Disturbed Eating Behavior and Eating Disorders in Preteen and Early Teenage Girls With Type 1 Diabetes

A case-controlled study

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OBJECTIVE — To compare the prevalence of eating disturbances in preteen and early teenage girls with type 1 diabetes to their nondiabetic peers.

RESEARCH DESIGN AND METHODS — A cross-sectional, case-controlled study of 101 girls with type 1 diabetes, ages 9–14 years, and 303 age-matched, female nondiabetic control subjects was conducted. Participants completed a Children’s Eating Disorder Examination interview. Socioeconomic status, BMI, and diabetes-related variables were assessed. Groups were compared using χ² analyses.

RESULTS — Binge eating, the use of intense, excessive exercise for weight control, the combination of two disturbed eating-related behaviors; and subthreshold eating disorders were all more common in girls with type 1 diabetes. Metabolic control was not related to eating behavior in this study population.

CONCLUSIONS — Eating disturbances, though mostly mild, were significantly more common in preteen and early teenage girls with type 1 diabetes. Screening and prevention programs for this high-risk group should begin in the preteen years.

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Eating disorders, including anorexia nervosa and bulimia nervosa and their milder variants (eating disorder not otherwise specified [ED-NOS] and subthreshold disorders), are a group of psychiatric disorders unified by highly disturbed eating behavior and a constellation of psychological traits and symptoms. The eating behaviors can include fasting and dieting; binge eating; self-induced vomiting; the abuse of laxatives, diet pills, diuretics, and other medications; and the use of intense, excessive exercise for weight control. The psychological traits and symptoms include preoccupation with body weight and shape, distortions of body image, and severely disturbed attitudes toward food, calories, and eating (1). Eating disorders have high medical and psychiatric comorbidity and the highest mortality rate of the psychiatric disorders, mostly by suicide (2–4).

The etiology of eating disorders appears to be complex and multifactorial, involving individual, familial, and environmental vulnerability factors (5). Living with type 1 diabetes may be one such risk factor, although the nature and specificity of this association has been debated since the first published reports of eating disorders among diabetic individuals in the 1970s (6). Most published studies have found an absolute, if not always statistically significant, increase in the risk of eating disorders among female patients with type 1 diabetes compared with their nondiabetic peers. Nielsen’s 2002 meta-analysis of the work to date (7) concluded that bulimia nervosa, ED-NOS, and subthreshold eating disorders are all more common in female patients with type 1 diabetes.

Disturbed eating behavior is very common among teenage girls and young women with type 1 diabetes, with binge eating reported by 45–80% and deliberate induction of glycosuria by reducing the insulin dosage or omitting insulin to promote weight loss reported by 12–40% (8–10). Eating disorders and milder disturbed eating behaviors are associated with many negative medical outcomes, including poor metabolic control, increased frequency of diabetes-related hospitalizations, and higher rates of diabetes-related complications, particularly retinopathy and perhaps neuropathy (11–13).

Several mechanisms have been proposed to explain the association between disturbed eating behavior and type 1 diabetes. These include the developmental effects of a chronic medical condition on body image and self-concept, the dietary focus and restraint imposed by a diabetes meal plan, and the higher BMI associated with insulin use (14,15). Beginning during the pubertal years, girls with type 1 diabetes are on average heavier than their nondiabetic peers (16–18). Increased BMI may be due to insulin use (19) and dietary dysregulation, in particular overeating and binge eating, which are com-
mon among older girls with type 1 diabetes. In vulnerable individuals, weight gain may promote a cycle of dieting, binge eating, and compensatory purging behavior, especially insulin omission, which is easily implemented and highly effective in promoting rapid weight loss.

The preteen and early teenage years are a period of rapid physical and psychological growth and development, as girls adjust to the physical changes of puberty, with its profound personal and social meaning. Body dissatisfaction, dieting, and exercise to control weight are all common in girls in the general population at this stage (20–22), although binge eating and more extreme weight control measures such as self-induced vomiting and laxative abuse are rare. The nature and prevalence of disturbed eating behavior in preteen and early teenage girls with type 1 diabetes have not been established. To our knowledge, only two studies have included girls age 11 years or younger with type 1 diabetes (23,24). Although one study (23) found no significant eating disorder symptoms in preteen girls, it included only 18 subjects in this age range. The study of Peveler et al. (24) included only five girls ages 11 and 12 years.

