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# Multimorbidity in the working-age population of Serbia: results from the 2019 National Health Survey

## Multimorbiditet radnoaktivnog stanovništva Srbije: rezultati nacionalnog istraživanja zdravlja iz 2019. godine

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**Abstract**

**Background/Aim.** Population aging and the increase in the prevalence of chronic diseases led to a rise in the number of people who live with more than one disease. The aim of the study was to determine the prevalence and predictors of multimorbidity in the working-age population (WAP) of Serbia. **Methods.** The study is part of "The 2019 Serbian National Health Survey", a cross-sectional study conducted on a representative stratified two-stage sample. For this paper, a representative data sample for 9,473 persons of the WAP (aged 15–64 years) was used. Multimorbidity was defined as the co-occurrence of two or more of 13 chronic conditions. Data on chronic conditions were self-reported, and data on body mass and body height were measured. Multivariable logistic regression was used to assess predictors of multimorbidity. **Results.** Multimorbidity prevalence among WAP was 12.0%, and it was significantly higher among women (13.3%) than in men (10.6%). The predictors of multimorbidity were: female gender, increasing age, lower level of education, lower income, unemployment, retirement, widowhood, and divorce. Being overweight and obese were associated with higher odds of multimorbidity in both men and women. **Conclusion.** Multimorbidity is an important public health problem amongst WAP in Serbia due to its high prevalence, especially among vulnerable groups, and its inequality in frequency among different socioeconomic groups.

**Key words:**
**multimorbidity; occupational groups; prevalence; risk factors; serbia; surveys and questionnaires.**

**Apstrakt**

**Uvod/Cilj.** Starenje stanovništva i porast prevalencije hroničnih bolesti doveli su do porasta broja ljudi koji boluju od dve ili više bolesti. Cilj rada bio je da se utvrde prevalencija i prediktori multimorbiditeta kod radnoaktivnog stanovništva (RAS) u Srbiji. **Metode.** Ovi rezultati su deo studije „Istraživanje zdravlja stanovništva Srbije 2019. godine", sprovedene kao studija preseka na reprezentativnom stratifikovanom dvostepenom uzorku. Za potrebe ovog rada korišćeni su podaci 9 473 osoba iz populacije RAS (životnog doba 15–64 godina). Multimorbiditet je definisan kao prisustvo dve ili više hroničnih bolesti od ukupno 13 ispitivanih bolesti. Podaci o hroničnim bolestima dobijeni su samoizjašnjavanjem, a podaci o telesnoj masi i telesnoj visini dobijeni su merenjem ispitanika. Za procenu prediktora multimorbiditeta korišćena je multivarijabilna logistička regresija. **Rezultati.** Prevalencija multimorbiditeta kod RAS iznosila je 12,0% i bila je značajno viša kod žena (13,3%) nego kod muškaraca (10,6%). Prediktori multimorbiditeta bili su: ženski pol, starije životno doba, niži nivoi obrazovanja, niži prihodi, nezaposlenost, penzionisanost, udovištvo i status razveden(a). Predgojaznost i gojaznost bili su povezani sa višim šansama za multimorbiditet i kod muškaraca i kod žena. **Zaključak.** Multimorbiditet je značajan javnozdravstveni problem kod RAS Srbije zbog njegove visoke prevalencije, posebno među ranjivim kategorijama stanovništva i zbog nejednake zastupljenosti među različitim socio-ekonomskim grupama.

