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Prevalence of depression in patients with diabetes mellitus type 1 and type 2 and its possible relations with glycaemic control

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Abstract

Background
Depression occurs 2-3 times more in people with diabetes mellitus (DM) with the majority of cases remaining under-diagnosed. Glycated hemoglobin (HbA1c) is an approved indicator for a long-term glycaemic control which is advised to be ≤ 7.
Aim: To determine the prevalence and severity of depression among people with DM and evaluate the possible links of glycaemic control with the severity of depression.
Methods: In 2019 – 2020 an anonymous survey of people diagnosed with DM type 1 and type 2 was carried out in Endocrinology Department, LUHS Kaunas Clinics, and online community ″Lietuvos diabetikai″. 281 adults with no previous record of depression were selected. An originally created questionnaire for respondents' demographic data and Patient Health Questionnaire - 9 (PHQ-9) for the screening of depression was used. Depression score was assessed using the evaluation guidelines of PHQ-9. Statistical analysis was performed by "IBM SPSS 25.0". Relations of qualitative variables were assessed by Pearson ($\chi 2$). Results were considered statistically reliable if $p \leq 0,05$.
Results: Out of 281 respondents only 31 (11 %) denied experiencing any mental health complaints during the past year. According to PHQ-9 score, 115 (40,9%) had minimal or none, 83 (29.5%) had mild, 41 (14,6%) had moderate, 25 (8,9%) had moderately severe, 17 (6%) had severe symptoms of depression.
When divided into 2 groups by their latest level of HbA1c, 50 (44,6%) respondents with HbA1c≤ 7 had minimal or none, 35 (31,3%) had mild, 17 (15,2%) had moderate, 10 (8,9%) had moderately severe and none of the respondents had severe depression symptoms. 55 (37,2%) respondents with HbA1c≥ 7 had minimal or none, 40 (27%) had mild, 22 (14,9%) had moderate, 14 (9,5%) had moderately severe, 17 (11.5%) had severe depression symptoms. There was a statistical significance of occurrence of depression and its possible severity between the two groups (p= 0,007).

Conclusions: 29 % of patients with DM could be suspected of having depression. Insufficient control of DM had a link with the possible depression and its severeness.
Keywords: depression, diabetes mellitus, glycaemic control, HbA1c .

Introduction

Diabetes mellitus (DM) is a chronic progressive disorder with rapidly increasing prevalence in both developing and developed countries. According to The Institute of Hygiene, it affected 109 162 (3,89%) Lithuanians in 2018 and was one of the eight most common chronic diseases in all age groups. (1) One of the most reliable indicators of a long-term glycaemic control is glycated haemoglobin (HbA1c) which provides evidence about individual's average blood glucose levels during the previous two to three months. Nowadays HbA1c is routinely performed and considered to be a standard for monitoring an efficient glycaemic control which is said to be achieved when the level of HbA1c is ≤ 7,0 percent. (2 – 4)

Chronic hyperglycaemia correlates with the risk of long-term diabetes complications while diabetes itself is often associated with numerous neuropsychiatric comorbidities. One of them is depression, which occurs 2 – 3 times more often in patients with diabetes than in general population (5 – 8). Depression is considered as one of the most overlooked symptoms in diabetics. However, there are various reliable screening methods which could be used in primary care and other medical settings to recognise patients with potential symptoms. One of them is Patient Health Questionnaire – 9 (PHQ – 9): a cut off score of 10 points or above identifies possible major depression with sensitivity of 0.88 (95% confidence interval 0.83 – 0.92), specificity of 0.85 (95% confidence interval 0.82 – 0.88). (9 – 12)

As depression is the leading cause of disability-adjusted life-years lost in middle- and high-income countries, (13) the purpose of this study was to evaluate its possible prevalence among presumably more susceptible group of diabetic patients in Lithuania and investigate its possible connections with sufficiently or insufficiently controlled diabetes.

Methods

During the period of 2019 – 2020 an anonymous survey was carried out in Endocrinology Department, LUHS Kaunas Clinics, and an online community "Lietuvos diabetikai" ("Lithuanian diabetics"). Patients who were diagnosed with type 1 or type 2 diabetes, were 18 years or older, and did not suffer from depression prior to index data were included in the study. A total amount of 281 respondents fulfilled these criteria. The survey consisted of questions about the respondents' sex, age, education, working capacity, marital status, duration and type of their illness, latest HbA1c level, and subjective evaluation of general health. The presence and severity of current depressive symptoms were measured by the Patient Health Questionnaire – 9 (PHQ – 9). This questionnaire comprises nine questions regarding patients' mental health, each scored as zero (no days), one (less than half the days), two (more than half the days) and three (almost every day). Respondents were stratified by the severity of current depressive symptoms according to the PHQ – 9 score: none-minimal (0 – 4 points), mild (5 – 9 points), moderate (10 – 14 points), moderately severe (15 – 19 points), and severe (20 – 27 points).