The present study used a cross-sectional, case-control design to compare the rates of disturbed eating behavior and eating disorders (a subset with more significant disturbed eating behavior) in preteen and early teenage girls with type 1 diabetes with those in a nondiabetic control group. We hypothesized that 1) disturbed eating behavior and eating disorders would be more common in preteen and early teenage girls with type 1 diabetes than in their nondiabetic peers, and 2) disturbed eating behavior would be associated with poorer metabolic control in diabetic girls. Determining the nature and prevalence of disturbed eating behavior and eating disorders in girls in this age range would help to clarify the age of optimal screening, prevention, and intervention in this high-risk group.

**RESEARCH DESIGN AND METHODS** — Girls with type 1 diabetes, ages 9–13 years, were recruited during their diabetes clinic appointments at the Hospital for Sick Children (HSC), Toronto, Canada. Girls who reached their 14th birthday after being recruited but before completing the assessment were included. This clinic provides comprehensive diabetes care to ~70% of the children and teenagers with type 1 diabetes in the Toronto area. Only girls who received regular comprehensive care at HSC were recruited into the study. Control girls were recruited from grades 4–8 at eight participating Toronto District School Board schools. These schools were nonrandomly selected for study participation by the Toronto Board’s Research Ethics Committee, as the committee was not able to provide randomized access to schools. Exclusion criteria for both groups were lack of fluency in English and developmental delay; for the diabetic group, a diagnosis of type 1 diabetes <6 months before the study or a diagnosis of type 2 diabetes; and for the control group, a history of diabetes. This project was approved by the Research Ethics Board of the HSC. The public school portion of the study was also approved by the Toronto Board’s Research Ethics Committee. Informed written consent to participate was obtained from a parent or guardian, and verbal assent was obtained from participants.

In all, 101 girls with type 1 diabetes (of 142 eligible girls; 71% participation) and 439 nondiabetic schoolgirls (of 655 eligible girls; 67% participation) completed the assessment. We randomly selected 303 of the 439 schoolgirls to provide a 3:1 ratio of age-matched nondiabetic subjects (age 9.1–14.3 years) to diabetic subjects (age 9.0–14.5 years; both groups, mean 11.8 ± 1.5 years). In the diabetic group, the age at diagnosis of diabetes ranged from 0.1 to 12.3 years (mean 7.1 ± 3.0 years). HbA1c levels were 6.3–12.3% (group mean 8.2 ± 1.0%).

Participants completed a private, semistructured, standardized diagnostic interview (Children’s Eating Disorder Examination [cEDE]) (25,26), administered by trained experienced Master’s level interviewers. Interrater reliability was high, ranging from 0.93 to 0.99 on the cEDE subscales. Interviewers met weekly to review ratings and minimize rater drift. The Eating Disorder Examination is a widely used tool with acceptable interrater reliability (26), test-retest reliability (27), and discriminant validity (28). It can be used to identify and rate the severity of the psychological and behavioral disturbances associated with eating disorders and to make clinical diagnoses of eating disorders (26). In the children’s version of this instrument, the language is slightly modified for use in individuals ages 7–14 years (25). The cEDE has been validated in a small clinical study (25), but neither it nor any other measure of eating disturbances has been extensively validated in this young age-group.

Height and weight were measured by study or clinic personnel, and BMI was calculated as weight in kilograms divided by height in meters squared. The BMI-for-age Z score, which allows the comparison of an individual’s BMI to general population norms of the same age, was calculated using the Centers for Disease Control and Prevention growth chart database (29). HbA1c, a measure of the overall level of metabolic control in the past 8–12 weeks, was measured in girls with type 1 diabetes by high-performance liquid chromatography using the Bio-Rad Variant Method (nondiabetic range 4–6.3%) (30). Mean HbA1c values from the day of recruitment and the preceding clinic visit were reported. After approval by the HSC Research Ethics Board, age, age at diagnosis of diabetes, BMI, and HbA1c levels were collected from the charts of diabetic girls who chose not to participate (n = 41). HbA1c was not measured in the nondiabetic schoolgirls, as it was assumed to be in the normal range for young individuals without overt symptoms of diabetes. Socioeconomic status (SES) level was estimated from participants’ postal codes using Statistics Canada 1998 data, which provide mean family income level by postal walk (a geographic grouping of several hundred households). Using Statistics Canada’s guidelines, six levels of mean family income were defined, with 1 representing the lowest and 6 the highest. The Tanner stage of pubertal development (from 1 [prepubertal] to 5 [fully mature]) was assessed in diabetic girls by their HSC endocrinologist.