**Ključne reči:**
**bolesti, interakcije; radnici; prevalenca; faktori rizika; srbija; ankete i upitnici.**

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## Introduction

Multimorbidity can be defined as "the co-existence of two or more chronic conditions (CCs) in the same individual" [1]. Population aging and the increase in the prevalence of chronic diseases (CDs) led to a rise in the number of people with more than one disease. The prevalence of multimorbidity varies from study to study, depending mainly on the study population and the number of CDs considered. One of the recent systematic reviews that included 49 countries showed that the overall prevalence of multimorbidity at a global level is 33.1% [2]. The prevalence of multimorbidity does increase with age, but it does not exclusively affect older populations, and many studies report high rates of multimorbidity among working-age populations (WAPs) [3, 4]. CDs are prevalent in Republic of Serbia (RS) and pose an important public health problem. In 2019, almost every second person in RS aged 15 and above stated that they had at least one of the 17 CDs/conditions. The most frequent CDs/conditions were arterial hypertension (AH) (29.6%), chronic low back disorder (17.2%), chronic neck disorder (12.1%), hyperlipidemias (10.8%), coronary heart disease (CHD)/angina pectoris (8.9%), and diabetes mellitus (DM) (7.8%) [5]. Results from the previous 2013 National Health Survey in RS revealed that the prevalence of multimorbidity among adults was 26.9% [6]. The Serbian population, with an average age of 43.5 years and almost a fifth of the population (21.3%) aged 65 and above, is one of the oldest populations in Europe, which makes age-related health issues more challenging [5]. Due to population aging and the increase in the prevalence of CDs (DM, chronic heart disease, stroke, and malignant diseases) [7, 8], it is expected that the public health importance of multimorbidity will continue to increase.

Even though the recent coronavirus disease 2019 (COVID-19) pandemic brought acute diseases back to the spotlight, it did not diminish the public health importance of multimorbidity. Since people with CDs have a higher risk of infection, they are thus more prone to suffering from some consequences of a disease like a more severe clinical picture and worse outcomes of COVID-19 [9, 10].

It is well known that CDs reduce the quality of life (QoL); hence, an increasing number of diseases significantly reduces the QoL. Physical health is affected more than mental health, and younger populations and females are burdened more [11].

Multimorbidity is a major challenge not only for patients but also for healthcare workers and the healthcare systems. People affected by multiple CDs have more complex needs; they are the most challenging patients to manage and also have a higher probability of poor outcomes. All this leads to using healthcare more frequently and is associated with higher healthcare costs [12, 13].

Not only is multimorbidity more prevalent in persons of lower socioeconomic (SE) status, but also the associated costs of long-term care result in greater health expenditure for these patients and their households, pushing them deeper into poverty and increasing health inequalities [12, 14–16].

Multimorbidity increases sickness absence, primarily due to musculoskeletal, cardiovascular, and mental illnesses [17, 18]. CDs decrease work productivity by limiting both the physical and psychosocial ability to perform specific work demands. With the increase in the number of CCs, the odds of having a work limitation increase significantly [18].

One of the facts that highlights the public health importance of multimorbidity is that it is associated with higher mortality. Jani et al. [19] found that all-cause mortality risk for individuals with four or more long-term conditions was nearly three times higher than those with no long-term condition.

The prevalence of multimorbidity increases with age, and most studies on multimorbidity have predominantly focused on older populations. However, in absolute numbers, the majority of patients with multimorbidity are younger than 65 [3]. A better understanding of the epidemiology of multimorbidity in WAP is necessary for the development of interventions to reduce the burden of multimorbidity, especially in the context of an aging population, such as the population of RS. The aim of the study was to estimate the prevalence and predictors of multimorbidity in WAP of RS.

## Methods

"The 2019 Serbian National Health Survey" was conducted in line with the ethical standards of the Declaration of Helsinki and the legislation of the RS. Participants were given a written document with the necessary study information and they signed informed consent before participating in the study. In order to keep the anonymity of the participants in the study, data that could identify the participant were not collected (the necessary identification that was replaced by code) [5]. The ethical aspects of the study were approved by the Ethics Committee of the Institute of Public Health of Vojvodina, RS (approval No. 01-969/1).

"The 2019 Serbian National Health Survey" is a cross-sectional study conducted by the Ministry of Health of RS, the Statistical Office of RS, and the Institute of Public Health of Serbia "Dr. Milan Jovanovic Batut". It was conducted in 2019 on a representative stratified two-stage sample and included 5,114 households with a response rate of 80.7%. Sample stratification was done according to the area type (urban, other) and region (Vojvodina, Belgrade, Southern and Eastern Serbia, and Šumadija and Western Serbia). The survey included people living in private households. The survey did not include population groups in collective households (student dormitories, dormitories for children and young people with disabilities, homes for socially endangered children, retirement homes, homes for the elderly and infirm, homes for adults with disabilities, convents, monasteries, etc.) [5]. For this paper, a representative sample of WAP (aged 15–64) of the RS was used. The analysis included 9,473 persons aged 15–64 years.

