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Anthropometric Nutritional Status and Arterial Blood Pressure in 7-10 Years Old Children

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The aim is to evaluate the associations of anthropometric nutritional status and abdominal obesity with arterial blood pressure (ABP) among 7-10 years old Bulgarian children. A total of 820 children (410 boys and 410 girls) aged 7-10 years were studied during the period 1993-2002. Body mass index (BMI) was calculated. Waist circumference (WC) and ABP were measured. Boys were heavier and had a higher mean BMI, WC and ABP than girls. The frequency of overweight boys and girls was 12.4% and 13.7%, respectively. Overall, 13.7% of the boys and 13.2% of the girls were abdominally obese (WC ≥ 90th percentile). The prevalence rates of prehypertension and hypertension were 4.5% and 0.45%, respectively in both genders. The correlations between BMI, WC and ABP in both sexes were positive and statistically significant. They were higher and highly significant in boys than in girls. BMI and WC values influenced the ABP values in schoolchildren.

Key words: body mass index, waist circumference, overweight, blood pressure, schoolchildren.

Introduction

Overweight and obesity are serious public health problem. The prevalence of obesity is rising rapidly during the last years and affects ever more children and adolescents. Childhood obesity is an important predictor of adult obesity [11, 21, 24]. More than 60% of children who are overweight before puberty will be overweight in early adulthood, which will probably reduce the age at which will occur variety of non-communicable diseases [9]. Furthermore, it is observed increased frequency of hypertension in childhood, especially of the essential, which manifests mainly in adolescence and more than 75% associated with overweight and obesity [27]. High blood pressure during childhood is a significant predictor of cardiovascular, metabolic and other diseases in adults [2, 7]. These findings are evidence of the importance of the discovery of high blood pressure during childhood, before the complications of this disease can lead to health problems later in life.

The aim of this report is to evaluate the associations of anthropometric nutritional status, and abdominal obesity with arterial blood pressure among 7-10 years old Bulgarian children.

Materials and Methods

During the period 1993-2002, totally 820 children from Sofia aged 7-10 years, of which 410 boys and 410 girls, distributed in four age groups were studied. The data of three directly measured anthropometric features - stature (St, cm), weight (W, kg) and waist circumference (WC, cm), and also arterial blood pressure (ABP, mmHg) were analyzed. The anthropometric measurements were carried out according to the Martin-Saller's classical method [14]. Blood pressure (BP) was measured with mechanical sphygmomanometer and stethoscope on the right arm, in sitting position.

On the basis of the data about stature and body weight, for each one of the studied individual the body mass index (BMI, kg/m^2) was calculated by the formula: Weight (kg)/Stature (m^2). The individuals were distributed into the categories underweight, normal weight, overweight and obese, according to the BMI cut-off points for 2-18 years old children, recommended by International Obesity Task Force (IOTF) and recently updated by Cole and Lobstein [4].

The distribution of children, according to the waist circumference values, into the categories under norm, norm and abdominal obesity was made in accordance with percentile cutoffs for European children (IDEFICS study 2007-2010) [19]:

WC $\leq P_{10}$ is taken as under norm;

WC between P_{10} and P_{90} is taken as norm;

WC $\geq P_{90}$ is taken as central obesity.

The evaluation of ABP as normal, high-normal BP (prehypertension) and hypertension was defined in accordance with the recommendations in the Fourth Report on the Diagnosis, Evaluation, and Treatment of High Blood Pressure in Children and Adolescents [20]. But for categorization of investigated children into four categories of ABP including hypotension was used percentile cutoffs for European children (IDEFICS study 2007-2010) [1]:

ABP $\leq P_3$ is taken as hypotension;

ABP between P_3 and P_{90} is taken as normal tension;

ABP between P_{90} and P_{97} is taken as high but normal ABP (prehypertension) and were considered to be an indication of heightened risk for developing hypertension;

ABP $\geq P_{97}$ is taken as hypertension.

The collected data were analysed by statistical software package SPSS 16.0. Mean and standard deviation for each of the anthropometric measurements and indexes were calculated. The frequency distribution of children from each gender and age into BMI, WC and ABP categories was made. Statistically signifficant differences between genders and age were evaluated by T-test of Student at P-level ≤ 0.05. Categorical variables were expressed as numbers (n) and percentages (%), and were compared by gender and age using the Chi-square test at P-level ≤ 0.05. The correlation analysis was used for the assessment of relationship between investigated morphological and functional features.

