Research Article

Association of depression, stress, and anxiety with type 2 diabetes mellitus: A case–control study

Niniya Jayaprasad, Prakash R Bhatkule, Uday W Narlawar

Department Community Medicine, Government Medical College, Gondia, Maharashtra, India

Correspondence to: Niniya Jayaprasad, E-mail: niniya.jayaprasad@yahoo.com

Received: January 03, 2018; **Accepted:** January 27, 2018

ABSTRACT

Background: The burden of type 2 diabetes mellitus (T2DM) is increasing due to aging, rising living standards, and changing lifestyles. Along with this, the presence of some psychological factors such as depression, anxiety, and stress have also been hypothesized as potential risk factors for T2DM. **Objectives:** The objective is to study the association of depression, anxiety, and stress with T2DM. **Materials and Methods:** This case–control study was conducted in diabetes outpatient department and urban field practice area of GMC Nagpur with 100 cases and 100 age- and gender-matched controls, respectively. Apart from assessing sociodemographic details and anthropometric measurement, the presence and severity of depression, anxiety, and stress were assessed using Hindi translated and validated version of Depression Anxiety and Stress Scale-21. Chi-square for linear trend followed by crude and age-gender adjusted odds ratio (OR) was calculated for each factor under the study. **Results:** A positive linear association was seen with increasing levels of each depression, anxiety, stress, and T2DM. A strong association was seen between the presence of depression, anxiety, stress, and T2DM, AOR = 4.02 (2.48–8.05), 5.77 (3.03–10.98), and 6.71 (3.56–12.63), respectively. **Conclusion:** Depression, stress, and anxiety were seen to be strongly associated with T2DM.

KEY WORDS: Depression; Stress; Anxiety; Type 2 Diabetes Mellitus

INTRODUCTION

Type 2 diabetes mellitus (T2DM) is a global public health crisis that threatens the economies of all nations, particularly developing countries. The global prevalence of diabetes has grown from 4.7% in 1980 to 8.5% in 2014.[1] Wild *et al.* estimated the prevalence of diabetes to be doubled globally from 171 million in 2000 to 366 million in 2030.[2] Much of this increase is occurring in developing countries like India which harbors 69.1 million diabetics with its prevalence in adults (20–79 years) to be 8.7%.[3]

Access this article online	
Website: http://www.ijmsph.com	Quick Response code
DOI: 10.5455/ijmsph.2018.0103127012018	

This increase is supposed to be due to population growth, aging, rising living standards, steady urban migration, and lifestyle changes such as unhealthy diets, obesity, and sedentary habits.[4]

Apart from these factors, psychological factors such as depression, anxiety, and stress have been increasingly emerged as potential risk factors. Several independent studies have tested the hypothesis that depression, anxiety, and stress is associated with an increased risk for the development of T2DM.[5-12] Literature has reported that patients with T2DM are almost twice as likely to suffer from depression, anxiety, and chronic stress as the general population.[13] The coexistence of these conditions represent a major clinical challenge, due to poor glycemic control, diabetes complications, worsened prognosis, and quality of life.[14,15] This could be prevented if these conditions be diagnosed and cross-screened.

Well-matched case–control studies targeting the population of specific setting are indicated to throw more light on association of these factors in the development of T2DM. Only then, prevention strategies for T2DM can be built around preventing and diagnosing conditions such as depression, anxiety, and stress. Moreover, a majority of the studies conducted to test the association between psychological factors and T2DM are carried out in foreign countries with only scare studies in an Indian setting. Therefore, there is a need of studies which would study the association of psychological factors in Indian settings.

Objective

The objective is to study the association of depression, anxiety, and stress with T2DM.

MATERIALS AND METHODS

This case–control study was conducted in diabetes outpatient department (OPD) and urban field practice area of GMC, Nagpur, after obtaining the ethics approval. The sample size was calculated using the study done by Vidya GS and Suryakanta AH[16] and estimated to be 100 in each group, i.e. a total of 200 subjects. Cases were selected from diabetes OPD, which included patients ≥30 years of age with recently (within one month) diagnosed T2DM as per the 2006 World Health Organization diagnostic criteria of diabetes.[17] Only urban residents were selected for the study for the convenience of selecting controls. Equal number of 5 years age group and gender-matched, non-diabetic individuals, who were permanent residents of the urban field practice area, were selected as controls from the urban health training center. Individual with type 1 diabetes mellitus, gestational diabetes, pregnant women, or on any anti-diabetic drugs were excluded from the study. After selection of controls by matching and applying exclusion criteria, their fasting blood glucose levels were measured using glucometer after observing overnight fasting of 8 h. Individuals with fasting blood glucose levels below 110 mg/dl were selected as controls.