Afterwards, patients were divided in two groups depending on the level of their latest HbA1c: group 1 (HbA1c≤ 7), which consisted of 112 patients who were considered to have a sufficient glycaemic control, and group 2 (HbA1c> 7), which consisted of 148 respondents who were considered to have an insufficient glycaemic control. 21

patients were excluded from this part of the study due to the lack of information about the level of their glycated haemoglobin. The analysis of any statistical difference between the sex, age, education, working capacity, marital status, duration and type of illness, and subjective evaluation of general health in both groups was performed. PHQ – 9 was used again to determine and compare the severity of possible depression between the two groups.

Statistical analysis was performed by "IBM SPSS 25.0". Relations of qualitative variables were assessed by Pearson ($\chi 2$). Results were considered statistically reliable if $p \leq 0,05$

Results

1.1. General characteristics of suitable respondents

From 281 respondents suitable for the study 224 (79.7%) were diagnosed with DM type 1 and 57 (20.3%) were diagnosed with DM type 2. General characteristics of their age and sex are shown in Table 1.

Table 1. Research respondents' gender and age

Variable	Males	Females	Age group					
			18 - 25	25 - 35	35 - 45	45 - 59	60 - 74	75 - 90
Number of respondents (%)	67 (23.8%)	214 (76.2%)	61 (21.7%)	85 (30.2%)	63 (22.4%)	41 (14.6%)	30 (10.7%)	1 (0.4%)

When questioned about their education, 2 (0.7%) respondents stated that they had primary, 19 (6.8%) had middle school, 70 (24.9%) had high school, 63 (22.4%) had college and 127 (45.2%) had university degree. 5 (1.8%) respondents have affirmed that they had no working capacity, 12 (4.3%) had 10-29% of working capacity, 18 (6.4%) had 30-39%, 100 (35.6%) had 40-59%, 10 (3.6%) had 60-70% and 136 (48.4%) people had > 70% of working capacity.

When asked about their marital status, 4 (1.4%) respondents stated that they were widows, 146 (52%) were married, 53 (18.9%) were in a relationship, 54 (19.2%) were single and 24 (8.5%) people were divorced.

1.2. **Complaints related to the mental health**Respondents were asked if they had any complaints related to their mental health over the past year. Only 31 (11 %) of people claimed that they had no mental health complaints. Most common complaints were anxiety, panic, sadness, loss of interests/ hobbies, tiredness, difficulties to concentrate, reluctance to communicate, feeling of guilt, hopelessness, grim thoughts about the future, suicidal or self-harming thoughts, suicidal or self-harming actions, sleeping disorders, increased/ decreased appetite, stress, and episodes of overeating while stressed (as shown in Figure 1). Every person who stated having some mental health complaints over the past year mentioned an average of 6,07 ± 3,77 complaints. 96 (34.2%) patients stated that they have experienced these negative feelings only briefly, 10 (3.6%) noted to suffer for less than 2 weeks, 33 (11.7%) for more than 2 weeks, 22 (7.8%) for more than 6 months and 89 (31.7%) indicated that they have experienced these complaints almost all the time during the past year.

