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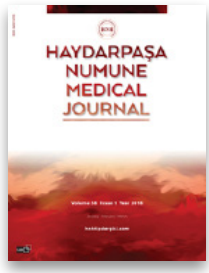

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ORIGINAL ARTICLE

Evaluation of Frequency of Metabolic Syndrome in Obese Children

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Abstract

Introduction: In recent years, increased obesity due to unfavorable changes in children's diet and lifestyle is the most important cause of the metabolic syndrome. Metabolic syndrome is a multiplex risk factor that arises from insulin resistance, and the prevalence is rapidly increasing. Our study aims to investigate the frequency of MS in obese and overweight children.

Methods: Obese and overweight children between the ages of six and 17 years, who were referred to our pediatric clinic from June 2017 to July 2018, were included in this study. MS was evaluated according to the IDF (The International Diabetes Federation, 2006) criteria.

Results: A total of 98 obese and overweight children were evaluated. According to IDF diagnostic criteria, MS prevalence was found as 25.8% (n=17) in obese children. The systolic arterial pressure averages BMI percentile and z score of obese boys were found to be statistically significantly higher than of obese girls.

Discussion and Conclusion: The prevention of obesity will decrease the MS frequency. A regular follow-up of all children and early intervention in the development of risk factors is one of the biggest steps in preventing MS affecting many systems.

Keywords: Children; obesity; metabolic syndrome.

Childhood obesity is one of the most important child health problems in recent years. Although childhood obesity has an effect on genetic factors, the main reason for this increase in recent years is the replacement of cookware with ready-made foods in child nutrition and the increase of time spent sitting at the head of technological products, such as tablet computers. In our country, the prevalence of obesity in childhood was found to range between 3.7% and 15.4% similar to the prevalence in the USA and many European countries [1–3]. Obesity is associated with cardiovascular diseases, hypertension (HT), type 2 diabetes (T2DM), fatty liver, orthopedic and psychological problems [4]. The most common metabolic disorder associated with obesity is insulin resistance (IR) [5]. Other conditions include elevated triglyceride (TG), LDL and total cholesterol (TC) values, as well as a decrease in HDL cholesterol (HDL-C) values. These conditions increase the risk of cardiovascular diseases [6]. Hypertension (increased blood pressure) can be seen in 16.6-39.7% of the obese children [7, 8]. The prevalence rates of MS in obese children (28-30%) are 7-10 times higher than the normal population [9]. Although childhood metabolic syndrome (MS) is defined by the presence of two factors among IR, dyslipidemia and HT associated with obesity, there is no consensus on its diagnostic criteria [9]. Often WHO's modified diagnostic criteria for children, the International Diabetes Federation (IDF) or modified Cook criteria are used. In this study, the prevalence of MS according to demographic, clinical and laboratory characteristics and IDF criteria of obese children admitted to outpatient clinic were discussed.

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Materials and Methods

In our study, children and adolescents aged 6–17 years with exogenous obesity who admitted to the Pediatric Outpatient Clinic between June 2017 and July 2018 were retrospectively analyzed. Children with chronic illnesses and drug use that caused obesity and excess weight gain were not included in this study. The body mass index and body mass index z- score (BMIz) were calculated according to the WHO AnthroPlus v1. 0.4 program recommended by the World Health Organization (WHO). Anthropometric measurement values in Turkish subjects were evaluated by finding the corresponding percentile ranges in growth curves formulated according to age and sex which is based on reference values of height, body weight, body mass index and waist circumference [10, 11].

BMIs above the 95th percentile were accepted as obesity, and 85–95 percentile as overweight. Files of the patients were examined, and it was seen that blood pressure measurements had been made from the right arm while the patient was resting and sitting, using a non-mercury sphygmomanometer with a cuff wrapping 3/4 of the arm circumference. The systolic and diastolic blood pressure values obtained were evaluated according to the percentile table of systolic/diastolic blood pressure values based on gender, age and height determined by the National High Blood Pressure Education Program (NHBPEP). Blood samples were taken between 08.30-10.30 hours after fasting for 12 hours. Blood glucose, Insulin, HOMA-IR estimates (using the formula: FBG (nmol/L) x Fasting insulin (mIU/ml)/22.5), HDL-Cholesterol, Triglyceride, Total cholesterol, LDL and VLDL levels were examined. IDF (Table 1) was used to diagnose MS in the patients included in our study.

Table 1. IDF MS diagnostic criteria in children and adolescents

	Abdominal obesity (waist circumference >90 p) and the presence of at least 2 of the following criteria are required:
	<6 years of age: IDF diagnostic criteria can not be used
	6-10 years of age: waist circumference above 90. Percentile (it does not establish the diagnosis of MS, however patients with family history of MS Type 2 diabetes, CVS diseases,HT, obesity should be closely followed up)
10-16 years:	· FBG ≥100 mg/dL or presence of type 2 diabetes
	· Systolic BP ≥130 mmHg or diastolic BP ≥85 mmHg
	· TG ≥150 mg/dL
	· HDLC <40 mg/dL
	16 years: IDF criteria defined for adults are used.

