



Eating disorders in type 1 diabetic adolescent

Troubles du comportement alimentaire de l'adolescent diabétique de type 1

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RÉSUMÉ

Introduction: Les adolescents atteints de diabète de type 1 (DT1) semblent avoir un risque plus élevé de développer des troubles du comportement alimentaire (TCA) qui peuvent s'associer à un mauvais contrôle métabolique du diabète.

Objectif : Estimer la prévalence des TCA dans une population d'adolescents diabétiques de type 1 et d'identifier les facteurs de risque associés à ces troubles afin de proposer des mesures préventives.

Méthodes: Nous avons mené une étude transversale analytique incluant 102 adolescents diabétiques de type 1, âgés de 11 à 18 ans, recrutés à l'Institut National de Nutrition de Tunisie sur une période d'un an, de Janvier 2017 à Janvier 2018.

Résultats: La prévalence des TCA était de 33,3%. Elle était significativement plus élevée chez les filles (46,2% vs 20%, $p = 0,005$). Les TCA non spécifiés étaient prédominants avec une prévalence de 29,4%. Les facteurs indépendants associés aux TCA étaient le sexe féminin, l'obésité abdominale et la qualité de vie. Le risque de développement de TCA a été multiplié par 3,5 chez le sexe féminin (OR ajusté = 3,5 et IC95% [1,4-8,6]) et par 5,6 pour les patients souffrant d'obésité abdominale (OR ajusté = 5,6 et IC95% [1,5-20,4]). L'altération de la qualité de vie et en particulier l'inquiétude concernant le diabète augmentaient considérablement le risque de développer un TCA chez nos patients. Cependant, nous n'avons pas trouvé d'association significative entre les TCA et l'âge, la durée du diabète, l'équilibre métabolique, l'adhésion aux médicaments et les complications du diabète.

Conclusion: Ce constat justifie l'importance d'un dépistage précoce des

TCA chez les adolescents atteints de DT1, en particulier les jeunes filles. La prise en charge du diabète nécessite une approche de soins multidisciplinaires comprenant un diabétologue, un diététicien et un psychiatre afin de promouvoir une alimentation saine et d'améliorer la qualité de vie des adolescents DT1.

Mot clés : Diabète de type 1, adolescence, troubles du comportement alimentaire, qualité de vie, contrôle métabolique

SUMMARY

Background: Adolescents with type 1 diabetes appear to be at greater risk for developing eating disorders (ED) which are often associated with impaired metabolic control of diabetes.

Aim: To estimate the prevalence of ED in a population of adolescents with type 1 diabetes (T1D) and to identify risk factors associated with this disorder in order to propose preventive measures.

Methods: A cross-sectional, population-based study involved 102 adolescents with type 1 diabetes, aged 11–18 years, recruited from the National Institute of Nutrition in Tunis, Tunisia over a period of one-year January 2017-January 2018.

Results: The prevalence of ED was 33.3%. It was significantly higher among girls (46.2% vs 20%, $p = 0.005$). Unspecified ED were predominant with a prevalence of 29.4%. Independent factors associated with ED were female sex, abdominal obesity and quality of life. The risk of developing ED was multiplied by 3.5 for women (adjusted OR = 3.5 and CI95% [1.4-8.6]) and by 5.6 for patients with abdominal obesity (Adjusted OR = 5.6 and CI95% [1.5-20.4]). Impaired quality of life and specifically anxiety about diabetes increased significantly the risk of developing ED in our patients. However, we didn't find significant association between ED and age, family characteristics, duration of diabetes, metabolic balance, treatment and complications of diabetes.

Conclusion: We concluded that ED should be always suspected in adolescents with T1D especially in girls. Unspecified ED are more common in this group of patients. Treatment of diabetes requires a multidisciplinary care approach including diabetologist, dietician and psychiatrist in order to promote healthy eating and to improve quality of life of adolescents with T1D.

Keywords: Type 1 diabetes, adolescence, eating disorders, quality of life, metabolic control

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INTRODUCTION

Eating disorders (ED) are a mental disorder defined by abnormal eating habits that negatively affect a person's physical or mental health (1).

