

Diabetes and depression in Lebanon and association with glycemic control: a cross-sectional study

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Background: Diabetes mellitus is a chronic noncommunicable disease characterized by hyperglycemia and is associated with chronic complications affecting the overall quality of life. As of 2017, the prevalence of diabetes in Lebanon is estimated to be 14.6%. Depression is noted to be common among Lebanese citizens, present in around 17.3%. This study aims to investigate the prevalence of depression among the diabetic Lebanese citizens and to study its relationship with poor glycemic control and diabetes complications.

Methods: In total, 436 diabetic patients participated in this cross-sectional study. Patients with diabetes mellitus attending several private clinics and health care centers were asked to fill out a well-structured questionnaire developed by an expert. Depression was assessed using Beck Depression Inventory (BDI). The study collected demographic information about the participants including their lifestyles, their last reported glycosylated hemoglobin values, and their reported microvascular and macrovascular complications. Data were collected, entered, and analyzed on SPSS software version 23.1. A descriptive analysis is carried out by calculating the mean and standard deviation for continuous variables and number and percentage for categorical ones. Association between categorical variables is evaluated using a chi-squared test. A *P*-value of <0.05 is considered to be significant.

Results: Depression was prevalent among 28.8% of the patients with diabetes mellitus. The average age of participants was 64.08 years. In total, 280 (64.2%) of the participants were females and the average diabetes duration was 8.89 years. There was no significant relationship found between depression and glycemic control. By contrast, a significant association between retinopathy, nephropathy, and stroke and depression was found.

Conclusion: Depression was found to be present among 28.8% of the patients with diabetes mellitus in Lebanon; however, no association was established between depression and glycemic control.

Keywords: glycemic control, quality of life, complications, glycosylated hemoglobin, diabetes, depression

Plain language summary

Diabetes mellitus, being highly prevalent, is characterized by high levels of blood sugar and is often associated with long-term complications affecting the retina of the eye, the nerves, and the kidneys, and may lead to higher risk of cardiac diseases or strokes. Depression is a mental illness which leads to symptoms such as low mood, not getting any pleasure from doing daily activities, and having weight and sleep changes, in addition to other symptoms. This study tries to find if an association exists between diabetes mellitus and depression and between diabetes control and depression. Participants with diabetes mellitus were asked to fill a survey and information was obtained about their age, gender, diabetes duration, diabetes

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control, and whether they got any complications associated with diabetes mellitus. In addition, a well-validated scale was used to assess whether they got depression or not and the severity of their depression. It was found that 29% of patients with diabetes mellitus in our study had depression. No association was found between diabetes control and depression; however, an association was found between certain complications associated with diabetes and depression.

Introduction

Diabetes mellitus (DM) is a chronic debilitating disease that affects a huge number of people, disturbing their quality of life.¹ It is a widespread disease; the International Diabetes Federation (IDF) estimated that 425 million people were diagnosed with DM in 2017. This number is expected to increase up to 629 million by 2045 with the majority of cases occurring in low- and middle-income countries.² It was found that from the 425 million patients worldwide, an average of 38.7 million resided in the Middle East and North Africa,³ with an average of 585,400 living in Lebanon.⁴ The increase in prevalence of DM in the Arab world can be a result of many factors including obesity, sedentary life style, and genetic predisposition.⁵

DM causes microvascular complications such as diabetic nephropathy, retinopathy, and neuropathy and macrovascular complications such as coronary artery disease, stroke, and peripheral artery disease.⁶ These complications may lead to psychological disturbances, including depression.⁷ A meta-analysis done among 42 published studies that included 21,351 adults found that the prevalence of major depression and clinically relevant depression in diabetic patients was 11% and 31%, respectively.⁸ According to American Psychiatric Association, depression is a serious medical illness that negatively affects how a person feels, thinks, and acts.⁹ In Lebanon, the prevalence of depression was estimated to be 17.3% among its population.¹⁰

Glycemic control is usually monitored using glycosylated hemoglobin (HbA1c) level, which is considered the most reliable test to follow the disease's progression, assess the patient's response to treatment, and monitor the patient's glycemic control in the past 2–3 months.^{11,12} The American Diabetes Association (ADA) recommends that the ideal rate of HbA1c for nonpregnant diabetic adults must be less than 7%.¹³ Diabetic patients with poor glycemic control, having higher levels of HbA1c, are found to be more depressed and anxious than patients who had good glycemic control,^{14,15} regardless of the presence of

many confounders.¹⁶ In Peru, the prevalence of depression in type 2 DM is high compared with the population, and patients with depression had a 1.3 times greater prevalence of poor glycemic control ($\text{HbA1c} \geq 7$).¹⁶ Furthermore, a study conducted by Carreira et al on type 1 DM found the prevalence of depression to be 21.7% and associated variables included female gender, unemployment, smoking, diabetic complications, lack of support, high number of weekly hyperglycemia, and poor quality of life.¹⁷ Camara et al noticed that depressive symptoms are worse in patients with HbA1c value $>9\%$.¹⁸

