Eating disorders in adolescent females with and without type 1 diabetes: cross sectional study

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Abstract

Objective To determine the prevalence of eating disorders in adolescent females with type 1 diabetes mellitus compared with that in their non-diabetic peers.

Design Cross sectional case-control led study.

Setting Diabetes clinics and schools in three Canadian cities.

Subjects 356 females aged 12-19 with type 1 diabetes and 1098 age matched non-diabetic controls.

Main outcome measure Eating disorders meeting Diagnostic and Statistical Manual of Mental Disorders (DSM-IV) criteria.

Results Eating disorders that met DSM-IV criteria were more prevalent in diabetic subjects (36, 10%) than in non-diabetic controls (49, 4%) (odds ratio 2.4, 95% confidence interval 1.5 to 3.7; P = 0.001). Subthreshold eating disorders were also more common in those with diabetes (49, 14%) than in controls (84, 8%) (odds ratio 1.9, 95% confidence interval 1.3 to 2.8; P = 0.001). Mean haemoglobin A1c concentration was higher in diabetic subjects with an eating disorder (9.4% (1.8)) than in those without (8.6% (1.6)), P = 0.04.

Conclusions DSM-IV and subthreshold eating disorders are almost twice as common in adolescent females with type 1 diabetes as in their non-diabetic peers. In diabetic subjects, eating disorders are associated with insulin omission for weight loss and impaired metabolic control.

Introduction

Eating disorders are common in late adolescent and young adult women in westernised countries. These conditions are of particular concern in young women with type 1 diabetes mellitus because of their association with impaired metabolic control and an earlier than expected onset of diabetes related complications. Aspects of type 1 diabetes and its treatment that have been postulated to increase the risk of eating disorders in young women include the cycle of weight loss at disease onset and subsequent weight gain with the initiation of insulin treatment, the trend towards higher body mass index, dietary restraint necessitated by diabetes management, and the availability of deliberate insulin underdosing or omission as a weight loss strategy. However, whether eating disorders occur more frequently in females with diabetes than their non-diabetic peers is controversial.

Five controlled, interview based prevalence studies of eating disorders in young women with type 1 diabetes have been reported in which the authors concluded that eating disorders were not more common than in similar non-diabetic populations. However, these negative findings were based on small sample sizes of young women in the age group at highest risk for eating disorders and consequently had low statistical power to detect significant differences in prevalence. We compared the prevalence of eating disorders in a large sample of adolescent girls with type 1 diabetes to that in a large age matched, non-diabetic female population to determine whether eating disorders are more common among those with diabetes.

Participants and methods

Females aged 12 to 19 years who had had type 1 diabetes for at least one year were identified from diabetes clinic lists at the Hospital for Sick Children in Toronto, the Children’s Hospital of Eastern Ontario in Ottawa, and the Children’s Hospital at Hamilton Health Sciences Corporation in Hamilton, Ontario. The subjects were approached by post and telephone call or during clinic appointments. All three diabetes clinics are the main primary treatment centres in their areas for children and adolescents with type 1 diabetes, providing care for about 70% of potential patients within their catchment areas.

A comparison group of 2494 female students without diabetes was identified at junior high and high schools in Toronto, Ottawa, and Hamilton. The study was described in the same way to both the students and the diabetic patients. The subjects were approached individually whereas the controls were approached as a group during a class. We obtained research ethics approval for each site and informed written consent from each participant and her parent, when required.

Study protocol

All participants completed a self report screening package that included the eating disorder inventory, the eating attitudes test (EAT-26), and the diagnostic survey for eating disorders (modified). Body mass index (weight (kg)/height (m)\(^2\)) was calculated based on self reported height and weight. Participants who were considered to be at risk of an eating disorder because they scored above predetermined cut off levels (box) were asked to complete the eating disorder assessment.
examination (version 11.5d-modified), which is a semi-structured diagnostic interview. An additional 15% of the subjects who did not meet the screening cut off were randomly selected for the interview to ensure interviewer blindness. Interviewers could not be blind to diabetes status because the questionnaire contained questions relating to diabetes, which we included for the diabetes sample (for example, on insulin omission for weight loss). Blood was obtained by finger prick from each of the diabetic subjects to measure haemoglobin A1c concentrations. All samples were analysed at the Hospital for Sick Children with the BioRad variant high pressure liquid chromatography assay (normal range 4-6%).

