ORIGINAL ARTICLE

Psychiatric disorders in adolescents with type 1 diabetes: a case-control study

Mireille C. Almeida,[1] Denise A. Claudino,[1] Ruth B. Grigolon,[1] Bacy Fleitlich-Bilyk,[2] Angélica M. Claudino[1]

[1]Departamento de Psiquiatria, Universidade Federal de São Paulo (UNIFESP), São Paulo, SP, Brazil. [2]Instituto de Psiquiatria, Faculdade de Medicina, Universidade de São Paulo (IPQ-FMUSP), São Paulo, SP, Brazil.

Objectives: To study the prevalence of psychiatric disorders in adolescents with and without type 1 diabetes, the factors associated with its presence, and to test the reliability of a screening tool for use in clinical settings.

Methods: Eighty-one adolescents were enrolled in this case-control study, including 36 diabetic participants and 45 controls. Clinical and sociodemographic data were collected and psychiatric symptoms and diagnoses were obtained from adolescents and their parents using a screening tool (Strengths & Difficulties Questionnaire) and a semi-structured interview (Development and Well-Being Assessment).

Results: Psychiatric disorders were identified in 22.2% of the sample (30.56% among diabetic adolescents vs. 15.56% of controls: OR = 2.39, 95%CI 0.82-6.99; p = 0.11). Overweight (body mass index percentile $\geqslant$ 85) was the only factor associated with psychiatric disorder (OR = 3.07; 95%CI 1.03-9.14; p = 0.04). Compared to the semi-structured interview, the screening instrument showed 80% sensitivity, 96% specificity, 88.9% positive predictive value and 92.3% negative predictive value for the presence of psychiatric diagnoses in adolescents.

Conclusion: Psychiatric morbidity was high in this sample of adolescents, especially among those with diabetes. Routine use of the Strengths and Difficulties Questionnaire can help with early detection of psychiatric disorders in this at-risk group.

Keywords: Adolescent; epidemiology; child psychiatry; diabetes mellitus; type 1

Introduction

Adolescence is a transitional period characterized by significant physical, mental and social changes. For this reason, it is a period of high risk for the development of psychiatric disorders, especially anxiety disorders and depression.[1] A substantial increase in the rate of psychiatric diagnoses among adolescents has been observed in recent years.[2] A meta-analysis of 41 studies from 27 different countries evaluating the worldwide prevalence of psychiatric disorders among children and adolescents found a mean rate of 13.4% of individuals with a mental illness.[3] Studies specifically examining the prevalence of mental disorders during adolescence are more scarce, but an estimated prevalence of 11-18% for this age group has been reported.[4,5] Type 1 diabetes mellitus (T1D), the juvenile form of diabetes, is a chronic endocrine disease that commonly emerges abruptly during childhood and adolescence. Individuals with T1D, generally young and previously healthy, become dependent on exogenous insulin to prevent metabolic decompensation and death.[6] It follows that T1D would add greater emotional instability to the common turbulence of adolescence, since these individuals must face a series of significant changes in their lives and self-care routine to avoid medical complications.[6,7]

There is increasing worldwide interest in the impact of T1D on mental health and quality of life, with additional focus on the influence that this comorbidity might have on adherence to treatment and, consequently, on its effectiveness.[8-12] The literature supports an association between T1D and the presence of psychiatric disorders in adolescents, especially depression and anxiety.[13] As an important consequence of this association, a considerable deterioration in glycemic control in patients with T1D has also been shown.[14-16]

Despite the growing interest of the international scientific community in the field, this topic has not been object of systematic research in Latin American populations. Thus, the main aim of this study was to assess psychiatric diagnoses in a Brazilian sample of adolescents with and without T1D. We also examined certain factors that could be associated with the presence of a psychiatric disorder in the sample. Finally, we investigated the reliability of the Strengths and Difficulties Questionnaire (SDQ) compared to the Development and Well-Being Assessment (DAWBA) as a screening tool for psychiatric comorbidity in adolescents with T1D.

