Assessment of depression and its associated factors among patients with type 2 diabetes

Akter N[1], Latif Z. A[2]

[1] Department of Medicine, MARKS Medical College & Hospital, Dhaka, Bangladesh
[2] BIRDEM General Hospital, Dhaka, Bangladesh

Abstract

Background:

Diabetes mellitus (DM) patients have an increased risk of developing several serious health problems in comparison with patients without DM. Depression is one of the more common co-morbid conditions found among diabetic patients. It is associated with poorer glycaemic control, reduced compliance with treatment, and increased complications, which can lead to impaired quality of life.

Objective:

This study was designed to assess the prevalence of depression and to recognize its associated factors among patients with type 2 diabetes mellitus attending a tertiary care hospital in Dhaka, Bangladesh.

Methods:

This cross-sectional study was conducted from July 2019 to February 2020. We recruited 318 types 2 diabetics (T2DM) patients who attended an out-patient diabetic clinic at a tertiary care hospital in Dhaka, Bangladesh. We used Patient Health Questionnaire-9 (PHQ-9) to assess depression among the subjects. A semi-structured questionnaire was used to collect demographic, clinical, and diabetes-related information after informed written consent was taken from the patients.

Results:

Among study subjects, the mean duration of diabetes was 7.51 ±6.18 (±SD) years. About one-third of the patients (34.9%) had been suffering from diabetes for more than 10 years. The prevalence of depressive illness using the PHQ-9 (score≥5) was found higher among female patients than male patients (46.2% vs.17.9%); (P=0.98). The calculated mean depression score was 6.89±6.08 (±SD). On the other hand, the prevalence of moderate to severe depressive illness using the PHQ-9 (score≥10) was 33.6% (male vs. female: 7.2% vs. 26.4%); (P=0.06). Mild depression (PHQ-9 score: 5-9) had been found among 30.8% of subjects. Moderate depression (PHQ-9 score: 10-14) and moderately severe depression (PHQ-9 score: 15-19) were found among 18.9% and 11.6% diabetic subjects respectively. The prevalence of severe depression (PHQ-9 score: 20-27) was only 3.1%; (p=0.12). Among demographic variables older age, urban residency, housewife, widow, lower education level, and low income were significantly associated with depression; (p<0.05). On the other hand, the clinical variables i.e. patients for a longer duration of diabetes (≥10 years), those with a co-morbid disease, or diabetes-related complications, and higher BMI, were significantly associated with a substantial risk for moderate to severe depression; (p<0.05). Poor glycaemic control (HbA1c >8.0%), was detected as a strong forecaster for depression; (p<0.001).

Conclusions:

The prevalence of depression specifically moderate to severe is very high among the study population. The high prevalence of depression in diabetic individuals suggests that patients with diabetes mellitus should be inquired for depression or mental disorders. Since depression could significantly impede a patient's adherence to treatment; mental health care needs to be incorporated into the management of diabetes for early diagnosis and treatment.

https://orcid.org/0000-0003-0830-0748

Introduction

Two major non-communicable diseases which have become global epidemics and cause significant mortality and morbidity are diabetes and depression (1). International Diabetes Federation (IDF) also declares diabetes as one of the largest global health emergencies of the 21st century (2). This indicates that the prevalence of diabetes mellitus has reached epidemic levels globally (3). People with poorly controlled diabetes have an increased risk of developing several serious health problems. In many countries, diabetes is a leading cause of cardiovascular disease, blindness, kidney failure, and lower limb amputation (4).

