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CARDIOVASCULAR SCREENING PROGRAM IN CHILDREN IN BUDAPEST

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Summary

Introduction. Obesity is one of the most common health problems of the developed countries. The prevalence is increasing among adults and children alike. In Hungary, the prevalence in children is 9-10%. In 1998, WHO (World Health Organization) classified obesity as a disease. Obesity, and other metabolic, endocrine and musculoskeletal diseases that are caused by obesity are seen as one of the biggest public health-related problem nowadays. Obesity increases the morbidity and mortality in all the populations.

Aim. The aim of our screening program was to investigate the prevalence of obesity and its association with hypertension in children.

Material and methods. A screening program was conducted between April 2010 and May 2011. The screening consisted of measuring blood pressure, heart rate, cholesterol, blood glucose, weight, height, calculating BMI, and determination of body composition.

Results. 2226 children aged 14-18 fullfilling the inclusion criteria participated in the program. 13% of the participants were overweight (i.e. their BMI was in between the 85th and 95th percentile of the BMI for their age) and 4% of them were obese (i.e. their BMI was above the 95th percentile for their age). High body fat content was detected in 12.98% of girls and 5.9% of boys that participated in the study. 66% of girls and 81% of boys with elevated BMI had high body fat content. Mean cholesterol level was significantly higher in the group of overweight and obese participants than in the group of participants with normal BMI. Mean systolic and diastolic blood pressure differed significantly between groups with different BMI for both girls and boys, with overweight participants most likely to have pathologically high blood pressure.

Conclusions. There was a significant increase in both systolic and diastolic blood pressure with an increase in BMI. The results of our study may help design preventive programmes for obesity and hypertension in children.

Keywords: children obesity, hypertension, screening

INTRODUCTION

Obesity and hypertension are two most important risk factors for cardiovascular diseases (1, 2).

Obesity is one of the most common health problems of the developed countries. The prevalence is increasing among adults and children alike. In Hungary, the prevalence in children is 9-10%. In 1998, WHO (World Health Organization) classified obesity as a disease. Obesity, and other metabolic, endocrine and musculoskeletal diseases that are caused by obesity are seen as one of the biggest public health-related problem nowadays. Obesity increases the morbidity and mortality in all the populations.

AIM

The aim of this screening was to investigate the frequency of obesity and its association with hypertension in a sample of children and adolescents in Budapest. The results of the study will help to design programmes for the prevention and controll of the disease in childhood, which could decrease the potential of chronic disease in adulthood.

MATERIAL AND METHODS

A screening program was conducted between April 2010 and May 2011 in Budapest. The screening program was conducted by the City Council and with medical supervision of the professionals from the "Heim Pál" Children Hospital in Budapest.

The screening program was financed by the City Council of Budapest. The screening consisted of measuring blood pressure, heart rate, cholesterol, blood glucose, weight, height, calculating BMI, and determination of body composition.

A sample of 2467 healthy children and adolescents (958 boys and 1509 girls) from the selected schools participated in the study. There were no special inclusion criteria. The participation in the screening program was voluntary and informed consent from the parents, as well as from the adolescents, was obtained in all cases. The

study was approved by the Institutional Research Ethical Committee of Heim Pál Children Hospital, Budapest.

Our screening program was a local program conducted in Budapest, in which we examined different areas: full orthopedic screening, eyesight screening, hearing screening, dentistry screening, internal medicine screening, celiac screening, cardiovascular screening and mental hygiene test as described previously in "New Medicine" in 2014 (3). The included students took part in all types of examinations, but in this study, we only analyze the results of the cardiovascular program. Obesity was defined as having BMI value greater than 95th percentile for participant's age and sex, and overweight was defined as having BMI value between the 85 and 95th percentile. The body composition was measured through multi-frequency bioelectric impedance analysis (Inbody 3.0 Biospace device). We considered the body fat (BF) to be abnormally high when it was greater than 25% for boys and 30% for girls (4). The serum cholesterol level greater than 5.0 mmol/l and fasting blood glucose greater than 5.5 mmol/l was considered abnormal.

Blood pressure was measured using a standardized automatic blood pressure meter. To diagnose hypertension in pediatric population, systolic and/or diastolic pressure value greater than 95th percentile for age, sex and height is required (5). If a student had mean blood pressure greater than the 95th percentile for age and height, their blood pressure was remeasured at Heim Pál Children Hospital due to safety considerations.

Microsoft Office Excel was used to process the collected data. For continuous variables, including age, weight, height, BMI, and blood pressure, mean and range were calculated. Categorical variables were summarized by count and percentage. The data was analysed using the SPSS Statistica 20.0 software. Level of statistical significance *alpha* was defined as $p < 0.05$.

