PREVALENCE OF RISK FACTORS FOR DEVELOPMENT OF CARDIOVASCULAR DISEASES IN URBAN AND RURAL AREAS OF EASTERN CROATIA: A CROSS-SECTIONAL STUDY

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SUMMARY

Objective: Cardiovascular diseases are the leading global cause of death. Due to the disparities in cardiovascular risk factors between rural and urban populations, this study aims to assess the differences in the prevalence of risk factors in urban and rural areas of eastern Croatia.

Methods: The cross-sectional study included 280 participants (140 from urban and 140 from rural areas) registered at studied general practice offices. Methods included e-health records, questionnaire, physical examination methods, and blood sampling for laboratory tests.

Results: The most common risk factors among participants were elevated total cholesterol (83.6%), elevated LDL cholesterol (81.8%), increased body mass index (75.0%), increased waist-hip ratio (82.9%), increased waist circumference (63.2%), and arterial hypertension (70.1%). The rural participants had a significantly higher prevalence of arterial hypertension ($p = 0.023$), increased body mass index ($p = 0.004$), increased waist circumference ($p = 0.004$), increased waist-hip ratio ($p < 0.001$), and increased LDL cholesterol ($p = 0.029$), while the urban participants had a significantly higher prevalence of insufficient physical activity ($p < 0.001$).

Conclusions: In the examined sample, the prevalence of cardiovascular risk factors is generally high. Participants from rural areas are significantly more susceptible to cardiovascular risk factors than participants from urban areas.

Key words: cardiovascular disease, risk factors, rural population, urban population

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https://doi.org/10.21101/cejph.a7709

INTRODUCTION

Cardiovascular diseases (CVDs) are the leading public health problem globally, while mortality rates are highest in low- and middle-income countries (1). The Republic of Croatia has a significantly higher mortality rate from cardiovascular diseases than the European Union average (2). Based on the Systemic Coronary Risk Estimation, the European Society of Cardiology categorized Croatia as a country of high CVDs risk (3).

The possibility of influencing the modifiable cardiovascular (CV) risk factors and thus reducing morbidity and mortality from CVDs is the subject of numerous latest scientific studies. The results of the studies indicate a significant prevalence of CV risk factors in various countries, and differences in the prevalence of CV risk factors between participants from urban and rural areas within a country (1, 4, 5). These differences possibly appeared due to providing better access to health care, clean household energy, improved water supply, and sanitation in urban areas compared to rural areas. However, urban areas are characterized by increased ambient air pollution, lack of access to high-quality food, and low levels of physical activity (6). Systematic reviews and meta-analyses (6, 7) showed that the urban population is associated with a higher prevalence of type 2 diabetes, while the rural population is associated with a higher prevalence of increased body mass index (BMI) (5). Meanwhile, in high-income countries, the prevalence of CV risk factors is higher among the rural population than the urban population (6).

In Croatia, several studies have been conducted to determine the prevalence of CV risk factors and regional patterns (8–11). According to the Croatian Adult Health Survey (CAHS) (participants aged 18 years or older), there are substantial regional differences in the cardiovascular risk burden (heart attack, stroke, blood pressure, overweight/obesity and risky behaviours) with higher prevalence in the continental than in the coastal Croatia

(9). The Cardiovascular Risk and Intervention Study in Croatia – family medicine (CRISIC-fm) involved participants aged 40 to 69 years and also confirmed regional differences. The study found that there were higher systolic and diastolic blood pressures, a higher prevalence of intense physical activity, higher levels of LDL-cholesterol, and higher BMI and increased waist circumference (WC) in the continental rural population. However, the inclusion of the continental population of eastern Croatia was lacking (11).

Although results of cardiovascular assessment studies indicate need for systematic approach, there are no national preventive programmes in the Croatia for reduction of CV risk factors (2). Primary health care, available to almost the entire population, covers about 97% of the Croatia population through family medicine. So, well national preventive programmes realised on the level of family medicine would probably be the best solution for decreasing prevalence of CV risk factors (2). A review of the relevant domestic and foreign literature shows an obvious lack of studies investigating the prevalence of CV risk factors, especially at the level of family medicine, and the underrepresentation of the continental population of eastern Croatia in these studies.

Therefore, this study aimed to examine the prevalence of CV risk factors (arterial hypertension, diabetes mellitus, dyslipidaemia, cigarette smoking, alcohol consumption, increased BMI, increased WC, increased waist-hip ratio (WHR), insufficient physical activity, stress) at the level of two comparable general practice (GP) offices in urban and rural areas of eastern Croatia, and to examine whether there are differences in the prevalence of the risk factors between urban and rural urban participants in that sample.

MATERIALS AND METHODS

Study Design

A three-month cross-sectional study was conducted in two GP offices. The selection criteria for the GP offices were: area of Osijek-Baranja County (eastern Croatia); one GP office in an urban area and the other in a rural area; both GP offices have a sufficient and approximately similar number of service users meeting the inclusion criteria (urban – 1,720; rural – 1,695).

Participants

The survey included 280 participants. The criteria for inclusion of participants in the study were: participants registered at studied GP offices; participants' age group was 45–69 years (included the age most exposed to CVD). The exclusion criterion was a previous diagnosis of a stroke or myocardial infarction. To observe statistical differences with a significance level of 0.05 and a test strength of 80%, 140 participants from urban and 140 participants from rural areas were required for proper statistical processing (G*Power software).