Studies showed that decrease in HbA1c level is associated with a decreased risk of diabetic complications, whether microvascular or macrovascular. According to the United Kingdom Prospective Diabetes Study (UKPDS), a 1% decrease in HbA1c value results in 37% decrease in risk of microvascular complications and 21% of other type 2 DM-related diseases.¹⁹ The Diabetes Control and Complications Trial/Epidemiology of Diabetes Interventions and Complications (DCCT/EDIC) study demonstrated a 35%–76% reduction in the early stages of microvascular complications, with a median HbA1c of 7% in type 1 diabetic patients.²⁰ Therefore, diabetic patients must maintain lifelong medical attention in order to decrease the occurrence of diabetic complications to improve the quality of life that can affect clinical outcomes of the disease.²¹

Among the depressed diabetic patients, there are several factors that increase depression level other than DM itself: low income and poor socioeconomic status are among the principal ones.^{12,22,23} In addition, patients with supportive and continuous medical care display less depression.²⁴ Also, age and form of medication determine the level of depression.²⁵ Berge et al concluded that diabetic patients in their 40s had twice more depression than nondiabetic patients, and patients in their 40s receiving oral treatment had a three times higher depression prevalence.²⁵ Another determinant of depression is the gender. Katon stated that female diabetics were more likely to be affected by depression (28%) than diabetic males were (18%).²⁶

Depression can affect patients with DM in many ways. Patients with depression and DM have poor adherence to diet and have trouble taking the medications as prescribed which leads to severe hypoglycemic episodes.²⁷ Depression in patients with DM is usually not diagnosed early and it is not treated until 6 months after diagnosis.^{28,29} There is a bidirectional relation existing between DM and depression: having DM increases the risk of developing depression and the opposite is also possible.³⁰

Since to the best of our knowledge no data are available on the subject, we propose to: determine the prevalence of depression among the diabetic patients in Lebanon; investigate whether DM complications and poor glycemic control are related to a higher prevalence of depression in these patients; and evaluate the association of demographic, social, and therapeutic factors with the level of depression among patients with diabetes.

Materials and methods

Study design and settings

This is a descriptive cross-sectional study that was carried out between April 2017 and April 2018. Data were collected between June 2017 and September 2017. The study was conducted in Lebanon by interviewing patients in public, several private clinics, and health care centers across Lebanese territories.

Ethical approval was obtained from the directors of the health care centers by presenting a formal request from Beirut Arab University Institutional Review Board (BAU IRB) (Approval code: 2017 H-0057-M-R-0225).

Sampling and sample size

Patients were selected by convenient sampling from all Lebanese governorates. A minimum of 384 participants were selected, with no limit in the maximum number of participants. The minimum sample size was calculated based on a confidence level of 95% and margin of error of 5% with population size estimated to be 6 million. These measures were selected to ensure that enough representation can be achieved to test different hypotheses for further analysis of the results. A pilot study was performed on 20 nondiabetic volunteers of different age groups and socioeconomic states to evaluate the procedure of assessment and the randomization of the research, and the questionnaire was edited based on its results to be suitable for a larger study population.

Inclusion and exclusion criteria

The study included people residing in Lebanon of all nationalities who are diagnosed with either type 1 or type 2 DM, whether treated or not.

Eligible candidates should be aged 16 and above, male or female, capable of answering the questions to complete the questionnaire and willing to take part in this study. BAU IRB approved that all participants, including those aged between 16 and 18, can provide written informed consent prior to their participation. All regions of Lebanon were

included. Excluded patients were those with mental and cognitive impairment who were unable to understand or to answer the questions, those who suffered from emotional drives while proceeding with the questionnaire including those who started crying and those who felt unwell when they were asked certain questions because of personal problems, and pregnant women.

Variables of interest and criteria of depression

A questionnaire was designed by a team of experts; each one took around 15 minutes to be completed. It was divided into four sections. The first section included information about the patient's age, gender, marital status, employment status, socioeconomic status, and governorate of residency. The second contained questions about the patient's exercise habits, smoking habits, and sleeping hours. The third one comprised information about medical follow-up in terms of diabetic years, HbA1C value, medication, commitment to treatment, treatment bothersome, associated complications, and source of awareness about DM, diet annoyance, physician visits, hospital admissions, physician–patient relation, and disease perception. In the last section, the exposure of interest was depression, and Beck Depression Inventory (BDI) was used to assess it.

BDI is a set of 21 self-reported items that assess symptoms and attitude of depression. Each item had an intensity ranging between 0 and 3.³¹ It is a globally used, validated scale that requires few minutes to be completed.³² Arabic version of the scale was also included. It was back-to-back translated and validated by a legal translator (Professor Abdelsattar Ibrahim).³³ The cutoff of 16 was used to detect depression such as individuals with scores >16 were considered depressed, and scores ≤16 were considered normal.³⁴ The cutoff of 16 showed the best balance between sensitivity and predictive values among diabetic patients.³⁴ Depression was further categorized into four levels: scores between 17 and 20 were considered to be borderline clinical depression; 21–30 were moderately depressed; 31–40 were severely depressed, and above 40 were extremely depressed.³⁵

Patients were asked to provide their recent HbA1C data to know objectively what their recent glycemic control have been, instead of relying on information obtained from the patients' memories. According to ADA, a cutoff of seven was adopted to determine glycemic control, where values ≥7 indicated poor glycemic control and values <7 indicated good glycemic control.¹³ Regarding diabetic complications,

they were self-reported, and participants were asked to choose from a provided list of diabetic complications included in the questionnaire.