Depression is a common and serious medical condition with a lifetime prevalence ranging from approximately 11% in low-income countries to 15% in high-income countries (5). Like any other chronic illness diabetes and depression also have a negative impact on its sufferer. People with diabetes and co-morbid depression can have poor self-care, treatment adherence, and glycaemic control as well as increased morbidity and mortality (6). Evidence also suggests that the prevalence of depression is moderately increased not only in prediabetic patients but also in undiagnosed diabetic patients, and markedly increased in the previously diagnosed diabetic patients compared to normal glucose level individuals (7). The prevalence rate of depression is three times higher in patients with type 1 diabetes and two times higher in the type 2 diabetes population compared with the general population worldwide (8). Diabetes and depression can have a bidirectional relationship. Due to the chronic nature of the disease and numerous complications, patients with diabetes tend to become depressed while diabetes can appear in depression due to an increase in counterregulatory hormones (9). The prevalence of diabetes, as well as depression, is increasing in Southeast Asia (10). According to different studies reports, the prevalence of depression among patients with diabetes in Bangladesh is ranging from 15.3 to 36% (11, 12). Diabetes is more prevalent in urban than in rural population 3 and frequent exposure to several unfavorable conditions make them vulnerable to depression. In the present study, it was speculated that persons with diabetes would have a higher prevalence of depression. Data on depression in the urban-type 2 diabetic population of Bangladesh is still inadequate. Therefore, this study was designed to explore the prevalence of depression and to recognize its associated factors influencing depression among patients with type 2 diabetes mellitus attending an out-patient clinic at a tertiary care hospital in Dhaka, Bangladesh.

Methodology

Study design & Study setting

This single center-based descriptive type of cross-sectional study was carried out among 318 types 2 diabetics (T2DM) patients attending a diabetic clinic at MARKS medical college hospital in Dhaka, Bangladesh from July 2019 to February 2020. This is a multidiscipline hospital and serves a good number of diabetes patients in the north part of Dhaka city.

Inclusion and Exclusion criteria

We purposively enrolled a total of 318 types 2 diabetes patients aged over 30 years attending the diabetic clinic. Informed written consent was taken from all. All the subjects were diagnosed with type 2

diabetes mellitus for at least 6 months. Patients with a previous history of psychiatric illness or currently treated with psychiatric medication and pregnant patients were excluded from the study.

Ethical consideration

The ethical approval was obtained from the ethics review board of the hospital.

Data collection, Study instruments, and Measurement

The study was approved by the proper authority of the Institutional Review Board. Two questionnaires were used for data collection. A semi-structured questionnaire was used by the interviewer for the collection of socio-demographic information, anthropometric, clinical, and diabetes-related variables. Depression was assessed by Patient Health Questionnaire 9 (PHQ-9) and relevant data were collected by a self-administered questionnaire of the local language (Bengali). The questionnaires were pre-tested in a similar setting on 20 type 2 diabetes patients in the outpatient department of MARKS medical college hospital. Feedback from the field testing was used to improve the contents of the questionnaire. The diagnostic validity of the PHQ-9 was established in studies involving primary care (13). They were designed by the investigator and validated by a clinical psychologist, among other experts. It is considered a reliable tool for the diagnosis of depression developed by Kroenke et al. (13). The PHQ-9 cut–off score of ≥10 had a sensitivity of 88% and a specificity of 88% to diagnose major depression (14). The reliability and validity of the tool have indicated it has sound psychometric properties (13).

The questionnaire is free to users and available in Bengali and over 29 other languages other than English. The Bengali version of the PHQ–9 questionnaire was evaluated previously and used in the different studies for diagnosis of depression 12. Minimal (or no depression), mild, moderate, moderately severe, and severe depression are defined by the tool as total scores of 0–4, 5–9, 10–14, 15-19, and ≥20, respectively (13). Depending on the PHQ-9 scoring system subjects are again categorized into two other groups, i.e. scores≥5 and ≥10. Score ≥5 includes all those subjects who had depression of any categories from mild to severe (i.e. mild, moderate, moderately severe, and severe depression). And score ≥10 categories those who had depression of moderate to severe categories (i.e. moderate, moderately severe, and severe depression) (14). The questionnaire comprised information about socio-demographic factors such as age, sex, residence (rural or urban), marital status (married, unmarried, widow), education (primary, secondary school, higher secondary school, and graduation), occupation (service holders, businessman, homemaker and retired), monthly income in Bangladeshi taka (BDT) [according to Asian development bank categories15: upper (≥ 100000 BDT), middle (25000- 50000 BDT) and low (<5000 BDT)]. The questionnaire also included health-related variables i.e. duration of diabetes, height, weight, body mass index (BMI), blood pressure, fasting blood sugar (FBS), postprandial blood sugar (PPBS), glycosylated hemoglobin (HbA1c) level, presence of other co-morbidities and diabetes-related complications (eye, cardiovascular diseases, cerebrovascular diseases, kidney diseases, peripheral vascular diseases, etc).

