Depression and Its Relation to Diabetes Control and Complications in Type 2 Diabetic Patients in Police Authority Hospital

Mohannad Mahmoud Mohamed*[1], Mohab Fawzy[2], Fayrouz Selim[1], Mohamed Sakr[1]
Departments of [1]Internal Medicine and [2]Psychiatry, Faculty of Medicine, Zagazig University, Egypt.
***Corresponding author:** Mohannad Mahmoud Mohamed Hassan, **Mobile:** (+20)01004785050,
E-mail: drmohaned@hotmail.com

ABSTRACT

Background: Type II diabetes mellitus (DM) is a progressive chronic disease with high prevalence all over the world. Psychological complications, such as depression are common in older people with diabetes. Unlike in other chronic conditions, good diabetes management relies heavily on a patient's self-care abilities. Although depression is common in older people with diabetes, it remains underdiagnosed and therefore often untreated

Objective: To assess presence and severity of depression and its relation to diabetic control and complications in type 2 diabetic patients at police authority hospital, Cairo, Egypt.

Patients and methods: The study included 322 patients recruited from the Outpatient Clinics of Police Authority Hospital-Nasr city. The studied patients were screened for the presence of depression with Hamilton depression rating scale, and then they were further classified into two groups: Group A diabetic patient without depression which included 172 patients and group B diabetic patients with depression which included 150 patients. All patients were subjected to clinical examination including Michigan Neuropathy Screening Instrument (MNSI), fundus examination and laboratory evaluation to assess diabetic control and the presence of macro and micro-vascular complications of diabetes.

Results: The percentage of depression among the studied patients was 46.6%. No statistically significant difference between the patients with and without depression in the laboratory data except for levels of fasting and postprandial glucose. High statistically significant difference was detected by the MNSI regarding the severity of depression.

Conclusion: depression is a common finding in patients with type II DM and the severity of the depressive symptoms were correlated to self-monitoring, diet regimen, type of anti-diabetic medications and adherence to medications.

Keywords: Depression, Diabetes mellitus, Hamilton, Michigan.

INTRODUCTION

Several studies report that depression is highly prevalent in patients with type 2 diabetes [(1)]. The prevalence has been reported to be about twice as likely as the general population [(2)]. Depression is associated with poor glycemic control, suboptimal self-management behavior, obesity, chronic complications and mortality [(3)]. Diabetes and depression appear to be interactively associated with each other in terms of the pathogenesis. Specifically, risk of diabetes is higher in patients with depression due to inappropriate eating behavior (e.g., overeating) and a decrease in physical activity is often found in patients with depression [(4)]. Meanwhile, for patients with diabetes, anxiety about future diabetic serious complications and limitations of physical function that accompany such complications may contribute to the development of depression [(5)].

Screening for depression may provide an opportunity for identifying patients at risk of having more severe psychological symptoms and worse outcomes, particularly if these patients do not present with current symptoms [(6)]. Limited studies have indicated that depression is also associated with a variety of diabetic microvascular complications such as diabetic neuropathy, retinopathy and nephropathy [(7)].

This study aimed to assess presence and severity of depression and its relation to diabetic control and complications in type 2 diabetic patients at police authority hospital, Cairo, Egypt.

PATIENTS AND METHODS

This study is a cross-sectional descriptive study. The patients recruited from the Outpatient Clinics of the Police Authority Hospital, Nasr city, Cairo, Egypt in the period from June 2018 to April 2019. This study aimed to assess presence and severity of depression among patients with type 2 diabetes mellitus and its relation to diabetic control and complications. The recruited patients were assessed for the presence of depression with Hamilton depression rating scale then they were subdivided into two groups. Group A included 172 diabetic patients without depression and group B that included 150 diabetic patients with depression.

Ethical approval:

A written informed consent was obtained from all patients before being included in the study. The study was approved by the Institute Review Board (IRB) of Zagazig University.

All patients were subjected to complete history taking and full physical examination. Routine laboratory investigations were done including urinary albumin excretion (UAE) rate using albumin creatinine ratio (ACR) in a spot urine sample. Additional performed

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investigations were Twelve Lead Electrocardiograph and fundus examination. In addition, Michigan Neuropathy Screening Instrument (MNSI) was used for evaluation of distal peripheral neuropathy [8].

Statistical analysis

Data entered and analyzed using Microsoft Excel software. Data were then imported into Statistical Package for the Social Sciences (SPSS version 16.0) software for analysis. Baseline characteristics of the study population were presented as frequencies and percentages (%) or mean values and standard deviations (SD). According to the type of data, the following tests were used to test differences for significance: Paired t-test was used to compare between both groups. Correlation of numeric data was done by person's correlation (r). P values ≤ 0.05 are considered significant.