Results

The mean values of anthropometric (weight, height, BMI, and WC), and ABP (SBP and DBP) data for each gender and age are presented in **Table 1**. The values of anthropometric features and ABP increased with age in both genders. Boys were heavier and had a higher mean BMI, WC and ABP than girls. They had a significantly larger waist on 7 and 8 years of age and significantly higher SBP values on 8 years, compared to girls. Significant differences between separate age groups there were in the mean values of stature, body weight and waist circumference, systolic and diastolic blood pressure du-

ring the whole age period in both genders. There were no significance between values of waist circumference and systolic blood pressure in girls aged 7-8 and 9-10 years. The significant differences in the means of BMI were observed only between 8-9 years of age in both boys and girls.

Table 1. Data of the investigated features in 7-10 years old children

Age	Sex	N	Features											
			Stature		Body weight		Waist circumference		Body mass index		Systolic BP		Diastolic BP	
			mean	SD	mean	SD	mean	SD	mean	SD	mean	SD	mean	SD
7	♂	110	125.78	5.83	25.84	4.53	54.77*	4.60	16.24	1.95	91.56	10.25	53.20	8.97
	♀	110	125.85	5.23	25.55	4.48	53.33	4.86	16.06	2.04	91.36	8.80	53.04	8.69
8	♂	100	131.01#	5.93	28.22#	5.01	56.91*#	4.60	16.35	1.97	96.24*#	8.51	59.43#	7.86
	♀	101	130.52#	5.13	27.37#	4.51	55.05#	4.51	15.99	1.96	93.42	9.27	57.41#	7.72
9	♂	100	136.48#	5.94	32.39#	6.50	58.47#	5.59	17.27#	2.54	99.50#	7.50	65.74#	6.76
	♀	101	137.56#	6.47	32.88#	7.48	57.45#	6.00	17.23#	2.84	97.98#	7.51	64.93#	6.71
10	♂	100	142.05#	7.14	36.28#	8.68	60.97#	6.89	17.79	2.92	103.58#	9.17	68.79#	7.91
	♀	98	142.30#	6.44	35.81#	7.44	59.16	6.40	17.57	2.86	103.52#	9.03	68.56#	7.08

* Statistically significant gender differences at $P \leq 0.05$

Statistically significant interage differences at $P \leq 0.05$

Table 2 presents the percentage distribution of the investigated children from the various age groups, according to the categories of BMI and WC. Among the studied 7-10 years old children 75.9% of boys and 70.7% of girls have normal weight. Underweight was observed in 8.5% of boys and 13.4% of girls. The frequency of overweight boys and girls (without obesity) was 12.4% and 13.7% respectively. The frequency of children with obesity was 3.2% for boys and 2.2% for girls, as it reached 3.6% in girls of 7 years of age, and 5.0% in boys aged 10 years. Differences between genders and age groups were insignificant.

The prevalence of WC in the 10th – 90th percentile was, respectively, 70.5% and 63.9% of the entire group of the studied individuals. Overall, 13.7% of the boys and 13.2% of the girls were abdominally obese (WC $\geq$ 90th percentile). A higher percentage of abdominal obesity was found in children of 10 years of age from both genders. There were no significant sexual and interage differences in the percentage distribution of children into categories.

Table 2. Percentage distribution of children, according to the body mass index and waist circumference categories

Age/Sex/n	BMI				WC		
	1	2	3	4	1	2	3
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
7 y ♂ (110)	7 (6.4)	86 (78.2)	14 (12.7)	3 (2.7)	24 (21.8)	76 (69.1)	10 (9.1)
♀ (110)	10 (9.1)	83 (75.5)	13 (11.8)	4 (3.6)	23 (20.1)	73 (66.4)	14 (12.7)
8 y ♂ (100)	8 (8.0)	80 (80.0)	10 (10.0)	2 (2.0)	12 (12.0)	77 (77.0)	11 (11.0)
♀ (101)	14 (13.9)	75 (74.3)	12 (11.9)	0	20 (19.8)	71 (70.3)	10 (9.9)
9 y ♂ (100)	8 (8.0)	75 (75.0)	14 (14.0)	3 (3.0)	15 (15.0)	71 (71.0)	14 (14.0)
♀ (101)	16 (15.8)	66 (65.3)	16 (15.8)	3 (3.0)	26 (25.7)	62 (61.4)	13 (12.9)
10 y ♂(100)	12 (12.0)	70 (70.0)	13 (13.0)	5 (5.0)	14 (14.0)	65 (65.0)	21 (21.0)
♀ (98)	15 (15.3)	66 (67.3)	15 (15.3)	2 (2.0)	25 (25.5)	56 (57.1)	17 (17.3)
Total ♂(410)	35 (8.5)	311 (75.9)	51 (12.4)	13 (3.2)	65 (15.9)	289 (70.5)	56 (13.7)
♀ (410)	55 (13.4)	290 (70.7)	56 (13.7)	9 (2.2)	94 (22.9)	262 (63.9)	54 (13.2)

