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The Prevalence of High-Normal Blood Pressure and Hypertension among 8 to 15-Year-Old Bulgarian Children and Adolescents with Various Nutritional Status (Smolyan Region, 2012-2014)

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ABSTRACT The aim of this paper is to investigate the prevalence of high-normal blood pressure and hypertension among 8 to 15-year-old Bulgarian children and adolescents with various nutritional status in the region of Smolyan, Bulgaria. The sample population of the study was 873 children between the ages of 8 to 15 years, examined by a cross-sectional study in the period 2012-2014. For each child was measured weight, height, waist circumference, blood pressure as well as body mass index and waist to height ratio. The results show that the high-normal blood pressure is found in average 20.3 percent of children and adolescents, while hypertension is found in 3.4 percent. The percentage of children with high-normal blood pressure and central obesity is 35.4 percent, and with hypertension and central obesity is 7.1 percent. Positive significant correlations between BMI, WHtR and blood pressure are observed in both sexes. The prevalence of children with high-normal blood pressure and hypertension and with central obesity increases.

INTRODUCTION

It is known that overweight, overall and abdominal obesity, as well as blood pressure in childhood are significant predictors of blood pressure (BP) in adulthood (Bao et al. 1995; Chen and Wang 2008; Owen et al. 2009; Petkeviciene et al. 2015; Hvidt 2015). Being overweight and obese in childhood are as well related to a lot of cardiovascular diseases in adulthood, such as ischemic heart disease, heart attack, arterial hypertension and resulting diseases and increasingly to rising morbidity and mortality caused by these diseases (Freedman et al. 2001; Ezzati et al. 2002; Lloyd et al. 2010; Reilly and Kelly 2011; Park et al. 2013; Ayer et al. 2015). According to data from the World Health Organization, sixty-four percent of mortality as a percentage of total deaths in Bulgaria in 2012-2013 is caused by cardiovascular diseases (World Health Organization 2014). Because of these 'dark' statistics, Bulgaria comes to one of the top places in the world. The report of the WHO highlights high blood pressure, overweight and obesity as major metabolic risk factors and everyday smoking and lack of exercise as major behavioral risk factors. The report further reads that men in Bulgaria tend to be more vulnerable and suffer higher morbidity and mortality compared to women (World Health Organization 2014). The rising percentage in recent years of overweight and obese people in Bulgaria who also suffer prehypertension and hypertension, including children, as well as the high morbidity and mortality of adults because of cardiovascular diseases undoubtedly raises very serious concerns. This makes early diagnostics and prevention of these abnormalities especially important in early childhood.

The great social significance of this problem has helped define the objective of this paper: a study of the prevalence of high-normal blood pressure (prehypertension) and hypertension among 8 to 15-year-old children and adolescents

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with various nutritional status in the region of Smolyan, Bulgaria.

METHODOLOGY

Sample

The present study includes 873 children and adolescents aged from 8 to 15 years (439 girls and 434 boys) from the region of Smolyan, Bulgaria, who were transversally examined in the period between 2012 and 2014.

Ethics

The study was conducted with the official approval of the Regional Inspectorate of Education, Bulgaria's Ministry of Education and Science and of Ethical Committee on Plovdiv University-Branch Smolyan. Also, the written informed consents of the parents or guardians of each child included in the research group were obtained, in accordance with the ethical principles for medical research involving human subjects in the Helsinki Declaration of World Medical Association (World Medical Association Declaration of Helsinki 2000).

Study Design

Children and adolescents were grouped into two age groups in accordance with their sex and age, with the 1st group including children from 8 to 11 years and the 2nd group comprising adolescents from 12 years to 15 years. The following anthropometric and functional indicators of each child were examined: weight (W, kg), height (H, cm), waist circumference (WC, cm), systolic blood pressure (SBP, mm Hg) and diastolic blood pressure (DBP, mm Hg). Furthermore, the body mass index (BMI) and the waist to height ratio (WHtR) were calculated.

Methods

The anthropometric data for height, weight and waist circumference were measured using the Martin-Saller method (1957), by means of original anthropometric instruments (GPM Anthropologishe Instrument). The body mass index (BMI) was calculated by the formula: Weight (kg)/Height (m^2), and the ratio waist-to -height ratio (WHtR) by the formula: Waist circumference (cm)/Height (cm).

