Depressive Symptoms in Youth With Type 1 or Type 2 Diabetes: Results of the Pediatric Diabetes Consortium Screening Assessment of Depression in Diabetes Study

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OBJECTIVE

To evaluate the frequency of depressive symptoms and the diagnosis and management of depression in youth with type 1 diabetes (T1D) and type 2 diabetes (T2D) enrolled in the Pediatric Diabetes Consortium T1D and T2D registries.

RESEARCH DESIGN AND METHODS

The Children's Depression Inventory (CDI) 2 Self-Report (Short) version was completed by 261 T1D and 339 T2D youth aged 10–17 years.

RESULTS

Symptoms of depression were identified in 13% of T1D and 22% of T2D ($P = 0.007$) participants; of these, only 4% of T1D and 9% of T2D youth were treated by a therapist within the prior 12 months. Depressive symptoms were associated with lower family income ($P = 0.006$) and obesity ($P = 0.002$) in T1D but not T2D youth.

CONCLUSIONS

Depressive symptoms are more frequent than diagnosed depression in youth with T1D or T2D. These results underscore the need for regular depression screening and appropriate referral for youth with diabetes.

Major depressive disorders and subclinical depressive symptomatology are more common in adolescents with than without diabetes, and the prevalence of subclinical depressive symptomatology in patients with diabetes appears to be even greater (1). As subclinical depressive symptomatology in youth with diabetes appears to be associated with poor clinical outcomes (2–4), current treatment guidelines recommend routine screening for this difficult to diagnose comorbidity of diabetes (5,6). Despite these guidelines, screening for subclinical depressive symptomatology in youth with type 1 diabetes (T1D) and type 2 diabetes (T2D) is difficult to implement in clinical practice.

The Pediatric Diabetes Consortium (PDC) includes eight academic pediatric diabetes treatment centers in the U.S. In order to improve the care of children with diabetes through sharing of best practices, the PDC established both a T1D New Onset registry of >1,000 participants (7) and a T2D registry of >500 youth with T2D. This article describes the results of the PDC Screening Assessment of Depression in Diabetes (SADD) Study undertaken to determine and compare the prevalence of

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**A full listing of the members of the Pediatric Diabetes Consortium is included in the APPENDIX.*

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depressive symptomatology in participants aged 10 to <18 years and to assess factors associated with depression in each type of diabetes.

RESEARCH DESIGN AND METHODS

Participants and Measures

Participants in the T1D New Onset registry were <19 years of age and managed at a participating PDC center within 3 months of diagnosis. Participants in the T2D registry were <21 years of age and diagnosed according to American Diabetes Association criteria. The Children's Depression Inventory (CDI) 2 Self-Report (Short) version is a 12-item self-reported scale of depressive symptoms (8). Since this survey is only validated up to the age of 17 years, only 261 T1D and 339 T2D participants aged 10–17 years were included. Institutional review boards at the eight participating centers approved the protocol. Written consent was obtained from parents and written assent from participants.

Data Collection

Demographic, socioeconomic, and clinical characteristics were collected from medical records and interviews with the patient and/or parent, and each SADD Study participant completed the CDI2 questionnaire.

Statistical Analysis

Symptoms were classified into four categories: "very elevated," "elevated," "high average," and "average or lower" based on set thresholds (8). The first three categories were combined into a "symptoms" category with the last category considered "no symptoms" (9). BMI percentile was calculated using the 2000 Centers for Disease Control and Prevention population growth chart data (10). Logistic regression was used to determine the association of depressive symptoms with demographic and clinical characteristics by diabetes type. Multivariate models were constructed using stepwise selection methods and included all factors with a P value <0.10. Owing to multiple comparison, only P values <0.01 were considered statistically significant. A sensitivity analysis was done using continuous CDI 2 raw score as the dependent variable and adjusting for age and sex.