RESULTS

The study results showed that 172 of diabetic patients had no depression (53.4%), 114 patients had mild depression (35.4%), 25 patients had mnoderate depression (7.7%) and 11 patients had severe depression (3.4%) as shown in table (1).

Table (1): Depression frequency in the studied patients with diabetes

Hamilton significance	**Frequency**	**Percentage**
No depression	172	53.4 %
Mild	114	35.4 %
Moderate	25	7.7 %
Severe	11	3.4 %

In table (2), the comparison of the baseline characteristics between depressed and non-depressed diabetic patients did not reveal any statistical significant difference as regards the mean age, sex distribution, marital status, onset of type 2 DM, positive family history of diabetes, body mass index (BMI) and the waist/hip ratio.

Table (2): Demographic and anthropometric criteria of diabetic patients with and without depression.

		No depression (N=172)		**Depression (N=150)**		***P* value**
Age (years)		53.24 ± 6.65		53.83 ± 8.53		0.483
Gender	Male	107	62.2%	92	61.3%	0.872
	Female	65	37.8%	58	38.7%	
Marital status	Single	1	0.6 %	3	2%	0.292
	Married	140	81.4%	115	76.7 %	
	Divorced	28	16.3%	25	16.7%	
	Widowed	3	1.7%	7	4.7%	
Residence	Urban	156	90.7%	140	93.3%	0.387
	Rural	16	9.3%	10	6.7%	
Age of onset (years)		46.57 ± 6.47		46.86 ± 8.24		0.729
Family history of DM		132 (76.7%)		105 (70%)		0.171
BMI (kg/m^2)		25.44 ± 2.17		26.17 ± 2.19		0.303
Waist/hip ratio		1.03 ± 0.14		1.05 ± 0.15		0.291

Among all studied laboratory parameters, only serum cholesterol levels and TSH levels revealed statistically significant difference between the two groups (p= 0.013 and 0.046 respectively), FBG levels and 2 HPP glucose levels revealed high statistically significant difference between the two groups (p < 0.001 and < 0.001 respectively) as shown in table (3).

Table (3): Laboratory parameters of diabetic patients with and without depression

	No depression (N=172)	Depression (N=150)	*P* value
FBG (mg/dl)	151.36 ± 9.76	182.33 ± 6.686	< 0.001*
2HPP (mg/dl)	246.31 ± 5.87	276.50 ± 6.11	< 0.001*
HBA1C (%)	7.34 ± 0.64	8.17 ± 1.22	0.318
Urea (mg/dl)	44.34 ± 5.88	48.73 ± 2.43	0.178
Creatinine (mg/dl)	1.31 ± 0.072	1.41 ± 0.083	0.255
AST (U/L)	32.67 ± 6.68	31.68 ± 5.28	0.35
ALT (U/L)	32.72 ± 6.48	31.98 ± 6.26	0.484
ALB/Creatinine (µg/mg)	61.98 ± 11.53	77.63 ± 13.71	0.268
Cholesterol (mg/dl)	194.03 ± 46.48	206.86 ± 44.91	0.013
TGs (mg/dl)	169.52 ± 5.49	176.52 ± 5.42	0.242
LDL (mg/dl)	142.37 ± 37.84	149.47 ± 37.83	0.094
HDL (mg/dl)	42.54 ± 9.39	41.66 ± 10.73	0.433
TSH (uIU/ml)	3.30 ± 0.11	3.06 ± 0.985	0.046

*: significant (p< 0.05).

There was a statistically significant difference between the diabetic groups with and without depression in the self-monitoring pattern, diet regimen, medication used for diabetic control, adherence to medication and Michigan neuropathy scale (p < 0.001). No statistically significant difference was detected in the smoking and exercise, adherence to other medications and positive findings in ECG and fundus between the 2 studied groups (Table 4).