The instruments were questionnaires designed in line with the European Health Interview Survey questionnaire. The interview was conducted by teams comprised of two members; one of the two members was a health professional. For this paper, data from two questionnaires were used. The first questionnaire was a household info panel used to collect information about all members of the household, i.e., SE characteristics of the household itself. This questionnaire had 18 questions, and we used the question about household income for this manuscript. The second questionnaire had 118 questions about background variables on demography and SE status (gender, age, education, employment status), health status (self-perceived health), CCs, limitation in everyday activities, disease-specific morbidity, physical and sensory functional limitations, healthcare use, unmet healthcare needs, use of medicines, preventive actions, health determinants, such as height and weight, fruit and vegetable consumption, etc. Data were collected by “face-to-face” interviews. The following data were used from this questionnaire for analysis: gender, age, level of education, employment status, marital status, region of residence, and data on CDs.

The outcome variable was multimorbidity, and it was defined as a co-occurrence of two or more CCs. Information on CCs was ascertained based on responses to the question: “Have you had any of the following diseases or conditions in the previous 12 months?”. A total of 13 CCs were selected for analysis (chronic bronchitis/chronic obstructive pulmonary diseases/emphysema, bronchial asthma, AH, myocardial infarction (MI)/consequences of infarction, stroke/consequences of stroke, coronary disease/angina pectoris, DM, arthrosis/degenerative joint disease (excluding arthritis), liver cirrhosis, allergies, depression, kidney problems, malignant disease). The presence of CDs was dichotomized into having or not having CDs, and variables were coded as dummy variables (yes/no).

Information on independent variables used in the analyses was obtained using the questionnaire, except for nutritional status (NS). NS was assessed using the body mass index (BMI), which was calculated based on the measured weight and height and was categorized as follows: obesity (BMI $\geq$ 30 kg/m$^2$), overweight (BMI 25.0–29.9 kg/m$^2$), normal weight (18.5–24.9 kg/m$^2$) and underweight (BMI < 18.5 kg/m$^2$). BMI data was available for 80.7% of participants.

The following independent variables were analyzed: Age was categorized into five 10-year age groups (15–24, 25–34, 35–44, 45–54, 55–64). Marital status was categorized as married (or in a relationship), never-married, widowed, and divorced. SE status was measured using the highest education attainment, employment status, and household income. The level of education was categorized into three educational groups: high (postsecondary diploma or university), intermediate (secondary school graduation), and low education (elementary school or lower). Employment status was categorized into four groups: employed, unemployed, in retirement/unable to work, and other inactive (students, housewives, other answer). Data on income were collected at the household level and disseminated by quintile of the income distribution (first, second, third, fourth, and fifth quintile groups). The first and second quintile groups were merged into a low-income group (most disadvantaged), and the fourth and fifth quintile groups were merged into a high-income group (most advantaged). All independent variables were analyzed as categorical variables.

Descriptive statistics were used to describe sample characteristics [means, standard deviations (SD), and proportions]. For testing the differences in variables between population groups with and without multimorbidity, independent *t*-tests and Chi-square tests were performed depending on the type of variables. Multivariable logistic regression was used to model the odds of multimorbidity (enter method). Separate logistic regression analyses were done for men and women. The dependent variable was the co-occurrence of two or more diseases, and the comparison group for analysis was one or no CDs. All logistic regression analyses were adjusted for the following independent variables: age, marital status, level of education, income, region, and NS. The fully adjusted logistic regression model for the whole sample was additionally adjusted for gender. All independent variables were significantly associated with the outcome variable (multimorbidity). That is why they were included in the final model. The odds of multimorbidity were presented as an adjusted odds ratio (OR) with a corresponding 95% confidence interval (CI). All the analyses used weighting to be representative of the population of RS. Statistical Package for the Social Sciences (SPSS) version 23 was used for statistical analyses.

