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Prevalence of depressive symptoms in school aged children with type 1 diabetes – a questionnaire study

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Summary

Aim. Current studies show that diabetic patients are at greater risk of developing psychiatric disorders than general population. The aim of this study was to evaluate the frequency of depressive symptoms in school-aged children with type 1 diabetes (T1D).

Methods. The study involved 477 children with T1D, with mean age of 13.1 ± 2.7 years and mean diabetes duration of 5.0 ± 3.5 years, treated for at least one year. Patients were asked to fill out the Polish version of the Children's Depression Inventory (CDI) and Quality of Life Questionnaire. Demographic data such as height, weight, diabetes duration, daily insulin dose (TDD) was also collected.

Results. 17% (81/477) of all participants presented depressive symptoms (CDI ≥ 13 scores), 20.9% of them were children ≥ 12 years of age, and 8.1% of them were children at the age of ≤ 12 years, $p = 0.0005$. Participants with CDI scores of 13 or higher were older ($p = 0.002$), had higher BMI ($p = 0.029$), TDD ($p = 0.026$) and lower quality of life ($p < 0.0001$) in comparison with children who scored < 13. There was no difference in glycated haemoglobin (HbA1c) values between groups with and without depressive symptoms ($p = 0.249$). However, there is a correlation between HbA1c value and CDI score ($r = 0.16$; $p = 0.0002$).

Conclusions. Depressive symptoms were observed in 1 out of 12 T1D children in a primary school and in 1 out of 5 teenagers. Depressive symptoms may affect metabolic control and quality of life. Therefore, early detection and treatment of depressive symptoms in T1D school children is needed.

Key words: depression, quality of life, diabetes mellitus

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Introduction

Type 1 diabetes (T1D) is a serious, life-threatening disease affecting a steadily growing number of children and adolescents [1]. Treatment requires adherence to a strict daily regimen that involves frequent monitoring of blood glucose, food intake and insulin dosing. The responsibility for management of diabetes is mainly placed in the hands of patients and their families [2]. Extensive education of paediatric patients with T1D and their families provides knowledge on the target HbA1c levels and the consequences of non-compliance. Children live in constant vigilance with regard to their blood glucose level and are under pressure to respond quickly to any deviations from its optimal values. Still, variations in daily routine with different physical activities, unpredictable food intake, particularly in case of small children and snacking in youths, as well as hormonal changes in adolescents make good metabolic control a challenge. Researchers demonstrate that fear of hypoglycaemia, an acute and potentially life-threatening complication is common in patients with T1D and their families [3, 4]. Especially nocturnal hypoglycaemia poses particular danger, as patients are unlikely to recognise the symptoms or are unable to wake up. Chronic fatigue caused by lack of sleep, anxiety, living under prolonged stress or lack of support may lead to development of Posttraumatic Stress Disorder and depression in parents caring for children with T1D [5–7]. Less active parental involvement in the tasks related to diabetes, depression and difficulties in transferring responsibility to a child on one hand and communication problems associated with adolescence, and treatment non-compliance leading to deterioration of metabolic control on the other, are likely to increase stress and conflicts in the family [7–9].

Negative family interactions, particularly critical parenting behaviours (i.e., criticism, nagging, and negativity), were shown to be associated with worse adherence and metabolic control as well as lower self-efficacy and more pronounced depressive symptoms in diabetic preadolescents and adolescents [10, 11]. Ineffective management of diabetes affects quality of life and increases the risk of depression in a child and its parents [12].

Many studies show that diabetic patients are at greater risk of developing psychiatric disorders than general population. Main concerns involve eating disorders with prevalence ranging from 8 to 30%, depression (10–26%) anxiety (9–19%) and disruptive behaviour problems (12–20%) [13]. Researchers demonstrate the association between these disorders, predominantly depression, and poor metabolic control, worse quality of life, coping and family functioning [14–16].

Aim

The aim of this study was to evaluate the frequency of occurrence of depressive symptoms in type 1 diabetic children.

