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Correlation Between Depression and Glycemic Control in Patients with Diabetes Mellitus: A Cross-Sectional Study in a Clinical Setting in India in the Year 2013

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Abstract

Background: Diabetes mellitus is a medical disorder running a chronic course and often co-morbid with depressive disorders. Many physicians do not consider the presence of depressive symptoms per se to be adequate reason for further workup unless they are severe (e.g. suicidal thoughts).

Objectives: We aimed to assess depression in adult patients suffering from diabetes mellitus, to study the socio-demographic data associated with depression in patients suffering from diabetes mellitus, and to assess glycemic control in patients with and without co-morbid depression suffering from diabetes mellitus.

Methods: This is a cross-sectional hospital-based study. The sample of the study comprised 100 outpatients with diabetes mellitus of either type-1 or type-2. After a semi-structured clinical interview, all patients were administered with the Mini-International Neuropsychiatric Interview (M.I.N.I.) and Becks depression inventory-II. The Chi-square test was utilized for testing the association between variables. To examine the difference between the two or three variables, the Mann-Whitney U test and the Kruskal-Wallis test were used.

Results: Among the individuals recruited for the study, 72% had depression and 28% were not affected by depression. The results showed there was a positive correlation between glycemic control, the presence of complications, the type, and duration of diabetes mellitus and depression.

Conclusions: The results clearly indicated a high rate of occurrence of depression in diabetes mellitus. Patients with a long duration of diabetes mellitus, poor glycemic control, and the presence of complications of diabetes mellitus were more likely to be severely depressed.

Keywords: Depression, Complications of Diabetes Mellitus, Poor Glycemic Control

1. Background

Diabetes mellitus (DM) is a chronic medical condition that could be associated with depressive syndromes (1). Diabetes mellitus is a varied group of disorders distinctive by elevated blood sugar levels and glucose intolerance (2). More than 90% of diabetes is type 2 diabetes mellitus (T2DM) worldwide (3). It is estimated that the number of individuals suffering from diabetes has risen to 366 million and by the year 2030, it is estimated to increase to 552 million people and its prevalence is expected to be higher in men than in women (4).

Depression is one of the most common and devitalizing psychiatric disorder (5). The worldwide estimated prevalence of depression is 25%. Depressive disorders are more in women than in men. Lifetime prevalence of depression is 5% - 17% (6). By the year 2020, the projection of global disability-adjusted life year is that after ischemic heart disease, depression could take the next position in terms of burden of disease globally (7).

Diabetes often leads to many complications involving brain functioning, including the decline of cognitive functions and mood fluctuations, mostly depressed mood. In addition, depression is a risk factor for developing diabetes. A loss of hippocampal neuroplasticity, which is hypothesized to impair the ability of the brain to adapt and reorganize important emotional and behavioral functions, provides a framework for understanding this reciprocal relationship (8). Comorbid diabetes and depression are a major clinical challenge as the outcomes of both conditions are worsened by the other (9).

A population-based study of 4319 individuals in the United States has shown that nearly a third had psychiatric disorders (10). The principal conclusion was that diabetes doubled the odds of depression (11). A study was conducted to evaluate the association between glycemic control and major depression in 33 type 1 and 39 type 2 diabetes mellitus patients. Those patients who were suffering from type 1 diabetes mellitus and also had a history of major depression during their lifetime showed significantly worse glycemic control than those patients who did not have a lifetime history of having suffered from a psychiatric illness. Type 2 diabetes patients with a lifetime history of major depression did not have significantly worse control than those with no history of psychiatric illness (12). The present study aimed to assess depression in patients suffering from diabetes mellitus, to study the sociodemographic data associated with depression in these patients, and assess glycemic control in patients with and without co-morbid depression. Earlier intervention for depression could improve the outcome in patients suffering from diabetes in terms of better glycemic control, lesser complications, and overall health scenario (13). Hence, an attempt was made to study the complex interplay between various factors associated with depression in patients suffering from diabetes mellitus, which may help us in making an informed choice in the selection of patients for intervention.