Methods

A questionnaire developed for this study was used. In addition to participants' general characteristics (age, gender), the questionnaire contained questions about the participants' behaviours and habits. When asked about physical activity, participants could choose one of three answers given by the criteria of the World Health Organisation (WHO) (12): daily (at least 30 minutes of moderate-intensity aerobic physical activity); two to three times per week (at least 75 minutes of vigorous-intensity aerobic physical activity per week); and occasionally (less than 75 minutes per week). The last response was considered insufficient physical activity. The category of smokers included individuals who smoke cigarettes, regardless of the number of cigarettes smoked per day. When asked about the frequency of consumption of alcohol, participants chose one of the following answers: less than once a month (rare occasions); once a month; once a week; and daily. Before filling out the questionnaire, based on Food-Based Dietary Guidelines in Europe (13) the tolerable daily intake (grams) of alcohol for men (20 g) and women (10 g) was explained with help of visual diagram to participants, with an additional explanation of the dose (10 g of alcohol corresponds to 0.125 L of wine, 0.25 L of beer, or 0.03 L of hard liquor). All participants who consumed alcohol above the tolerated daily dose (once a month) were placed in the risk category. Participants' stressful experiences in the past year were assessed using the Holmes-Rahe stress scale (14), which consists of a list of 43 stressful life events ordered hierarchically and scored with points, from most stressful (death of spouse – 100 points) to least stressful (minor legal violations – 11 points). Less than 150 points (first level) indicates a low frequency of stressful events and minimal risk of illness, from 150 to 299 points (second level) indicates moderate frequency and risk of illness, while 300 and more points (third level) indicates high frequency of stressful events and high risk of illness. The second and third levels were interpreted as pathological in the data analysis.

In addition to the questionnaire, the method of physical examination was used for data collection. Kilograms (kg) and height (m) for body mass index were measured on a mechanical scale with a stadiometer. From the values obtained, BMI was calculated and interpreted according to WHO and NIH guidelines (15) (≤ 24.99 – normal body weight; 25–29.99 – overweight; ≥ 30 – obese). All individuals with a BMI index of 25 kg/m^2 and over were included in the increased BMI category. The circumference of the waist and hips in cm was measured for each subject. From the obtained values, the waist-hip ratio was calculated as the ratio of waist circumference (cm) and hip circumference (cm). All subjects with WHR above 0.8 for women and 0.9 for men were included in the category with elevated WHR (16). Increased WC is also determined according to the guidelines of WHO as WC > 88 cm for women, WC > 102 cm for men (16).

Each participant's blood pressure was measured. The prevalence of hypertension (systolic > 140 mm/Hg or diastolic > 90 mm/Hg) was determined by reviewing e-health records of participants, included those who had diagnose of arterial hypertension (AH) by their primary care physician, participants who had measured hypertensive values at least three times in the previous three months and/or had elevated blood pressure on the day of the study examination. If they had elevated blood pressure values on the day of examination for the first time, they were checked three more times over a period of four weeks (in home conditions per patronage or the participants who had validated – calibrated sphygmomanometers, which are reliable for diagnosing hypertension, measured their own blood pressure) and counted as hypertensive if the values were still elevated in subsequent measurements, according to the European Society of Cardiology (ESC) and European Society of Hypertension (ESH) guidelines for the management of arterial hypertension (17). We took mean of three times measured blood pressure on both upper arms because of easier explanation for those participants who measured blood pressure themselves (who had hypertensive values for the first time in our physical examinations).

In addition to the physical examination, a blood sample was obtained from the cubital vein for medical biochemical tests to determine total cholesterol, LDL cholesterol, HDL cholesterol, triglycerides, and fasting plasma glucose. The recommended values according to the European guidelines ESC, EAS, ESH, ISBM, ESGP/FM, and EHN (18) were used for the physiological values of the results (total cholesterol < 5.0 mmol/L; LDL cholesterol < 3.0 mmol/L; HDL cholesterol > 1.0 mmol/L for men and 1.2 mmol/L for women; triglycerides < 1.7 mmol/L).

The diabetes mellitus category consisted of participants with established insulin-dependent or non-insulin-dependent diabetes mellitus and participants who had at least two elevated fasting plasma glucose levels in their medical records with elevated fasting plasma glucose levels on the day of the study examination. A normal fasting plasma glucose result is ≤ 6.9 mmol/L according to the WHO (19).

Participants who have therapy for hypertension, dyslipidaemia and diabetes are included in the total number of respondents with the above diagnoses and they are also included in the prevalence. The risk of CVD was calculated for each participant according to SCORE 2 in accordance with ESC guidelines (20).

Data Collection

Participants from both clinics were selected using a computer randomization procedure (one in ten participants with circular repetition of the procedure) from the e-record, with a predefined criterion/filter: age 45–69 years. The method was used until the required number of participants (G*Power) was reached in rural and urban areas. Participants were invited by phone. We contacted 317 potential participants (161 in urban and 156 in rural areas) of whom 21 (13.0%) refused to participate in urban and 16 (10.3%) in rural areas. Response rate was 87% in urban and 90% in rural areas.

