ASIAN JOURNAL OF PHARMACEUTICAL AND CLINICAL RESEARCH

INNOVARE ACADEMIC SCIENCES
Knowledge to Innovation

Vol 17, Issue 9, 2024

Online - 2455-3891
Print - 0974-2441

Research Article

CO-MORBID DEPRESSION IN ADULTS WITH TYPE 2 DIABETES MELLITUS – A STUDY OF PREVALENCE, SOCIO-DEMOGRAPHIC PROFILE, AND IMPACT ON GLYCEMIC CONTROL

SARMISTHA PRIYADARSHANI[1], RUPA PRADHAN[2]*

[1]Department of Psychiatry and De-addiction Centre, MKCG Medical College and Hospital, Berhampur, Odisha, India. [2]Department of General Medicine, MKCG Medical College and Hospital, Berhampur, Odisha, India.
***Corresponding author: Rupa Pradhan; Email: rupa750@gmail.com**

Received: 26 April 2024, Revised and Accepted: 03 July 2024

ABSTRACT

Objectives: The objectives are to study the prevalence of depression in established type 2 diabetes mellitus (T2DM) patients and the association of the severity of depression with the level of glycemic control, second, to explore the relationship of co-morbid depression with the sociodemographic variables and diabetic complications, and third, to assess the association of co-morbid depression with the ongoing diabetic treatment regimen.

Methods: Data of OPD patients with established diagnosis of T2DM who came for follow-up were collected. A total of 224 patients underwent a clinical and psychiatric evaluation and details were analyzed as per the objectives of the study.

Results: The total sample of diabetic patients included 126 (56%) males and 98 (44%) females with the majority seen in the 45–60-year age group. The sociodemographic parameters were assessed and comorbid depression was seen in 83 diabetic patients. Among them, 42 had moderate depression. Females (n=43) outnumbered males and the majority were seen in the 45–60-year age group (n=39). Comorbid depression was most prevalent among unemployed (n=41), urban residents (n=48), joint family (n=49), Hindus (n=73), and people on only insulin treatment regimen (n=33) but all this was statistically insignificant, whereas illiterates (n=45), HbA1C level >7% (n=71), diabetes-related complications (n=50), and diabetic neuropathy being the most common (n=28) among all the complications were seen and this difference was statistically significant.

Conclusion: By taking all our research findings, it can be concluded that comorbid depression modifies the course and prognosis of diabetes.

Keywords: Comorbid depression, T2DM, Sociodemographic variables, Diabetic treatment regimen.

 DOI: http://dx.doi.org/10.22159/ajpcr.2024v17i9.51237. Journal homepage: https://innovareacademics.in/journals/index.php/ajpcr

INTRODUCTION

Diabetes mellitus refers to a group of common metabolic disorders sharing the phenotype of hyperglycemia resulting from either reduced insulin secretion, decreased glucose utilization or increased glucose production [1]. It is a chronic disease which affects virtually every organ in the human system. The WHO projected that 300 million people will suffer from diabetes by 2025 [2]. India has the largest number of diabetic patients and it is expected to reach 69.9 million by 2025 [2]. Depression is common among diabetics [3] and is associated with worst outcomes [4,5]. The prevalence of depression is higher in diabetics having long-term complications [5,6]. Compared with patients with diabetes alone, the coexistence of depression and diabetes has been shown to have poorer self-management and poor adherence to treatment [7] as well as more likely to have higher cardiovascular risk factors [6] and higher mortality rates [8].

Nevertheless, the awareness of mental health remains to be a stigma in our society. As a result, psychiatry co-morbidities such as depression remain hidden like the tip of the iceberg. To date, no studies have examined the factors associated with depression in patients with diabetes in Odisha. This study aims to investigate the prevalence of depression and explore the influencing factors associated with depression in a group of patients with type 2 diabetes mellitus (T2DM).

METHODS

The study "Co-morbid Depression in Adults with Type 2 Diabetes Mellitus – A Study of Prevalence, Socio-Demographic Profile, and Impact on Glycemic Control" is a single-center cross-sectional observational study with a sample size of 224 conducted in the Department of Psychiatry in collaboration with the Department of Endocrinology, SCB MCH, Cuttack, Odisha, for a period of 1 year from November 2014 to October 2015 after seeking permission from the Institutional Ethical Committee.