RESULTS

Clinical characteristics of adolescents with T1D or T2D are shown in Supplementary Table 1. T2D participants were more likely than T1D participants to be obese minority females from disadvantaged families receiving government insurance. Most of the T2D participants had a duration of diabetes <2 years, whereas most T1D participants had a duration of diabetes ≥2 years. Mean ± SD HbA_{1c} was slightly higher in T1D than T2D participants (8.3 ± 1.7% [67 ± 18 mmol/mol] vs. 7.9 ± 2.4% [63 ± 26 mmol/mol], respectively).

Symptoms of depression were identified in nearly twice as many T2D as T1D participants (Table 1), but depressive symptoms were not associated with age, diabetes duration, sex, race/ethnicity, or parent education in either cohort (Table 1). Depressive symptoms in T1D participants were associated with obesity (adjusted odds ratio 4.3 [99% CI 1.1–17.6], unadjusted P = 0.002, adjusted P = 0.007) and low family income (adjusted odds ratio 3.1 [0.9–10.5], unadjusted P = 0.006, adjusted P = 0.02). No associations were found between T2D and these clinical and demographic characteristics. Results were similar when analyzing the CDI2 score as a continuous variable. There were not any site differences in symptoms of depression.

In T1D, mean HbA_{1c} levels were 8.5% (70 mmol/mol) vs. 8.3% (67 mmol/mol) (P = 0.48) in participants with and without depressive symptoms, respectively, and in T2D 8.3% (67 mmol/mol) vs. 7.8% (62 mmol/mol) (P = 0.19), respectively.

Only 5 (14%) of 35 T1D and 11 (15%) of 75 T2D participants with depressive symptoms carried a diagnosis of depression in their medical record in the year prior to this study (Table 1). Conversely, three T1D and eight T2D participants who had been diagnosed with depression during the year before enrollment in the study had no symptoms of depression on the CDI 2 survey. Among

Table 1—Depressive symptom associations and psychiatric diagnoses and treatments in the medical record

	T1D (N = 261)*			T2D (N = 339)*		
	No symptoms	Symptoms†	P‡	No symptoms	Symptoms†	P‡
N (%)	226 (87)	35 (13)		264 (78)	75 (22)	
Age, years	13.9 ± 2.1	14.0 ± 2.1	0.73	15.1 ± 1.9	15.0 ± 2.1	0.53
Diabetes duration, years	3.2 (2.8, 3.7)	3.0 (2.6, 3.6)	0.37	1.7 (0.6, 3.3)	1.8 (0.5, 3.1)	0.89
Female	110 (49)	18 (51)	0.76	172 (65)	47 (63)	0.69
White	139 (62)	16 (46)	0.07	20 (8)	6 (8)	0.92
BMI >95%	17 (15)	9 (47)	0.002	219 (87)	61 (86)	0.77
Family income <$25,000	24 (15)	10 (38)	0.006	81 (45)	25 (50)	0.55
Parent education ≤HS	74 (39)	15 (54)	0.16	180 (73)	48 (68)	0.39
Psychological problems						
Depression	3 (1)	5 (14)		8 (3)	11 (15)	
Anxiety	1 (<1)	0 (0)		2 (<1)	3 (4)	
Sleep disorder	0 (0)	0 (0)		3 (1)	0 (0)	
Eating disorder	1 (<1)	0 (0)		1 (<1)	1 (1)	
Other	1 (<1)	1 (3)		10 (4)	7 (9)	
Any psychiatric treatment in past year	8 (4)	3 (9)		18 (7)	12 (16)	
Psychotropic meds in past year	1 (<1)	1 (3)		8 (3)	4 (5)	

Data are mean ± SD, median (interquartile range), or n (%) unless otherwise indicated. HS, high school; meds, medications. *Participants with missing or unknown data by type (T1D/T2D): race/ethnicity (3/3), BMI (130/17), family income (74/110), and parent education (45/21). †Combination of "very elevated," "elevated," and "high average" categories. ‡Univariate P value from logistic regression model.

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these 11 participants, none of the 3 T1D and 7 of the 8 T2D participants received psychological treatment in the previous year. Moreover, only 2 T1D participants and 12 T2D participants received psychotropic medications for any psychiatric diagnosis during the year before completion of the CDI 2 (Table 1). Of the 14 participants on psychotropic medication within the year prior to study, 64% (n = 9) had no symptoms of depression on the CDI 2 survey.