Table (4): Life style and complications among diabetic patients with and without depression

		No depression (N=172)		Depression (N=150)		*P* value value
Self-monitoring	Regular	106	61.60%	30	20%	<0.001*
	Not regular	66	38.40%	120	80%	
Diet regimen	Adherent	144	83.70%	84	56%	< 0.001*
	Not adherent	28	16.30%	66	44%	
Exercise	Regular	41	23.80%	31	20.70%	0.496
	Not regular	131	76.20%	119	79.30%	
Smoking	Smoker	95	55.20%	85	56.70%	0.796
	Non smoker	77	44.80%	65	43.30%	
Anti-diabetic drugs	Oral	146	84.90%	97	64.70%	< 0.001*
	Insulin	11	6.40%	19	12.70%	
	Both	15	8.90%	34	22.70%	
Other medications	None	68	39.50%	50	33.30%	0.784
	Lipid lowering	40	23.30%	40	26.70%	
	ACEI	13	7.60%	10	6.70%	
	both	28	16.30%	26	17.30%	
	Other	23	13.40%	24	16%	
Adherence	Adherent	155	90.10%	87	58%	< 0.001*
	Not adherent	17	9.90%	63	42%	
ECG	Positive	41	23.80%	44	29.30%	0.264
	Negative	131	76.20%	106	70.70%	
Fundus	Positive	81	47.10%	75	50%	0.603
	Negative	91	52.90%	75	50%	
Michigan neuropathy scale	Positive	18	10.50%	46	30.70%	< 0.001*
	Negative	154	89.50%	104	69.30%	

*: significant (p< 0.05). The four subgroups of patients subdivided by Hamilton depression severity score into no depression, mild, moderate and severe depression revealed no statistical significant difference for most of the parameters except for self-monitoring, diet regimen, antidiabetic drugs and adherence to medications that showed high statistically significance (p < 0.001, < 0.001, < 0.001 and < 0.001 respectively) as illustrated in the table (5).

Table (5): Severity of depression in relation to lifestyle parameters

		No depression	Mild	Moderate	Severe	*P* value
Self-Monitoring	Regular	107	27	2	0	<0.001*
	Not regular	66	86	23	11	
Diet regimen	Adherent	145	72	9	2	<0.001*
	Not adherent	28	41	16	9	
Exercise	Regular	42	20	9	1	0.135
	Not regular	131	93	16	10	
Smoking	Smoker	95	63	17	5	0.567
	Non-smoker	78	50	8	6	
Medications	Oral	147	76	15	5	<0.001*
	Insulin	11	18	1	0	
	Both	15	19	9	6	
Adherence to medication	Adherent	156	72	11	3	<0.001*
	Not adherent	17	41	14	8	

*: significant (p< 0.05).

The four subgroups of patients subdivided by Hamilton depression severity score into no depression, mild, moderate and severe depression revealed high statistical significant difference for HBA1c levels and Michagin neuropathy score (p < 0.001 and < 0.001 respectively) (Table 6).

Table (6): Severity of depression in relation to diabetic complications

		No depression	Mild	Moderate	Severe	Significance
ECG	positive	41	34	7	3	0.690
	negative	132	79	18	8	
Fundus	positive	82	57	12	5	0.961
	negative	91	56	13	6	
HbA1c (%)	mean	7.34	7.86	8.88	9.82	< 0.001*
	SD	0.642	.742	1.563	2.228	
A/C ratio (µg/mg)	mean	61.82	91.77	26.96	51.55	0.065
	SD	117.216	152.78	19.240	49.498	
Michagin neuropathy	mean	0.54	1.10	2.20	2.27	< 0.001*
	SD	1.092	1.476	2.102	1.794	

*: significant (p< 0.05).

Table (7) showed no statistical significant correlation except for waist to hip circumference, serum cholesterol level, TGs and LDL that showed positive correlation with Hamilton depression score (0.047, 0.004, 0.042, and 0.042 respectively). While BMI, FBS, 2h PP, HBA1c and Michagin neuropathy scale showed positive correlation with high significance with Hamilton depression score (p < 0.001, p < 0.001, p < 0.001, p < 0.001 and p < 0.001 respectively).

Table (7): Correlation between depression and different variables

	r	*P* value
Age (years)	-0.026	0.638
Age of onset (years)	-0.035	0.53
BMI (kg/m^2)	0.226	< 0.001**
Waist to hip ratio	0.111	0.047*
FBS (mg/dl)	0.341	< 0.001**
2hpp (mg/dl)	0.326	< 0.001**
HBA1C (%)	0.548	< 0.001**
Creat (mg/dl)	0.016	0.782
UREA (mg/dl)	0.001	0.98
AST (U/L)	-0.024	0.668
ALT (U/L)	-0.047	0.405
CHOLEST (mg/dl)	0.162	0.004*
TG (mg/dl)	0.114	0.042*
LDL (mg/dl)	0.113	0.042*
HDL (mg/dl)	-0.015	0.787
ALB/CREAT (µg/mg)	-0.016	0.772
Michagin	0.442	< 0.001**

With using univariate analysis of risk factors associated with depression, BMI, irregular self-monitoring and lack of adherence to medication, uncontrolled FBG, TSH level and the presence of retinopathy were shown to be risk factors for depression. After using multivariate analysis, all these factors were shown to be independent risk factors for depression except for serum TSH (Table 8).

