Journal of Medical and Scientific Research

JMSR
www.jmsronline.com

Singh A et al. J Med Sci Res. 2023; 11(2):96-103
http://dx.doi.org/10.17727/JMSR.2023/11-19

ORIGINAL RESEARCH OPEN ACCESS

Association between depression and diabetes in the South-Eastern zone of the state of Uttar Pradesh-India: A cross-sectional study

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Abstract

Background: Depression is among the most common mental health problems among people with chronic complications like type 2 diabetes mellitus is brought on by flaws in insulin secretion and activity; however, genetic factors also play a role in both insulin resistance and beta-cell failure, but environmental factors also play a role in aggravating both problems. The presence of depression in patients with type 2 diabetes may interfere with treatment and efficacy. This study aimed to determine the prevalence of depression in this metabolic variant clinical condition, type 2 diabetes mellitus, in major tertiary care hospitals in the South-Eastern Uttar Pradesh cities of Allahabad and Varanasi.

Subjects and methods: For this study, 206 subjects with type 2 diabetes mellitus from rural and urban areas were recruited. Demographic, clinical, and diabetes-related data were collected using a semi-structured questionnaire. Depression was assessed using the Patient Health Questionnaire 9 (PHQ9), a standardized questionnaire developed in the United States and validated in the Indian population.

Results: The prevalence of depression in diabetics in the community was 43.2%. The most common type of depression was mild (29.3%, 26), and the least common was severe depression (3, 3.37%). Several factors were associated with depression in the female gender: living in a rural area, unemployment, and being single. The complications of diabetes and other chronic conditions, such as hypertension and obesity, are also associated with depression.

Conclusion: Depression was found to be particularly high in the study population. Because depression can significantly impede patient adherence to treatment, there is an urgent need for early diagnosis and treatment. This requires integrating mental health care for diabetes patients.

Keywords: prevalence; diabetes; depression; community; higher rate

Introduction

Worldwide, diabetes mellitus (DM) is a tremendous hormonal/endocrine disease with high morbidity and mortality rates [1-2]. DM is a clinical metabolic-disorder condition that affects all age groups of people all over the world. DM arises due to mainly two reasons (i) Insufficient insulin production brings it on by the pancreas; (ii) Ineffective insulin utilization by the body [3-6]. The International Federation of Diabetes (IFD) reports defined that the prevalence of diabetes mellitus (DM) has already reached epidemic levels worldwide, especially in many developing economies like China and India [7]. The majority of diabetes patients worldwide

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Received 12 December 2022; *Revised* 22 February 2023; *Accepted* 2 March 2023; *Published* 10 March 2023

Citation: Singh A, Shukla J, Sachan N, Kumari R, Dubey GP. Association between depression and diabetes in the South-Eastern zone of the state of Uttar Pradesh-India: A cross-sectional study. J Med Sci Res. 2023; 11(2):96-103. DOI: http://dx.doi.org/10.17727/JMSR.2023/11-19

reside in India [8-10]; Considering approximately 17% of all diabetes patients worldwide reside in India, the country is frequently called the "Diabetes Capital of the World". In India, there are currently nearly 80 million diabetics, and by 2045, that number is expected to grow to 135 million; however, the prevalence has nearly doubled from 4.7%- 8.5%, mainly due to different geographical-demographic along with other risk factors related to lifestyle- "Physical inactivity, obesity, smoking" [3].

World Health Organization (WHO) reported that DM affected four-fold time higher in 2016 as compared to 1990 [8] while diabetes has risen dramatically in India, from 35th rank in 1990 to 13th place in 2016 [9]. Recent reports have indicated that the prevalence is high in low & middle-income countries due to poor lifestyle [8-9]; however, diabetes mortality rates linked with age-specific increased by 3% between 2000 and 2019 [10], as per available reports around two million individuals died in 2019 from diabetes-related kidney disease. It accounted for about 1.5 million deaths globally in 2012, with more than eighty percent believed to have occurred in low & middle-income countries [2, 10].