According to the diagnostic criteria of the 4th revised edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-4-TR), eating disorders are classified into 3 categories (2):

- Anorexia nervosa, which is characterized by the refusal to keep body weight at a normal minimum value.
- Bulimia characterized by repeated episodes of binge eating, followed by inappropriate compensatory behaviors such as induced vomiting, fasting or the misuse of laxatives or diuretics.
- Unspecified eating disorders for eating disorders that do not meet the criteria for anorexia nervosa or bulimia.

These disorders constitute one of the major public health problems, especially during adolescence, due to their prognosis and their serious psychological, somatic and social consequences (3). A very common association existing between eating disorders and adolescents with type 1 diabetes (T1D) which seems to be at a high risk for developing eating disorders (4-6).

The incidence of T1D in young children continues to increase during the recent decades worldwide (7-10). In 2017, the number of children and adolescents with T1D was estimated at 1.106.500 with 132.600 new cases were diagnosed each year (11).

In Tunisia, in a multicenter study conducted from 2009 to 2011, the incidence was estimated at 8.5/100 000 children under the age of 15 years (10).

The daily constraints of insulin management and diet could lead to psychological and somatic repercussions for these diabetics that can alter their quality of life (12).

All of these factors support the hypothesis of the existence of a risk of developing eating disorders (ED) in adolescents with T1D (4-6).

Eating disorders appear to be a risk factor for metabolic imbalance in diabetes resulting in an increase in morbidity and mortality, with a greater number of hospitalizations for ketoacidosis, as well as microvascular complications such as diabetic retinopathy (12-14).

This association between T1D and ED was first reported

in the 1970s (15). Many studies have subsequently treated this complex association. However, most of these data suffered from different biases and the results were variable. They did not allow us to conclude on the prevalence of ED in this population (12). The interest of our study lies in the fact that it was the first in Tunisia to discuss the prevalence of ED in a population of type 1 diabetic adolescents (T1D). The purpose of this work was to estimate the prevalence of these disorders in a group of type 1 diabetic adolescents aged between 11 to 18 years old and to identify risk factors associated with this disorder in order to propose better care for these fragile patients.

METHODS

A cross-sectional study was conducted for a period of one year between January 2017 and January 2018. One hundred and two adolescents with diabetes Type 1 (T1D) were recruited from the National Institute of Nutrition in Tunis. We included in our study adolescents, aged 11–18 years with type 1 diabetes diagnosed at least 1 year before the beginning of the study.

We didn't include adolescents with any other type of diabetes, celiac disease, thyroid dysfunction, pregnancy or severe psychiatric illness.

Patients were asked about their socio-demographic characteristics and of their parents. The characteristics of diabetes were collected from patients' medical records. Participants benefited from anthropometric measurements. Adolescent abdominal obesity is defined by a waist size / Height > 0.5 (16). Each diabetic adolescent benefited from a food survey based on the food history method with a 24-hour reminder. A blood sample (fasting blood sugar, glycated hemoglobin (HbA1c), lipid and thyroid test, and celiac disease serology) was taken from each adolescent with diabetes.

To assess adherence to treatment, we used the Arabic version of the self-administered questionnaire derived from the Medication Adherence Questionnaire (MAQR) by Morisky-Green (17). To assess the quality of life, we used a quality-of-life questionnaire Diabetes Quality of Life for Youth Scale (DQOLY –SF) validated in 2006 specific to diabetes and adapted to the age group of our population (11-18 years) (18). The DQOLY-SF is composed of 5 areas and 22 items (impact of diabetes symptoms, impact of treatment, impact on activities, involvement of parents and anxiety about diabetes) with an additional question

on perception of health status. Eating disorders were screened using the self-questionnaires: Eating Attitudes Test 40 (EAT40) and Bulimic Investigatory Test Edinburgh (BITE). The EAT40 is one of the most widely used instruments for the detection of anorexia nervosa (19-20) and unspecified eating disorders (21). This scale is consisting of 40 items and was validated in Tunisia in 2007 (19). The BITE is an instrument to detect bulimia or binge eating disorder. It is a self-questionnaire made up of 33 items, established in 1987 (22) and validated in Tunisia in 2007 (19). The presence of an eating disorder (ED+) was defined by an EAT40 score and/or a BITE score higher than threshold score (19).