Statistical analysis

Data were entered into the Statistical Package of Social Science (SPSS version 23.1; IBM Corporation, Armonk, NY, USA), which was then used for data reviewing (data were double checked), management, and analyses using built range checks with automatic error prompts. In addition, ascending/descending order view of variables and descriptive histograms were performed to easily identify outliers, but none were found.

Analyses were carried out by calculating the mean and standard deviation for continuous variables and number and percentage for categorical ones. Continuous variables included the HbA1c value of each participant and the BDI score. Categorical variables included age, gender, place of residence, occupational status, marital status, nationality, monthly income, sports practice, smoking, daily sleeping hours, duration of diabetes since diagnosis, recent HbA1c testing (past 6 months), HbA1c value categories (good vs bad glycemic control), form of medication, types of oral drugs, commitment to treatment, satisfaction with treatment, refusal of insulin intake, causes of insulin refusal, duration of insulin therapy, number of visits to the physician (in the past 6 months), number of admissions to hospitals (in the past 6 months), patient relief by the physician, sources of patient education about DM, DM complications, bothersome from DM complications, presence of hypoglycemic symptoms, frequency of occurrence of hypoglycemic episodes, annoyance from having diet restrictions, social performance impairment due to DM, self-perceived health status, self-reported disease perception, and levels of depression.

Throughout the study, chi-squared, ANOVA, *t*-test, as well as exploratory tests were used.

Results

Prevalence of depression

From the 450 subjects initially approached to participate, 440 accepted but four were excluded due to missing data or refusal to continue, hence a total of 436 diabetic patients were included in this study. In total, 125 patients (28.8%) were found to have depression. The mean BDI score was found to be 13.45 (SD: 9.36) among all participants. Depressed patients had a mean BDI score of 25.65, while nondepressed patients had a mean of 8.54. Among the depressed patients, 36 had borderline clinical depression (28.8%), 59 had mod-

erate depression (47.2%), 25 had severe depression (20%), and only five had extreme depression (4%).

Population characteristics

The average age of the participants was 64.08 years (SD: 17.06). In total, 280 were females (64.2%), with average disease duration of 8.89 years (SD: 5.59).

Table 1 shows the different frequencies of levels of depression among population characteristics.

Further exploratory studies and ANOVA for the significantly associated variables were done to determine which subcategories were associated with higher BDI scores. Results showed that living in Beqaa and being retired had higher means with scores being 16 (SD: 9.16) and 17.98 (SD: 10.09), respectively.

In total, 279 (64%) of the participants were married, 47 were single (10.8%), 14 were divorced (3.2%), and 96 (22%) were widowed. There was no significant relationship between marital status and depression ($P=0.401$).

When asked about sports practice, 173 (39.7%) participants revealed practicing sports. Sports practice, however, had no significant relation to depression ($P=0.337$).

Diabetes and disease management

Moving on to DM-related issues, patients were asked if they had measured their HbA1c levels in the past 6 months. In total, 356 (81.5%) presented their recent HbA1c levels during the time of data collection. The regular measurement of HbA1c blood levels was significantly associated with depression ($P=0.031$); those who measured their HbA1c levels in the past 6 months had a mean BDI score of 13.23 (SD: 8.96), whereas those who did not had a mean score of 14.59 (SD: 12.09).

The mean HbA1c was 7.9 (SD: 1.95). A cutoff of 7 was used to determine the glycemic control, and it was found that 156 (43.8%) had it below or equal to 7 while 200 (56.2%) had it above 7. There was no significant correlation between glycemic control and depression ($P=0.843$).

Table 2 shows the percentages of participants with either good or poor glycemic control among different levels of depression.

Upon questioning about treatment, 429 (98.39%) were being treated.

Table 3 shows the frequencies of different levels of depression among different forms of medication, types of oral drugs used, and insulin therapy duration.

When asked about recommendations for insulin therapy, 49 (11.2%) of all participants admitted refusing

Table 1 Characteristics of the study population according to different levels of depression