The distribution of the examined children into categories of nutritional status assessed through the body mass index (BMI) was made using the recommendations of the International Obesity Task Force (IOTF) for BMI cut-off points of children and adolescents (Cole et al. 2000; Cole et al. 2007). The distribution of children in accordance with their nutritional status assessed on the basis of the waist circumference/height ratio (WHtR) was made based on a WHtR discriminatory value of 0.500 (McCarthy and Ashwell 2006).

Systolic and diastolic blood pressure were measured using the auscultation method of Korotkoff, phases I and V using a "SENDO" (Japan) mechanical sphygmomanometer and stethoscope. The blood pressure was measured on the left arm, with age-appropriate arm cuff, after a 10-minute rest of the child in a sitting position. In case of deviation from normal blood pressure, three consecutive measurements were made within 5 minutes, taking into account the mean value.

The evaluation of normotension, high-normal blood pressure and hypertension in children 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 of the National High Blood Pressure Education Program (National High Blood Pressure Education Program Working Group on High Blood Pressure in Children and Adolescents 2004) and Management of high blood pressure in children and adolescents: recommendations of the European Society of Hypertension (Lurbe et al. 2009). In accordance with these recommendations, children with normotension have BP below 90th percentile (P) of the standard distribution for the respective age, sex and height. Furthermore, the high-normal blood pressure (prehypertension) is defined with SBP and/or DBP values between the 90th and the 95th percentile (P) plus 5 mm Hg, or by values higher than 120/80 mmHg, but under the 95th P, while the hypertension is diagnosed with SBP and/or DBP higher or equal to the 95th P plus 5 mmHg for the respective age, sex and height. In case of variance with the blood pressure categories, which the examined subject falls into according to their SBP or DBP higher value was considered.

Statistics

The mathematical and statistical processing of the data was done using software package STATISTICA 10.0 by means of a variation and

correlation analysis. The intergroup differences were assessed by using Tukey's multiple comparison test (HSD test) and the Chi-square test.

RESULTS

Table 1 presents the results of the percentage distribution of the examined children and adolescents from the various age groups according to the categories of systolic and diastolic blood pressure. A total of 76.29 percent of the examined children have normotension (75.12% of the boys and 77.45% of the girls). A total of 20.27 percent of the examined children have high-normal blood pressure (21.20% of the boys and 19.36% of the girls), and a total of 3.44 percent have hypertension (3.69% of the boys and 3.19% of the girls). No considerable and statistically significant differences in the percentage distribution of the examined boys and girls from the various blood pressure categories are observed with increased age (p>0.05).

Regarding the boys, the relative share of the examined children with normotension decreases insignificantly with respect to age (from 76.37% in 8-11-year-olds to 73.60 % in 12-15-year-olds), but the relative percentage of those with high-normal blood pressure rises slightly (from 19.83% for 8-11-year-olds to 22.87% for 12-15-year-olds), while the hypertension decreases. However, the differences between the age groups are statistically insignificant (p>0.05).

The group of the girls shows a different trend. The relative percentage of the girls with normal blood pressure rises (from 74.40% in 8-11-year-olds to 81.48 % in 12-15-year-olds) but the percentages of those with high-normal blood pressure and hypertension drop (from 22% to 15.87% and from 3.60% to 2.64%, respectively). However, the differences among the girls from the various age groups are statistically insignificant (p>0.05).

Table 2 presents the results of the correlations analysis that examines the correlation between the systolic and diastolic blood pressure and anthropometric indicators body mass index (BMI) and waist circumference/height ratio (WHtR). The correlation in both sexes between the BMI, the systolic blood pressure (SBP) and

Table 2: Pearson correlations between systolic and diastolic blood pressure and anthropometric variables according to age and sex

Anthropometric variables		*SBP r*	*p-value*	*DBP r*	*p-value*
Boys	BMI	0.481	0.00*	0.344	0.000**
	WHtR	0.263	0.00*	0.242	0.000**
Girls	BMI	0.314	0.000**	0.173	0.000**
	WHtR	0.118	0.013*	0.071	0.135

SBP- systolic blood pressure. DSP-diastolic blood pressure. BMI –Body mass index. WHtR –waist/height ratio. r- Pearson correlation coefficient. p-value- level of significance of correlation coefficient; *p <0.05; **-p<0.001- significant difference; p>0.05 –non significant differences.

