HOSPITAL PHARMACOLOGY
International Multidisciplinary Journal

ISSN 2334-9492 (Online)

Hospital Pharmacology. 2024; 11(3):1555-1564

UDC: 616.12/.14-058

doi:10.5937/hpimj2403555S

Original Study

Socio-Demographic Differences In The Prevalence of Cardiovascular Diseases And The Association With Risk Factors In The Population of Serbia

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SUMMARY

Introduction: Cardiovascular diseases are the leading cause of mortality in the world. This study aimed to examine the prevalence of cardiovascular diseases in relation to socio-demographic characteristics, behavioral and metabolic risk factors, and to analyse the association between presence of cardiovascular diseases and self-perceived health and attitudes towards factors affecting health in the population of Serbia over the age of fifteen.
Material and Methods: The data of the 2019 National Health Survey of the Population of Serbia were analyzed, on a sample of 13,178 respondents over the age of fifteen, which was conducted in accordance with the methodology of the European Health Interview Survey (Wave 3). Data on socio-demographic characteristics, metabolic and behavioral risk factors and self-reported health and factors influencing health in relation to cardiovascular diseases were used for our analysis. Testing the difference in frequencies of categorical variables was performed using the X^2 test. Values of significance level $p<0.05$ are considered statistically significant.
Results: By analyzing the data obtained from this research, it was estimated that every ninth resident of Serbia (11.2%) suffers from some form of cardiovascular diseases, with a statistically significant difference observed in the prevalence of cardiovascular diseases in relation to gender, age, income, education, self-assessment of health and attitudes towards health and risk factors, except for physical activity.
Conclusion: The high prevalence of cardiovascular diseases is strongly associated with preventable risk factors, such as obesity, hypertension, alcohol consumption, and smoking.

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This highlights the need for the development of preventive programs aimed at strengthening cardiovascular health education.

Keywords: Cardiovascular Diseases, Risk Factors, Socio-Demographic Factors, Self-Assessment of Health

INTRODUCTION

Due to rapid and significant changes in the lifestyle and diet of the population due to industrialization and economic development in the last decades of the 20th century, chronic noncommunicable diseases (NCDs) have been on the rise [1]. Among these, cardiovascular diseases (CVDs) represent one of the most significant health and developmental challenges of the 21st century [2]. CVDs affect people of all ages and in all parts of the world, especially in developing and transition countries [1]. These include conditions such as heart failure, ischemic heart disease, peripheral artery and aortic disease, arrhythmias, valvular disease, and stroke, which are the leading cause of mortality in the world [3]. According to an estimate by the *American College of Cardiology* (ACC), 19.8 million people died from CVDs in 2022, and 34% of deaths occurred before the age of 70 [3]. According to the World Health Organization (WHO), in 2019, the percentage of CVDs deaths under the age of 70 in Europe was 24% (36% of men and 13% of women) and in Serbia 21% (31% of men and 12% of women) [2]. It is noticeable that the wave of the CVDs epidemic is increasingly shifting towards the working population [4]. The sharp increase in CVDs globally is due to behavioral risk factors, where we single out four most significant: tobacco use, unhealthy diet, harmful alcohol use and physical inactivity [5]. These behavioral risk factors also contribute to the development of hypertension, overweight and obesity, high blood glucose, and high cholesterol [5]. CVDs are not caused by a single risk factor, but by several of them acting together, and it is a multiplier effect [4]. Smokers with hypertension have a higher risk of cardiovascular death than non-smokers, and the risk of peripheral artery disease increases threefold. The risk of myocardial infarction is twice as high in people with hypertension as in normotensive, and in people with high blood cholesterol levels, the risk is 15 times higher. The risk of developing coronary heart disease is 3 to 4 times higher in people with hypertension, and the risk of developing an stroke is seven times higher than in people with normal blood pressure [4]. This study aimed to examine the prevalence of CVDs in relation to sociodemographic characteristics, behavioral and metabolic risk factors, and to analyse the association between presence of CVDs and self-perceived health and attitudes towards factors affecting health in the population of Serbia over the age of fifteen.

