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Research Article

Psychological Disorders in Adolescents with Type 1 Diabetes and their Relation to Metabolic Control

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Abstract

Background: There is greater psychiatric morbidity in type 1 diabetes patients than in the general population, with depression and anxiety being the most common psychiatric disturbance and these disorders have a direct impact on metabolic control.

Purpose of the Study: The purpose of this study was to assess the psycological disorders (anxiety, depression) among adolescens with type 1diabetes, and to relate any detected psycological disorder to patients' compliance and metabolic control.

Methods: A cross sectional study with a total of 100 adolescents with type 1 diabetes had participated. Their mean age was 13.17 years ± 1.36 SD. All patients were subjected to: social classification I (high), II (middle), III (low), history of the disease (age at onset of diabetes, disease duration, insulin regimen and compliance to treatment), anthropometric measures, mean glycated hemoglobin (HbA1C%) over the last year, lipid profile, and urinary albumin/creatinine ratio. Psychological assessment was done using Children depression inventory (CDI) and Children anxiety scale.

Results: The current study showed that all included adolescent with type 1 diabetes had anxiety while the majority of them suffered from depression (73%). Longer diabetes duration, poor glycemic control, and non compliance are important risk factors for psychological disorders in type 1 diabetic adolescents.

Conclusion: Anxiety and depression should be considered serious complications of diabetes. Under-recognition of psychological disorders in adolescents with diabetes is a major concern. Treatment of these psychological disorders in diabetic adolescents should receive great attention.

Keywords: *Adolescents; Type 1 Diabetes; Depression; Anxiety*

Abbreviations

CDI: Children Depression Inventory; SBGM: Self-Blood Glucose Monitor

Introduction

Type 1 diabetes (T1DM) is one of the most frequent chronic metabolic diseases in childhood and adolescence. An effective treatment that leads to improved metabolic control is essential to prevent severe diabetes related complications and minimize long-term outcome [1].

Several reviews of the literature have been published over the last 20 years concerning association of psychological disorders and T1DM. There is greater psychiatric morbidity in T1DM patients than in the general population, with depression being the most common psychiatric disturbance followed by anxiety, and these disorders have a direct impact on metabolic control [2].

Depression is the most prevalent and harmful comorbidities, if untreated, depression becomes chronic, recurrent, and increasingly devastating. Among people with depression and chronic illness, those with diabetes reported the greatest decrement in health [3,4], as it contributes to poor adherence to medication and dietary regimens, physical inactivity, poor glycemic control, reduced quality of life, and increased health care expenditures [5,6].

Consensus guidelines produced by The International Society of Pediatric and Adolescent Diabetes (ISPAD) made it clear that diabetes management and metabolic control were very strongly influenced by psychological factors [7].

Anxiety symptoms present in 15 - 25% of adolescents with type 1 diabetes. Associated poor self-care, suboptimal glycemic control and recurrent diabetic ketoacidosis are common [8].

Aim of the Study

The aim of the current work was to study the prevalence of psychological disturbances (anxiety and depression) in adolescents with type 1diabetes, and their impact on patients' compliance and metabolic control.

Patients and Methods

The current study is a cross sectional study, a total of 100 adolescents (10 - 19 year) with type 1 diabetes had participated. Their mean age was 13.17 years ± 1.36 SD. All patients were following at Diabetes Endocrine and Metabolism Pediatric Unit (DEMPU), Cairo University Children's Hospital. The following exclusion criteria were applied: presence of a cognitive disorder or mental retardation that would interfere with the assessment, any psychiatric disorder prior to time of diagnosis of diabetes, and significant medical disease other than diabetes. An informed consent was obtained from patients and their parents. All patients were subjected to the following:

- Socio-demographic profile: Patients were classified into social classes I (high), II (middle), III (low) according to an Egyptian Classification scoring system developed by Fahmy and Sherbini [9] which encompassed the education and occupation of the parents, income and family size.
- Clinical evaluation that included history taking, with special emphasis on age at onset of diabetes, disease duration, insulin regi men and compliance to treatment regarding frequency of blood glucose monitoring (copmliant; BGM ≥ 4 times/day). Thorough clinical examination including anthropometric measures (weight, height, body mass index). Measurements are plot ted on Egyptian growth charts (2002) [10].
- Laboratory investigations included mean random blood glucose over the last week, mean glycated hemoglobin (HbA1C %) over the last year (optimal glycemic control; HbA1C < 7.5%, [11]), serum total cholesterol, LDL cholesterol, HDL cholesterol and serum triglycerides, and urinary albumin/creatinine ratio.
- Psychological assessment:

Children depression inventory (CDI) (Arabic version)

The CDI was completed by all the patients. This scale was developed by Maria Kovacs [12]. It is a 27 item self-rated survey designed to assess cognitive, behavior and neuro-vegetative signs of depression in children.

