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Original Research Article

Impact of Glycemic Control on Depression among Type 2 Diabetic Patients

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ABSTRACT

Background: Type 2 diabetes mellitus (T2DM) have demonstrated rates of psychological distress, particularly depression tend to be higher than the general population, but are usually comparable to those reported in individuals with other chronic diseases.

Objectives: To investigate the prevalence and determinants, particularly the glycemic control, of depression in patients with T2DM attending family medicine and diabetic clinics in Makkah MOH hospitals and primary care centers.

Subjects and Methods: A cross-sectional study was conducted among adult diabetic type 2 patients (aged over 18 years) attending Family Medicine and Diabetic clinics, Ministry of health hospitals and primary care centers in Makkah Al-Mukarramah, KSA. Two general hospitals and 4 primary health care centers were randomly selected to be involved in the study by a simple random technique. Data were collected using a questionnaire composed of three main parts. The first part includes patient`s demographics, the second part composed of diabetes-related variables: insulin treatment, compliance with therapy, presence of complications. In addition to data collected from patient`s file. The third part included the Arabic version of the Depression Anxiety Stress Scale (DASS).

Results: The study included 352 patients out of a targeted 380 with a response rate of 92.6%. Their age ranged between 19 and 81 years with a mean±SD of 48.3±14.4 years. Almost two-thirds of them (64.2%) were females. Prevalence of depression among type 2 diabetic patients was 64.2%; it was severe and extremely severe among 11.4% and 15.1% of them, respectively. Multivariate logistic regression analysis revealed that patients aged over 60 years were more likely to be depressed as compared to those aged 19-30 years (Adjusted OR=3.57, 95% CI=1.36-9.38, p=0.010). Patients with borderline fasting blood glucose level were at almost double fold risk for depression compared to those with good fasting blood glucose level (Adjusted OR=2.09, 95% CI=1.19-3.66, p=0.010). Compared to patients who reported perfect compliance with DM therapy, those who never compliant with DM therapy were at three-folded risk to develop depression (Adjusted OR=3.21, 95% CI=1.36-4.07, p=0.042). Female diabetic patients were more likely to have depression compared to male patients (Adjusted OR=2.55, 95% CI=1.56-4.18, p<0.001). Glycosylated hemoglobin was not significant and removed from the final model.

Conclusion: Almost two-thirds of type 2 diabetic patients were depressed. According to glycated hemoglobin, diabetes was poorly or very poorly controlled among almost one-quarter of patients. However, glycemic control was not significantly associated with depression.

Keywords: Depression, Glycated hemoglobin, Fasting blood glucose, DASS.

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INTRODUCTION

Diabetes is a chronic disease which affects almost every organ in the human system. The World Health Organization reported that 300 million people will suffer from diabetes by 2025.[1] In the Kingdom of Saudi Arabia; the number of people with diabetes is increasing due to population growth, aging, urbanization, and increasing prevalence of obesity and physical inactivity. The overall prevalence of diabetes was 23.7%, with 26.2% being males and 21.5% females. The calculated age- adjusted prevalence for Saudi population for the year 2000 was 21.9%. Diabetes mellitus is more prevalent among Saudis living in urban areas 25.5% compared to rural areas as 19.5%.[2]

Diabetes is a major contributor to the global burden of disease and a growing number of studies show links between depression and diabetes.[3–6] The rate of depression in people with diabetes is much higher than in the general population.[7] A meta-analysis including 20 controlled studies found that the risk of depression in

the diabetic groups was two-fold higher than that in the non-diabetic comparison groups.[8] This relative risk of depression is greater than found in most other chronic diseases.[9] The risk of depression increases in women with diabetes.[9] The prevalence of depression is higher in patients with diabetes who have long-term complications.[10,11]

Given the high prevalence of depression in patients with DM2, and the fact that these psychological problems are often overlooked and undertreated, while effective treatments are available, current guidelines recommend screening for depression.[12] Bogner et al.[13] has shown that the all-cause mortality risk decreased when treating depression in primary care patients with diabetes mellitus.

