

PREVALENCE OF ANTHROPOMETRIC AND CARDIOVASCULAR RISK FACTORS AMONG BULGARIAN UNIVERSITY STUDENTS

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Summary. The aim of this paper is to investigate the prevalence of cardiovascular risk factors and their connection with health risk anthropometrical factors among Bulgarian university students, the main in the South Bulgaria. The sample population of the study included total 386 young people, of which 303 females and 83 males, between 18-30 years of age i.e. the mean age is 21.3-21.4 years. They were from different regions of Bulgaria, mainly from Southern Bulgaria. The study was conducted transversally in the period between 2015 and 2017. For each person the weight, height, waist circumference and blood pressure were measured. On this base the body mass index and waist to height ratio were calculated by formulas. Underweight was defined as BMI < 18.5 kg/m², overweight as BMI 25-29.9 kg/m² and obesity as BMI ≥ 30 kg/m². Waist-to-height ratio (WHtR) was used for evaluation of central (abdominal) obesity, that was defined as WHtR ≥ 0.5. The prehypertension was defined when SBP > 120 < 139 and/or DBP > 80 < 89 mmHg and hypertension when SBP ≥ 140 and/or DBP ≥ 90 mmHg. The statistical processing of the data was done using software package Statistica 10.0 and SPSS 20.0 by means of descriptive statistics and multiple regression analysis. The results show that the underweight occurs among 1.2% of the men and among 15.2% of the women, the overweight occur among 32.5% of men and 13.9% of women and obesity was found among 10.8% of the men and 8.6% of the women. Central obesity occur among 32% of males and 17% of females, independently of their nutritional status. The prehypertension occur among 46% of the men and 28% of the women. The hypertension found among 18% of the men and among 2% of the women. Among male students with prehypertension the overweight occur among 35.7%, and obesity occur among 10.7% of participants, while among hypertensive male the overweight and obesity occurs in 18.2% and 36.4%, respectively. In group of prehypertensive females 22.4% are overweight and 14.9% are obese. Hypertension occur among 20% of overweight and 40% of obese female students. In group of central obese male the prehypertension and hypertension occurs among 55% and 20%, respectively. Among central obese females 47.5% are prehypertensive and 7.5% are hypertensive. The results also show that the waist circumference has a serious potential to influence on the blood pressure level at an early adulthood in both sexes. The higher prevalence of elevated blood pressure, overweight, general and central obesity among Bulgarian university students maybe connect with factors such as a sex, hormonal status, hereditary burden and sexual differences in some lifestyle habits as a nutrition, smoking, alcohol consumption, physical activity, individual physiological and biochemical status, psychological stress during student life and other. The prevalence of this risk factors among young Bulgarian adults needs of urgent attention and further evaluation because of the grave consequences of obesity and hypertension and because the hypertension and overweight is an important amendable risk factors in young life.

Key words: Prehypertension. Hypertension. Overweight. Obesity. Central Obesity. Bulgarian university students.

Introduction

The cardiovascular disease was estimated to be the leading cause of death and disability in worldwide. Most of cardiovascular disease events nowadays are taking place in low and middle income countries with 80% of the burden occurring in these countries (Mackay, Mensah, 2004). The development of major cardiovascular risk factors at an early age is closely related to clustering of risk factors and health behaviour (Paavola et al., 2004). Hypertension, dyslipidemia, glucose intolerance and overweight are usually tolerated at a younger age (Rogacheva et al., 2006). Overtime these conditions especially if associated with overweight and obesity, poor dietary habits, smoking or physical inactivity can lead to higher risk of metabolic and cardiovascular disease and of excessive morbidity and mortality in late adulthood (Li et al., 2003; Andreenko, 2005; Andreenko, 2009).

The global burden of cardiovascular diseases (CVD) is increasing around the world, in Bulgaria as well. Among 15 European countries, Bulgaria ranked first among men and fifth among women with respect to the increase in cardiovascular disease mortality between 1970 and 2012, and now has among the highest rates of both coronary heart disease and stroke mortality in Europe. According to data from the World Health Organization 64 % of mortality as a percent of total deaths in Bulgaria in 2012-2013 years are caused by cardiovascular diseases (World Health Organization, 2015). Because of this '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, 2015). The risks factor for CV diseases might differ among different countries and populations, which will affect the implementation of intervention programs.