Methods

Participants

This sample was derived from a larger study that aimed to investigate disordered eating amongst children and adolescents with T1D attending the outpatient endocrinology clinic

Correspondence: Mireille Coêlho Almeida, Rua Borges Lagoa, 570, 7° andar, Vila Clementino, CEP 04038-000, São Paulo, SP, Brazil.
E-mail: mireille_coelho@hotmail.com

of the Universidade Federal de São Paulo's (UNIFESP) Pediatrics Department,[17] which also identified, using a self-report questionnaire, high levels of depressive symptoms in participants. Continuing the previous study and extending the exploration of psychiatric symptoms and disorders in adolescents with T1D, adolescents of both sexes from 11-16 years old who had been diagnosed with T1D for at least 6 months and were undergoing treatment at the above-mentioned clinic were invited between August 2013 and August 2014 to participate in this case-control study. Thirty-six adolescents agreed to collaborate. The exclusion criterion was any clinical comorbidity that could lead to specific dietary restrictions (criteria used for the previous eating disorder study). The control sample of this study consisted of adolescents of the same age range from two public schools and one non-profit educational institution located in the same region as the outpatient clinic (South Zone of São Paulo). They were invited to participate in the study between March and December 2015 and were paired (one-to-one) by sex and age with the T1D patients, although an additional 9 adolescents of the same age range who also volunteered for the study were included; thus, the control group included a total of 45 adolescents. The exclusion criterion for the control group was a diagnosis of T1D or any other disease that involved dietary restrictions. Volunteers and their parents/caregivers signed the informed consent form before participation in any procedures. This study was approved by the ethics committee of UNIFESP, in accordance with the Declaration of Helsinki.

Procedures and measures

Sociodemographic and biometric data, as well as clinical information regarding T1D, especially disease duration (in months) and glycosylated hemoglobin (HbA1c) were obtained through direct interviews conducted by the research team and from additional information available in the patients' medical records. Patient weight and height values on the day of the consultation were used to calculate body mass index (BMI), whose adequacy for age was assessed using National Center for Health Statistics standard curves for boys and girls. Data on HbA1c levels were gathered from the results of routine blood tests collected within a maximum interval of 4 weeks from the date the study questionnaires were applied. HbA1c analysis was conducted using the high performance liquid chromatography method at the Central Laboratory of the Hospital São Paulo/UNIFESP.

In order to assess the participants' psychopathological symptoms and psychiatric disorders, two well-established instruments, the SDQ screening test and the semi-structured DAWBA interview, were applied with prior permission from author Robert Goodman. The SDQ is a brief behavioral screening questionnaire used to predict the presence of a psychiatric diagnosis, whereas the DAWBA consists of a series of interviews and evaluation techniques developed for diagnosing psychiatric disorders in children and adolescents (5-17 years-old). The DAWBA includes a group of sections, and each section begins with a set of screening questions related to a particular psychiatric diagnosis. When symptoms are identified,

the interviewer is directed to semi-structured questions and additional open questions to more fully explore and clarify the nature of the problem. Information obtained from various sources (patient and parents) is inserted and then read by a specific computer program. The results are produced by summarizing the information provided in these reports and the preliminary diagnosis. This algorithm serves as a starting point for further assessment by an experienced clinician, which results in definitive diagnoses. The SDQ and DAWBA were translated into Portuguese and have been validated for the Brazilian child and adolescent population with good psychometric properties[18-20] and can also be used in clinical populations.[21,22] Both instruments were applied by trained research personnel, and the results were analyzed by two trained and experienced psychiatrists (MCA, DAC) and reviewed by a third (LVN). As recommended by the previously mentioned studies, a score $\geqslant 17$ was considered positive for SDQ.[23] DSM-IV diagnostic criteria were used as a reference for psychiatric diagnoses because the DAWBA was based on this system when our data collection began (2013).

