

Disturbed eating behavior in pre-teen and teenage girls and boys with type 1 diabetes

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Summary. *Aim:* To investigate Disturbed Eating Behavior (DEB) and eating patterns in the context of a teenage population with T1D. *Methods:* DEB was investigated using Eating Disorder Examination (EDE) test by a psychologist. Questions regarding insulin dosage manipulation or omission to obtain decrease in weight were added. Specific behavioral items from the EDE were used to define DEB: Objective Binge-eating, Self-induced Vomiting for weight control; the use of Diuretics, Laxatives or Insulin Omission for weight loss. Some EDE items provided information about four composite subscales which assess Restraint, Eating concern, Shape concern and Weight concern. *Results:* Shape and Weight concern showed significantly higher scores than those observed in the other two subscales ($p=0.021$). Average scores of each subscale resulted significantly higher in girls than in boys as well as in teen than in pre-teen participants. Objective binge eating (20%) and insulin dosage omission or reduction (17.6%) were the most common DEB ($p<0.03$). Forty-one percent of participants reported to consume three, 25% four and 34% five meals daily. A significantly lower proportion of females than males resulted to consume breakfast and mid-afternoon snacks. *Conclusions:* Findings from this study suggest that caregivers working in pediatric diabetes units should be alert in order to discover some DEB such as medication omission and binge-eating, all indicative symptoms of dissatisfaction of the body and psychological distress in diabetes management. (www.actabiomedica.it)

Key words: disturbed eating behavior, eating disorders, type 1 diabetes, insulin omission, teenagers

Introduction

Disturbed eating behavior (DEB) is a broad term that includes binge eating and a range of compensatory energy-eliminating behaviors, such as self-induced vomiting, misuse of laxative, diet pills, diuretics, and compulsive exercise for weight loss (1). These abnormal habits cannot be categorized as veritable eating disorders (ED), which on the contrary concern well identified and more severe disorders, such as anorexia

nervosa, bulimia nervosa, pica, rumination (2). However, DEB evaluation, especially in younger generations, is justified because these habits often evolve towards the more severe clinical manifestations of ED.

DEB occurs frequently in teenagers and it has been related to low self-esteem, body dissatisfaction due to a high BMI, depression, and parental eating disorders (1, 3, 4). DEB is reported in children with type-1 diabetes (T1D) too, with a prevalence of 30-50% in teenage females (5, 6). In male adolescents with T1D

the prevalence seems to be lower, at approximately 9% (5, 7). There is general agreement that DEB is more frequent in pre-teen and teenage girls and boys with T1D than in their non-diabetic peers (8, 9).

The explanation of this increased prevalence of DEB in adolescents with T1D remains unclear. It has been postulated that being affected by T1D during an important psychological process such as the adolescence while the physical and social development is under way, may amplify the risk of developing DEB (10). The unexpected onset in this context of a chronic disease such as T1D burdened by frequent blood and urine glucose measurements, dietary restrictions and lifestyle modifications can develop disturbed attitudes toward food (11). It has been reported that the association of ED as well as DEB with diabetes causes a serious deterioration in metabolic control, a high morbidity and mortality rate, and a high risk of diabetes-related complications appearance (11-13)

Given this scenario, it is crucial that DEB has to be regularly screened in pre-teen and teenage patients with T1D with a particular attention to adolescent girls who are at greater risk than boys (5-7). The purpose of the present study was to investigate DEB and eating patterns in the context of a teenage population with T1D.

Patients and Methods

The study was conducted at the Regional Diabetes Center of the University Children Hospital, in Parma, Italy. Patients recruited were 8 to 14 years old and were diagnosed with T1D for more 1 year at the same Centre. All patients were treated with the same protocol at diagnosis (14). At post diagnosis discharge from hospital, an integrated package of care was offered to parents and patients by a multidisciplinary team. The team consisted of pediatric diabetologists, diabetes specialist nurses, dieticians, psychologists and social workers. Repeated educational advices on diabetes management, hypoglycemic episodes and DKA prevention were provided at hospital and in outpatient clinics. Sticks for capillary blood glucose determination, urine glucose assay, insulin and syringes were free distributed. An emergency toll-free telephone number

was also provided (15). The patients were routinely followed in outpatient clinic four times per year. All patients were treated with a multiple insulin injection regimen, and a balanced meal plan including three meals, two snacks daily, and carbohydrates counting was recommended. Patients with T1D diagnosis < 6 months at recruitment time were excluded from the study. Clinical data for this study were collected from the medical records of each patient and included age, gender, height, weight, body mass index (BMI), Tanner stage, duration of diabetes, glycated hemoglobin (HbA1c).