Pre-designed proforma was used to assess sociodemographic details by interview method. All the anthropometric measurement such as height, weight, and waist circumference were measured using standard guidelines[18] following which body mass index (BMI) was calculated. Depression, anxiety, and stress were assessed using the depression anxiety stress scale-21 (DASS-21), a short version of DASS-42[19] which has 42 items. DASS-21 consists of 21 items, divided into 3 separate subscales with 7 items each for depression, anxiety, and stress and has good reliability estimates.[20] The translated and validated version of the scale into Hindi language was available[21] and was therefore used in this study.

The individuals were required to indicate the presence of symptoms indicated in each of the items over the period of the previous week using a 4-point severity scale, as follows:

0 - did not apply to me at all over last week;
1 - applied to me to some degree/for some time;
2 - applied to me to a considerable degree/for a good part of time;
3 - applied to me very much/most time over past week;

Classification of these factors was done as follows:

Levels	Depression score	Stress scores	Anxiety scores
Normal	0–4	0–7	0-3
Mild	5–6	8–9	4-5
Moderate	7–10	10–12	6-7
Severe	11–13	13-16	8-9
Extremely severe	≥14	≥17	≥10

Statistical Analysis

Data were entered and analyzed using statistical software Epi Info 7.1.5.2 and STATA. Descriptive statistics were used to summarize baseline characteristics. To assess the association, odds ratio (OR) and 95% confidence interval (CI) was calculated. Chi-square test for linear trend was applied to assess the linear relationship between the risk factors and T2DM. Further, age- and gender-adjusted OR was calculated by binary logistic regression analysis. $P < 0.05$ was considered to be statistically significant.

RESULTS

The study included 100 cases and 100 controls with 62 males in each group. Characteristic variables of subjects are depicted in Table 1. BMI and waist circumference were significantly higher among cases.

Table 2 shows that in comparison to controls, cases had higher severity of depression and as the levels of depression increased,chances of having T2DM were also increasing. This was supported by MH Chi-square for trend = 20.03; $P < 0.001$.

Table 3 shows that the number of cases in each level of anxiety was higher in comparison with controls. On application of Chi-square for trend, it was seen that there is a statistically significant linear association between level of anxiety and T2DM (MH Chi-square = 32.02; $P < 0.001$). In comparison with the normal level of anxiety, those subjects having a mild level of anxiety had OR = 3.58, those with moderate level had OR = 11.42, and those with severe/extremely severe anxiety had OR = 26.66.

Table 4 shows that, when Chi-square test for trend was applied, it was seen that there was a statistically significant increased risk of T2DM with increasing severity of stress (MH Chi-square for trend = 39.21, df = 3, $P < 0.001$). When compared to normal levels, the risk of T2DM was 3, 8, and 21 times higher in individuals having mild, moderate, and

Table 1: Characteristic variables of the study subjects

Variables	Cases		Control		*P*
	Mean±SD	Range	Mean±SD	Range	
Age (years)	53.78±11.03	30–86	54.08±10.94	30–86	0.84
BMI (kg/m^2)	25.24±03.16	18.9–33.02	23.00±2.34	18.08–30.94	0.007
Waist circumference (cm)	90.30±07.92	72.2–110.6	85.91±06.81	73.2–102.4	<0.001

BMI: Body mass index, SD: Standard deviation

Table 2: Linear association between levels of depression and T2DM

Levels of depression	Study subjects, *n* (%)		OR
	Cases	Control	
Normal	39 (39.00)	71 (71.00)	1.00
Mild	36 (36.00)	21 (21.00)	3.12
Moderate	19 (19.00)	07 (07.00)	4.94
Severe	05 (05.00)	01 (01.00)	10.92*
Extremely severe	01 (01.00)	00 (00.00)	
Total	100 (100.00)	100 (100.00)	

Mantel–Haenszel Chi-square for trend=20.03; df=3; *P*<0.001. *For analysis, severe and extremely severe level of stress was combined as there were no controls in extremely severe level. OR: Odds ratio, T2DM: Type 2 diabetes mellitus