Material

The study was performed in the Department of Paediatrics, Medical University of Warsaw. The studied group included children at the age between 7 and 18 years diagnosed with diabetes at least 1 year prior. Further analysis was conducted on all 477 children (252 girls and 225 boys) with mean age of 13.1 ± 2.7 years, mean diabetes duration of 5.0 ± 3.5 years and mean HbAc 7.6 ± 1.1. 147 children were in primary school (< 12 years of age), 330 participants were in secondary school (>12 years of age). All participants were treated with intensive insulin therapy, 437 out of 477 (92%) children were treated with continuous subcutaneous insulin infusion, other participants administered insulin using multiple daily injections. Participants with type 2 diabetes, mental dysfunction or genetic disorders were excluded from this study. All participants were Polish-speaking.

Method

During the routine visit in the outpatient clinic, participants were asked to fill in Polish version of Children's Depression Inventory (CDI) by Maria Kovacs. This self-report questionnaire is often used in clinical studies due to high coefficient of reliability (Cronbach's alpha between 0.81 and 0.89). This questionnaire consists of 27 items, each with three answers scored from 0 to 2 points. The questions create 5 subscales evaluating different depressive symptoms: negative mood, anhedonia, ineffectiveness, negative self-esteem and interpersonal problems. Patient should cross one answer which characterises the feelings present in the last 2 weeks. According to Children's Depression Inventory Manual a score of 13 points and higher has optimal sensitivity and specificity to indicate elevated depressive symptoms, while a score higher than 19 points indicates severe depression [17]. Additional analysis was performed in the group of children attending primary school (< 12 years of age) following some authors' suggestions that a score of 11 points is a cut-off indicating elevated depressive symptoms [18]. Patients aged 11 and older were additionally asked to answer questions in 58-item Quality of Life Questionnaire, based on the DCCT Diabetes Quality of Life Measure [19]. This tool is specifically related to diabetes and measures different aspects of life with T1D. At the same time other data, important in diabetes treatment and associated with depression, such as body mass index (BMI), daily insulin dose, a place of living, was collected. Metabolic control was assessed by glycated haemoglobin (HbA1c) level. Each child provided a sample of blood for glycated HbA1c measured by high-performance liquid chromatography (reference range 4.0 – 6.0%, Bio-Rad Polska Tosoh 2.2; Tosoh Bioscience, South San Francisco, CA). To define good metabolic control HbA1c cut-off of 7.5% was chosen following International Society for Paediatric and Adolescent Diabetes (ISPAD) guideline [20]. The study was approved by the Medical University of Warsaw Bioethical Committee.

Statistical analysis

The results were analysed using Statistica 8.0 for Windows (StatSoft, Poland). The assumption that data was sampled from populations that follow normal distribution was tested using the Kolmogorov–Smirnov test. The comparisons between groups were made with the use of the Student's t-test or, in the case of non-parametric data, the Mann–Whitney U test or Chi-square tests. Odds ratios (OR) was calculated with 95% confidence intervals (CI). Correlations were made using Spearman rank correlation and logistic regression. P-values less than 0.05 were considered as significant.

Results

477 out of 500 (95.4%) questionnaires handed out to eligible children were included in our analysis. 23 questionnaires were excluded from the study due to incomplete data. In the present study, internal reliability coefficient was Cronbach's alpha = 0.88 (Cronbach's alpha ranging from 0.86 to 0.88 for subscales). Internal reliability coefficient for the present sample was Cronbach's alpha = 0.89.

17% (81/477) of participants reported depressive symptoms, as indicated by CDI scores ≥ 13. There was a statistically significant difference between participants with CDI < 13 and CDI ≥ 13 in all subscales evaluating different depressive symptoms. Participants with scores of 13 or higher were older (p = 0.002), had statistically higher BMI (p = 0.029) and total daily insulin doses (p = 0.026) in comparison with children who scored below 13 (Table 1).

