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UNDERWEIGHT, OVERWEIGHT, GENERAL AND CENTRAL OBESITY IN 5-YEAR-OLD CHILDREN FROM NORTH MACEDONIA

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Abstract

The objective of this study is to investigate the distribution of underweight, overweight, and the general and central obesity in 5-year-old children from North Macedonia, through the use of the anthropometric indices, BMI for general and WHR for central or abdominal obesity.

In this study, a total of 248 children (124 boys and 124 girls) are investigated. Anthropometric indicators are measured using a standard protocol. We select four parameters to measure (weight and height) and two circumferences (waist WC and hip HC). The following indices are taken into consideration: Body mass index (BMI) and waist-to-hip ratio (WHR). The percentile distribution of the tested variables was done by gender.

Some anthropometric parameters (weight, height, and BMI) have shown significant sex-specific differences in favour of boys, with exception of circumference and WHR. Overweight occurs in 5.65% of the boys and 12.1% of the girls, and obesity occurs in 10.48% of boys and 4.84% of the girls. The underweight is 4.84 % of the boys and 5.64% of the girls. Central or abdominal obesity across cut-off points (WHR and WC-for-age >=90th percentile) occurs in 13.7 % and 12.9 % of the boys and 12.1 % and 10.48% of the girls respectively.

Central obesity, as well as general obesity, is more frequent in boys than girls. These results and the determination of BMI, WC, and WHR cut-off values can be used for estimating underweight, overweight, general, and central obesity and consequences associated with it in children aged 5 years from R. North Macedonia.

Keywords: BMI, WC, WHR, children, overweight, central obesity, underweight.

Introduction

Childhood obesity is increasing worldwide [1]. Obesity is now considered a global epidemic because its prevalence and severity both in adults and children are increasing worldwide at alarming rates [2]. Obesity prevalence was 13.4% among 2- to 5-year-olds, 20.3% among 6- to 11-year-olds, and 21.2% among 12- to 19-year-olds. Also, approximately one-fourth of children worldwide are obese or overweight [3].

Obesity in children and adolescents is defined as a body mass index (BMI) above the 95th percentile for sex and age [4]. While BMI is a simple measure calculated by dividing the body weight by the squared height, it does not fully reflect adiposity or body composition. This indicator is simple, easy to calculate, and has clearly defined cut-off points to determine general obesity [5].

Since central obesity is known to be an indicator of cardiometabolic risk, better anthropometric measures than BMI to screen for central obesity are needed.

Among the anthropometric measures used to evaluate adiposity, the Waist circumference (WC) and WHR indices can be easily measured in clinical settings and can act as an indicator of central adiposity [6,7]

WC is a highly sensitive and specific measure of upper body fat in young people and thus it is valuable for identifying overweight and obese adolescents at risk of developing metabolic complications [8,9]. It has also been suggested that WHR can be used for assessing central obesity, visceral fat, and the risk factors for chronic diseases.

Our aim in this study was to investigate the distribution of underweight, overweight, and the general and central obesity in 5-year-old children through the use of the anthropometric indices, BMI for general and WC and WHR for central or abdominal obesity, and to find their optimal cut-off points.

Material and methods

Subjects

The study included healthy children of both sexes aged 5 living in Skopje, R. of North Macedonia. It excluded children with systemic and metabolic diseases that may be affected on growth and development children, as well as those children with a family history of systemic illness. The total number of subjects (n=248) was divided into subgroups by gender: (124 boys and 124 girls).

Anthropometry

Anthropometric indicators were measured using a standard protocol. When the measurements were done, the children were wearing light clothes (T-shirts and shorts), they removed their shoes and their anthropometric points and levels were previously marked. The following anthropometric parameters were measured: weight, height, waist circumference (WC) (measure at the end of several consecutive natural breaths, at a level parallel to the floor, a midpoint between the top of the iliac crest and the lower margin of the last palpable rib in the midaxillary line) and the hip circumference (HC) measured at a level parallel to the floor, at the largest circumference of the buttocks [10,11].