In Bulgaria they were many investigation about risk factors for CVD and other disease in adults (Dyakova et al., 2008; Andreenko et al., 2015a; 2015b; Andreenko et al., 2017). A representative sample of Bulgarian urban population (n = 3810) from five Bulgarian cities was included in a cross-sectional observation study performed in the period 2005-2007 from Dyakova et al. (2008). The results of this study shows that the cardiovascular risk is high in a large proportion of Bulgarian urban population, especially in men aged over 65 years.

The many research reported for prevalence of anthropometric, cardiovascular and environmental risk factors in children, adolescents and young adults from various countries – in Bulgaria (Nikolova, 1997; Nikolova et al., 2005; Andreenko and Nikolova, 2010; Mitova, 2010; Mladenova and Andreenko, 2015; Andreenko et al., 2015a, 2015b), Turkey (Aynaci, Akdemir, 2018), Serbia (Stojanovic, 2009; Crnobrnja et al., 2012), Portugal (Brandao et al., 2008), Columbia (Feliciano-Alfonso, 2010), Japan (Furukawa et al., 2009), Jordan (Gharaibeh et al., 2012), Egypt (Farrag et al., 2015), India (Jain et al., 2014), Malaysia (Cheah et al., 2018) and many other.

In connect to the fact that overweight and obesity were the significant risk factors for CVD the many autors reported for prevalence of overweight and obesity among Bulgarians-children, young and older (Petrova et al., 2012; Birdanova et al., 2013; Mitova, 2010; Mladenova and Andreenko, 2015; Andreenko et al., 2015a, 2015b). The rising percentage in recent years of overweight and obese people in Bulgaria who also suffer prehypertension and hypertension, including young people, as well as the high morbidity and mortality of adults because of cardiovascular diseases undoubtedly raise very serious concerns. This makes early diagnostics and prevention from these abnormalities especially important still in early adulthood.

Objective

To study of prevalence of the cardiovascular risk factors among Bulgarian university students and their relationship with some anthropometric indicators.

Methodology

Sample

The subject of this study are 386 Bulgarian students in Plovdiv University "Paisii Hilendarski" range from 18 to 30 years (mean age 21.3years), of which 303 women (78.5 %) and 83 men (21.5%). They were from different regions of Bulgaria, mainly from Southern Bulgaria. The study was conducted transversally in the period between 2015 and 2017.

In sample include only clinically healthy students with Bulgarian nationality and origin.

Ethics

The study was conducted with the official approval of the Ethical Committee on Plovdiv University – Branch Smolyan. The written informed consent of each person included in the research group was obtained, in accordance with the ethical principles for medical research involving human subjects in the Helsinki Declaration of World Medical Association (2000).

Study design

The study design included a four directly measured anthropometric and functional indicators: height (H,cm), weight (W, kg),waist circumference (WC, cm), systolic and diastolic blood pressure (mmHg).On this base two additional indexes were calculated - body mass index (BMI, kg/m²), and waist to height ratio (WHTR).

Methods

The anthropometric data of height (H, cm), weight (W, kg) and waist circumference (WC,cm), of each person were measured using the Martin-Saller's anthropometrical method (1957), by means of original anthropometric instruments (GPM, Swiss). Furthermore, the Body Mass Index (BMI) and the Waist to Height Ratio (WHTR) were calculated. The Body Mass Index (BMI) was calculated by the formula: Weight (kg)/Height (m²). The Waist-to-Height Ratio (WHTR) was calculated by the formula: Waist circumference (cm)/Height (cm). The categories of anthropometric nutritional status was assessed through in accordance with recommendations of the International Obesity Task Force (IOTF) for BMI cut-off points of adults, where the values of BMI<18.5 kg/m² is underweight, values between 18.5-24.9 kg/m² is normal weight, values from 25-29.9 kg/m² is overweight, and BMI ≥30 kg/m² is obesity (WHO, 1995). The central obesity was assessed on the base on a relation between the waist circumference and height (WHTR), where WHTR<0.500 is without central obesity and WHTR ≥0.500 is central obesity (Hsieh, Muto, 2005).