MATERIAL AND METHODS

The data presented in this paper are part of the fourth national study „Serbian Population Health Survey 2019", which was conducted in accordance with the methodology of the European Health Interview Survey (EHIS Wave 3) [6], which ensured the comparability of the health indicators of our population with the indicators of the health of the population of the European Union [6,7]. The survey did not include the population from the territory of the AP of Kosovo and Metohija [7]. This research is based on the results of the Population Health Survey, conducted at the end of 2019 by the Statistical Office of the Republic of Serbia in cooperation with the Institute of Public Health of Serbia „Dr Milan Jovanović Batut" and the Ministry of Health of the Republic of Serbia [7]. Three methods of data collection were employed: face-to-face interviews (to fill in the household info panel and to collect information about all members of the household, i.e. socio-economic characteristics of the household; questionnaire for respondents aged 15 years and more), self-filling of a questionnaire by respondents without the participation of an interviewer due to the sensitivity, e.g. alcohol consumption), and measurement of basic anthropometric characteristics (height and body weight) and blood pressure [7]. The primary target population consisted of all persons age 15 and over living in private (non-institutional) households

in the Republic of Serbia, who represent the usual population (2011 census) [7]. Persons in collective households (student and pupil dormitories, homes for children and youth with developmental disabilities, for socially disadvantaged children, for pensioners, the elderly and infirm, for disabled adults, monasteries) are excluded [7]. The sample size was calculated based on the required precision of assessments, for the assessment of the standard error of the indicator „proportion of persons prevented from performing daily activities unhindered" in accordance with the recommendations of Eurostat for conducting population health surveys [7]. A sample of 5,144 households was realized in which a total of 15,621 persons were registered, of which 13,589 persons aged 15 and over. In the final analysis, 13,178 people over the age of 15 (6,431 men and 6,747 women) were involved, which gives a response rate of 97%. Ethical standards in the Health Survey of the Population of Serbia are in accordance with the international Helsinki Declaration, improved by amendments as of 2013, as well as the legislation of the Republic of Serbia [7]. The study is academic (non commercial). All data used in this study have been approved by the Ethics Committee of the Institute of Public Health of Vojvodina (No. 01-896/3, dated September 19, 2024). For this analysis, we used statistically processed sociodemographic data (gender, age, marital status, education and income), data related to metabolic and behavioral risk factors (nutrition, treatment of high blood pressure, physical activity, smoking and alcohol consumption) and data related to self-assessment of health and factors affecting health (the impact of diet, physical activity, smoking and alcohol consumption) of the selected population in relation to CVDs. Respondents were classified as having CVDs based on a positive answer to the question about chronic diseases or conditions in the previous 12 months (myocardial infarction, coronary heart disease, or stroke). The data related to smokers, ex-smokers and non-smokers was obtained from a self-completed questionnaire. Smokers were defined as people who smoked any tobacco product (excluding electronic cigarettes or similar electronic de-

Table 1. Sociodemographic characteristics of the respondents in relation to the presence of CVDs

		CVD							
		No		Yes		Total		X^2	P
		N	%	N	%	N	%		
Gender	Male	5,750	89.4	681	10.6	6,431	100.0	4.948	0.026
	Female	5,950	88.2	797	11.8	6,747	100.0		
	Total	11,700	88.8	1,478	11.2	13,178	100.0		
Age (years)	15-24	1,515	99.7	4	0.3	1,519	100.0	1599.464	<0.001
	25-34	1,617	99.3	12	0.7	1,629	100.0		
	35-44	1,915	98.3	34	1.7	1,949	100.0		
	45-54	1,866	93.8	123	6.2	1,989	100.0		
	55-64	2,086	87.4	301	12.6	2,387	100.0		
	65-74	1,751	76.2	546	23.8	2,297	100.0		
	75-84	757	67.3	368	32.7	1,125	100.0		
	85+	193	68.2	90	31.8	283	100.0		
Marital Status	Never married	2,927	98.7	39	1.3	2,966	100.0	655.804	<0.001
	Married	6,971	88.7	885	11.3	7,856	100.0		
	Divorced/Widowed	1,778	76.3	552	23.7	2,330	100.0		
Level of education	No school and incomplete elementary school	770	72.9	286	27.1	1,056	100.0	393.086	<0.001
	Elementary school	2,085	84.4	384	15.6	2,469	100.0		
	High School	6,560	91.7	597	8.3	7,157	100.0		
	High and higher education	2,279	91.6	209	8.4	2,488	100.0		
Income	Poor	4,716	87.1	697	12.9	5,413	100.0	32.580	<0.001
	Middle	2,359	88.6	303	11.4	2,662	100.0		
	Rich	4,625	90.6	478	9.4	5,103	100.0		