Both male and female T2DM patients in the age group of 18–65 years diagnosed as per the ADA criteria [9] and previous patient records with duration of diabetes >2 years were included in the study after taking informed and written consent.

Any patient with diabetes other than T2DM, new onset, with history of other endocrine disorders was excluded from the study. Patients with prior and current clinical evidence of psychiatric disorders other than depression were not included. Patients with impaired consciousness, malignancy, any recent stressful event, deaf and dumb, and who did not give consent were also excluded.

A semi-structured, self-designed *proforma* to collect personal and sociodemographic details of the subjects were used. Anthropometric examinations to calculate BMI were done and laboratory tests were obtained to assess the metabolic control of diabetes. Long-term complication of diabetes, namely neuropathy diagnosed by biothesiometer (VPT at great toe >25mV was considered significant and ankle reflex) [10], incipient nephropathy diagnosed by micral test (positive if two out of three values of urinary albumin-to-creatinine ratio were ranging from 30 to 300 mcg/mg) [11], clinical nephropathy diagnosed by estimation of 24 h urinary protein (>500 mg) [12], retinopathy diagnosed by fundoscopy, CAD by previous treatment records, etc.

After the clinical interview, all patients diagnosed with major depressive disorder as per DSM-V criteria were taken up for further evaluation with Beck's Depression Inventory (BDI-II) for the severity of depression [13-15].

Statistical analysis
Data were analyzed in SPSS-20 version and Microsoft Word Excel. Regression analysis, descriptive statistical analysis, and t-tests were used and applied as required. Differences were considered significant if $p<0.05$.

RESULTS AND DISCUSSION

Patient Socio-demographic characteristics
A total of 224 consecutive T2DM patients underwent detailed clinical history and mental state examinations. The total sample included 126 (56%) males and 98 (44%) females. The sociodemographic characteristics of patients and the prevalence of severity of depression were evaluated. Comorbid depression was seen in 83 (37.05%) of T2DM patients out of which moderate grade of depression was prevalent in 42 (18.75%), 34 (15.17%) had severe depression whereas only 7 (3%) had mild depression. Coming to gender-specific, females (n=43) outnumbered males (n=40) with more severe grades of depression as per BDI scores. The majority of patients with comorbid depression were seen in the age group of 45–60 years (n=39 [46.90%]), n=18 (21.70%) were in <45 years whereas n=26 (31.30%) were seen in >60 years age group. While estimating employment status and the prevalence of comorbid depression, n=41 (49.40%) were unemployed, n=40 (48.20%) were employed, and only n=2 (2.40%) were retired; this difference was not statistically significant (p=0.015). Comorbid depression was seen in urban residents (n=48 [33.80%]) and in rural residents (n=35 [42.70%]) but this difference was not statistically significant (p=0.185, Pearson Chi-square=1.7575).

When the family pattern was estimated, comorbid depression was prevalent in patients coming from joint family (n=49 [59.00%]), nuclear family (n=30 [36.10%]), and widow/divorcee accounting for only 4.90% (n=4). However, this difference was not statistically significant (p=0.501, Pearson Chi-square=1.3837). Comorbid depression was also more prevalent among Hindu patients (n=73 [87.95%]) than among other religious people though it was not statistically significant. The education level of patients showed illiterates having more comorbid depression (n=45 [54.20%]) whereas matriculate, basic, and higher education showed 28.90%, 7.20%, and 9.70%, respectively. This difference was statistically significant (p=0.000, Pearson Chi-square=80.9202).

Patient diabetes status and comorbid depression
Patients with T2DM of >2-year duration were included in the study. They were further divided into three groups of 2–5 years, 6–10 years, and >10-year duration with comorbid depression seen as 34.50%, 37.90%, and 41.10%, respectively. It was seen that with longer duration, a slightly higher preponderance of depression was seen.

HbA1c levels were tested and patients were divided into two groups of <7% and >7% levels. The majority of patients (85.55%) with comorbid depression had poor long-term glycemic control whereas only 14.45% were seen in the <7% group and this difference was statistically significant (p=0.000, Pearson Chi-square=51.3506, OR=10.441176).

The majority of patients (60.25%) with comorbid depression had one or more diabetes-related complications and it was statistically significant (p=0.000, Pearson Chi-square=34.2588). Diabetic neuropathy was the most common (68.30%) but comorbid depression was most prevalent among diabetic nephropathy (100%) whereas least in diabetic retinopathy (37.50%) and this difference was statistically significant (p=0.004).