Cross-sectional studies of adults with T2DM have demonstrated repeatedly that rates of psychological distress, particularly depression tend to be higher than the general population, but are usually comparable to those reported in individuals with other chronic diseases.[14]

This study aimed to investigate the prevalence and determinants, particularly the glycemic control, of depression in patients with T2DM attending family medicine and diabetic clinics in Makkah MOH hospitals and primary care cenetrs.

SUBJECTS AND METHODS

A cross-sectional study was conducted among adult diabetic type 2 patients (aged over 18 years) attending Family Medicine and Diabetic clinics, Ministry of health hospitals and primary care centers in Makkah Al-Mukarramah, KSA. It is the holy capital of Kingdom of Saudi Arabia, located in western area. Makkah Al-Mukarramah is a modern city. Health services in Makkah Al-Mukarramah are provided via 85 primary health care (PHC) centers, 2 specialized hospitals, 4 general hospitals and one security forces hospital.

The sample size was calculated by Raosoft online sample size calculator using the criteria of; number of registered diabetic type 2 patients: 34920, expected frequency of depression: 50%, accepted margin of error: 5%, confidence level: 95%; consequently the estimated sample size was 380 diabetic patients.

Two general hospitals and 4 primary health care centers were randomly selected to be involved in the study by a simple random technique. The sample was distributed over the selected hospitals and PHC centers proportional to the number of registered diabetic patients. Within each hospital/center, 10 patients were randomly selected every working day by systematic random sampling technique according to the number of patients visited each hospital/center daily. Thus, approximately two weeks were required to complete data collection.

Data were collected using a questionnaire composed of three main parts. The first part includes patient`s demographics (Age, sex, employment, marital status, marital status, number of children, presence of co-morbidity (e.g., hypertension, heart disease, bronchial asthma, renal disease, etc.). the second part composed of diabetes-related variables: insulin treatment, compliance with therapy, presence of complications. In addition to data collected from patient`s file (number of follow-up visits over the last year, last fasting blood glucose level, last HBA1c, weight and height). Fasting blood sugar levels (mg/dL) were assessed for diabetic patients. The level of control of diabetes as indicated by fasting blood sugar control was determined according to Campbell and Braithwaite,[15] follows: Good (<126 mg/dl) borderline (126-180 mg/dl) and poor (>180 mg/dl). Glycosylated hemoglobin (HBA1c) levels above 9% was considered as poor control, and levels above 12% was considered as very poor control.[16] Body mass index (BMI) was calculated by dividing the weight in kg by the square of the length in meter. Participants were categorized, based on their BMI values into four subgroups; normal (BMI from 18.5 to 24.9 kg/m^2), overweight (BMI from 25 to 29.9 kg/m^2), Obese (BMI from 30 to 39.9 kg/m2), and extremely obese (BMI ≥ 40 kg/m^2). The third part included the Arabic version of the Depression Anxiety Stress Scale (DASS). The DASS-42 is using for data collection to assess the negative emotional symptoms among students. It is a 42-item self-report inventory designed to measure the presence and severity of symptoms of depression, anxiety and stress among people as young as 18.[17] This scale was psychometrically validated to the Arabic culture by Taouk et al.[18] This screening and outcome measure reflects the experience of the person over the previous 7 days. Each of the three scales contains 14 items. In this manuscript, scores of depression were calculated by summing the scores of the relevant items; 3, 5, 10, 13, 16, 17, 21, 24, 26, 31, 34, 37, 38, and 42. Table 1 shows the scoring and grading of the DASS for depression.

Scoring and grading of the Depression Scale (DASS)[17]

Category	Depression
Normal	0-9
Mild	10-13
Moderate	14 – 20
Severe	21 – 27
Extremely Severe	28+

Data were collected by a self-administered questionnaire while patients waiting for their appointment. Trained data collector helped in collection of data from illiterate patients.

Approvals from the local Research and Ethics committee and directors of the involved hospitals and primary health care centers were requested before collection of data. Informed consent was asked from all patients.