According to the International Diabetes Federation (IDF), the top three economies with the highest number of diabetics in 2019 are China (116.4 million), India (77.0 million), and the United States of America (31.0 million). This trend is anticipated to continue in 2030 and 2045, with China (140.5 and 147.2 million) and India (101.0 and 134.2 million) having the largest diabetes burdens [8, 11]. The Global Burden of Disease Study found that population growth and aging in the world's major nations, such as China and India, drive the absolute increase in diabetics.

Although the progressive nature of DM is linked with higher expenses for the family, the community, and the healthcare system [9-11] and hyper-glycemia/ uncontrolled DM is also associated with other complications;-vascular disease, microvascular (Diabetic-retinopathy (DR), Nephropathy & Neuropathy) [11] and macrovascular (cardiovascular (CV), cerebrovascular, peripheral artery disease (PAD), though, depression complications account for a significant portion of the burden of type 2 diabetes [10-16]. Several studies found that females who felt depression and glucose intolerance phenotypes are highly correlated with each other [13]. Type 2 diabetic mellitus women are more susceptible to depression. Still, even this window of time is frequently disregarded as a crucial period for the co-occurrence of these two conditions [16-18], which affects the woman's health [16-18].

The World Health Organization(WHO) defined "depression as a common mental disorder characterized by some symptoms "Sadness, loss of interest or pleasure, feelings of guilt or low self-worth, disturbed sleep or appetite, feelings of tiredness, and poor concentration" [19].

According to recent studies, depression is documented in 350 million diabetes patients [20], and several studies have been conducted across states, regions, and continents [21-28]. Only a few studies have reported that symptoms of depression in diabetic patients negatively affect treatment adherence and effectiveness [29]. While very limited reports are available on the linkage between depression and diabetes, few studies showed significant relationships, and others could not show significant associations; these contradictory results may be due to different demographics and designs and how depression and care indicators are evaluated [29]. Including common risk factors-Gender, income, socioeconomic status, comorbid conditions, and complications [29-35].

A thorough understanding of the severity and contributing variables of depression in diabetic patients could be extremely important since it could help clinicians better and more successfully treat the difficult DM. Additionally, it might aid academics and policymakers in identifying the population at the greatest risk of depression and help them adopt effective prevention measures [19-22].

This study aimed to evaluate the prevalence of depression and establish the factors that influence it in individuals with type 2 diabetes who lived in the South-Eastern Zone of the State of Uttar Pradesh-India.

Subjects and methods

The present study was a cross-sectional study conducted in the Department of Internal Medicine and Obstetrics & Gynaecology of two hospitals (i) Motilal Nehru Hospital Allahabad, and (ii) Sir Sunder Lal Hospital, Varanasi, of the Indian state of Uttar Pradesh, for 12 months from October 2020 to September 2021. A tertiary healthcare organization provided ethical approval and approved the protocol. Subjects with type 2 diabetes who visited study sites or respective departments during the study period and were willing to participate after receiving consent made up this study subjects. Then, assessments were with all confirmed Type 2 diabetes mellitus (T2DM). Subjects' privacy was guaranteed.

This study recruited a total sample size-206 of; the sample size was calculated by using the 'prevalence of depression' among T2DM patients in the respective

study site, which was found to be around 45% in a prior study [29], and maintaining the study's power at 85% with a minor error of 5%.

Defined subjects were recruited (18 or above 18 and 70 years of age) from both study sites/hospitals concerning the average number of patient visits to the centers in previous months. The study recruited subjects with a history of diabetes of at least twelve months or more than 1 year.

Patient interviews and records were done for the collection of data by using questionnaires on demographic and socioeconomic factors, clinical details such as period of illness, treatment- method, and other comorbidities or complications related to DM. Using a modified version of Kuppuswamy's socioeconomic scale, socioeconomic status was evaluated [30].

