Evaluation of Children with Type 1 Diabetes Mellitus in terms of Overweight / Obesity in Tertiary Care Hospital

What's know

It was known that the rate of overweight / obesity was low in children with type 1 diabetes mellitus. Obesity complication was ignored in treatment planning.

What's New

We found that children with type 1 diabetes mellitus may be overweight / obesity at the time of diagnosis.

We detected the tendency of the patients to obesity also after treatment.

We think that this complication, which is very important in the treatment planning of patients, should be taken into consideration.

Abstract

Objective: Obesity was once a rare problem in Type 1 diabetes mellitus, but is a growing problem today. The aim of our study is to determine the frequency of overweight / obesity at the time of diagnosis and during follow-up in children with type 1 diabetes mellitus as well as review the conditions that may accompany.

Methods: 315 patients with type 1 diabetes mellitus were retrospectively analyzed. The patients were divided into two groups according to the last examination as normal weight and overweight / obese. The two groups were compared in terms of age at diagnosis, gender, birth weight, family history, anthropometric measurements, insulin dose used and blood pressure measurements, and insulin, c-peptide, hemoglobin A1c, triglyceride, and high-density lipoprotein levels at the time of diagnosis and follow-up.

Results: The prevalence of overweight / obese in all patients was 4.8% at the time of diagnosis, while it was 9.8% at the last examination. The height, weight and BMI SD scores and c-peptide levels at the time of diagnosis of the overweight / obese group were higher than those with normal weight (p <0.001 and p = 0.008, respectively). The frequency of dyslipidemia and hypertension was higher in the overweight / obese group than in the normal weight group [18.2% versus 5% (p = 0.015) and 10% versus 1.5% (p = 0.003), respectively].

Conclusion: In our study, the fact that the overweight / obese group had higher BMI and c-peptide and lower HDL values at the time of diagnosis can be evaluated as indicators that insulin resistance syndrome can accompany T1DM from the beginning (double diabetes). When determining the treatment and follow-up strategies of patients with type 1 diabetes mellitus, considering the risk of obesity and taking the necessary precautions is very important in terms of morbidity.

Keywords: Type 1 Diabetes Mellitus, Obesity, Overweight

Introduction

Type 1 diabetes mellitus (T1DM) is a chronic disease characterized by absolute insulin deficiency due to the immune-mediated destruction of pancreatic beta cells. T1DM is one of the most common chronic diseases of childhood. Studies show that both the incidence and prevalence of this disease have increased over the years.[1] In patients with T1DM, the main pathophysiological mechanism of chronic hyperglycemia is classical insulin deficiency rather than insulin resistance.[2-4] Obesity has long been known to contribute to the pathophysiology and complications of type 2 diabetes mellitus (T2DM).[5] Although it is classically thought that patients with T1DM have a lower body mass index (BMI) than do those with T2DM, recent

studies show the opposite.[6] Obesity was once a rare problem in T1DM, but it is now an increasing problem.[7] The trend of obesity prevalence is increasing at a faster rate in patients with T1DM compared to the general population.[8] Overweight and obesity cause insulin resistance and hyperinsulinemia. This situation has been associated with the development of cardiovascular and malignant diseases. While the incidence of microvascular complications in the T1DM population has decreased due to intensive insulin therapy, macrovascular complications are now more common in relation to the increased incidence of obesity.[9,10] Weight gain in patients with T1DM can trigger the same metabolic disorders seen in patients with T2DM. Therefore, some authors have suggested using the term "double diabetes" to refer to the formation of insulin resistance in T1DM.[11] Increasing evidence on the prevalence and consequences of obesity in patients with T1DM clearly shows that these comorbidities are underestimated and not well understood.[7] The aim of our study is to determine the frequency of overweight/obesity at the time of diagnosis and during follow-up in children with T1DM as well as review the conditions that may accompany overweight/obesity.

Patients and Method

A total of 395 patients, aged 1–18 years and diagnosed with T1DM between 2000 and 2016, were retrospectively analyzed. Patients with insufficient file records or a follow-up period of less than 6 months (n: 80) were excluded from the study. T1DM was diagnosed based on the need for permanent insulin therapy and autoantibody positivity against pancreatic beta cells. Physical, clinical, and laboratory data were obtained from the patients' medical files. Weight and height were measured by standard methods, and BMI was calculated as weight (kg)/height square (m^2). Overweight and obesity were defined as BMI 85–95 percentile and ≥95 percentile, respectively, according to the current WHO criteria. The patients were divided into two groups according to their last examination as BMI <85 percentile (normal weight) and ≥85 percentile (overweight/obesity). The two groups were compared in terms of age at