Table 1. **Characteristics of participants with and without depressive symptoms**

	CDI score <13	CDI score ≥ 13	p
N	396	81	-
Age (years)	12.9 ± 2.9	14 ± 2.5	0.002
Sex (female/male)	196/200	49/32	NS
BMI (kg/m^2)	20.2 ± 3.4	21.0 ± 3.4	0.029
Daily insulin dose (U/kg/24h)	0.81 ± 0.25	0.88 ± 0.2	0.026
HbA1c (%)	7.7 ± 1.5	7.8 ± 1.4	NS
Diabetes duration (years)	5.5 ± 6.4	5.6 ± 3.5	NS

CDI – Children's Depression Inventory; BMI – Body Mass Index; HbA1c – glycated haemoglobin; NS – not significant

There was no difference in diabetes duration between children with CDI scores ≥ 13 and < 13 as well as no correlation was found between diabetes duration and CDI scores (r = 0.09; p = 0.053). We did not find any statistical difference in the prevalence of elevated depressive symptoms between girls and boys (χ^2 = 2.8; p = 0.092). There were no differences in the number of children with elevated depressive symptoms living in large cities 36/213 (15%), small cities (below 20 thousand of inhabitants) 24/120

(20%) and villages 21/144 (15%), (total $\chi^2 = 2.1$; $p = 0.352$). Mean HbA1c was slightly higher in children with scores of 13 or higher on a CDI scale compared to participants scoring below 13, however, without statistical difference ($p = 0.249$). There was a poor correlation between the HbA1c level and CDI scores ($r = 0.16$; $p = 0.0002$). Analysis of diabetes control did not show any statistical differences in the number of children with depressive symptoms between groups with different HbA1c levels: 24/181 (13%) HbA1c ≤ 7% vs. 25/138 (18%) HbA1c 7–8>% vs. 18/77 (22%) HbA1c 8–9% vs. 9/42 (21%) HbA1c 9–10% vs. 6/38 (16%) HbA1c ≥ 10%, $p = 0.414$ (Figure 1).

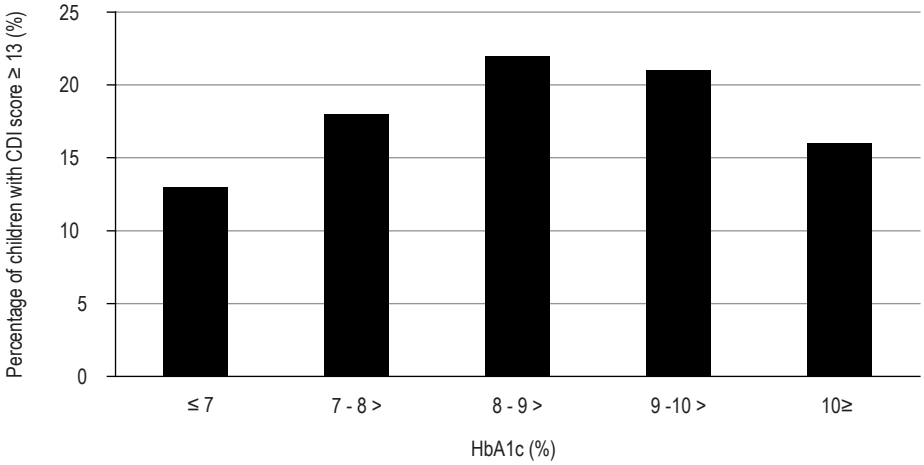

Figure 1. **Percentage of participants with CDI score ≥ 13 (%) in groups with different glycated haemoglobin (HbA1c) levels**

There was statistically significant correlation between CDI score and the quality of life $r = 0.65$, $p < 0.0001$ (Figure 2). Children with depressive symptoms (CDI ≥ 13) had lower quality of life than children scoring below 13 (mean 134, scores range 118–149 vs. 106 scores range 94–118, respectively, $p < 0.0001$).