The score of the test: Each of the 27 items consists of three choices which represent three degrees of the severity of symptoms. According to the severity the degrees range from 0 - 2 as follows: No symptoms = 0, Mild to moderate symptoms = 1, Severe symptoms = 2. Total score ranges from (0 - 54), the score: Normal (0 - 9), Mild depression male (9 - 14) and female (9 - 16), Moderate depression male (14 - 18) and female (16 - 22), Severe depression male <18 and female < 22.

Children anxiety scale (Arabic version)

Children Anxiety Scale was completed by all the patients. This scale was developed by Castaneda., *et al* [13]. It consists of 53 items and each item consists of one statement which has two answers yes or no. If the answer is (Yes) the degree = 1, If the answer is (No) the degree = zero.

Total score ranges from (0 - 53). According to their scores, they were classified into mild, moderate and severe degrees: Mild anxiety is less than 18, Moderate anxiety is between 19-28, Severe anxiety is more than 29.

Statistical analysis

Analysis of data was done by IBM computer using SPSS (statistical program for social science version 12) as follows: Description of quantitative variables as mean, SD and range. Description of qualitative variables as number and percentage. Student's t-test was used to assess the statistical significance of the difference between two population means in the study involving independent samples. Correlation test was used to rank different variables against each other positively or inversely. Correlation coefficient denoted symbolically r, defines the strength and direction of the linear relationship between two variables. The level P 0.05 was considered the cut-off value for significance: P ≤ 0.05 is significant.

Results

The current study included 100 adolescents with type 1 diabetes, their mean age was 13.17 years (+1.36 SD), their descriptive statistics were presented in table 1.

Parameters studied		Mean ± SD or percentage
Age (years)		13.17 ± (1.36)
Gender	Male	(26%)
Female	(74%)	
Socio-economic	Low	(14%)
Middle	(86%)	
Education	No	(18%)
Still at school	(82%)	
Anthropometric data	Height (SDS)	-0.646 ± (1.28)
Weight (SDS)	-0.147 ± (1.34)	
BMI (SDS)	-0.124 ± (1.54)	
Age at onset (years)		8.02 ± (2.12)
Diabetes duration(years)		5.13 ± (1.84)
Insulin regimen	Conventional	(18%)
	Intensive	(82%)
Compliance	(SBGM<4)	(89%)
	(SBGM≥ 4)	(11%)
HDL Cholesterol (mg\dl)		65.99 ± (12.76)
Low HDL		9%
LDL Cholesterol (mg\dl)		95.14 ± (37.19)
High LDL		10%
Triglycerides(mg\dl)		85.56 ± (39.48)
High Triglycerides		3%
Total Cholesterol(mg\dl)		154.5 ± (49.45)
High Total Cholesterol		22%
MRBG(mg\dl)		215.29 ± (67.87)
HbA1c (%) (glycemic control)	(HbA1c < 7.5)	8.37 ± (1.39)
		27%
	(HbA1c ≥ 7.5)	73%
Urinary albumin/creatinine ratio (mg\dl)	-ve (alb/create < 30)	14.45 ± (10.78)
		85%
	+ve (alb/create ≥ 30)	15%

Table 1: *Demographic, clinical and laboratory characteristics of the studied group.*

SDS: Standard Deviation Score; BMI: Body Mass Index; SBGM: Self-Blood Glucose Monitoring; HDL: High Density Lipoprotein; LDL: Low Density Lipoprotein; MRBG: Mean Random Blood Glucose; HbA1c: Glycated Haemoglobin.