vices) daily or occasionally. To illustrate the data on the treatment of high blood pressure, the four responses (yes, diet only; yes, medication only; yes, both of the above; no treatment) are grouped into two categories (yes, no). For a clearer overview of the results obtained related to self-assessment of health and factors that affect health, the five answers offered (very good, good, neither good nor bad, bad and very bad) are grouped into three categories - very good/good, neither good nor bad, and bad/very bad. Also, for the same reason, the answers to the questions regarding the impact of diet, physical activity, smoking and alcohol consumption on health (very large, large, neither large nor small, small and very small) are combined into three categories (very large/large, neither large nor small and small/very small). The assessment of the level of nutrition in the research was done on the basis of the body mass index (BMI), which is defined as a person's body weight in kilograms divided by the square of body height in meters (kg/m^2). According to the definition of the WHO, people whose BMI is in the range of 18.5 to 24.9 kg/m^2 are considered normal weight, underweight is indicated by BMI values below 18.5 kg/m^2, and values from 25 to 29.9 kg/m^2 indicate pre-obesity and obesity when the BMI is 30 kg/m^2 or more. The Statistical Package for Social Sciences – SPSS 21 was used for statistical data processing. Attributive markers are represented by frequencies and percentages. Testing of the frequency difference of attributive features was carried out using the χ^2 test. Statistically significant values are considered to be values of the significance level $p<0.05$. The results are presented in tables.

RESULTS

The research included 13,178 inhabitants (6,431 men and 6,747 women). The analysis of socio-demographic characteristics, summarized in Table 1, a statistically significant difference in the distribution of respondents in relation to the existence of CVDs was obtained in gender - a higher percentage of women (11.8%) had CVDs compared to men (10.6%). Older age groups compared to younger recorded a significant increase in the percentage

Table 2. Association of risk factors and presence of CVDs

		CVD							
		No		Yes		Total		X^2	P
		N	%	N	%	N	%		
Nutritional status	Underweight	238	94.8	13	5.2	251	100.0	148.036	<0.001
	Normal weight	3,852	92.0	336	8.0	4,188	100.0		
	Pre-obesity	3,456	87.9	477	12.1	3,933	100.0		
	Obesity	1,911	82.3	411	17.7	2,322	100.0		
Treatment of high blood pressure	Yes	2,956	73.9	1,046	26.1	4,002	100.0	19.858	<0.001
	No	124	91.2	12	8.8	136	100.0		
	Total	3.080	74.4	1.058	25.6	4.138	100,0		
Sports, fitness or recreation free time	Yes	1,353	98.1	26	1.9	1,379	100.0	0.005	0.946
	No	99	98.0	2	2.0	101	100.0		
Smoker	Yes	2,617	91.1	255	8.9	2,872	100.0	84.383	<0.001
	Former	935	81.0	219	19.0	1,154	100.0		
	No	4,133	89.0	513	11.0	4,646	100.0		
Drinking alcoholic beverages in the past 12 months	Every day or almost every day	229	84.5	42	15.5	271	100.0	138.171	<0.001
	5/6 days a week	115	94.3	7	5.7	122	100.0		
	3-4 days a week	321	91.2	31	8.8	352	100.0		
	1-2 days a week	578	93.8	38	6.2	616	100.0		
	2/3 days monthly	829	94.7	46	5.3	875	100.0		
	Once a month	703	94.6	40	5.4	743	100.0		
	Less than once a month, not in previous 12 months, never drank	4,799	87.3	699	12.7	5,498	100.0		

of CVDs, in the age group 55-64 years (12.6%), followed by 65-74 years (23.8%), with a peak of 32.7% in the category 75-84 years. Regarding marital status, 23.7% of divorcees or widowers suffered from CVDs, compared to respondents who are married or a member of an unmarried couple, of which 88.7% denied cardiovascular diseases. Results showed that increasing CVDs is inversely proportional to the level of education and income, i.e. 27.1% of respondents without school and with incomplete primary school suffer from some CVDs, as opposed to 8.3% of respondents who completed high school and 8.4% of respondents who completed the highest level of education. The proportion of CVDs in the poor population was 12.9% compared to the rich, whose percentage was 9.4%. A statistically significant difference in the presence of CVDs was found for all observed risk factors in Table 2, except for the question of sports or recreation during the week. Among obese respondents, 17.7% reported CVDs, while the percentage in normal body weight persons was 8.0%, which means that almost every fifth obese person had some CVD. Of the total number of respondents who reported having high blood pressure, among those who treated hypertension, 26.1% of them suffered from CVDs. The prevalence of CVDs in ex-smokers was 19.0%. In subjects who drink alcohol every day or almost every day, the prevalence of CVDs was the highest (15.5%). Table 3 shows the prevalence of CVDs in relation to self-perceived health and attitude towards factors affecting health. 40.1% of respondents who assessed their health as bad/very bad had CVD compared to those who assessed as very good/good (3.0%). Those who believed that nutrition had a small/very small impact on their health had the highest prevalence of CVDs (20.7%). Also, respondents who believed that physical activity has small or little impact on their health had the highest prevalence of CVD (17.5%). Among respondents who think smoking has neither a big nor a small impact on health was the highest prevalence of CVDs (12.3%).