This current study followed some exclusion criteria-Type 1 diabetes mellitus, family history of depression or other psychiatric issues before the diabetes diagnosis, patients under the age of 15, and seriously ill patients was not eligible to take the participant in the study. In addition, if patients confirmed TDM2 but had an issue with neurophysiology, they could not participate in this study.

Study tools

During the data collection process, 2 questionnaires were used. A Semi-structured questionnaire for collecting sociodemographic data and clinical and other diabetes-related variables. It was formed by the researchers and approved by a clinical psychologist. The Patient Health Questionnaire 9(PHQ-9), a free instrument created by Niraula et al. [31] with funding from Pfizer Inc. for educational purposes, was applied to diagnosing depression. According to the tool, total scores of 0-4, 5–9, 10–14, and 15 and above indicate minimal (or no depression), mild, moderate, and severe depression [31]. Before now, the instrument had been tested among Indians [9].

Study procedure

The respective medical superintendent of each hospital granted permission for the study to be conducted there. All confirmed T2DM patients visiting an outpatient clinic and those staying inwards were assessed. All participants were interviewed and included following the protocol to the letter. They also read the participant information sheet and carefully understood it before being asked to sign the informed consent form if they were interested.

Statistical analysis

Statistical Software for the Social Sciences-16(SPSS-16 Inc., Chicago, IL, USA) was used to analyse the collected data. The mean and standard deviation of normally distributed continuous variables and the median and interquartile range of continuously "skewed" variables were used to summarise continuous variables. Frequencies and percentages were used to summarise categorical variables. The chi-square test calculates the association between depression and categorical variables. Univariate logistic regression analyses modeled and determined the unadjusted and adjusted odds ratios.

Results

Table 1 represents the sociodemographic information or data of the total recruited T2DM patients, i.e., 206, and the study found that 80 (38%). T2DM were either single or widowed, while 126(61%) were married. Participants from a range of social classes were included in this study's population-35.9% from the upper class, 55.1% from the middle class, and 9.00% from the lower class. The average age was 56(±12.057) of patients, and most (37.56%) of patients were aged between 56 and 65 years DMT-2 patients were found to have a median duration of 8.6 years (interquartile range: ±11.25). The study revealed that 96(46%) and 110(54%) of participants were men and women, respectively. There were 141 (68%), urban participants while 65(31.53%) were from rural. This accurately represents the target population's estimated distribution between the two settlements.

82(39%) T2DM patients with hypertension were the most prevalent comorbid condition, affecting more than half 124(61%) participants. Asthma and obesity were among the other conditions, but they weren't the only ones. A few subjects also had diabetic complications and were affected by Coronary artery disease. Retinopathy was among the complications, with CAD and retinopathy common with diabetic metabolic alteration. The study also observed that 25% of the subjects had experienced more complicated complications.

We observed 89(43.2%) of T2DM patients expressed as an actual figure of depression. As per the current study methodology, participants were screened using the PHQ-9 for different stages of depression. The internal consistency of the PHQ-9 was 0.81, i.e., indicating good consistency of this psychometric scale in a study population. The majority of type of depression was "Mild"-26(29.3%) people further reported as moderate types i., e., 10(11.2%) and the least type was severe, 3(3.37%), values were presented in Table 2.

Table 1: Sociodemographic distribution of study population (N=206).

Variables	*Number*	*Frequency(%)*
Age-Group(years)		
20-25	14	6.79
26-55	39	18.93
56-65	78	37.86
66-70	52	25.24
>70	23	11.16
Gender		
Male	96	46
Female	110	54
Marital status		
Single	19	9.22
Married	126	61.16
Widowed	61	29.61
Residence		
Rural	65	31.55
Urban	141	68.44
Educational-status		
Illiterate	31	15.04
Primary-school	68	33
Secondary-school	62	30.09
College-above	59	28.64
Socioeconomic-status		
Upper-class	74	35.9
Middle-class	114	55.33
Lower-class	18	8.73
Occupation		
Professional	23	11.16
Skilled	31	15.04
Unskilled	13	6.31
Homemaker	88	42.71
Retired	49	23.78
Unemployed	2	0.9
Monthly income (INR*)		
<5000	110	53.39
≥5000	96	46.60

*INR=Indian Rupee.