2. Objectives

The study intended to assess depression in adult patients suffering from diabetes mellitus, to study the sociodemographic data associated with depression in patients suffering from diabetes mellitus, and to assess glycemic control in patients with and without co-morbid depression suffering from diabetes mellitus.

3. Materials and Methods

This is a hospital-based cross-sectional study conducted in the Outpatient Department of Endocrinology, Narayana Medical College and Hospital, Nellore, Andhra Pradesh. This study included consecutive patients diagnosed with diabetes mellitus of either type (type-1/type-2). The Ethics Review Committee of this institution approved this study with an ethical committee approval code: IEC-NMCH-06/11/2012. Data were collected over a period of one year from December 2012 to December 2013. The sample of the study comprised outpatients attending the Department of Endocrinology at Narayana Medical College, Nellore, who had been diagnosed with diabetes mellitus of either type (type-1/type-2). 100 patients who met the inclusion criteria were administered with the Beck depression inventory (BDI-II).

3.1. Inclusion Criteria

The inclusion criteria included outpatients from endocrinology department, patients aged 18 - 65 years, males and females with diabetes mellitus of Type-1/Type-2 diagnosed by using the criteria of American Diabetes Association, and patients who provided their consent for participation in the study.

3.2. Exclusion Criteria

The exclusion criteria were patients with other chronic medical illness, patients with a history of mental illness, patients with mental retardation, and pregnant women.

3.3. Description of Tools

3.3.1. Beck Depression Inventory (BDI-II)

The Beck depression inventory is a 21-item, self-report rating inventory that measures characteristic attitudes and symptoms of depression (14). The BDI-II, like its previous version, consists of 21 items. These items assess the intensity of depression in both clinical and normal patients. Every item has four statements. These statements are sequenced in an order of increasing severity about a particular depressive symptom. The diagnostic and statistical manual-IV criteria (DSM-IV) and BDI-II are brought into alignment by these new items. Because the Beck depression inventory is self-reported, there is a possibility that the participants exaggerate or minimize their symptoms.

3.3.2. The Mini-International Neuropsychiatric Interview

The Mini-International Neuropsychiatric Interview (M.I.N.I.) is an extensively used diagnostic interview. It is short, structured, and accurate test lasting for about 15 minutes. It focuses on the presence of major axis I psychiatric disorders according to DSM-IV and ICD-10. Studies have been done to compare the M.I.N.I. to the structured clinical interview for DSM-IV-TR axis 1 disorders (SCID-P) and the Composite International Diagnostic Interview (CIDI), showing the highly acceptable validity and reliability results. A drawback is that symptom severity is not taken into account in the MINI.

3.3.3. Criteria for the Diagnosis of Diabetes

They included hemoglobin A1c (HbA1c) more than or equal to 6.5% (OR), fasting blood sugar levels (FBS) > 125 mg/dL (fasting is defined as abstinence from caloric intake for a minimum of 8 hours) (OR), 2-hour plasma glucose $\geq$ 200 mg/dL (11.1 mmol/L) during an oral glucose tolerance test (a glucose load containing the equivalent of 75 g anhydrous glucose dissolved in water was used in the test

in accordance with the world health organization guidelines) (OR), and a random plasma glucose $\geq$ 200 mg/dL (11.1 mmol/L) if a patient presented with characteristic symptoms related to hyperglycemia or hyperglycemic crisis.

Although national standards exist to eliminate technical error with HbA1c testing, patient conditions can falsely decrease or elevate the HbA1c, i.e. conditions that impair erythrocyte production or alter the normal process of glycation.