Questions about current anthropometric and clinical data (e.g. Height, Weight, BMI, HbA1c level, other co-morbidities, macro or microvascular complications) were collected from the patients' medical book or medical records. Patients were categorized as underweight (BMI: ≤18.5 kg/ m2), normal weight (BMI: 18.5–22.9 kg/m2), overweight (BMI: 23–24.9 kg/m2) and obese (BMI: ≥25 kg/m2) according to the BMI (kg/m2) criteria for Asian population (16). Glycaemic control was categorized as good, fair and poor depending on HbA1c (%) (Good: < 7%, fair: 7.0 - 8.0% and poor: > 8%).
Statistical analysis

Data were analyzed with Statistical Package for Social Science (SPSS) software version 20. The means and standard deviations were used to describe continuous data. Categorical variables were estimated by frequencies and percentages. Association between depression and categorical variables was calculated using the Chi-square test. p-value <0.05 was considered as significant.

Results

Baseline characteristics of the study participants
The study recruited 318 types 2 diabetes subjects with a male to female ratio of 28:72. The mean age of the study subjects was (±SD) of 48.88 ± 11.51 years. Among them, 8.5% of the study population was over the age of 66 years. The majority of the subjects (84.0%) were married. More than 60% of the subjects completed secondary or higher education. About half of the subjects were housewives but unemployed, and one-third were service holders or businessmen. Among all, 39.0% of the study population had low income. Anthropometric and socio-demographic data of the subjects are synopsized in Tables 1 and 2.

Table 1 Comparison of anthropometric parameters of study subjects (n=318)			
Variables	**Male Mean ±SD**	**Female Mean ±SD**	**Total Mean ±SD**
Age (years)	50.25 ±12.33	48.34 ±11.15	48.88 ±11.51
Height (meter)	1.64 ±6.61	1.56 ±7.39	1.58 ±8.04
Weight (kg)	66.69 ±8.57	61.36 ±8.23	62.85 ±8.65
BMI (kg/m^2)	24.76 ±2.83	25.10 ±2.90	25.00 ±2.88

BMI: Body Mass Index

Table 2 Socio-demographic distribution of study subjects (n=318)

Variables		Male N (%)	Female N (%)	Total N (%)	p value
Age Groups (years)	30-55 years	63(19.8)	169 (53.1)	232(73.0)	
	56-65 years	13 (4.1)	46(14.5)	59(18.6)	
	66-70 years	9 (2.8)	10 (3.1)	19(6.0)	0.086
	>70 years	4(1.3)	4(1.3)	8(2.5)	
Marital Status	Married	74 (23.3)	193(60.7)	267(84.0)	
	Widow	15(4.7)	36(11.3)	51(16.0)	0.805
Residence	Urban	58(18.2)	136(42.8)	194(61.0)	
	Rural	31 (9.7)	93(29.2)	124(39.0)	0.206
Educational Status	Primary	3(0.9)	32(10.1)	35(11.0)	
	SSC	9(2.8)	78(24.5)	87(27.4)	
	HSC	35(11.0)	85(26.7)	120(37.7)	<0.001
	Graduate	42(13.2)	34(10.7)	76(23.9)	
Occupation	Homemaker	0(0.0)	144(45.3)	144(45.3)	
	Service Holder	41(12.9)	45 (14.2)	86 (27.0)	
	Businessman	28 (8.8)	2 (0.6)	30(9.4)	<0.001
	Retired	20 (6.3)	38(11.9)	58(18.2)	
Socio-economic Status	High Income	2 (0.6)	0(0.0)	2(0.6)	
	Mid Income	66(20.8)	126(39.6)	192(60.4)	<0.001
	Low income	21(6.6)	103(32.4)	124(39.0)	

Chi-square analyses were done; p value <0.05 considered as significant

The mean duration of diabetes was 7.51±6.18 (±SD) years. About one-third of the subjects (34.9%) had diabetes for more than 10 years. Mean (±SD) HbA1c (%) was 8.75 (±1.60). Only 8.8% had good glycaemic control (HbA1c <7.0%); (p=0.83). Most of the patients (49.6%) were obese and the majority of them were female (35.8%) (p=0.33). About two-thirds (62.6%) of study participants reported having other co-morbidities (e.g. Bronchial asthma, osteoarthritis, hypertension, dyslipidemia, etc.); (p=0.66). The presence of diabetes-associated complications (macro and microvascular) was significantly higher among female than male patients (49.4% vs. 18.9%); (p=0.84) (Table 3).