Table 2: Frequency of total depression out of 206 sample size by using PHQ-9 scale.

Types of depression	*Frequency(%) (n)*	*Prevalence (%)*
Mild	29.3(26)	
Moderate	11.2(10)	43.2
Severe	3.37(3)	
NO	56.8(117)	Total number of depressions=89 out of 206

Table 3 demonstrates that overweight patients (high BMI) had significantly higher levels of depression than those who were normal weight or underweight (P< 0.001). Table 4 shows that complications like neuropathy, nephropathy, macrovascular complications, diabetes foot, amputations, and sexual dysfunction were positively correlated with depression among the participants as well as with others. Comorbid conditions like coronary heart disease and hypertension were linked to depression.

Table 3: Diabetes patients' Body Mass Index (BMI) and depression (n=89).

BMI	*Depression with diabetic patents=n(%)*
Underweight (less than 18.5)	18(20.22%)
Normal Weight (Equal to 18.5)	12(13.48%)
Overweight (18.5 to <25)	59(66.29%)

Table 4: Depression and comorbidities or complications in diabetic patients.

Complication/ Comorbidities	*Depressed-diabetic patients=n(%)*
Neuropathy	22 (24)
Nephropathy	36(40)
Macrovascular complications	30(33)
Diabetic foot (DF)	46(51)
Amputations	19(21)
Sexual dysfunction (SD)	47(52)
Coronary heart disease (CHD)	35(39)
Hypertension	39(43)

As depression can present with various symptoms, multiple responses were permitted when assessing for depressive symptoms. Among all the depressive symptoms reported by 89 patients, like-hopelessness (86.65%) exhaustion (81.2%), lack of interest or pleasure (79.12%), and sleep disturbances (69.21%) were found to be among the most prevalent. The least were suicidal thoughts and concentration issues.

Numerous factors were discovered to be significantly associated with depression. The variables that are statistically significantly correlated with one another are female gender (P<0.05), while not correlated with living in a rural area or urban area and also not with marital status. However, unemployment showed significant relation with depression (P<0.01). Other clinical factors included comorbid conditions (P< 0.05) and complications from diabetes (P<0.05), and also with age and socioeconomic status. On the other hand, there was no evidence of a significant relationship between depression and educational attainment or marital status. However, tables 5 and 6 provide summaries of this study's data.

Table 5: Association of depression with sociodemographic variables (n=206).

Variable	*Status of depression=n(%)*		*Chi-square(c2) with 1 degrees of freedom(DF) and P-value*
	Yes(n=89)	*No(n=117)*	
Age-group(years)			
20-25	06(6.74)	15(12.82)	
26-55	05(5.61)	29(24.78)	
56-65	37(41.57)	54(46.15)	7.61 & 0.0058
66-70	25(28.09)	12(10.25)	
>70	16(17.97)	7(5.98)	
Gender			
Male	35(39.32)	45(38.46)	5.42 & 0.016
Female	54(60.67)	72(61.53)	
Marital status			
Married	84(94.38)	104(88.88)	2.24 &0.155
Unmarried	5(5.61)	13(11.11)	
Residence			
Rural	29(32.58)	25(21.36)	3.288 & 0.0698
Urban	60(67.41)	92(78.64)	
Educational status			
Illiterate	14(15.73)	24(20.51)	
Primary-school	29(32.58)	38(32.47)	4.54 & 0.312
Secondary-school	25(28.08)	42(35.89)	
College & above	21(23.59)	13(11.11)	
Socioeconomic status			
Upper-class	19(21.34)	91(77.77)	
Middle-class	26(29.21)	14(11.96)	17.53 & 0.0002
Lower-class	44(49.43)	12(10.25)	
Occupation			
Professional	08(8.98)	12(10.25)	
Skilled	05(5.61)	06(5.12)	
Unskilled	12(13.48)	18(15.38)	12.565 & 0.032
Homemaker	09(10.11)	21(17.94)	
Retired	35(39.32)	18(15.39)	
Unemployed	20(22.47)	19(16.23)	
Monthly income (INR)			
<5000	65(73.03)	96(82.05)	2.4076 & 0.120
≥5000	24(26.96)	21(17.94)	