Filling out the questionnaire took on average 20 minutes and was not time limited. According to the researcher's instructions, each respondent had been fasting for 12 hours before blood sampling.

Ethical Considerations

The participants were informed about the details and ethical aspects of the study before completing the questionnaire. The procedures used in this study were under the ethical standards of the Ethics Committee of the Faculty of Medicine Osijek (No. 2158-61-07-17-38). Informed consent had been obtained from all study participants before they participated in the study.

Statistical Analysis

Categorical data were presented using absolute and relative frequencies. Differences in categorical variables were tested using the Chi-square test. Normality of distribution for numerical variables was tested using the Shapiro-Wilk test. Continuous data were described using mean and standard deviation. The t-test was used to test differences in continuous variables between two independent groups (rural vs. urban), with reported differences and 95% confidence intervals (CI). All p values were two-tailed. The significance level was set at alpha = 0.05. Data analysis was performed using MedCalc® statistical software version 22.018 (MedCalc Software Ltd, Ostend, Belgium*) and IBM SPSS 23 (IBM Corp. Released 2015. Armonk, NY: IBM Corp.). The results after statistical analysis are described according to the guidelines for biomedical research**.

RESULTS

Socio-demographic Characteristics of Participants and Prevalence of Risk Factors Among Rural and Urban Areas

A total of 280 participants participated in our study (140 participants from urban areas and 140 from rural areas). Participants from rural and urban areas were comparable per age ($p>0.980$) and gender ($p=0.632$). Most of them were between the ages of 55 to 59 in both areas (32.9% rural vs. 30.0% urban) (Table 1).

Participants from urban areas had elevated total cholesterol (82.1%), followed by elevated LDL cholesterol (76.4%), increased WHR (73.6%), and increased BMI (67.1%) as the most common CV risk factors. Among participants from rural areas, increased WHR (92.1%), elevated LDL cholesterol (87.1%), elevated total cholesterol (85.0%), elevated BMI (82.9%), and elevated WC (71.4%) were the most common CV risk factors. The prevalence of diabetes in both populations was 18.6%. In both groups, low HDL cholesterol and alcohol consumption were the least common risk factors.

Four risk factors were significantly more common in participants from rural areas than in participants from urban areas: arterial hypertension ($p=0.023$), elevated LDL cholesterol ($p=0.029$), increased BMI ($p=0.004$), increased WC ($p=0.004$), and increased WHR ($p<0.001$). Only one CV risk factor, insufficient physical activity, was significantly more common in participants from urban areas ($p<0.001$). Alcohol consumption was slightly more common ($p=0.050$) in participants from rural areas, while low HDL cholesterol was slightly more common ($p=0.050$) in participants from urban areas. Furthermore, normal value of WHR was less significant in rural than urban areas in both genders ($p<0.050$).

In the total sample, among hypertensive participants on antihypertensive therapy there were 65.3% of participants, 8.9% without therapy and 25.7% newly discovered. More newly diagnosed hypertensions were in rural than in urban areas (30.9% vs. 19.6%).

*https://www.medcalc.org
**https://www.equator-network.org

Table 1. Socio-demographic characteristics of participants in rural and urban areas (N = 280)

	Rural n = 140 n (%)	Urban n = 140 n (%)	Total n (%)	p-value*
Gender				
Male	69 (49.3)	65 (46.4)	134 (47.9)	0.632
Female	71 (50.7)	75 (53.6)	146 (52.1)	
Age				
45–49	22 (15.0)	23 (16.4)	44 (15.7)	> 0.98
50–54	28 (20.0)	32 (22.9)	60 (21.4)	
55–59	46 (32.9)	42 (30.0)	88 (31.4)	
60–64	26 (18.6)	21 (15.0)	47 (16.8)	
65–69	20 (14.3)	21 (15.1)	41 (14.6)	

*Chi-squared test

Among the participants with inadequately treated hypertension on antihypertensive therapy, there were significantly more rural than urban participants ($p < 0.001$). Among the adequately treated hypertension, there are significantly more participants from the urban areas ($p < 0.001$). In both areas, there was significantly more inadequately treated hypertension ($p < 0.001$).

Analysis of the prevalence of each CV risk factor per participant from urban and rural areas showed no participant without or with only one CV risk factors. For this analysis total cholesterol, HDL, LDL cholesterol, and triglycerides were included in one category – dyslipidaemia. Most participants, 67 (23.9%), had six CV risk factors, of whom 38 (27.1%) participants were from rural areas and 29 (20.7%) from urban areas. A total of 58 (20.7%) participants had seven risk factors, of whom 33 (23.6%) were from rural areas and 25 (17.9%) from urban areas. A total of 33 (11.8%) participants had eight risk factors, of whom 15 (10.7%) were from rural areas and 18 (12.9%) from urban areas. Seven participants had nine risk factors, of whom 6 (4.3%) were from rural areas and 1 (0.7%) from urban area. Ten risk factors were found only in one participant from rural area.

According to SCORE 2 significantly more participants had high, then moderate risk of CVD in rural areas while low risk of CVD was significantly more prevalent in urban areas ($p = 0.042$) Participants had high (57.1%), followed by moderate (33.6%) and low overall CV risk (9.3%) (Table 2).