We used the Diagnostic Interview (Mini International Neuropsychiatric Interview "M.I.N.I.") according to DSM-4 criteria in order to specify the types of ED (23). All patients in whom we detected ED (ED+) by the self-questionnaires EAT40 and BITE answered the questions of the two diagnostic modules of mental anorexia and bulimia of MINI: MINI Mental Anorexia and MINI Bulimia. We selected an unspecified eating disorder if one of the criteria for anorexia nervosa or bulimia nervosa was missing (24).

We have studied the association between presence of ED and socio-demographic factors, anthropometric measurements, clinical characteristics of diabetes, biological characteristics, and quality of life by univariate analysis using chi-square test and the Student's t-test to compare the percentages and averages, respectively and crude Odds Ratio for risk estimation with a CI95%. Then we conducted a multivariable analysis to adjust the confounding variables applying binary logistic regression technique following the step-by-step descending method. Only variables with the p-value of < 0.20 in univariate analysis were introduced in the multivariable analysis by calculating the adjusted Odds Ratio (ORa). We selected in the final model variables independently associated with the variable of interest with the p-value of ≤ 0.05 .

Ethical considerations:

We have ensured confidentiality, anonymity, privacy of personal data and the right to refuse. We informed all the participants about the objectives of this study in order to allow them to accept or refuse their participation. Oral informed consent was obtained before investigating with people.

RESULTS

Description of the total population

The study population consisted of 102 adolescents with type 1 diabetes. 51% were female (sex ratio = 0.96). Participants classified underweight (UW) were 3(2.9%), those of normal weight (NW) were 82 (80.4%), overweight (OW) 10 (9.8%) and obese (O)7 (6.9%). Abdominal obesity was present in 21.6% of our patients with a significant female predominance (34.6% of girls vs 8% of boys, $p < 10^{-3}$).

The mean duration of diabetes was $7,1 \pm 4,3$ years. The mean age of diabetes discovery was $9,7 \pm 4,4$ years. The daily average of insulin dose was $1 \pm 0,4$ U / kg / day.

The majority (78.9%) of our patients had an HbA1c level > 9%. Therapeutic adherence was low in 29.4% of the cases. Insulin omission was present in 7.8% of patients (girls: 11.5% vs. boys: 4%; $p = 0.2$).

Severe hypoglycemia rate in the past 3 months was 1.8 ± 7.9 per month. The average number of ketosis or Ketoacidosis decompensations in the last year was 3.6 ± 6.3 per year.

Diabetic retinopathy, nephropathy, and neuropathy were found respectively in 3.9%, 5.9%, and 5.9%.

The quality of life of our diabetic adolescents was relatively good with an average total score of 36.9 ± 18.3 . It was significantly more impaired in diabetic girls (girls: 41 ± 18.9 vs boys: 32.8 ± 16.8 , $p = 0.02$).

A separate study of the score for each quality of life domain showed that "Parental involvement" was the most incriminated domain in the impairment of quality of life with a high score of 71 ± 29.7 .

Prevalence of eating disorders

Eating disorders were detected in 34 patients (33.3%) (95% CI [24.5-42.2%]). ED were significantly more common among girls (female: 46.2 % vs male: 20%, $p=0.005$). Unspecified eating disorders were predominant with a prevalence of 29.4%. Anorexia nervosa and bulimia were respectively present in only one (1%) and 3 (3%) diabetics.

Description of patients with eating disorders

The majority of patients with eating disorders were girls (70.6%). Normal weight was observed in the majority (85.3%) of these adolescents. Two of them (5.9%) were overweight, and 3 (8.8%) were obese. Abdominal obesity was diagnosed in 38.2%.

The mean duration of diabetes was 6.5 ± 4.6 years. The mean age of diabetes discovery was 4.9 ± 0.8 years. The daily average of insulin dose was 0.99 ± 0.35 U / kg / day. Low adherence to treatment was observed in 20.6% of these patients. Omission of insulin was found in 9.4%. The proportion of severe hypoglycemia during the last 3 months was 4.8 18.3 per month. The average number of ketosis or ketoacidosis in the last year was 4 ± 9.5 . Diabetic retinopathy, nephropathy, and neuropathy were found respectively in 5.9%, 8.8%, and 8.8%. The average rate of HbA1c was $10.7 \pm 2.6\%$. Total cholesterol and triglyceridemia were respectively 4.84 ± 1.53 and 1.37 ± 1.23 mmol /l.