CONCLUSIONS

As expected, depressive symptomatology was common in T1D participants (1), but the prevalence of depressive symptoms was nearly twofold higher in youth with T2D. Higher prevalence of depressive symptoms in adolescents with T2D versus T1D has been reported in the SEARCH study, with socioeconomic factors noted as contributing causes (11).

The obesity epidemic has not spared adolescents with T1D (12), and our findings indicate that the adverse consequences of obesity in patients with T1D extends beyond insulin resistance to include an increased risk for depressive symptomatology, especially in low-income families. In the T2D cohort, the percentage of nonobese children from higher-income families was too small to determine whether these factors were associated with a lower frequency of having depressive symptoms.

In contrast to other studies, females with depressive symptoms were not overrepresented in either cohort and HbA_{1c} levels were not substantially different in participants with and without depressive symptoms (3,4,13). The short duration of diabetes of $<$2 years in most of the patients with T2D limited our ability to show an effect of depression on metabolic control, since residual endogenous insulin secretion early in the course of T2D enables them to be readily managed with metformin monotherapy (14). Since residual insulin secretion is lost much more rapidly in youth with T1D and most of the T1D cohort had a duration of diabetes of $\geq$2 years, the failure to see an effect of depressive symptoms on HbA_{1c} in T1D participants is more difficult to explain.

Since routine screening of 10- to 17-year-olds with diabetes was not being carried out at PDC centers, it is not surprising that only 14–15% of T1D and T2D participants with depressive symptoms based on the CDI 2 survey were identified in their medical record as having experienced with depressive symptoms. Moreover, only 4% of T1D and 9% of T2D participants received any psychological intervention during the year prior to the CDI 2 survey completion, and very few (2 T1D and 12 T2D) participants received psychotropic drug therapy. These results provide strong support for routine screening for depressive symptoms and depression in 10- to 17-year-olds with T1D and T2D and appropriate referral for treatment when needed. The results also underscore the need for more time-efficient methods of screening that can be adopted by busy diabetes practices, such as the self-administered electronic version of the CDI developed by Corathers et al. (15).

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Author Contributions. J.S., P.C., K.J.R., G.J.K., and W.V.T. researched data, contributed to discussion, wrote the manuscript, and reviewed and edited the manuscript. C.K., R.W.B., J.R.W., S.W., F.B., J.L., E.C., and M.J.R. researched data, contributed to discussion, and reviewed and edited the manuscript. R.W.B. is the guarantor of this work and, as such, had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

Appendix

The following comprises a listing of the Pediatric Diabetes Consortium Study Group by clinical center. Personnel are listed as principal investigator (PI), coinvestigator (I), and coordinator (C). Baylor College of Medicine: Fida Bacha (PI), Morey Haymond (I), Maria J. Redondo (I), Elizabeth Johnson (C), and Andrene McDonald (C). Children's Hospital Los Angeles: Jamie R. Wood (PI), Brian Ichihara (C), Megan Lipton (C), and Marisa Cohen (C). Stanford University, Stanford, CA: Bruce Buckingham (PI), Breanne Harris (C), and Satya Shanmugham (C). Barbara Davis Center for Childhood Diabetes: Georgeanna J. Klingensmith (PI), Eric Cruz (C), Heidi Haro (C), Maria King (C), and Katherine Manseau (C). University of Florida: Desmond Schatz (PI), Janet Silverstein (I), Michael J. Haller (I), and Erica Dougherty (C). Yale University: William V. Tamborlane (I), Eda Cengiz (PI), Melody Martin (C), Amy Steffen (C), Lori Carria (C), and Darryll Cappiello (C). University of Michigan: Joyce M. Lee (PI), Surair Bashir (C), and Ashley Eason (C). Children's Hospital of Philadelphia: Steven M. Willi (PI) and Tammy Mawson (C). Jaeb Center for Health Research (coordinating center): Roy W. Beck, Katrina J. Ruedy, Craig Kollman, Crystal G. Connor, Beth Stevens, and T.J. Mouse.

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