Table 6: Depression in univariate logistic regression analyses with sociodemographic and clinical variables.

Variables	*Odd-Ration (OR) (95%-CI)*	*P value*
Age-group (Years)		
>65 verse <65	1.55 (0.86-2.78)	0.183
Gender		
Male Verse Female	2.67 (1.46-4.87)	0.001*
Marital status		
Unmarried Verse Married	1.76 (0.92-3.41)	0.097
Residence		
Urban Verse Rural	2.31 (1.25-4.43)	0.005*
Monthly income (INR)		
≥5000 Verse <5000	2.56 (1.02-5.03)	0.002*
Occupational status		
Employed Verse Unemployed	2.47 (1.25-5.01)	0.005
Comorbidity		
No Verse Yes	1.93 (1.04-3.62)	0.05*
Complication		
No Verse Yes	2.53 (1.22-4.39)	0.002*

Note: P<0.05=significant; OR=Odds ratio; CI=Confidence-interval; DM=Diabetes mellitus; INR=Indian Rupee.

Discussion

The poor quality of life, less effectiveness of medical treatment, and medication adherence are negatively impacted by depression in DM. According to the current finding, 43.2% of subjects had depression experience with its symptoms. This was higher than other studies reported-ranging from 33-41% [23, 32-35]. However, the other research conducted in Ambedkar Circle revealed that depression in T2DM had a slightly higher than 43.2% prevalence of depression [4]. Furthermore, socioeconomic status is significantly linked to depression, consistent with other studies findings [4]. In contrast, another type of depression, the worst form of depression- Sever- was reported with 3.37%, which was less than other observations finding; they ranged from 18 to 20% [29-30].

Although several 'Risk factors' were associated with depression.65-year-old subjects have higher rates of depression experience rather than other age groups of patients [1-6]. This may be due to the loneliness and financial burden. Most subjects (in this age group) were retired and relied entirely on their families to pay for their medical expenses and others. However, several other studies found no connection between depression prevalence among T2DM patients and age [4, 21], while some research supported our study finding [17].

Even though depression was more common in female patients than males due to extra home burden and positively linked T2DM, that led to negatively destruct brain performance and daily routine activity [4, 12-17], consistent with findings from other studies [12-16]. Furthermore, such an association increases the risk of other complications [13]. The social roles assigned to women (passivity, dependence, and emotional expression) may allow them to be more emotional and outgoing, which may be another explanation for why women experience depression at higher rates [4]. Mainly depression affects women twice as often as men and oestrogen levels appear to regulate depression in females [34]. However, the analysis of another study perceived social and stress measures did not support females because they were highly linked to the risk of T2DM, even though these were among many significant risk factors [14]. Similarly, in other studies conducted in Bahrain, no correlation between marital status and depression was found, and similar results were elevated from the present study [4]. However, in several other studies, single respondents scored higher on the depression scale than their married counterparts [25, 34-35].

The present study found no association between educational status and depression, consistent with a few other studies [17, 30]. However, numerous other studies found a significant correlation between the two [25]. The current study also identified occupation as a risk factor. Patients/subjects employed in low-skilled jobs or retired had higher rates of depression. This could result from the disease's financial burden on these groups [4]. Consequently, people with low earning potential must balance providing for their families with paying for health care, primarily-out-of-pocket (OOP) in India [4].