## Results

The study population included 9,473 individuals with a mean age of 40.81 years (± SD 14.06), and 50.0% were females. More than half of the participants had an intermediate level of education (59.8%). Every eighth person of working age had multimorbidity (12.0%). Multimorbidity was more prevalent in women than men (13.3% vs. 10.6%). More people had overweight or obesity (53.9%) than normal weight (43.5%). Other demographic and SE characteristics are presented in Table 1. The average age of women was higher than that of men ($p < 0.001$). Among women, there were more individuals with a high level of education than among men ($p < 0.001$). Men had a higher proportion of employed individuals than women ($p < 0.001$). Overweight and obesity were more prevalent among men than women ($p < 0.001$).

Table 2 shows the prevalence of multimorbidity according to gender. The most prevalent single condition amongst males and females was AH. Almost every fifth person of working age had AH, and it was more prevalent among women (19.5%) than among men (17.9%). After AH, the most prevalent conditions in men and women were allergies, DM, and CHD/angina pectoris. The prevalence of CDs was higher in women than in men, except DM, MI/consequences of MI, stroke/consequences of stroke, and liver cirrhosis, which were more prevalent amongst men.

**Table 1**

**Sample characteristics by gender, Serbia 2019**

| Parameter | All | Men | Women | *p*-value* |
|---|---|---|---|---|
| Age (years) | | | | |
| 15–24 | 1,519 (16.1) | 793 (16.6) | 726 (15.7) | < 0.001 |
| 25–34 | 1,629 (19.5) | 866 (20.0) | 763 (19.1) | |
| 35–44 | 1,949 (21.9) | 991 (22.2) | 958 (21.6) | |
| 45–54 | 1,989 (20.7) | 991 (20.5) | 998 (20.9) | |
| 55–64 | 2,387 (21.7) | 1,126 (20.7) | 1,261 (22.8) | |
| Level of education | | | | |
| high | 1,888 (22.3) | 860 (20.2) | 1,028 (24.3) | < 0.001 |
| intermediate | 5,776 (59.8) | 3,065 (63.2) | 2,711 (56.4) | |
| low | 1,803 (17.9) | 836 (16.6) | 967 (19.3) | |
| Employment status | | | | |
| employed | 4,758 (52.6) | 2,675 (57.9) | 2,083 (47.2) | < 0.001 |
| unemployed | 2,274 (23.5) | 1,180 (24.3) | 1,094 (22.8) | |
| retired | 826 (7.8) | 327 (5.9) | 499 (9.6) | |
| other inactive | 1,590 (16.1) | 575 (11.9) | 1,051 (20.4) | |
| Marital status | | | | |
| married | 5,714 (59.5) | 2,693 (56.8) | 3,021 (62.3) | < 0.001 |
| never married | 2,886 (30.9) | 1,768 (37.0) | 1,118 (24.9) | |
| widowed | 325 (3.6) | 58 (1.2) | 267 (5.9) | |
| divorced | 527 (6.0) | 238 (5.0) | 289 (6.9) | |
| Income | | | | |
| high | 3,756 (42.1) | 1,880 (41.7) | 1,885 (42.4) | < 0.001 |
| intermediate | 1,839 (18.9) | 914 (18.7) | 925 (19.2) | |
| low | 3,869 (39.0) | 1,973 (39.6) | 1,896 (38.4) | |
| Region of Serbia | | | | |
| Belgrade | 2,207 (24.5) | 1,059 (23.6) | 1,148 (25.4) | < 0.001 |
| Vojvodina | 2,104 (27.0) | 1,060 (27.3) | 1,044 (26.8) | |
| Šumadija and Western | 3,127 (27.2) | 1,617 (27.5) | 1,510 (27.0) | |
| Southern and Eastern | 2,034 (21.2) | 1,031 (21.7) | 1,004 (20.8) | |
| Nutritional status | | | | |
| normal weight | 3,255 (43.5) | 1,297 (34.1) | 1,958 (52.6) | < 0.001 |
| underweight | 203 (2.6) | 52 (1.3) | 151 (3.8) | |
| overweight | 2,711 (35.4) | 1,619 (43.5) | 1,092 (27.6) | |
| obesity | 1,478 (18.5) | 817 (21.1) | 661 (15.9) | |
| Number of chronic diseases | | | | |
| none or one | 8,222 (88.0) | 4,210 (89.4) | 4,012 (86.7) | < 0.001 |
| two or more | 1,223 (12.0) | 542 (10.6) | 681 (13.3) | |
| total | 9,473 (100.0) | 4,767 (50.0) | 4,706 (50.0) | |