### Screening measures

The eating disorders inventory and eating attitudes test are self administered questionnaires shown to be reliable and valid screening measures for eating disorders in both diabetic and non-diabetic populations. The eating disorders inventory provides quantitative assessments of specific eating attitudes and behaviours, and the eating attitudes test provides a total score for disturbed eating attitudes and behaviour. Scores on both questionnaires were corrected to discount items that may be scored positively because of diabetes and its treatment (such as "Aware of the calorie content of foods that I eat"). The diagnostic survey for eating disorders is a self administered questionnaire that allows the frequency of disturbed behaviour to be quantified. We modified this measure to include diabetes related items such as intentional insulin omission for weight loss. The eating disorders examination is a semi-structured diagnostic interview that quantifies the symptoms, behaviour, and psychopathology of eating disorders and allows eating disorders to be diagnosed according to the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV). This interview has good reliability and validity and is currently considered the gold standard for the standardised assessment of eating disorders.

### Classification of eating disorders

The classification of eating disorders was based on data from the eating disorder examination interview. Subjects were classified as having a full syndrome eating disorder based on DSM-IV criteria (anorexia nervosa, bulimia nervosa, or “eating disorder not otherwise specified”); a subthreshold eating disorder; or no eating disorder. These three categories were mutually exclusive (see BMJ’s website for details of diagnostic criteria).

Based on DSM-IV criteria a minimum of four clinical symptoms over the past three months were necessary for the diagnosis of anorexia or bulimia nervosa. DSM-IV provides broad suggestions for diagnosis of eating disorders not otherwise specified. We operationalised the diagnosis of these disorders more precisely based on DSM-IV criteria and treatment reported in diagnostic survey for eating disorders.

### Statistical analysis

We used $\chi^2$ analyses with Yates's correction for continuity to test the prevalence of clinical and subthreshold eating disorders between the three cities and in the combined samples. Fisher’s exact test was used to test the proportions for bulimia. We compared normally distributed continuous variables using Student’s $t$ tests and analysis of variance. Scheffè’s method for post-hoc comparisons was used to deal with inflated type I error rates when significant effects were found by analysis of variance. Non-normal data were transformed logarithmically and independent $t$ tests were used for comparisons between two groups. Odds ratios and corresponding confidence intervals were calculated to measure the main effect of diabetes on eating disorders. P values < 0.05 were considered significant. All P values are two tailed.

### Results

#### Participants and non-participants

In total, 361 of 430 eligible females with type 1 diabetes (84%) agreed to participate in the study. Of the 2494 eligible school girls without diabetes, 1840 (74%) returned signed consent forms and agreed to take part in the study, and an additional 151 (8%) subjects were absent or could not participate because of school tests on the day of the survey. Screening data were collected on 1689 subjects without diabetes. Based on projected numbers of diabetic subjects at each site, we randomly selected a subsample of 1114 age and site matched control subjects (roughly 3:1 ratio).

There were no significant differences between the three clinics or between the schools across the three cities. Therefore, all subsequent analyses were based on two groups—that is, combined diabetes and combined control samples. The mean body mass index was higher in the diabetes group (22.7 (SD 3.8) versus 20.6 (3.3), P < 0.001), and the proportion of subjects from higher socioeconomic groups (IV, V, and VI) was slightly higher among control subjects (53% versus 61%, P = 0.02) (table 1).
In subjects with diabetes, deliberate insulin omission is likely to have a subthreshold eating disorder than controls. In total, 220 (61%) subjects with diabetes and 616 (55%) controls completed the eating disorder examination. Our study has some limitations. Although the participation rates of 84% in the diabetes group and 74% in the control group, even though they reported more binge eating.

**Table 2** Self reported behaviours of diabetic and control groups based on diagnostic survey for eating disorders (modified)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Diabetic subjects (n=361)</th>
<th>Controls (n=1114)</th>
<th>Odds ratio (95% CI)</th>
<th>P value*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Binge eating</td>
<td>108 (30)</td>
<td>251 (23)</td>
<td>1.5 (1.1 to 1.9)</td>
<td>0.004</td>
</tr>
<tr>
<td>Dieting for weight loss</td>
<td>43 (12)</td>
<td>254 (23)</td>
<td>0.5 (0.3 to 0.6)</td>
<td>0.001</td>
</tr>
<tr>
<td>Self induced vomiting</td>
<td>25 (7)</td>
<td>95 (8)</td>
<td>0.8 (0.5 to 1.3)</td>
<td>0.333</td>
</tr>
<tr>
<td>Laxative use</td>
<td>9 (2)</td>
<td>14 (1)</td>
<td>2.0 (0.9 to 4.7)</td>
<td>0.100</td>
</tr>
<tr>
<td>Omission or underdosing of insulin for weight loss</td>
<td>41 (11)</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
</tbody>
</table>

*For comparison between diabetic subjects and controls by χ² analysis.