The data were collected and verified by hand then coded before computerized data entry. The statistical Package for Social Sciences (SPSS) software version 22.0 was used for data entry and analysis. Descriptive statistics (e.g. number, percentage, mean, range, standard deviation) and analytic statistics using chi-square "χ^2" was applied. Multivariate logistic regression analysis was performed to identify predictor of depression among patients after controlling for confounders. The results were expressed as adjusted odds ratio and 95% confidence intervals. P-values less than 0.05 were considered as statistically significant.

RESULTS

The study included 352 patients out of a targeted 380 with a response rate of 92.6%. Their age ranged between 19 and 81 years with a mean±SD of 48.3±14.4 years.

Table 1 summarized their demographic and baseline characteristics. And Almost two-thirds of them (64.2%) were females and married (63.4%). Slightly more than one third of them (35.8%) were house wives or not working whereas 24.1% were governmental employees. Co-morbid diseases with diabetes were

reported among 48% of the type 2 diabetic patients. Slightly less than half of them (46%) used four or more drugs on daily basis. Nearly half of them (49.4%) used insulin. About two-thirds of them (63.1%) claimed that they perfectly compliant with diabetes therapy.

Diabetic complications were reported in 28.4% of the participants. Number of follow-up visits per year ranged between 4 and 6 among almost half of the patients (51.7%) whereas they were three or less among 23.6% of them. Last fasting blood glucose level and glycosylated hemoglobin were poor among 28.2% and 24.3% of the patients, respectively. More than one third of the (37.2%) were obese and 4.8% were extremely obese. Prevalence of depression among type 2 diabetic patients was 64.2%; it was severe and extremely severe among 11.4% and 15.1% of them, respectively as illustrated in figure 1.

Among studied factors associated with depression among type 2 diabetic patients, age, gender, compliance with diabetic therapy and last blood glucose level were significant. Patents aged over 60 years were more likely to be depressed compared to those aged between 19 and 30 years (79.3% versus 54.9%). The difference was statistically significant, p=0.007. Female patients expressed depression more significantly than male patients (70.8% versus 52.4%, p=0.001). Divorced women were more likely to be depressed compared to single (80.6% versus 57.1%). However, the difference did not reach a statistically significant level.

Table 1: Demographic and baseline characteristics of the participants (n=352)

Variables	Categories	Frequency	Percentage
Age (years)	**19-30**	51	14.5
	31-40	47	13.4
	41-50	94	26.6
	51-60	102	29.0
	>60	58	16.5
Gender	**Male**	126	35.8
	Female	226	64.2
Marital status	**Single**	49	13.9
	Married	223	63.4
	Divorced	31	8.8
	Widowed	49	13.9
Employment status	**Governmental**	85	24.1
	Private	37	10.5
	Business	19	5.4
	House wife/not working	126	35.8
	Retired	62	17.6
	Others	23	6.5
Co-morbid diseases	**Yes**	169	48.0
	No	183	52.0
Number of daily drugs taken	**One**	55	15.6
	Two	64	18.2
	Thee	71	20.2
	≥Four	162	46.0
Insulin use	**Yes**	174	49.4
	No	178	50.6
Compliance with DM therapy	**Yes, perfect**	222	63.1
	Yes, to some extent	114	32.4
	Never	16	4.5
Diabetic complications	**Yes**	100	28.4
	No	252	71.6
Number of follow-up/year	**≤3**	83	23.6
	4-6	182	51.7
	>6	87	24.7
Last fasting blood glucose	**Good**	114	32.5
	Borderline	138	39.3
	Poor	99	28.2
Last HBA1c	**Controlled**	253	73.1
	Poor	84	24.3
	Very poor	9	2.6
BMI	**Underweight**	6	1.7
	Normal	81	23.0
	Overweight	117	33.3
	Obese	131	37.2
	Extremely obese	17	4.8

Table 2: Factors associated with depression among type 2 diabetic patients: Bivariate analysis