**All values are expressed as unweighted numbers of participants (weighted percentages).**
*** Chi-square for testing differences between men and women.**

The prevalence of multimorbidity increased substantially with age in both men and women. According to age and gender, the prevalence of multimorbidity reached the highest value (32.1%) in women aged 55–64 years. Multimorbidity was significantly more prevalent in the population with a lower educational level. Gender differences in multimorbidity prevalence were especially pronounced between men (14.5%) and women (22.4%) with low levels of education. There were also significant differences in prevalences of multimorbidity in the four regions in RS. Every third obese woman (34.1%) and every fifth obese man (19.5%) had two or more CDs. Other values for the prevalence of multimorbidity for the examined population in 2019 are shown in Table 3.

Table 4 presents ORs for multimorbidity from the multivariable logistic regression. The logistic regression models used as the outcome variable two or more CCs vs. no or one CC. In a fully adjusted logistic regression model being female was associated with 14% higher odds of multimorbidity (OR = 1.14; 95% CI: 1.13–1.15). The association between age and multimorbidity was positive in both men and women. The age gradient in multimorbidity was more pronounced in women than in men. Women aged 55–64 years had almost 19 times higher odds of multimorbidity compared to women aged 15–24 years (OR = 18.88; 95% CI: 18.12–19.68). The population with a lower level of education had higher odds of multimorbidity. Never-married men and women had lesser odds of multimorbidity compared to married men and women. Divorced and widowed persons had higher odds of multimorbidity compared to married ones. Men with low income had 5% higher odds of multimorbidity (OR = 1.05; 95% CI:

**Table 2**

**Prevalence and 95% confidence interval (CI) of chronic diseases in the working-age population according to gender**

| Chronic disease | All | | Men | | Women | | *p*-value* |
|---|---|---|---|---|---|---|---|
| | n** | % (CI)*** | n** | % (CI)*** | n** | % (CI)*** | |
| Arterial hypertension | 1,915 | 18.7 (18.67–18.74) | 911 | 17.9 (17.84–17.94) | 1,004 | 19.5 (19.46–19.57) | < 0.001 |
| Allergies | 626 | 6.9 (6.89–6.94) | 252 | 5.7 (5.67–5.73) | 374 | 8.2 (8.10–8.17) | < 0.001 |
| Diabetes mellitus | 447 | 4.4 (4.34–4.38) | 229 | 4.6 (4.53–4.58) | 218 | 4.2 (4.14–4.19) | < 0.001 |
| CHD/angina pectoris | 408 | 3.8 (3.82–3.85) | 181 | 3.1 (3.13–3.17) | 227 | 4.5 (4.49–4.54) | < 0.001 |
| Arthrosis/degenerative joint disease | 369 | 3.4 (3.31–3.34) | 118 | 2.2 (2.21–2.25) | 251 | 4.5 (4.39–4.44) | < 0.001 |
| Depression | 338 | 3.2 (3.19–3.22) | 129 | 2.5 (2.51–2.55) | 209 | 3.9 (3.86–3.91) | < 0.001 |
| Bronchial asthma | 265 | 2.8 (2.75–2.78) | 121 | 2.5 (2.52–2.57) | 144 | 3.0 (2.96–3.00) | < 0.001 |
| Kidney disease | 257 | 2.6 (2.55–2.58) | 94 | 1.8 (1.77–1.81) | 163 | 3.3 (3.31–3.36) | < 0.001 |
| Chronic bronchitis/ COPD/emphysema | 230 | 2.4 (2.33–2.36) | 100 | 2.0 (1.97–2.00) | 130 | 2.7 (2.68–2.72) | < 0.001 |
| Malignant disease | 117 | 1.2 (1.15–1.17) | 35 | 0.8 (0.78–0.80) | 82 | 1.5 (1.50–1.54) | < 0.001 |
| MI/consequences of MI | 90 | 0.8 (0.80–0.82) | 69 | 1.2 (1.19–1.22) | 21 | 0.4 (0.41–0.43) | < 0.001 |
| Stroke/consequences of stroke | 55 | 0.5 (0.49–0.50) | 37 | 0.7 (0.65–0.67) | 18 | 0.3 (0.33–0.34) | < 0.001 |
| Liver cirrhosis | 24 | 0.20 (0.19–0.20) | 14 | 0.23 (0.22–0.23) | 10 | 0.17 (0.16–0.17) | < 0.001 |