Diabetes treatment regimens were evaluated and patients with comorbid depression were grouped into the insulin group (39.76%) and OHA group (single pill [36.15%], multiple pills [21.69%], and insulin+pill [2.41%], respectively). Moreover, this difference was not statistically significant (p=0.352, Pearson Chi-square=3.2406).

Diabetes mellitus comprises a group of common metabolic disorders that share the phenotype of hyperglycemia. Depressive disorders are also of equal antiquity as descriptions of it figure in ancient medical monographs of India [16]. Today, the world is bracing against these two non-communicable diseases [17]. India has the dubious distinction of being the possible capital of both diseases [18,19]. The data regarding the prevalence of depression in India are scarce.

In our study, the total sample of diabetic patients included 126 (56%) males and 98 (44%) females as shown in Tables 1 and 2. The majority were seen in the age group of 45–60 years (46%, n=39). This is in line with a study from North India by Joseph *et al*. and Raval *et al*. (reported a figure of 41%) and Poongothai *et al*. study from South India reported a figure of 23.4% who found increasing age was associated with depression [20-22]. Our study showed that >1/3rd of patients with T2DM were ailing from various grades of depression and the prevalence for the same was 37%. Similarly, a meta-analysis by Anderson *et al*. [23] identified the prevalence of depression in diabetes ranging from 8 to 61%. It is proposed that T2DM could affect mood through at least two mechanisms: Either through biochemical changes due to hyperglycemia or through psychosocial problems of chronicity of the disease [24].

In our study, although males predominated the total sample of diabetic patients (56% v/s 43%), but diabetic females suffered more from depression (51.8%, n=43). Moreover, this finding has been supported by other Western as well as Indian studies [20,25-29]. It is thought that women being more depressed could be explained by the social role attributed to women (passivity, dependence, and emotional expression) which possibly leads to less extroversiveness [30]. Hence, women with diabetes have consistently shown higher rates of depression than men [31].

The majority of patients (19%, n=42) in our study had a moderate grade of depression as analyzed by BDI-II (minimal=0–13, mild=14–19, moderate=20–28, and severe=29–63) [15]. On the other hand, the

Table 1: Sociodemographic characteristics of patients

	Number of patients	% of sample
Gender		
Male	126	56
Female	98	44
Age		
<45 years	32	14.28
45–60 years	122	54.50
>60 years	70	31.25
Occupation		
Employed	118	52.70
Unemployed	94	41.96
Retired	12	5.36
Residence		
Urban	142	63.40
Rural	82	36.60
Family type		
Nuclear	84	37.50
Joint	124	55.35
Widow/Divorcee	16	7.15
Religion		
Hindu	210	93.75
Others	14	6.25
Education		
Illiterate	54	24.10
Basic	64	28.60
Matriculate	56	25
Higher	50	22.30

Table 2: Sociodemographic parameters showing the prevalence of comorbid depression

Characteristics	Comorbid depression (%)	No Co-morbidity	Total
Age			
<45 years	18 (21.70)	14 (9.90)	32 (14.38)
45–60 years	39 (46.90)	83 (58.90)	122 (54.46)
>60 years	26 (31.30)	44 (21.20)	70 (31.25)
Occupation			
Employed	40 (48.20)	78 (55.30)	118 (52.68)
Unemployed	41 (49.40)	53 (37.60)	94 (41.97)
Retired	2 (2.40)	10 (7.10)	12 (5.36)
Residence			
Urban	48 (33.80)	94 (66.20)	142
Rural	35 (42.70)	47 (57.30)	82
Family pattern			
Nuclear	30 (36.10)	54 (38.30)	84 (37.5)
Joint	49 (59)	75 (53.20)	124 (55.80)
Widow/Divorcee	4 (4.90)	12 (8.51)	16 (7.14)
Religion status			
Hindu	73 (87.95)	137 (97.20)	210
Others	10 (12.05)	4 (2.80)	14
Education level			
Illiterate	45 (54.20)	9 (6.40)	54
Basic	6 (7.20)	58 (41.20)	64
Matriculate	24 (28.90)	32 (22.70)	56
Higher	8 (9.70)	42 (29.70)	50

prevalence of severe depression in this study (15.2%, n=34) was lower than the observations made in the study by Raval *et al*. where it ranged from 18 to 20% [21].

