Depressive Symptoms in Children and Adolescents With Type 1 Diabetes

Association with diabetes-specific characteristics

KOREY K. HOOD, PHD[1,2,3]
SAMANTHA HUESTIS, BS[1,2]
ALLISON MAHER, BA[1,2]
DEBBIE BUTLER, MSW[1,2,3]
LISA VOLKENING, BA[1,2]
LORI M.B. LAFFEL, MD, MPH[1,2]

Depression in children and adolescents with type 1 diabetes has been associated with negative diabetes-related health outcomes such as poorer glycemic control (1–5) and recurrent diabetic ketoacidosis (DKA) admissions (6,7). While mechanisms that link depression and suboptimal health outcomes are poorly understood (8), it is apparent that the chronicity of type 1 diabetes and the demands of management provide a fertile environment for adjustment problems. Our aim was to investigate depressive symptoms in children and adolescents with type 1 diabetes and their association with demographic, diabetes-specific, and family-functioning variables.

RESEARCH DESIGN AND METHODS — Study participants were 145 youth and their parents (107 mothers, 35 fathers, and 3 guardians) who received care at a pediatric diabetes center from a multidisciplinary team. The sample of 145 youth (56% female) had a mean age of 14.9 ± 2.3 years (range 10–18). Duration of type 1 diabetes was 8.3 ± 3.5 years, and mean HbA_{1c} (A1C) was 8.7 ± 1.4%. At the time of the participant's clinic appointment, a trained research assistant obtained written informed consent and assent and then administered questionnaires. This sample of 145 parent-youth dyads represented 88% of the families approached.

Insulin dose and frequency of insulin injections were documented by the youth's medical provider. Frequency of blood glucose monitoring (BGM) was documented through meter downloads and parent report. Each participant provided a sample of blood for A1C, measured by high-performance liquid chromatography (reference range 4.0–6.0%, Tosoh 2.2; Tosoh Bioscience, South San Francisco, CA).

Depressive symptoms in youth were assessed with the Children's Depression Inventory (CDI) (9), a self-report questionnaire consisting of 27 items. A score of ≥13 is indicative of elevated depressive symptoms (10). The CDI has wide use across chronic health conditions, specifically diabetes (9). Parents completed the CDI "parent," a proxy report of the youth's depressive symptoms developed for use in conjunction with the youth-reported CDI (9). A CDI parent score of ≥17 is indicative of elevated depressive symptoms observed in the youth. In this study, families were notified of elevated scores on the CDI or the CDI parent, and referrals were made for in-clinic or local mental health services.

Diabetes-specific family conflict across 19 diabetes management tasks was evaluated with the Diabetes Family Conflict Scale (11). Family responsibility for diabetes tasks was ascertained through the Diabetes Family Responsibility Questionnaire (12). The Blood Glucose Monitoring Communication questionnaire (13) was used to evaluate emotional responses to the youth's high and low blood glucose values. Parents completed the Pediatric Assessment in Diabetes survey, parent version (14,15), to assess perceived burden related to diabetes care.

Statistical analysis was performed with Statistical Analysis System (version 8.02; SAS Institute, Cary, NC). Univariate analyses reported in Table 1 consisted of independent *t* tests, one-way ANOVAs, and χ^2 calculations. The multivariate analysis used general linear modeling to allow for inspection of the independent contribution of each variable while controlling for all others.

RESULTS

Depressive symptoms

On the CDI, 22 of 145 youth (15.2%) scored at or above the clinical cutoff. Youth with elevated depressive symptoms, as determined by an elevated score on the CDI, were more likely to be female ($P = 0.008$), have lower BGM frequency ($P = 0.02$), have higher A1C values ($P = 0.02$), have higher diabetes-specific conflict reported by both the youth ($P = 0.0002$) and parent ($P = 0.02$), have more youth-reported negative affect around BGM ($P = 0.02$), and have a higher degree of diabetes-specific burden reported by the parent ($P = 0.003$). A multivariate model predicting the youth's CDI score showed that higher levels of youth-reported diabetes-specific family conflict ($P = 0.001$), youth-reported negative affect around BGM ($P = 0.03$), and parent-reported diabetes-specific burden ($P = 0.03$) were significant predictors, [$F(14,128) = 3.77$, $P < 0.0001$, $R^2 = 0.29$].

Parent-youth agreement

Parent and youth reports of youth-depressive symptoms were highly correlated ($r = 0.61$, $P < 0.0001$). A large percentage (83%, $n = 121$) of parent-youth dyads agreed about the presence or absence of depressive symptoms. Discor-

From the [1]Pediatric and Adolescent Section, Joslin Diabetes Center, Harvard Medical School, Boston, Massachusetts; the [2]Genetics and Epidemiology Section, Joslin Diabetes Center, Harvard Medical School, Boston, Massachusetts; and the [3]Behavioral Research and Mental Health Section, Joslin Diabetes Center, Harvard Medical School, Boston, Massachusetts.