Table (8): Factors associated with prevalence of depression (logistic depression analysis)

Variables	**Univariate analysis**	**Multivariate analysis**		
		B	**95% CI**	***P* value**
Age	0.482			
Gender	0.872			
Marital status	0.109			
Residence	0.606			
BMI	0.011*	1.176	1.036 – 1.336	0.012*
Waist to hip ratio	0.322			
Age of onset	0.418			
Family history	0.407			
Self-monitoring	< 0.001*	0.174	0.099 – 0.303	<0.001*
Diet regimen	0.110			
Exercise	0.748			
Smoking	0.239			
Anti-diabetic drugs	0.087			
Other Medication	0.355			
Adherence to medication	0.001*	0.246	0.123 – 0.492	<0.001*
FBS (mg/dl)	0.012*	1.009	1.003 – 1.015	0.002*
2hpp (mg/dl)	0.485			
Urea (mg/dl)	0.372			
Creatinine (mg/dl)	0.536			
AST (U/L)	0.489			
ALT (U/L)	0.813			
ALBCREAT (µg/mg)	0.931			
CHOLEST (mg/dl)	0.088			
TG (mg/dl)	0.989			
LDL (mg/dl)	0.320			
HDL (mg/dl)	0.487			
TSH (uIU/ml)	0.036*	0.865	0.673 – 1.109	0.250
ECG	0.767			
FUNDUS	0.030*	2.217	1.257 – 3.910	0.006*
Michagin	0.115			

*: significant (p< 0.05)

DISCUSSION

The relationship between diabetes and depression appears to be bidirectional. Diabetes and its complications lead to increased prevalence of depressive symptoms and depression leads to an increased risk of diabetes [10]. Structural, functional and neurochemical changes in the brain may increase the risk of depression in people with diabetes [11]. Hyperglycemia can contribute towards low mood through reducing hippocampal integrity, neurogenesis and neuroplasticity leading to hippocampal atrophy [12].

For patients, an awareness of their diagnosis, along with its associated complications, and the burden of treatment may lead them to feel helpless, which may result in depression [13].

In this study, there were no statistically significant difference between diabetic patients without depression (group A) and those with diabetes and depression (group B) as regards mean age, sex distribution and marital status (p = 0.483, 0.872 and 0.292 respectively). Alshehri and his colleagues agree with the results of this study as they reported no statistically significant difference between the two groups with and without depression regarding age and sex [14]. While, this come in contrast to a study done in Kolkata (India) by **Paul *et al.*** [15] who found the depressed diabetic subjects were significantly older. **Abuhegzy *et al.*** [16] revealed statistically significant difference in the group with and without depression regarding sex (higher prevalence among females) (p = 0.005). Moreover, the results of **Joseph and his colleagues** [17] reported significant difference between the group with and without depression regarding age and sex distribution with more females in the group with depression.

It is known that major depression occurs twice as frequently in women than in men and seems to be influenced by estrogen levels and the social role attributed to women (passivity, dependence and emotional expression), which possibly allows them to be more emotional and extroversive [18]. The absence of this difference in our study can be explained by the fact that the number of females in our study was relatively less than the males (one third of the sample). another explanation may be that most of the females were housewives not subjected to much stressors at work.

Also in the current study, there was no statistically significant difference between the two groups concerning BMI and the waist/hip ratio (p= 0.303 and 0.291 respectively). This come in agreement with **Abuhegazy and his colleagues** [16] who showed no statistically significant difference in age and BMI within the cases with depression compared to patients without depression. That can be explained by the fact that the majority of our patients were none obese. Although, in another study, patients who were overweight were found to be significantly more depressed than patients of normal weight or underweight [17]. A number of other studies also found statistically significant association between obesity (BMI ≥ 30 kg/m2) and depression among T2DM patients [19-21].

In this study, serum blood glucose levels and 2-hour postprandial glucose levels were different with high level of significance between the two groups (p < 0.001). This come in agreement with another study where the fasting blood glucose levels in the depression group was significantly higher than in the cases without depression (p = 0.007) [22]**.** This may be explained by lack of interest (anhedonia) in controlling blood glucose levels, not regularly measuring blood glucose levels, skipping some medications doses and redundant lifestyle including neglecting exercise and dietary regimen among depressed group.