3.4. The Method of Data Collection

Patients were first screened from the outpatient department of endocrinology to satisfy the inclusion and exclusion criteria. Patients were administered with the Mini-International Neuropsychiatric Interview to exclude other psychiatric disorders. They were then brought to a separate room to answer the questionnaires after obtaining their consent. Those without recent HbA1c, FBS, and PPBS values were excluded at this stage. The general proforma was then administered that consisted of the demographic details like age, address, occupation, and income along with information on treatment, weight, height, and blood pressure, and investigations like FBS, post prandial blood sugar, and HbA1c done previously. Clinical parameters related to diabetes mellitus such as its type, age at onset, duration, the presence of complications, and modality of treatment were also taken using a predesigned clinical proforma. The patients were then assessed for depression through a clinical interview and the international classification of diseases-10 (ICD-10) was used to diagnose depression, dysthymia, and recurrent depressive disorders. Patients were then asked to answer the Beck depression inventory-II. The Becks depression inventory was used to categorize depression based on the symptom severity into mild, moderate, and severe subtypes. Patients who were suffering from depressive disorders were further assessed on parameters related to age at onset of depression, number of episodes of depression, and current episode of depression by using a clinical proforma. The interview was ended by giving a feedback to the patient. The treating clinician was informed in case of significant depressive symptoms being present. Statistical Package for the Social Sciences version 20.0 was utilized to analyze the data. The values have been depicted as numbers and percentages for categorical variables and means and standard deviation for continuous variables. The Chi-square test was utilized for testing the association between variables. To test the difference between the two or three variables, the Mann-Whitney U test and the Kruskal-Wallis test were used. Statistical significance (SIG) was assigned to all P values of $<$ 0.05.

Table 1. Socio-Demographic Variables

Socio-Demographic Variables	Percent
Age (y)	
18 - 29	8
30 - 41	28
42 - 53	41
54 - 65	23
Gender	
Male	34
Female	66
BMI, kg/m^2	
18.5 - 24.5	55
25 - 29.9	25
30 or more	20

4. Results

The total number of patients recruited for the study was 100. The mean age of the sample was 41.67 with a standard deviation (SD) of 12.8. The mean Body mass index (BMI) of the sample was 24.2 with an SD of 4.8. The majority of the individuals participated in the study had type 2 diabetes mellitus (92%) and type 1 was 8% in frequency. Among the individuals recruited for the study, 72% had depression and 28% did not. In those with depression, 10% had mild, 25% had moderate, and 8% had severe depression. Dysthymia was seen in 20% of the individuals and recurrent depressive disorder was seen in 9% of them. Majority of the individuals in the study had HbA1c levels of 6.5% or more (52%) and 48% had HbA1c levels of less than 6.5%. The age at onset of diabetes mellitus was categorized into three levels of $<$ 30 years (12% of the patients), 30 - 50 years (56% of the patients), and $>$ 50 years (32% of the patients). The duration of diabetes mellitus was also categorized into three levels of $<$ 10 years (37% of the patients), 10 - 20 years (42% of the patients), and $>$ 20 years (21% of the patients).

There was no significant correlation between gender, marital status, and BDI scoring (Table 2). There was a significant correlation between age, type of diabetes mellitus, the age at DM onset, duration of DM, the presence of complications, BMI, and BDI scoring (Table 2).

There was a significant correlation between the type of diabetes mellitus, age at DM onset, duration of diabetes mellitus, HbA1c levels, the presence of complications, and modality of treatment and current episode of depression (ICD-10) (Table 3).

There was a significant correlation between age of depression onset, number of depressive episodes, and age of diabetes mellitus onset. There was a significant relation-

Table 2. Correlation Between Socio-Demographic Data and BDI Scoring

	Chi-Square	P Value
Age	36.809	< 0.0001 (SIG)
Gender	0.871	0.832 (NOT SIG)
Marital status	20.711	0.055 (NOT SIG)
Type of diabetes mellitus	24.543	< 0.0001 (SIG)
Age at DM onset	15.398	0.017 (SIG)
Duration of DM	53.983	< 0.0001 (SIG)
presence of complications	27.600	< 0.0001 (SIG)
BMI	29.286	< 0.0001 (SIG)

Table 3. Correlation Between Factors Related to Diabetes Mellitus and the Current Episode of Depression

Type of DM	Chi-Square	P Value[a]
Type-1		< 0.0001
Type-2	37.117	
Age of onset DM	31.677	< 0.0001
Duration of DM	42.974	< 0.0001
HbA1c levels	12.554	0.028
presence of complications	32.470	< 0.0001
Modality of treatment	45.615	< 0.0001

[a] Values are expressed as significant.

ship between BDI scoring, the age of depression onset and HbA1c levels. There was a significant correlation between age of depression onset, number of depressive episodes and the presence of complications (Table 4).