The instruments for measuring were standard and were regularly calibrated before measuring; their precision was controlled throughout the entire measurement process. The following standard anthropometric instruments were used: an anthropometer by Martin for measuring height with a reading precision of 1 mm; medical decimal scales for measuring weight with a precision of 0.1 kg; stretch-resistant tape for measuring circumferences with a precision of 1 mm. The following indices were taken into consideration: BMI (dividing the weight by the square of the height) and WHR (waist divided by hip circumference).

Definitions

For the aim of categorization of the anthropometric indices' values, the following percentile cut-off points were used: <5th percentile for the category of extremely low values or underweight; from the 5th to less than the 85th percentile for mean values of normal or healthy weight; from the 85th to lees than the 95th percentile for the category of overweight or category of above-average values; and 95th percentile or grater for obese and for extremely high values; for WHR and WC-for-age>=90th percentiles were considered high value or abdominal, central obesity[12-16].

Statistics

The gathered data for the relevant variables were analyzed with descriptive statistics represented by central tendency and its deviation (arithmetic mean ± standard deviation) and percentage. BMI, WC, and WHR were distributed by pc (5th, 25th, 50th, 85th, 90th, and 95th pc) according to gender. Testing of sex differences was done with the analysis of variance for large, independent samples-ANOVA. Differences for $p < 0.05$ were considered significant.

Results

The study included a sample of 248 children of both sexes (124 boys and 124 girls) aged 5 years. Table 1 presents the statistical characteristics of weight, height, BMI, WC, HC, and WHR (mean, standard deviation, and their gender differences (ANOVA- test).

The 5-years old boys had body height of 115.28 ± 4.42 cm, a weight of 21.91 ± 3.59 kg, BMI of 16.45 ± 2.23 kg/m^2, WC of 54.7 ±7.93cm, HC of 67.79±7.39cm and WHR of 0.891±0.08. The values of these parameters in girls were: body height of 113.95 ± 4.45 cm, the weight of 20.45 ± 3.18 kg, BMI of 15.69 ± 1.85 kg/m^2, WC of 54.2 ±6.15cm, HC of 60.01±6.69cm and WHR of 0.9±0.05. The 5-year-old

boys have statistically significant highest values for BMI, weight, and height ($p<0.05$). A comparison of other anthropometric parameters (WC, HC, and WHR) showed no statistically significant differences between the sexes ($p>0.05$).

Table 1. Mean and standard deviations and sex-specific differences of examined anthropometric parameters in Macedonian 5-year-old children (n=248).

Age 5	n	Weight (kg)	Height (cm)	BMI (kg/m^2)	WC (cm)	HC (cm)	WHR
All	248	21.18±3.46	114.62±4.48	16.07±2.08	54.43±5.75	60.01±6.25	0.91±0.06
Girls	124	20.45±3.18	113.95±4.45	15.69±1.85	54.2±6.15	60.01±6.69	0.9±0.05
Boys	124	21.91±3.59[a]	115.28±4.42[a]	16.45±2.23[a]	54.7±5.35	60.21±5.8	0.91±0.06

Values are mean ±SD=Standard deviation, BMI=Body Mass Index, WC=Waist Circumference, HC=Hip Circumference, WHR=Waist-Hip Ratio
[a]$p<0.05$ boys *vs* girls (ANOVA)

Table 2, shows the percentile distribution (5th, 50th, 85th, 90th, and 95th) of BMI, WC, and WHR in our 5-year-old subjects by gender.

Table 2. Percentile distribution of BMI, WC, WHR in Macedonian 5-year-old children

Age 5	n	5	25	50	85	90	95
BMI							
All	248	13.35	14.57	15.65	18.04	18.77	20.43
Girls	124	13.09	14.43	15.32	17.72	18.25	19.15
Boys	124	13.49	15.02	15.95	18.45	19.9	20.24
WC							
All	248	47.5	49.97	53.5	60	63	66
Girls	124	47	49	53	60	62.7	66.5
Boys	124	47.64	50.8	54	60.4	63	64.8
WHR							
All	248	0.81	0.86	0.91	0.96	0.98	1.00
Girls	124	0.82	0.86	0.9	0.96	0.97	0.99
Boys	124	0.81	0.86	0.91	0.96	0.98	1.01

Figure 1 and 2 shows the percentage distribution of underweight, across BMI cut-off points for our 5-year-old boys and girls. In the present study, the number of boys and girls with underweight, normal weight, overweight, and obesity across BMI cut-off points was, for boys: 6 (4.84 %), 98(79.03 %), 7 (5.65 %), and 13 (10.48%), respectively. With the girls the results are as follows：7 (5.64%), 96 (77.42 %), 15 (12.1%) and 6 (4.84%).