DISCUSSION

The survey was conducted in accordance with the methodology of the European Health Interview Survey (EHIS wave 3) on 13,178 residents of Serbia aged 15 years and over with a share of 48.8% men and 51.2% women [7]. The analysis of the data obtained from this research, it was estimated that every ninth inhabitant of Serbia (11.2%) suffers from some form of CVD. These results align with findings from the 2013 Health survey of Serbia, which indicates that, similar to the populations of European Society of Cardiology (ESC) member countries and the United States, CVDs are more prevalent among those who are less educated, poorer, and older, compared to those who are highly educated, have higher

Table 3. Association of respondents attitudes about factors affecting health with the presence of CVDs

		CVD							
		No		Yes		Total		X^2	P
		N	%	N	%	N	%		
Self-perceived health	Very Good/Good	7,724	97	242	3	7,966	100.0	1933.424	<0.001
	Neither good nor bad	2,462	81	579	19	3,041	100.0		
	Very bad/Bad	870	59.9	583	40.1	1,453	100.0		
Impact of nutrition on their health	Very big/Big	10,204	89.2	1,241	10.8	11,445	100.0	18.617	<0.001
	Neither big nor small	658	85.8	109	14.2	767	100.0		
	Small/Very small	88	79.3	23	20.7	111	100.0		
Impact of physical activity on their health	Very big/Big	10,273	89.2	1,250	10.8	11,523	100.0	18.221	<0.001
	Neither big nor small	596	84.7	108	15.3	704	100.0		
	Small/Very small	94	82.5	20	17.5	114	100.0		
Impact of smoking on their health	Very big/Big	9,664	88.8	1,224	11.2	10,888	100.0	7.809	0.02
	Neither big nor small	811	87.7	114	12.3	925	100.0		
	Small/Very small	444	92.5	36	7.5	480	100.0		
Impact of alcohol consumption on their health	Very big/Big	9,514	88.9	1,185	11.1	10,699	100.0	4.784	0.091
	Neither big nor small	931	87	139	13	1,070	100.0		
	Small/Very small	474	90.3	51	9.7	525	100.0		

incomes, and are younger [8,9,10]. Our findings are consistent with studies investigating the relationship between differences in socioeconomic status and cardiovascular health in middle-income countries - Republika Srpska and Bosnia and Herzegovina, where Serbia also belongs, which found that behavioral risk factors, as well as metabolic ones, are the least represented by the highly educated and employed [11]. The obtained results are explained by the fact that a more educated population will better understand the recommendations of health organizations related to a healthier life, will have greater opportunities for employment and, therefore, make healthier choices to the issue of harmful habits.