BMI – body mass index; 1 – Thinness; 2 – Norm; 3 – Overweight; 4 – Obesity;
WC – waist circumference; 1 – WC ≤ P_{10}; 2 – WC between P_{10} – P_{90}; 3 – WC ≥ P_{90}

Table 3. Percentage distribution of children, according to the arterial blood pressure categories

Age/Sex/n	Systolic blood pressure				Diastolic blood pressure			
	1	2	3	4	1	2	3	4
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
7 y ♂ (110)	29(26.4)	77 (70.0)	3 (2.7)	1 (0.9)	58 (52.7)	48 (43.6)	4(3.6)	0
♀ (110)	31 (28.2)	77 (70.0)	2(1.8)	0	57 (51.8)	49 (44.5)	4 (3.6)	0
8 y ♂ (100)	9 (9.0)*#	85 (85.0)	5 (5.0)	1(1.0)	16 (16.0)#	76 (76.0)#	7 (7.0)	1 (1.0)
♀ (101)	28 (27.7)	69 (68.3)	4 (4.0)	0	26 (25.7)#	71 (70.3)	4 (4.0)	0
9 y ♂ (100)	3 (3.0)	94 (94.0)	3 (3.0)	0	0 #	81 (81.0)	19 (19.0)	0
♀ (101)	4 (4.0) #	96 (95.0)	1 (1.0)	0	4 (4.0) #	86 (85.1)	11 (10.9)	0
10 y ♂(100)	2 (2.0)	88 (88.0)	9 (9.0)	1 (1.0)	0	65 (65.0)	33 (33.0)	2 (2.0)
♀ (98)	0	87 (88.8)	10 (10.2)	1 (1.0)	0	73 (74.5)	22 (22.4)	3 (3.1)
Total ♂(410)	43 (10.5)	344 (83.9)	20 (4.9)	3 (0.7)	74 (18.0)	270 (65.9)	63 (15.4)	3 (0.7)
♀ (410)	63 (15.4)	329 (80.2)	17 (4.1)	1 (0.2)	87 (21.2)	279 (68.0)	41 (10.0)	3 (0.7)

1 – Hypotension; 2 – Normal ABP; 3 – High but normal ABP (prehypertension); 4 – Hypertension
* Statistically significant gender differences at P ≤ 0.05
# Statistically significant interage differences at P ≤ 0.05

Table 3 shows the percentage distribution of children according to the categories of systolic and diastolic blood pressure. Overall, the prevalence rates of prehypertension and hypertension, according to SBP were low - 4.5% (4.9% for boys and 4.1% for

girls), and 0.45% (0.7% for boys and 0.2% for girls), respectively. Boys were more often normotensive than girls (83.9% and 80.2%, respectively). The younger participants (aged 7-8 years) were more likely to have hypotension than the older children (aged 9-10 years). The children aged 10 years were more likely to have prehypertension and hypertension than these aged 7-9 years (9.0% till 10.0% versus 1.0% till 5.0%). There were statistically significant differences in the percentage distribution of the studied boys and girls only in 8-year-old hypotonic children. Significant interage differences in the percentage distribution of children according to SBP categories were established between 7 and 8 years in boys and between 8 and 9 years in girls of the hypotensive group. Significant differences in percentage distribution of children according to DBP categories were found between 7 and 8, 8 and 9 years for both genders in the hypotension category and between 7- 8-year-old normotensive boys.