Address correspondence and reprint requests to Lori M.B. Laffel, MD, MPH, Pediatric and Adolescent Section, Joslin Diabetes Center, One Joslin Place, Boston, MA 02215. E-mail: lori.laffel@joslin.harvard.edu.

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Abbreviations: BGM, blood glucose monitoring; CDI, Children's Depression Inventory; DKA, diabetic ketoacidosis.

A table elsewhere in this issue shows conventional and Système International (SI) units and conversion factors for many substances.

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Table 1—*Participant characteristics*

	CDI score <13	CDI score ≥13	
n	123	22	*P*
Age (years)	14.9 ± 2.4	15.5 ± 1.7	NS
Sex (% female)	51	82	0.008
Ethnicity (% Caucasian)	94	91	NS
Family structure (%)			NS
Two-parent	79	73	
One-parent	21	27	
SES (Hollingshead)*	2.4 ± 1.2	2.7 ± 1.3	NS
Duration of type 1 diabetes (years)	8.1 ± 3.5	9.3 ± 3.8	NS
BGM frequency (% ≥4 times/day)	63	36	0.02
Mode of insulin therapy (% ≥4 injections/day or CSII)	53	45	NS
A1C (%)	8.6 ± 1.4	9.3 ± 1.5	0.02
DFRQ (responsibility)			
Child report	30.8 ± 5.0	31.4 ± 5.2	NS
Parent report	35.3 ± 5.4	34.9 ± 4.6	NS
DFCS (family conflict)			
Child report	23.4 ± 3.8	26.7 ± 4.0	0.0002
Parent report	24.1 ± 3.8	26.9 ± 5.1	0.02
BGMC (negative affect)			
Child report	11.3 ± 2.8	13.5 ± 3.9	0.02
Parent report	13.5 ± 3.5	14.1 ± 2.9	NS
PAID-P (burden)			
Parent report only	51.6 ± 13.2	60.5 ± 10.0	0.003

Data are means ± SD unless otherwise indicated. Poorer family functioning is indicated by higher scores on the Diabetes Family Conflict Scale (DFCS), Diabetes Family Responsibility Questionnaire (DFRQ), Blood Glucose Monitoring Communication questionnaire (BGMC), and the Problem Area in Diabetes-Parent (PAID-P) survey. *Scale: 1, major professionals; 2, minor professionals; 3, skilled workers; 4, semiskilled workers; 5, unskilled workers; 6, unemployed/retired/students. CSII, continuous subcutaneous insulin infusion; SES, socioeconomic status.

dant reports (17%, $n = 24$) were associated with less intensive insulin regimens ($P = 0.03$), higher diabetes-specific conflict by both the child ($P = 0.0008$) and parent ($P = 0.002$), more child-reported negative affect around BGM ($P = 0.005$), and higher degree of diabetes-specific burden reported by the parent ($P = 0.02$).

CONCLUSIONS — Findings indicate that nearly one in seven youth with diabetes met the clinical cutoff for depression by their own report. This level of depressive symptoms in children and adolescents with type 1 diabetes is nearly double that of the highest estimate of depression in youth in general (16–18). While consistent with recent reports of depression in youth with type 1 diabetes (8,19), the percentage of youth meeting the clinical cutoff for depression found in this study is different from several prior reports (20–22). This likely reflects differences in the methodologies for assessing depression. However, the intensification of diabetes management since those past reports may also account for these differences, as the nature and demands of living with type 1 diabetes has changed significantly in the past decade.

Factors associated with elevated levels of depressive symptoms included demographic, diabetes-specific, and family-functioning variables. Female subjects were more likely to have elevated scores on the CDI. Less frequent BGM, an indicator of suboptimal adherence, and poorer glycemic control were associated with higher levels of depressive symptoms. While 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), these findings beg for longitudinal research to elucidate the link between glycemic control and depression by examining adherence as a mediator between the two. Further, close inspection of the timing of depression onset and familial patterns of depression (e.g., maternal depression) in future studies will advance our understanding of the natural history of depression in youth with type 1 diabetes.

More diabetes-specific burden reported by the parent, and both youth and parent report of significant diabetes-specific family conflict, were associated with problematic emotional functioning for the youth. Parents or caregivers who are more stressed by diabetes management may provide less support, further promoting difficult emotional functioning. Further, when the youth's level of negative affect around BGM was elevated, so were depressive symptoms.

Rates of parent-youth agreement about youth depressive symptoms were higher than the correlation rates found in the general population of youth (9). Parents of children with diabetes may be more aware of symptoms of problematic emotional functioning due to the high level of involvement that is prescribed and required for effective diabetes management.