Since 2013, when there were 29.2% of smokers in Serbia (32.6% of men and 26.0% of women) and 23.9% in Europe, the prevalence of smoking still growing. The results of our survey show that 19.0% of ex-smokers reported having CVD. These data are consistent with the Interheart study and other studies [12,13,14,15]. Although smoking is known to increase the risk of CVDs death by up to three times, the prevalence of smokers in Serbia is one of the highest in Europe (40%), close to Armenia, Georgia and Kyrgyzstan where smokers make up about 50% while in Iceland they make up only 12% of the population [2,8]. Alarmingly high percentage of Serbian residents over the age of 15 (40% of men and 39% of women) are smokers compared to 25% of current smokers over the age of 15 in Europe (32% of men and 19% of women) [2]. Of particular concern is the double percentage of current smokers among women in Serbia compared to Europe (39% vs. 19%) [2,8]. Tobacco use among women around the world has increased dramatically over the past century. The prevalence of tobacco use among women was 6% in 1924 and 33% in 1965 to gradually decrease to about 18% in the United States [16]. The tobacco industry is increasingly promoting smoking among women. Cigarettes became a sign of their freedom and emancipation, and later a means of losing weight [16]. The high prevalence of smoking among women in Serbia is likely a result of cultural and sociological factors, which must be urgently addressed. One in three women and one in four men, as well as more than 80% of adolescents in the world, are not physically active enough to achieve good health [5]. As early as 2000, the physical inactivity of the Serbian population aged 35 to 39 was twice as high as that of the population of Australia [15,17]. This negative trend is also present in 2022 compared to the population of Europe, with results showing that in Serbia 45% of the population over the age of 18 is physically insufficiently active compared to 25% of Europeans of the same age [2]. Despite the well-established link between physical inactivity and an increased risk of CVDs, our study did not find a statistically significant difference in frequencies of CVDs between the respondents who practesed sport or fitness in their free time and other who did not [8]. Hypertension is the most significant metabolic risk factor for CVDs. An estimated 1.28 billion adults between the ages of 30 and 79 worldwide have hypertension [5,8,18]. Two-thirds of the world's people with hypertension live in low- and middle-income countries [8,3]. The reasons lie in an unhealthy diet (excessive consumption of salt, a diet high in saturated and trans fats), physical inactivity, tobacco and alcohol consumption, being overweight, but also the ever-present stress that brings an increasingly fast pace of life [18]. Between 1990 and 2019, the prevalence of treated hypertension in ESC member countries increased in both women (from 32% to 57%) and men (from 19% to 45%) [8]. In 2019, 38% of men and 47% of women aged 30 to 79 years treated hypertension worldwide, 48% of men and 59% of women in Europe, and 50% of men and 68% of women in Serbia [2]. The prevalence of high blood pressure in the Serbian population in 2019 compared to 2013 was almost the same (46% vs. 47.5%) [2,10]. Despite the increasing prevalence of hypertension treatment, only 21% of patients with hypertension in the world, 26% in Europe and 25% in Serbia keep it under control, in line with the results of our study in which every fifth treated subject has CVD [1,18]. Obesity is a growing risk factor for CVDs in high-income countries for decades and is now growing rapidly in both middle- and low-income countries as a result of economic development and urbanization [5,19]. A sharp increase, especially among young people, is due to a sedentary lifestyle, physical inactivity and consumption of large amounts of industrially processed foods. The prevalence of obesity worldwide more than doubled between 1990 and 2022 [19]. In our study, the prevalence of CVDs in the pre-obese adult population was 12.1% and in the obese population of 17.7%, which is consistent with

the results of other studies [13,14,15]. It is worrying that the more than half population (57.1%) aged 15 and over in Serbia were overweight (pre-obese (36.3%) and obese (20.8%)) [7]. In Europe the situation was very similar (56% of the population overweight), while globally there were 43% of adults who were overweight (31% in the Southeast Asian and African regions, up to 67% in the Americas) [2,19]. Harmful alcohol use is a widespread problem around the world, especially in Europe where alcohol is responsible for 240,000 to 290,000 deaths each year [8]. Global alcohol consumption per capita in 2019 was 9.2 liters per year, ranging from less than 2 l in Azerbaijan and Turkey, to more than 11 l in Austria, Bulgaria, the Czech Republic, Estonia, France, Latvia and Slovenia, while in Serbia it was 8 l per year per capita [2,8]. The consumption of alcohol and tobacco products is largely culturally imposed in this geographical area, which can make it difficult, but not impossible, to implement prevention programs to combat risk factors. High alcohol intake has been linked to an increased risk of cardiovascular disease. Harmful alcohol use is a significant health, economic and social problem due to consequences such as accidents, traffic accidents, violence, domestic problems, unemployment [10]. The results in our study showed that among subjects who drank alcohol every day or almost every day, the prevalence of CVDs was the highest (15.5%). The role of positive attitudes and health education in avoiding risk factors for CVDs for an individual has been shown by over 88% of respondents who are aware of the importance of a healthy diet, physical activity, avoiding smoking and alcohol are not affected by CVDs. Of all the risk factors, the most frequent in the population with CVDs are hypertension and obesity, while physical inactivity is the least present. Our results are in line with the WHO's assessment of the impact of the NCDs on CVDs from 2021 [5,20]. Investing in health interventions can yield significant returns [5]. According to the WHO's economic estimate, investing $1 in a healthy diet yields $11.93, in the prevention of alcohol abuse a return of $8.32, in the prevention of smoking a return of $7.11, in physical activity a return of $3.2, and in the treatment of cardiovascular disease and diabetes a return of $3.12 [5]. With this program, nearly 10 million cases of heart attack and stroke would be prevented and nearly 7 million lives saved [5]. While our cross-sectional study offers valuable insights, it is limited by the reliance on self-reported data, and does not account for the simultaneous effects of multiple risk factors. Also, the results of our research do not provide data on the simultaneous multiple effects of risk factors for CVDs, only individually. Still, on the other hand, they indicate the importance of the data obtained on the representative sample for the entire territory of Serbia, which is comparable to the countries of the European Union. The results obtained in our research can be used to identify a priority health problem and develop a preventive program aimed at one or more risk factors for CVDs.