Prevalence of CV Risk Factors in Total Sample

The analysis of the total sample for the prevalence of examined CV risk factors was performed. The most common CV risk factors were elevated total cholesterol (83.6%), increased WHR (82.9%), and LDL cholesterol (81.8%), increased BMI (75%), arterial hypertension (72.1%), and increased WC (63.2%) (Fig. 1).

Prevalence of Measured Values of CV Risk Factors

The mean measured values (higher than recommended values) most of CV risk factors were significantly higher in rural participants: systolic pressure, diastolic pressure, LDL cholesterol,

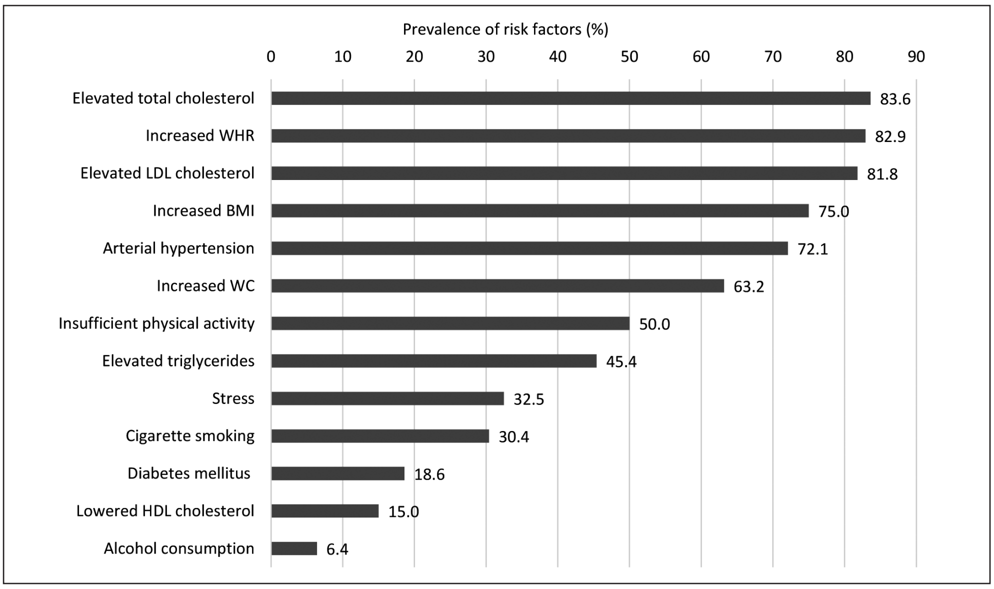

***Fig. 1.** Prevalence of CV risk factors among participants (N = 280).*

Table 2. Differences in prevalence of risk factors among participants from rural and urban areas (N = 280)

	Rural n = 140 n (%)	Urban n = 140 n (%)	Total n (%)	p-value*
Cardiovascular risk factors				
Arterial hypertension	110 (78.6)	92 (65.7)	202 (72.1)	0.023
Elevated total cholesterol	119 (85.0)	115 (82.1)	234 (83.6)	0.629
Elevated LDL cholesterol	122 (87.1)	107 (76.4)	229 (81.8)	0.029
Lowered HDL cholesterol	15 (10.7)	27 (19.3)	42 (15.0)	0.050
Elevated triglycerides	59 (46.5)	68 (48.6)	127 (45.4)	0.337
Diabetes mellitus	32 (22.9)	20 (14.3)	52 (18.6)	0.090
Cigarette smoking	42 (49.4)	43 (50.6)	85 (30.4)	> 0.99
Alcohol consumption	13 (9.3)	5 (3.6)	18 (6.4)	0.050
Increased BMI	116 (82.9)	94 (67.1)	210 (75.0)	0.004
Increased WHR	129 (92.1)	103 (73.6)	232 (82.9)	< 0.001
Increased WC	100 (71.4)	77 (55.0)	177(63.2)	0.004
Insufficient physical activity	56 (40.0)	84 (60.0)	140 (50.0)	< 0.001
Stress	52 (37.1)	39 (27.9)	91 (32.5)	0.126
Normal WHR (n = 48)				
Female (≤ 0.8)	7 (63.6)	26 (70.3)	33 (68.8)	< 0.001
Male (≤ 0.9)	4 (36.4)	11 (29.7)	15 (31.2)	0.061
Increased WC				
Female (> 88 cm)	56 (80.0)	42 (56.0)	98 (67.6)	0.002
Male (> 102 cm)	44 (63.8)	35 (53.8)	79 (59.0)	0.243
Hypertension (n = 202)				
AH from earlier	76 (60.0)	74 (80.4)	150 (74.3)	0.081
AH newly diagnosed	34 (40.0)	18 (19.6)	52 (25.7)	
Hypertension (n = 150)				
AH with drug therapy	66 (60.0)	66 (71.7)	132 (65.3)	0.800
AH without drug therapy	10 (9.1)	8 (8.7)	18 (8.9)	
Antihypertensive therapy (n = 132)				
Inadequately treated AH	64 (97.0)	49 (74.2)	113 (85.6)	< 0.001
Adequately treated AH	2 (3.0)	17 (25.8)	19 (14.4)	
Number of risk factors				
1	0 (0.0)	0 (0.0)	0 (0.0)	0.115
2	1 (0.7)	3 (2.1)	4 (1.4)	
3	5 (3.6)	5 (3.6)	10 (3.6)	
4	13 (9.3)	26 (18.6)	39 (13.9)	
5	28 (20.0)	33 (23.6)	61 (21.8)	
6	38 (27.1)	29 (20.7)	67 (23.9)	
7	33 (23.6)	25 (17.9)	58 (20.7)	
8	15 (10.7)	18 (12.9)	33 (11.8)	
9	6 (4.3)	1 (0.7)	7 ((2.5)	
10	1 (0.7)	0 (0.0)	1 (0.4)	
Risk of CVD according to SCORE 2				
Low	7 (5.0)	19 (13.6)	26 (9.3)	0.042
Moderate	51 (36.4)	43 (30.7)	94 (33.6)	
High	82 (58.6)	78 (55.7)	160 (57.1)	