4.8% (23/477) of participants scored ≥ 19 in CDI, indicating severe depressive symptoms. Mean age in this group was 14.3 ± 2.4, 4 children was below the age of 12, mean HbA1c level was 7.7 ± 1.6%. In the group over 12 years of age, 20.9% of children scored ≥ 13 in CDI, comparing to 8.1% of children under 12 years of age (OR 1.35, 95% CI 0.18–0.64; $p = 0.0005$). Considering lower cut-off point for children in primary school 14% (21/147) of participants scored ≥ 11 in CDI. In this group there were more boys than girls (14 vs. 7). There were no difference between children below the age of 12 and over 12 years of age in the number of depressive symptoms (CDI ≥13) (OR 0.63, 95% CI 0.35–1.09; $p = 0.099$). There were no differences in HbA1c, BMI and daily insulin dose between children in primary school with CDI ≥ 11 vs. CDI < 11. In comparison to subjects from a primary school, adolescents from a secondary school

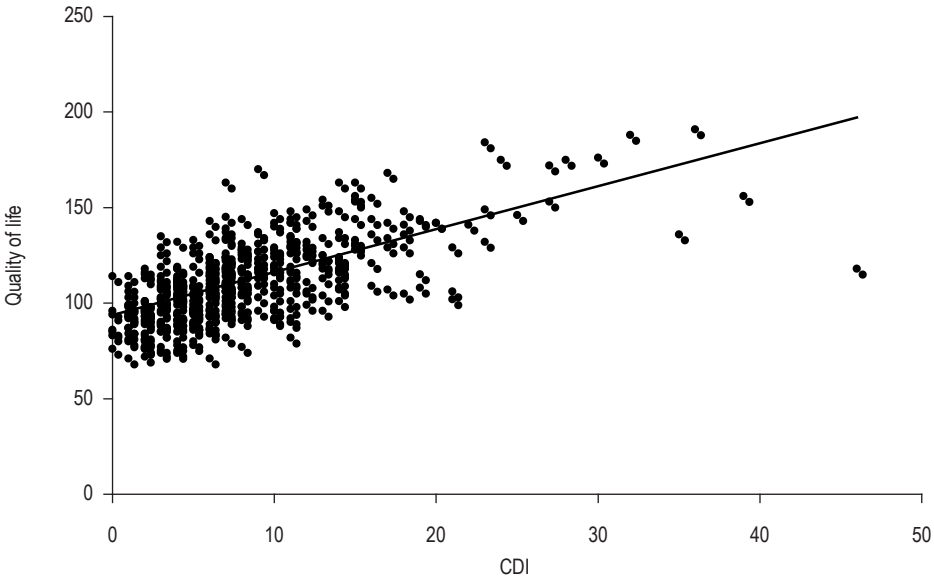

Figure 2. **Relationship between CDI score and the quality of life of all participants**

had statistically higher: HbA1c value (p = 0.0006), BMI (p = 0.0001), daily insulin dose (p = 0.0001) and longer diabetes duration (p = 0.0001). The characteristic of children in different age groups is shown in Table 2.

Table 2**. Characteristics of participants in different age groups**

	Children < 12 years	Children ≥ 12 years	p
N	147	330	-
Age (years)	9.5 ± 1.3	14.7 ± 1.7	0.0001
Sex (female/male)	83/64	162/168	0.165
BMI (kg/m2)	17.9 ± 2.3	21.4 ± 3.1	0.0001
Daily insulin dose (U/kg/24h)	0.77 ± 0.22	0.85 ± 0.26	0.0001
HbA1c (%)	7.3 ± 1.2	7.9 ± 1.6	0.0006
Diabetes duration (years)	4.0 ± 2.7	6.3 ± 8.9	0.0001
Number of children with CDI score ≥ 13/ <13	12/135	69/261	0.0005

CDI – Children's Depression Inventory; BMI – Body Mass Index; HbA1c – glycated haemoglobin

9.8% (47/477) of participants reported suicidal ideation although without intention to commit it as based on answer to question 9 on the CDI. Suicidal ideation had a significant impact on CDI scores (OR = 1.2, 95% CI 1.1–1.3; p < 0.0001) and quality of life (OR = 0.04, 95% CI 1.03–1.06; p < 0.0001) but not on HbA1c (OR = 1.2, 95%

CI 0.97–1.4; p = 0.111). 38% (18/47) of participants who reported suicidal ideation scored below 13 on the CDI.