The correlation coefficients between systolic and diastolic blood pressure and investigated anthropometric features and BMI were presented in **Table 4**. The correlations in both genders were positive and statistically significant ($p < 0.05$; $p < 0.001$), except for the relationship between diastolic blood pressure and stature in girls of 7 and 8 years of age ($p > 0.05$). The correlation coefficients between ABP and anthropometric measures were higher and highly significant in boys ($r = 0.194 \div 0.812$) than in girls ($r = 0.139 \div 0.800$).

Table 4. Correlation coefficients between arterial blood pressure, body mass index and anthropometrical features

Sex	Age (n)	Correlation coefficients								
		SBP/ DBP	**SBP/ Stature**	**SBP/ Weight**	**SBP/ BMI**	**SBP/ WC**	**DBP/ Stature**	**DBP/ Weight**	**DBP/ BMI**	**DBP/ WC**
Boys	7 y (110)	0.752**	0.302**	0.489**	0.468**	0.453**	0.194*	0.356**	0.367**	0.352**
	8 y (100)	0.812**	0.339**	0.579**	0.572**	0.578**	0.258**	0.549**	0.588**	0.540**
	9 y (100)	0.747**	0.433**	0.557**	0.497**	0.496**	0.312**	0.391**	0.344**	0.370**
	10 y (100)	0.801**	0.504**	0.617**	0.560**	0.586**	0.417**	0.566**	0.550**	0.529**
Girls	7 y (110)	0.752**	0.263**	0.302**	0.226*	0.235*	0.139	0.238*	0.219*	0.257**
	8 y (101)	0.800**	0.306**	0.431**	0.386**	0.391**	0.179	0.276**	0.265**	0.307**
	9 y (101)	0.607**	0.459**	0.458**	0.356**	0.453**	0.343**	0.451**	0.393**	0.383**
	10 y (98)	0.751**	0.473**	0.471**	0.350**	0.374**	0.409**	0.534**	0.465**	0.494**

SBP – Systolic blood pressure; DBP – Diastolic blood pressure; BMI – body mass index; WC – waist circumference;
** Correlation is significant at the 0.01 level (2-tailed); * Correlation is significant at the 0.05 level (2-tailed).

Table 5 presents average values of WC and ABP, according to the BMI categories.

Table 5. Data of BMI, waist circumference and arterial blood pressure, according to BMI categories

Age	BMI categories	N	Boys								N	Girls							
			BMI		WC		SBP		DBP			BMI		WC		SBP		DBP	
			mean	SD	mean	SD	mean	SD	mean	SD		mean	SD	mean	SD	mean	SD	mean	SD
7	1	7	13.63	0.42	50.47	2.12	83.14	8.07	48.57	5.13	10	13.30	0.53	49.83	3.24	87.70	8.27	48.10	5.63
	2	86	15.78	0.98	53.87	3.04	90.92	9.17	52.92	9.17	83	15.66	1.11	52.39	3.60	91.47	9.19	53.28	8.75
	3	14	18.93	0.92	59.24	3.69	96.21	11.64	54.64	7.84	13	18.83	0.62	57.82	3.51	92.54	4.61	54.23	10.06
	4	3	23.04	2.54	69.83	8.74	108.00	16.00	65.33	5.03	4	22.27	0.46	67.10	4.35	94.50	12.15	56.50	7.00
8	1	8	13.82	0.41	52.88	2.45	95.00	5.35	56.88	3.72	14	13.45	0.56	50.27	2.58	89.29	11.58	53.79	8.22
	2	80	16.02	1.18	56.23	3.46	94.33	6.71	57.98	6.75	75	15.84	1.14	54.79	3.38	93.20	8.25	57.60	7.23
	3	10	19.61	0.80	62.81	4.91	109.30	9.21	70.00	7.82	12	19.93	0.78	62.20	3.79	99.58	10.10	60.42	9.16
	4	2	23.43	1.12	70.60	2.26	112.50	10.61	75.00	7.07	0								
9	1	8	13.66	0.62	53.39	2.25	93.75	6.41	62.63	6.93	16	13.75	0.72	51.69	1.54	93.44	3.01	60.63	5.12
	2	75	16.67	1.34	57.09	3.52	99.00	7.07	65.17	6.42	66	16.77	1.29	56.52	4.10	98.53	7.88	65.65	6.65
	3	14	20.94	1.09	65.78	4.73	103.21	6.68	70.00	7.07	16	20.98	1.11	63.49	3.56	98.63	7.63	63.75	4.65
	4	3	24.65	1.28	72.43	9.06	110.00	10.0	68.33	7.64	3	26.01	1.82	76.33	4.51	106.67	2.89	78.33	2.89
10	1	12	14.45	0.31	54.46	2.64	100.08	7.99	67.42	7.43	15	14.13	0.67	52.15	2.18	100.67	7.99	63.67	4.42
	2	70	17.15	1.54	59.25	3.66	101.74	7.92	66.89	6.93	66	17.07	1.43	58.10	4.06	103.18	9.23	68.27	6.83
	3	13	21.14	0.86	68.70	2.89	109.62	7.49	75.23	6.51	15	22.23	1.37	69.46	3.79	106.33	8.12	73.87	6.76
	4	5	26.19	1.34	80.54	7.01	122.00	4.47	82.00	4.47	2	24.97	0.21	69.50	4.95	115.00	7.07	75.00	7.07