Seventy-three % of patients (73%) had depression of which 23 patients (31.5%) had mild depression, 41 patients (56.2%) had moderate depression and 9 patients (12.3%) had severe depression. The studied sample had a mean CDI score of 15.86 (±7.29 SD, range: 4 - 35) (Figure 1).

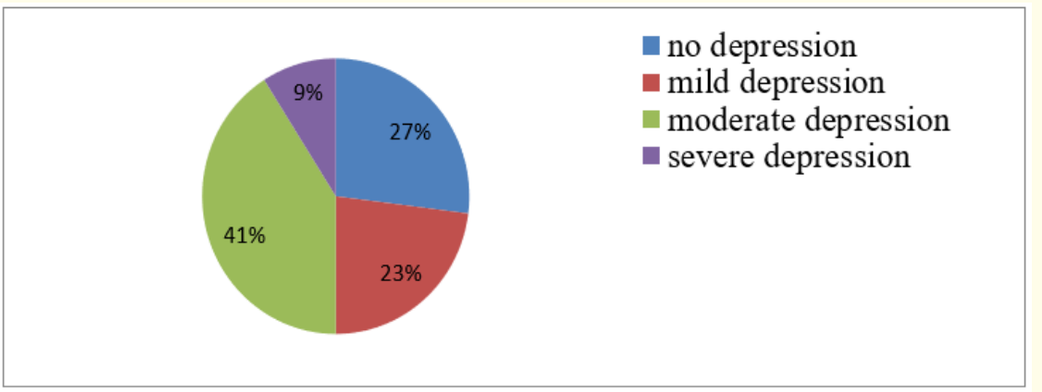

Figure 1: *Frequency of depression in adolescents with type 1 diabetes.*

All studied cases suffered from anxiety, 35 patients (35%) had mild anxiety, 44 patients (44%) had moderate anxiety and 21 patients (21%) had severe anxiety. The studied sample had a mean Children Anxiety Scale score of 21.35 (±8.05 SD, range: 7 - 39) (Figure 2).

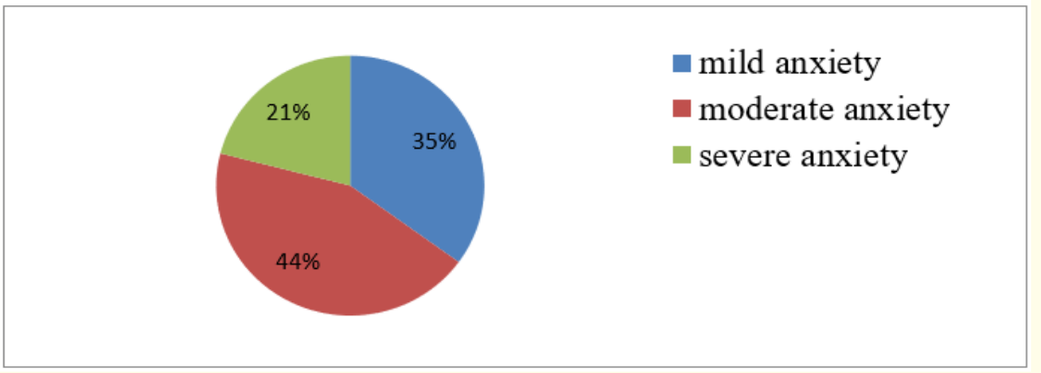

Figure 2: *Frequency of anxiety in adolescents with type 1 diabetes.*

The depression and anxiety co-morbidity in the studied group was shown in table 2. Twenty-seven % of patients (27%) had anxiety with no associated depression

		Degree of depression				
		No depression	**Mild**	**Moderate**	**Severe**	**Total**
Degree of anxiety	Mild	20	9	6	0	35
	Moderate	7	10	25	2	44
	Severe	0	4	10	7	21
	Total	27	23	41	9	100

Table 2: *Depression and anxiety comorbidity in adolescents with type 1 diabetes.*

Our results showed no statistically significant relation between degree of depression and age, neither the degree of anxiety ($p > 0.05$). Also, our results revealed no significant relation between degree of depression or anxiety and weight, height or BMI ($p > 0.05$).