Table 1: Prevalence (%) of blood pressure categories among Bulgarian children based on 90th and 95th percentiles of systolic and diastolic blood pressure for age, sex and height

Blood pressure categories	*8-15 years N (%)*	*8-11 years N (%)*	*12-15 years N (%)*	*Pearson Chi-square*	*p-value*
Boys					
Normotension	326 (75.12)	181 (76.37)	145 (73.60)	0.587	0. 74
High - normal blood pressure	92 (21.20)	47 (19.83)	45 (22.87)		
Hypertension	16 (3.69)	9 (3.79)	7 (3.55)		
Overall	434 (100.0)	237 (100.0)	197 (100.0)		
Girls					
Normotension	340 (77.45)	186 (74.40)	154 (81.48)	3.09	0.21
High-normal blood pressure	85 (19.36)	55 (22.00)	30 (15.87)		
Hypertension	14 (3.19)	9 (3.60)	5 (2.64)		
Overall	439 (100.0)	250 (56.95)	189 (43.05)		
All					
Normotension	666 (76.29)	367 (75.35)	299 (77.46)	0.584	0.74
High- normal blood pressure	177 (20.27)	102 (20.94)	75 (19.54)		
Hypertension	30 (3.44)	18 (3.69)	12 (3.10)		
Total	873 (100.0)	487 (100.0)	386 (100.0)		

Pearson Chi-square –value of Chi-square. p-value -level of significance. p<0.05 , **p<0.001- significance differences

the diastolic blood pressure (DBP) is positive and statistically significant ($p<0.05$; $p<0.001$). This is the case, too, with the correlation between the WHtR and the SBP for both sexes ($p<0.05$; $p<0.001$), as well as between WHtR and DBP with the boys ($p<0.001$). Furthermore, there seems to be a stronger correlation between blood pressure (BP) and BMI in comparison with WHtR, which is characteristic for both sexes. The correlation coefficients regarding all studied indicators are higher among the boys than among the girls.

Table 3 presents the mean values of blood pressure in accordance with age and nutritional status assessed on the basis of the BMI and WHtR. The results show that the boys from both age groups (8-11 years and 12-15 years) who are overweight and obese assessed on the basis of the BMI have significantly higher mean values of the systolic and diastolic blood pressure compared to their peers with normal and subnormal weight ($p<0.001$). Hence, 8 to 11-year-old boys with obesity have higher systolic blood pressure by on average 9.3 mmHg and higher diastolic pressure by 6.04 mmHg compared to their peers with normal weight. In the group of the 12-15-year-old boys, the blood pressure values differ by 11.59 mmHg with respect to the systolic pressure and by 8.34 mm Hg with respect to the diastolic pressure ($p< 0.001$). The results from the group of the girls are similar, however, statistically significant differences are observed only with the SBP of 12-15-year old girls with overall obesity that is on average higher by 12.06 mmHg than the SBP of girls with normal weight ($p<0.05$).

The results about mean values of blood pressure in accordance with age and nutritional status assessed on the basis of the WHtR (Table 3) show that the boys with central obesity (WHtR ≥ 0.500) from both age groups (8-11 years and 12-15 years) have significantly higher systolic and diastolic blood pressure compared to their

Table 3: Mean values (mmHg) of systolic and diastolic blood pressure according to age and nutritional status, based on body mass index (BMI) and waist to height ratio (WHtR)