Table 3 Comparison of clinical parameters among subjects (n=318)

Variables		Male	Female	Total	p value
Duration of DM (years)		8.12 ±7.27	7.27 ±5.69	7.51 ±6.18	0.272
HbA1C (%) (Mean ±SD)		8.72 ±1.43	8.76 ±1.66	8.75 ±1.60	0.838
Glycaemic Control	Good Control (HbA1C :< 7.0%)	7(2.2)	21(6.6)	28(8.8)	.835
	Fair Control (HbA1C:7.0 - 8.0%)	26(8.2)	72(22.6)	98(30.8)	
	Poor Control (HbA1C :> 8.0%)	56(17.6)	136(42.8)	192(60.4)	
Different Categories of BMI [N (%)]	Normal Weight	25(7.9)	49(15.4)	74(23.3)	0.334
	Over Weight	20(6.3)	66(20.8)	86(27.0)	
	Obese	44(13.8)	114(35.8)	158(49.7)	
Duration of DM [N (%)]	<10 years	56(17.6)	151(47.5)	207(65.1)	0.612
	≥10 years	33(10.4)	78(24.5)	111(34.9)	
Co-morbidities (N (%))	Yes	54(17.0)	145(45.6)	199(62.6)	0.662
	No	35(11.0)	84(26.4)	119(37.4)	
Complication of DM [N (%)]	Yes	60(18.9)	157(49.4)	217(68.2)	0.844
	No	29(9.1)	72(22.6)	101(31.8)	

DM: Diabetes Mellitus; SBP: Systolic Blood Pressure; DBP: Diastolic Blood Pressure; FBS: Fasting blood Sugar; PPBS: Post Prandial Blood Sugar; BMI: Body Mass Index; Chi-square analyses were done; p value <0.05 considered as significant

Prevalence of depression

In our study, the mean depression score was 6.89±6.08 (±SD). The general prevalence of depressive illness (PHQ-9 score ≥5) was higher among female patients than male patients (46.2% vs.17.9%); (P=0.98). On the other hand, the prevalence of moderate to severe depressive illness (PHQ-9 score ≥10) was 33.6% (male vs. female: 7.2% vs. 26.4%); (P=0.06). The most usual level of depression was mild depression (30.8%), and then moderate depression (18.9%). The prevalence of moderately severe depression and severe depression were 11.6% & 3.1% respectively; (p=0.12) (Table 4 and Figure 1).

Table 4 Prevalence of depression (using PHQ-9) among type 2 diabetes mellitus subjects (n=318)

Variables		Male	Female	Total	p value
Depression Score (Mean ±SD)		6.01 ±5.41	7.24 ±5.66	6.89 ±6.08	0.106
Depression Score ≥5 [N (%)]	Yes	57(17.9)	147(46.2)	204(64.2)	0.980
	No	32(10.1)	82(25.8)	114(35.8)	
Depression Score ≥10 [N (%)]	Yes	23(7.2)	84(26.4)	107(33.6)	0.066
	No	66(20.1)	145(45.6)	211(66.4)	