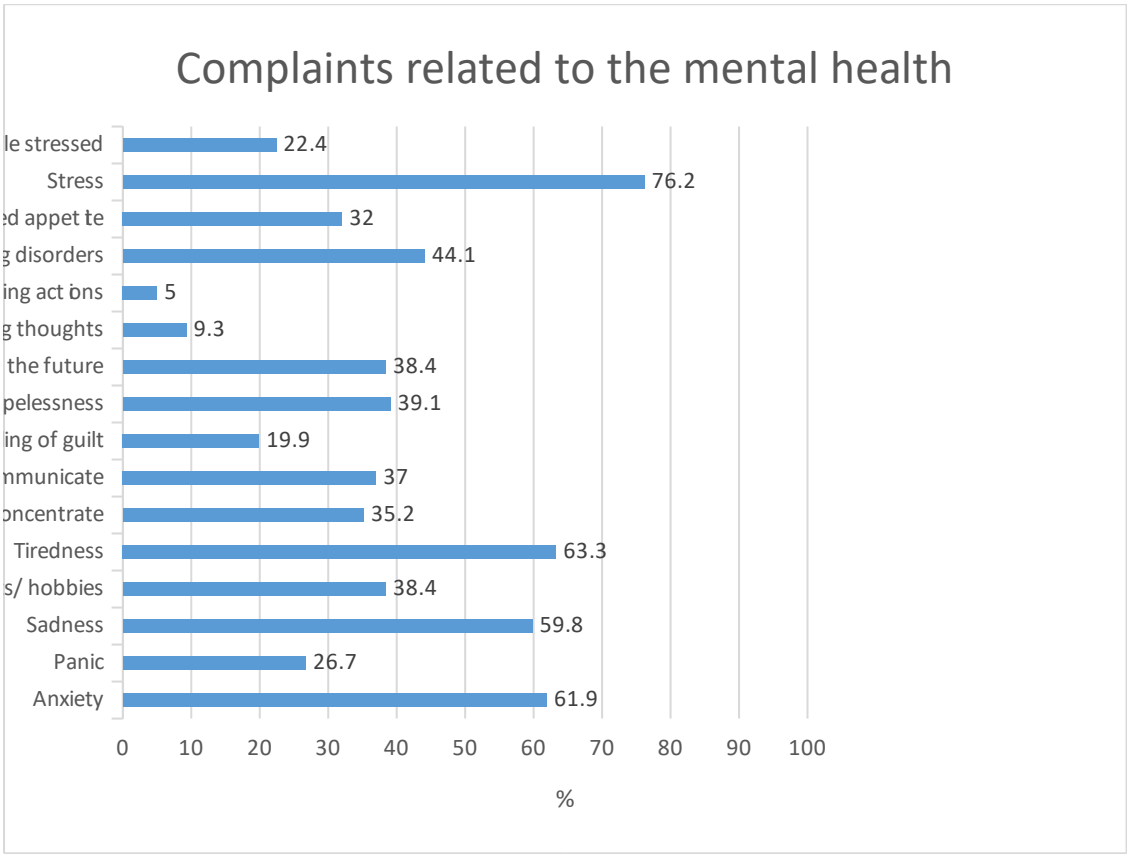

Figure 1. Complaints related to the mental health

When asked to subjectively evaluate their current general health, 2 (0.7%) patients indicated that their general health was great, 17 (6%) thought that it was very good, 92 (32.7%) stated that it was good, 129 (45.9%) thought that it was not bad and 41 (14.6%) stated that it was bad.

25 (8.9%) respondents believed that their health was much better than before the diagnosis of DM, 32 (11.4%) people stated that it was a little bit better and 58 (20.6%) told it was simmilar as before. For 87 (31%) respondents their current general health was a little bit worse and for 79 (28.1%) it was much worse than before the diagnosis of DM.

The score of PHQ – 9 was also evaluated. It varied from 0 to 27 with the average of 7,57 ± 6,438. 115 people (40,9%) had minimal or none, 83 (29.5%) had mild, 41 (14.6%) had moderate, 25 (8.9%) had moderately severe, 17 (6%) had severe depression symptoms.

1.3. Comparison between the respondents with sufficiently and insufficiently controlled diabetes mellitus

Out of 281 respondents there were 50 (17.8%) with HbA1c ≤ 6,5, 62 (22.1%) with HbA1c 6,5 – 7, 102 with HbA1c 7,1 – 8,4 and 46 with HbA1c ≥ 8,5. 21 people were not sure or had no documentation of their latest HbA1c level.

Patients were divided into 2 groups according to their latest level of glycated haemoglobin: group 1 (HbA1c ≤ 7), which

was considered to have a sufficient glycaemic control, and group 2 (HbA1c> 7), which was considered to have an insufficient glycaemic control. 21 people with unknown HbA1c were excluded from this part of the study.

General characteristics of both groups were analysed. Statistically significant aspects are shown in Table 2. There was no statistically significant difference of the type of diabetes, age, and gained education in both groups.