The blood pressure was measured twice using auscultation method of Korotkoff, phases I and V using a "SEND0"(Japan) mechanical sphygmomanometer and stethoscope. The two measurements of the blood pressure (BP) were taken within an interval of one minute. If the difference in the BP was more than 5 mmHg, one additional reading was taken, and

the two readings closest in value (nearest to two decimal points) were used for data entry. The final reading used in analysis was based on the average of the two readings recorded. The evaluation of categories blood pressure was defined in three categories (normotension, prehypertension and hypertension), according to recommendations of the Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure - JNC 7 (Chobanian et al., 2003). The normotension was defined when SBP <120 and/or DBP < 80 mmHg, prehypertension was defined when SBP >120 <139 and/or DBP >80 <89 mmHg. Hypertension was defined in value of SBP ≥140 and/or DBP ≥ 90mmHg.

The statistical processing of the data was done using software packages STATISTICA 10.0 and SPSS 20.0 by means of descriptive statistics and multiple regression analysis. The intergroup differences were assessed by using T-test of Student and Chi-square test.

Results

The mean and SD of anthropometric and blood pressure variables of the studied population are shown in Table 1. As can be seen in table the average mean age of the studied individuals was 21.2±2.4 years, with a range of 19–30 year. Males were significantly taller, heavier, and had significantly higher mean values of waist circumference (WC), body mass index (BMI), waist to height ratio (WHtR), systolic blood pressure (SBP) and diastolic blood pressure (DBP). There were significant difference in mean of all anthropometric and physiological indicators between males and females ($p < 0.000$).

Table 1. Basic characteristics of the study population

Variables	Males	Females	p-level
	(n=83)	(n=303)	
	(mean±SD)	(mean±SD)	
Age (year)	21.3 ± 2.4	21.1 ± 2.3	>0.05
Height (cm)	175.1 ± 6.2	162.9 ± 6.3	<0.000*
Weight (kg)	76.6 ± 16.2	60.1 ± 13.8	<0.000*
Waist circumference (cm)	83.3 ± 10.9	71.8 ± 9.8	<0.000*
Body mass index (kg/m ²)	24.9 ± 4.9	22.6 ± 4.9	<0.000*
Waist to height ratio	0.475± 0.06	0.441± 0.06	<0.000*
Systolic blood pressure (mm/Hg)	119.9 ± 13.8	108.6 ± 11.8	<0.000*
Diastolic blood pressure (mm/Hg)	75.8 ± 11.6	70.6 ± 8.5	<0.000*

In Table 2 are present the results of the percentage distribution of the Bulgarian students being surveyed according to the different type of body nutritional status and blood pressure. The distribution of the individual surveyed according to the different categories of body nutritional status, based on BMI shows that the most common in both sexes is the normal body nutritional status in over half of those surveyed. Among women, second most common deviation is underweight - 15.2%, while overweight and obesity occur among total of 22.5% - 13.9% and 8.6%, respectively. Among the young men surveyed, the most common deviation from the normal nutritional status is overweight, which occurs in 32.5%, and obesity - 10.8%. Underweight is rarely encountered, found among 1.2% of men. The differences in the percentage distribution of the persons surveyed by categories between both sexes are statistically significant ($p < 0.0000$). Central obesity (WHtR ≥ 0.5), assessed on the basis of WHtR occurs in almost 31.7 % of the men surveyed, compared with the female, where it is

found in about 17% of those surveyed. The gender differences are statistically significant ($p < 0.002$). The percentage distribution of different blood pressure categories based on the limit values of systolic blood and diastolic blood pressure showed that the overall prehypertension occurs among 33.2% of students – 46% in males and 30% in females. The hypertension occurs among 18% of males and 2.2% of the females. The differences between the groups are statistically significant ($p < 0.0000$).