When evaluating the findings obtained in this study, statistical analysis for IBM SPSS Statistics 20 (IBM SPSS, Turkey) programs was used. Descriptive statistical methods (mean, standard deviation, frequency) as well as Student's t-test were used for comparison of means, and Chi-square test was used for comparison of categorical data. Statistical significance level was accepted as $p<0.05$.

Results

This study was carried out between June 2017 and July 2018 with a total of 98 children (31 boys and 67 girls). The mean age of the patients was 10.46±2.86 years (Table 2).

BMI frequency distributions of the cases were as follows: three (3.1%) patients were in 86th, one (1%) patient in 87th, one (1%) patient in 89th, four (4.1%) patients in 90th, three (3.1%) patients in 91th, six (6.1%) patients in 92th, eight (8.2%) patients in 93th percentile, six (6.1%) patients in 94th, 66 (67.3%) in >95th percentiles (Table 3).

A total of 98 obese and overweight children were screened according to IDF criteria, and 18 (18.4%) of them were diagnosed with metabolic syndrome (Table 4).

Seventeen (25.8%) of 66 obese cases were diagnosed as

Table 2. Distribution demographic characteristics

	n	%
Gender		
Male	31	31.6
Female	67	68.4
Age (year)		
≥10	55	56.1
<10	43	43.9
Obesity		
Obese	66	67.3
Overweight (>85. Pers)	32	32.7

Table 3. Distribution of rates of BMI

BMI Percentile	n	%
86	3	3.1
87	1	1.0
89	1	1.0
90	4	4.1
91	3	3.1
92	6	6.1
93	8	8.2
94	6	6.1
>95	66	67.3

metabolic syndrome and one (3.1%) of 32 cases was overweight. According to IDF criteria, 3.1% of overweight, and 25.8% of obese patients were diagnosed with metabolic syndrome (Table 5). There was no statistically significant difference between the sexes in terms of the incidence of metabolic syndrome according to IDF criteria (p=0.697). According to IDF criteria, 16.1% of boys and 19.4% of girls were diagnosed with metabolic syndrome (Table 6).

Average WHO BMI z scores of the boys were statistically higher than the scores of the girls (p=0.004; p<0.05). Average WHO BMI percentiles of males were statistically higher than those of females (p=0.002; p<0.05). The mean systolic arterial pressure of male patients was found to be statistically significantly higher than that of the female patients (p=0.019; p<0.05). There was no statistically significant difference between genders (p>0.05) (Table 7).

Average WHO BMI z scores of obese children were found to be significantly higher than those of overweight children (p=0.000; p<0.01). Average WHO BMI percentiles of obese children were significantly higher than those of overweight children (p=0.001; p<0.01). The mean systolic arterial pressure of obese children was significantly higher than that of overweight children (p=0.008; p<0.05).

Mean triglyceride levels of obese children were significantly higher than mean triglyceride levels of overweight children (p=0.005; p<0.01). There was a statistically significant difference between obese and overweight children in terms of average values for weight, waist circumference, diastolic arterial pressure, FBG, fasting insulin, total cholesterol, HDL and LDL cholesterol (p>0.05) (Table 8).

Table 4. Distribution of Metabolic Syndromes among Obese, and ovrweight children according to IDF criteria

	No n (%)	Yes (≥10 years) n (%)	Risky (6-10 years) n (%)	Total
Obese	49 (74.2)	11 (16.7))	6 (9.1)	66
Overweight	31 (96.9)	1 (3.1)	0 (0.0)	32
Total	80 (81.6)	12 (12.3)	6 (6.1)	98

Table 5. Evaluation of IDF in Obese, and Overweight Children

	No n (%)	Yes n (%)	Total
Overweight	31 (96.9)	1 (3.1)	32
Obese	49 (74.2)	17 (25.8)	66
Total	80 (81.6)	18 (18.4)	98

Chi-square test.

Table 6. IDF Evaluation according to gender of the patients

	No n (%)	Yes n (%)	Total
Male	26 (83.9)	5 (16.1)	31
Female	54 (80.6)	13 (19.4)	67
Total	80 (81.6)	18 (18.4)	98

Chi-square test.