PHQ-9: Patient Health Questionnaire-9; Chi-square analyses were done; p value <0.05 considered as significant
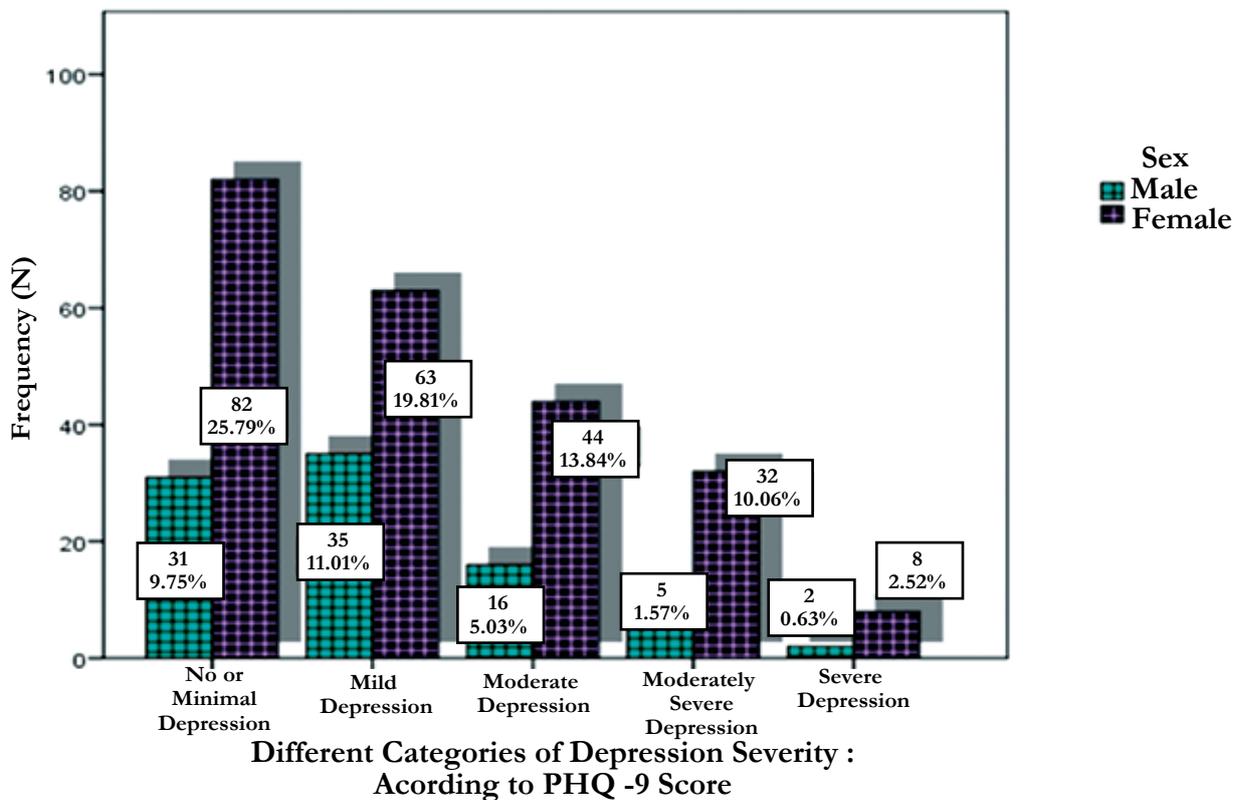

Figure 1 Distribution of different categories of depression among subjects (n=318)

PHQ-9: Patient Health Questionnaire -9

Association between diabetes and depression

The chi-square analysis examined the associations between demographic and clinical factors, and moderate to severe depression symptoms (using PHO-9 scores ≥10); (Table 5). Among the demographic variables, those had statistically signif-icant association with depression were older age; (p<0.05), urban residency; (p<0.05), housewife (i.e. unemployed); (p<0.05), widow; (p<0.05), lower education level; (p<0.05) and low income; (p<0.05).

Among the clinical variables, patients for longer duration of diabetes (≥10 years); (p<0.05), those with co-morbid disease;(p<0.001) or diabetes re-

lated complications; (p<0.001) and higher BMI; (p<0.05), were significantly associated with a substantial risk for moderate to severe depression. Poor glycaemic control (manifested by HbA1c values > 8.0%), was also detected as a strong forecaster for depression; (p<0.001); (Table 5).