There was high positive significant correlation between duration of diabetes and both depression ($r = 0.84$, $p < 0.001$) and anxiety ($r = 0.82$, $p < 0.001$); and high negative significant correlation between age at onset of diabetes and both depression ($r = 0.66$, $p < 0.001$) and anxiety ($r = 0.65$, $p < 0.001$) (Figures 3 and 4).

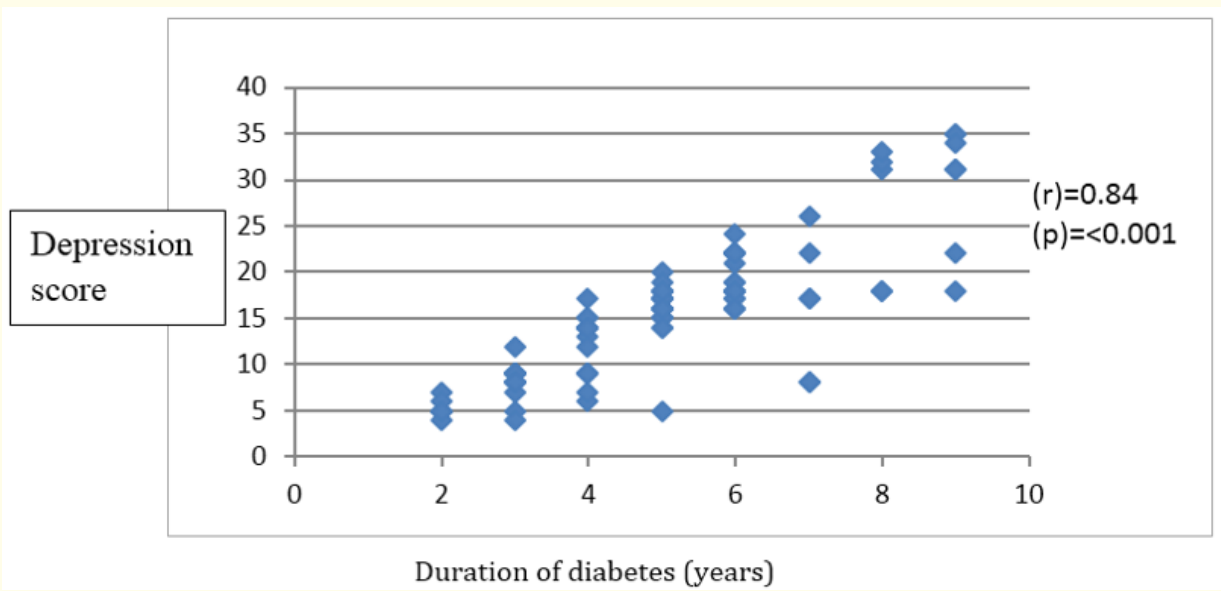

Figure 3: *Correlation of duration of diabetes with depression in adolescents with diabetes type 1.*

There was a significant association between gender and degree of anxiety as females showed higher degrees of anxiety ($p = 0.03$). On the contrary, no statistically significant association between gender and degree of depression ($p > 0.05$). The results showed no significant association between degree of depression or anxiety and educational level or socioeconomic standard ($p > 0.05$). Also, insulin regimen (conventional or intensive) had no statistically significant relation to degree of depression or degree of anxiety ($p > 0.05$).

There was a significant association between compliance to treatment and degree of depression ($p = 0.05$), and degree of anxiety ($p = 0.03$), so that non-compliant patients had higher degrees of depression and anxiety (Table 3).