	8-11 years			*12-15 years*		
	N	*SBP Mean (SD)*	*DBP Mean (SD)*	*N*	*SBP SBP (SD)*	*DBP Mean (SD)*
BMI Categories						
Boys	*237*			*197*		
Underweight	18	99.50 (8.78)	64.11 (8.31)	17	106.41 (10.41)	69.04 (9.00)
Normal weight	155	101.73 (9.39)	68.69 (8.36)	129	108.05 (11.90)	70.58 (11.50)
Overweight	45	105.75 (10.50)	72.04 (9.03)	37	116.35 (9.51)	74.86 (10.74)
Obesity	19	111.00 (11.40)	74.73 (9.29)	14	119.64 (13.42)	78.92 (14.29)
ANOVA (F, p)		F=7.12 p < 0.001*	F=6.53 p < 0.001*		F=8.80 p < 0.001*	F=6.42 p < 0.001*
Girls	*231*			*144*		
Underweight	20	102.36 (11.09)	68.78 (8.48)	21	106.60 (9.20)	70.52 (8.22)
Normal weight	158	102.50 (10.69)	69.95 (9.92)	98	110.44 (10.22)	71.72 (7.99)
Overweight	42	105.35 (9.46)	70.85 (7.93)	23	115.39 (9.56)	75.91 (7.60)
Obesity	11	110.540 (10.89)	73.00 (8.61)	2	122.50 (10.60)	76.50 (7.07)
ANOVA (F, p)		F=2.60 p > 0.05	F=0.94 p > 0.05		F=2.80 p < 0.05*	F=1.40 p > 0.05
WHtR Categories						
Boys	*237*			*197*		
WHtR < 0.500	197	101.80 (9.45)	68.51 (8.52)	166	108.90 (11.84)	70.16 (9.77)
WHtR ≥ 0.500	40	109.25 (11.05)	74.15 (9.12)	31	117.67 (11.31)	75.32 (12.64)
ANOVA (F, p)		F=19.38 p < 0.001*	F=14.12 p < 0.001*		F=14.52 p < 0.001*	F=6.60 p < 0.05*
Girls	*249*			*189*		
WHtR < 0.500 (I gr)	220	102.63 (10.83)	68.62 (8.73)	177	108.72 (10.93)	70.11 (10.57)
WHtR ≥ 0.500 (II gr)	29	108.62 (10.13)	71.62 (9.05)	12	113.16 (10.54)	69.33 (7.31)
ANOVA (F, p)		F=7.94 p < 0.05*	F=2.99 p = 0.08		F=1.86 p = 0.17	F=0.06 p = 0.80

SBP- systolic blood pressure. DSP-diastolic blood pressure. BMI –Body mass index. WHtR- waist to height ratio. ANOVA- analysis of variance; Mean –average values. SD-standard deviation. F- coefficient of Fisher; p- level of significance; WHtR < 0.500 –without central obesity. WHtR e" 0.500-with central obesity. p <0.05*; p<0.001 *-significant difference; p>0.05 –non significant differences.

peers without central obesity (WHtR < 0.500). The results also show that the 8-11-year-old boys with central obesity have systolic blood pressure higher by 7.45 mmHg and diastolic pressure higher by 5.64 mmHg than boys with normal weight ($p<0.001$). In the group of the 12-15-year-old boys, the blood pressure values differ by 8.77 mmHg with respect to the systolic pressure ($p<0.001$) and by 5.36 mmHg with respect to the diastolic pressure ($p<0.05$). The girls show similar results, however, statistically significant differences can be seen only among the 8-11-year-old girls with central obesity, whose systolic blood pressure is higher by, on average, 6 mmHg than that of their peers without the problem of central obesity ($p<0.05$).

Table 4 presents the percentage distribution of the examined children with different blood pressure according to their nutritional status assessed on the basis of BMI.

The results show that the overall percentage of the examined children with normotension drops from 80.58 percent in the group of normal weight to 47.91 percent among the obese children. The percentage of the high-normal blood pressure rises from a total of 16.86 percent among children with normal weight to 41.68 percent among obese children. The overall mean percentage of hypertension among the examined children rises, on average, from 2.47 percent among children with subnormal weight, to 10.41 percent among obese children. With respect to the boys, the prevalence of hypertension rises from zero percent in boys who are underweight to 15.15 percent in obese boys. The opposite trend is observed among the girls, the relative percentage of the girls with hypertension drops from 4.3 give percent in the group who is underweight to zero percent in the obese group. There are statistically significant differences in the percentage distribution of the examined girls from the various categories of blood pressure in accordance with their BMI status ($p=0.000$; $p=0.003$).