Table 2. Prevalence (% , n) of participants according to different BMI, WHtR and BP categories

Categories	All %(N)	Males %(N)	Females %(N)	Pearson Chi-square	p-value
BMI categories					
Underweight	12.2 (47)	1.2 (1)	15.2 (46)	24.0	0.000**
Normal weight	60.9 (235)	55.4 (46)	62.4 (189)		
Overweight	17.9 (69)	32.5 (27)	13.9 (42)		
Obesity	9.1 (35)	10.8 (9)	8.6 (42)		
All	100.0 (386)	100.0 (83)	100.0 (303)		
WHtR categories					
WHtR<0.5	79.9 (307)	68.3 (56)	83.1 (251)	8.83	0.002*
WHtR≥0.5	20.1 (77)	31.7 (26)	16.9 (51)		
All	100.0 (384)	100 (82)	141 (302)		
Blood pressure categories					
Normotension	61.2 (175)	36.1 (22)	68.0 (153)	33.2	0.000**
Prehypertension	33.2 (95)	45.9 (28)	29.8 (67)		
Hypertension	5.6 (16)	18.0 (11)	2.2 (5)		
Total	100.0 (286)	100.0 (61)	100.0 (225)		

Note: WHtR<0.500 - without central obesity; WHtR ≥ 0.500 - with central obesity

Table 3 presents the percentage distribution of the individuals surveyed with different categories of blood pressure according to their body nutritional status, assessed on the basis of BMI. In group of prehypertensive students from both sexes overall 10.5 % of participants are with underweight, 49.5 % are with normal weight, 26.3% are with overweight and 13.7% are obese. In group of hypertensive overall 43.8% are with normal weight, 18.7% are with overweight and 37.5% are obese. There were statistically significant differences in the percentage distribution of the different blood pressure categories according to their BMI status ($p = 0.000$). In group of **male** students with prehypertension the normal weight occurs among 50%, overweight among 35.7% and obesity among 10.7% of males. In group of hypertensive male students the normal weight occurs among 45.5%, overweight and obesity among 18.2% 36.4%, respectively. There are no statistically significant differences in the percentage distribution of different blood pressure categories according to their BMI status in men ($p > 0.326$). In group of prehypertensive **females** with underweight are 13.4%, with normal body nutritional status are 49.3%, 22.4% are overweight and 14.9% are obese. Hypertension occurs among 40% of normal weight females, among 20% of overweight and 40% of obese female students. There are statistically significant differences in the percentage distribution of different blood pressure categories according to their BMI status ($p = 0.007$).

Table 3. Prevalence (% , n) of students with different blood pressure categories according to their nutritional status, evaluated by categories of BMI.

Blood pressure categories	Underweight %(N)	Normal weight %(N)	Overweight %(N)	Obese %(N)	Chi-square	p-value
Males (n=61)						
Normotension	0.0 (0)	63.4 (14)	27.3 (6)	9.1 (2)	6.93	0.326
Prehypertension	3.6 (1)	50.0 (14)	35.7 (10)	10.7 (3)		
Hypertension	0.0 (0)	45.5 (5)	18.2 (1)	36.4 (4)		
All	1.64 (1)	54.1 (33)	29.5 (18)	14.7 (9)		
Females (n=225)						
Normotension	14.4 (22)	69.3 (106)	9.1 (14)	7.2 (11)	17.59	0.007*
Prehypertension	13.4 (9)	49.3 (33)	22.4 (15)	14.9 (10)		
Hypertension	0.0 (0)	40.0 (2)	20.0 (1)	40.0 (2)		
All	13.8 (31)	62.8 (141)	13.3 (30)	10.2 (23)		
ALL (n=286)						
Normotension	12.6 (22)	68.6 (120)	11.4 (20)	7.4 (13)	27.44	0.000**
Prehypertension	10.5 (10)	49.5 (47)	26.3 (25)	13.7 (13)		
Hypertension	0.0 (0)	43.8 (7)	18.7 (3)	37.5 (6)		
Total	11.2 (32)	60.8 (174)	16.8 (48)	11.2 (32)		

Note: Pearson Chi-square – value of Chi-square. p-value – level of significance.