BMI – body mass index; WC – waist circumference; SBP – Systolic blood pressure; DBP – Diastolic blood pressure;
1 – Underweight; 2 – Normal weight; 3 – Overweight; 4 – Obesity

The results show that the boys and girls who were overweight and obese have higher mean values of the BMI, WC, systolic and diastolic blood pressure compared to their peers with normal weight and underweight during the whole age period. The differences for the average SBP and DBP between children with underweight and obesity were about 15.0-20.0 mmHg.

The results about mean values of the features in accordance with age and nutritional status assessed on the basis of the WC (**Table 6**) show that the children with abdominal obesity (WC ≥ 90th percentile) from four age groups have higher values of BMI, WC and ABP compared to their peers without abdominal obesity. The differences for the ABP values were established between 5.0 and 15.0 mmHg.

Discussion

This study presents the percentage distribution of children according to the categories of BMI, WC and ABP and relationship between anthropometric nutritional status (assessed on the basis of the BMI and WC) and ABP among 7-10 years old schoolchildren.

The body mass index is a measure commonly used to assess the nutritional status. Among the investigated 7-10 years old children frequency of boys with overweight was 12.4% and 13.7% in girls. The prevalence of obesity was 3.2% for boys and 2.2% for girls. A higher percentage of children with overweight and obesity was found in the group of the 9-10-year-olds. The similar frequency of overweight and obesity was established in 9-15 year-old Bulgarian children and adolescents [15]. Lower percent of Turkish children with overweight (7.7%) and similar percent of obese children (3.1%) was revealed by Gundoglu [10]. Other researchers reported for higher percentage of schoolchildren distributed in these categories of nutritional status [16, 26]. The study conducted in Lithuania showed lower prevalence of overweight and obesity among 12- to 15-year-old adolescents, except of overweight boys (14.3% for boys and 10.2% for girls and 2.7% for boys and 2.2% for girls, respectively) [5].

Another specific measurement for assessment of the nutritional status, especially of abdominal obesity, is the waist circumference. In boys of 7 years of age it was 54.8 cm, and in girls – 53.3 cm. The values of the trait increased with age in both genders and reached respectively 61.0 cm and 59.0 cm in 10-year-olds. In other studies carried out in Bulgaria and Greece higher values of WC in children and adolescents above 6 years were established [8, 23, 26]. The overall relative share of schoolchildren with abdominal obesity from our survey was 13.45% (13.7% for boys and 13.2% for girls). The frequency of abdominally obese Greek children was lower in boys (12.5%) and higher in girls (14.2%) compared to Bulgarians [23]. Over 50% of boys and girls with waist circumference > P90 were with overweight and obesity. A high percentage of overweight and obesity in children with waist circumference above the norm was found by Konstantinova [26].

The overweight, general and central obesity are risk factors of metabolic and cardiovascular diseases, including hyprtension, both in adults and children. The average ABP values among the studied 7 years old children was 91.5/53.1 mm Hg, and among the 10-year-olds was 103.5/68.7 mm Hg. Over 70.0% from boys and girls of 7-10 years old had normotensive ABP, and with prehypertension and hypertension were about 5.0% of children. The frequency of boys and girls with hypotension decreased with age, and prevalence of these with prehypertension and hypertension increased. Other studies of children and adolescents show similar results [10, 15, 17].

