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Int J Diabetes Dev Ctries
DOI 10.1007/s13410-016-0530-5

ORIGINAL ARTICLE

Type 1 diabetes mellitus and eating disorders

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Received: 14 May 2016 / Accepted: 7 November 2016
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Abstract The choice of type and quantity of food is vital to achieving glycaemic control in diabetes, more so in type 1 diabetes mellitus. The attention to detail could however reach a level of obsession of an eating disorder and thereby have a negative impact on glycaemic control. We conducted a study to see if there was a risk of developing eating disorders among adolescent, young and middle-aged adults with type 1 diabetes mellitus and whether it has an association with HbA_1C levels. A cross-sectional study was conducted on 113 type 1 diabetes mellitus patients and age-gender-matched healthy controls. The two groups were screened using the Eating Attitude Test-26 (EAT-26) questionnaire. EAT-26 identified type 1 diabetes as having a high risk for developing eating disorder when compared to those without diabetes (OR = 38.5 with 95% CI 8.7, 170.7; $p < 0.001$). The risk of developing eating disorder increased with the duration of diabetes. There was no significant difference in the risk between males and females. The risk of developing eating disorder did not correlate with glycaemic control. EAT-26 identified subjects with type 1 diabetes as high risk for developing eating disorder in comparison to those without diabetes. In our setting, this did not reflect on poor glycaemic control.

Keywords Eating disorders · Type 1 diabetes mellitus · EAT-26

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Introduction

Patients with type 1 diabetes mellitus (T1DM) are prone to significant changes in their blood glucose levels with various types and amount of food. Hence, they often have to make careful choice of foods to obtain appropriate proportion of macronutrients (carbohydrates, proteins and fats) and also reduce blood glucose fluctuations. This intense diet consciousness is imbibed at an early point in life and increases the patient's risk for disturbances in eating behaviours. Since both the entities T1DM and eating disorder affect largely the adolescent and young adult population, these disorders tend to coexist in this age group [1–3].

The Diagnostic and Statistical Manual of Mental Disorders (DSM-V, 5th edition) defines eating disorder as a serious mental illness characterised by eating, exercise and body weight or shape becoming an unhealthy preoccupation of someone's life. This includes anorexia nervosa, bulimia nervosa, binge eating disorders (BED) or the other eating and feeding disorders [4].

Previously, eating disorders were mostly reported from the Western society; it now pervades the Asian and African continents due to large-scale globalisation. However, the lifetime prevalence of bulimia nervosa (DSM-V/CIDI) varied between countries. The World Mental Health Surveys report that in a low-income country like Colombia, the prevalence was 0.4%; it was higher in middle-income countries like Brazil (2.0%), and in the high-income European countries, it ranged from 0.7 to 0.9% [2]. The prevalence of eating disorders among young North American adolescents (1–3%) was comparable to their Japanese counterparts (0.025–2.9%) [5]. In the study by Mammen et al., using International Classification of Diseases (ICD 10) coding of diagnoses from a tertiary centre in south India, the prevalence of eating disorder among adolescents and children was 1.25% [6].

Published online: 15 November 2016

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Subjects with diabetes and eating disorders may omit or reduce insulin to lose weight. Diabulimia is the term used to define the condition when prescribed insulin doses are omitted or altered with the sole goal of achieving weight loss [7, 8].

Western literature has indicated a higher prevalence of eating disorder in diabetes patients as against those without diabetes [8, 9]. Faulty eating habits which may be seen as relatively mild in a person without diabetes can have life-threatening consequences in a patient with diabetes. It can cause poor glycaemic control, dehydration, fatigue, muscle wasting and increased risks of developing infections. If eating disorders are not recognised and treated early, the resulting poor metabolic control can lead to progression of diabetes-related vascular complications. A disordered eating status was more predictive of diabetic retinopathy than the duration of diabetes [1, 8].

Thus, early screening, diagnosis and correction of eating disorders can potentially improve the quality of life of patients. The main objectives of this study were to screen for the risk of developing eating disorders among young adults with and without T1DM and study its association with metabolic control in T1DM patients.

Methods

This cross-sectional study was conducted at the Young Adults Diabetes Clinic, Department of Endocrinology, Diabetes and Metabolism of Christian Medical College, Vellore, India, over a 3 month period. Adolescents, young and middle-aged adults with T1DM (n = 113; 15–43 years of age) were recruited as cases after obtaining informed consent. During their routine hospital visit to the out-patient Diabetes Clinic, they were administered the Eating Attitude Test (EAT-26) questionnaire [11] in English or their mother tongue (Tamil) to detect the risk of developing eating disorders. The Tamil version was translated and back translated to check its accuracy. The control group consisted of age-gender-matched healthy volunteers who visited the hospital as accompanying relatives (n = 61; 16–42 years of age). A face-to-face interview of 30-min duration between the subject and investigator was conducted to collect the data.