Table 2. Respondents' gender, working capacity, relationship status, duration of DM compared by their latest level of glycated haemoglobin

Characteristics		**n (%)**			**p**
		HbA1c < 7, n=112	**HbA1c > 7, n=148**	**Total, n= 260**	
Gender	**Male**	45 (40.2)	16 (10.8)	61 (23.5)	χ^2= 30,620, df=1, **p< 0,001**
	Female	67 (59.8)	132 (89.2)	199 (76.5)	
Working capacity	**no working capacity**	2 (1.8)	0 (0)	2 (0.8)	χ^2= 35,554, df=5, **p< 0,001**
	10-29%	3 (2.7)	9 (6.1)	12 (4.6)	
	30-39%	2 (1.8)	16 (10.8)	18 (6.9)	
	40-59%	30 (26.8)	68 (45.9)	98 (37.7)	
	60-70%	2 (1.8)	8 (5.4)	10 (3.8)	
	> 70%	73 (65.2)	47 (31.8)	120 (46.2)	
Relationship status	**Widow**	0 (0)	4 (2.7)	4 (1.5)	χ^2= 11,780, df=4, **p= 0,019**
	Married	60 (53.6)	76 (51.4)	136 (52.3)	
	In a relationship	24 (21.4)	25 (16.9)	49 (18.8)	
	Single	14 (12.5)	35 (23.6)	49 (18.8)	
	Divorced	14 (12.5)	8 (5.4)	22 (8.5)	
Duration of DM	**< 6 months**	15 (13.4)	0 (0)	15 (5.8)	χ^2= 39,920, df= 4, **p< 0,001**
	6-12 months	15 (13.4)	2 (1.4)	17 (6.5)	
	1-4 years	14 (12.5)	17 (11.5)	31 (11.9)	
	5-10 years	10 (8.9)	20 (13.5)	30 11.5)	
	> 10 years	58 (51.8)	109 (73.6)	167 (64.2)	

Analysis of mental health complaints which were experienced over the past year was performed. Frequencies of the same malaises (anxiety, panic, sadness, loss of interests/ hobbies, tiredness, difficulties to concentrate, reluctance to communicate, feeling of guilt, hopelessness, grim thoughts about the future, suicidal or self-harming thoughts, suicidal or self-harming actions, sleeping disorders, increased/ decreased appetite, stress, episodes of overeating while stressed) were examined. Statistically significant data is shown in table Table 3.

Characteristics		**n (%)**			**p**
		HbA1c< 7, n= 112	**HbA1c> 7, n= 148**	**Total, n= 260**	
Tiredness	**Yes**	63 (56.3)	104 (70.3)	167 (64.2)	χ^2= 5,455, df=1, **p= 0,020**
	No	49 (43.8)	44 (29.7)	93 (35.8)	
Difficulties to concentrate	**Yes**	31 (27.7)	63 (42.6)	94 (36.2)	χ^2= 6,123, df=1, **p= 0,013**
	No	81 (72.3)	85 (57.4)	166 (63.8)	
Episodes of overeating while stressed	**Yes**	17 (15.2)	41 (27.7)	58 (22.3)	χ^2= 5,770, df=1, **p= 0,016**
	No	95 (84.8)	107 (72.3)	202 (77.7)	
Suicidal or self-harming actions	**Yes**	2 (1.8)	11 (7.4)	13 (5)	χ^2= 4,280, df=1, **p= 0,039**
	No	110 (98.2)	137 (92.6)	247 (95)	
Sleeping disorders	**Yes**	41 (36.6)	75 (50.7)	116 (44.6)	χ^2= 5,107, df=1, **p= 0,024**
	No	71 (63.4)	73 (49.3)	144 (55.4)	
Increased/ decreaed appetite	**Yes**	22 (19.6)	61 (41.2)	83 (31.9)	χ^2= 13,653, df=1, **p< 0,001**
	No	90 (80.4)	87 (58.8)	177 (68.1)	

Table 3. Complaints related to the mental health compared by the latest level of respondents' glycated haemoglobin

There was a statistical significance of subjective current general health evaluation between the two groups (p= 0,003). In group 1 there were 2 (1.8%) patients who said that their health was great, 5 (4.5%) who thought that it was very good, 39 (34.8%) who said that it was good, 60 (53.6%) who thought that it was not bad and 6 (5.4%) people who stated that it was bad. In group 2 there were no patients who said that their health is great, 9 (6.1%) patients who thought that it was very good, 41 (27.7%) who decided that it was good, 67 (45.3%) who thought that it was not bad and 31 (20.9%) people who stated that it was bad.