	Depression levels					
	Nondepressed	Borderline clinical depression	Moderate depression	Severe depression	Extreme depression	P-value ^a
Place of residence						
Beirut	156 (50.2%)	24 (66.7%)	43 (72.9%)	17 (68%)	4 (80%)	0.007
South	99 (31.8%)	5 (13.9%)	4 (6.8%)	1 (4%)	0	
North	20 (6.4%)	1 (2.8%)	5 (8.5%)	2 (8%)	1 (20%)	
Beqaa	5 (1.6%)	1 (2.8%)	1 (1.7%)	1 (4%)	0	
Mount Lebanon	31 (10%)	5 (13.9%)	6 (10.2%)	4 (16%)	0	
Gender						
Male	106 (34.1%)	15 (41.7%)	25 (42.4%)	8 (32%)	2 (40%)	0.691
Female	205 (65.9%)	21 (58.3%)	34 (57.6%)	17 (68%)	3 (60%)	
Nationality						
Lebanese	211 (67.8%)	27 (75%)	48 (81.4%)	14 (56%)	3 (60%)	0.126
Syrian	40 (12.9%)	4 (11.1%)	6 (10.2%)	8 (32%)	2 (40%)	
Palestinian	59 (19%)	4 (11.1%)	5 (8.5%)	3 (12%)	0	
Others	1 (0.3%)	1 (2.8%)	0	0	0	
Occupation						
Employed	80 (25.7%)	5 (13.9%)	11 (18.6%)	5 (20%)	0	0.037
Unemployed	176 (56.6%)	21 (58.3%)	31 (52.5%)	9 (36%)	2 (40%)	
Student	4 (1.3%)	1 (2.8%)	0	1 (4%)	0	
Retired	51 (16.4%)	9 (25%)	18 (28.8%)	10 (40%)	3 (60%)	
Monthly income (in Lebanon \$)						
<300\$	140 (45%)	18 (50%)	36 (61%)	19 (76%)	5 (100%)	0.157
300–600\$	89 (28.6%)	11 (30.6%)	16 (27.1%)	4 (16%)	0	
601–1,000\$	47 (15.1%)	7 (19.4%)	5 (8.5%)	2 (8%)	0	
1,001–1,500\$	22 (7.1%)	0	1 (1.7%)	0	0	
1,501–2,500\$	6 (1.9%)	0	1 (1.7%)	0	0	
>2,500\$	7 (2.3%)	0	0	0	0	
Diabetes duration						
<1 year	31 (10%)	2 (5.6%)	2 (3.4%)	3 (12%)	0	0.447
1–5 years	89 (28.6%)	5 (13.9%)	16 (27.1%)	5 (20%)	1 (20%)	
6–10 years	54 (17.4%)	9 (25%)	16 (27.1%)	5 (20%)	2 (40%)	
>10 years	137 (44.1%)	20 (55.6%)	25 (42.4%)	12 (48%)	2 (40%)	
Sleeping hours						
<6 hours	87 (28%)	16 (44.4%)	22 (37.3%)	11 (44%)	1 (20%)	0.033
6–7 hours	144 (46.3%)	9 (25%)	24 (40.7%)	8 (32%)	1 (20%)	
7–9 hours	72 (23.2%)	10 (27.8%)	12 (20.3%)	3 (12%)	3 (60%)	
>9 hours	8 (2.6%)	1 (2.8%)	1 (1.7%)	3 (12%)	0	
Patient relief						
Yes	266 (85.5%)	30 (83.3%)	39 (66.1%)	23 (92%)	3 (60%)	0.002
No	45 (14.5%)	6 (16.7%)	20 (33.9%)	2 (8%)	2 (40%)	
Social performance impairment						
Yes	75 (24.1%)	14 (38.9%)	30 (50.8%)	13 (52%)	2 (40%)	0.00
No	236 (75.9%)	22 (61.1%)	29 (49.2%)	12 (48%)	3 (60%)	
Disease perception						
Terrified	48 (15.4%)	8 (22.2%)	19 (32.2%)	10 (40%)	3 (60%)	0.00
Okay with it	180 (57.9%)	22 (61.1%)	36 (61%)	10 (40%)	1 (20%)	
Will never be cured	10 (3.2%)	3 (8.3%)	0	3 (12%)	1 (20%)	
Neutral	72 (23.2%)	3 (8.3%)	3 (5.1%)	2 (8%)	0	
Other	1 (0.3%)	0	1 (1.7%)	0	0	

Notes: ^aComparative studies were performed using the chi-squared test.

Table 2 Frequencies of glycemic control according to different levels of depression

Glycemic control	Depression level					P-value ^a
	Nondepressed	Borderline clinical depression	Moderate depression	Severe depression	Extreme depression	
HbA1c ≤7%	115 (73.7%)	14 (8.9%)	20 (12.8%)	6 (3.8%)	1 (0.6%)	0.843
HbA1c >7%	140 (70%)	16 (8%)	32 (16%)	11 (5.5%)	1 (0.5%)	

Note: ^aComparative studies were performed using the chi-squared test.

Abbreviation: HbA1c, glycosylated hemoglobin.

Table 3 Frequencies of different levels of depression among different forms of medications, types of oral drugs used, and insulin therapy duration