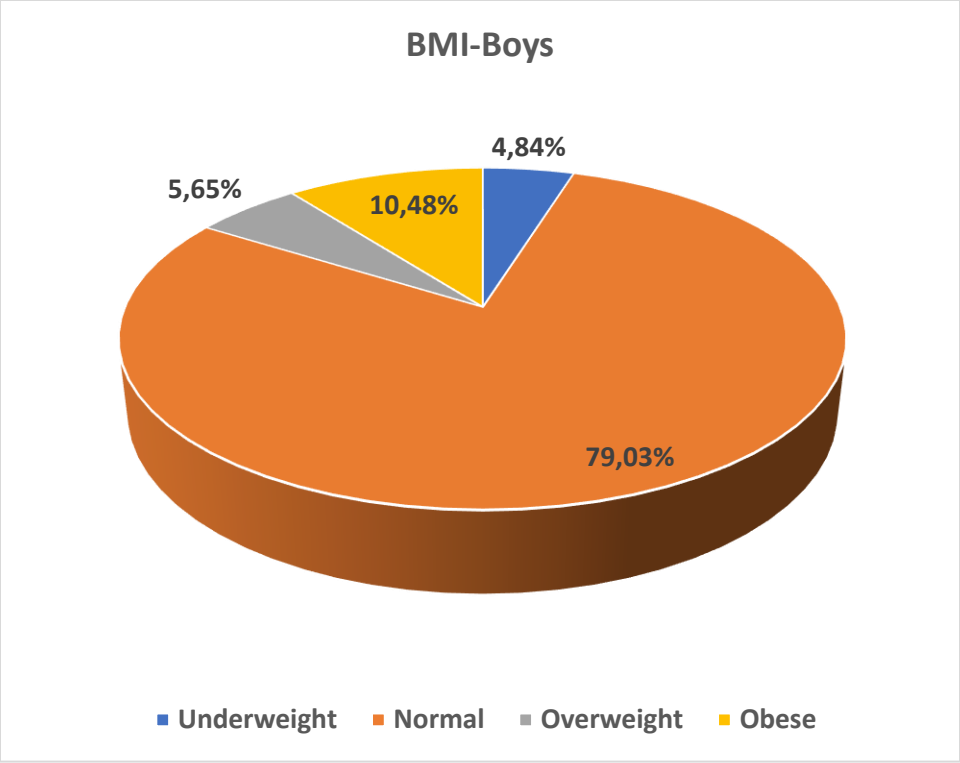


Fig. 1. Percentage distribution of underweight, normal, overweight, and general obesity across BMI cut off points for Macedonian 5-year-old children, boys