Table 7. Evaluation of laboratory results according to gender

	Male Meant±SD	Female Mean±SD	P
Height (cm)	147.00±16.52	144.43±14.83	0.844
Weight (kg)	53.77±17.44	53.40±17.12	0.921
Waist circumference (cm)	75.00±10.92	74.31±11.64	0.783
WHO BMI Z Score	2.41±0.35	2.16±0.39	0.004
WHO BMI Percentile	98.86±1.05	97.74±2.43	0.002
Systolic AP	114.10±13.77	107.84±11.23	0.019
Diastolic AP	68.90±10.67	65.84±11.19	0.204
FBG	82.77±2. 29	82.87±3.37	0.891
Fasting insulin	8.52±2.59	16.08±6.36	0.068
Total Cholesterol	170.71±26.52	172.90±28.70	0.720
HDL	47.37±12.81	45.04±8.86	0.304
LDL	102.03±21.02	104.37±23.41	0.640
Triglyceride	110.45±47.17	123.37±71.62	0.362

Student t Testi.

Table 8. Evaluation of laboratory results in obese and overweight children

	Overweight Mean±SD	Obese Mean±SD	P
Height (cm)	145.13±15.53	145.30±15.37	0.957
Weight (kg)	49.44±15.52	55.50±17.63	0.101
Waist circumference (cm)	72.19±10.04	75.67±11.86	0.157
WHO BMI Z Score	1.80±0.25	2.46±0.25	0.000**
WHO BMI Percentile	95.96±2.57	99.13±0.67	0.000**
Systolic AP	105.09±10.54	112.11±12.62	0.008**
Diastolic AP	64.00±9.57	68.17±11.55	0.081
FBG	82.72±3.58	82.89±2.80	0.792
Fasting insulin	11.16±5.41	16.76±6.45	0.097
Total cholesterol	172.03±29.49	172.29±27.34	0.966
HDL	47.97±9.07	44.73±10.64	0.147
LDL	106.68±25.89	102.23±20.96	0.369
Triglyceride	95.25±50.48	130.94±68.20	0.005**

Student t Testi; **p<0.01; * p<0.05.

Discussion

Increase in the incidence of obesity has become a problem of our age in our country as in the whole world. Based on the findings of a thirty-five-year study, the incidence of obesity increased from 5.6% to 30.8% (5-fold) in children and adolescents aged 5-17 years [12]. Parallel to this, the incidence of metabolic syndrome (MS) increases [9].

MS is a condition explained by obesity on the basis of insulin resistance, high blood pressure, high triglycerides, low HDL and fasting blood sugar higher than normal values [13, 14].

In April 2007, the International Diabetes Federation (IDF) defined the criteria for the diagnosis of MS in children and adolescents in Barcelona by age groups. The IDF criteria are not used in children under six years of age. The use of the IDF criteria is not recommended for children under 10 years of age, but follow-up of the patients with a waist circumference above the 90th percentile, with a family history of MS, Type 2 DM, CVS diseases, HT, and obesity has been recommended . In addition to body mass index, waist circumference reflecting excessive abdominal fat accumulation was added to these criteria determine obesity and its risks.

Other criteria are the same in the adult age group, except that the waist circumference in children aged 10–16 years is above the 90th percentile for their age. Children and adolescents who meet at least three criteria, regardless of age, are considered to have MS [15–17]. Studies have shown that the prevalence of MS ranges between 1, and 7% in the whole population and 20 and 42% in overweight and obese children. In studies in Turkey, MS prevalence in obese children usually ranges between 20, and 27.2% [7, 9, 18–20].

According to IDF criteria, Güven et al., [21] found MS prevalence to be 29.4% in obese children. In our study, the prevalence of MS (25.8%) was found to be similar to other studies performed in our country.

In some studies, there was a difference between the genders in terms of the incidence of MS [22, 23]. In this study, as in many other studies, this difference was not found [21, 24, 25]. However, MS was found to be different between male and female obese children. BMI z score and WHO BMI percentile, and systolic arterial pressure averages were found to be statistically higher in boys when compared with girls. In our study, insulin resistance developed in obese children, even in the absence of MS. It is obvious that this condition will cause MS in the future. Elimination of insulin resistance in children by exercise, diet, or medication will significantly reduce the incidence of MS in obese children [26]. Dyslipidemia in obese children is also explained by the lipolysis of visceral fat cells and the resulting increase in fatty acids. This is also closely related to peripheral IR [27].

In our study, when the obese children were evaluated according to the age groups, the average values for height, weight and waist circumference, WHO BMIz scores, WHO BMI percentiles, systolic and diastolic artery pressures, fasting insulin and triglyceride levels of the children aged 10 years and over were found to be statistically significantly higher than those of smaller children, which suggests that 10 years of age is a turning point. This finding is recommended to be considered during follow-up.

Conclusion

In conclusion, obesity is one of the most important causes of metabolic syndrome in childhood. Strategies should be developed for the follow-up of children at risk, and early diagnosis and treatment of the factors that may develop. Breastfeeding during the new-born period should be encouraged for all children. One of the many benefits of breast milk is its protection of the children from obesity. To be able to choose the ideal nutrient during the transition to supplementary foods and teaching childminders balanced nutrition in other childhood periods; giving time and space opportunities for physical activities are the first steps in keeping the children away from the risks of obesity.

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