The average total score of the quality of life questionnaire (DQOLY □SF) was 46.7 ± 20.3 . The most incriminated domain in the impairment of quality of life was "Parents' involvement" with the highest score of 77.2 ± 29 .

Factors associated with eating disorders

Univariate analysis (Table1) showed that the main risk factors associated with ED among adolescents with T1D were female sex, abdominal obesity, hypercholesterolemia and impaired quality of life.

Multivariate analysis (Table2) revealed the independent risk factors associated with ED among adolescents with T1D. Among these factors, female sex was significantly associated with this disorder (adjusted OR = 3.5 and 95% CI = 1.4-8.6). Abdominal obesity was also significantly associated with ED (adjusted OR = 5.6 and 95% CI = 1.5-20.4). Finally, the risk of developing ED was higher among patients with impaired quality of life specifically anxiety about diabetes increased significantly the risk of developing ED. We didn't find a significant association between having an eating disorder and age, BMI, diabetes duration, age at diabetes' diagnosis, HbA1c, diabetes complications, medication adherence and total cholesterol (Table2).

DISCUSSION

Prevalence of eating disorders

The current study was the first in Tunisia to assess eating disorders in adolescents with type 1 diabetes including both sexes using the self-questionnaires EAT40 and BITE validated in Arabic and adapted according to the Tunisian context. Our study demonstrated that the prevalence of

ED was 33.3% with a 95% CI [24.5-42.2]. This prevalence was similar to that estimated in the literature. In fact, in worldwide, especially in Western countries, the prevalence of ED in type 1 diabetics varied from 8% to 55% (25–28). However, some studies conducted elsewhere (29-30) have found a higher prevalence than our study.

Unspecified ED were the most frequent in our diabetic adolescents with a prevalence of 29.5%. Indeed, several studies have also found that unspecified feeding were the most prevalent form (25,31).

In our study, anorexia nervosa was found in only one adolescent girl (1%). Our results were close to those of the two large studies of Jones (25) and Engstrom (32) which reported no cases of anorexia nervosa.

Bulimia nervosa was diagnosed in only 3 of our diabetic adolescents (2.9%). Mannucci's meta-analysis showed a prevalence of 1.7% of bulimia in adolescent diabetics (33).

Factors associated with eating disorders

In this study, female sex was independently associated with the ED. This significant association between ED and female sex has also been demonstrated in many studies (26,34). This finding could be explained by the fact that adolescent girls had a more negative body image than adolescent boys, which predisposed them more to eating disorders (35).

However, Cherubini et al did not find a significant difference in the prevalence of ED between boys and girls (36). In our study, the risk of developing ED was 5.6 higher in patients with abdominal obesity. Furthermore, we have not identified an association between BMI and eating disorders. Several studies have shown the association between overweight and eating disorders in diabetic adolescents. Cherubini has shown in their study that the prevalence of eating disorders was significantly higher in overweight or obese patients compared to normal weight or underweight (36).

Moreover, we did not find significant associations between the ED and the age. Similar results have been reported by Cecilia Costa (26), and Cherubini (36) who did not find significant age differences between adolescents at very high risk and low risk of ED.

However, in Wisting study including 770 adolescents with type 1 diabetes, the prevalence of ED was significantly higher in older adolescents (17 to 19 years old) than the