diagnosis, gender, birth weight, family history, anthropometric measurements, insulin dose used, blood pressure measurements, and insulin, c-peptide, hemoglobin A1c, triglyceride, and high-density lipoprotein levels at the time of diagnosis and follow-up. The total daily insulin dose of patients over the last three months was obtained by randomly selecting three days from the patient records, and the mean daily dose (IU/kg) was calculated by dividing the total daily IU by the patient weight (kg). Patients with other diabetes types, such as T2DM, secondary diabetes, and maturity-onset diabetes of the young, were excluded. Pediatric percentile curves were used for height, body weight, BMI, and hypertension (HT). The presence of HT was defined by the presence of mean blood pressure measurements above the 95th percentile of Turkish pediatric age measurements determined by Tümer et al. or by a history of antihypertensive drug use. Values between the 90th and 95th percentiles were accepted as pre-HT, and values below the 90th percentile were considered normal.[12] For children and adolescents, HDL concentration <50 mg/dL and triglycerides >150 mg/dL were considered as dyslipidemia.

Our study was approved by the local ethics committee of our hospital with decision number 2018/393.

Statistical analysis

Statistical analyzes were made using SPSS 15 software. Normal distribution fit of the variables was examined by visual and analytical methods. Descriptive analyzes were given using mean (± standard deviation) for normally distributed numerical variables and percentage (%) for ordinal variables. Type 1 diabetes study group was divided into two subgroups based on whether they were overweight. Normally distributed variables between these two groups were compared using Student's t test and ordinal variables using Chi-square or Fisher's tests, depending on the location. A p value below 0.05 was considered as a statistically significant result.

Results

The data of 315 patients with T1DM were available in our study. Of this number, 141 (44.7%) were girls and 174 (55.3%) were boys. The mean age was 8.7 ± 3.8 in the group with a BMI <85 and 10.0 ± 3.81 in the overweight/obesity group. The frequency of overweight/obesity in all patients was 4.8% at the time of diagnosis and rose to 9.8% (31/315) at the last examination. The prevalence of overweight/obesity at presentation was 0.7% (1/147) before 2012 and increased to 8.3% (14/168) after 2012 ($p < 0.001$). At the time of diagnosis, the height, weight, BMI SD scores, and c-peptide levels of the overweight/obesity group were higher than those with normal weight ($p < 0.001$ and $p = 0.008$, respectively), and the HDL level was lower ($p < 0.001$). Although the delta BMI SD score calculated according to the first and last examinations was higher in the overweight/obesity group than in the normal weight group ($+ 1.20$ versus $+ 0.79$), the difference was not statistically significant ($p = 0.061$). The frequency of dyslipidemia and HT was higher in the overweight/obesity group than in the normal weight group [18.2% vs. 5% ($p = 0.015$) and 10% vs. 1.5% ($p = 0.003$), respectively]. No difference was found between the two groups in terms of other parameters (Table 1).

Discussion

Our study provides information on the prevalence of obesity in children and adolescents with T1DM in Turkey. In our 315 patients diagnosed with T1DM in a single center, the total prevalence of overweight and obesity was found to be 9.8%.

The prevalence of overweight/obesity in children and adolescents from different regions of our country has been reported to be between 12.8% and 20.2%. [13-15] Our study shows that the

frequency of overweight/obesity at the time of diagnosis has increased in the patient group with T1DM in recent years in parallel with the general population.

Studies from other countries have shown that the increased incidence of overweight and obesity in the T1DM population reflects the increase in the general population.[16-18] The traditional belief is that patients with T1DM are of normal weight or underweight, but the rates of overweight and obesity increase in parallel with the normal population in these patients. The increase is attributed to the anabolic and lipogenic effect of insulin from intensive insulin therapy. Changes in dietary habits and, possibly, the transition to a sedentary lifestyle, which is responsible for a global increase in overweight/obesity, have also affected the young population with T1DM.[19,20] In addition to the global increase in childhood obesity, modern intensive insulin therapy (multiple daily injection therapy, continuous subcutaneous insulin infusion) is associated with weight gain in patients with T1DM.[21,22] Endogenous insulin in the body first passes to the liver through the portal vein to suppress gluconeogenesis while exogenous insulin enters the systemic circulation and affects muscle and adipose tissue disproportionately compared to the liver.[23] In one study, patients treated with intensive insulin therapy administered insulin daily by multiple injections or by continuous subcutaneous insulin infusion with insulin pumps. Participants in traditional therapy usually administer fast-acting insulin injections one to two times a day, without daily adjustments. More weight gain was observed in the intensive insulin therapy cohort than in conventional therapy, regardless of the administration of multiple injections or continuous subcutaneous insulin infusion.[24] All patients in our study were receiving intensive insulin therapy. Intensive insulin therapy further increased the BMI of both normal weight and overweight/obesity groups and doubled the frequency of overweight/obesity under treatment.

In many studies, higher body weight has been reported in girls with T1DM compared to boys.[25-27] In our study, no significant difference was found between boys and girls with T1DM in terms of obesity prevalence.