Disturbances of body image, eating attitudes, and eating behavior occur along a continuum of severity and degree of related distress and impairment, making it difficult to define a threshold above which they can be considered “full syndrome” or clinically significant disorders. It is particularly challenging to select appropriate and well-validated diagnostic criteria and measures for eating disturbances in the preteen group because of the limited psychometric work done in this age-group. Diagnostic criteria for eating disorders in clinical and research settings have fluctu-
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ated considerably over the past two decades. Both ED-NOS and subthreshold eating disorders are not well operationalized in the Diagnostic and Statistical Manual of Mental Disorders, 4th Edition (DSM-IV) (1) or in the research literature. Jones et al. (8) published study criteria to categorize individuals as having no eating disorder, a subthreshold eating disorder, or a full-syndrome eating disorder. These groupings were found to discriminate among female teenagers with type 1 diabetes on the basis of metabolic control, with a stepwise worsening of metabolic control associated with progressively more disturbed eating. For this study, diagnoses of anorexia nervosa and bulimia nervosa were based on DSM-IV criteria (1). Jones et al.’s (8) operational definitions for ED-NOS and subthreshold eating disorders were used (see list below).

Subthreshold eating disorders
1. An individual engages in occasional (three or more times) binge eating, and/or purging over the past 3 months; or
2. An individual whose self-evaluation is unduly influenced by shape or weight, and who regularly engages in extreme dietary restraint (<500 kcal/day); or
3. An individual whose self-evaluation is unduly influenced by shape or weight, and who regularly engages in intense, excessive exercise for the purpose of weight control (at least five times weekly) over the past 3 months.

Statistical analysis
Data were analyzed using SPSS version 9.0. A 3:1 control group (303 of 439 schoolgirls who completed the assessment) was randomly selected using SPSS.

RESULTS — SES was significantly lower among diabetic than nondiabetic girls (3.7 ± 1.1 vs. 4.4 ± 1.2; P < 0.0005). BMI did not differ between the two groups (19.9 ± 3.1 in diabetic girls vs. 19.5 ± 3.7 kg/m² in nondiabetic girls; P = 0.24), although diabetic girls had a borderline higher BMI for age Z score than nondiabetic girls (0.5 ± 0.8 vs. 0.3 ± 0.9; P = 0.05). Menstruation had begun in 27% of diabetic girls and 25% of nondiabetic girls (P = 0.69); 54% of diabetic girls were at Tanner stage 1 or 2 (prepubertal/early pubertal), and 46% were at a more advanced stage. Compared with diabetic study participants (n = 101), the diabetic girls who chose not to participate (n = 41) did not differ significantly in age, BMI, or age at diagnosis of diabetes. However, nonparticipants had higher HbA1c levels (9.0 ± 1.9 vs. 8.2 ± 1.2%; P = 0.008), indicating poorer metabolic control.

The same percentage of diabetic (16 of 101; 16%) and nondiabetic (49 of 303; 16%) girls reported at least one disturbed eating behavior in the previous month on the cEDE interview. Significantly more diabetic (8 of 101; 8%) than nondiabetic (3 of 303; 1%) girls reported currently engaging in two or more disturbed eating behaviors (P < 0.0005). The most common behavioral combination was strict dieting with intense, excessive exercise for weight control. Dieting in the past month was reported by 11 of 101 (11%) diabetic girls and 46 of 303 (15%) nondiabetic girls (P = 0.36). Intense, excessive exercise for weight control was more common in diabetic than in nondiabetic girls (10 of 101 [10%] vs. 3 of 303 [1%]; P < 0.0005). Binge eating was also more common in diabetic than in nondiabetic girls (3 of 101 [3%] vs. 1 of 303 [0.3%]; P = 0.05). Among the 101 diabetic girls, 2 (2%) reported omitting their insulin for the purpose of losing weight in the previous month. No girls in either group reported using self-induced vomiting, laxatives, diuretics, or diet pills for weight control in the previous month. The total cEDE score, a composite measure of eating-related pathology, was similar in the two groups (0.31 ± 0.68 in diabetic girls vs. 0.26 ± 0.62 in nondiabetic girls; P = 0.58).