Table 5 Association of depression (PHQ Score≥10) with socio-demographic and clinical parameters

Variables		Depression Status (PHQ Score≥10)		p value
		Yes [N (%)]	No [N (%)]	
Age Group (years)	30-55 years	65(20.4)	167 (52.5)	
	56-65 years	28(8.8)	31(9.7)	
	66-70 years	11(3.5)	8 (2.5)	0.004
	>70 years	3(0.9)	5(1.6)	
Marital Status	Married	82(25.8)	185(58.2)	
	Widow	25(7.9)	26 (8.2)	0.011
Residence	Urban	56(17.6)	138 (43.4)	
	Rural	51(16.0)	73(23.0)	0.024
Educational Status	Primary Level	20(6.3)	15(4.7)	
	SSC	31(9.7)	56(17.6)	
	HSC	39(12.3)	81(25.5)	0.004
	Graduate	17(5.3)	59(18.6)	
Occupation	Home maker	51(16.0)	93(29.2)	
	Service Holder	18(5.7)	68(21.4)	
	Businessman	9(2.8)	21(6.6)	0.004
	Retired	29(9.1)	29 (9.1)	
Economical Status	High Income	2(0.6)	0(0.0)	
	Mid Income	53(16.7)	139(43.7)	
	Low Income	52(16.4)	72(22.6)	0.004
Different Categories of BMI	Normal Weight	18(5.7)	56(17.6)	
	Over Weight	38(11.9)	48(15.1)	
	Obese	51 (16.0)	107(33.6)	0.026
Duration of Diabetes	< 10 years	58(18.2)	149(46.9)	
	≥ 10 years	49(15.4)	62(19.5)	0.004
Co-morbidities	Yes	97(30.5)	102(32.1)	
	No	10(3.1)	109(34.3)	<0.001
Complication of Diabetes	Yes	88(27.7)	129(40.6)	
	No	19(6.0)	82(25.8)	<0.001
Glycaemic Control	Good Control (HbA1C :< 7.0%)	3(0.9)	25(7.9)	
	Fair Control (HbA1C:7.0 - 8.0%)	24(7.5)	74(23.3)	<0.001
	Poor Control (HbA1C :> 8.0%)	80(25.2)	112(35.2)	

Discussion

In our study, the overall prevalence of depression was higher (64.1%) in comparison to previous studies done in Bangladesh (11,12). This figure was also much higher in comparison to the prevalence of depression among the adult general population of Bangladesh (4.6%) (17). However, this finding is comparable to those reported in many hospital-based studies of different countries ranging from 21% to 83% with the majority having a prevalence of 41% and above) (18).

In the present study, depression was more common among females (46.2%) than male subjects (17.9%). Similar reports were appeared in many other studies (18,19,20). The majority (72%) of our study subjects were female. Among them, most were housewives and unemployed. We found moderate to severe depression score (≥10) was high among housewives and low among businessmen. Another study (21) also reported a significant correlation between unemployment status and depression score.

Advancing age is usually a predictor for depression and more so in patients with diabetes (22). A significant association between age and depression was also noticed in our study. Reports from different studies advocate that the civil status of subjects with those being married has fewer chances of depression (23). This has been observed in our subjects as well. Depression was markedly lower among married subjects in contrast to those who were widowed.

Depression was deemed to be linked with lower education levels in our study. Association of education with depression was also revealed by some other studies (24,25). Individual monthly income was also seen to be correlated with depression status in our study. Similar findings were also reported in some other studies (26,27). Depression is more frequent in rural residents compared to urban counterparts reported by other studies (28,29). But in our study, the proportion was higher among the urban than rural diabetic population; as the current study was done in an urban tertiary care hospital.

We found higher BMI was significantly associated with a substantial risk for moderate to severe depression. Many studies also have noted a similar relationship between obesity and depression (30). In our study, patients with a longer duration of diabetes (≥10 years) had a high depression score. But some other studies did not find any correlation between the duration of diabetes and depression (21). Diabetes associated complication i.e. macro or microvascular is well studied to have adverse psychological effects among patients with diabetes (31). Findings of some recent studies exhibit that the risk of depression is significantly correlated with the number of macro or microvascular complications (32,33). Our findings also approved the association of diabetic complications (macro/ microvascular) with depression. Contrarily, the presence of other chronic diseases such as hypertension, dyslipidemia, osteoarthritis, asthma, etc was also significantly associated with moderate to severe depression. These reports match with findings of many other studies (20,28). The negative influence of depression on quality of life and glycaemic control is well known (33). Poor glycaemic control was spotted as a significant forecaster of depression in our study. Several other cross-sectional studies also support our findings and reveal the association of depression with poor glycaemic control (34).