5. Discussion

In the present study, the type of diabetes mellitus (type-1, type-2) demonstrated a significant association with age of depression onset, current episode of depression classified according to ICD-10, and BDI scoring. It showed that 87.5% of type 1 and 69.7% of type 2 diabetes patients had depression. A larger percentage of type 1 subjects (87.5%) showed an earlier age of depression onset compared to type 2 diabetes mellitus patients (35.9%). Instead, type 2 subjects showed the age of depression onset in later years (30 - 50 years vs. > 50 years). A larger percentage of type-1 subjects had severe depression (62.5%) when compared to type 2 subjects who showed moderate depression (27.2%) and dysthymia more commonly (21.7%) (Table 2). In other studies, the symptoms of depression were seemingly more prevalent in T2DM than in T1DM, in spite of that this difference was statistically insignificant (11). Scores indicating clinical depression have been shown in other similar studies in 11% - 16% of all participants with type 1 diabetes mellitus and 18% - 25% of those with type 2 diabetes mellitus ($P < 0.001$) (15). In the current study, the correlation of the duration of diabetes mellitus with depression was statistically significant while depression was studied in terms of the current episode of depression according to ICD-10 and BDI scoring. In respect to the duration of diabetes mellitus and the current episode of depression, the association was significant ($\chi^2 = 42.974$, P value ≤ 0.0001). More subjects with the duration of diabetes mellitus of < 10 years and > 20 years were depressed as 91.9% and 90.5%, respectively, while 45.2% of the subjects with the duration of diabetes mellitus of 10 - 20 years were depressed. Subjects with longer duration of diabetes mellitus scored high on BDI, i.e. 28.6% of the subjects with the duration of diabetes mellitus of > 20 years had severe depression, 50% of the subjects with duration of diabetes mellitus of 10 - 20 years had minimal and mild depression, and 56.8% of the subjects with the duration of diabetes mellitus of < 10 years had moderate depression. In contrast to our study, a study stated that no such association was observed between depression/anxiety and duration of diabetes and duration of treatment of diabetes mellitus (16).

The correlation of HbA1c levels with depression was significant in the current study. 84.6% of the subjects with HbA1c levels of $\geq$ 6.5% had depression while 58.3% of the subjects with HbA1c levels of < 6.5% had depression. When HbA1c levels were correlated with the current episode of depression according to ICD-10, subjects with HbA1c levels of $\geq$ 6.5% had moderate depression more frequently, followed by dysthymia and severe depression. On the other hand, subjects with HbA1c levels of < 6.5% had dysthymia more frequently, followed by mild depression and moderate depression. The correlation of HbA1c levels with BDI scores showed that 59.6% of the subjects with HbA1c levels of $\geq$ 6.5% scored high (moderate to severe) while 18.8% of the subjects with HbA1c levels of < 6.5% did so. 81.3% of the subjects with < 6.5% HbA1c levels had minimal to mild scores on BDI. In another study, 2055 outpatients with diabetes mellitus were assessed, from a random sample belonging to three different diabetes clinics. The scales and questionnaires related to depression were completed by 772 patients. About 33% of the type 1 DM patients and 37% - 43% of the T2 DM patients had the depressive affect. Depressive affect was associated with poor glycemic control (defined as HbA1c > 8.5%) in T1DM, but not in T2DM (15). In the current study, complications of diabetes mellitus were taken into consideration. In this study, the presence of diabetes mellitus complications was seen in 56% of the patients and the absence of complications was observed in 44% of the sample. Among 56 subjects who had complications of diabetes mellitus, 85.7% reported to be depressed and among 44% of the subjects without complications of diabetes mellitus, 54.5% had depression. This de-