Table 1. Univariate analysis of the factors associated with eating disorders

| | ED+(n=34) n(%) or Mean \pm SD | ED-(n=68) n(%) or Mean \pm SD | Crude OR | CI 95% | p |
|---|------------------------------------|------------------------------------|------------|----------------|--------------|
| Sociodemographic characteristics | | | | | |
| Age | 17.06 \pm 1.65 | 16.68 \pm 1.76 | 0.3 | 0.9-1.5 | 1.1 |
| Genre | | | | | |
| Male (Ref) | 10 (29.4) | 40 (58.8) | | | |
| Female | 24 (70.6) | 28 (41.2) | 3.4 | 1.4-8.3 | 0.006 |
| Anthropometric characteristics | | | | | |
| BMI classes | | | | | |
| UW/NW(Ref) | 29 (85.3) | 56 (82.4) | | | |
| OW/O | 5(14.7) | 12 (17.6) | 0.8 | 0.2-2.5 | 0.7 |
| Abdominal obesity | 13(38.2) | 9(13.2) | 0.0054 | 1.5-10.8 | 0.005 |
| Clinical characteristics | | | | | |
| Diabetes duration. years | 6.5 \pm 4.6 | 7.3 +/- 4 | 0.9 | 0.9-1.1 | 0.3 |
| Age at diabetes diagnosis | 4.9 \pm 0.8 | 4.2 \pm 0.5 | 1.1 | 0.96-1.2 | 0.2 |
| Insulin dose (U/kg/day) | 0.99 \pm 0.35 | 1.02 \pm 0.4 | 0.7 | 0.2-2.4 | 0.6 |
| Injection number | 3.26 \pm 1 | 3.41 \pm 1.1 | 0.8 | 0.6-1.3 | 0.5 |
| Medication adherence | | | | | |
| Good or moderate (ref) | 27 (79.4) | 45 (66.2) | | | |
| poor | 7 (20.6) | 23 (33.8) | 0.5 | 0.2-1.3 | 0.2 |
| Insulin omission | 3 (9.4) | 5 (7.6) | 1.3 | 0.3-5.6 | 0.7 |
| Severe hypoglycemia rate per month | 4.8 \pm 18.3 | 0.3 \pm 1.2 | 1 | 0.9-1.3 | 0.04 |
| Ketosis or ketoacidosis rate in the last year | 4 \pm 9.5 | 3.77 \pm 8 | 1 | 0.9-1 | 0.9 |
| Diabetic retinopathy | 2(5.9) | 2(2.9) | 0.7 | 0.4-11.3 | 0.8 |
| Diabetic nephropathy | 3(8.8) | 3(4.4) | 2.2 | 0.3-13.2 | 0.3 |
| Diabetic neuropathy | 3(8.8) | 3(4.4) | 2.2 | 0.3-13.2 | 0.3 |
| Paraclinical characteristics | | | | | |
| HbA1c. % | 10.7 \pm 2.6 | 10.5 \pm 2 | 1 | 0.8-1.2 | 0.8 |
| Total cholesterol (mmol/l) | 4.84 \pm 1.53 | 4.19 \pm 1.17 | 1.5 | 1-2.2 | 0.04 |
| Triglycerides (mmol/l) | 1.37 \pm 1.23 | 1.12 \pm 0.83 | 1.3 | 0.8-2 | 0.3 |
| Life Quality. DQOLY –SF | | | | | |
| Total score | 46.7 \pm 20.3 | 32.2 \pm 15.1 | 1.1 | 1-1.1 | <10-3 |
| Diabetes symptoms impact | 49.26 \pm 3 | 35 \pm 20.9 | 1 | 1-1.1 | 0.005 |
| Treatment impact | 47.1 \pm 28 | 31.9 \pm 25.3 | 1 | 1-1.1 | 0.007 |
| Impact on activities | 27.4 \pm 27.3 | 13.2 \pm 16.2 | 1 | 1-1.1 | <10-3 |
| Parents' involvement | 77.2 \pm 29 | 67.8 \pm 29.8 | 1 | 1-1.1 | 0.1 |
| Anxiety about diabetes | 46.1 \pm 30.5 | 27.32 \pm 23.4 | 1.1 | 1-1.1 | <10-3 |
| Health perception score | 60.6 \pm 32.8 | 48 \pm 26.6 | 1 | 1-1.1 | 0.04 |

ED =Eating disorders; n=number; SD=standard deviation; ORc = Crude Odds Ratio ; CI=Confident Interval; .Ref=Reference; BMI: Body Mass Index; UW=Underweight; NW=Normal weight; OW= Overweight; O=Obese; HbA1c: Hemoglobin A1c ; DQOLY –SF= Quality-of-life questionnaire Diabetes Quality of Life for Youth Scale