	Depression		p-value*
	No N=126	Yes N=226	
Age (years)			
19-30 (n=51)	23 (45.1)	28 (54.9)	
31-40 (n=47)	20 (42.6)	27 (57.4)	
41-50 (n=94)	35 (37.2)	59 (62.8)	
51-60 (n=102)	36 (35.3)	66 (64.7)	
>60 (n=58)	12 (20.7)	46 (79.3)	0.007
Gender			
Male (n=126)	60 (47.6)	66 (52.4)	
Female (n=226)	66 (29.2)	160 (70.8)	0.001
Marital status			
Single (n=49)	21 (42.9)	28 (57.1)	
Married (n=223)	85 (38.1)	138 (61.9)	
Divorced (n=31)	6 (19.4)	25 (80.6)	
Widowed (n=49)	14 (28.6)	35 (71.4)	0.096
Employment status			
Governmental (n=85)	33 (38.8)	52 (61.2)	
Private (n=37)	19 (51.4)	18 (48.6)	
Business (n=19)	7 (36.8)	12 (63.2)	
House wife/not working (n=126)	34 (27.0)	92 (73.0)	
Retired (n=62)	24 (38.6)	38 (61.3)	
Others (n=23)	9 (39.1)	14 (60.9)	0.116
Co-morbid diseases			
Yes (n=169)	57 (33.7)	112 (66.3)	
No (n=183)	69 (37.7)	114 (62.3)	0.437
Number of daily drugs taken			
One (n=55)	23 (41.8)	32 (58.2)	
Two (n=64)	24 (37.5)	40 (62.5)	
Thee (n=71)	28 (39.4)	43 (60.6)	
≥Four (n=162)	51 (31.5)	111 (68.5)	0.445
Insulin use			
Yes (n=174)	60 (34.5)	114 (65.5)	
No (n=178)	66 (37.1)	112 (62.9)	0.612
Compliance with DM therapy			
Yes, perfect (n=222)	96 (43.2)	126 (56.8)	
Yes, to some extent (n=144)	25 (21.9)	89 (78.1)	
Never (n=16)	5 (31.3)	11 (68.8)	0.001
Diabetic complications			
Yes (n=100)	28 (28.0)	72 (72.0)	
No (n=252)	98 (38.9)	154 (61.1)	0.055
Number of follow-up/year			
≤3 (n=83)	26 (31.3)	57 (68.7)	
4-6 (n=182)	70 (38.5)	112 (61.5)	
>6 (n=87)	30 (34.5)	57 (65.5)	0.509
Last fasting blood glucose			
Good (n=114)	54 (47.4)	60 (52.6)	
Borderline (n=138)	40 (29.0)	98 (71.0)	
Poor (n=99)	32 (32.3)	67 (67.7)	0.007
Last HBA1c			
Controlled (n=253)	90 (35.6)	163 (64.4)	
Poor (n=84)	32 (38.1)	52 (61.9)	
Very poor (n=9)	2 (22.2)	7 (77.8)	0.631
BMI			
Underweight (n=6)	5 (83.3)	1 (16.7)	
Normal (n=81)	26 (32.1)	55 (67.9)	
Overweight (n=117)	48 (41.0)	69 (59.0)	
Obese (n=131)	43 (32.8)	88 (67.2)	
Extremely obese (n=17)	4 (23.5)	13 (76.5)	0.052