Table 4. Correlation of Parameters of Diabetes Mellitus with Depression

	Age of Depression Onset	Number of Depression Episodes	Current Episode of Depression (ICD-10)	BDI Scoring
Type of diabetes mellitus				
Correlation coefficient	0.067	-0.087	-0.101	-0.314**
P value	0.506	0.391	0.315	0.001
Age of onset of DM				
Correlation coefficient	0.289**	0.200*	0.036	-0.076
P value	0.004	0.047	0.724	0.455
Duration of DM				
Correlation coefficient	0.162	0.165	-0.067	-0.181
P value	0.106	0.101	0.508	0.071
HbA1c levels				
Correlation coefficient	0.215*	0.177	0.230*	0.487**
P value	0.031	0.078	0.021	0.000
Presence of complications				
Correlation coefficient	-0.381**	-0.247*	-0.242*	-0.422**
P value	0.000	0.013	0.015	0.000

notes that a higher number of subjects with complications of diabetes mellitus report depression compared to subjects without complications of diabetes mellitus. Concerning the BDI scoring, among subjects with complications of diabetes mellitus, about 58.9% scored high on BDI (from moderate to severe) while only 15.9% of the subjects without complications of diabetes mellitus scored high on BDI. The correlation of the presence of complications of diabetes mellitus with depression was statistically significant in this study. An observational study gave a few important conclusions: (a) Patients with type 2 diabetes mellitus, (b) those suffering from 2 or more complications, and (c) patients with complications of neuropathy or nephropathy are at greater risk of depression (17). The present study was in line with the previous studies in which the presence of complications of diabetes mellitus was associated with depression.

5.1. Conclusions

This was a cross-sectional study; therefore, it prevents deciphering the relationship between cause and effect between different variables.

As the subjects were not prospectively followed, it is difficult to comment on the interplay between the given variables and hence, the likely course of future depressive symptoms and suicidal behavior.

The study selected patients with both type 1 and type 2 diabetes mellitus, but the number of patients with type 1 diabetes mellitus was very low. In addition, the recall bias cannot be totally eliminated.

5.2. Limitations of the Study

Patients with poor glycemic control and presenting with complications of diabetes and with a longer duration of diabetic illness were more likely to be depressed and they also had a more severe depressive illness (higher BDI –II scores).

Those patients suffering from type 1 diabetes were more frequently depressed and had a comparatively severe depressive illness to those patients with type 2 diabetes.

The results indicated a higher rate of occurrence of depression in diabetes mellitus. Depression was likely to influence the glycemic control in patients with diabetes mellitus.

Depression in medically ill patients could be a result of the psychological impact of the illness or the physiologic impact of illness or due to its treatment. Depression by itself could be a cause of medical illness. Appropriate management requires first establishing the most likely diagnosis that has caused depression. It is obligatory on the part of healthcare professionals to identify patients with comorbid depression and diabetes when present and treat them effectively so that the best clinical outcomes for these individuals can be attained.

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Footnotes

Authors' contribution: Ranjit Kumar Pindikura studied and designed the concept. Sonasree Jammulapati gathered and prepared the data. Enreddy Ananda Reddy analyzed and interpreted. Ranjit Kumar Pindikura drafted the manuscript. Ranjit Kumar Pindikura did critical revision of the manuscript for important intellectual content. Enreddy Ananda Reddy analyzed the data. Sonasree Jammulapati administrated technically and supported for material. Sonasree Jammulapati study supervision.

Declaration of Interests: Conception and design of the work and revision for important intellectual content: Sonasree Jammulapati; acquisition of data: E. Ananda Reddy; analysis and interpretation of data: Ranjit Kumar Pindikura.

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