	Depression level					
	Nondepressed	Borderline clinical depression	Moderate depression	Severe depression	Extreme depression	P-value ^a
Form of medication						
Pills	229 (73.6%)	23 (63.9%)	38 (64.4%)	16 (64%)	3 (60%)	0.485
Injections	15 (4.8%)	4 (11.1%)	6 (10.2%)	4 (16%)	1 (20%)	
Pills and injections	63 (20.3%)	8 (22.2%)	13 (22%)	5 (20%)	1 (20%)	
None	4 (1.3%)	1 (2.8%)	2 (3.4%)	0 (0%)	0 (0%)	
Total	311	36	59	25	5	
Type of pills						
Metformin	242 (72.8%)	26 (7.8%)	42 (12.6%)	19 (5.7%)	3 (0.9%)	0.681
Sulfonylurea	95 (70%)	15 (11%)	15 (11%)	11 (8%)	0 (0%)	0.136
DPP4 inhibitors	47 (73.4%)	4 (6.3%)	8 (12.5%)	2 (3.2%)	3 (4.6%)	0.837
SGLT2 inhibitors	4 (44.5%)	1 (11.1%)	3 (33.3%)	0 (0%)	1 (11.1%)	0.317
GLP1 agonists	4 (57.1%)	1 (14.2%)	2 (28.7%)	0 (0%)	0 (0%)	0.7
Insulin therapy duration						
<1 year	9 (11.5%)	2 (16.7%)	0 (0%)	3 (33.3%)	0 (0%)	0.109
1–5 years	28 (35.9%)	3 (25%)	7 (36.8%)	3 (33.3%)	2 (100%)	
>5 years	41 (52.6%)	7 (58.3%)	12 (63.2%)	3 (33.3%)	0 (0%)	
Yes	254 (81.7%)	26 (72.2%)	37 (62.7%)	17 (68%)	3 (60%)	0.011
No	57 (18.3%)	10 (27.8%)	22 (37.3%)	8 (32%)	2 (40%)	

Note: ^aComparative studies were performed using the chi-squared test.

Abbreviations: DPP4, dipeptidyl peptidase 4; GLP1, glucagon-like peptide 1; SGLT 2, sodium glucose cotransporter 2.

taking insulin with fear of injection being the major cause in 25 patients (51%). Other causes were fear of becoming used to it in 12 patients (3%), financial difficulties in eight patients (16.32%), and feeling of embarrassment in four patients (6.12%). However, insulin refusal and its causes showed no significant correlation with depression ($P=0.2$).

Further inquiring revealed that, of the participants receiving treatment, 403 (92.4%) were committed to their treatment, but there was no significant relationship with depression ($P=0.89$).

In total, 337 patients (77.3%) were satisfied with their treatment. There was a significant correlation between treatment satisfaction and depression ($P=0.011$). Further analysis revealed that those who were not satisfied by the treatment

scored higher on BDI with a mean of 16.17 (SD: 9.81) than those who were satisfied who had a mean score of 12.65 (SD: 9.08).

The study showed that 55 (12.6%) participants never visited the physician in the past 6 months. Mean BDI score of these participants was 16.16 (SD: 8.27). Those who visited the physician at least once in the past 6 months had a mean BDI score of 13.06 (SD: 9.45). There was no significant relationship with depression ($P=0.117$).

In total, 361 (82.7%) were relieved from concerns about the disease by the physician. There was a significant relationship between patient relief and depression ($P=0.002$). Those who were not relieved by the physician had a higher mean BDI score of 15.87 (SD: 9.57), whereas those who were relieved had a mean of 12.94 (SD: 9.25).

Table 4 Relation between diabetes complications and depression

Diabetic complications	Depression levels					P-value
	Nondepressed	Borderline clinical depression	Moderate depression	Severe depression	Extreme depression	
Nephropathy						
Yes	19 (6.1%)	3 (8.3%)	10 (16.9%)	4 (16%)	1 (20%)	0.035
No	292 (93.9%)	33 (91.7%)	49 (83.1%)	21 (84%)	4 (80%)	
Retinopathy						
Yes	121 (38.9%)	17 (47.2%)	33 (55.9%)	14 (56%)	5 (100%)	0.005
No	190 (61.1%)	19 (52.8%)	26 (44.1%)	11 (44%)	0	
Cerebrovascular accidents						
Yes	5 (1.6%)	2 (5.6%)	4 (6.8%)	2 (8%)	1 (20%)	0.017
No	306 (98.4%)	34 (94.4%)	55 (93.2%)	23 (92%)	4 (80%)	
Neuropathy						
Yes	133 (42.8%)	15 (41.7%)	35 (56%)	14 (56%)	2 (40%)	0.143
No	178 (57.2%)	21 (58.3%)	24 (40.7%)	11 (44%)	3 (60%)	
Cardiovascular conditions						
Yes	30 (9.6%)	6 (16.7%)	5 (8.5%)	5 (20%)	0	0.296
No	281 (90.4%)	30 (83.3%)	54 (91.5%)	20 (80%)	5 (100%)	
Coronary artery disease						
Yes	22 (7.1%)	3 (8.3%)	4 (6.8%)	1 (4%)	0	0.934
No	289 (92.9%)	33 (91.7%)	55 (93.2%)	24 (96%)	5 (100%)	
Skin conditions						
Yes	31 (10%)	2 (5.6%)	4 (6.8%)	6 (24%)	1 (20%)	0.116
No	280 (90%)	34 (94.4%)	55 (93.2%)	19 (76%)	4 (80%)	
Gangrene						
Yes	2 (0.6%)	0	0	0	0	0.937
No	309 (99.4%)	36 (100%)	59 (100%)	25 (100%)	5 (100%)	
Hypoglycemic symptoms						
<1/week	71 (74.7%)	12 (85.7%)	19 (67.9%)	6 (60%)	0	0.012
1–3/week	17 (17.9%)	2 (14.3%)	7 (25%)	1 (10%)	1 (50%)	
>3/week	7 (7.4%)	0	2 (7.1%)	3 (30%)	1 (50%)	

In addition, 64 (14.7%) patients were admitted to the hospital at least once in last 6 months. Hospital admissions were not related to depression ($P=0.401$).