Table 3: Linear association between levels of anxiety and T2DM

Levels of anxiety	Study subjects, *n* (%)		OR
	Cases	Control	
Normal	42 (42.00)	80.00 (80.00)	1
Mild	32 (32.00)	17.00 (17.00)	3.58
Moderate	12 (12.00)	02.00 (02.00)	11.42
Severe	07 (07.00)	01.00 (01.00)	26.66*
Extremely severe	07 (07.00)	00.00 (00.00)	
Total	100 (100.00)	100 (100.00)	

Mantel–Haenszel Chi-square for trend=32.02; df=3; *P*<0.001. *For analysis, severe and extremely severe level of stress was combined as there were no controls in extremely severe level. OR: Odds ratio, T2DM: Type 2 diabetes mellitus

severe cum extremely-severe level of stress levels of stress, respectively.

Table 5 shows the results of bivariate analysis and also age- and gender-adjusted OR calculated by logistic regression analysis, which reveal that even after adjustment depression, anxiety and stress were strongly associated with T2DM.

DISCUSSION

The age and gender distribution of the study subjects were similar in both the groups as matching was carried out, and therefore, there was no significant difference between cases and control regarding age and gender. It was seen that higher number of cases had depression (61%), anxiety (58%), and

Table 4: Linear association between levels of stress and T2DM

Levels of stress	Study subjects, *n* (%)		OR
	Cases	Control	
Normal	31 (31.00)	74 (74.00)	1
Mild	22 (22.00)	16 (16.00)	3.22
Moderate	29 (29.00)	08 (08.00)	8.65
Severe	15 (15.00)	02 (02.00)	21.48*
Extremely severe	03 (03.00)	00 (00.00)	
Total	100 (100.00)	100 (100.00)	

Mantel–Haenszel Chi-square for trend=41.26;df=3; *P*<0.001. *For analysis, severe and extremely severe level of stress was combined as there were no controls in extremely severe level. OR: Odds ratio, T2DM: Type 2 diabetes mellitus

stress (69%) than controls, with a higher number of subjects in cases in every levels of each depression, anxiety, and stress. On applying Mantel–Haenszel (MH) Chi-square for trend, a linear association was seen for each of the 3 factors, as the levels of depression (MH Chi-square = 20.03; $P < 0.001$), anxiety (MH Chi-square = 32.02; $P < 0.001$), and stress MH Chi-square = 41.26; $P < 0.001$) increased, chances of having T2DM also increased. Apart from the linear association, it was also seen that the presence of any of this factors increases the risk of having T2DM; the presence of depression was increased risk by 3.8 times, anxiety by 5.5, and stress by 6.33 times. It was seen that even after age and gender adjustment made by binary logistic regression analysis, there was a very strong association between depression, anxiety, and stress (AOR = 4.02, 5.7, and 6.71, respectively.)

It was seen that BMI and central obesity were significantly higher in cases in comparison to controls which is supported by various other authors.[22-27] Bener A *et al*.[28] also showed the linear association between increasing levels of depression, anxiety, stress, and risk of T2DM. Studies by Islam *et al*.[29] and Saadalla *et al*.[30] independently showed that depression and T2DM are significantly associated. The finding of our study regarding the association of anxiety is also supported by studies conducted by Balhara[8] ($P = 0.02$), Engum,[7] Almawi *et al*.[31] ($P < 0.001$), and Afzal *et al*.[32] (OR = 5.348;CI = 2.15–13.29). Stress is also studied as an independent risk factor by various authors like Dutt *et al*.[33] (OR = 4.3;Cl = 2–9.4; $P < 0.001$), Majgi *et al*.[34] (OR = 10.5; CI = 1.3–90.7, $P = 0.03$), and Afzal *et al*.[32] (OR = 4.52; CI = 1.95–10.50) and emerged as

Table 5: Results of bivariate and binary logistic regression analysis

Variables	Unadjusted OR	95% CI	*P*	Adjusted OR	95% CI	*P*
Depression	3.82	2.12–6.90	<0.001	4.02	2.48–8.05	<0.001
Anxiety	5.52	2.93–10.37	<0.001	5.77	3.03–10.98	<0.001
Stress	6.33	3.42–11.72	<0.001	6.71	3.56–12.63	<0.001

OR: Odds ratio, CI: Confidence interval

an independent risk factor for T2DM, which is in concordance with our study.