*Chi-squared test

Table 3. Differences in mean values of measured parameters among participants from urban and rural areas (N = 280)

	Rural Mean (SD)	Urban Mean (SD)	Difference	95% CI for mean	p-value*
Risk factor (diagnostic parameters)					
Systolic pressure (mmHg)	154.86 (22.03)	143.54 (18.61)	−11.32	−16.12 to −6.52	< 0.001
Diastolic pressure (mmHg)	93.54 (10.34)	89.29 (10.36)	−4.25	−6.69 to −1.81	< 0.001
Total cholesterol (mmol/L)	6.34 (1.32)	6.03 (1.14)	−0.30	−0.59 to −0.01	0.039
LDL cholesterol (mmol/L)	4.56 (1.22)	3.80 (1.03)	−0.76	−1.02 to −0.49	< 0.001
HDL cholesterol (mmol/L)	1.35 (0.19)	1.43 (0.41)	0.08	0.01 to 0.15	0.043
Triglycerides (mmol/L)	2.94 (2.23)	1.85 (1.03)	−1.10	−1.51 to −0.69	< 0.001
Fasting plasma glucose (mmol/L)	5.72 (1.28)	5.40 (0.88)	−0.32	−0.57 to −0.05	0.020
BMI (kg/m^2)	29.51 (4.31)	27.62 (4.58)	−1.89	−2.94 to −0.84	< 0.001
Waist circumference (cm)	101.84 (12.89)	97.16 (15.93)	−4.68	−8.10 to −1.27	0.007
Hip circumference (cm)	104.26 (7.52)	103.99 (9.06)	−0.27	−2.23 to 1.69	0.789
WHR	0.98 (0.11)	0.93 (0.11)	−0.05	−0.07 to −0.02	< 0.001
WHR					
Male	1.04 (0.09)	0.99 (0.09)	−0.05	−0.07 to −0.01	0.004
Female	0.92 (0.09)	0.88 (0.11)	−0.04	−0.07 to −0.01	0.023

SD – standard deviation; *t-test

triglycerides, BMI, WHR ($p < 0.001$), WC ($p = 0.007$), and total cholesterol ($p = 0.039$).

Mean WHR was significantly higher among men from rural ($p = 0.004$) than men from urban areas and among woman from rural ($p = 0.023$) than woman from urban areas (Table 3).

DISCUSSION

The population in the focus of this research was aged 45–69 years in which the most common harmful CV events occur. The results of this study showed a high prevalence of AH among the participants, with significantly higher prevalence among participants from rural areas (78.6%) than in urban areas (65.7%). Despite the stable global age-standardized prevalence, the number of people aged 30–79 years with hypertension doubled from 1990 to 2019. In Europe, the AH prevalence in 2019 was the highest in Central and Eastern Europe, while hypertension prevalence among women was the lowest in Western Europe (21). Meta-analysis (6) showed a higher prevalence of hypertension among the rural population compared to the urban population in low-income and middle-income European countries. This phenomenon is caused by young people out-migration, consequently increasing older age structure, and by environmental and lifestyle changes associated with urbanization (6). Previously conducted studies in Croatia confirm increase in the prevalence of AH (9). In the CRISIC-fm study (age group 40–69), the hypertension prevalence in continental Croatia was 69%, in urban areas 63%, and in rural areas 74.5% (11). However, high prevalence observed in the CRISIC-fm study might be due to the biased sample used. The first 55 health service users aged 40 years or older who visited the clinic for any reason were selected for the study. This method of sampling increases the possibility of selecting participants with a predetermined diagnosis of AH (or any other condition included in the study). In contrast to the CRISIC-fm study (11), the mean systolic blood pressure values measured in our study indicate a hypertensive value in participants from both areas, while elevated diastolic pressure values were recorded only in participants from rural areas.

Among the participants with poorly controlled AH on antihypertensive therapy, there were significantly more rural than urban participants. In our sample, there were more newly diagnosed AH in the rural areas. This may be a consequence of less availability of doctors, lower level of education and awareness of the importance of treating risk factors in the countryside than in the city. However, the high prevalence of poorly regulated hypertension in both areas may also indicate lack of awareness and/or lack of interest among general practitioners about the need to prevent CVD, which is in line with the findings of earlier research (22).