DEB was investigated using Eating Disorder Examination (EDE), a valid and reliable investigator-based interview (16, 17). EDE was explained and administered to the participants of the study in Italian language by a psychologist without the presence of parents, according to the methodology of the "mediated interview", during which the interviewer is interacting with the interviewee (18). Because the EDE is not designed for patients with T1D and does not include questions specifically regarding this disease, the psychologist added during the interactive interview also questions regarding insulin dosage manipulation or omission to obtain decrease in weight.

Specific behavioral items from the EDE were used to define DEB: Objective Binge-eating (how much one has actually eaten), Self-induced Vomiting for weight control; the use of Diuretics, Laxatives or Insulin Omission for weight loss. Compulsive exercise was not investigated. The information on recurrent episodes concerned the past 4 weeks. Some EDE items provided information about four composite subscales which assess Restraint, Eating concern, Shape concern and Weight concern. A 7-point Linkert scale was used with responses ranging from 0 to 6. Higher total EDE score indicated more severe ED-related psychopathology.

Frequency of meals (breakfast, lunch and dinner) and snacks (mid-morning and mid-afternoon) consumption over the past week basis was also recorded with the support of an experienced dietitian. Breakfast was defined as any intake of food or beverage between 6 and 8 a.m.. Reports of eating breakfast or snacks less than three times per week were defined as "Skip breakfast" or "Skip snacks".

HbA1c levels were measured by the Bayer DCA 2000 method (upper limit of normal value: 6.0%). For this study the most recent HbA1c value was used. Height and weight were measured by experienced clinic personnel, and BMI was calculated as weight in kilograms divided by height in meters squared. Height, weight and BMI were evaluated according Italian growth reference charts (19).

The study was performed according to the criteria of the Helsinki II Declaration. Tutors or parents of all patients admitted to our Department were in general accustomed to sign an informed consent document for the use of clinical data regarding their children for scientific purposes only. Informed written consent to participate was obtained from a parent or tutor, and verbal assent was also obtained from participants. No conflict of interest existed in relation to the subject matter of the present paper.

Statistical analysis

Data were summarized as numbers (n) and frequencies (%) if they were categorical and as mean and standard deviation (SD) if quantitative. If the data were normally distributed a two-tailed unpaired T-test or otherwise a non-parametric Mann-Whitney U-Test was applied in order to compare results between groups. Chi-square test (χ^2) or Fisher exact test was used to compare frequencies between groups. P-values less than 0.05 were considered as statistically significant.

Results

Patients characteristics

Eighty-five young people with T1D (60% females) were recruited for this study. Mean age was 13.4±4.8 years: 40% were pre-teen and 60% teenagers. Mean age at T1D onset was 7.1±4.0 (range: 4-12) years. Mean BMI percentile was 54.16±4.7: 68% of participants were normal weight, 30% overweight and 2% underweight. Overweight recurred more frequently in girls than in boys (38.8 vs 20.4%; $\chi^2=4.69$; $p<0.03$).

Mean HbA1c value at enrollment was 7.7±0.9 (range: 5.7-10.0) %. All patients were treated with the same multiple daily insulin injection regimen: one injection with long lasting insulin analog (40%) at bed time, and rapid acting insulin analog at breakfast, lunch and dinner. Males and females did not differ significantly on age, HbA1c, duration of diabetes. Forty-eight percent of girls and 35% of boys were at Tanner stage 1 or 2, the remaining patients were at stage 3 or 4. Menarche was reported in 34% of teenage girls.