Regarding patient education about the disease, 377 (86.5%) got their information from the doctor, 71 (16.3%) learned about their disease from the Internet, 65 (14.9%) got instructions from their family, 34 (7.8%) watched television programs, 20 (4.6%) attended awareness campaigns, and 41 (9.4%) relied on other sources. However, the only source that was found to be significantly correlated with depression was the Internet ($P=0.049$). Mean score of depression among Internet users was 10.21 (SD: 7.08).

Diabetic complications were reported in many participants, with the most common being neuropathy in 199 (45.6%), then retinopathy in 190 (43.6%), cardiovascular conditions in 46 (10.6%), skin conditions in 44 (10%), nephropathy in 37 (8.5%), coronary artery disease in 30 (6.88%), cerebrovascular accidents in 14 (3.2%), and gangrene in 2 patients (0.5%). However, retinopathy ($P=0.00$),

nephropathy ($P=0.004$), and cerebrovascular accidents ($P=0.013$) were significantly correlated with depression.

Table 4 shows the frequencies of different levels of depression among the diabetic complications and hypoglycemic symptoms.

Figure 1 shows the prevalence of different levels of depression among those bothered from diabetic complications. Those who were severely bothered from diabetic complications scored higher on the depression scale with a mean of 18.84 (SD: 9.5).

Occurrence of hypoglycemic symptoms was significantly correlated with depression ($P=0.016$). Hypoglycemia was present in 149 (34.2%) of all participants. From those who had hypoglycemic symptoms, 108 (72.4%) had less than one episode per week, 28 (18.79%) had between one and three episodes per week, and 13 (8.72%) had more than three times episodes per week. Those who had hypoglycemic symptoms more than three times per week showed the highest mean values of depression of 19.23 (SD: 12.5), while those who

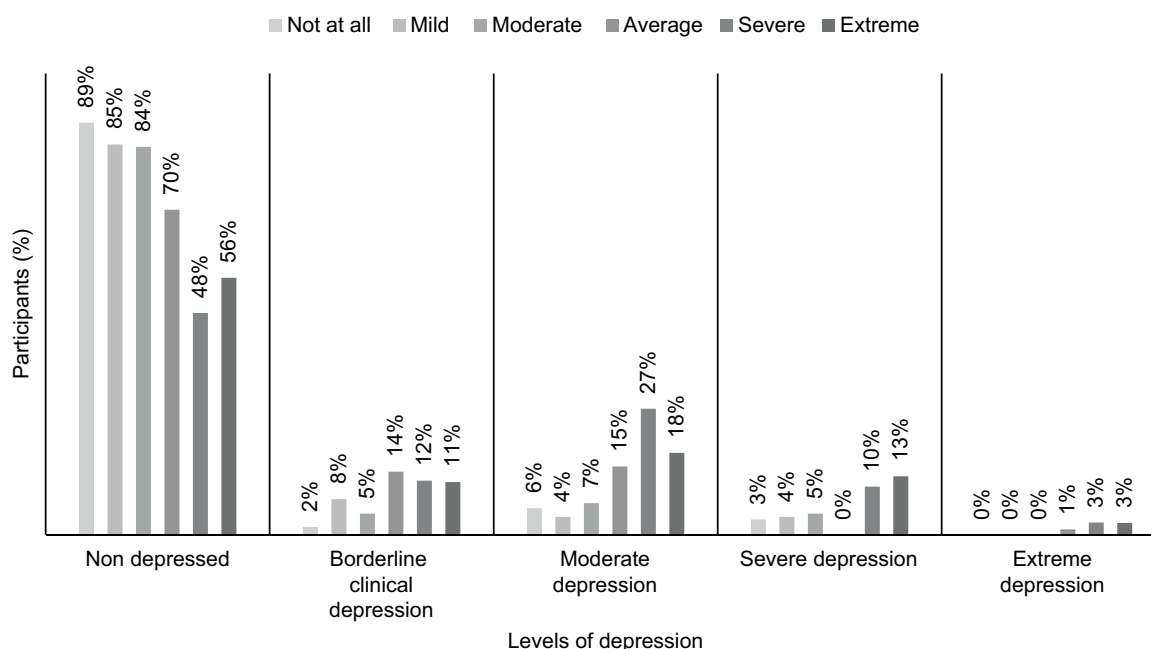


Figure 1 Percentages of different levels of depression among different levels of bothersome from diabetic complications.

had less than one episode per week had a mean score of 14.66 (SD: 8.24) and those who had one to three episodes per week had a mean score of 15.61 (SD: 11.73).

Impact on lifestyle

When inquired about their diet, 161 (36.9%) were annoyed from having restrictions. Diet restrictions, however, had no significant correlation with depression ($P=0.348$).

Regarding the participants' social performance, 134 (30.7%) felt that DM impaired their usual activities. It was significantly correlated with depression ($P=0.00$). Those being socially impaired had a mean score of depression of 16.75 (SD: 9.95), higher than who were not with a mean of 11.98 (SD: 8.7).