Table 5 presents the percentage distribution of the examined children from the various categories of blood pressure in accordance with the waist to height ratio (WHtR) that may suggest the presence of central (abdominal) obesity. The results show that, on average, 79.07 percent of the examined children without central obesity (WHtR < 0.500) of both sexes have normal blood pressure. A total of 18.02 percent have high-normal blood pressure, and 2.91 percent have hypertension among the examined girls without central obesity. A total of 57.53 percent from the examined children with central obesity (WHtR $\geq$ 0.500) have normal blood pressure, while those with high-normal blood pressure and hypertension are, respectively, 35.39 percent and 7.08 percent. There are statistically significant differences in the percentage distribution of the examined girls from the various categories of blood pres-

Table 4: Prevalence (n, %) of children with different blood pressure categories according to their nutritional status, evaluated by categories of body mass index (BMI)

Blood pressure categories	*Underweight N (%)*	*Normal weight N (%)*	*Overweight N (%)*	*Obese N (%)*	*Pearson Chi-square*	*p-value*
Boys						
Normotension	28 (80.00)	229 (80.63)	52 (63.41)	17 (51.52)	30.61	0. 000**
High- normal blood pressure	7 (20.00)	50 (17.61)	24 (29.27)	11 (33.33)		
Hypertension	0 (0.00)	5 (1.76)	6 (7.32)	5 (15.15)		
	35 (100)	284 (100)	82 (100)	33 (100)		
Girls						
Normotension	35 (76.07)	224 (79.15)	55 (73.33)	6 (40.0)	15.69	0.003*
High- normal blood pressure	9 (19.56)	49 (17.31)	18 (24.00)	9 (60.0)		
Hypertension	2 (4.37)	10 (3.54)	2 (2.67)	0 (0.00)		
	46 (100)	283 (100)	75 (100)	15 (100)		
All						
Normotension	63 (77.78)	473 (80.58)	107 (68.15)	23 (47.91)	34.93	0.000**
High -normal blood pressure	16 (19.75)	99 (16.86)	42 (26.76)	20 (41.68)		
Hypertension	2 (2.47)	15 (2.56)	8 (5.09)	5 (10.41)		
Total	81 (100)	587 (100)	157 (100)	48 (100)		

Pearson Chi-square –value of Chi-square. p-value -level of significance. $p<0.05$, **$p<0.001$- significance differences

Table 5: Prevalence (n, %) of children with different blood pressure categories according to their nutritional status, evaluated by categories of waist to height ratio (WHtR)

Blood pressure categories	*WHtR < 0.500 n (%)*	*WHtR ≥ 0.500 n (%)*	*Pearson Chi-square*	*p-value*
Boys				
Normotension	287 (79.06)	39 (54.93)		
High- normal blood pressure	67 (18.46)	25 (35.21)	21.24	0.000**
Hypertension	9 (2.48)	7 (9.86)		
	363 (100)	71 (100)		
Girls				
Normotension	314 (79.10)	26 (61.90)		
High- normal blood pressure	70 (17.63)	15 (35.71)	8.53	0.014*
Hypertension	13 (3.27)	1 (2.38)		
	397 (100)	42 (100)		
All				
Normotension	601 (79.07)	65 (57.53)		
High -normal blood pressure	137 (18.02)	40 (35.39)	26.32	0.000**
Hypertension	22 (2.91)	8 (7.08)		
	760 (100)	113 (100)		

Note: WHtR-waist /height ratio. WHtR < 0.500 - without central obesity. WHtR e" 0.500 – with central obesity. Pearson Chi-square –value of Chi-square. p –value- level of significance. * p < 0.05, **p < 0.001- signifficance differences.

sure in accordance to their waist-to-height ratio (p=0.000).

The relative share of the examined children of both sexes with normal blood pressure (normotension) decreases from 79.07 percent in the group without central obesity to 57.53 percent in the group with central obesity, that is, by an average of 21.5 percent. In return, however, there is a rise in the relative share (%) of the examined children with high-normal blood pressure and hypertension combined with central obesity. Hence, the prevalence of high-normal blood pressure and central obesity is 35.39 percent among the examined children with central obesity and 18.02 percent among those without central obesity. The prevalence of hypertension among the children with central obesity (WHtR ≥0.500) is, on average, 7.08 percent and 2.91 percent among those without central obesity.

In general, the relative share of the examined children of both sexes with normal blood pressure and without central obesity decreases at the expense of a rise in the share of examined children with high-normal blood pressure, hypertension and central obesity. Furthermore, the percentage of boys with central obesity and hypertension (9.86%) is almost four times higher than that among the girls (2.38%).

DISCUSSION

This study presents for the first time, data on the prevalence of high-normal blood pressure and hypertension among the children and adolescents with various nutritional status from the region of Smolyan, Bulgaria.