Obesity is an important risk factor for the development of cardiovascular diseases.[28,29] Patients with T1DM are at risk for cardiovascular diseases such as HT and dyslipidemia.[30,31] In a study comparing normal weight and overweight/obese patients with T1DM, the rate of dyslipidemia and HT was found to be high in the overweight/obese group.[32] In another study conducted in obese and normal weight patients with T1DM, the only difference was the presence of abdominal adiposity. All other features, such as dyslipidemia, HT, non-alcoholic steatohepatitis, and polycystic ovary syndrome, were present in both groups with T1DM, who were already predisposed to a metabolic syndrome.[33] Although there was a difference between the two groups in terms of dyslipidemia and HT in our study, it was not statistically significant. A statistically significant decrease was observed in HDL levels in the overweight/obese group.

A new term used to describe patients with T1DM who show clinical signs of T2DM such as double diabetes, obesity, and insulin resistance.[34,35] Decreased glycemic control and, consequently, higher daily insulin doses may cause the pro-inflammatory state associated with the metabolic syndrome and, subsequently, double diabetes. Increased insulin dose due to insulin resistance can cause weight gain, thus exacerbating the weight problem.[36] In our study, the fact that the overweight/obesity group had higher BMI and c-peptide and lower HDL values at the time of diagnosis can be considered as indicators that insulin resistance syndrome can accompany T1DM from the beginning (double diabetes).

Hyperglycemia is known to induce an acute inflammatory process in both healthy individuals and patients with diabetes.[37] However, whether this heightened inflammatory state persists after the hyperglycemic episode has resolved remains unclear. This is especially true for

children with T1DM and poor glycemic control, where repeated hyperglycemic peaks are common. A well-known therapeutic approach to reducing the inflammatory state in the body is exercise training.[38] Increased physical activity to increase weight loss is widely accepted, but in one study, patients with T1DM tended to engage in less physical activity than did patients without diabetes. The biggest obstacle to physical activity reported in the study was the fear of severe hypoglycemia.[39] Our study will raise awareness that exercise programs should become widespread in addition to treatments owing to the tendency of patients with T1DM toward obesity.

The limitation of our study was the considerably lower number of patients in the overweight/obese group compared to the number of patients with normal weight, a discrepancy that could have caused some problems in comparison. Our study analyzes a 16-year period and reveals that obesity has increased in recent years.

As a result, the prevalence of overweight and obesity in the group with T1DM was similar to that in the population in the same age group in Turkey. It was observed that all the children and adolescents with T1DM gained weight under intensive insulin therapy. While organizing the insulin treatment strategy, we want to draw attention to the evaluation of patients in terms of overweight/obesity. Further studies are likewise needed to investigate the precise effect of overweight in T1DM and better understand the underlying pathophysiological processes in patients whose number is increasing. The additional consequences of obesity in T1DM must be evaluated so as to recognize this problem at an early stage and develop better methods and strategies to prevent negative consequences.

Declaration of Conflicting Interests

The Authors declares that there is no conflict of interest.

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Table 1. Comparison of clinical and laboratory findings of T1DM patients with normal weight and overweight / obesity

Clinical and Laboratory Features	Patients with a BMI <85 percentile (n:284)	Patients with a BMI ≥85 percentile (n:31)	P value
History			
Birth Weight (g)	3347±560	3427±649	0.503
Obesity history in the family (%)	53 (19)	13 (41)	0.064
Family history of type 2 diabetes (%)	150 (59)	22 (76)	0.082
During diagnosis			
Girl / Boy	124/160	17/14	0.235
Age (years)	8.7±3.8	10.0±3.81	0.061
Diabetic ketoacidosis / Ketosis / Hyperglycemia (%)	52/22/26	45/21/35	0.643
Height SDS	-0.11±1.06	0.85±1.20	**<0.001**
Body Weight SDS	-0.60±1.11	0.91±1.06	**<0.001**
BMI SDS	-0.77±1.27	0.59±1.12	**<0.001**
Insülin (µU/mL)	2.92±2.75	3.20±2.76	0.740
C-peptide (ng/mL)	0.50±0.38	0.78±0.61	0.008
Triglyceride (mg / dL)	152±129	201±107	0.294
HDL (mg/dL)	46±14.9	30±10	**<0.001**
Final Examination			
Height SDS	-0.43±1.06	0.57±0.95	**<0.001**
Body Weight SDS	-0.22±0.99	1.91±0.47	**<0.001**
BMI SDS	0.01±1.04	1.80±0.63	**<0.001**
Delta BMI SDS	0.79±1.17	1.20±1.04	0.061
Dyslipidemia (%)	5.0	18.2	0.015
Hypertension (%)	1.5	10	0.003
Insulin Dose (U / kg / day)	0.83±0.30	0.81±0.29	0.830
HbA1c (%)	8.6±2.7	8.2±1.4	0.393
Duration of diabetes	7.26±3.15	2.09±1.01	0.001

P: <0.001