Discussion

Current analysis showed that 17% of examined subjects reported depressive symptoms. Further evaluation of the prevalence of depressiveness in relation to HbA1c indicated an increase in depressive symptoms with rising HbA1c values but this correlation was weak. This result may be a result of relatively good metabolic control of the whole research group which oscillates around the recommended optimal level of HbA1c.

Similarly to our observation, previous studies reported particularly high risk of depression in youths with T1D. Depending on a testing method and population the rates of depressive symptoms in diabetic children range from 15 to 20 % compared with less than 7% in youths without diabetes [14, 21, 22]. Moreover, previous studies pointed out that depressive symptoms were linked to suboptimal metabolic control in type 1 diabetic children [15, 23, 24]. Increase in HbA1c values were associated with an increase in depressive symptoms. Present analysis is partially consistent with the results of other authors. However, in our study further increase in HbA1c over 8% was not accompanied by an increase in prevalence of depressive symptoms. What is even more surprising, comparison of children and adolescents with higher and lower scores in CDI shows that patients with scores higher than 13 points obtained similar level of HbA1c to their peers without reported depressive symptoms. Strong association between HbA1c and depression reported by other authors inclines to regard HbA1c as a hidden measure of depressive symptoms but our results do not confirm such a suggestion. Our earlier study also showed a high prevalence (18%) of depressive symptoms in youths with good metabolic control (HbA1c < 7.5%). Children with good metabolic control and long diabetes duration were particularly at risk of developing depression [25]. Butwicka et al. recommended paediatric diabetologists HbA1c level as a useful screening tool for depression [26]. In such a situation it is easy to overlook depressive symptoms in patients with good metabolic control.

92% of children who participated in our study were treated with continuous subcutaneous insulin infusions. Previous studies showed that children treated with insulin pump therapy reported more flexibility in lifestyles compared with multiple daily injections [27]. Unfortunately, using continuous subcutaneous insulin infusion does not free patients from the day-to-day management aimed at achieving good diabetes control, it is sometimes required to measure glycaemia even more often than being treated with pen therapy.

In a group of our patients with tight glycaemic control a large percentage of children reported depressive symptoms. In our study, the quality of life in children with depressive symptoms was lower than in subjects without depressive symptoms. Our observations are consistent with those of other authors, who reported that worse

metabolic control may affect the quality of life [28]. What is even more worrying in our sample we found a large group of patients who do not report depressive symptoms but present suicidal ideation. As much as 14.8% of these children achieved excellent metabolic control. Although depression is associated with low self-esteem, loss of interest in daily activities and diabetes self-care [29], we may only speculate that in this group of patients suicidal thoughts are not related to diabetes. Probably their life is so concentrated on illness that their other activities are left to minimum with little pleasure left beside success in good HbA1c level.

The question is raised what causes such a high prevalence of depressive symptoms in children and adolescents with good metabolic control. We have no data on their functioning in family, school performance and their relationships with peers. We may only speculate that other environmental and psychophysical factors but diabetes affect the mood of these patients [30].

It is very important to follow-up patients whose scores indicate elevated levels of depressive symptoms. Clinical studies point out to a high risk of recurrence and persistence of depression. Asarnow et al, reported that 45% of patients discharged with diagnosis of major depressive disorder were rehospitalised within 2 years due to recurrence of depression or suicidal behaviours [31]. Kovacs et al. observed that 69% of children with diagnosis of major depression disorder recovered. Within 2 years of recovery depression reoccurred in 32% of patients, and after 6.5 years – in 47%. Only 37.5% of children received treatment after the first episode of depression [32].