The available and accessible literature data on the prevalence high-normal blood pressure (prehypertension) and of hypertension, among Bulgarian children of other regions in Bulgaria, is also sporadic and often based on other methods regarding the classification of blood pressure, as well as regarding the age of the participants. Nevertheless, they provide information about the trends of prevalence of the abnormally high blood pressure among Bulgarian children and adolescents. In her dissertation study, Rachneva (1988) reported that the frequency of arterial hypertensions among 6 to 15-year-old children and adolescents from Sofia city, was 6.8 percent in 1972-1973 and six percent in 1982-1983.

In other later Bulgarian studies for prevalence of hypertension on 14-17-years old adolescents and youth from town of Varna, on the base of the own norms for SBP and DBP according to age and sex, Marinov (2000) found, that the high-normal blood pressure is prevalent among 2.44 percent of investigated youth (2.72% of boys and 2.16% of girls), while the hypertension was prevalent among 2.57 percent of them (1.86% of boys and 2.91% of girls).

A later study by another Bulgarian author, Mitova (2010), carried out in 2001-2002 on 9-15-year old children and adolescents from Sofia city

and based on a blood pressure assessment that uses percentiles defined by her (5^{th}, 90^{th} and 95^{th} percentile) shows that the prevalence of systolic prehypertension (BP > 90^{th} and < 95^{th} P) averaged 2.37 percent among both sexes, and the systolic hypertension (BP $\geq$ 95^{th} P) averaged 5.34 percent. Respectively, the diastolic prehypertension averaged 3.07 percent among both sexes, and the diastolic was 3.86 percent. Furthermore, the researcher presents data about the frequency of prevalence of hypertension and normotension among the children and adolescents living in capital city in Bulgaria-Sofia.

Despite the differences in methodology regarding the classification of blood pressure and age of the examined children and adolescents, the prehypertension among Bulgarian children from the region of Smolyan seems to have a higher prevalence (on average 20.2%) compared to their peers from Sofia from the previous decade (2.37% systolic and 3.07% diastolic prehypertension). The frequency of prevalence of hypertension among the children in this study, that is 3.4 percent, seems to be very similar to that of their peers from Varna with 2.57 percent (Marinov 2000), lower of hypertension of their peers from Sofia at 5.43 percent of systolic hypertension, and 3.86 percent of diastolic hypertension (Mitova 2010), but it has seemingly lower prevalence than the data (6%) for arterial hypertension of Rachneva (1988).

The researchers of the present study do not claim accuracy for their findings based on a large number of comparative studies on the prevalence of this problem among the Bulgarian children, but rather seek to make a general comparison with some of the available and known data. Future, more detailed and accurate comparisons based on the same methodology would be very useful and important for both, science and clinical practice. There are also restrictions and obstacles in comparing these results about the prevalence of high-normal blood pressure and hypertension among Bulgarian children and adolescents with similar studies covering children from European or other countries around the world again due to the differences in the methods of blood pressure measurement (auscultatory and oscillometric), the classification criteria for both blood pressure and nutritional status, and the age groups of the examined individuals.

Nevertheless, this study of the prevalence of high-normal blood pressure (prehypertension) suggests that it is much more frequent (20.2%) compared to other studies using similar methodology, age grouping and classification such as this. This percentage is higher than in other European countries: 3.17 percent for boys and 3.05 percent for girls in Spain (Marrodán Serrano et al. 2013), 8.4 percent in 15-18-year-old adolescents in Croatia (Pecin et al. 2013), 12.8 percent in Lithuania (Dulskiene et al. 2014) and compared with other countries around the world: eleven percent in United Arab Emirates (Abdulle et al. 2014), 3.4 percent in USA (Hansen et al. 2007), 3.9 percent in 8-12-year-old children in Thailand (Sukhonthachit et al. 2014), 2.2 percent in Canada (Shi et al. 2012) and 1.6 percent systolic and diastolic prehypertension in Nigeria (Oyewole and Oritogun 2012).

Most likely it is the high frequency of high-normal blood pressure (prehypertension) among studied children and adolescents that is connected to the pressor effects of certain hormones, which are produced by intensively endocrine glands in period of puberty.

Also it is important to have in mind that the evaluation of blood pressure in these adolescents is carried out based on international cut off percentiles for SBP and DBP, not by percentiles for the investigated group, which probably also has its importance for the resulting higher frequency of prehypertension among the studied children and adolescents.