**CHD – coronary heart disease; COPD – chronic obstructive pulmonary disease; MI myocardial infarction.**

***Chi-square test for testing differences between men and women; **Unweighted number of participants; ***Weighted percentage.**

**Table 3**

**Prevalence of multimorbidity according to demographic and socioeconomic characteristics and nutritional status**

| Parameter | All | | | Men | | | Women | | |
|---|---|---|---|---|---|---|---|---|---|
| | chronic diseases | | *p*-value* | chronic diseases | | *p*-value* | chronic diseases | | *p*-value* |
| | one or no | two or more | | one or no | two or more | | one or no | two or more | |
| Age (years) | | | | | | | | | |
| 15–24 | 1,490 (98.2) | 28 (1.8) | | 775 (97.8) | 17 (2.2) | | 715 (98.6) | 11 (1.4) | |
| 25–34 | 1,580 (96.5) | 48 (3.5) | | 841 (97.0) | 24 (3.0) | | 739 (96.0) | 24 (4.0) | |
| 35–44 | 1,822 (93.3) | 121 (6.7) | < 0.001 | 922 (92.8) | 65 (7.2) | < 0.001 | 900 (93.8) | 56 (6.2) | < 0.001 |
| 45–54 | 1,674 (84.7) | 307 (15.3) | | 858 (87.3) | 129 (12.7) | | 816 (82.3) | 178 (17.7) | |
| 55–64 | 1,656 (70.6) | 719 (29.4) | | 814 (73.6) | 307 (26.4) | | 842 (67.9) | 412 (32.1) | |
| Level of education | | | | | | | | | |
| high | 1,737 (92.2) | 151 (7.8) | | 789 (92.4) | 71 (7.6) | | 948 (92.1) | 80 (7.9) | |
| intermediate | 5,049 (88.5) | 711 (11.5) | < 0.001 | 2,712 (89.4) | 346 (10.6) | < 0.001 | 2,337 (87.4) | 365 (12.6) | < 0.001 |
| low | 1,432 (81.2) | 361 (18.8) | | 705 (85.5) | 125 (14.5) | | 727 (77.6) | 236 (22.4) | |
| Employment status | | | | | | | | | |
| employed | 4,317 (91.3) | 431 (8.7) | | 2,425 (91.3) | 245 (8.7) | | 1,892 (91.2) | 186 (8.8) | |
| unemployed | 1,973 (88.1) | 293 (11.9) | < 0.001 | 1,031 (88.2) | 143 (11.8) | < 0.001 | 942 (88.0) | 150 (12.0) | < 0.001 |
| retired | 482 (59.6) | 341 (40.4) | | 198 (62.6) | 127 (37.4) | | 284 (57.7) | 214 (42.3) | |
| other inactive | 1,426 (90.8) | 157 (9.2) | | 546 (95.2) | 27 (4.8) | | 880 (88.3) | 130 (11.7) | |
| Marital status | | | | | | | | | |
| married | 4,799 (86.0) | 899 (14.0) | | 2,278 (86.3) | 408 (13.7) | | 2,521 (85.7) | 491 (14.3) | |
| never married | 2,778 (96.5) | 101 (3.5) | < 0.001 | 1,695 (96.1) | 68 (3.9) | < 0.001 | 1,083 (97.0) | 33 (3.0) | < 0.001 |
| widowed | 204 (62.7) | 118 (37.3) | | 34 (60.6) | 23 (39.4) | | 170 (63.1) | 95 (36.9) | |
| divorced | 421 (79.3) | 104 (20.7) | | 194 (81.2) | 42 (18.8) | | 227 (77.9) | 62 (22.1) | |
| Income | | | | | | | | | |
| high | 3,375 (90.6) | 383 (9.4) | | 1,691 (90.8) | 185 (9.2) | | 1,684 (90.5) | 198 (9.5) | |
| intermediate | 1,613 (88.0) | 225 (12.0) | < 0.001 | 836 (91.1) | 78 (8.9) | < 0.001 | 777 (85.0) | 147 (15.0) | < 0.001 |
| low | 3,234 (85.2) | 615 (14.8) | | 1,683 (87.1) | 279 (12.9) | | 1,551 (83.3) | 336 (16.7) | |
| Region of Serbia | | | | | | | | | |
| Belgrade | 1,960 (90.1) | 242 (9.9) | | 952 (91.5) | 104 (8.5) | | 1,008 (88.7) | 138 (11.3) | |
| Vojvodina | 1,800 (87.0) | 294 (13.0) | | 906 (87.1) | 150 (12.9) | | 894 (86.9) | 144 (13.1) | |
| Šumadija and Western | 2,775 (89.1) | 347 (10.9) | < 0.001 | 1,467 (90.8) | 147 (9.2) | < 0.001 | 1,308 (87.5) | 200 (12.5) | < 0.001 |
| Southern and Eastern | 1,687 (85.5) | 340 (14.5) | | 885 (88.1) | 141 (11.9) | | 802 (82.9) | 199 (17.1) | |