**Table 3** Frequency of DSM-IV and subthreshold eating disorders among diabetic subjects and matched controls

<table>
<thead>
<tr>
<th>Eating disorder</th>
<th>Diabetic subjects (n=366)</th>
<th>Controls (n=1114)</th>
<th>Odds ratio (95% CI)</th>
<th>P value*</th>
</tr>
</thead>
<tbody>
<tr>
<td>DSM-IV disorder</td>
<td>36 (10)</td>
<td>49 (4)</td>
<td>2.4 (1.5 to 3.7)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Anorexia nervosa</td>
<td>0</td>
<td>0</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Bulimia nervosa</td>
<td>5 (1)</td>
<td>5 (0.5)</td>
<td>3.1 (0.9 to 10.6)</td>
<td>0.07</td>
</tr>
<tr>
<td>Not otherwise specified</td>
<td>31 (9)</td>
<td>44 (4)</td>
<td>2.3 (1.4 to 3.7)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Subthreshold disorders</td>
<td>49 (14)</td>
<td>84 (8)</td>
<td>1.9 (1.3 to 2.8)</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

*For χ² tests.

**Discussion**

This multivariate case-controlled study has shown that eating disorders that meet DSM-IV diagnostic criteria and their subthreshold variants are about twice as common in adolescent females with type 1 diabetes as in their non-diabetic peers. Among diabetic subjects, the mean haemoglobin A₁c concentration was higher in those with an eating disorder than in those without an eating disorder. Such an association between eating disorders and impaired metabolic control may contribute to an increased risk of microvascular complications in young women with diabetes and eating disorders.1, 27

Insulin omission, which is recognised as a purging behaviour in the DSM-IV criteria, was the most common weight loss method after dieting among the diabetic subjects. The availability of this method of weight control, together with the dietary restrictions imposed by the diabetes regimen, may explain why the diabetes group reported less dieting to lose weight than the control group, even though they reported more binge eating.

In conclusion, our study showed that eating disorders are common in adolescent females with type 1 diabetes as in their non-diabetic peers. Among diabetic subjects, the mean haemoglobin A₁c concentration was higher in those with an eating disorder than in those without an eating disorder. Such an association between eating disorders and impaired metabolic control may contribute to an increased risk of microvascular complications in young women with diabetes and eating disorders.
The prevalence of eating disorders was about twice as high among diabetic females aged 12-19 as that among age matched controls.

Diabetic subjects with eating disorders had higher haemoglobin A1c concentrations than those without eating disorders in the control group are high, the possibility of selection bias cannot be excluded. In addition, our diabetes sample is not truly population based, and a referral bias to the paediatric diabetes clinics may exist. Finally, a higher proportion of our control subjects were in the upper socioeconomic group than the diabetic subjects. However, we found no statistical relation between socioeconomic status and eating disorder.

Despite these limitations, our study overcomes the methodological difficulties of previous studies. The findings are both statistically and clinically meaningful, and the magnitude of the difference in prevalence is comparable with that found in previous studies with small sample sizes. The increased prevalence of eating disorders in adolescent females with type 1 diabetes may reflect an interaction between individual and environmental factors in the pathogenesis of eating disorders, similar to that observed in other high risk groups, such as competitive athletes, models, and ballet dancers. However, eating disorders in adolescent females with type 1 diabetes pose a particular health risk in that they are associated with impaired metabolic control and about a threefold increase in the risk of diabetic retinopathy. Preliminary research suggests that clinic based interventions may help to diminish disordered eating attitudes in these young women. Further study is needed to determine whether intensive diabetes treatment regimens contribute to the increased risk of eating disorders in this population.

We acknowledge the time and effort of the young women who participated in our study. We also thank David Streiner and Gerald Devins for their statistical and methodological contributions and Susan Bennett and Anne Rydall for help with data collection. Finally, we thank the staff at the participating hospitals and schools, and in particular John Valverdeun at Hamilton Health Services.

Contributors: The research was developed within the diabetes and eating disorders research group of the University Health Network, the Hospital for Sick Children, Toronto, and the University of Toronto, of which GR, WD, and MPO are senior members. The research formed part of JMj’s PhD thesis at the Institute of Medical Science, University of Toronto, which was supervised by GR. JMj conducted the data collection and statistical analysis and drafted the paper. MPO and MLL provided statistical guidance. All authors contributed to the revision and editing of the paper. GR and JMj will act as guarantors for the paper.