The arterial hypertension (AH) prevalence of 3.4 percent (3.7% in boys and 3.2% in girls) among the children and adolescents in this study is similar compared with the AH prevalence in other European countries: Spain 3.15 percent in boys and 3.05 percent in girls (Marrodán Serrano et al. 2013), Poland – 3.3 percent (Kardas et al. 2005), Italy – 4.2 percent (Genovesi et al. 2005), Bosna – 4.7 percent (Sporiševic et al. 2009), Turkey – 4.8 percent in girls and 3.8 percent in boys (Uçar et al. 2000), and in other countries outside Europe: USA – three point six percent (Hansen et al. 2007), Thailand – 4.7 percent (Sukhonthachit et al. 2014) and United Arab Emirates – 16.6 percent (Abdulle et al. 2014).

Higher AH prevalence among children and adolescents has been found in the following countries to be: Romania – 7.6 percent (Cinteza and Balgraden 2013), India – 7.5 percent (Prabhjot 2005), Croatia – 8.5 percent (Pecin et al. 2013), Lithuania – twenty-two point two percent (Dulskiene et al. 2014), Portugal – 12.8 percent (Mal-

donado et al. 2011), while lower AH prevalence has been found outside Europe, in countries like Canada - less than one percent (Shi et al. 2012), Nigeria – 0.1 percent (Oyewole and Oritogun 2012) and in other countries.

In conformity with the results obtained, there is a positive correlation between the systolic and diastolic blood pressure values, the BMI and the WHtR among the children and adolescents. The findings confirm the results of Martin et al. (2005), Marrodán Serrano et al. (2013) and Pecin et al. (2013). Other researchers also report a positive correlation between blood pressure in children and adolescents and the body mass index (Dulskiene et al. 2014; Genovesi et al. 2005; Vlajinac et al. 2003). Positive correlation between age, height, weight, body mass index, waist and hip circumferences, waist to hip ratio and systolic and diastolic blood pressure were found by Amandeep et al (2009). The higher values of the BMI, the WC and the WHtR are directly related to the high blood pressure of Chinese children and adolescents according to Hu et al. (2011).

In conformity with the resulted obtained in this study, overweight and overall obesity lead to higher values of blood pressure among both sexes, with the systolic and diastolic blood pressures of the examined children with overweight or overall obesity showing significantly higher values compared to children with normal and subnormal weight. Similar results are reported by Marrodán Serrano et al. (2013) and Dulskiene et al. (2014).

In addition, the results show also that Bulgarian children with central obesity assessed on the basis of the WHtR have significantly higher mean values of systolic and diastolic blood pressure compared to those of their peers who do not have central obesity (WHtR<0.500). Other researchers also report similar results (Marrodán Serrano et al. 2013; Hu et al. 2011).

Also, the findings on the higher frequency of prevalence of the high-normal blood pressure and hypertension among children and adolescents with overweight and overall obesity confirm the results of other researchers (Mitova 2010; Pecin et al. 2013; Sukhonthachit et al. 2014; Maldonado et al. 2011; Hu et al. 2011). Furthermore, the findings on the higher frequency of prevalence of the high-normal blood pressure and hypertension among children and adolescents with overall obesity confirm some earlier results too (Marrodán Serrano et al. 2013; Hu et al. 2011).

CONCLUSION

According to the results of the study, high prevalence of high-normal blood pressure (prehypertension) and comparative normal prevalence of hypertension was observed among 8-15-year-old children and adolescents living in Smolyan region, Bulgaria. Body mass index and waist to height ratio were significantly correlated with systolic and diastolic blood pressure in Bulgarian schoolchildren from both sexes. The values of blood pressure were significantly higher among groups of overweight, obese and central obese children. The results confirm the tendency for high-normal blood pressure and hypertension to increase among children and adolescents with overweight, obesity and central obesity.

RECOMMENDATIONS

The transition of overweight and obesity and high blood pressure from childhood to adulthood is a serious health problem in the world, including in Bulgaria. For this reason a national preventive strategy including early identification of child and adolescents at risk of obesity and high blood pressure is very important for early diagnosis, prevention and treatment of many socially important cardiovascular and metabolic diseases in childhood and adulthood, and also for decreasing mortality in adulthood.

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