The strong positive association between depression, anxiety, and stress with T2DM could be explained through various pathways. The first pathway is through behavioral mechanisms; emotional changes are associated with unhealthy lifestyle behaviors such as inappropriate eating behaviors, low exercise levels, smoking, and alcohol abuse, all these factors which are again risk factors for the development of T2DM. The second is through physiological mechanisms, wherein chronic stress reactions and depression are often characterized by long-term activation of hypothalamic-pituitary-adrenal axis and sympathetic nervous system which were found to be associated with the development of abdominal obesity.[35] Chronic stress can also initiate changes in immune system activity and rise in the concentration of pro-inflammatory cytokines and glucocorticoids, particularly cortisol, contributing to the development of T2DM.[36]

This study highlighted the strong association between depression, anxiety, and stress with T2DM, which are some generally neglected risk factors. This study included only recently diagnosed cases of T2DM to avoid the recall bias, and controls were selected by proper age group and gender matching. This increases the strength of the study. Limitation in this study is that the presence of subjectivity during eliciting depression, anxiety, and stress cannot be completely eliminated even though validated scales were used with the proper interview.

CONCLUSION

Depression, stress, and anxiety are strongly associated with T2DM. Therefore, it is indicated that during health awareness campaigns, emphasis should be given regarding leading a healthy stress-free life. Individuals with these factors should be screened for T2DM for early diagnosis and treatment.

REFERENCES

1. World Health Organization. Global Report on Diabetes. France: WHO; 2016.
2. Wild S, Roglic G, Green A, Sicree R, King H. Global prevalence of diabetes estimates for the year 2000 and projections for 2030. Diabetes Care 2004;27:1047-53.
3. International Diabetes Federation. India Profile. Available from: http://www.idf.org/membership/sea/india. [Last accessed on 2017 Mar 25].
4. WHO Factsheet on Diabetes Mellitus. Available from: http://www.who.int/mediacentre/factsheets/fs138/en. [Last accessed on 2017 Dec 25].
5. Knol M, Twisk J, Beekman A, Heine R, Snoek F, Pouwer F. Depression as a risk factor for the onset of Type 2 diabetes: A meta-analysis. Diabetologia 2006;49:837-45.
6. Mezuk B, Eaton WW, Albrecht S, Golden SH. Depression and Type 2 diabetes over the lifespan. Diabetes Care 2008;31:2383-90.
7. Engum A. The role of depression and anxiety in onset of diabetes in a large population-based study. J Psychosom Res 2007;62:31-8.
8. Balhara YP. Diabetes and psychiatric disorders. Indian J Endocrinol Metab 2011;15:274-83.
9. Pouwer F, Kupper N, Adriaanse MC. Does emotional stress cause Type 2 diabetes mellitus? A review from the European depression in diabetes (EDID) research consortium. Discov Med 2010;9:112-8.
10. Mooy JM, De Vries H, Grootenhuis PA, Bouter LM, Heine RJ. Major stressful life events in relation to prevalence of undetected Type 2 diabetes, the Hoorn study. Diabetes Care 2000;23:197-201.
11. Rod NH, Grønbaek M, Schnohr P, Prescott E, Kristensen TS. Perceived stress as a risk factor for changes in health behaviour and cardiac risk profile: A longitudinal study. J Intern Med 2009;266:467-75.
12. Kato M, Noda M, Inoue M, Kadowaki T, Tsugane S, JPHC Study Group. Psychological factors, coffee and risk of diabetes mellitus among middle-aged Japanese: A population-based prospective study in the JPHC study cohort. Endocr J 2009;56:459-68.
13. Ghuloum S, Bener A, Burgut FT. Ethnic differences in satisfaction with mental health services among psychiatry patients. Open Psychiatr J 2010;4:19-24.
14. Peyrot M, Rubin RR. Levels and risks of depression and anxiety symptomatology among diabetic adults. Diabetes Care 1997;20:585-90.
15. Lustman PJ, Anderson RJ, Freedland KE, De Groot M, Carney RM, Clouse RE. Depression and poor glycemic control: A meta-analytic review of the literature. Diabetes Care 2000;23:934-42.
16. Vidya GS, Suryakanta HA. A study on risk factors of Type-2 diabetes mellitus-a case-control study. Indian J Public Heal Res Dev 2013;4:236-40.
17. WHO. Prevention and Control of Non-Communicable Diseases: Guidelines for Primary Health Care in Low Resource Setting or World Health Organization, Definition and Diagnosis of Diabetes Mellitus and Intermediate Hyperglycemia: Report of a WHO/IDF Consultation; 2006.
18. World Health Organization. WHO STEPS Surveillance. Part 3: Training and Practical Guides. Section 3: Guide to Physical Measurements (Step2); 2008. Available from: http://www.