The findings reported here indicate a need to pay close attention to the emotional functioning of youth with type 1 diabetes and the family's functioning across a number of areas. Poorer diabetes-specific family functioning is a red flag for problematic emotional functioning in youth. Likewise, when parents and youth disagree about the youth's emotional functioning, they also tend to disagree about other areas, suggesting larger problems within the family system worthy of evaluation and intervention. In an effort to promote optimal management of diabetes, these youth and family factors must be considered in day-to-day treatment and in attempts to prevent future problems. Multidisciplinary pediatric diabetes teams are in an ideal position to offer early identification and steer families in the direction of family-based interventions.

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References

1. Kovacs M, Iyengar S, Goldston D, Stewart J, Obrosky DS, Marsh J: Psychological functioning of children with insulin-dependent diabetes mellitus: a longitudinal study. *J Pediatr Psychol* 15:619–632, 1990
2. La Greca AM, Swales T, Klemp S, Madigan S, Skyler J: Adolescents with diabetes: gender differences in psychosocial func-

tioning and glycemic control. *Child Health Care* 24:61–78, 1995
3. Grey M, Cameron ME, Thurber FW: Coping and adaptation in children with diabetes. *Nurs Res* 40:144–149, 1991
4. Grey MJ, Genel M, Tamborlane WV: Psychosocial adjustment of latency-aged diabetics: determinants and relationship to control. *Pediatrics* 65:69–73, 1980
5. Grey M, Boland EA, Yu C, Sullivan-Bolyai S, Tamborlane WV: Personal and family factors associated with quality of life in adolescents with diabetes. *Diabetes Care* 21:909–914, 1998
6. Smaldone A, Judy H, Raymond A, Weinger K: Comorbid hospitalizations for children with single and recurrent ketoacidosis (Abstract). *Diabetes* 53 (Suppl. 2):A425, 2004
7. Stewart SM, Rao J, Emslie GJ, Klein D, White PC: Depressive symptoms predict hospitalization for adolescents with type 1 diabetes mellitus. *Pediatrics* 115:1315–1319, 2005
8. Grey M, Whittemore R, Tamborlane W: Depression in type 1 diabetes in children: natural history and correlates. *J Psychosom Res* 53:907–911, 2002
9. Kovacs M: The Children's Depression Inventory (CDI). *Psychopharmacol Bull* 21: 995–998, 2003
10. Kovacs M: *Children's Depression Inventory: Technical Manual*. North Tonawanda, NY, Multi-Health Systems, 2003
11. Rubin RR, Young-Hyman D, Peyrot M: Parent-child responsibility and conflict in diabetes care (Abstract). *Diabetes* 38:7A, 1989
12. Anderson BJ, Auslander WF, Jung KC, Miller JP, Santiago JV: Assessing family sharing of diabetes responsibilities. *J Pediatr Psychol* 15:477–492, 1990
13. Hood KK, Butler DA, Volkening LK, Anderson BJ, Laffel LM: The Blood Glucose Monitoring Communication questionnaire: an instrument to measure affect specific to blood glucose monitoring. *Diabetes Care* 27:2610–2615, 2004
14. Antisdel J: Diabetes-specific distress among parents of youth with type 1 diabetes (Abstract). *Diss Abstr Int* 61:6123, 2001
15. Polonsky WH, Anderson BJ, Lohrer PA, Welch G, Jacobson AM, Aponte JE, Schwartz CE: Assessment of diabetes-related distress. *Diabetes Care* 18:754–760, 1995
16. Anderson J, McGee R: Comorbidity of depression in children and adolescents. In *Handbook of Depression in Children and Adolescents*. Reynolds WM, Johnson HF, Eds. New York, Plenum, 1994, p. 581–601
17. Fleming JE, Boyle MH, Offord DR: The outcome of adolescent depression in the Ontario Child Health Study follow-up. *J Am Acad Child Adolesc Psychiatry* 32:28–33, 1993
18. Lewinsohn PM, Clarke GN, Seeley JR, Rohde P: Major depression in community adolescents: age at onset, episode duration, and time to recurrence. *J Am Acad Child Adolesc Psychiatry* 33:809–818, 1994
19. Kokkonen J, Taanila A, Kokkonen ER: Diabetes in adolescence: the effect of family and psychologic factors on metabolic control. *Nord J Psychiatry* 51:165–172, 1997
20. Blanz BJ, Rensch-Riemann BS, Fritz-Sigmund DI, Schmidt MH: IDDM is a risk factor for adolescent psychiatric disorders. *Diabetes Care* 16:1579–1587, 1993
21. Kovacs M, Goldston D, Obrosky DS, Drash A: Major depressive disorder in youths with IDDM. *Diabetes Care* 20:25–50, 1997
22. Jacobson AM, Hauser ST, Willett JB, Wolfsdorf JI, Dvorak R, Herman L, de Groot M: Psychological adjustment to IDDM: 10-year follow-up of an onset cohort of child and adolescent patients. *Diabetes Care* 20:811–818, 1997