Although most of the patients with comorbid depression were unemployed (49.40%, n=41), we did not find any significant association with depression (p=0.015). This was in line with other studies where the employment status of the patient did not have any association with comorbid depression [31,32].

Patients with rural backgrounds had more prevalence of depression (42% v/s 33%) than urban patients, but this did not have a significant association (p=0.185). This was in accordance with the studies by Rezvanfar *et al*. [29] who found that depression had no significant association with the place of residence.

Comorbid depression was more prevalent in patients living in the joint family than in the nuclear family, but this difference was not statistically significant (p=0.501) supported by an earlier study done by Singh *et al*. [32]

Patients who were illiterate had a higher prevalence of depression than those who were educated and this had a significant association with depression (p=0.000). Not many studies have found an association of depression with the education level of patients. This association of illiteracy with depression in diabetics was earlier shown by a study done by Mier *et al*. [33]. This is because illiterate patients have a lower knowledge and awareness about the disease process which makes them more anxious and distressed about any kind of health problem. Furthermore, the strict lifestyle modifications needed for the proper control of diabetes make it difficult to follow for illiterate patients.

In our study, patients with a duration of diabetes >10 years presented with a greater incidence of depression as shown in Table 3. It was not statistically significant and was in accordance with other studies where duration was not a factor associated with depression [20,22].

In patients without depression, 37% had HbA1C levels >7%, whereas in the group with comorbid depression, almost 85% had higher HbA1C levels. The statistical analysis revealed that patients with uncontrolled diabetes had 10 times higher chances of developing depression than those who had adequate control of diabetes. This is in accordance with several investigators who found poor glycemic control as a significant factor associated with depression [32,34]. In other words, diabetics with good glycemic control were less likely to be depressed than patients with poor glycemic control as assessed by HbA1C levels [32,34-40].

Table 3: Patient's diabetes status and comorbid depression

Diabetes status	Comorbid depression (%)	No comorbidity	Total
Duration (in years)			
2–5 years	38 (34.50)	72 (65.40)	110
6–10 years	22 (37.90)	36 (62.10)	58
>10 years	23 (41.10)	33 (58.90)	56
HbA1C level (%)			
<7%	12 (14.45)	88 (62.41)	100
>7%	71 (85.55)	53 (37.59)	124
Diabetic complications			
Absent	33 (39.76)	106 (75.18)	139
Present	50 (60.25)	35 (24.83)	85
Type of complication			
Neuropathy	28 (68.30)	13 (31.70)	41
Retinopathy	6 (37.50)	10 (62.50)	16
Peripheral vascular disease	14 (53.80)	12 (46.20)	26
Nephropathy	2 (100)	0	2
Treatment regimen type			
Insulin	33 (39.76)	55 (39)	88
Single pill	30 (36.15)	38 (26.96)	68
Multiple pills	18 (21.69)	42 (29.79)	60
Insulin and pill	2 (2.41)	6 (4.25)	8
Treatment compliance			
Yes	67 (80.73)	133 (94.33)	200
No	16 (19.28)	8 (5.68)	24

Depression does not seem to have a direct effect on glycemic control, and the relationship is indirect through self-care behaviors. Depression impedes the adoption of effective self-management behaviors (including physical activity, appropriate dietary behavior, foot care, and appropriate self-monitoring of blood glucose) through a decrease in social motivation, probably leading to poor glycemic control [41]. While there is a direct relationship between depression and behavior, social motivation exists in this predicted pathway and is potentially modifiable through diabetes educational efforts [4,42].

The apparent effect of low mood on glycemic control is both short term and long term. Skaff *et al*. found that mood changes were acutely

associated with higher blood glucose values [43]. Richardson *et al.* reported a significant longitudinal relationship between depression and glycemic control and concluded that depression is associated with persistently higher HbA1C levels over time [44].

Eighty-five patients of the total diabetic sample presented with one or more diabetes-related complications. 60% (n=50) of patients with comorbid depression had diabetic complications which were more than twice that of patients without any comorbidity (25%, n=35). Thus, according to our study, depression doubles the risk of diabetic complications. Most of the patients presented with neuropathy (56%, n=28). The presence of complications among the study participants was found to be significantly associated with depression in the present study which is similar to the observations made in other studies [20-22,25,26].