Table 2. Independent factors associated with developing eating disorders

| | Univariate analysis | | | Multivariate analysis | | |
|--------------------------------------|---------------------|----------|----------|-----------------------|-------------|----------|
| | p | Crude OR | CI 95% | p | Adjusted OR | CI 95% |
| Sex | | | | | | |
| male/female | 0.006 | 3.4 | 1.4-8.3 | 0.007 | 3.5 | 1.4-8.6 |
| Abdominal obesity | 0.005 | 4 | 1.5-10.8 | 0.009 | 5.6 | 1.5-20.4 |
| Characteristics of Diabetes | | | | | | |
| Age at diabetes diagnosis | 0.2 | 1.1 | 0.9-1.2 | 0.1 | 1.1 | 1-1.3 |
| Severe hypoglycemia rate | 0.04 | 1 | 0.9-1.3 | 0.2 | 1.1 | 1-1.1 |
| Medication adherence | 0.2 | 0.5 | 0.2-1.3 | 0.8 | 0.8 | 0.2-3 |
| Total cholesterol | 0.04 | 1.5 | 1-2.2 | 0.1 | 1.4 | 0.9-2 |
| Life quality. DQOLY –SF | | | | | | |
| Total score Diabetes symptoms impact | <10 ⁻³ | 1 | 1-1.1 | 0.006 | 1.1 | 1.1-1.2 |
| Treatment impact | 0.005 | 1 | 1-1.1 | 0.1 | 1 | 1-1.1 |
| Impact on activities | 0.007 | 1 | 1-1.1 | 0.9 | 1 | 1-1.1 |
| Parents' involvement | <10 ⁻³ | 1 | 1-1.1 | 0.09 | 1 | 1-1.1 |
| Concern about diabetes | 0.1 | 1 | 1-1.1 | 0.4 | 1 | 1-1.1 |
| Health perception score | <10 ⁻³ | 1 | 1-1.1 | 0.04 | 1.1 | 1.1-1.3 |
| | 0.04 | 1 | 1-1.1 | 0.6 | 1 | 1-1.1 |

OR=Odds Ratio ; CI : Confidence Interval

youngest adolescents (11 to 13 years old) (28).

Omitting insulin to control or losing weight is common in adolescents with diabetes. It is used to induce glycosuria, thus allowing young people type 1 diabetics to afford to take high calorie and carbohydrate intakes without resulting weight gain (4).

Insulin omission was found in 8.2% of our diabetic patients. This frequency was not significantly different between the 2 groups (ED+ and ED-). Contrary to some previous studies conducted by Berger (37) and Peveler (14) that there was a significant association between ED and insulin omission.

In this study, we did not find a significant association between HbA1c levels and presence of ED. Our results were similar with those of Engström (32). Divergent results have been reported by the study of Cherubini (36) who found poor metabolic control and significant increase of HbA1c levels in T1D adolescents with ED compared to those who did not have ED.

In our study, we did not find any significant association between microvascular complications and presence of ED which was consisted with the study of Friedman (38).

However, several previous studies have shown an association between the presence of ED and the occurrence of complications microvascular, especially diabetic retinopathy (14,39).

Impaired quality of life and specifically anxiety about diabetes increased significantly the risk of developing ED in our diabetic adolescents.

Similar results were found in other previous studies which concluded that adolescents with type 1 diabetes suffering from eating disorders had an impaired general quality of life (40-41).

CONCLUSIONS

The results of this study showed the importance of screening for ED in diabetic adolescents. An early diagnosis is one

of the factors of good prognosis for this comorbidity and allows better management. The latter should essentially be based on the experience of the different teams involved and, due to its complexity, requires collaboration between diabetologists, dieticians, psychologists and psychiatrists in order to treat it before the occurrence of irreversible complications.

Each diabetic adolescent must receive care multidisciplinary individualized medical, nutritional, psychological and social which aims to take into account the needs, projects and desires of each adolescent, in order to prevent certain psychiatric disorders such as the TCA which can accompany this difficult period of each diabetic.

The authors declare no competing interest

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