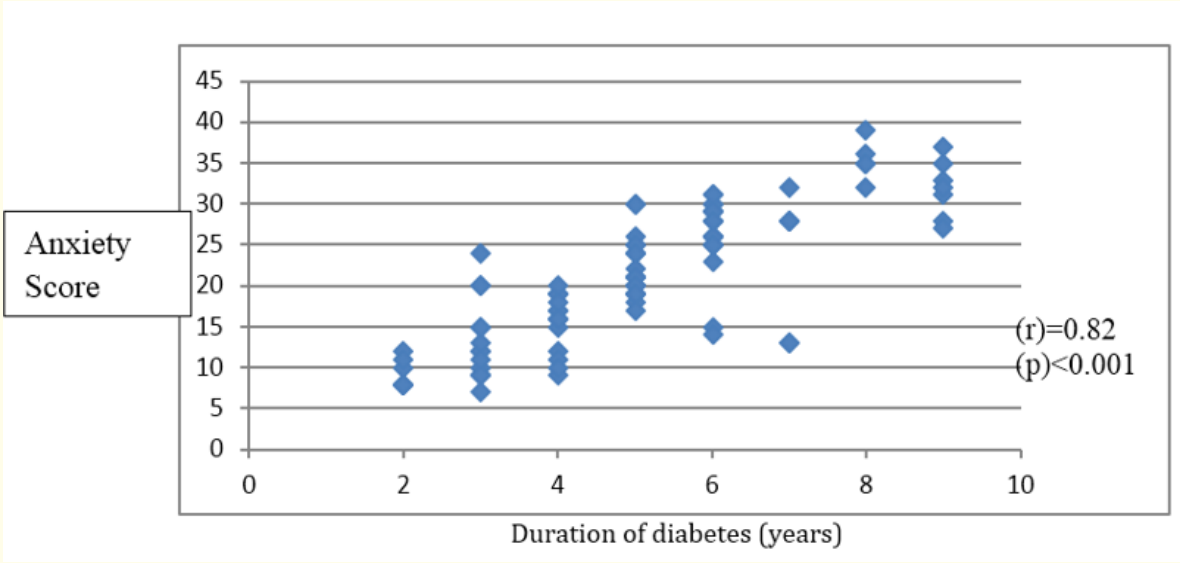

Figure 4: *Correlation of duration of diabetes with anxiety in adolescents with diabetes type 1.*

There was high positive correlation between MRBG level with depression (r = 0.29, p = 0.003) and anxiety (r = 0.23, p = 0.01). HbA1c was also positively correlated with depression (r = 0.7, p < 0.001) and anxiety (r = 0.58, p < 0.001) (Figures 5 and 6). However, no significant relations were found between HDL, LDL, Triglycerides, total cholesterol or albumin creatinine ratio with depression or anxiety (p = >0.05).

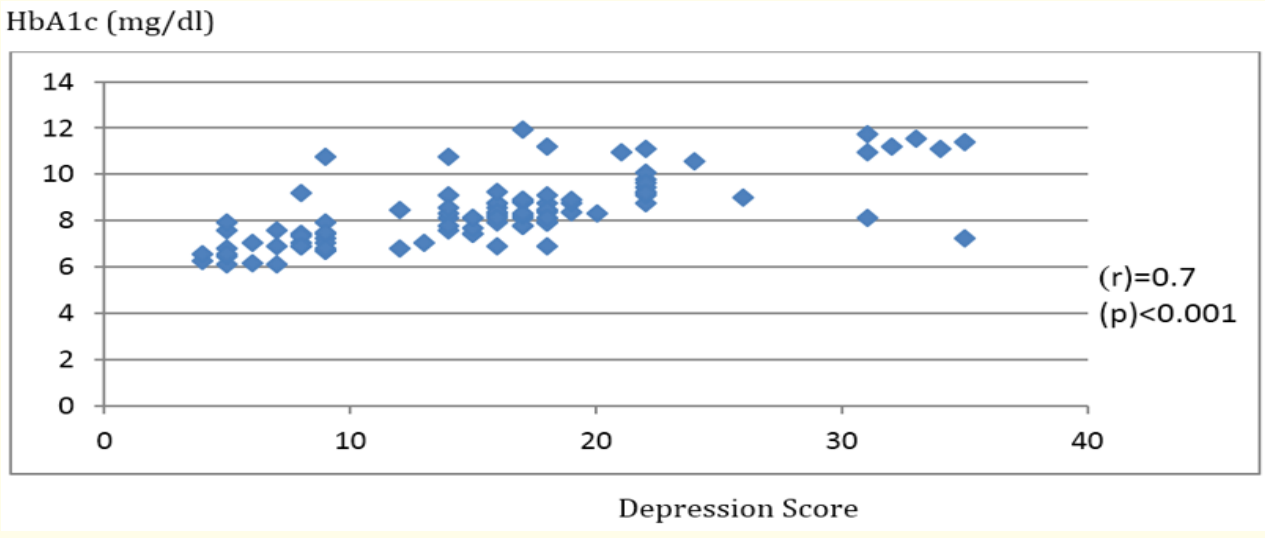

Figure 5: *Correlation of HbA1c with depression in adolescents with type 1 diabetes.*