It was also found in our study that patients receiving treatment in the form of insulin injections were more depressed than other treatment groups. However, this was not statistically significant. The Chandigarh-based study reported similar findings [21,31]. Comorbid depression was associated with 4 times increased risk of non-compliance to anti-diabetic treatment regimens. This is in line with available literature [25] which found an increased incidence of non-compliance to treatment by depressive patients with diabetes.

CONLUSION

T2DM is a crucial public health issue in Odisha as well as the whole country, with massive medical, social, and economic effects; few studies focus on depression in patients with diabetes. By taking all our research findings, it can be concluded that depression modifies the course and prognosis of diabetes if not treated in the right way and at the right time. Hence, to improve the quality of life and minimize the disease burden of diabetes, mental health conditions and screening should be done routinely when a patient is diagnosed with T2DM.

Limitation of the study

Further research is needed to determine whether effective treatment of comorbid depression in diabetes would reduce hyperglycemia and diabetic complications. Longitudinal prospective studies are needed to shed more light on the potential relationship between depression and diabetes mellitus in the future.

CONFLICT OF INTEREST

None to report.

AUTHORS CONTRIBUTION

Dr. Sarmistha Priyadarshani and Dr. Rupa Pradhan were involved in the conceptualization of protocols, data collection, and research. The manuscript was finalized, edited, and submitted for publication by Dr. Rupa Pradhan.

FUNDING

None.