Data analysis

Fisher's exact test and Student's t-test were used to compare sociodemographic and clinic characteristics between the groups, and then to investigate the existing relationship between psychopathological measures (SDQ, DAWBA) and HbA1c levels in individuals with T1D. Univariate logistic regression was used to investigate risk factors for psychiatric morbidity among the participants, including T1D. Finally, kappa statistics were used to check diagnostic agreement between the SDQ and DAWBA. The analyses were conducted in SAS® version 9.4, with a significance level of 0.05.[24]

Results

Eighty-one adolescents participated in this study, including 36 with T1D and 45 without (controls). The groups were homogenously distributed (p > 0.05) regarding sex, age, socioeconomic status (family income per capita and parental education) and nutritional status, as shown in Table 1.

The prevalence of mental disorders in this sample of adolescents was 22.2% (n=18/81). Among participants with a psychiatric disorder, 16.67% had two concomitant diagnoses (n=3/18). Mental disorders were more frequent in patients with T1D than controls: 30.56% vs. 15.56% (odds ratio [OR] = 2.389, 95% confidence interval [95%CI] 0.816-6.989), but the difference was not statistically significant (p = 0.112). The most prevalent psychiatric diagnoses in this sample according to the DAWBA were depression, anxiety disorders and developmental disorders. The complete distribution of psychiatric disorder prevalence by group is shown in Table 2. Since there were few or no individuals with certain categories of disorders, differences between groups per diagnostic category could not be tested.

Of the total sample, 32.5% had undergone some kind of psychological counseling prior to the study, and five (6.17%)

Table 1 Sociodemographic and clinic characteristics of the adolescents

	T1D group (n=36)	Control group (n=45)	Total (n=81)	
	n (%)	n (%)	n (%)	p-value*
Gender				0.822
Male	14 (38.89)	19 (42.22)	33 (40.74)	
Female	22 (61.11)	26 (57.78)	48 (59.25)	
Age (years)				0.785
11 and 12	10 (27.78)	16 (35.56)	26 (32.10)	
13 and 14	14 (38.89)	15 (33.33)	29 (35.80)	
15 and 16	12 (33.33)	14 (31.11)	26 (32.10)	
Family per capita income				0.216
< 1/2 minimum wage	20 (55.56)	17 (38.64)	37 (46.25)	
1/2 to 1 minimum wage	8 (22.22)	17 (38.64)	25 (31.25)	
> 1 minimum wage	8 (22.22)	10 (22.73)	18 (22.5)	
Parental education				0.798
Illiterate/incomplete elementary school	16 (44.44)	16 (36.36)	32 (40)	
Elementary school/incomplete high school	6 (16.67)	8 (18.18)	14 (17.5)	
High school or university level	14 (38.89)	20 (45.45)	34 (42.5)	

	n	Mean (SD)	n	Mean (SD)	n	Mean (SD)	p-value[†]
Body mass index	36	20.81 (4.03)	43	20.77 (3.74)	79	20.79 (3.85)	0.962
Glycosylated hemoglobin	31	9.21 (2.51)	-	-	-	-	
Age of T1D onset (years)	36	8.91 (2.84)	-	-	-	-	
Duration of T1D (months)	36	57.03 (35.83)	-	-	-	-	

SD = standard deviation; T1D = type 1 diabetes mellitus.
* Fisher's exact test; [†] Student's t-test.

Table 2 The prevalence of psychiatric disorders in adolescents according to the Development and Well-Being Assessment

	Type 1 diabetes group (n=36)	Control group (n=45)	Total (n=81)	p-value*
Any diagnosis	11 (30.56)	7 (15.56)	18 (22.22)[†]	0.112
Depression	6 (16.67)	-	6 (7.4)	
Anxiety disorders: separation anxiety, specific phobia, social phobia, generalized anxiety	3 (8.33)	3 (6.67)	6 (7.4)	
Eating disorders: bulimia nervosa, eating disorder not otherwise specified	1 (2.78)	-	1 (1.2)	
Developmental disorders: intellectual disability, attention deficit hyperactivity disorder	2 (5.56)	2 (4.44)	4 (4.9)	
Other disorders: post-traumatic stress disorder, oppositional defiant disorder, conduct disorder	2 (5.56)	2 (4.44)	4 (4.9)	

Data presented as n (%).
The listed psychiatric diagnosis corresponded to conditions presented by at least one participant.
* Univariate logistic regression.
[†] Of 18 adolescents with a psychiatric diagnosis, three had more than one diagnosis; thus, the sum of diagnoses (21) is greater than the number of participants with a psychiatric diagnosis (18).

had been seen by a psychiatrist. Of the 18 adolescents diagnosed with a psychiatric disorder, 50% were currently undergoing or had undergone psychological treatment; however, only 11.11% had ever received a psychiatric consultation.