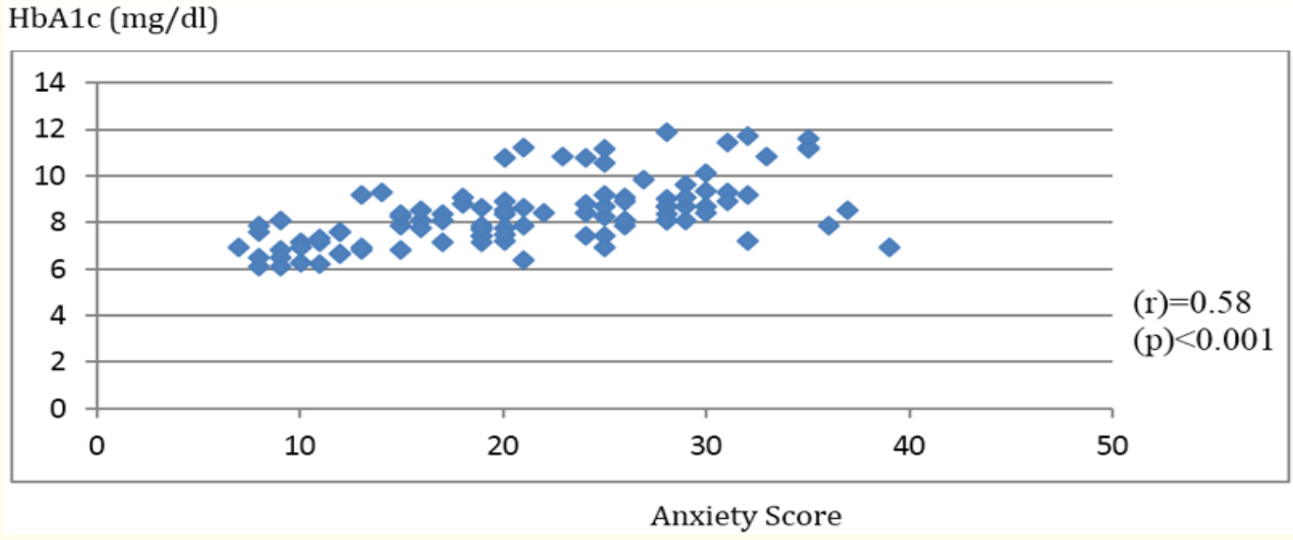

Figure 6: *Correlation of HbA1c with anxiety in adolescents with type 1 diabetes.*

	Degree of depression				Degree of anxiety		
	No (27)	**Mild (23)**	**Moderate (41)**	**Severe (9)**	**Mild (35)**	**Moderate (44)**	**Severe (21)**
Gender							
Male	16	7	3	0	11	12	3
Female	11	16	38	9	24	32	18
P value	> 0.05				= 0.03		
Education							
Not	3	7	4	4	5	6	18
Still sat	24	16	37	5	30	38	82
P value	> 0.05				>0.05		
Socioeconomic							
Low	5	4	4	1	8	3	3
Middle	22	19	37	8	27	41	18
P value	> 0.05				>0.05		
Insulin regimen							
Intensive	27	19	31	5	32	36	14
Conventional	0	4	10	4	3	8	7
P value	> 0.05				>0.05		
Compliance							
Negative	16	23	41	9	26	42	21
Positive	11	0	0	0	9	2	0
P value	= 0.05				= 0.03		

Table 3: *Relation between gender, educational level, socioeconomic standard, insulin regimen, compliance to treatment and both depression and anxiety in adolescents with type 1 diabetes.*

Discussion

The current study shows that 73% of adolescents with type 1 diabetes have depression with a mean Children Depression Inventory score of 15.86 ± 7.29 SD, and that 100% of them have anxiety with a mean Children Anxiety Scale score of 21.35 ± 8.05 SD. The depression and anxiety co-morbidity exists in 73%.