Conclusions

In our study, the prevalence of depression specifically moderate to severe is very high among adults with type 2 diabetes. We found depression was significantly associated with older age, female gender, widow, residing in urban areas, low income, lower educational level, unemployment status, high body mass index, diabetic complication and/or other co-morbidities, and longer duration of diabetes. The findings indicate that patients with diabetes should be inquired for depression or mental disorders and it is also important to incorporate mental health care into the management of diabetes.

Limitation of the study

This is a PHQ-9 questionnaire-based study. The cross-sectional nature of this study could not give any tangible perception into the causal effect relationship. Inclination to recall bias is one of the lim-

itations of our study. Secondly, self-reported by patients and previous medical record book-based data about complications or co-morbidities could not be verified by clinical or laboratory investigations. A control or comparison group could be used as a testimonial in the precise estimation of depression among diabetic and non-diabetic individuals.

Acknowledgment

Conflict of interest

None.

References

1. Islam SM, Purnat TD, Phuong NTA, Mwingira U, Schacht K, Fröschl G, et al . Non-Communicable Diseases (NCDs) in developing countries: a symposium report. *Global Health.* 2014;10:81. Medline:25498459 doi**:10**.1186/s12992-014-0081-9

2. International Diabetes Federation. IDF Diabetes, 9th ed. Brussels, Belgium: International Diabetes Federation, 2019. http://www.diabetesatlas.org.

3. Egede LE, Ellis C. Diabetes and depression: Global perspectives. Diabetes Research and *Clinical Practice.* 2010; **87**: 302-12.

4. Australian Institute of Health and Welfare 2013. Diabetes and disability: impairments, activity limitations, participation restrictions and co-morbidities. Diabetes series no. 20. Cat. no. CVD 63.Canberra: AIHW.

5. Bromet E, Andrade LH, Hwang I, Sampson NA, Alonso J, de GG, et al. Cross-national epidemiology of DSM-IV major depressive episode. *BMC Med.* 2011; **9**:90.

6. Ciechanowski P. Diapression: An integrated model for under-standing the experience of individuals with co-occurring diabetes and depression. *Clinical Diabetes.* 2011; **29**(2):43–49.

7. Chen S, Zhang Q, Dai G, Hu J, Zhu C, Su L, et al. Association of depression with pre-diabetes, undiagnosed diabetes, and previously diagnosed diabetes: a meta-analysis. Endocrine. 2016.

8. Roy T, Lloyd CE. Epidemiology of depression and diabetes: a systematic review. *J Affect Disord.* 2012; **142**:S8-21.

9. Egede LE. Diabetes, major depression, and functional disability among U.S. adults. *Diabetes Care.* 2004; **27**(2):421–28.

10. Ghaffar A, Reddy KS, Singhi M. Burden of non–communicable diseases in South Asia. BMJ. 2004; 328:807 -10. Medline:15070638 doi:10.1136/bmj.328.7443.807

11. Asghar S, Hussain A, Ali SM, Khan KAK, Magnusson A. Prevalence of depression and diabetes: A population-based study from rural Bangladesh. Diabet Med.2007;24:872-7. Medline:17403122 doi:10.1111 /j.1464-5491.2007.02136.

12. Roy T, Parvin M, Mohiuddin KGB, Rahman M. Prevalence of co–morbid depression in out–patients with type 2 diabetes mellitus in Bangladesh. BMC Psychiatry.2012;12:123. Medline:22909306 doi:10.1186/1471-244X-12-123

13. Kroenke K, Spitzer RL, Williams JB. The PHQ 9: Validity of a brief depression severity measure. *J Gen Intern Med.* 2001;**16**:606 13.

14. Kroenke K, Spitzer RL. The PHQ–9: a new depression diagnostic and severity measure. *Psychiatr Ann.* 2002; **32**:509 -15. Doi:10.3928/0048-5713-2002

15. The Business Standard. Who are the middle class in Bangladesh. The Business Standard, 4 October 2020.https://www.tbsnews.net

16. Pan WH, Yeh WT. How to define obesity? Evidence-based multiple action points for public awareness, screening, and treatment: an extension of Asian-Pacific recommendations. *Asia Pac J Clin Nutr.* 2008;**17**(3):370–74.