The EAT-26 questionnaire is a validated economical screening tool which has been widely used to detect the risk of eating disorders in clinical and non-clinical samples [11]. It consists of 26 questions which are related to eating attitudes or behaviours. The questions pertain to dieting, bulimia, preoccupation and oral control. The patient responds to each question by indicating as to whether the question applies to him/her always, usually, often, sometimes, rarely or never (scoring 5, 4, 3, 2, 1 and 0, respectively). An overall score greater than 20 indicates a risk of developing eating disorders.

Height and weight of the subjects were determined using standard procedures. Insulin dose and glycosylated haemoglobin (HbA_1C) levels were collected from patient medical records. HbA_1C was measured by high-performance liquid chromatography (HPLC). The study protocol conformed to the ethical guidelines of the 1975 Declaration of Helsinki, and approval was obtained from the Institutional Review Board of Christian Medical College, Vellore, India (IRB Min. No. 9547 dated 22.07.2015).

Statistical analysis The data was analysed using SPSS version 18. Chi-square analysis, odds ratio and logistic regression (univariate and multivariate) were done to study the association between eating disorder in diabetes and non-diabetes subjects. p values <0.05 were considered significant.

Results

A total of 113 patients with T1DM and 61 control subjects completed the EAT-26 questionnaire, with approximately equal number of males and females. The basal characteristics of the cases and controls are presented in Table 1. Cases and controls did not differ significantly with respect to gender and age. Controls had a significantly higher body mass index (BMI) than T1DM subjects (23.7 vs. 20.9 kg/m^2, $p < 0.001$) (the BMIs of four non-ambulatory T1DM patients were not

Table 1 Comparison of basal characteristics of subjects with and without Diabetes mellitus

Profile	With T1DM n (%)	Without T1DM n (%)	p value
Gender			
Male	58 (51)	31 (51)	–
Female	55 (49)	30 (49)	
Age[a]	24.6 (6.3)	26.7 (5.3)	$p = 0.288$
BMI[a]	20.9 (3.0)	23.7 (4.7)	*$p < 0.001$
BMI category[b]			
Underweight	23 (21.1)	6 (10)	
Normal	56 (51.4)	24 (40)	–
Overweight	19 (17.4)	10 (16.7)	
Obese	11 (10.1)	20 (33.3)	
EAT-26 score	29.8 (8.6)	16.8 (11.9)	*$p < 0.001$
Risk for eating disorder			
Yes	111 (98.2)	36 (59)	–
No	2 (1.8)	25 (41)	

*Significant at 1% level

[a] Reported in mean and standard deviation. BMI: TIDM n = 109; controls n = 61

[b] The Asia-Pacific perspective: redefining obesity and its treatment. Melb Int Diabetes Inst. 2000;11–2

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Table 2 Clinical characteristics of type 1 diabetes mellitus patients (n = 113)

Variables	Males (n = 58)	Females (n = 55)	p value
Mean HbA1C (SD) %	9.0 (2.2)	9.2 (3.1)	0.93
Duration of diabetes(SD) years	8.8 (7.2)	9.3 (7.2)	0.71
Regularity in insulin injections			
Yes	94.8%	87%	0.15
No	5.2%	13%	
Insulin regimes			
Split mix	75.4%	68.5%	0.42
Basal bolus	24.6%	31.5%	

recorded. In the control group, the BMI of one subject was excluded due to heavy clothing (n = 60).

Table 2 depicts the characteristics of T1DM patients. The mean duration of diabetes in the entire group was 9.1 years (SD 7.2 years; range 1–31 years) and their overall mean HbA_1C level was 9.1% (SD 2.7%; range 5.9 to 19.7). There were no significant differences between male and female T1DM patients with respect to their BMI, duration of diabetes, insulin regimens, regularity of insulin administration and HbA_1C levels. The TIDM group had a significantly higher EAT-26 score indicating that they were at higher risk of developing eating disorder ($p < 0.001$). No significant association was found between BMI and the risk of developing eating disorders in the two groups ($p = 0.855$). Multivariate logistic regression after adjusting for BMI indicated that T1DM subjects were 33 times more likely at risk for developing eating disorders (OR = 33, 95% CI 7.4, 152.0; Table 3) compared to the non-diabetes counterparts ($p < 0.001$). In the TIDM group, gender, age, BMI, HbA_1C and insulin regimen were not significantly associated with risk of developing eating disorder. Duration of diabetes was significantly associated with risk of developing an eating disorder ($p = 0.013$, OR = 11.03, 95% CI = 1.4, 87.1).