Most participants in our sample had hyperlipidaemia, with elevated levels of total cholesterol in 83.6% of participants and elevated triglyceride levels in 45.4% of participants, with no differences according to the place of residence. Elevated levels of LDL cholesterol were found in 81.8% of participants and were significantly more prevalent among participants from rural areas (87.1%) than from urban areas (76.4%). Systematic review and meta-analysis indicate that adults' exposure to unhealthy food may differ across urban and rural areas, influencing blood lipid levels via dietary intake (7). According to the CRISIC-fm study, increased LDL-cholesterol levels in continental rural areas in Croatia are caused by nutrition patterns and population migration (11). The population of Eastern Croatia is well known for its traditional continental diet, which is abundant in saturated fats, concentrated carbohydrates and salt and which is widely accepted in both areas, although more in rural than in urban areas. (23).

Fasting plasma glucose levels in our sample were elevated in 18.6% of participants, with no significant difference according to their place of residence, although the frequency was slightly higher in participants from rural areas. In the CRISIC-fm study (11) elevated total cholesterol is more common in urban areas, and hyperglycaemia is more common compared to the results of this study. Those results could be a consequence of the sampling method mentioned earlier. In addition, in the CRISIC-fm study, there were significantly more participants from continental urban areas than from rural areas (74% vs. 26%).

In this study, 75% of the participants had increased BMI, and significantly more were from rural areas. Increased WC was significantly prevalent in rural areas. This finding shows that abdominal obesity, as an excellent indicator of cardiometabolic risk, is more common in our sample in the rural population. Also the increased WHR had significantly more participants from rural than from urban areas. Nowadays, the fastest increase in BMI comes from rural rather than urban areas (7). Specific changes, referred to as 'urbanization of rural life' have contributed to an increase in BMI (24). In middle-income countries, agriculture is increasingly mechanized; road infrastructure improvement increased the use of cars for rural transport; services (e.g., water connection) have become common in rural areas; and some household tasks are no longer needed. Furthermore, higher incomes due to economic growth influence more spending on food and higher caloric intake. The consumption of processed carbohydrates increases more in rural rather than urban areas, where such foods are becoming more available (24). According to the WHO European Regional Obesity Report 2022, increased BMI in adults has reached epidemic proportions (25). The WHO estimates that 59% of adults in the European Region have increased BMI. The highest levels of increased BMI are recorded in the Mediterranean and Eastern European countries (25). The proportion of Croatians with increased BMI deviates from the European average in all age groups, with a larger proportion in the 50–64 age group (26). According to the Croatian study, almost 60% of the Croatian adult population has increased BMI (10). The reasons for differences in results may be the inclusion of a younger population in the previous study (on the opposite, most of our participants were in the 50–55 and 56–59 age groups) and lower coverage of participants from rural areas and participants from eastern Croatia.

More than a quarter of the world's adult population is insufficiently active (12). Insufficient physical activity was prevalent in 50% of participants in this study, with a higher prevalence in urban areas (60%) than in rural areas (40%). Meeting physical activity guidelines is less likely for the rural than the urban population (27). However, it is necessary to consider domain-specific patterns in physical activity among rural and urban populations in different countries since both populations meet physical activity guidelines differently (e.g., in low-income countries, people meet physical activity guidelines during more work/household activity, and in high-income countries during more leisure-time physical activity) (27). Therefore, the rural population, compared to the urban population, might achieve more physical activity through domestic or occupational tasks (28). According to the CAHS study, insufficient physical activity was found in 26.8% of participants in eastern Croatia and was more prevalent in urban areas (29). However, according to the CRISIC-fm study, insufficient physical activity was noticed in 36% of participants in continental Croatia, with no significant difference regarding the place of residence (11). Possible reasons for the high prevalence of insufficient physical activity among participants from this study compared with previous studies are the differently defined criteria for insufficient physical activity and the lower coverage of participants from eastern Croatia.

Stress is another major CVDs risk factor, more so when associated with insufficient physical activity (30, 31). CVD affects 40% of the population exposed to stressful environments (30). In this study, the magnitude of stress (stressful events that are considered to cause disease as they exhaust the individual's adaptive mechanisms) were tested. The study showed that 32.5% of the participants had a pathological stress level. Unexpected results emerged when comparing participants from urban and rural areas. It was found that participants from rural areas (37.1%) were more stressed than participants from urban areas (27.9%). The results may be a consequence of more stressful life events in rural areas than in urban areas: uncertain sources of basic needs in conditions of economic stagnation, which is more pronounced in small agricultural businesses, frequent change or loss of employment, lower availability of leisure activities, social affirmation, and a lower level of education.

According to Bjartveit, even light smokers (1–4 cigarettes per day) are at higher risk of death from ischaemic heart disease and other CVDs (32). Cigarette smoking was found in 30.4% of participants in this study, with no significant differences between rural and urban areas, although slightly more participants smoked in urban than rural areas. The results of the CRISIC-fm study in continental Croatia indicate 16.7% of smokers, with a significantly higher prevalence in urban areas than in rural areas (11). The results of this study represent a higher smoking population which points to the need for active planning and implementation of prevention programmes in primary health care.