Intensive treatment with multiple insulin injections and frequent self-blood glucose monitoring especially with longer diabetes duration reflecting the burden of treatment and advancing disease that can increase negative emotions and maladaptive behaviors [14]. Nouwen., *et al.* [15] stated that diabetes appears to be a risk factor for depression. Also, researches indicated shared predisposing and precipitating factors between diabetes and depression. Both conditions show familial clustering suggesting possible genetic influence or shared environments influencing disease pathogenesis and progression [16,17].

Other similar studies reported different frequencies; Zdunczyk., *et al.* [18] reported 39% had depressive symptoms (CDI > 13) (the clinical cutoff), Lawrence., *et al*. [19] reported 22.8% where Center for Epidemiological Studies-Depression Scale (CES-D) >16 (the clinical cutoff), and Herzer and Hood [20] reported 21% had CDI score > 13 (the clinical cutoff). In another analysis conducted by Grey., *et al.* [21] they found that the overall prevalence of depressive symptoms was 17, depressive symptoms were more common in the earlier years post diagnosis, less common between 4 and 9.9 years after diagnosis and rose again after 10 years.

These variations in the prevalence of depression in people with diabetes suggest international variations in prevalence, how symptoms of depression are reported [22], variation in the scoring system used and the clinical cutoff value.

Also, it is important to note that measures of depressive symptoms and anxiety symptoms all were based on self-report scales alone, which might be less reliable for younger adolescents. We also need to put in consideration the different social factors affecting patients in different geographical regions.

Herzer and Hood [20] found that 13.4% and 17% of adolescents who had a diagnosis of type 1 diabetes reported state and trait anxiety scores (respectively) and approximately 21% of adolescents had CDI (as a measure of depression) scores ≥ 13 (the clinical cutoff). Northam., *et al.* [23] reported 17% anxiety disorders in the sample of children with Type 1 diabetes. Also, Axelson and Birmaher [24] found that anxiety disorders and depression are frequently comorbid in children and adolescents. About 25 - 50% of depressed youth have comorbid anxiety disorders and about 10 - 15% of anxious youth have depression.

As regards gender relation to anxiety, the current study showed a significant association between gender and degree of anxiety as females showed higher degrees of anxiety. This gender difference can be explained by genetics determinants, the disturbance of neurotransmitter systems and fluctuation in reproductive hormones. Psychosocial risk factors might also be involved in explaining the gender difference [25]. Anxiety disorders have been shown to be more common in females at an earlier age as by the age of six years, females are twice as likely as males to have experienced an anxiety disorder [26].

Results of the current study revealed no significant association between degree of depression or anxiety and age, educational level or socioeconomic standard ($p > 0.05$). Other studies came in concordance are: Herzer and Hood [20], Grey., et al. [21] and Hood., et al [27].

The age of onset of diabetes and diabetes duration were significantly correlated with degree of depression and anxiety. These findings indicate that the degree of depression and anxiety were likely a result of the difficulties encountered in living with Type 1diabetes and its stressors, and accumulated burden of problems related to longstanding diabetes including; restriction of social life, physical disturbances, to some extent limitations in physical activity, daily inconveniences in managing diabetes, emotional distress and worries about long-term complications.

Katon., *et al.* [28] reported major depression had an earlier age of onset of diabetes. Also, Cho., *et al.* [29] found that depression score was higher in old children and adolescents with diabetes type 1 (disease duration ≥ 1 year) and Grey., *et al.* [21] found that duration of diabetes was significantly correlated with depressive symptoms. However, our result disagreed with Hood., *et al.* [27] and Herzer and Hood [20] who reported that depression was not correlated with duration of diabetes. This could be explained by the diverse methodological details including study design, sample source and, and depression and anxiety assessment techniques.

In the present work, no significant relation between degree of depression or anxiety to weight, height or BMI ($p > 0.05$). This came in concordance with the results of Grey., *et al.* [21], Wardle., *et al.* [30], and Lee., *et al* [31]. On the contrary, Anderson., *et al.* [32] reported that only females obese as adolescents may be at increased risk for development of anxiety disorders, and Visser-van., *et al.* [33] who reported that short adolescents exhibited higher than normal scores for anxious/depressed behavior which were significant ($p = 0.03$). The disagreement between findings of our study and findings of the prior study maybe due to diversity in the study samples or the measures assessing depressive and anxiety symptoms.