Disturbed eating behavior (DEB) examination

Range scores about the subscales for Shape concern, Weight concern, Eating concern and Dietary restraint are summarized In Table 1. Shape and Weight concern showed significantly higher scores than those observed in the other two subscales ($F=9.289$; $p=0.021$). Average scores of each subscale resulted significantly higher in girls than in boys (Figure 1) as well as in teen than in pre-teen participants (Figure 2).

Table 1. Scores evaluated by EDE questionnaire in pre-teen and teen males and females with T1D (* : $p=0.021$)

| Subscales | Parameters | Values |
|-------------------|--------------|-----------|
| Shape concern | N (patients) | 85 |
| | Min | 0 |
| | Max | 6.0 |
| | Mean | 1.497 (*) |
| | SD | 1.575 |
| Weight concern | N | 85 |
| | Min | 0 |
| | Max | 6.0 |
| | Mean | 1.535 (*) |
| | SD | 1.830 |
| Eating concern | N | 85 |
| | Min | 0 |
| | Max | 5.2 |
| | Mean | 0.959 |
| | SD | 1.271 |
| Dietary restraint | N | 85 |
| | Min | 0 |
| | Max | 5.2 |
| | Mean | 1.054 |
| | SD | 1.295 |

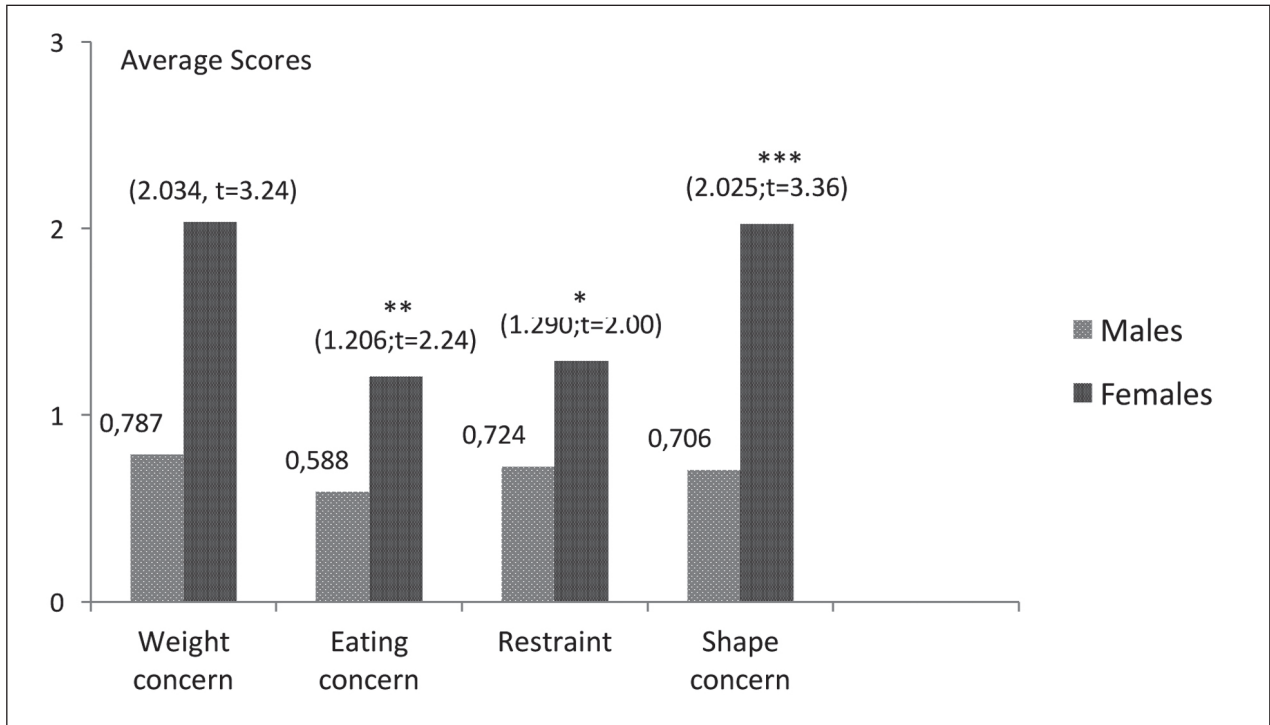


Figure 1. Average scores for each subscale distribution according to the gender (***: p=0.001; **: p=0.02; * p=0.05)