The results of CVD risk calculation according to SCORE 2 also showed a significantly higher prevalence of high and moderate risk in rural areas than in urban areas, while low CVD risk is more prevalent in urban areas in our study. Also, participants had high (57.1%), followed by moderate (33.6%) and low overall CV risk (9.3%). In the CRISIC-fm study, participants aged 40 to 69 years had moderate (40.2%), followed by high and very high (33.0%), and low (25.9%) overall CV risk. A significant difference was not found in overall CV risk between participants in continental and coastal Croatia, nor by the place of residence area (rural/urban) (11). Such differences in the results may be a consequence of the smaller coverage of the population of eastern Croatia and rural areas, as well as the inclusion of younger participants (40–69 years) in the earlier research.

Furthermore, there were more respondents with a greater number of risk factors (six, seven, and nine) in rural areas than in urban areas, so although the difference is not statistically significant, a larger sample could show larger differences. These results suggest that the rural population in our sample is more susceptible to CVD than the urban population.

Study Limitations

This study has several limitations. Because of a relatively small sample, the results cannot be generalized to eastern Croatia. In addition, this study was conducted in family medicine clinics under the influence of the so-called "white coats", which may affect the objectivity of participants' answers and make them more likely to give socially desirable answers. However, the selection criteria for the clinics and the adequate comparability of the rural and urban areas are the strength of this study due to the more objective assessment of the differences studied (CV risk factors) concerning the place of residence. Reliance and trust in the family physician ensured a high response rate in the study.

CONCLUSIONS

The results of this study indicate a higher prevalence of CV risk factors in rural than in urban participants. A significantly higher prevalence of CV risk factors (arterial hypertension, increased BMI, increased WC, and a higher measured value of risk factors determined by diagnostic measurements – elevated LDL cholesterol) are represented in rural areas, while the prevalence of insufficient physical activity is significantly higher in urban areas. The differences in the prevalence of CV risk factors between rural and urban areas and the generally high prevalence of risk factors indicate the need for intensive monitoring and extensive research of the target population at the county level through a representative number of family medicine clinics. Based on these studies, prevention programmes in eastern Croatia could be developed for rural and urban populations with high CV risk factors.

