American Journal of Medicine and Medical Sciences 2025, 15(6): 1767-1771
DOI: 10.5923/j.ajmms.20251506.27

Characteristics of Anthropometric Indicators in Children with Abdominal Obesity Complicated by Metabolic Syndrome

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Abstract **Relevance of the study.** The degree of obesity, the age of onset of obesity, and the type of distribution of adipose tissue in the child's body are of great importance in the development of metabolic syndrome in children. **Objective of the study:** to conduct a comparative characteristic of anthropometric indicators in children with different types of obesity and metabolic syndrome. **Material and methods:** 211 children with primary exogenous constitutional obesity, aged 7 to 18 years, anthropometric methods used. A set of anthropometric studies was conducted. **Results of the study:** in boys aged 7-9 years with abdominal obesity, the body mass index and waist-to-hip ratio exceeded the indicators of girls and approached the anthropometric indicators of older children. The dependence of anthropometric indicators on the presence of metabolic syndrome components was noted. Conclusion: obese boys aged 7-9 years had anthropometric indicators corresponding to severe obesity. The waist-to-hip ratio characterizing abdominal obesity was highest in children with complete metabolic syndrome, and increased depending on the number of metabolic syndrome components. **Conclusion:** boys with obesity aged 7-9 years had anthropometric indicators corresponding to severe obesity. The waist-to-hip ratio characterizing abdominal obesity was highest in children with complete metabolic syndrome, and increased depending on the number of metabolic syndrome components.

Keywords Obesity, Children, Anthropometry, Metabolic syndrome

1. Introduction

Childhood obesity is currently a global problem. The World Health Organization's European Childhood Obesity Surveillance Initiative (COSI) shows that "...29% of children aged 7–9 years are overweight and obese, with a higher prevalence of pathology in boys (31%) compared to girls (28%)..." [1]. The relevance of the problem of obesity is that this pathology is associated with the development of metabolic syndrome (MS), one of the most acute medical and social problems of the modern healthcare system [2,3].

Abdominal obesity is an important component of metabolic syndrome, and if previously it was believed that MS is a problem of middle-aged people, then in the last decade its steady growth has been observed among children. Thus, the prevalence of MS among adolescents with obesity is 26–49% [4].

The degree of obesity, the age of onset of obesity, and the type of distribution of adipose tissue in the child's body are of great importance [4,5], in connection with this, the aim of the study was set: to conduct a comparative analysis of anthropometric indicators in children with different types of obesity and metabolic syndrome.

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Received: Apr. 30, 2025; Accepted: Jun. 2, 2025; Published: Jun. 7, 2025
Published online at http://journal.sapub.org/ajmms

2. Material and Methods

We examined 211 children with primary exogenous constitutional obesity, aged from 7 to 18 years (12.29±0.28 years), of which 114 were boys (54.0%) and 97 girls (46.0%), as well as 104 children with normal body weight of similar age composition (12.36±0.31 years), with the distribution of boys 61 (58.6%) and girls 43 (41.3%).

The diagnosis of obesity was made based on WHO recommendations; the standard deviation (SD) of the body mass index (BMI) was calculated taking into account the sex and age of the children [6].

In accordance with the aim of the study, we formed the following groups: Group I - 123 children with abdominal obesity (visceral obesity, complicated obesity) with a waist circumference (WC) over the 90th percentile for the corresponding age and gender (BMI 30.61±0.83 kg/m2). Group II consisted of 88 children with a uniform type of

obesity (simple obesity) with a WC below the 90th percentile, respectively, for age and gender (BMI 25.96±0.45).

An anthropometric examination of children was conducted to determine BMI, WC, hip circumference (HC), and the WC/HC ratio.

Waist circumference (WC) was assessed according to percentile tables provided in the National Clinical Guidelines of the All-Russian Scientific Society of Cardiologists (ASS C Moscow 2009) [7]. Obesity was considered abdominal when WC was ≥90 percentile and above. The criterion for abdominal obesity in adolescents over 16 years old was WC≥80 cm in girls and WC≥94 cm in boys. The hip circumference (HC) was determined, as well as the WC to HC ratio (WHR - Waist-hip ratio) determined by dividing the waist circumference by the hip circumference. Normally, this ratio should be no more than 0.85 for girls, and 0.9 for boys (WHO).

The diagnosis of metabolic syndrome was made based on the diagnostic criteria for MS in children and adolescents developed by the International Diabetes Federation (IDF).

The results of the study of children with abdominal obesity showed that complete metabolic syndrome with a combination of Abdominal Obesity (AO) and 4 signs was observed in 20 children (16.2%), 3 components in 23 (18.7%) children with abdominal obesity, in combination of AO with 2 components occurred in almost 1/4 of children in the AO group (32 children - 26.0). The frequency of occurrence of 1 component of MS in children with AO was 1/3 of cases (39 children - 31.7%).