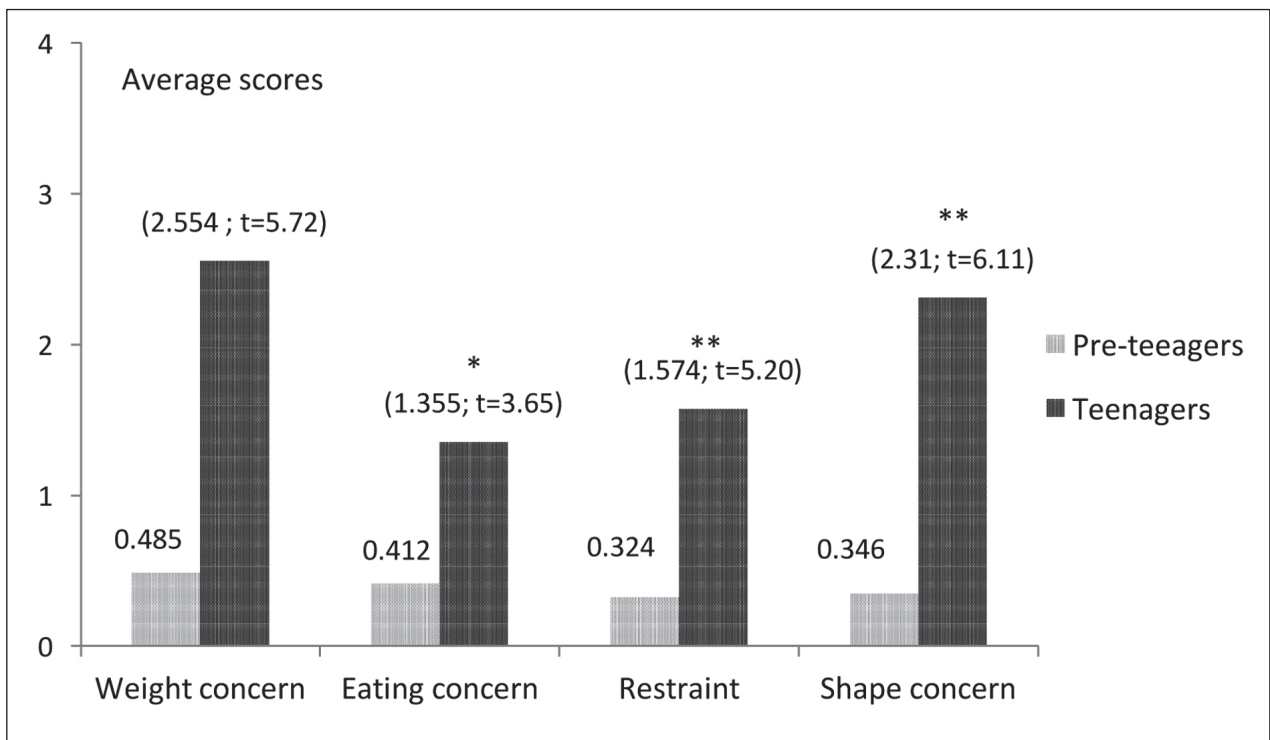


Figure 2. Average scores for each subscale distribution according to the chronological age (**: p=0.00001; *: p=0.004)

As displayed in Table 2 forty-three patients (50.5%) reported DEB episodes. Objective binge eating (20%) and insulin dosage omission or reduction (17.6%) were the most common DEB ($\chi^2=4.58$; $p<0.03$). Binge eating episodes occurred significantly more numerous in girls than in boys ($t=2.25$; $p=0.026$). Among 51 girls, 11 (21.5%) reported omitting insulin dose for the purpose of losing weight. On the contrary only 2 boys (5.8%) reported insulin dose manipulation ($\chi^2=3.87$; $p=0.049$). Among 11 girls prone to omit or reduce insulin dose 10 girls were overweight.