Conflicts of Interest

None declared

REFERENCES

1. Rosengren A, Smyth A, Rangarajan S, Ramasundarahettige C, Bangdiwala SI, AlHabib KF, et al. Socioeconomic status and risk of cardiovascular disease in 20 low-income, middle-income, and high-income countries: the Prospective Urban Rural Epidemiologic (PURE) study. Lancet Glob Health. 2019 Jun;7(6):e748-60.
2. Kralj V, Čukelj P. Cardiovascular diseases in Croatia: why do we need a cardiovascular diseases national plan? Cardiol Croat. 2022 Nov;17(9-10):250. doi: 10.15836/ccar2022.250.
3. Visseren FLJ, Mach F, Smulders YM, Carballo D, Koskinas KC, Bäck M, et al. 2021 ESC Guidelines on cardiovascular disease prevention in clinical practice. Eur Heart J. 2021 Sep 7;42(34):3227-337.
4. Kendall S. Primary care research - influencing and implementing into policy. Zdr Varst. 2021 Jun 28;60(3):138-44.
5. Vasan SK, Antonisamy B, Gowri M, Selliah HY, Geethanjali FS, Jebasingh FS, et al. Prevalence, incidence and predictors of cardiovascular risk factors: longitudinal data from rural and urban South India and comparison with global data. BMJ Open Diabetes Res Care. 2020 Oct;8(1):e001782. doi: 10.1136/bmjdrc-2020-001782.
6. Ranzani OT, Kalra A, Di Girolamo C, Curto A, Valerio F, Halonen JI, et al. Urban-rural differences in hypertension prevalence in low-income and middle-income countries, 1990-2020: a systematic review and meta-analysis. PLoS Med. 2022 Aug 25;19(8):e1004079. doi: 10.1371/journal.pmed.1004079.
7. de Groot R, van den Hurk K, Schoonmade LJ, de Kort WLAM, Brug J, Lakerveld J. Urban-rural differences in the association between blood lipids and characteristics of the built environment: a systematic review and meta-analysis. BMJ Glob Health. 2019 Jan 24;4(1):e001017. doi: 10.1136/bmjgh-2018-001017.
8. Kern J, Polasek O, Milanović SM, Dzakula A, Fister K, Strnad M, et al. Regional pattern of cardiovascular risk burden in Croatia. Coll Antropol. 2009 Apr;33 Suppl 1:11-7.
9. Erceg M, Kern J, Babić-Erceg A, Ivicević-Uhernik A, Vuletić S. Regional differences in the prevalence of arterial hypertension in Croatia. Coll Antropol. 2009 Apr;33 Suppl 1:19-23.
10. Fister K, Kolcić I, Milanović SM, Kern J. The prevalence of overweight, obesity and central obesity in six regions of Croatia: results from the Croatian Adult Health Survey. Coll Antropol. 2009 Apr;33 Suppl 1:25-9.
11. Bergman Marković B, Vrdoljak D, Kranjčević K, Vučak J, Kern J, Bielen I, et al. Continental-mediterranean and rural-urban differences in cardiovascular risk factors in Croatian population. Croat Med J. 2011 Aug 15;52(4):566-75.
12. World Health Organization. Physical activity [Internet]. Geneva: WHO; 2022 [cited 2023 Dec 23]. Available from: https://www.who.int/news-room/fact-sheets/detail/physical-activity.
13. European Commission. Health promotion and disease prevention knowledge gateway. Food-based dietary guidelines in Europe [Internet]. European Commission [cited 2023 Dec 27]. Available from: https://knowledge4policy.ec.europa.eu/health-promotion-knowledge-gateway/food-based-dietary-guidelines-europe-table-17_en.
14. The American Institute of Stress. The Holmes-Rahe Stress Inventory [Internet]. Weatherford: The American Institute of Stress [cited 2024 Feb 3]. Available from: https://www.stress.org/holmes-rahe-stress-inventory.
15. Weir CB, Jan A. BMI Classification percentile and cut off points [Internet]. Treasure Island: StatPearls Publishing; 2024 [cited 2024 Feb 6]. Available from: http://www.ncbi.nlm.nih.gov/books/NBK541070/.
16. Baioumi AYAA. Comparing measures of obesity: waist circumference, waist-hip, and waist-height ratios. In: Watson RR, editor. Nutrition in the prevention and treatment of abdominal obesity. London: Elsevier; 2019. p. 29-40.
17. Williams B, Mancia G, Spiering W, Agabiti Rosei E, Azizi M, Burnier M, et al. 2018 ESC/ESH Guidelines for the management of arterial hypertension: The Task Force for the management of arterial hypertension of the European Society of Cardiology (ESC) and the European Society of Hypertension (ESH). Eur Heart J. 2018;39(33):3021-104.
18. Perk J, De Backer G, Gohlke H, Graham I, Reiner Z, Verschuren WM, et al. [European Guidelines on Cardiovascular Disease Prevention in Clinical Practice (version 2012). The Fifth Joint Task Force of the European Society of Cardiology and other societies on cardiovascular disease prevention in clinical practice (constituted by representatives of nine societies and by invited experts)]. G Ital Cardiol (Rome). 2013 May;14(5):328-92. Italian.
19. World Health Organization. The Global Health Observatory. Mean fasting blood glucose [Internet]. Geneva: WHO [cited 2024 Feb 4]. Available from: https://www.who.int/data/gho/indicator-metadata-registry/imr-details/2380.
20. SCORE2 working group and ESC Cardiovascular risk collaboration. SCORE2 risk prediction algorithms: new models to estimate 10-year risk of cardiovascular disease in Europe. Eur Heart J. 2021 Jul 1;42(25):2439-54.
21. NCD Risk Factor Collaboration (NCD-RisC). Worldwide trends in hypertension prevalence and progress in treatment and control from 1990 to 2019: a pooled analysis of 1201 population-representative studies with 104 million participants. Lancet. 2021 Sep 11;398(10304):957-80.
22. Wändell PE, de Waard AM, Holzmann MJ, Gornitzki C, Lionis C, de Wit N, et al. Barriers and facilitators among health professionals in primary care to prevention of cardiometabolic diseases: a systematic review. Fam Pract. 2018 Jul 23;35(4):383-98.
23. Sila S, Trivić I, Mašić M, Marić L, Radunić A, Niseteo T, et al. Adherence to the Mediterranean diet in children and adolescents in the Mediterranean and continental regions of Croatia. Coll Antropol. 2022;46(1):21-7.
24. NCD Risk Factor Collaboration (NCD-RisC). Rising rural body-mass index is the main driver of the global obesity epidemic in adults. Nature. 2019 May;569(7755):260-4.
25. WHO European regional obesity report 2022. Copenhagen: WHO Regional Office for Europe; 2022.
26. Maltarić M, Ruščić P, Kolak M, Bender DV, Kolarić B, Ćorić T, et al. Adherence to the Mediterranean diet related to the health related and well-being outcomes of European mature adults and elderly, with an additional reference to Croatia. Int J Environ Res Public Health. 2023 Mar 10;20(6):4893. doi: 10.3390/ijerph20064893.
27. Pelletier C, White N, Duchesne A, Sluggett L. Work, travel, or leisure: comparing domain-specific physical activity patterns based on rural-urban location in Canada. BMC Public Health. 2023 Nov10;23(1):2216. doi: 10.1186/s12889-023-16876-1.
28. Whitfield GP, Carlson SA, Ussery EN, Fulton JE, Galuska DA, Petersen R. Trends in meeting physical activity guidelines among urban and rural dwelling adults - United States, 2008-2017. MMWR Morb Mortal Wkly Rep. 2019 Jun 14;68(23):513-8.

29. Milosević M, Golubić R, Mustajbegović J, Jelinić JD, Janev Holcer N, Kern J. Regional pattern of physical inactivity in Croatia. Coll Antropol. 2009 Apr;33 Suppl 1:35-8.
30. Satyjeet F, Naz S, Kumar V, Aung NH, Bansari K, Irfan S, et al. Psychological stress as a risk factor for cardiovascular disease: a case-control study. Cureus. 2020 Oct 1;12(10):e10757. doi: 10.7759/cureus.10757.
31. Brborović O, Rukavina TV, Pavleković G, Dzakula A, Sogorić S, Vuletić S. Psychological distress within cardiovascular risks behaviors, conditions and diseases conceptual framework. Coll Antropol. 2009 Apr;33 Suppl 1:93-8.
32. Bjartveit K, Tverdal A. Health consequences of smoking 1-4 cigarettes per day. Tob Control. 2005 Oct;14(5):315-20.

Received January 15, 2023
Accepted in revised form February 6, 2024