We observed higher BMI and daily insulin dose in subjects reporting depressive symptoms. It can be assumed that food is a way of coping with stress in these patients. Researchers show that some individuals not only increase their food consumption but also shift from healthy products to higher fatty foods which they normally avoid [33]. In patients with diabetes such changes in diet mean the increase in insulin dose leading to higher BMI.

In our study, mean duration of diabetes was similar (over five years) in groups with and without depressive symptoms. Moreover, no correlation between the increase in symptoms of depression and diabetes duration was noticed. This finding is of great interest because the so-called burnout syndrome associated with reluctance to self-control of glycaemia is often observed in clinical practice after several years of illness. We noted significantly higher number of adolescents reporting depressive symptoms than children below the age of 12. The number of depressive episodes rise with age from 1–2% in preschool children, to 5% in early adolescence and up to 20% in late adolescence [34]. Maturation processes, brain development, biological and psychological changes characteristic for adolescence are seen as factors contributing to depression development. In case of patients with diabetes poor metabolic control causing hormonal and neurotransmitter imbalance may be an additional element triggering mood disorders. Still, when we look at the prevalence of depression reported in population based studies our sample group did not differ in the number of reported depressive symptoms from general population of adolescents. At the same time we

noted an unexpected high number of depressive symptoms in younger group of participants in comparison with children from general population. It is likely that early diabetes onset affects maturation processes in these children with necessity to take responsibilities, to obey more rules, to learn to resign from activities to comply with diabetes requirements and be all the time vigilant about the current state of health. The burden of the illness may take its toll not only on a patient itself but also on his/her parents and the whole family, adding to already present stress. In case of younger children with diabetes the responsibility for diabetes management is mostly placed in hands of caregivers. Worries about parents, feelings of guilt for being a burden to family, conflicts between parents about diabetes management, anxiety may be additional factors leading to depression development. Data on depression in preadolescent children is scarce. Researchers usually focus more on adolescents with diabetes and the problem of adherence to treatment stemming from depression. As clinical features may differ from the ones present in adolescents and adults it is also easy to overlook symptoms of depression in younger children.

We were surprised not to find any differences between boys and girls in the whole studied group in prevalence of depressive symptoms. It is not consistent both with trends in general population and in patients with diabetes [34]. It is a question if wide age range had an effect on the lack of those differences. In this situation, reversed proportions between boys and girls in younger age groups (< 12 years of age) are even more surprising. In this group more boys than girls reported depressive symptoms. Our study concentrates on prevalence of depressive symptoms in children and adolescents with diabetes type 1. We should take into consideration the difference between girls and boys in the meaning of illness for both sexes, diabetes experience and coping skills. Girls at this age may experience less problems with adherence to treatment while for boys diabetes may limit their physical activity and cause the feeling of being left out on one hand, on the other – fear of hypoglycaemia in parents may make them overprotective towards their child reducing his participation in sport – a very important activity at this age in building self-image and relationships with peers [30].

There are several limitations to our study. This is a questionnaire study; the participants of survey fill out CDI questionnaire on their own. Not all answers can be reliable as patients may have a tendency to overestimate or underestimate their symptoms. Secondly the CDI was used for screening the depressive symptoms and not to diagnose depression. Respondents who scored higher than 13 points require further psychiatric diagnosis. We compared our study results with estimated prevalence of depression reported in population based studies, and not with control group of Polish children and adolescents. As researchers use different screening methods the results may also differ.

Conclusion

Summing up, depressive symptoms were observed 1 out of 12 T1D children from a primary school and in 1 out of 5 teenagers. Depressive symptoms are associated with worse quality of life and metabolic control. Our results show that depression poses a clinical problem affecting not only children with poor metabolic control but also those who achieve a good HbA1c level. It is customary to focus on patients who do not adhere to treatment requirements, mainly adolescents, often overlooking problems of prepubertal children.

Based on our study results, screening all children with diabetes, regardless of age and metabolic control, for depression is highly recommend.

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