*p<0.05, **p<0.001– significance differences

Table 4 presents the percent distribution of students from different blood pressure categories according to the waist to height ratio (WHTR), giving information about the presence of central (abdominal) obesity. The results showed that in the group of all students with WHTR < 0.500 overall 67.3 % are normotensive, 28.7% are prehypertensive and 4% are hypertensive. In group of central obese students 39% are normotensive, 49.1% are prehypertensive and 11.9% are hypertensive. There were statistically significant differences in

Table 4. Prevalence (%) of students with different blood pressure categories according to their nutritional status, evaluated by categories of waist to height ratio (WHTR)

WHTR categories	Normotension % (n)	Prehypertension % (n)	Hypertension % (n)	Pearson Chi-square	p-value
Males(n=61)					
WHTR < 0.500	41.5 (17)	41.5 (17)	17.1 (7)		
WHTR ≥ 0.500	25.0 (5)	55.0 (11)	20.0 (4)	1.61	0.446
All	36.1 (22)	45.9 (28)	18.0 (11)		
Females (n=225)					
WHTR < 0.500	73.0 (135)	25.9 (48)	1.1 (2)		
WHTR ≥ 0.500	45.0 (18)	47.5 (19)	7.5 (3)	14.2	0.000**
All	68.0 (153)	29.8 (67)	2.2 (5)		
ALL (n=286)					
WHTR < 0.500	67.3 (152)	28.7 (65)	4.0 (9)		
WHTR ≥ 0.500	39.0 (23)	49.1 (29)	11.9 (7)	17.16	0.000**
Total	61.2 (175)	33.2 (95)	5.6 (16)		

Note: WHTR – waist to height ratio. WHTR < 0.500 – without central obesity. WHTR ≥ 0.500 – with central obesity. Pearson Chi-square – value of Chi-square. p – level of significance.

*p < 0.05, **p < 0.001 –significance differences.

the percentage distribution of the different blood pressure categories according to their WHTR status ($p < 0.000$). In group of **male** students without central obesity the normotension occurs among 41.5%, while prehypertension and hypertension among 41.5% and 17.1%, respectively. In group of central obese male students thenormotension prevail among 25%, while prehypertension and hypertension among 55% and 20%, respectively ($p = 0.446$). In group of **females** without central obesity the normotension are 73%, prehypertension 25.9% and hypertension 1.1%. Among central obese females 45% are normotensive, 47.5% are prehypertensive and 7.5% are hypertensive ($p < 0.000$).

Table 5 presents the results of multiple linear regression analysis for study of influence of the anthropometric risk factors on value of blood pressure. As a predictors are waist circumference, body mass index and waist to height ratio and as a dependent variable are systolic and diastolic blood pressure. The results show that waist circumference have a potential to impact significance on the level of systolic and diastolic blood pressure in young females and on diastolic blood pressure in young males ($p < 0.05$). The other anthropometric indicators such as BMI and WHTR have a insignificant impact on the values of blood pressure-systolic and diastolic in this early period of life.

Table 5. Multiple regression analysis of obesity measures with blood pressure

Dependent variable	Predictors	Beta(b*)		p-level	Beta(b*)		p-level
		Female	Male		Female	Male	
SBP	WC	0.619	0.233	0.008*	0.779	0.490	0.117
	BMI	0.055	0.122	0.651	0.227	0.342	0.509
	WHTR	-0.302	0.228	0.186	-0.680	0.516	0.192
DBP	WC	0.373	0.242	0.000*	1.620	0.462	0.000*
	BMI	0.156	0.126	0.125	0.177	0.323	0.585
	WHTR	-0.242	0.236	0.216	-1.532	0.486	0.002*

Note: WC – waist circumference cm. BMI – body mass index, kg/m^2 WHTR – waist to height ratio.

SBP – systolic blood pressure, mmHg. DBP – diastolic blood pressure, mmHg. Beta – regression coefficient.

p – level of significance of regression coefficient.

Discussion

This study presents original new data for prevalence of the prehypertension, hypertension and other cardiovascular and metabolic risk factors among Bulgarian university students.