Through univariate logistic regression, we tested several factors that could be associated with the presence of a mental disorder (DAWBA) in the total sample: diabetes, BMI, family history of psychiatric disorders. However, we only found higher risk for a BMI percentile $\geqslant$ 85 (24.59% vs. 50%; OR = 3.07; 95%CI 1.03-9.14; p = 0.044).

Considering the diabetic group specifically, there was no association between disease duration (T1D) and the presence of psychiatric comorbidity ($\leqslant$ 2 years, 18.18%;

Table 3 Strengths and Difficulties Questionnaire psychometric properties compared to Development and Well-Being Assessment in diabetic adolescents (n=36)

	Parent SDQ	Adolescent SDQ
Sensitivity	54.5	80
Specificity	72	96
Positive predictive value	46.1	88.9
Negative predictive value	78	92.3
Agreement (kappa) compared to DAWBA	12	78

Data presented as %.
DAWBA = Development and Well-Being Assessment; SDQ = Strengths and Difficulties Questionnaire.

2-4 years, 27.27%; 4-8 years, 36.36%; > 8 years, 18.18%; p = 0.563). In addition, the mean HbA1c level in adolescents with a psychiatric disorder was not significantly different than that of those without a comorbid psychiatric disorder (10.06% vs. 8.91%; p = 0.272). The distribution of psychiatric diagnosis (DAWBA) in relation to glycemic control (n=31) was as follows: among patients with HbA1c ⩽ 7.5% (n=10), 2 were positive and 8 negative; among those with HbA1c > 7.5% (n=21), six were positive and 15 negative (p = 0.310; Fisher's exact test).

Finally, the psychometric properties from the SDQ screening test were compared to those of the DAWBA interview for the diabetic group, and very good rates were found when the questionnaire was applied to adolescents. Comparative results (Parent SDQ vs. Adolescent SDQ) are presented in Table 3.

Discussion

The prevalence of psychiatric disorders in the total sample of adolescents was considerably high, with almost double the rate in the diabetic group, although this difference was not statistically significant. The main diagnoses identified among all participants were depression, anxiety and neurodevelopmental disorders. In addition, being in the overweight range increased the chance of a psychiatric disorder. However, only half of those with a disorder had received any kind of psychological care, and access to psychiatric evaluation was even more limited. The mean level of glycosylated hemoglobin in the adolescents with T1D was also high, but, unlike the findings of similar studies,[14-16] the presence of a mental disorder was not associated with poorer glycemic control (p = non-significant). Finally, we found very good psychometric properties for the SDQ screening instrument in comparison with diagnoses obtained using the DAWBA in the diabetic group, with an agreement rate of 78%.

Our findings were similar to those found in the literature,[16,25] which have described rates of psychiatric disorders among adolescents with T1D up to 37% (depending on study design and instrument used).[13,25,26] During the development of this case-control study, large and important studies were published,[21,26] which clearly reinforce the impact of diabetes as a risk factor for developing a psychiatric disorder. Stahl-Pehe et al.,[21] in a German population study involving 629 adolescents (11-17 years old) with early onset and long-duration T1D, and a control group of 6,813 adolescents without the condition, found a higher proportion

of young people with mental health problems in the T1D group (4.4% vs. 2.9% - adjusted OR = 1.61, p = 0.044). Among those with mental health issues, impairment in quality of life was also greater in the T1D group. A longitudinal study conducted by Butwicka et al. in Sweden[26] compared population cohorts consisting of 17,122 adolescents with T1D and 18,847 healthy siblings (from birth to 18 years old) followed up from 1973 to 2009. The risk of psychiatric morbidity in the T1D group compared to the general population tripled in the first 6 months of disease, and doubled in the overall study time. There was also an increased risk of suicide attempts (hazard ratio: 1.7; 95%CI 1.4-2.0) and most categories of psychiatric disorders among participants with T1D.