Our results showed that insulin regimen had no statistically significant relation to the degree of depression or the degree of anxiety ($p = > 0.05$) that came in concordance with results reported by Cho., *et al* [29]. It is suggested that the number of daily insulin injections does not affect the risk of developing psychological distress.

There was a significant association between compliance to treatment and degree of depression ($p = 0.05$) and anxiety ($p = 0.03$). Associated psychosocial stress and reduced coping ability may contribute to depression. Additionally, the psychological burdens of diabetes treatments, such as insulin injection or self-blood glucose monitoring, can increase negative emotions and maladaptive behaviors and lead to a loss of interest, abnormal eating patterns and poor treatment compliance [34].

Also, Herzer and Hood [20], Rewers., *et al.* [35], McGrady., *et al.* [36] and Hilliard., *et al.* [37] found that psychological symptoms (depression and anxiety) complicate diabetes management and detract from regular blood glucose monitoring (BGM), subsequently leading to suboptimal glycemic control. However, Herzer and Hood [20] found adolescent state anxiety was significantly correlated with SBGM frequency ($r = -.25$, $p < .001$), and depressive symptoms ($r = .55$, $p < .001$). Adolescent trait anxiety was also associated with BGM frequency ($r = -.17$, $p = .005$) and depressive symptoms ($r = .72$, $p < .001$).

Results of the current study revealed that there was a high positive correlation between mean HbA1c level with depression ($r = 0.7$, $p < 0.001$) and anxiety ($r = 0.58$, $p < 0.001$) as patients with poor glycemic control had higher degrees of depression and anxiety. MRBG was also positively correlated with depression ($r = 0.29$, $p = 0.03$) and anxiety ($r = 0.23$, $p = 0.01$). These findings could be explained by the association between the presence of anxiety and depressive symptoms and the greater perceived illness burden as well as functional impairment and their associations with SBGM frequency and glycemic control. Further, both anxiety and depression are associated with increased cognitive burden [20]. So that, poorer control, and less frequent SBGM, as an indicator poor compliance, were associated with higher levels of depressive symptoms. These associations can be bidirectional (e.g. more depression causing poorer glycemic control and vice versa) and are connected (e.g. less adherence leads to poorer glycemic control) [27].

In concordance with this, Hilliard., *et al.* [37] reported that higher depressive symptoms (higher CDI scores) were correlated with higher HbA1c level ($r = 0.22$, $P < 0.01$). Likewise, higher anxiety symptoms (higher STAIC-state scores) were correlated with higher HbA1c ($r = 0.30$, $p < .001$). In addition, Cho., *et al.* [29] found depression scores were significantly higher in poorly controlled subjects than in normal control subjects. Furthermore, Herzer and Hood [20] found that adolescent state anxiety was significantly correlated with A1C values. Also, Lawrence., *et al.* [19] indicated that participants' level of depressed mood was associated with their HbA1c as higher mean HbA1c was associated with depressed mood ($P < 0.01$).

In the present work, serum concentrations of HDL cholesterol, LDL cholesterol, triglycerides, total cholesterol and urinary albumin/creatinine ratio were not found to be correlated with degrees of depression or anxiety ($p = >0.05$). Bajaj., *et al*. [38] reported that the prevalence of dyslipidemia as one of diabetes complications, although higher among those with depression, was not statistically significant, however they found that positive urine microalbumin was significantly associated with depression in newly diagnosed type 2 diabetics.

Possible explanations to the contradictory results are that; different study designs, various depression assessment scales used, different sample sizes, contained a small proportion of depressed subjects, covered a restricted age range such as adolescents or pre-puberty children, or included either males or females and others included patients with type 2 diabetes, this reduce comparability of studies and genaralizability of results to general practice.

Conclusion

In conclusion, all patients with type 1 diabetes mellitus in the current study have been found to have anxiety while the majority of them suffered from depression (73%). Anxiety and depression can be attributed to; prolonged duration of diabetes, poor glycemic control, and non-compliance to treatment. Anxiety and depression should be considered serious complications of diabetes, along with retinopathy, neuropathy, nephropathy, and cardiovascular disease. Under-recognition of psychological disorders in adolescents with diabetes is a major concern. Treatment of these psychological disorders in diabetic adolescents should receive great attention.

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