Our study reported that complications among study subjects were significantly correlated with depression, which is consistent with the findings of other-study [4]. The presence of complications like-neuropathy, nephropathy, and diabetic foot disease (DFD) was significantly related to depression in DM [4, 24–29]. Nephropathy and ischemic heart disease were found to be significantly associated with depression in the Bahrain-based study [4] and supported by other studies, including the significant relationship between macrovascular complication and sexual dysfunction [4,25]. These findings are supported by the observations [17-19]. According to studies conducted in Bahrain and Greece, diseases like peripheral vascular disease,

microvascular complications, and retinopathy were not linked to depression [4].

In this metabolic variant-DM who were overweight were significantly more depressed than normal or underweight patients [4]. Numerous other studies also found a statistically significant link between depression in T2DM patients and obesity (BMI 30 kg/m^2) [4, 17, 24, 34]. This may be because obesity is frequently linked to decreased self-esteem and social and psychological issues. However, such an association was found in some other studies [25, 27].

Diabetes and depression are two chronic conditions affecting millions worldwide, and a growing body of research indicates a correlation [10-11]. This correlation is particularly noteworthy because depression can harm diabetes management, making it harder for patients to manage their blood sugar levels and increasing the risk of developing diabetes-related complications. Studies have shown that individuals with diabetes who suffer from depression are less likely to adhere to their medication, diet, and exercise regimens, leading to poorer glycemic control, increased risk of hospitalization and complications, and decreased quality of life [12]. Furthermore, depression can exacerbate the physiological symptoms of diabetes, such as fatigue and sleep disturbances, leading to a vicious cycle of metabolic imbalances that further compromise a patient's physical and mental health. Research suggests that the link between diabetes and depression is bidirectional, with both conditions potentially influencing the onset and worsening of the other [13, 24].

For instance, a 2014 study showed that individuals with depression were at higher risk for developing type 2 diabetes even after adjusting for confounding factors such as age, sex, BMI, and family history of diabetes [32]. Similarly, a study published in the same journal in 2019 showed that patients with type 2 diabetes who were newly diagnosed with depression had a higher incidence of macrovascular and microvascular complications than those without depression [10]. These findings underscore the importance of routinely screening diabetes patients for depression and providing appropriate interventions to improve their mental health outcomes and overall quality of life. Patients with diabetes should have access to mental healthcare services to address their care's psychological and emotional aspects [10, 15]. Such services may include cognitive-behavioral therapy, effectively improving depression symptoms and glycemic control among patients with type 2 diabetes [19, 25-28]. Therefore, depression might make it more difficult to treat diabetes, making patients less likely to follow their treatment regimens effectively. Diabetes patients should be screened for depression and other common mental disorders and treated as necessary. This could significantly increase treatment adherence, leading to better diabetes management, not in general.

Instead of surveying the general population, the current study was conducted among patients who visited both hospitals. Because only the more concerned diabetic patients may be looking for specialized diabetes care, a potential selection bias cannot be completely ruled out. The cross-sectional design of this study could be a drawback because it makes it impossible to conclude the relationship between depression and diabetes causality and other community people. Although recall bias cannot be eliminated, it has been reduced through document review and data validation. Due to practicality issues, most participants' height and weight could not be recorded.

Conclusion

Depression was common among diabetes patients, with nearly one in every three diabetic patients reporting one of three categories of depression. T2DM patients were also shown to often suffer from moderate depression. In India's massive diabetes burden, a modest percentage of individuals suffered severe depression, which might translate into many participants. Before implementing successful intervention programs, "GAP" analysis between patients and healthcare specialists is required; we need to enhance access to diabetes pharmacological therapies. Early identification of depression would improve or enhance the quality of life and lower total treatment expenses of diabetes, which are often out of reach for most diabetics in India. On the other hand, positive women had a greater risk of developing depression when compared to controls. Diabetes is a substantial risk factor for depression in women. Furthermore, our findings argue that early screening for women without a history of mental health problems is critical.

Conflicts of interest

Authors declare no conflicts of interest.

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