Like other authors, we attempted to investigate factors associated with the presence of a psychiatric disorder in the total sample of adolescents, such as T1D, BMI, and family history of psychiatric disorders, but only found that BMI in the overweight range (BMI ⩾ percentile 85) increased this risk. Merikangas et al.[1] also tested some sociodemographic factors such as sex, age, race, parental education and marital status, poverty and urbanicity, reporting that only parental divorce was frequently associated with mental disorders in youth. When assessing variables according to diagnosis, they pointed out that mood and anxiety disorders were more associated with female sex, and substance use with male sex. Additionally, rates of mood and substance use disorders increased with age.

Another well-established hypothesis in the current scientific community is that metabolic/glycemic control usually deteriorates during adolescence, partially due to hormonal changes during puberty, but also, and importantly, because of psychosocial and behavioral problems that compromise adherence to recommended treatment.[27-33] The addition of a mental illness such as depression during increases the challenge of achieving ideal metabolic control, since patients feel unmotivated to adequately follow medical and nutritional recommendations.[27,28,34] However, probably due to our small sample size and the fact that the majority of patients presented inadequate levels of HbA1c (> 58.5 mmol/mol or 7.5%), we did not find a significant association between the presence of psychiatric diagnoses (DAWBA) and poorer glycemic control (HbA1c), as expected.[14,17]

As a result of these worrisome findings about adolescents with T1D, researchers and clinicians in the field have suggested that more attention should be given to emotional issues in this population.[7,16,21] Use of a simple and practical screening instrument for early detection of mental health problems in the clinical context is also a common recommendation, as pointed out in American Diabetes Association guidelines.[33,35,36] We therefore tested the SDQ as a screening tool for mental disorders and obtained very good results; its adolescent version proved to quite cost-effective (self-report questionnaire). Thus, systematic use of the Adolescent SDQ in diabetes care services could be a useful measure to help with the early identification and referral of these patients to specific mental health care.

In addition to the above recommendations, services should be restructured to include planning for the mental

health care of diabetic patients. Thus, the potential positive effects on their physical and psychological health and the consequent improvement in their overall quality of life can be maximized.[21] This necessary action requires the cooperation of the pediatricians, clinicians and endocrinologists in charge of these patients, as well as that of policy makers, so that investment can be made in health services to enable appropriate care and, thus, reduce this burden. Careful evaluation for psychiatric symptoms in individuals with T1D who present increased difficulties with metabolic control and medical complications should be routine.

Although limited by the cross-sectional design and the small sample size, our results corroborate those in the literature regarding the high rate of mental disorders among adolescents with T1D. The use of an extensive diagnostic interview (DAWBA), which required considerable time and collaboration on the part of the eligible subjects and their parents, partially explains the limited size of this sample, especially for the control group, since parents are usually not available during class time. A longitudinal study could allow for more precise follow-up and could identify the development of psychiatric symptoms and their impact on diabetes control. It would also allow investigation in the opposite direction, i.e., the association between lack of metabolic control and psychiatric symptoms. Nevertheless, this is the first study to provide data on the psychiatric morbidity of adolescents with T1D in Brazil to have used a reliable, gold-standard diagnostic interview. It has also provided grounds for the early screening of T1D adolescents at risk for psychiatric disorders by means of a tool that can be recommended for routine use.

Acknowledgements

Disclosure

The authors report no conflicts of interest.

References

1 Merikangas KR, He JP, Burstein M, Swanson SA, Avenevoli S, Cui L, et al. Lifetime prevalence of mental disorders in U.S. adolescents: results from the national comorbidity survey replication – adolescent supplement (NCS-A). J Am Acad Child Adolesc Psychiatry. 2010; 49:980-9.