CONCLUSION

One in nine residents of Serbia suffers from cardiovascular diseases. There are significant differences in the prevalence of cardiovascular diseases in relation to gender, age, income, and education, and the prevalence was significantly higher among respondents with risk factors such as obesity, hypertension, alcohol consumption and smoking. Additionally, a lack of awareness about modifiable risk factors among individuals with CVD highlights the need for targeted prevention programs. Strengthening cardiovascular health education and developing national health policies are essential steps toward improving public awareness and achieving the Sustainable Development Goals.

CONFLICT OF INTEREST

All authors declare no conflict of interest.

ACKNOWLEDGEMENT

The authors are grateful to the Statistical Office of the Republic of Serbia, the Institute of Public Health of Serbia „Dr. Milan Jovanović Batut" and the Ministry of Health of the Republic of Serbia, who jointly conducted „The 2019 Serbian National Health Survey" and thus provided the database that was used in this study. The right to use the aforementioned database, as a scientific institution, is granted to the Institute of Public Health of Vojvodina. Additionally, all authors would like to thank Zoran D. Topalov, a graduate electrical engineer and head of the Department for technical and other related tasks at the Institute of Public Health of Vojvodina, for the statistical

data processing.

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Socijalno-demografske razlike u prevalenciji kardiovaskularnih bolesti i povezanosti sa faktorima rizika kod stanovnika Srbije

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KRATAK SADRŽAJ

Uvod: Kardiovaskularne bolesti su vodeći uzrok mortaliteta u svetu. Cilj ovog istraživanja bio je da se ispita rasprostranjenost kardiovaskularnih bolesti u odnosu na socio-demgrafske karakteristike, bihejvioralne i metaboličke faktore rizika, kao i da se analizaira povezanost prisustva kardiovaskularnih bolesti i samoprocene zdravlja i stavova ispitanika o faktorima koji utiču na zdravlje kod stanovnika Srbije starijih od 15 godina.

Materijal i metode: Analizirani su podaci Nacionalne studije istraživanja zdravlja stanovništva Srbije iz 2019. godine, na uzorku od 13.178 ispitanika starijih od petnaest godina, koja je sprovedena u skladu sa metodologijom Evropske ankete o zdravlju (European Health Interview Survey wave 3). Za našu analizu su korišćeni podaci o socio-demografskim karakteristikama, metaboličkim i bihejvioralnim faktorima rizika i za samoprocenu zdravlja i faktora koji utiču na zdravlje u odnosu na kardiovaskularne bolesti. Testiranje razlike frekvencija atributivnih obeležja vršeno je primenom X^2 testa. Statistički značajnim se smatraju vrednosti nivoa značajnosti $p<0.05$.

Rezultati: Analizom podataka dobijenih ovim istraživanjem, procenjeno je da svaki deveti stanovnik Srbije (11,2%) boluje od nekog oblika kardiovaskularnih bolesti, pri čemu je statistički značajna razlika u rasprostranjenosti kardiovaskularnih bolesti uočena u odnosu na pol, starost, prihode, obrazovanje, samoprocenu zdravlja i stavova o zdravlju i faktora rizika izuzev fizičke aktivnosti.

Zaključak: Uočava se da je visoka prevalencija kardiovaskularnih bolesti prisutna kod preventabilnih faktora rizika (kao što su gojaznost, hipertenzija, konzumiranje alkohola i pušenje) i ukazuje na neophodnost kreiranja preventivnih programa za jačanje kardiovaskularnog zdravstvenog obrazovanja.

Ključne reči: kardiovaskularne bolesti, faktori rizika, socio-demografski faktori, samoprocena zdravlja

Received: November 1, 2024
Accepted: November 23, 2024