REFERENCES

1. Loscalzo J, Fauci A, Kasper D, Hauser S, Longo D, Jameson JL. Harrison's Principles of Internal Medicine. 21st ed. United States: Mcgraw Hill; 2022.
2. King H, Aubert RE, Herman WH. Global burden of diabetes 1995-2005: Prevalence, numerical estimates and projections. Diabetes Care. 1998;21:1414-31. doi: 10.2337/diacare.21.9.1414
3. Gavard JA, Lustman PJ, Clouse RE. Prevalence of depression in adults with diabetes. An epidemiological evaluation. Diabetes Care. 1993;16:1167-78. doi: 10.2337/diacare.16.8.1167
4. Lustman PJ, Anderson RJ, Freedland KE, de Groot M, Carney RM, Clouse RE. Depression and poor glycaemic control: A meta-analytic review of the literature. Diabetes Care. 2000;23:934-42. doi: 10.2337/diacare.23.7.934
5. De Groot M, Anderson R, Freedland KE, Clouse RE, Lustman PJ. Association of depression and diabetes complications: A meta-analysis. Psychosom Med. 2000;63:619-30. doi: 10.1097/00006842-200107000-00015
6. Katon WJ, Simon G, Russo J, Von Kroff M, Lin EH, Ludman E, *et al*. Quality of depression care in a population based sample of patients with diabetes and major depression. Med Care. 2004;42:1222-9. doi: 10.1097/00005650-200412000-00009
7. Lin EH, Katon W, Von Kroff M, Rutter C, Simon GE, Oliver M, *et al*. Relationship of depression and diabetes self-care, medication adherence and preventive care. Diabetes Care. 2004;27:2154-60. doi: 10.2337/diacare.27.9.2154
8. Katon WJ, Rutter C, Simon G, Lin EH, Ludman E, Ciechanowski P, *et al*. The association of comorbid depression with mortality in patients with Type 2 diabetes. Diabetes Care. 2005;28:2668-72. doi: 10.2337/diacare.28.11.2668
9. Black SA, Markides KS, Ray LA. Depression predicts increased incidence of adverse health outcomes in older Mexican Americans with Type 2 diabetes. Diabetes Care. 2003;26(10):2822-8. doi: 10.2337/diacare.26.10.282
10. Davies M, Brophy S, Williams R, Taylor A. The prevalence, severity and impact of painful diabetic peripheral neuropathy in Type 2 diabetes. Diabetes Care. 2006;29:1518-22. doi: 10.2337/dc05-2228
11. American Diabetes Association. Standard of medical care in diabetes. Diabetes Care. 2008;31 Suppl 1:S12-54. doi: 10.2337/dc08-S012
12. Molitch ME, DeFronzo RA, Franz MJ, Keane WF, Mongensen CE, Parving HH, *et al*. Nephropathy in diabetes. Diabetes Care. 2004;27 Suppl 1:S79-83. doi: 10.2337/diacare.27.2007.s79
13. Palinkas LA, Barrett-Connor E, Wingard DL. Type 2 diabetes and depressive symptoms in older adults: A population based study. Diabet Med. 1991;8:532-6. doi: 10.1111/j.1464-5491.1991.tb01646.x
14. American Diabetes Association. Diagnosis and classification of diabetes mellitus. Diabetes Care. 2010;33 Suppl 1:S62-9. doi: 10.2337/dc10-S062, PMID: 20042775
15. Beck AT, Steer RA, Brown GK. Beck Depression Inventory. 2nd ed Manual. San Antonio, TX: The Psychological Corporation; 1996. doi: 10.1007/978-1-4419-1005-9_441
16. Rao AV. Depression illness in India. Indian J Psychiatry. 1984;26:301-11. PMC3011191
17. World Federation for Mental Health. Diabetes and Depression. Woodbridge, VA, USA; 2010. Available from: https://www.wfmh.org/img/what-we-do/publications/depression-awareness-packet-english-2010.pdf
18. Mohan V, Sandeep S, Deepa R, Shah B, Varghese C. Epidemiology of type 2 diabetes: Indian scenario. Indian J Med Res. 2007;125:217-30. PMID: 17496352
19. Bromet E, Andrade LH, Hwang I, Sampson NA, Alonso J, de Girolamo G, *et al*. Cross national epidemiology of DSM IV Major depressive episode. BMC Med. 2011;9:90. doi: 10.1186/1741-7015-9-90, PMC3163615
20. Joseph N, Unnikrishnan B, Raghavendra Babu YP, Kotian MS, Nelliyanil M. Proportion of depression and its determinants among Type 2 diabetes mellitus patients in various tertiary care hospitals in Mangalore city of South India. Indian J Endocrinol Metab. 2013;17:681-8. doi: 10.4103/2230-8210.113761, PMC3743370
21. Raval A, Dhanaraj E, Bhansali A, Grover S, Tiwari P. Prevalence and determinants of depression in Type 2 diabetes patients in tertiary care centre. Indian J Med Res. 2010;132:195-200. PMID: 20716820
22. Poongothai S, Anjana RM, Pradeepa R, Ganesan A, Unnikrishnan R, Rema M, *et al*. Association of depression with complications of type 2 diabetes- the Chennai Urban Rural Epidemiology study (CURES 102). J Assoc Physicians India. 2011;59:644-8. PMID: 22479744
23. Anderson RJ, Freedland KE, Clouse RE, Lustman PJ. The prevalence of comorbid depression in adults with diabetes: A meta-analysis. Diabetes Care. 2001;24:1069-78. doi: 10.2337/diacare.24.6.1069, PMID: 11375373
24. Kaplan H, Sadock B. Synopsis of Psychiatry. 10th ed. Philadelphia, PA: Williams and Wilkins; 2009. PMC2802389
25. Tellez Zenteno JF, Cardiel MH. Risk factors associated with depression in patients with type 2 diabetes mellitus. Arch Med Res. 2002;33:53-60. doi: 10.1016/s0188-4409(01)00349-6, PMID: 11825632
26. Larijani B, Bayat MK, Gorgani MK, Bandarian F, Akhondzadeh S, Sadjadi SA. Association between depression and diabetes. German J Psychiatry. 2004 Oct 29;7(3):62-5.
27. Chaudhry R, Mishra P, Mishra J, Parminder S, Mishra BP. Psychiatric morbidity among diabetic patients: A hospitalized study. Ind Psychiatry J. 2010;19:47-9. PMID: 21694791, doi: 10.4103/0972-