Participants were asked about their self-perceived health status, and 12 (2.8%) described it as being the worst, 47 (10.8%) considered it bad, 54 (12.4%) said it was average, 162 (37.2%) found it to be good, 111 (25.5%) reported it as being very good, and it was excellent in 50 (11.5%). The overall health status was significantly correlated with depression ($P=0.00$).

Figure 2 shows the relation between self-estimated overall health status and different levels of depression. Those who perceived their health as worst had the highest mean BDI score of 26.33 (SD: 12.93). Those who perceived it as bad had a mean score of 20.77 (SD: 9.95), those who said it was average had a mean score of 16.07 (SD: 9.56), those who said it was good had a mean score of 13.26 (SD: 7.97), those

who described it as very good had a mean score of 11.17 (8.2), and those who said it was excellent had a mean score of 6.3 (SD: 4.95).

As for patient's perception of DM, 88 (20.2%) felt terrified and had a mean BDI score of 17.09 (SD: 10.69), 249 (57.1%) were dealing fine with it and had a mean score of 13.5 (SD: 8.45), 17 (3.9%) felt they would never be cured and had a mean score of 16 (SD: 13.79), 80 (18.3%) were neutral about DM and had a mean score of 8.6 (SD: 7.23), and 2 (0.5%) could not provide a specific response and had a mean score of 18.5 (SD: 7.77). The perception of DM was significantly related to depression ($P=0.005$).

Discussion

The study showed the prevalence of depression to be 28.8% among our participants with DM in Lebanon. This was found to be lower when compared with other studies conducted in Palestine and Saudi Arabia, where the prevalence of depression was 40.2% and 49.6%, respectively,^{12,36} while it was found to be higher than other studies done in developed countries, where depression prevalence was 8.3% in USA³⁷ and 2.6% in Japan.³⁸ Lebanon is a developing country, which explains its position compared with other countries when comparing levels of depression among diabetic patients.

The main purpose of this study was to find whether there exists a relation between glycemic control expressed as HbA1c levels and depression. However, the analysis of

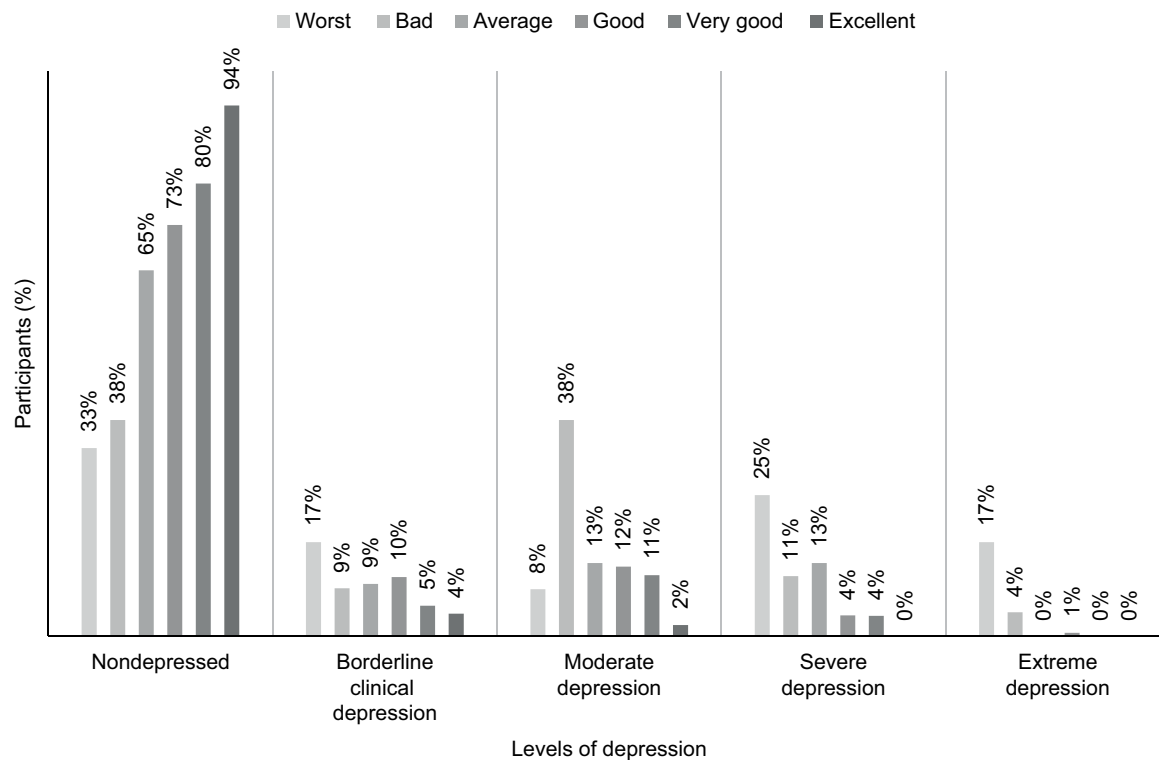


Figure 2 Percentages of different levels of depression among self-perceived health status by the patients.

data showed no significant association between HbA1c levels and the prevalence of depression ($P=0.843$). This finding was supported by various research such as those done by Parham et al,³⁹ Nejati Safa et al,⁴⁰ Georgiades et al,⁴¹ and de Groot et al⁴² who also failed to find any significant relationship between glycemic control and depression among diabetic patients. On the opposite side, a meta-analysis done by Lustman et al among 24 studies indicated the presence of a significant correlation between depression and poor glycemic control.⁴³ Other factors, however, played a role in the outcome of depression. These will be further discussed in the upcoming sections.