According to our results the prevalence of underweight in male (4.5%) is lower compared to the data of National Representative Survey from Nutrition and Nutritional status of the Bulgarian population, conducted in 2004 by Petrova et al. (2012), for the group 19-29 years, as well as of the data of other Bulgarian's (Birdanova et al., 2013) and foreign authors (Daud, Javaid, 2012). At the same time the prevalence of underweight among our female students is 15.2%. It is lower than established results by other Bulgarian authors - 17.3%, according to Petrova et al. (2012) and 18% according to data of Birdanova et al. (2013). Also, the underweight in our students is significantly lower than the results published in 2010-2011 for students from other countries - 26.8% for Denmark (Skovlund et al., 2011) and 25.7% for Turkey (Unal et al., 2010).

Our study showed that the total prevalence of overweight and obesity among students from both sexes are 17.9% and 9.1% respectively. The prevalence of overweight is 32.5%

for men and 13.9% for women. According to the results obtained at today's Bulgarian male students there is a higher frequency of overweight encounter, according to Petrova et al. (2012) from a data of National Representative Survey for Bulgaria (NRS), where the overweight in males from 19-29 years is 23.3%. The rate of obesity in male students in our study (10.8%) is also higher than the percentage rate of obesity in NRS (6%) conducted in 2004. At the same time, the 13.9% prevalence rate of overweight among our female students is lower than previous established results, reported in NRS –18.1%. Our results are very similar to results of other Bulgarian authors (Birdanova et al., 2013) for female medical students from Pleven town, where the overweight is 10.9%. Overall obesity prevail among 8.6% of the female students in current study, which is twice more, compared to results of other Bulgarian authors (Petrova et al., 2012; Birdanova et al., 2013).

In the group of the young women the “double burden“ is observed – on the one hand, an increased prevalence of overweight and obesity and on the other hand an increased prevalence of underweight. There is a potential risk for the physical and reproductive health of this women, connected with their nutritional status and underweight. This our results corresponded with results of other authors that found similar tendency among young women and girls in Bulgaria (Petrova et al., 2012; Birdanova et al., 2013) and other countries on the world (Lee, Ryu, 2018; Khan and Khoi, 2008).

Data from a study conducted in Copenhagen in 2011 among medical students (Skovlund et al., 2011) show average rates of overweight of 7.3% for female and 9.7% for male students, which is significantly lower than the rate found in our survey. The relative share of overweight (2.8%) and obesity (4.7%) among Turkish university students (Unal et al., 2010) are lower compared with our data. The similar share of overweight -21% and very lowest percent of obesity, compared with our data were found among Serbian university students of Crnobrnja et al. (2012). The authors also were found the higher frequency of overweight and obesity in male respondents.

For a considerable spread an overweight and obesity over the past two decades among university students from a many European Universities in Italy, Spain, Czech Republic, Greece reported many authors (Emmons, 2000; Karen et al., 2009; Michael et al., 2011). The relative share of overall overweight and obesity among students in Europe ranges between 20.5-30%, where a values among female are approximately two times lower.

Many authors reported that the waist- to- height ratio (WHTR) showed the highest correlation with intraabdominal fat compared to BMI, waist circumference and waist-to-hip ratio (Aswell et al., 1985; Hsiesh and Muto, 2005). WHTR was first used in the Framingham study (Higgins et al., 1988) and proved to be weakly associated with age. We used this index to evaluation of central (abdominal) obesity among Bulgarian students. According to WHTR cut-off points our results show that prevalence of central obesity among students is 20.1%, independently of sex. Male students suffered central obesity at a higher rate -31.7%, compared to female students- 16.9%. Our results are show significant lower prevalence of central obesity compared with Egypt students-43.9% (Farrag et al., 2015) and other.

The present study found that the total prevalence of prehypertension independently of sex is 33.2%, while the hypertension prevail among 5.6% of respondents, respectively. Results of our study were similar to results of recent study in Turkey (Aynaci, Akdemir, 2018), where rate of hypertension was the same -5.6%. but the rate of prehypertension is very lower (8.6%), than our data. The results for current study for prehypertension and hypertension were lower compared to the results of other study in students from India (Jain et al., 2014), Malaysia (Cheah et al., 2018). Also our results showed insignificant lower percentage on hypertension compared with studies that found 7% hypertension in Kuwait (Al-Majed, Sadek, 2012) and 7.5% in Saudi Arabia (Baig et al, 2015).