Although the values of HBA1c were not statistically different between the two main groups (p= 0.318). Further analysis of the four subgroups (no depression , mild , moderate and severe depression) revealed that there was statistically significant difference between the four groups with the higher HBA1c value associated with higher depression severity (p < 0.001). **Ismail and colleagues** [22] reported no statistically significant difference in the level of HBA1c between cases with and without depression at the beginning of their study. However, in the same study, after six months of follow up the mean level of HBA1c was significantly higher in the group with depression.

The majority of our patient were on oral anti-diabetic drugs. The percentage of insulin users (insulin with or without oral hypoglycemic drugs) was significantly higher (35.4%) in diabetic with depression than in diabetic without depression (15.3%) (P < 0.001). This finding is in line with several studies conducted on diabetic patients receiving treatment in the form of insulin injections where they were more depressed than other treatment groups [17]. Another study showed that patients on insulin therapy were almost twice as likely to have mild to moderate depression compared to patients who were on other therapies [23]. In addition, Bahrain, Jordanian and US-based studies reported insulin users to be more likely to develop severe depression than users of oral anti-diabetic agents [24-26]. On the other hand , the Chandigarh-based study reported no significant association of depression with insulin use among patients [20]. This could be because patients are finding insulin as the most burdensome treatment and the pain of injection compared to oral treatment [27].

In our study, the mean Hamilton depression score of the cases was 8.21 ± 4.43 with range between 1 and 22. According to Hamilton significance score, 172 cases had no depression (53.4%), 114 cases with mild depression (35.4%), 25 cases with moderate depression (7.7%) and 11 cases with severe depression (3.4%). Similar results are shown in another study where the severity of depression was assessed. About

13% of the studied participants had moderate depression, 7.07% had moderately severe depression and less than 1% had severe depression [14]. A meta-analysis of 16 studies that examined the risk of depression in those with diabetes showed that both relative risk (RR) and hazard ratio (HR) were significant at 1.27 and 1.23 (1.08 to 1.40) [28]. Conversely, depression increases the relative risk of diabetes by 65%. In a prospective study of 4,803 adults aged 55 years or older, the incidence rate of diabetes was higher among depressed subjects (19.70 per 1,000 person-years) relative to non-depressed subjects (12.36 per 1,000 person-years). An increased risk of diabetes mellitus was also associated with characteristics such as non-severe and untreated depression [29].

The current study showed that cholesterol levels were higher among diabetic patients with depression in comparison with the non-depressed group with statistically significant difference between the two groups. This finding come in agreement with other studies that reported higher lipid levels especially LDL and TG to be associated with the risk of depression [30]. On the other hand, many studies reported that lower cholesterol levels were associated with depression [31]. The presence of higher cholesterol level as predictors of depression in the present study might be due to the higher numbers of overweight patients in the studied depressed diabetic group (BMI= 26.17 ± 2.19 & WHR 1.05 ± 0.15 cm). Overweight individuals are more likely to have higher lipid levels [32].

In this study, with using univariate analysis of risk factors associated with depression all of BMI, FBG, TSH, positive fundus examination, irregular self-monitoring and lack of adherence to medication were shown to be risk factors for depression. After using multivariate analysis, all these factors were shown to be independent risk factors for depression except serum TSH. In another study conducted by **Alshehri *et al.*** [14], they revealed that only the number of associated comorbidities is the independent risk factor for depression among the cases included in their study [14]. Depression was found to be significantly associated with female gender, residing in rural areas, lower monthly income, the presence of complication and/or comorbidities, and unemployment among others [33].

Diabetes self-care was measured in the current study by assessment of adherence to diet regimen, exercise, adherence to medication and blood glucose self-monitoring. It was noticed that there were statistically significant differences between the two studied groups as the depressed group showed poorer diabetes self-care. The finding of this study is in agreement with the available studies which reported non satisfactory diabetes self-care practices [34]. This could be explained by that depression leads to problems such as apathy, hopelessness, fatigue, memory problems and loss of confidence in performing daily activities, which are all required in managing a chronic disease like diabetes [35].

CONCLUSION

This study revealed that depression affects controlling of blood glucose levels among diabetics. Diabetes self-care domains (regular self-monitoring, adherence to diet and adherence to medications) are affected by depression, which plays an important role in diabetes control and complications. Microvascular complications in the form of retinopathy and neuropathy have a positive correlation with the severity of depression among diabetics. Depression is a risk factor for diabetic microvascular complications.

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