17. Firoz AHM, Karim ME, Alam MF, Rahman AHM, Zaman MN, Chandra V. Community Based Multicentric Service Oriented Research on Mental Illness with focus on Prevalence, Medical Care, Awareness and Attitude towards Mental Illness in Bangladesh. WHO published data, 2003-2005. Bang J Psychiatry. 2006; 20(1):9-32.

18. Nasser J, Habib F, Hasan M, Khalil N. Prevalence of depression among people with diabetes attending diabetes clinics at primary health settings. *Bahrain Med Bull.* 2009;**31**:1 7.

19. Sotiropoulos A, Papazafiropoulou A, Apostolou O, Kokolaki A, Gikas A, Pappas S. Prevalence of depressive symptoms among non insulin treated Greek type 2 diabetic subjects. *BMC Res* Notes. 2008;**1**:101.

20. Téllez Zenteno JF, Cardiel MH. Risk factors associated with depression in patients with type 2 diabetes mellitus. *Arch Med Res.* 2002;33:53 60.

21. Miyaoka Y, Miyaoka H, motomiya T, Kitamura S, Asai M. Impact of socio-demographic and diabetes-related characteristics on depressive state among noninsulin-dependent diabetic patients. *Psychiatry and Clinical Neurowienm.* 1997;**51**:203-6.

22. Lyness JM, Noel TK, Cox C, King DA, Cornwell Y, Caine ED. Screening for depression in elderly primary care patients: a comparison of the Center for Epidemiological Studies Depression Scale and the Geriatric Depression Scale. *Archives of Internal Medicine.* 1997;**157**:449–54.

23. Kessler RC, McGonagle KA , Swartz M, Blazer DG, Nelson CB. Sex and depression in the National Comorbidity Survey I: lifetime prevalence, chronicity and recurrence. *Journal of Affective Disorders.* 1993; **29**(2-3):85–96.

24. Engum A, Mykletun A, Midthjell K, Holen A, Dahl AA. Depression and Diabetes: A large population-based study of sociodemographic, lifestyle, and clinical factors associated with depression in type 1 and type 2 diabetes. *Diabetes Care.* 2005;**28**:1904–9.

25. Fisher L, Chesla CA, Mullan JT, Skaff MM, Kanter RA. Contributors to Depression in Latino and European-American Patients with Type 2 Diabetes. *Diabetes Care.* 2001;**24**:1751–7.

26. World Health Organization. Depression [Fact Sheet No. 369]; 2015. Available from: http://www.who.int/mediacentre/factsheets/fs369/en/. [Last accessed on 2016 Feb 20].

27. Egede LE, Zheng D, Simpson K. Co-morbid depression is associated with increased health care use and expenditures in individuals with diabetes. *Diabetes Care.* 2002;**25**:464 70.

28. Raval A, Dhanaraj E, Bhansali A, Grover S, Tiwari P. Prevalence and determinants of depression in type 2 diabetes patients in a tertiary care centre. *Indian J Med Res.* 2010;**132**:195 200.World Health Organization. Diabetes;2016.Availablefrom:http://www.who.int/mediacentre/factsheets/fs312/en/. [Last cited on 2016 Apr 03].

29. Katon WJ, Rutter C, Simon G, Lin EHB, 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.

30. De Groot M, Anderson R, Freedland KE , Clouse RE, Lustman P J. Association of depression and diabetes complications: a meta-analysis. *Psychosomatic Medicine.* 2001;**63**(4):619–30.

31. Reddy P, Ford D, Dunbar JA. Improving the quality of diabetes care ingeneral practice. *Aust J Rural Health.*2010;**18**(5):187–93.

32. 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.

33. Holt RIG, Phillips DIW, Jameson KA, Cooper C, Dennison EM, Peveler RC. The relationship between depression and diabetes mellitus: findings from the Hertfordshire Cohort study. *Diabet Med.*2009,**26**:641–48.