Gender also contributed to the significant association towards hypertension. There was a greater proportion of males who were hypertensive compared to females. This was consistent with other studies (Gharaibeh et al 2012; Cheah et al., 2018 Sakurai et al., 2006). This difference, according to may be due to data collection methods, the socioeconomic status of the evaluated population, and differences in healthy lifestyle behaviours (Aynaci, Akdemir, 2018). Also, the higher prevalence of elevated blood pressure among men could be explained by the fact that hormones, such as testosterone, can play an important role in gender-associated differences in blood pressure regulation, as well as have a protective effect, such as oestrogen in females. It was further explained by Celermajer et al. (1994) that gender differences can affect the arterial physiology of a human being. Men tend to exhibit a gradual decline in endothelial responses after the age of 40, but a woman's vascular physiology remains normal for another 10 years beyond 40. However, once a woman reaches menopause, the rate of decline in endothelial responses will increase. Hence, women's risk of hypertension will eventually be the same as men's.

Our results are confirmatory the fact for higher percent of hypertensive male and show that the risk-based cardiovascular and metabolic factors studied are more common among males, than females. Sex "male" is associated with a higher risk of cardiovascular and metabolic diseases from a young age among Bulgarian people. This fact is to connect with higher relative share on cases with prehypertension and hypertension, and also prehypertension and hypertension combined with overall and central obesity among men, compared with women.

According to sex, the our results show that 18% of male and 2.2% of female were hypertensive, and another 45.9% of male and 2.8% of female are prehypertensive. The higher prevalence of elevated blood pressure among Bulgarian male students maybe connect with factors such as a sex, hormonal status, hereditary burden and sexual differences in some lifestyle habits as a nutrition, smoking, alcohol consumption, physical activity, individual physiological and biochemical status, higher sensitivity on stress, and other. The current our results corresponded with other studies that reported for higher prevalence of hypertension in males (Celermajer et al., 1994; Sakurai et al., 2006; Gharaibeh et al 2012; Cheah et al., 2018).

The prevalence of prehypertension and hypertension among young Bulgarian adults needs of urgent attention and further evaluation because of the grave consequences of hypertension and because secondary hypertension is likely in this age group. Lee and Cooper (2009) suggested that for CVD the hypertension is an important amendable risk factor.

The current study demonstrate a significant association of systolic blood pressure with waist circumference among male ($p < 0.008$), and between waist circumference and diastolic blood pressure among students from both sexes ($p < 0.000$). The other anthropometric factors such as a BMI and WHTR have an impact on the level of blood pressure also, but lower and insignificant. Therefore, this overall finding agrees with other studies (Amandeep et al., 2009; Dalton et al. 2003 and other) and suggests significant prevalence of risk factors in Bulgarian university students. Therefore, it may be suggested from the present study that proper population based monitoring and modified lifestyle for cardiovascular risk will decline the cardiovascular mortality in young Bulgarian population.

Our results also show that at this young age (18-30 years) the waist circumference has a serious potential to affect the blood pressure level at an early adulthood in both sexes. Similar results was found of other authors (Jain et al., 2014). In the aforementioned study, the pressure components - SBP and DBP correlated to all of the evaluated anthropometric indicators, but WC has shown higher correlation both in males and females. (Jain et al., 2014). Our results confirm this fact.

Although BMI is the most studied index, being significantly related to CVD risk factors as demonstrated by cross-sectional and prospective studies (Yusuf et al., 2004), there are increasing

doubt about its role in predicting CVD events which has led to an increasing focus for abdominal obesity indices (Ribeiro et al. 2010; Mladenova and Andreenko, 2015; Andreenko et al., 2015a, 2015b)

The increase of prevalence of overweight, general and central obesity and prehypertension and hypertension among Bulgarian university students could be explained by the heredity burden, psychological stress during student life, lack of time and financial resources for quality and healthy food, by the tobacco use, alcohol consumption and sedentary lifestyle.