There were no current diagnoses of
anorexia nervosa or bulimia nervosa among the diabetic or nondiabetic girls. Using Jones et al.’s previously defined criteria (8), 8% (8 of 101) of the diabetic girls were diagnosed with ED-NOS or a subthreshold eating disorder compared with 1% (3 of 303) of the control group ($P = 0.001$). In the diabetic girls, there were two cases of ED-NOS and six cases of subthreshold disorders, whereas in the control group all three cases were subthreshold disorders.

The study sample was weighted toward higher SES in the 9- and 10-year-old control group because of the schools assigned. However, SES was not significantly correlated with total cEDE score (the partial correlation of SES with total cEDE score, controlling for age, was $-0.06; P = 0.22$). Furthermore, disturbed eating behavior was uncommon among those girls in whom SES matching was poor (i.e., the youngest girls in the sample). To ensure that SES was not a confounding factor, subsample analyses were carried out in girls ages 11–14 years, for whom SES was well matched (67 diabetic and 201 nondiabetic girls). The SES level was 3.9 ± 1.1 in diabetic girls and 4.1 ± 1.1 in nondiabetic girls ($P = 0.1$).

Within this subsample, 18% (12 of 67) of diabetic girls and 19% (38 of 201) of nondiabetic girls reported at least one disturbed eating behavior in the previous month ($P = 0.86$). However, 10% (7 of 67) of diabetic girls and only 1.5% (3 of 201) of nondiabetic girls met criteria for ED-NOS or a subthreshold eating disorder ($P = 0.003$).

Among the diabetic girls, the BMI Z score was higher in those with an eating disorder ($n = 8; 1.5 ± 0.4$) than in those without ($n = 93; 0.4 ± 0.7; P < 0.0005$), as was the Tanner stage (3.5 ± 1.3 vs. 2.4 ± 1.2; $P = 0.02$). Age (12.7 ± 1.3 years in those with an eating disorder, 11.7 ± 1.5 years in those without; $P = 0.07$), age at diagnosis of diabetes (8.7 ± 2.8 vs. 6.9 ± 3.0 years; $P = 0.11$), and HbA1c level (8.1 ± 1.2 vs. 8.2 ± 1.0%; $P = 0.77$) did not differ significantly.

CONCLUSIONS — In this population of preteen and early teenage girls with and without type 1 diabetes, disturbed eating behavior was moderately common, although usually mild in severity. Binge eating; intense, excessive exercise for weight control; reporting two or more current disturbed eating behaviors; and ED-NOS or subthreshold eating disorders were all significantly more common among diabetic girls than in their nondiabetic peers. All differences were confirmed or heightened when analyses were limited to participants age 11 years or older, for whom both age and SES were well matched. These findings lend support to our hypothesis that disturbed eating behavior and ED-NOS or subthreshold eating disorders are more common in preteen and early teenage girls with type 1 diabetes.

The current study’s findings parallel those of an Ontario multicenter study of 356 girls with type 1 diabetes and 1,098 age-matched nondiabetic control subjects ages 12–19 years (8). In that study, the authors found that eating disorders were more than twice as common among girls with type 1 diabetes as in their nondiabetic peers. However, as would be expected, in a younger cohort that includes many preteen and even prepubertal girls, we found that the prevalence rates of all disturbances were much lower than in the teenage study, both in girls with type 1 diabetes and in the nondiabetic control group. Subthreshold eating disorders were diagnosed in 6% of preteen diabetic girls in the current study compared with 14% of the teenage girls in the Jones et al. study (8). ED-NOS was diagnosed in 2% of preteen girls in the current study versus 9% of the Jones et al. teenage group. Bulimia nervosa was present in 1.4% of the Jones et al. group.

Insulin omission is the most common purging behavior among teenage girls and women with type 1 diabetes (8,13,31,32), but it has been little studied in preteen girls. The most frequently cited reason for deliberate insulin omission among female patients with type 1 diabetes is weight control (31,33). We found the prevalence of insulin omission for weight control to be 2% in preteen girls, 14% in teenage girls (8), and 34% in young adult women (13). Our findings are similar to those of other studies in the general population, which have reported very low rates of purging behavior in the preteen years, with rising prevalence during the teenage years (21,34,35).