Table 6. Data of waist circumference, BMI and arterial blood pressure, according to waist circumference categories

Age	WC categories	N	Boys								N	Girls							
			WC		BMI		SBP		DBP			WC		BMI		SBP		DBP	
			mean	SD	mean	SD	mean	SD	mean	SD		mean	SD	mean	SD	mean	SD	mean	SD
7	1	24	49.72	1.26	14.87	0.72	87.37	8.71	50.25	7.52	23	47.80	1.66	14.46	0.75	89.78	10.33	50.52	7.87
	2	76	55.09	2.23	16.14	1.34	91.55	9.45	53.28	9.05	73	53.24	2.18	15.96	1.59	90.85	8.02	52.68	8.50
	3	10	64.52	5.99	20.33	2.43	102.70	13.23	59.70	8.84	14	62.87	3.90	19.20	2.18	96.64	8.76	59.00	8.88
8	1	12	50.80	1.24	14.67	0.75	90.58	3.99	56.25	3.77	20	49.65	1.52	14.25	0.83	90.50	11.91	56.30	9.07
	2	77	56.51	2.71	16.11	1.43	95.66	7.68	58.69	7.66	71	55.27	2.74	16.01	1.63	92.96	7.77	56.86	6.95
	3	11	66.35	2.91	19.88	2.15	106.45	9.76	68.09	7.22	10	64.25	1.77	19.32	1.24	102.50	8.58	63.50	8.18
9	1	15	52.03	0.95	14.60	1.02	94.33	4.57	61.0	4.71	26	51.66	1.08	14.62	1.18	93.65	5.40	61.08	5.91
	2	71	57.70	2.67	16.95	1.57	99.51	7.18	66.18	6.69	62	57.45	3.32	17.35	1.88	98.56	7.31	65.48	6.25
	3	14	69.24	4.71	21.75	2.05	105.00	8.09	68.57	6.91	13	68.98	5.00	21.89	2.79	103.85	7.68	70.00	6.45
10	1	14	53.14	1.14	15.12	1.00	98.43	9.15	64.57	8.08	25	52.04	1.84	14.88	1.21	97.80	5.96	63.20	4.97
	2	65	59.28	2.83	17.01	1.66	101.88	7.59	67.34	6.63	56	59.07	3.03	17.32	1.51	104.64	9.33	69.12	6.48
	3	21	71.40	6.52	22.02	2.63	112.29	8.38	76.10	7.19	17	69.93	3.10	22.35	1.95	108.23	7.89	74.59	6.15

WC – waist circumference; BMI – body mass index; SBP – Systolic blood pressure; DBP – Diastolic blood pressure;
1 – WC < P10; 2 – WC P10 – P90; 3 – WC ≥ P90 (abdominal obesity)

With increasing of BMI and WC the ABP and anthropometric features reached higher mean values. The values of systolic and diastolic blood pressure in children with overweight and obesity were higher compared to these of children with normal weight and underweight. Similar results were observed when comparing the ABP values of schoolchildren with different average waist circumference. In children with waist circumference over P90 (abdominal obesity) was observed higher mean values of SBP and DBP. Increased frequency of ABP in children with overweight and obesity showed a number of studies. According to Bogalusa Heart Study the children with overweight had 2.4-4.5 times higher risk of developing of arterial hypertension [6]. Sorof and Daniels examined the relationship between hypertension and BMI and found that in 94.0% of children with obesity was observed elevated systolic blood pressure [22]. The results obtained from Kolarova-Janeva also suggest that the presence of abdominal obesity and metabolic syndrome is associated with a higher risk of cardiovascular diseases in children [25].

In our report, as well as in the other studies, the variables weight, BMI and WC were positively and significantly associated with ABP values. The correlations between ABP and anthropometric measures were stronger and highly significant in boys than in girls [3, 12, 13, 17, 18].

This fact reinforces the importance of measuring these indicators to detect hypertension and future cardiovascular risks.

Conclusions

The children with overweight and obesity in both genders have higher values of systolic and diastolic blood pressure.

In boys a systolic blood pressure correlated positively with BMI and waist circumference, as in 8- and 10-year old children strength of the correlation is the highest.

In girls, the relationship between BMI, waist circumference and systolic and diastolic blood pressure was positive, but slighter.

The values of BMI and waist circumference affect blood pressure values in children of school age.

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