Conclusion

The percent of Bulgarian university students with overall and abdominal obesity, prehypertension and hypertension increases. These tendencies are more often pronounced among male students. In the group of the female students the “double burden” is observed – on the one hand, an increased prevalence of overweight and obesity and on the other hand an increased prevalence of underweight. The relative share of young people with combination of overweight and obesity and with central fat accumulation and elevated blood pressure increases in both sexes and occurs more often among men. The waist circumference has a serious potential to affect the blood pressure level at an early adulthood in both sexes. The higher prevalence of elevated blood pressure, overweight and central and abdominal obesity among Bulgarian students maybe connect with factors such as a sex, hormonal status, hereditary burden and sexual differences in some lifestyle habits as a nutrition, smoking, alcohol consumption, physical activity, individual physiological and biochemical status, psychological stress during student life and other. The prevalence of prehypertension and hypertension among young Bulgarian adults needs urgent attention and further evaluation because of the grave consequences of hypertension and because the hypertension is an important amendable risk factor.

Limitations

The major limitations of this survey is the relatively small number of participants. Because the sample was taken only university students, this could not be representative to the whole sector of young adults in Bulgaria. Inclusion of family history of CVD risk factors could enhance the interpretation of risk factors in our participants. However, this was beyond our scope.

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PREVALENCIJA ANTROPOMETRIJSKIH I KARDIOVASKULARNIH FAKTORA RIZIKA KOD BUGARSKIH UNIVERZITETSKIH STUDENATA

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Sažetak. Ovaj rad istražuje prevalenciju kardiovaskularnih faktora rizika i njihovu povezanost sa antropometrijskim faktorima zdravstvenu riziku na bugarskom studentskom univerzitetu, koji su glavni u južnom Bugarskom. Ulazak populacije u istraživačkom obučavanju je ukupno 386 mladih ljudi, od 303 žene i 83 muškarca, između 18-30 godina starosti, t. Srednja starost je 21.2 godine. Oni su bili iz različitih regiona Bugarskih, uglavnom iz južne Bugarske. Ispitivanje je sprovedeno transverzalno u periodu od 2015. do 2017. godine. Za svu osobu izmjenjena je težina, visina, obic struka i krvav pritisak. Na toj osnovi indeks mase i odnos struka do visine izračunat je po formulama. Rezultati su pokazali da je manji iznos od 1.2% muškarca i 15.2% žena, dok je na drugom mjestu 32.5% muškaraca i 13.9% žena, a godišnja zarada je 10.8% muškaraca i 8. 6% žena. Centralna gojaznost se odnosi na 32% muškaraca i 17% žena, nezavisno od njihovog nutritivnog statusa. Pre-hipertenzija se javlja kod 46% muškaraca i 28% žena. Hipertenzija se nalazi u 18% muškarca i 2% žena. Među učenicima je bilo 35.7%, a broj bodova 10.7% ispitanik, dok je kod hipertenzivnih muškarca prekomerna težina i gojaznost iznosila 18.2%, što je 36.4%. U grupi prehipertenzivnih žena 22.4% ima prekomernu težinu, a 14,9% su gojazne. Hipertenzija se javna kod 20% prekomerne teže i 40% kod govornih žena. U grupama muškaraca sa centralna gojaznost, prehipertenzija i hipertenzija se javlja kod 55%, odno 20%. Među srednje dugim ženama 47.5% su prehipertenzija i 7.5% su hipertenzija. Rezultati takvog pokazivanja da obicni struka ima ozbiljanski potencijal da ucie na nivo osnovnog priliva u ranom prelaznom periodu po oba pola. Zaključak: Veća prevalenca povišenog krvnog pritiska, prekomerne težine i centralne i abdominalne gojaznosti među bugarskim studentima može se povezati sa faktorima kao što su pol, hormonski status, nasljedni teret i seksualne razlike u nekim životnim navikama kao ishrana, pušenje, konzumiranje alkohola, fizička aktivnost, individualni fiziološki i biohemijski status, psihološki stres tokom studentskog života i drugo. Prevalencija ovih faktora rizika među mladim Bugarskih studenta hitnu pažnju i dalju evaluaciju zbog teških posledica gojaznosti i hipertenzije i zbog toga što je hipertenzija i prekomerna težina važan faktor rizika koji se može menjati u mladom životu.

Ključne reči: prehipertenzija, hipertenzija, prekomernatežina, gojaznost. centralna gojaznost. studenti bugarskih univerziteta.