**Table 3 (continued)**

| Parameter | All: chronic diseases one or no | All: chronic diseases two or more | All: $p$-value* | Men: chronic diseases one or no | Men: chronic diseases two or more | Men: $p$-value* | Women: chronic diseases one or no | Women: chronic diseases two or more | Women: $p$-value* |
|---|---|---|---|---|---|---|---|---|---|
| Nutritional status | | | | | | | | | |
| normal weight | 3,008 (93.2) | 242 (6.8) | < 0.001 | 1,206 (93.5) | 89 (6.5) | < 0.001 | 1,802 (93.0) | 153 (7.0) | < 0.001 |
| underweight | 188 (92.2) | 14 (7.8) | | 49 (96.6) | 2 (3.4) | | 139 (90.8) | 12 (9.2) | |
| overweight | 2,319 (86.5) | 384 (13.5) | | 1,423 (88.9) | 193 (11.1) | | 896 (83.0) | 191 (17.0) | |
| obesity | 1,067 (74.0) | 407 (26.0) | | 644 (80.5) | 170 (19.5) | | 423 (65.9) | 237 (34.1) | |
| Total | 8,222 (88.0) | 1,223 (12.0) | | 4,210 (89.4) | 542 (10.6) | | 4,012 (86.7) | 681 (13.3) | |