RESULTS

The distribution of BMI, age and gender of the study participants is shown in table 1. Mean age was 15 year (SD = 1.18). 13% of children were overweight and 4% were obese. Detailed characteristics of the population by BMI are shown in table 2. The mean body fat percentage (BF) was pathologicaly high in 12.98% of all girls and 5.9% of all boys, and in the groups with elevated BMI the frequency of high BF was 66% in girls and 81% in boys. The mean cholesterol was significantly higher in the overweight and obese groups (tab. 3). The mean systolic and diastolic blood pressure was significantly different ($p < 0.05$) between BMI groups and between sexes. High blood pressure was most frequently found in the group of overweight boys and girls (tab. 4). After comparing BMI between children from urban and rural stations, no statistically significant difference was found. Caries was found to be significantly more common in obese children.

In our study, 20% of children had an initially elevated BP at the first measurement.

DISCUSSION

Obesity of children and adolescents has become a global health problem (1, 2). In our study, 13% of the participants were overweight and 4% of them were obese.

Tab. 1. Number (percentile) of screened population by BMI, age and gender

Age (years)	Gender	Body Mass Index Percentile			All N (%)
		< 85 pc. normal weight N (%)	85-95 pc. overweight N (%)	> 95 pc. obese N (%)	
14	Girls	65 (80%)	13 (16%)	3 (4%)	81 (100%)
	Boys	70 (85%)	7 (9%)	5 (6%)	82 (100%)
15	Girls	337 (86%)	42 (11%)	12 (3%)	391 (100%)
	Boys	271 (82%)	44 (13%)	14 (5%)	329 (100%)
16	Girls	424 (81%)	79 (15%)	22 (4%)	525 (100%)
	Boys	296 (84%)	45 (13%)	13 (3%)	354 (100%)
17	Girls	217 (81%)	36 (13%)	16 (6%)	269 (100%)
	Boys	89 (88%)	10 (10%)	2 (2%)	101 (100%)
18	Girls	57 (78%)	11 (15%)	5 (7%)	73 (100%)
	Boys	16 (76%)	3 (14%)	2 (10%)	21 (100%)
Total	Girls	1100 (82%)	181 (14%)	58 (4%)	1339 (100%)
	Boys	742 (84%)	109 (12%)	36 (4%)	887 (100%)
All		1842 (83%)	290 (13%)	94 (4%)	2226

Tab. 2. Detailed characteristics of the population by BMI

	BMI girls			BMI boys			BMI all	
	< 85 pc. normal weight	**85-95 pc. overweight**	**> 95 pc. obese**	**< 85 pc. normal weight**	**85-95 pc. overweight**	**> 95 pc. obese**	**< 85 pc. normal weight**	**85-95 pc. overweight**
Age [years]	15.89*, + (SD = 1.02)	15.99 (SD = 1.33)	16.26++ (SD = 1.34)	16.77 (SD = 0.94)	16.05 (SD = 0.96)	16.15 (SD = 0.99)	15.77+++ (SD = 1.05)	15.85 (SD = 1.18)
BMI, [kg/m²] p < 0.000	20.43 (SD = 2.37)	27.14 (SD = 1.37)	34.93 (SD = 5.12)	20.34 (SD = 2.21)	27.23 (SD = 1.44)	33.08 (SD = 3.14)	20.39 (SD = 2.30)	27.17 (SD = 1.40)
BF p < 0.000	18.75 (SD = 6.82)	27.45 (SD = 6.16)	35.77 (SD = 8.07)	9.30 (SD = 5.53)	18.13 (SD = 6.61)	28.67 (SD = 5.74)	14.95 (SD = 7.85)	23.92 (SD = 7.78)
Cholesterol [mmol/L]	4.05**, *** (SD = 1.73)	4.09 (SD = 0.79)	4.29**** (SD = 0.96)	3.67** (SD = 0.64)	3.99 (SD = 0.71)	3.97 (SD = 0.81)	3,70	3.78 (SD = 1.26)
SBP p < 0.000	118.47 (SD = 10.93)	124.76 (SD = 10.97)	127.45 (SD = 13.14)	130.64 (SD = 13.07)	137.28 (SD = 13.24)	140.00 (SD = 14.14)	123.35 (SD = 13.21)	129.49 (SD = 13.29)
DBP p < 0.000	70.62 (SD = 7.79)	72.38 (SD = 8.26)	78.26 (SD = 11.97)	71.85 (SD = 8.72)	75.89 (SD = 9.44)	78.53 (SD = 12.29)	71.12 (SD = 8.19)	73.67 (SD = 8.88)
Height [cm]	165.53 (SD = 6.45)	165.38 (SD = 6.47)	165.06 (SD = 7.50)	177.56 (SD = 6.96)	178.03 (SD = 6.96)	177.64 (SD = 6.07)	170.37 (SD = 8.89)	170.16 (SD = 9.06)
Weight [kg] p < 0.000	56.06 (SD = 7.38)	71.75 (SD = 9.36)	90.97 (SD = 19.15)	64.67 (SD = 9.69)	86.15 (SD = 8.13)	103.48 (SD = 15.58)	59.51 (SD = 9.38)	77.17 (SD = 11.29)
Urban	20.41 (SD = 2.39)	27.25 (SD = 1.38)	34.73 (SD = 4.94)	20.40	27.33 (SD = 1.44)	32.69 (SD = 2.81)	20.36 (SD = 2.31)	27.29 (SD = 1.39)
Rural	20.46 (SD = 2.35)	26.98 (SD = 1.37)	35.15 (SD = 5.38)	20.41 (SD = 2.22)	27.01 (SD = 1.44)	33.67 (SD = 3.65)	20.43 (SD = 2.29)	26.97 (SD = 1.39)
Dental status – caries	20.61 (SD = 2.42)	26.94 (SD = 1.34)	36.55 (SD = 5.95)	20.29 (SD = 2.24)	27.04 (SD = 1.11)	36.23 (SD = 4.07)	20.49 (SD = 2.32)	26.97 (SD = 1.28)
Dental status – no caries	20.37 (SD = 2.33)	27.27 (SD = 1.38)	32.57 (SD = 2.36)	20.37 (SD = 2.19)	27.29 (SD = 1.55)	32.08 (SD = 2.13)	20.37 (SD = 2.27)	27.23 (SD = 1.43)