Girls omitting insulin injection showed a mean HbA1c value ($8.0\pm 0.4\%$) mildly higher than girls who did not ($7.5\pm 0.8\%$; $t: 1.99$, $p=0.046$). No differences were found in HbA1c values among girls who reported binge-eating episodes ($7.8\pm 0.6\%$) and who did not (7.3 ± 1.2 ; $t: 1.32$, $p=0.19$)

Meals and snacks consumption

Forty-one percent of participants reported to consume three, 25% four and 34% five meals daily. A significantly lower proportion of females than males resulted to consume breakfast and mid-afternoon snacks (Table 3). No gender differences were found about lunch, dinner and mid-morning snacks. Teenage females showed to skip breakfast or snacks more frequently than pre-teen females (3.2 ± 0.9 vs 2.5 ± 0.2 ; $t=4.13$; $p=0.0001$). No difference in pre-teen and teen male patients.

Limitations

We are aware that the present study has some limitations. One of the limitations is related to the absence

Table 3. Daily consumption of meals and snacks reported by the participants to the study

| Meals/Snacks | Females (n. 51) | Males (n. 34) | χ^2 | p-value |
|---------------|--------------------|------------------|----------|---------|
| Breakfast | 66.6 | 88.2% | 5.10 | 0.023 |
| Lunch | 88.3 | 88.2% | 0.10 | 1.00 |
| Dinner | 82.3 | 91.7% | 1.31 | 0.25 |
| Mid-morning | 49.0 | 58.8% | 0.79 | 0.37 |
| Mid-afternoon | 41.7 | 73.5% | 8.60 | 0.003 |

of a control group. We have tried to recruit a group of pre-teen and teenage healthy subjects from the same schools attended by the children with T1D enrolled in the present study, but our invitation was considered inappropriate, and at risk of triggering possible latent DEB in these healthy adolescents. However, in a previous case-control study, we found that DEB was more mildly frequent in patients with T1D than in control peers ($\chi^2=2.883$, $p=0.09$) (20).

A further limitation concerns the questionnaire used to investigate the frequency of the DEP. The tool herein applied (EDE) was widely employed with acceptable validity and reliability (16, 17). It is currently used to identify psychological and behavior disturbances associated with eating disorders and to diagnose eating disorders (16). We knew that this instrument was also available an edition adapted to children, but we did not find an Italian version fully validated. So we preferred to use the original EDE version, and to ask an experienced psychologist in the epistemic interview technique (18) to help pre-adolescent and adolescent patients to correctly understand the questions and to express their appropriate answers.

Table 2. Frequency of DEB in the studied population (F=frequency; * = $p<0.03$)

| DEB | No | | Yes | | Total | |
|--------------------------------------|----|------|-----|--------|-------|-----|
| | F | % | F | % | F | % |
| Objective Binge eating | 68 | 80 | 17 | 20.0 * | 85 | 100 |
| Self-induced vomiting | 80 | 94.1 | 5 | 5.9 | 85 | 100 |
| Insulin dosage omission or reduction | 70 | 82.4 | 15 | 17.6 * | 85 | 100 |
| Laxatives | 80 | 94.1 | 5 | 5.9 | 85 | 100 |
| Diuretics | 84 | 98.8 | 1 | 1.2 | 85 | 100 |

Discussion

Minor eating disorders which do not meet the diagnostic criteria for anorexia and bulimia nervosa, such as binge eating, and compensatory behaviors inappropriately used for rapid weight loss such as self-induced vomiting, use of laxatives and diuretics, and manipulation of insulin dose (all these symptoms were here categorized as DEB) were found in the patients enrolled in the present study. Some of these DEB were prevalent (Insulin dosage omission or reduction, and Binge eating) on others (self-induced vomiting, use of laxatives and diuretics).