Statistical processing of the obtained data was carried out on a personal computer using the Statistica 10 program. Methods of variational parametric and nonparametric statistics were used with the determination of the arithmetic mean (M), standard deviation (σ), standard error of the mean (m), and relative values (frequency, %). The statistical significance of the obtained measurements was determined using the Student criterion (t) with the calculation of the probability of error (P).

3. Results of the Study

In accordance with the stated objective, we analyzed the anthropometric characteristics of children with abdominal obesity with manifestations of metabolic syndrome. The main characteristics depending on the type of distribution of adipose tissue are presented in Table 1.

The obtained data characterize a significant reliable difference between children with abdominal obesity and generalized obesity, as well as with children in the control group. The most objective reflection of body weight is BMI, which in children with abdominal obesity was significantly high in relation to the comparison groups.

Also, the distribution of the standard deviation of BMI (SDS BMI), the determination of which contributed to the diagnosis of obesity of varying severity, was significantly higher compared to the group with GO.

It should be noted that the average growth rates of children in all groups were almost the same and did not differ statistically; this distribution applied to the HC indicators, while WC was significantly higher in the group of children with AO, which was accompanied by a significant increase in the WC/HC ratio, which is an objective indicator of the presence of abdominal, visceral obesity.

Characteristics of anthropometric indicators depending on gender and age showed that the average BMI in children with AO in the age group of 7-9 years had differences between the BMI of boys and girls, with a statistically lower level in girls, and a fairly high BMI in boys of this age category, which indicates a more progressive accumulation of adipose tissue in boys, and a slower accumulation of adipose tissue in girls aged 7-9 years.

Table 1. Comparative characteristics of children in the study groups (M±m)

Indicators	**I Group AO n= 123**	**II Group Generalized type n= 88**	**Control Group n= 104**
BMI; M±m	30,70±0,41 P_1<0,0000; P_2<0,0000	26,65±0,39 P_1<0,0000	21,07±1,38
SDS BMI; M±m	2,95±0,04 P_1<0,0000; P_2<0,0000	2,34±0,05 P_1<0,0000	0,67±0,06
Body weight; M±m	72,48±1,88 P_1<0,0000; P_2<0,001	62,74±2,01 P_1<0,0000	47,59±1,30
Height; M±m	151,43±1,37	151,70±1,65	153,74±1,54
WC; M±m	91,15±1,07 P_1<0,0000;P_2<0,0000	71,23±0,88 P_1<0,0000	65,23±0,62
HC; M±m	85,15±0,95	83,17±0,87	80,27±0,71
WC/HC; M±m	1,07±0,00 P_1<0,0000; P_2<0,0000	0,85±0,00 P_1<0,0000	0,81±0,00

Note: *P1 – compared with the control group; P2 – compared with group II*

Table 2. BMI in children of the compared groups depending on gender and age

Age		I group AO n= 123		II group Uniform type n= 88		Control group n= 104
7- 9 years old	b; n=11	30,7±1,27*,º	b; n=8	23,30±0,60^	b; n=15	17,60±0,14
	g; n=14	25,00±1,12*,**	g; n=14	24,83±0,80^	g; n=8	18,41±0,48
	t; n=25	27,50±1,00*,º	t; n=22	24,27±0,56^	t; n=23	17,89±0,20
10-15 years old	b; n=42	29,95±0,60*,º	b; n=31	26,47±0,64^	b; n=35	19,81±0,30
	g; n=30	31,86±0,78*,º	g; n=18	26,22±0,78^	g; n=27	19,84±0,30
	t; n=72	30,73±0,48*,º	t; n=49	26,38±0,49^	t; n=62	19,82±0,21
16-18 years old	b; n=15	33,41±0,47*,º	b; n=7	30,36±0,62^	b; n=19	21,84±0,34
	g; n=11	34,0±1,04*,º	g; n=10	30,60±0,57^	g; n=11	20,91±0,45
	t; n=26	33,66±0,51*,º	t; n=17	30,50±0,41^	t; n=8	21,45±0,29

***Note**: * p>0.001 difference compared to the control group, ºp>0.01 difference compared to the group with GO; **p>0.02 difference between girls and boys in the group with AO*