* $p < 0.05$ normal weight girls/obese girls
+ $p < 0.05$ normal weight girls/normal weight boys
++ $p < 0.05$ obese girls/obese boys
+++ $p < 0.05$ boys and girls normal weight/boys and girls obese
** $p < 0.05$ normal weight/over weight; normal weight/obese girls and boy normal weight/over weight; and normal weight/obese girls; and normal weight/obese boys
*** $p < 0.05$ normal weight girls/normal weight boys
**** $p < 0.05$ obese girl/obese boys
There was no statistically significant difference between the children who lived in rural and urban area.

Tab. 3. Percentage of children with cholesterol level above 5.15 umol/l, by BMI and gender

Gender	Body Mass Index %		
	< 85% normal weight	85-95% overweight	> 95% obese
Girls	6.7%	24.3%	29.1%
Boys	2.3%	32.9%	38.2%

Tab. 4. Percent of pathological high blood pressure, by BMI and gender

Gender	Body Mass Index %	
	85-95% overweight	> 95% obese
Girls	16.6%	11.8%
Boys	58.6%	64.5%

There was no significant difference in the prevalence of obesity between boys and girls. Basiratnia et al. received similar results, but some other researchers found the percentage of obese children to be even higher (6-8).

In our study, we diagnosed obesity in children by calculating their BMI and measuring their body fat percentage (BF). High BF of obese subjects can contribute to the pathogenesis of their hypertension (9). The primary hypertension in our subjects was rare, and was frequently secondary to kidney disease, but epidemiological studies showed an increase in the prevalence of primary hypertension in children and adolescents (10). We used Hungarian guide for diagnosing hypertension in children that was published in 2010 (11). In our study, there was a significant increase in both systolic and diastolic blood pressure with an increase in BMI. The prevalence of systolic hypertension was 64.5% in obese boys and 11.8% in obese girls, and 58.6% in overweight boys and 18.6% in overweight girls. Basiratnia et al. (6) reported lower prevalence of hypertension in children with high BMI, which complies with the results of Muntner et al. (12). In our study, 20% of children had an initially elevated BP at the first measurement, proving the importance of repeated measurements in diagnosing hypertension. Other studies reported similar results (13, 14). Results of these studies have limited value, as they are based on a single BP measurement. However, among adolescents who had elevated blood pressure in single measurement only, 68% of boys and 43% of girls developed prehypertension or hypertension within the next two years (5). Hypertension is reported to be more prevalent in urban regions than in rural areas (15). In our study, we did not observe such a relationship.

CONCLUSIONS

There was a significant increase in both systolic and diastolic blood pressure with an increase in BMI. The high prevalence of hypertension in overweight and obese children implies that there is need for more efficient prevention in health basic service.

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Conflict of interest
None

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