of depressive symptoms and diabetes-specific distress compared to those diagnosed later [25]. A large-scale analysis of electronic medical records from the UK (n= 230,932) and USA (n=1,143,122) revealed that people diagnosed with T2DM between ages 18-39 had a 23-57% higher risk of depression compared to those diagnosed after age 50 years [26]. A cross-sectional survey conducted by Gupta SS and Adhikari UR at government hospitals in Kolkata, with 290 sample size, found that young adults (18-40 years) had a 63.9% prevalence of depression, which was higher than middle-aged and

S. No.	Author Name and Year	Place of study	Sample size	Objective	Parameters assessed	Conclusion
1.	Raval A et al., 2010 [16]	North India	300	Prevalence and determinants of depression in patients with T2DM	Depression, obesity, diabetes, neuropathy, nephropathy	The risk factors for depression were age, central obesity, diabetic complications particularly neuropathy and diabetic foot disease and increased pill burden.
2.	Madhu M et al., 2013 [17]	South India	100	Assess undiagnosed depression and its predictors among adult diabetic patients	Elevated Fasting Blood Sugar (FBS) level	Predictors of depression were female gender, elevated fasting blood sugar (FBS) level, physical disability and lack of physician's advice about lifestyle modifications.
3.	Singh H et al., 2014 [18]	Central India	200	Prevalence of depression in diabetes and to identify associated risk factors	Hypertension, somatic neuropathy symptoms, autonomic neuropathy symptoms, Semmes–Weinstein monofilament, Serum creatinine levels	Physical symptoms mask depression; attention needs to be paid to treat depression in diabetes with effective glycaemic control.
4.	Khullar S et al., 2016 [19]	Punjab	787	To identify the prevalence and predictors of depression in diabetes	Waist Hip Ratio (WHR) ratio, statin use, plasma level of density lipoproteins	Depression was strongly associated with advancing age >30 years, low income, sedentary lifestyle, drinking alcohol, BMI, glucose levels.
5.	Gupta SS and Adhikari UR 2024 [20]	West Bengal	290	Prevalence and predictors of depression in diabetic patients	Socio-demographic and clinical characteristics	Depression was linked with poor glycaemic control, marital status and family support.
6.	Sousa AD et al., 2026	India	10,638	Analyse components of depression associated as co-morbidity in diabetic patients	Demographic and clinical characteristics, diabetes, Depression, Fasting Plasma Glucose (FPG) Post-Prandial Blood Glucose (PPBG), haemoglobin	Depression was significant in patients with diabetes with more prevalence in young adults and smokers.

[Table/Fig-4]: Findings from similar studies [16-20].

older adults [20]. However, the present study found a comparatively lower prevalence of 49.8% (n=915/1835) in the same age group of T2DM patients. This difference can be attributed to two important factors. First, the present study was conducted on a substantially larger sample size, which provides more robust and representative estimates by reducing the influence of sampling variation. Second, in recent years, there has been a gradual increase in awareness about mental health and diabetes care in India, leading to earlier identification, better coping strategies, and improved access to medical and psychological support. Together, these factors may explain the relatively lower prevalence in the present study, while still reaffirming the heightened vulnerability of younger adults to depression compared to older age groups.

A previous study by Alzahrani A et al., among 450 diabetic patients found the prevalence of depression (56.9%) in male patients and (43.1%) female patients [27]. The present study also found that the prevalence of depression was slightly more in male (n=3130/6684; 46.8%) patients compared to female patients (n=1801/3954; 45.6%), however the difference was statistically non-significant. Additionally, the present study revealed that an increased duration of diabetes was significantly associated with an increased odd of having depression.

All grades of HbA1c correlating with glycaemic control were associated with some grades of depression in majority of patients though it was not statistically significant. This was in line with the study conducted by Langberg J et al., [28]. The importance of lifestyle modifications (dietary regulation and regular exercise) in reducing the risk of depression and the importance of physicians addressing them has been shown by several studies [29,30]. Regular physical exercise independently had a positive impact on depression [31]. Since better blood glucose control can be achieved by regular physical exercise, diabetics with depression who exercise regularly are more likely to show an improvement in depressive symptoms than those who do not. Hence, it is imperative that physicians advise T2DM patients regarding dietary regulation and exercise. The present study also demonstrated significant association of regular exercise in reducing the risk of depression, though with numerical difference [46.2% regular exercise patients (n=3284/7112) and 46.8% non-exercise patients (n=1647/3526), p-value <0.001]. However, on multivariate regression analysis, exercise was not found to be significantly associated with depressive symptom severity (p-value=0.084).

A study by Guo Y and Yan J indicate a strong association between smoking and depression, with smoking being a risk factor for depression development [32]. Similarly, in the present study the prevalence of depression was considerably high in diabetic patients with smoking habits compared to non-smokers [51.7% in smokers (n=1767/3416) and 43.8% in non-smokers (n=3164/7222), p-value <0.001). Given the significant association of lifestyle habits such as exercise routine and smoking with co-morbid depression in T2DM patients, healthcare providers may find them as value addition towards promoting a healthier lifestyle. Cognitive behavioural therapy combined with exercise programs has been shown to enhance health outcomes in patients with T2DM and depression, as well as in those receiving behavioural counselling and medication for smoking cessation [33,34].

The DEP-INDIA study can prove to be the largest pan-India cross-sectional survey to date assessing the burden of depression among patients with T2DM, enrolling 10,638 participants across 725 clinical sites. The large, geographically diverse cohort and the use of the validated PHQ-9, aligned with DSM-5 criteria, enhance the representativeness, reliability, and comparability of the findings. Unlike previous Indian studies, which were limited by smaller, region-specific samples, this study provides robust national-level evidence demonstrating that nearly half of patients with T2DM experience depression, with higher prevalence among younger adults, individuals with longer diabetes duration, and smokers. Furthermore, multivariable regression analysis strengthened the validity of the findings by identifying independent determinants of depression. Collectively, these results underscore the need for routine depression screening, integration of mental health services into diabetes care, and targeted lifestyle interventions, including smoking cessation, to improve comprehensive diabetes management.

Limitation(s)

Despite its strengths, certain limitations must be acknowledged. As a cross-sectional study, causal inferences between depression and associated factors cannot be established. The use of a self-reported questionnaire (PHQ-9), while validated, may still be subject to reporting bias and under- or over-estimation of depression prevalence. Furthermore, the study did not capture the severity of diabetes-related complications in detail, nor did it assess psychosocial variables such as family support, socio-economic status, or treatment adherence, which may influence depression risk. Finally, the survey was conducted within clinical settings, which may limit applicability to undiagnosed or non-hospital-attending populations, potentially underestimating the true community burden.

CONCLUSION(S)

This was the first large-scale pan-India study evaluating 10,638 T2DM patients for depression symptoms, with a prevalence of 46.4%, emphasises the significant burden of depression in patients with diabetes. Depression was more prevalent in young adults, smokers and longer diabetes duration in T2DM patients. The use of a standardised tool (PHQ-9 ≥10) in this study improved the reliability of prevalence estimation. These results highlight the need for integrated care methods that include regular depression screening, patient education, and lifestyle changes. A team-based multidisciplinary model that provides mental health support along with T2DM management may improve both mental health and blood glucose levels in these patients.

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