2 Verhulst FC, Tiemeier H. Epidemiology of child psychopathology: major milestones. Eur Child Adolesc Psychiatry. 2015;24:607-17.

3 Polanczyk GV, Salum GA, Sugaya LS, Caye A, Rohde LA. Annual research review: a meta-analysis of the worldwide prevalence of mental disorders in children and adolescents. J Child Psychol Psychiatry. 2015;56:345-65.

4 Roberts RE, Attkisson CC, Rosenblatt A. Prevalence of psychopathology among children and adolescents. Am J Psychiatry. 1998;155:715-25.

5 Anselmi L, Fleitlich-Bilyk B, Menezes AM, Araújo CL, Rohde LA. Prevalence of psychiatric disorders in a Brazilian birth cohort of 11-year-olds. Soc Psychiatry Psychiatr Epidemiol. 2010;45: 135-42.

6 Sherwin RS. Diabetes melito. In: Goldman L, Ausiello D, editores. Cecil – Tratado de medicina interna. 22ª ed. São Paulo: Elsevier; 2005. p. 1658-92.

7 Delamater AM, de Wit M, McDarby V, Malik J, Acerini CL; International Society for Pediatric and Adolescent Diabetes. ISPAD Clinical Practice Consensus Guidelines 2014. Psychological care of children and adolescents with type 1 diabetes. Pediatr Diabetes. 2014; 15:232-44.

8 Kristensen LJ, Birkebaek NH, Mose AH, Hohwu L, Thastum M. Symptoms of emotional, behavioral, and social difficulties in the Danish population of children and adolescents with type 1 diabetes – results of a national survey. PLoS One. 2014;9:e97543.

9 de Wit M, Winterdijk P, Aanstoot HJ, Anderson B, Danne T, Deeb L, et al. Assessing diabetes-related quality of life of youth with type 1 diabetes in routine clinical care: the MIND youth questionnaire (MY-Q). Pediatr Diabetes. 2012;13:638-46.

10 Novato TS, Grossi SAA. Fatores associados à qualidade de vida de jovens com diabetes mellitus do tipo 1. Rev Esc Enferm USP. 2011;45:770-6.

11 Sivertsen B, Petrie KJ, Wilhelmsen-Langeland A, Hysing M. Mental health in adolescents with type 1 diabetes: results from a large population-based study. BMC Endocr Disord. 2014;14:83.

12 Cameron FJ. The impact of diabetes on brain function in childhood and adolescence. Pediatr Clin North Am. 2015;62:911-27.

13 Wändell P, Ljunggren G, Wahlström L, Carlsson AC. Diabetes and psychiatric illness in the total population of Stockholm. J Psychosom Res. 2014;77:169-73.

14 Colton PA, Olmsted MP, Daneman D, Rodin GM. Depression, disturbed eating behavior, and metabolic control in teenage girls with type 1 diabetes. Pediatr Diabetes. 2013;14:372-6.

15 Plener PL, Molz E, Berger G, Schober E, Mönkemöller K, Denzer C, et al. Depression, metabolic control, and antidepressant medication in young patients with type 1 diabetes. Pediatr Diabetes. 2015;16:58-66.

16 Bernstein CM, Stockwell MS, Gallagher MP, Rosenthal SL, Soren K. Mental health issues in adolescents and young adults with type 1 diabetes: prevalence and impact on glycemic control. Clin Pediatr (Phila). 2013;52:10-5.

17 Claudino D, Morgan C, Claudino A, Palavras M. Impact of disordered eating behaviors on the treatment of children with type 1 diabetes. In: International Conference on Eating Disorders; 2015; Boston, USA. p. 63.

18 Woerner W, Fleitlich-Bilyk B, Martinussen R, Fletcher J, Cucchiaro G, Dalgalarrondo P, et al. The strengths and difficulties questionnaire overseas: evaluations and applications of the SDQ beyond Europe. Eur Child Adolesc Psychiatry. 2004;13:II47-54.