who.int/chp/steps/Part3_Section3.pdf. [Last accessed on 2017 Dec 24].
19. Levibond PF, Levibond SH. The structure of negative emotional states: Comparison of the depression anxiety stress scales (DASS) with the beck depression and anxiety inventories. Behav Res Ther 1995;33:335-43.
20. Henry JD, Crawford JR. The short-form version of the depression anxiety stress scales (DASS-21): Construct validity and normative data in a large non-clinical sample. Br J Clin Psychol 2005;44:227-39.
21. Singh B, Kapse PP, Eqbal S, Singh AR. Depression stress anxiety scale: Reliability and validity of hindi adaptation. Int J Educ Manage Stud 2013;3:446-9.
22. Megerssa YC, Gebre MW, Birru SK, Goshu AR, Tesfaye DY. Prevalence of undiagnosed diabetes mellitus and its risk factors in selected institutions at bishoftu town, East shoa, Ethiopia. Diabetes Metab 2013;S12:1-7.
23. Murad MA, Abdulmageed SS, Iftikhar R, Sagga BK. Assessment of the common risk factors associated with Type 2 diabetes mellitus in Jeddah. Int J Endocrinol 2014;2014:616145.
24. Vijayakumar G, Arun R, Kutty VR. High prevalence of Type 2 diabetes mellitus and other metabolic disorders in rural Central Kerala. J Assoc Phys India 2009;57:563-7.
25. Ghorpade AG, Majgi SM, Sarkar S, Kar SS, Roy G, Ananthanarayanan PH, *et al*. Diabetes in rural Pondicherry, India: A population-based study of the incidence and risk factors. WHO South-East Asia J Public Heal 2013;2:149-55.
26. Ghosh JR, Bandyopadhyay AR. Abdominal circumference as a screening measure for Type 2 Diabetes. Kathmandu Univ Med J 2012;1012-5.
27. Mohan V, Shanthirani CS, Deepa R. Glucose intolerance (diabetes and IGT) in a selected south Indian population with special reference to family history, obesity and lifestyle factors-the Chennai Urban population study (CUPS 14). J Assoc Phys India 2003;51:771-7.
28. Bener A, Al-hamaq AO, Dafeeah EE. High prevalence of depression, anxiety and stress symptoms among diabetes mellitus patients. Open Psychiarty J 2011;5:5-12.
29. Islam SM, Ferrari U, Seissler J, Niessen L, Lechner A. Association between depression and diabetes amongst adults in Bangladesh: Hospital-based case-control study. J Global Health 2015;5:020406.
30. Saadalla AM, Mirghani HO, Mohammed OS, Alyoussef AA, Alfarraj MH. Depression and Type 2 diabetes mellitus: A case-control study in Tabuk, Saudi Arabia. Basic Res J Med Clin Sci 2015;4:1-9.
31. Almawi W, Tamim H, Al-Sayed N, Arekat MR, Al-Khateeb GM, Baqer A, *et al*. Association of comorbid depression, anxiety, and stress disorders with Type 2 diabetes in Bahrain, a country with a very high prevalence of Type 2 diabetes. J Endocrinol Invest 2008;31:1020-4.
32. Afzal S, Kashif AM, Ahmad I, Amer H, Shoaib H, Ibrahim H, *et al*. Psychosocial determinants of Type 2 diabetes mellitus. Ann King Edward Med Univ 2013;19:311-6.
33. Dutt D, Roy G, Chatterjee P. Risk factor assessment for Type II diabetes mellitus in a tertiary hospital in Kolkata. Indian J Community Med 2004;29:10-2.
34. Majgi S, Soudarssanane B, Roy G, Das A. Risk factors of diabetes mellitus in rural Puducherry. Online J Heal Allied Sci 2012;11:1-7.
35. Björntorp P. Do stress reactions cause abdominal obesity and comorbidities? Int Assoc Study Obesity 2001;2:73-86.
36. Anisman H. Cascading effects of stressors and inflammatory immune system activation: Implications for major depressive disorder. J Psychiatry Neurosci 2009;34:4-20.

How to cite this article: Jayaprasad N, Bhatkule PR, Narlawar UW. Association of depression, stress, and anxiety with type 2 diabetes mellitus: A case–control study. Int J Med Sci Public Health 2018;7(4):282-286.

Source of Support: Nil,**Conflict of Interest:** None declared.