Table 3. SDS BMI in children of the compared groups depending on gender and age

Age		I group AO n= 123		II group Generalized type n= 88		Control group n= 104
7- 9 years old	b; n=11	3,30±0,17*,º **	b; n=8	2,43±0,18^	b; n=15	0,85±0,11
	g; n=14	2,70±0,14*	g; n=14	2,53±0,18^	g; n=8	0,62±0,22
	t; n=25	2,96±0,12*,º	t; n=22	2,49±0,13^	t; n=23	0,77±0,10
10-15 years old	b; n=42	2,84±0,09*	b; n=31	2,31±0,09^	b; n=35	0,80±0,12
	g; n=30	2,96±0,09*,º	g; n=18	2,17±0,11^	g; n=27	0,70±0,12
	t; n=72	2,89±0,06*,º	t; n=49	2,26±0,07^	t; n=62	0,76±0,17
16-18 years old	b; n=15	3,13±0,12*,º	b; n=7	2,40±0,11^	b; n=19	0,36±0,25
	g; n=11	3,1±0,14*,º	g; n=10	2,33±0,11^	g; n=11	0,12±0,24
	t; n=26	3,12±0,08*,º	t; n=17	2,36±0,78^	t; n=8	0,26±0,17

***Note**: * p>0.001 difference compared to the control group, ºp>0.01 difference compared to the group with GO; **p>0.01 difference between girls and boys in the group with AO*

In children aged 10–15 years and 16–18 years, no differences were observed between boys and girls, while BMI increased in accordance with the age of the children and was statistically different from both the control indicators of a similar age distribution and gender, and the indicators of children with generalized obesity (Table 2).

The distribution features of SDS BMI in children with obesity repeated the statistical difference in BMI indicators in children. Differences between boys and girls were noted only at the age of 7-9 years in children with AO. With a statistically significant difference in the indicators of children with AO compared with the same age and gender distribution of the group with a generalized type of obesity and the control group.

It should be noted that the BMI indicators in children with GO were statistically different from similar indicators in the control group, the BMI SDS distribution of which was within the range from +1 to -1 BMI SDS (Table 3).

When analyzing the average level of the WC/HC ratio in children of the compared groups, it was revealed that this ratio was statistically high in relation to both the group with GO and the control group, while in the group with generalized obesity this ratio approached the indicators of children in the control group.

In boys aged 7-9 years, the development of abdominal obesity with significant WC/HC indices was observed, compared to girls, which characterizes the inclusion of this category of patients in the high-risk group (Table 4).

According to the objectives of the study, we were interested in studying the distribution of anthropometric indicators in children with abdominal obesity who have MS. Of particular interest was the study of the indicators of the complete metabolic syndrome: AO + 4 components of MS, it was found that the BMI in children of this category statistically exceeded the indicators of children with AO + 3 components of MS, AO + 1 component of MS and children who did not have metabolic disorders. Moreover, the BMI indicators for complete MS and incomplete metabolic syndrome were close to each other and did not differ statistically.

When comparing the average BMI level in boys with complete MS, it was found that no difference was found compared to children with 3 components, and no statistical difference was noted compared to children with no MS components, i.e., the BMI was at a fairly high level and did

not differ from the BMI indicators in children with MS. This fact spoke about obesity that is not accompanied by metabolic disorders and remains compensated for a long time, while there are cases when the BMI is close to normal, but is accompanied by metabolic disorders characteristic of metabolic syndrome.

It should be noted that the most optimal BMI was in girls with no MS components, which was statistically lower both in relation to boys in this group and in relation to girls in the group with complete MS.

When studying the distribution of the standard deviation in groups with different variants of MS, it was revealed that the static difference in the indicators of complete MS was observed only in relation to the group with AO+1 component, in particular to the general contingent and girls, and to children with no MS components, both in relation to girls, boys and the general contingent.

The WC/HC ratio indicators showed a clear dependence on the MS variants, so in children with the complete MS variant, the highest ratio indicator was noted, which had a reliable difference both with the incomplete variant, and with children with AO+1 component, and with children with the absence of components. A similar distribution was noted in relation to the distribution of this indicator in boys. Whereas in girls, the indicators did not differ from each other, remaining at an average level for all MS variants, and decreasing only in girls with the absence of MS components (Table 5).

Table 4. The WC/HC index in children of the compared groups depending on gender and age

Age		I group AO n= 123		II group Generalized type n= 88		Control group n= 104
7- 9 years old	b; n=11	1,07±0,01*,º,**	b; n=8	0,84±0,01^	b; n=15	0,80±0,01
	g; n=14	1,04±0,01*,º	g; n=14	0,82±0,02	g; n=8	0,81±0,02
	t; n=25	1,05±0,00*,º	t; n=22	0,82±0,11^	t; n=23	0,81±0,00
10-15 years old	b; n=42	1,07±0,01*,º	b; n=31	0,87±0,01^	b; n=35	0,81±0,00
	g; n=30	1,06±0,01*,º	g; n=18	0,83±0,01^	g; n=27	0,79±0,00
	t; n=72	1,07±0,01*,º	t; n=49	0,86±0,01^	t; n=62	0,80±0,00
16-18 years old	b; n=15	1,09±0,01*,º	b; n=7	0,91±0,03	b; n=19	0,89±0,02
	g; n=11	1,10±0,02*,º	g; n=10	0,87±0,01^	g; n=11	0,77±0,01
	t; n=26	1,10±0,01*,º	t; n=17	0,89±0,01^	t; n=8	0,84±0,02