Discussion

This study showed that T1DM patients were at 33 times greater risk for developing eating disorders when compared to subjects without diabetes. This is in line with a meta-analysis of 13 studies comparing the risk of developing eating disorders among T1DM and subjects without diabetes [12]. A Canadian study using the DSM-IV criteria found that subjects with diabetes had a higher prevalence of eating disorders (10%) when compared to non-diabetes controls (4%) (odds ratio 2.4, 95% CI 1.5 to 3.7; $p < 0.001$) [10]. Similar reports have been published from different TIDM populations across the world [13, 14]. T1DM patients constitute a vulnerable population who have to consciously make the right choices at each meal to attain an acceptable degree of glycaemic control. Hence, it is not surprising to find that eating behaviours tend to get overstated. Nutritionists and medical personnel should maintain a high index of suspicion when managing T1DM patients. The EAT-26 is a quick and easy tool to screen patients for risk of developing eating disorders. Timely intervention with the help of a mental health professional during routine out-patient visits will ensure appropriate treatment.

In our study, there was no difference in the risk of developing eating disorders between male and female patients. The only factor that increased the risk of developing eating disorders was the duration of diabetes. Whether the risk of eating disorders escalates over the years or is initiated at a specific point in time necessitates long-term follow-up studies.

In our study, BMI was not linked to the risk of developing an eating disorder. This is in line with studies by Neumark-Sztainer et al., who found inconsistent associations between BMI and eating disorders [9]. Similar findings were reported by Kaminsky and Dewey who also found no significant differences in the prevalence of eating disorder between adolescents with type 1 diabetes and healthy subjects [15]. In contrast, Colton et al., in a study of adolescent subjects with T1DM, found a higher prevalence of eating disorders in those

Table 3 Risk factor analysis

Variable	Univariate			Multivariate		
	OR	95% CI	p value	OR	95% CI	p value
EAT-26 score	38.5	8.7, 170.7	<0.001	33.5	7.4, 152.0	*$p < 0.001$
BMI	0.88	0.79, 0.97	0.013	0.99	0.88, 1.1	$p = 0.671$

*Significant at 1% level

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with higher BMI using the Children's Eating Disorders Examination score. He rationalised that this could be due to a greater dissatisfaction about body image [16].

The metabolic control (measured as glycosylated haemoglobin level) was not associated with eating behaviour in our study population. Similar findings were reported by Colton et al. [16]. In contrast, Jones et al. found that the mean HbA_1C was higher in diabetes subjects with eating disorders in comparison to those without diabetes (9.4 vs. 8.6%; $p = 0.04$) [10]. Pinhas-Hamiel et al. had also reported that eating disorders compromised glycaemic control of the patients [17].

Nash and Skinner [18] in their extensive review of eating disorders among T1DM patients proposed studying the insulin regimens and the risk of developing eating disorders. In our patients, the "split mix" and "basal-bolus" insulin regimens were largely practised [19]. There was no significant association between the insulin regimen and the risk of developing eating disorders.

Some patients with T1DM may omit insulin injections to control body weight. However, most of our patients took their insulin injections regularly. In the few cases where some insulin injections were missed, the major reason for non-compliance was the non-availability of insulin due to lack of resources. No patient was admitted to the in-patient facility due to omission of insulin to control weight. However, Western literature has reported that 11% of the patients with diabetes resorted to underdosing of insulin and 42% misused their insulin to control weight [10]. Neumark-Sztainer et al. studied young adolescents with T1DM using the AHEAD survey (Assessing Health and Eating among Adolescents with Diabetes) and found a higher prevalence of unhealthy eating practices among females (37.9%) as against their male counterparts (15.9%) [9]. Deliberate underdosing or omission of insulin was resorted to as a weight loss strategy among the females. About 10.3% skipped insulin doses, and 7.4% of the subjects reported taking lower doses of insulin to control their weight. Only one male subject in that study practised either of these behaviours [9]. Similar findings were reported by Ackard et al. who found that 1.4% male and 7.4% female youth resorted to insulin dosage reduction as a means of weight control [20].

To our knowledge, this is the first study from southern India that looked at the risk of developing eating disorders in subjects with and without T1DM. The EAT-26 questionnaire identified subjects with type 1 diabetes as high risk for developing eating disorder in comparison to those without diabetes. In our setting, this did not reflect on poor glycaemic control.

The limitation of our study was that we do not have long-term data on the eating behaviour of our T1DM patients. Longitudinal studies are required to understand the factors triggering the initiation and progress of eating disorders in this group of patients.

Acknowledgements We are grateful to Ms. Vidya AC for administering the EAT-26 questionnaire in Tamil, the native language of the respondents. Dr. Mini Joseph extends her gratitude to University Grants Commission of India (UGC) for the Research Award. We acknowledge Ms. Devika S Senior Statistician for her assistance in the statistical analysis of the data.

Compliance with ethical standards The study protocol conformed to the ethical guidelines of the 1975 Declaration of Helsinki, and approval was obtained from the Institutional Review Board of Christian Medical College, Vellore, India (IRB Min. No. 9547 dated 22.07.2015).

Conflict of interest The authors declare that they have no conflicts of interest.

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