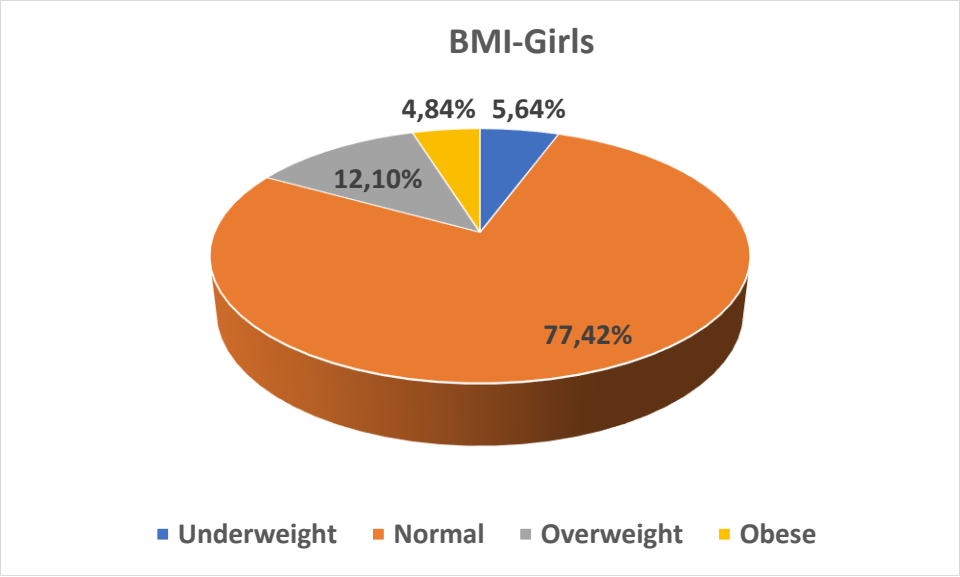
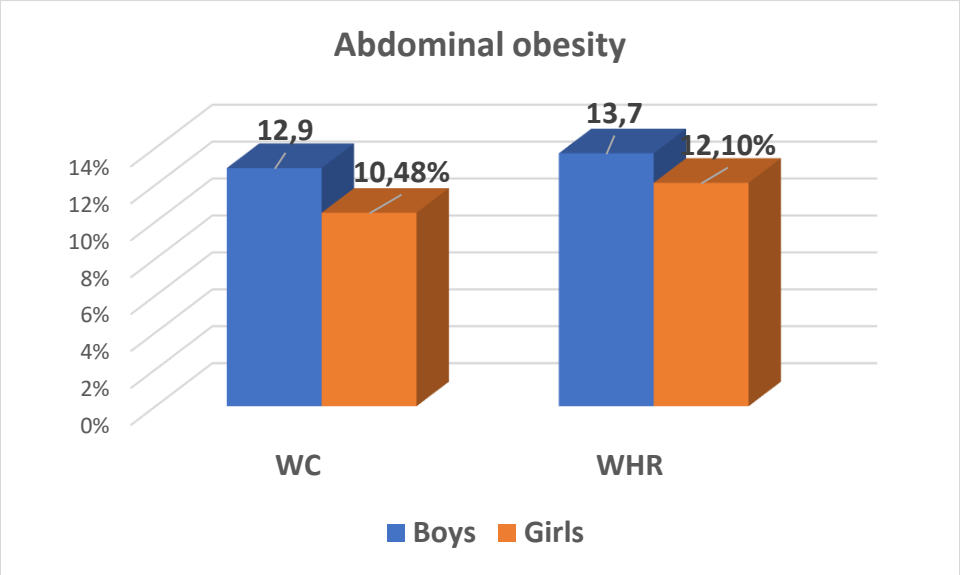


Fig.2. Percentage distribution of underweight, normal, overweight, and general obesity across BMI cut off points for Macedonian 5-year-old children, girls

Graphic 1 shows the percentage distribution of central or abdominal across WC and WHR cutoff points for our 5- year-old children.

In the examined population of girls, abdominal or central obesity for WC was registered in girls 13 or (10.48%) and based on WHR is 12.1%. or 15 girls. Both cut-off points for boys were similar with the same values for girls respectively. The percentage distribution of abdominal obesity in boys was 12.9 % or 16 for WC and 13.7 % for WHR or17 boys.



Graph 1. Percentage distribution of central or abdominal across WC and WHR cut-off points in Macedonian 5- year-old children, boys, and girls.

Discussion

This study was designed to establish values for anthropometric indicators, their sex -differences as well as cut-off points which are used for assessment of underweight, overweight, and the general and central obesity in 5-year-old children from North Macedonia Sex-specific differences related to certain anthropometric parameters were observed in favour of male subjects, and this results in agreement with the results reported in other anthropometric studies[17,18].

The obtained values enabled comparison with corresponding anthropometric research in children from other regions and populations. BMI is used commonly to classify obesity among adults, and is recommended for use with children and adolescents. It is often used to measure general adiposity and to classify children and adolescents as “underweight”, “normal weight”, “overweight”, or “obese”. Cutoff criteria are based on the sex-specific BMI-for-age. Cole et al. have established the first age- and sex-specific BMI cut-off values to detect overweight and obesity. He used a reference sample that largely preceded the obesity epidemic to derive the IOTF (International Obesity Task Force) [19].