* Chi-square test

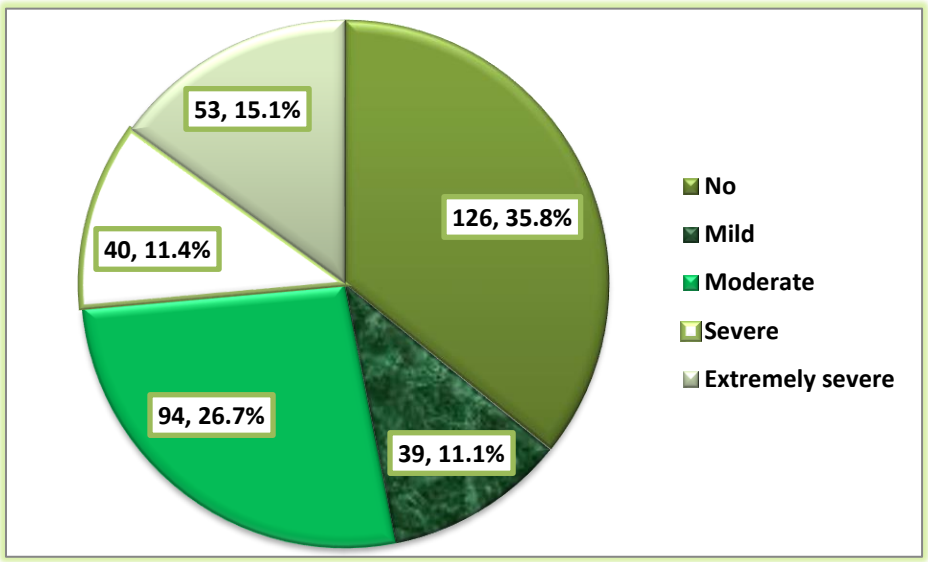

Fig 1: Prevalence and severity of depression among type 2 diabetic patients, Makkah

Patients who compliant with diabetic therapy to some extent were more likely to be depressed opposed to those perfectly compliant with diabetic therapy (78.1% versus 56.8%), p=0.001. Diabetic patients presented with complications had higher rate of depression compared to those without complications (72% versus 61.1%). However the difference was not statistically significant, p=0.055.

Patients with borderline fasting blood glucose level and those with poor level were more likely to develop depression compared to those with good levels (71% and 67.7% versus 52.6%, respectively. This was statistically significant, p=0.007. Patients with very poor glycemic control tended to be more depressed than thos e with good glycemic control (77.8% versus 64.4%). However, the difference was not statistically significant. Regarding body mass index, extremely obese subjected reported the highest rate of depression (76.5%) whereas underweight subjects reported the lowest rate (16.7%). However, the difference did not reach the statistically significant level, p=0.052.

Table 3 presents the results of multivariate logistic regression analysis. Patients aged over 60 years were more likely to be depressed as compared to those aged 19-30 years (Adjusted OR=3.57, 95% CI=1.36-9.38, p=0.010).

Patients with borderline fasting blood glucose level were at almost double fold risk for depression compared to those with good fasting blood glucose level (Adjusted OR=2.09, 95% CI=1.19-3.66, p=0.010). Compared to patients who reported perfect compliance with DM therapy, those who never compliant with DM therapy were at three-folded risk to develop depression (Adjusted OR=3.21, 95% CI=1.36-4.07, p=0.042).

Female diabetic patients were more likely to have depression compared to male patients (Adjusted OR=2.55, 95% CI=1.56-4.18, p<0.001). Glycosylated hemoglobin, body mass index, and diabetic complications were not significant and removed from the final model.

Table 3: Predictors of depression among type 2 diabetic patients, Makkah: Multivariate logistic regression analysis

	B	SE	p-value	OR (95% CI_
Age (years)				
19-30 (n=51)[a]	1.0	1.0		
31-40 (n=47)	0.066	0.448	0.884	1.07 (0.44-2.57)
41-50 (n=94)	0.354	0.387	0.360	1.43 (0.67-3.04)
51-60 (n=102)	0.450	0.385	0.243	1.57 (0.74-3.34)
>60 (n=58)	1.274	0.492	0.010	3.57 (1.36-9.38)
Last fasting blood glucose				
Good (n=114) [a]	1.0	1.0		
Borderline (n=138)	0.736	0.287	0.010	2.09 (1.19-3.66)
Poor (n=99)	1.173	0.329	0.600	1.19 (0.62-2.27)
Compliance with DM therapy				
Yes, perfect (n=222) [a]	1.0	1.0		
Yes, to some extent (n=144)	-0.774	0.592	0.191	1.46 (0.14-1.47)
Never (n=16)	0.188	0.620	0.042	3.21 (1.36-4.07)
Gender				
Male (n=126)[a]	1.0	1.0		
Female (n=226)	0.936	0.252	<0.001	2.55 (1.56-4.18)

[a] Reference category B: Slope SE: Standard error
OR: Odds ratio CI: Confidence interval
Terms of Glycosylated hemoglobin, body mass index, and diabetic complications were not significant and removed from the final model.