19 Fleitlich B, Cortazar PG, Goodman R. Questionário de capacidades e dificuldades (SDQ). Infanto Rev Neuropsiquiatr Infanc Adolesc. 2000;8:44-50.

20 Fleitlich-Bilyk B, Goodman R. Prevalence of child and adolescent psychiatric disorders in southeast Brazil. J Am Acad Child Adolesc Psychiatry. 2004;43:727-34.

21 Stahl-Pehe A, Lange K, Bächle C, Castillo K, Holl RW, Rosenbauer J. Mental health problems among adolescents with early-onset and long-duration type 1 diabetes and their association with quality of life: a population-based survey. PLoS One. 2014;9:e92473.

22 Aebi M, Kuhn C, Metzke CW, Stringaris A, Goodman R, Steinhausen HC. The use of the development and well-being assessment (DAWBA) in clinical practice: a randomized trial. Eur Child Adolesc Psychiatry. 2012;21:259-67.

23 Cury CR, Golfeto JH. Strengths and difficulties questionnaire (SDQ): a study of school children in Ribeirão Preto. Rev Bras Psiquiatr. 2003;25:139-45.

24 Landis JR, Koch GG. The measurement of observer agreement for categorical data. Biometrics. 1977;33:159-74.

25 Kakleas K, Kandyla B, Karayianni C, Karavanaki K. Psychosocial problems in adolescents with type 1 diabetes mellitus. Diabetes Metab. 2009;35:339-50.

26 Butwicka A, Frisén L, Almqvist C, Zethelius B, Lichtenstein P. Risks of psychiatric disorders and suicide attempts in children and adolescents with type 1 diabetes: a population-based cohort study. Diabetes Care. 2015;38:453-9.

27 Hegelson VS, Siminerio L, Escobar O, Becker D. Predictors of metabolic control among adolescents with diabetes: a 4-year longitudinal study. J Pediatr Psychol. 2009;34:254-70.

28 Kongkaew C, Jampachaisri K, Chaturongkul CA, Scholfield CN. Depression and adherence to treatment in diabetic children and adolescents: a systematic review and meta-analysis of observational studies. Eur J Pediatr. 2014;173:203-12.

29 Goldston DB, Kelley AE, Reboussin DM, Daniel SS, Smith JA, Schwartz RP, et al. Suicidal ideation and behavior and noncompliane with the medical regimen among diabetic adolescents. J Am Acad Child Adol Psychiatry. 1997;36:1528-36.

30 Hood KK, Huedis S, Maher A, Butler D, Volkening L, Laffel LM. Depressive symptoms in children and adolescents with type 1 diabetes: association with diabetes-specific characteristics. Diabetes Care. 2006;29:1389-91.

31 Rewers A, Chase HP, Mackenzie T, Walravens P, Roback M, Rewers M, et al. Predictors of acute complications in children with type 1 diabetes. JAMA. 2002;287:2511-8.

32 Cohen DM, Lumley MA, Naar-King S, Partridge T, Cakan N. Child behavior problems and family functioning as predictors of adherence and glycemic control in economically disadvantaged children with type 1 diabetes: a prospective study. J Pediatr Psychol. 2004;29:171-84.

33 Silverstein J, Klingensmith G, Copeland K, Plotnik L, Kaufman F, Laffel L, et al. Care of children and adolescents with type 1 diabetes: a statement of the American Diabetes Association. Diabetes Care. 2005;28:186-212.

34 McGrady ME, Laffel L, Drotar D, Repaske D, Hood KK. Depressive symptoms and glycemic control in adolescents with type 1 diabetes: mediational role of blood glucose monitoring. Diabetes Care. 2009; 32:804-6.

35 Blanz BJ, Rensch-Riemann BS, Fritz-Sigmund DI, Schmidt MH. IDDM is a risk factor for adolescent psychiatric disorders. Diabetes Care. 1993;16:1579-87.

36 Northam EA, Matthews LK, Anderson PJ, Cameron FJ, Werther GA. Psychiatric morbidity and health outcome in Type 1 diabetes – perspectives from a prospective longitudinal study. Diabet Med. 2005;22:152-7.