Similar values have been created by the World Health Organization and the Centers for Disease Control [18]. Based on recommendations from expert committees, children and adolescents with BMI values at or above the 95th percentile of the growth charts are categorized as having obesity. Results from the 2017–2018 National Health and Nutrition Examination Survey (NHANES), using measured heights and weights, indicate that an estimated 19.3% of U.S. children and adolescents aged 2–19 years have obesity, including 6.1% with severe obesity, and another 16.1% are overweight [20].

In our study distribution of general obesity across BMI based on the CDC cut-off points among Macedonian 5- year-old children were: 5.65 % of boys were overweight and 12.1 % were girls at the same

age, while 10.48% of boys were obese and 4.84 % girls. Our findings show differences in the distribution of overweight and obesity between girls and boys. General obesity is more frequent in boys than girls. Contrary to that, overweight is more frequent in our 5 -year-old girls. Similar trends are reported by other authors [3,17]. The children from both sexes at risk according to IOTF International Obesity Task Force cut-off values of BMI are as follow: in our 5-year-old boys BMI values (18.45 and 21.24 kg/m^2) for the 85th and 95th percentile were higher than in the boys examined by the International Obesity Task Force (IOTF) (17.45 and 19.47 kg/m^2) [19]. BMI values in our 5-year-old girls were 17.72 kg/m^2 for the 85th percentile and 19.15 kg/m^2 for the 95th percentile against the relevant results of 17.3 kg/m^2 for the 85th percentile and 19.34 kg/m^2 for the 95th percentile.

Waist circumference (WC) and waist/hip ratio (WHR) are the measurements most commonly used to estimate abdominal fat because they have a positive, significant correlation to the amount of intra-abdominal fat as assessed by imaging studies both in adults and children. Waist circumference (WC) is a simple, easily available anthropometric measurement, giving relevant information about the fat distribution and reflecting the degree of central adiposity in children[22-23]. Central obesity has been associated with the risk of cardiovascular and metabolic disease in children and anthropometric indices predictive of childhood central obesity include waist circumference (WC), waist-hip ratio (WHR), and waist-height ratio (WHtR)[24].

Recently, Xi et al. proposed international WC percentile cut-off points, specific for age and sex, to define central obesity based on data of 113,453 children and adolescents aged 4-20 years from eight countries in different regions (Bulgaria, China, Iran, Korea, Malaysia, Poland, Seychelles, and Switzerland). The 90th percentile was established as the WC cut-off to detect central obesity in this population, with good performance in predicting cardiovascular risk in normal-weight children, and was suggested to be used in the assessment of abdominal adiposity in children and adolescents in different countries[25].

First, the 90th percentile WC cutoff is also used by the IDF(International Diabetes Federation)[16]. IDF recommended the 90th percentile WC cutoffs for defining central obesity for youth aged 5 to 15 years. According to this recommendation, we also chose the 90th WC percentile as the cutoff to identify central obesity in children in our study. Abdominal obesity in our 5-year- old girls was registered at 10.48 % for WC and 12.1 % for WHR. In our 5-year-old boys, abdominal obesity was found in 12.9% for WC and 13.7% for WHR Our established percentile curves for WC and WHR are in line with previous studies in Bulgarian, Pakistan, Turkey, Venezuela, etc.

These cut-offs and curves can serve as valuable criteria for screening and identifying children at a higher metabolic risk, for international comparisons, and to better understand secular trends in pediatric obesity.

Conclusion

We have determined cut-off points from the 5th to the 95th percentile for anthropometric parameters commonly used to estimate underweight, normal weight, overweight, and general and central obesity in 5-year-old children.

The present findings provide a tool that can be used in the clinical setting for the early detection and prevention of childhood obesity. Comparing the incidence of obesity in the world and our country, we see that our country follows the trend of increasing obesity. Planning for obesity prevention is an important global health priority. The determination of central and general obesity assessment based on anthropometric measurements is still an important method of choice in clinical investigations.

Moreover, anthropometric measures are rapid, easy to perform, economic, and are especially important for estimating obesity and children. The presentation, therefore, in this study of waist circumference percentiles can help in further investigation of specific cut-offs concerning certain metabolic complications of obesity in children.

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