The current study might underestimate rates of disturbed eating behavior in the preteen population and of insulin omission in the diabetic population because individuals with significant eating problems have been shown to be less likely to participate in studies of eating problems (36). This study’s nonparticipants with diabetes had significantly higher HbA1c levels than did the study participants, reflecting poorer metabolic control among nonparticipants. Disturbed eating behavior is a common and often unrecognized cause of poorer metabolic control among girls and young women with type 1 diabetes (13) and may have been related to some of the nonparticipants’ reluctance to take part in the study. Conversely, recruitment from a specialist clinic might have been biased toward recruiting participants with more psychosocial and medical problems than the general population, although the majority of patients seen at the HSC Diabetes Clinic receive regular comprehensive care there from time of diagnosis until age 18 years, and we did not recruit participants who were attending the clinic for a brief consultation.

The literature regarding the relationship of SES to eating problems has been inconsistent. A 1996 review (37) suggested that there is no proven link between higher SES and the risk of anorexia nervosa, but that there may be a link between bulimia nervosa and lower SES. Any difference in SES that existed in the past may have diminished or been eliminated by the widespread dissemination of disturbed attitudes toward eating and body shape across cultures and social classes. A study of a large community sample of teenage girls suggested that although dieting was more common in those of higher SES, clinically significant, eating-disordered behavior had no relation to SES (38).

Longitudinal studies suggest that early and relatively mild eating disturbances, such as those identified in this study, are likely to persist and worsen, both in individuals with type 1 diabetes (10,13) and in the general population (39,40). Binge eating, which has highly deleterious effects on metabolic control in individuals with type 1 diabetes, tends to emerge later in adolescence in girls with and without type 1 diabetes. We did not find a relationship between metabolic control (HbA1c) and eating disturbances, although such a relationship may emerge over the next several years as binge eating and insulin omission for weight control become more common and entrenched. These behaviors may develop in girls who exhibited only negative body image, diet-
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ing, and excessive exercise for weight control at age 9–14 years, none of which should worsen metabolic control. In fact, dieting and exercise might be expected to improve metabolic control in the absence of more dysregulated eating behavior; therefore, the clinical significance of the mild eating disturbances identified in this study is unclear at present.

The increased risk of eating disorders seen in the girls with type 1 diabetes may be partially explained by the tendency for these girls to be heavier than their nondiabetic peers, although we found this difference to be quite subtle. However, the BMI Z score was dramatically higher in those with eating disorders, a relationship that may be mediated by pubertal development, eating behavior, and body composition. Higher BMI and body fat content are strongly related to past and current dieting in preteen individuals (41,42). It is not possible to ascertain from this cross-sectional study whether the higher BMI was a cause of the eating problems identified, a result, or both. It is also unknown whether we identified girls with syndromes that will evolve into more serious eating disorders with compromised metabolic control or whether their dieting and intense exercise could reflect medically advantageous attempts to optimize both metabolic control and weight.

However, the serious medical sequelae of even mild eating disorders in teenage girls and young women with type 1 diabetes, and the significant prevalence of disturbed eating behavior in this young cohort, suggest that screening and treatment should begin early in the preteen years. Longitudinal data will be helpful in understanding the natural history of these eating problems and in elucidating whether these are benign behaviors, “health-motivated” syndromes, or the early forms of significant psychiatric and medical problems. It is somewhat reassuring that HbA1c levels were not significantly higher in the girls with disturbed eating behavior. However, the absence of more severe hyperglycemia in these girls likely reflected the low frequency of binge eating and insulin omission in this age group. Such behavior, which worsens metabolic control, is infrequent at this age, at least in part because of the considerable parental supervision of food choices and insulin administration.

The present study is the first systematic, controlled study of disturbed eating behavior in young girls with type 1 diabetes. The strengths of this study include a relatively large sample size, inclusion of an appropriate control group, and the use of a standardized diagnostic interview administered by trained interviewers. The limitations include the participation rate (~70%), which is not unusual for this type of study but limits the generalizability of the results to other samples, and the cross-sectional design. Recruitment from a specialist clinic, although it mostly provides primary care, could have biased the study toward a more medically compromised population. In addition, the psychometric properties of the cEDE and other measures of eating disturbances are not well established in girls younger than age 11 years. Inexact SES matching suggests caution in the analysis and interpretation of these data. A longitudinal study now under way in the girls with type 1 diabetes will be helpful in understanding the course and consequences of these early and mostly mild eating disturbances and disorders and inrationally tailoring prevention and treatment interventions targeting the needs of this high-risk group.

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