Note: ** p>0.001 difference compared to the control group, º p>0.01 difference compared to the group with GO; **p>0.01 difference between girls and boys in the group with AO*

Table 5. Anthropometric indices depending on the components of metabolic syndrome in children with AO

components of metabolic syndrome	AO n= 123	BMI	SDS BMI	WC/HC
1 component MS	boys	29,64±1,04*	2,91±0,16	1,05±0,01*
	girls	28,04±0,97 º	2,67±0,09º	1,06±0,01
	total	29,06±0,76**	2,79±0,09**	1,06±0,00**
2 components MS	boys	30,81±0,67*	3,02±0,11	1,06±0,01*
	girls	32,82±1,33	3,12±0,12	1,09±0,02
	total	31,48±0,69	3,06±0,08	1,07±0,01**
3 components MS	boys	31,35±1,09	2,93±0,15	1,08±0,01
	girls	29,81±1,76	2,85±0,19	1,06±0,02
	total	30,74±0,95**	2,9±0,11	1,07±0,01**
4 components MS	boys	33,87±0,68	3,26±0,10	1,12±0,02
	girls	33,20±1,85	3,20±0,09	1,07±0,02
	total	33,71±0,66	3,24±0,08	1,11±0,01
no components	boys	30,43±1,80 ºº	2,5±0,30*	1,01±0,00*
	girls	26,53±2,10 º	2,58±0,23 º	1,02±0,01 º
	total	28,56±1,86**	2,67±0,20**	1,03±0,00**

Note: ** p>0.01 difference compared to boys in the group with 4 MS components, º p>0.01 difference compared to girls in the group with 4 MS components; **p>0.01 difference compared to the total contingent of the group with 4 MS components; ºº difference between girls and boys in the group without MS components.*

4. Conclusions

In boys aged 7-9 years with abdominal obesity, BMI and WC/HC ratio statistically exceeded the indicators of girls and approached the BMI and WC/HC ratio of senior school-age children, and also statistically exceeded the BMI and WC/HC ratio of boys with uniform obesity, which indicates a significant accumulation of body weight in boys with abdominal obesity even in primary school age and serves as a risk factor for the occurrence and progression of MS in children.

The obtained data characterize the presence of a dependence of BMI and SDS BMI on the components of MS, while the anthropometric indicators in children with complete and incomplete variants were statistically different from the indicators of children with AO +1 component and with the absence of MS components, while the WC/HC indicator clearly depended on the number of MS components, having the greatest results in children with the complete variant of MS.

Information about the source of support in the form of grants, equipment, and drugs. The authors did not receive financial support from manufacturers of medicines and medical equipment.

Conflicts of interest. The authors have no conflicts of interest.

REFERENCES

[1] WHO European Childhood Obesity Surveillance Initiative (COSI). WHO/EURO: 2022-6594-46360-67071.

[2] Vasyukova O.V. Obesity in Children and Adolescents: Diagnostic Criteria / O.V. Vasyukova // Obesity and Metabolism. – 2019. – Vol. 16, No. 1. - P. 70-73. Panda P.K. Metabolic Syndrome in Children: Definition, Risk Factors, Prevention, and Management - A Brief Overview. Pediatr Oncall J. 2019; 16: 67-72. doi: 10.7199/ped.oncall.2019.17.

[3] Bokova T.A. Risk Factors for the Development of Metabolic Syndrome in Obese Children. Russian Journal of Perinatology and Pediatrics, 2018, 63: (3); - P. 64-69.

[4] Kobylińska M, Antosik K, Decyk A, Kurowska K, Skiba D. Body Composition and Anthropometric Indicators in Children and Adolescents Aged 6-15 Years. Int J Environ Res Public Health. 2022 Sep 14; 19(18): 11591. doi: 10.3390/ijerph191811591. PMID: 36141862; PMCID: PMC9517036.

[5] Alves Junior CA, Mocellin MC, Gonçalves ECA, Silva DA, Trindade EB. Anthropometric Indicators as Body Fat Discriminators in Children and Adolescents: A Systematic Review and Meta-Analysis. Adv Nutr. 2017 Sep 15; 8(5): 718-727. doi: 10.3945/an.117.015446. PMID: 28916572; PMCID: PMC5593108.

[6] World Health Organization. WHO Child Growth Standards: Methods and Development. Geneva: WHO; 2017.

[7] Peterkova V.A., Bezlepkin O.B., Vasyukova O.V., et al. Obesity in Children. Clinical Guidelines. Moscow: Ministry of Health of the Russian Federation; 2021. 77 p.