Also in the present study we observed that deliberate insulin omission for the purpose of losing weight was more common in teenage girls than peer boys with T1D. Our findings are similar to other studies which investigated DEB in teen-age girls with T1D (8, 21). In contrast to other Authors, we did not find the same purging behavior in the pre-teen girls and boys. In pre-teens children insulin omission is generally reported at very low rate (8). This discrepancy may be due to the fact that pre-teen children are still under the supervision of parents regarding diabetes management.

In the current study the great majority of teenage girls who omitted or reduced insulin dose were also overweight and more dissatisfied with their body image. No episode of insulin omission was conversely reported in the 2% of underweight girls, although they were similarly dissatisfied with their body image for diametrically opposed reasons. The fewer desire to lose weight in boys has been associated with less body dissatisfaction levels than in girls (22).

We can speculate that overweight and body dissatisfaction may have influenced the decision to reduce or omit insulin dose. Intensive insulin therapy is generally associated with an increase in BMI, and this relationship could lead adolescents with T1D to omit or underdose insulin to obtain a rapid weight loss (12). This dangerous behavior may result in hyperglycemia, loss of glucose in the urine, dehydration and then in weight reduction.

Repeated episodes of insulin purging has been associated with poor metabolic control, ketoacidosis, long stay at hospital, and a high risk of morbidity and mortality (13). In our experience, episodes of insulin

manipulation have not been so frequent (on average 0.53 episodes/patient/month) to require hospital access. However, in girls who were prone to insulin dosage manipulation we found HbA1c values mildly higher than in girls who were not. Similar results have been previously reported (7), however other authors did not find any differences in glycemic control (23).

A further inappropriate compensatory behavior for weight control is the irregular or infrequent meal consumption (24). Skipping meals were observed in about 28% of female and 7% of male adolescents with T1D (25). In our study two meals were involved in this unhealthy habit, breakfast and mid-afternoon snack. We found that skipping breakfast was more common in girls (34%) than in boys (11.8%) with proportions mildly higher than those reported in other studies (11, 25). The percentages of girls (58%) who skipped the mid-afternoon snack were even more elevated.

Skipping breakfast or snacks recurs frequently in the general young population. In a previous study, we reported a prevalence of breakfast omission of 22% among healthy school children from the same area where the current study was done (26), very close to that found in the girls with T1D. The lack of relation we found between infrequent consumption of meals and poor metabolic control, binge-eating and self-induced vomiting suggest that the habit to skip meals in adolescents with T1D could not be due to an unhealthy weight control behavior, such as reported by some authors (11), but an omission attributable to a more general no perception of the importance of a healthy and balanced diet. Breakfast omission has been associated with decreased daily total energy intake and poor school performance (27, 28). Children with low caloric consumption showed higher rates of school absenteeism and more psychological problems compared to children with more adequate dietary intakes (29).

Objective binge-eating episodes were reported by 20% of our diabetic patients, a similar percentage to that we found in a previous case-control study (20). Objective overeating was reported to be associated with skipping meals among individual with bulimia nervosa (24), but it is not our case. Further diabetes-specific triggers have been speculated in binge-eating behavior among adolescents with T1D.

Food preoccupation (e.g. carbohydrates counting and restriction, portion sizes, food composition) and erroneous knowledge about eating and nutrition associated with weight gain and body dissatisfaction can contribute to improve the risk for binge-eating in adolescents with T1D (30). Fear of hypoglycemia attacks and the resulting often inappropriate use of fast-acting carbohydrates in order to increase or maintain safety levels of blood glucose against hypoglycemia has been associated with unregulated eating behaviors, such as binge-eating, among adults with T1D (31). This pattern of behavior may be hypothesized in adolescents with T1D too.

Previous studies suggested that binge-eating in adolescents with T1D may also be due to psychological distress and demoralization that patients experience against failures in diabetes treatment. In these situations motivation and self-esteem can be compromised, and the resulting depression, anxiety or bad mood can trigger a disturbed eating behavior, such as binge-eating (12).

In conclusion, despite some limitations, findings from this study suggest that caregivers working in pediatric diabetes units should be alert in order to discover some DEB such as medication omission and binge-eating, all indicative symptoms of dissatisfaction of the body and psychological distress in diabetes management.

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