After the evaluation of average PHQ-9 scores in both groups, a statistical significance was identified (p=0,002). Group 1 scored an average amount of 6,33 ± 4,855 points while group 2 scored an average amount of 8,84 ± 7,399 points. What is more, there were 50 people (44.6%) in group 1 who had minimal or none, 35 (31.3%) who had mild, 17 (15.2%) who had moderate, 10 (8.9%) who had moderately severe and none who had severe symptoms of depression. In group 2 there were 55 (37.2%) respondents who had minimal or none, 40 (27%) who had mild, 22 (14.9%) who had moderate, 14 (9.5%) who had moderately severe and 17 (11.5%) who had severe symptoms of depression. It was statistically significant (p= 0,007).

Discussion

In our study, 89% of respondents stated that over the past year they have experienced some complaints related to their mental health. Adding to this, more than a half (51.2%) of them indicated that those complaints have lasted for a period longer than two weeks.

After analysing the results of PHQ-9 questionnaire it was discovered that 29 % of patients diagnosed with diabetes scored more than 10 points meaning they have shown moderate, moderately severe or severe signs of depression. Considering that the standard cut off score of 10 points or above in PHQ-9 questionnaire identifies depression very sensitively and specifically, (9 - 12) a very strong suspicion of possible depression in this group could be made. This result would be similar to many recent studies which showed that the prevalence of any degree of depression in diabetics varies up to 41,7 % with most cases showing the prevalence of about 30% (6, 16 - 18)

In our study, the presence of worse glycaemic control (HbA1c > 7) in the population with diabetes mellitus was higher in women and especially among widowed and single adults, individuals who had lower working capacity, and those who were diagnosed with DM for a longer period of time. People who had HbA1c > 7 mentioned mental health complaints like being fatigued, having concentration and sleeping disorders, suffering from overeating episodes, experiencing appetite changes and suicidal or self-harming actions significantly more often than those with a sufficient glycaemic control (HbA1c ≤ 7). They also reported negative changes in their daily habits and duties at home, the urge to spend less time at work, and a significantly worse

evaluation of their general health than those with a lower level of HbA1c. These results are similar to the ones published by Ceretta et al. which suggested that the severity of depressive episodes, dysthymia, mood disorders, and suicidal ideation is associated with lower quality of life and poor diabetes control. (14) Possible reasons might be explained by de Ornelas Maia et al., which states that diabetic individuals with symptoms of depression and anxiety had worse quality of life due to physiological changes that accompany illness and impose behavioural changes in their lifestyle. What is more, a chronicity of the illness itself was mentioned as a possible reason of many dysfunctional thoughts. (15)

Even though there is a strong evidence that poor glycaemic control and high levels of HbA1c in diabetic patients have a negative effect on various cognitive functions, their roles for the development of depression are on a constant debate. For instance, in a research published by Fisher et al. glycaemic control was associated with an experienced distress but not linked to a depression suggesting that there was no statistical relation. (19) On the other hand, a metanalysis of Lustman et al. found that depression was linked with hyperglycaemia in patients with both types of diabetes although the nature of this link remained unclear. (20) Lustman's results were further confirmed in two independent studies of Zhang et al. and Jacob et al. which also stated that higher HbA1c level had a strong effect on the risk of developing depression. (21 – 22)

The same significance was determined in our research. In group 1, which was considered to have a sufficient glycaemic control (HbA1c ≤ 7), there were no patients who showed signs of severe depression while in group 2 (HbA1c > 7) there were 11.5 % of respondents with these symptoms. What is more, in group 1 there were 24.1% and in group 2 there were 35.8% people who scored more than 10 points in PHQ-9 questionnaire meaning that they had moderate, moderately severe or severe symptoms of depression. The results were statistically significant and suggested that people with HbA1c> 7 might be having depression more often and to a more advanced extent. The reasons of this finding might be explained by Tabac et al. who stated that both depression and diabetes-distress might have a direct adverse effect on glycaemic control via dysregulation of stress hormones. (23) Alternatively, Snoek et al. claimed that glycaemic control might be mediated via impaired self-care behaviours because of depression or depressive symptoms and result in a poor diabetes control and higher levels of HbA1c. (24)

As a brief conclusion, it is important to remember that diabetes and depression are common disorders and often occur together. Therefore, there is a need for personalised treatments and managements in order to prevent the development of depression in patients with diabetes. As depression remains underdiagnosed, an important aspect for the diabetic specialist would be the awareness of this quite common co-morbidity. A multidisciplinary approach of the diabetic patient should be encouraged and would help to improve the outcomes of both diseases.

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