6748.77637, PMC3105558
28. Murrell SA, Himmelfarb S, Wright K. Prevalence of depression and its correlates in older adults. Am J Epidemiol. 1983;117:173-85. doi: 10.1093/oxfordjournals.aje.a113528, PMID: 6829547
29. Rezvanfar MR, Salehi B, Rafiee M, Shirian F. Correlation of HbA1c and major depressive disorder in type 2 diabetic patients. IJDO. 2010;2(1):16-9.
30. Roupa Z, Koulouri A, Sotiropoulou P, Makrinika E, Marneras X, Lahana I, *et al*. Anxiety and depression in patients with Type 2 Diabetes mellitus, depending on sex and body mass Index. Health Sci J. 2009 Jan;3(1):32-40.
31. Collins MM, Corcoran P, Perry IJ. Anxiety and depression symptoms in patients with diabetes. Diabet Med. 2009;26:153-61. doi: 10.1111/j.1464-5491.2008.02648.x, PMID: 19236618
32. Singh H, Raju M, Dubey V, Kurrey R, Bansal S, Malik M. A study of socio-demogrphic clinical and glycaemic control factors associated with co-morbid depression in type 2 diabetes mellitus. Ind Psychiatry J. 2014;23:134-42. doi: 10.4103/0972-6748.151687, PMID: 25788803, PMC4361976
33. Mier N, Bocanegra-Alonso A, Zhan D, Wang S, Stoltz SM, Acosta-Gonzalez RI, *et al*. Clinical depressive symptoms and diabetes in a binational border population. J Am Board Fam Med. 2008;21:223-33. doi: 10.3122/jabfm.2008.03.070255, PMID: 18467534
34. Mathew CS, Dominic M, Issac R, Jacob JJ. Prevalence of depression in consecutive patients with Type 2 diabetes mellitus of 5 year duration and its impact on glycaemic control. Indian J Endocrinol Metab. 2012;16:764-8. doi: 10.4103/2230-8210.100671, PMC3475901, PMID: 23087861
35. Zhang W, Xu H, Zhao S, Yin S, Wang X, Guo J, *et al*. Prevalence and influencing factors of co-morbid depression in patients with Type 2 diabetes mellitus: A General Hospital based study. Diabetol Metab Syndr. 2015;7:60. doi: 10.1186/s13098-015-0053-0, PMID: 26167205, PMC4499190
36. Sahota PK, Knowler WC, Looker HC. Depression, diabetes and glycaemic control in an American Indian community. J Clin Psychiatry. 2008;69:800-9. doi: 10.4088/jcp.v69n0513
37. Fisher L, Skaff MM, Mullan JT, Arean P, Glasgow R, Masharani U. A longitudinal study of affective and anxiety disorders, depressive affect and diabetes distress in adults with type 2 diabetes. Diabet Med. 2008;25:1096-101. doi: 10.1111/j.1464-5491.2008.02533.x, PMID: 19183314, PMC2635496
38. Aikens JE, Perkins DW, Piette JD, Lipton B. Association between depression and concurrent Type 2 diabetes outcomes varies by diabetes regimen. Diabet Med. 2008;25:1324-9. doi: 10.1111/j.1464-5491.2008.02590.x, PMID: 19046223, PMC6398157
39. Trief PM, Morin PC, Izquierdo R, Teresi JA, Eimicke JP, Goland R, *et al*. Depresssion and glycaemic control in Elderly Ethnically diverse patients with diabetes. The IDEATel Project. Diabetes Care. 2006;29:830-5. doi: 10.2337/diacare.29.04.06.dc05-1769, PMID: 16567823
40. Papelbaum M, Moreira RO, Coutinho W, Kupfer R, Zagury L, Freitas S, *et al*. Depression, glycaemic control and Type 2 diabetes. Diabetol Metab Syndr. 2011;3:26. doi: 10.1186/1758-5996-3-26, PMID: 21978660, PMC3212883
41. Knol MJ, Twisk JW, Beekman AT, Heine RJ, Snoek FJ, Pouwer F. Depression as a risk factor for the onset of Type 2 Diabetes mellitus. A meta-analysis. Diabetologia. 2006;49:837-45. doi: 10.1007/s00125-006-0159-x, PMID: 16520921
42. Egede LE. Disease- focused or integrated treatment: Diabetes and depression. Med Clin North Am. 2006;90:627-46. doi: 10.1016/j.mcna.2006.04.001, PMID: 16843766
43. Skaff MM, Mullan JT, Almeida DM, Hoffman L, Masharani U, Mohr D, *et al*. Daily negative mood affects fasting glucose in type 2 diabetes. Health Psychol. 2009;28:265-72. doi: 10.1037/a0014429, PMID: 19450031, PMC2810194
44. Richardson LK, Egede LE, Mueller M, Echols CL, Gebregziabher M. Longitudinal effects of depression on glycaemic control in veterans with Type 2 diabetes. Gen Hosp Psychiatry. 2008;30:509-14. PMID: 19061676