DISCUSSION

It has been previously documented that co-existence of depression with diabetes is associated with adverse diabetes outcomes.[19] Therefore, this study was conducted to explore the possible association between depression and type 2 diabetes and its determinants in Makkah, Saudi Arabia.

The overall prevalence of depression, regardless its severity among type 2 diabetic patients in the present study was 64.2%, it was severe and extremely severe among 11.4% and 15.1% of them, respectively. In another study carried out in Makkah (2010), the prevalence was 41.9%.[20] In Riyadh, AL-Baik et al (2013) reported a prevalence of 45.8%.[(21)] In the Qatif area, a prevalence of 14.5% for depression among diabetic has been reported.[22] In Jeddah (2005), it was 48%.[23]

Worldwide, In Iran 2007 Khamseh et al reported a major depression prevalence of 71.8% among patients with diabetes (both types; type 1 and type 2).[24] In North India, Raval et al (2010) reported a prevalence of 41% of clinically significant depression.[25]

This difference in prevalence rates of depression among diabetic patients between different studies either local or worldwide could be attributed to the fact that some studies included only major depression according to Diagnostic and Statistical Manual of Mental Disorders, IV (DSM VI) criteria while others, like the present study included depression as one category, in addition to different tools used for diagnosis of depression as well as different patients` background criteria.

In the present study and in agreement with other studies conducted in Saudi Arabia[20,23] as well as outside Saudi Arabia[25-27] a higher prevalence of depression among older patients (>60 years) was observed. In addition, this finding remained controlling for confounding effect in multivariate regression analysis. This finding could be explained by the fact that aging is accompanied by longer duration of the disease and the increasing possibility of diabetes complications.[28] Contrary to the current finding, higher prevalence of depression was reported among younger population as a result of more stress, conflicts and irritability.[29]

Female patients were at almost 2.5-folds risk for developing depression compared to male patients in the present study. Similar results have been observed in other studies.[3, 10, 26, 30-32] However, others did not find an association between gender and depression among diabetics.[33]

In the current research work, presence of diabetic complications, although not significant was associated with a higher rate of depression. Earlier studies reported an association between development of diabetic complications and depression.[20,24,28,34] Moreover, it has been reported that having more than two diabetic complications increased odds ratio of having depression by almost three times.[35] Additionally, Lustman et al[36] reported that longer depression period increased the risk of developing diabetic retinopathy as a result of long periods of poor glycaemic control. Also, in a meta-analysis published by De Groot et al,[8] a significant association between diabetic complications (retinopathy, neuropathy, nephropathy, sexual dysfunction and macrovascular complications) and depression was confirmed.

As expected, partial or noncompliance with diabetic therapy was significantly associated with depression in the present study even after controlling for confounders. The same has been reported by others.[20,23,37]

Uncontrolled diabetes, as indicated by levels of fasting blood sugar was significantly associated with depression even in multivariate analysis. However, glycosylated haemoglobin percentage was not significantly associated with depression although the rate of depression was higher among poorly controlled patients. Other studies reported that uncontrolled diabetes would increase the risk of having depression.[28,37,38] However other studies[8,36] in agreement with the present study did not observe significant differences in average HbA1C by depression status.

Almost two-thirds of type 2 diabetic patients attended Family Medicine and Diabetic clinics, Ministry of health hospitals and primary care centers in Makkah Al-Mukarramah, KSA were depressed. According to glycated hemoglobin, diabetes was poorly or very poorly controlled among almost one-quarter of patients. Older, female patients, patients who reported partial or no compliance with therapy and patients with borderline fasting blood glucose level were more prone to develop depression compared to their counterparts.

Important imitations to the present study included the cross-sectional nature of the study design which doesn't permit causation, as well as the use of self-report questionnaires, as literature documented that rate of depression is higher in self-report questionnaires than psychiatric interview.[3]

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