This study noted that many environmental factors played an important role in affecting the outcome of depression among the participants, such as the place of residence and the occupation. It was found out that participants residing in Beqaa (1.8%) had more depression than those residing in other areas of Lebanon. In accordance to this result, Probst et al demonstrated that depression levels in residents of rural areas were higher than those of residents of urban areas, as they are more prone to have poor health status, chronic diseases, and poverty, which can affect this outcome.⁴⁴ Houle et al⁵⁸ stated that socioeconomic factors had a major impact on patients' behaviors and depressive symptoms.⁴⁵ The present study is consistent with this statement, as those who were retired (20.6%) scored higher.

Other analysis showed that the total amount of sleeping hours the participants had per day were correlated with their BDI score. Most notably, participants who had more than 9 hours of sleep per day (3%) had higher scores and thus were more depressed. It was well established that there exists a positive relation between depression and excessive daytime sleepiness, expressed as increased daytime sleepiness with increased depression.⁴⁶

While the obtained results failed to prove the existence of a significant relation between glycemic control, expressed as HbA1c levels, and depression among the participants, the present study found that the regular measurement of HbA1c was actually implicated in this matter. In total, 10.5% of the participants did not measure their HbA1c levels in the past 6 months. These specific individuals had more depression than those who did. Many studies supported the idea that depression is highly associated with HbA1c levels. The present study, however, found that it was the regular follow-up and not the actual HbA1c levels that determined depression in the participants.

Bassett et al stated that there was a significant relationship between treatment satisfaction and depression among type 2 DM patients.⁴⁷ In the present study, self-reported treatment satisfaction also had a significant relationship to depression. The more satisfied a patient was with his/her treatment, the less depressed he/she was.

Concerning physician visits, it was noted that the more the patients visited their physicians, the less they were likely to develop depression. Patients who did not visit their physician at all in the last 6 months (12.6%) were more depressed compared with those who had at least one visit. In accordance to this result, another study conducted by Delucchi et al stated that the number of clinic visits affected patient's depression ($P=0.03$).⁴⁸

The physician role can affect the outcome of depression in the patient, and when a physician addresses the patient with respect and care, the patient will feel more comfortable and will have a better disease care.⁴⁹

Patient education about DM leads to better glycemic control,⁵⁰ and the present study revealed that the more the patients obtained information about DM, mostly through the Internet, the less depression they had.

Many patients admitted deterioration in their social activities due to DM (30.7%), which was also related to depression. DM has been associated with multiple cognitive dysfunctions⁵¹ and even increased the risk of developing dementia in many patients.⁵²

Complications related to DM had a significant relation to depression. The present study showed that retinopathy, nephropathy, and strokes were the most important, and it was noted that participants who had a previous incident of stroke (3.2%) had higher scores on the BDI scale. Takasaki et al stated that nephropathy is likely associated with increased depression, which is actually decreased following kidney transplant.⁵³ Another study stated that not only did retinopathy worsen the presence of depression in diabetic patients but also the depression itself worsened the retinopathy in return.⁵⁴ As for strokes, it was well established that history of type 2 DM and a past cardiovascular accident event were highly predictive of depression and could even lead to dementia.⁵⁵

Hypoglycemia symptoms were among the most notable causes of depression. A study conducted in Japan revealed that hypoglycemic symptoms were strongly associated with severity of depression independent of glycemic control.⁵⁶

Self-perceived health status had a highly significant relation to depression. The better a patient perceived his/her health status, the less depression he/she had. Self-perceived health status is generally considered among the most important indicators of depression.⁵⁷

Illness perception was also strongly correlated with depression. It is thus very essential for hospitals and care centers to manage diabetic patients' disease perception and provide an adequate environment to ensure good information delivery and prevent depression by ensuring good coping behaviors.⁵⁵

Limitations

There were some limitations encountered in this study to be acknowledged. The participants were selected by convenient sampling, which means that the number of participants from each region of Lebanon was not proportional to the actual population. Participants in Beqaa showed the highest levels of depression; however, the very limited number of participants from this region could have affected this outcome. In addition, diabetic complications were assessed subjectively based only on the patient's medical history and current symptoms, without performing an examination to confirm the diagnosis of these complications. Finally, some participants either had not measured their HbA1c levels or could not present their test results at the time of interview.

Conclusion

Depression was found to be prevalent among diabetic patients in Lebanon (28.8%). However, no association was established between depression and glycemic control. On the other hand, the presence of other disease-related factors was greatly associated with depression, including hypoglycemic symptoms, DM complications especially nephropathy, retinopathy, and stroke, self-reported treatment satisfaction, patient education of the disease, patient-physician relationship, self-perceived health status, and patient's own perception of the disease. Therefore, the early detection of depression in the diabetic patients residing in Lebanon should be an important part of the assessment and management of DM to improve their quality of life and to achieve better therapy outcomes.

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Disclosure

The authors report no conflicts of interest in this work.

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