**All values are expressed as unweighted numbers of participants (weighted percentages). * Chi-square test.**

**Table 4**

**Association between demographic and socioeconomic variables and nutritional status with multimorbidity**

| | All* OR | All* 95% CI | Men** OR | Men** 95% CI | Women** OR | Women** 95% CI |
|---|---|---|---|---|---|---|
| Gender | | | | | | |
| male | 1 | | | | | |
| female | 1.14 | 1.13–1.15 | – | – | – | – |
| Age (years) | | | | | | |
| 15–24 | 1 | | 1 | | 1 | |
| 25–34 | 2.38 | 2.32–2.44 | 1.70 | 1.64–1.76 | 4.03 | 3.86–4.21 |
| 35–44 | 3.77 | 3.68–3.86 | 3.11 | 3.01–3.22 | 5.66 | 5.42–5.90 |
| 45–54 | 8.30 | 8.10–8.51 | 5.18 | 5.01–5.36 | 15.78 | 15.14–16.44 |
| 55–64 | 13.04 | 12.72–13.36 | 11.00 | 10.64–11.38 | 18.88 | 18.12–19.68 |
| Level of education | | | | | | |
| high | 1 | | 1 | | 1 | |
| intermediate | 1.24 | 1.22–1.25 | 1.47 | 1.45–1.49 | 1.06 | 1.05–1.08 |
| low | 1.80 | 1.77–1.82 | 1.94 | 1.91–1.98 | 1.68 | 1.65–1.70 |
| Employment status | | | | | | |
| employed | 1 | | 1 | | 1 | |
| unemployed | 1.04 | 1.03–1.05 | 0.99 | 0.97–0.998 | 1.05 | 1.03–1.06 |
| retired | 2.51 | 2.48–2.53 | 2.21 | 2.17–2.24 | 2.87 | 2.82–2.91 |
| other inactive | 1.63 | 1.61–1.65 | 1.86 | 1.81–1.92 | 1.56 | 1.53–1.58 |
| Marital status | | | | | | |
| married | 1 | | 1 | | 1 | |
| never married | 0.75 | 0.74–0.76 | 0.75 | 0.74–0.76 | 0.68 | 0.67–0.70 |
| widowed | 1.33 | 1.32–1.35 | 1.76 | 1.70–1.81 | 1.22 | 1.20–1.24 |
| divorced | 1.67 | 1.65–1.69 | 1.52 | 1.49–1.54 | 1.71 | 1.69–1.74 |
| Income | | | | | | |
| high | 1 | | 1 | | 1 | |
| middle | 1.15 | 1.14–1.16 | 0.82 | 0.80–0.83 | 1.49 | 1.47–1.51 |
| low | 1.28 | 1.27–1.29 | 1.05 | 1.04–1.06 | 1.52 | 1.50–1.54 |
| Region of Serbia | | | | | | |
| Belgrade | 1 | | 1 | | 1 | |
| Vojvodina | 0.80 | 0.80–0.81 | 1.14 | 1.12–1.15 | 0.63 | 0.62–0.64 |
| Šumadija and Western | 0.68 | 0.67–0.68 | 0.80 | 0.78–0.81 | 0.61 | 0.60–0.62 |
| Southern and Eastern | 0.92 | 0.91–0.93 | 1.10 | 1.08–1.11 | 0.82 | 0.80–0.83 |
| Nutritional status | | | | | | |
| normal weight | 1 | | 1 | | 1 | |
| underweight | 1.57 | 1.53–1.61 | 0.64 | 0.59–0.69 | 2.11 | 2.05–2.18 |
| overweight | 1.55 | 1.54–1.56 | 1.42 | 1.40–1.44 | 1.58 | 1.56–1.60 |
| obesity | 2.88 | 2.85–2.90 | 2.35 | 2.32–2.39 | 3.33 | 3.29–3.37 |

**OR – odds ratio; CI – confidence interval. *Logistic regression model was adjusted for gender, age, level of education, employment status, marital status, income, region, and nutritional status; **Logistic regression model was adjusted for age, level of education, employment status, marital status, income, region, and nutritional status.**

1.04–1.06), while women with low income had 52% higher odds of multimorbidity (OR = 1.52; 95% CI: 1.50–1.54). The results showed that being overweight or obese was positively associated with multimorbidity. Obese men had 2.4 times higher chances for multimorbidity (OR = 2.35; 95% CI: 2.32–2.39), and obese women had a 3.3 times higher chance

(OR = 3.33; 95% CI: 3.29–3.37) for multimorbidity compared to men and women with an optimal BMI. Underweight was associated with higher odds of multimorbidity in women, while underweight in men was associated with lower odds of multimorbidity.

**Discussion**

The study was conducted on a representative sample of WAP in RS. To our knowledge, no prior studies assessed the burden of multimorbidity specifically amongst WAP in RS. It documented the burden of multimorbidity among WAP and the predictors of multimorbidity. Associations between multimorbidity and demographic and SE variables were found to be consistent in men and women, with some differences in the magnitudes of these relationships. The burden of multimorbidity was greater in women, the older, lower educated population, people with lower household incomes, widowed, divorced, and people who lived in the Belgrade region. Being overweight or obese was associated with higher odds of multimorbidity, in both men and women. Underweight was associated with higher odds of multimorbidity only in women.

The proportion of people with multimorbidity increased significantly with age, which is consistent with previous studies on multimorbidity [3, 14]. This was expected, since aging leads to multiple organ systems dysregulation and it is the most important risk factor for many CDs [20].

Multimorbidity was more prevalent among women than men. After controlling for age and other significant variables women had 14% higher odds of multimorbidity compared to men. Many other studies found that women have a higher risk of multimorbidity than men [2, 21]. A recent study by Bezerra et al. [21] reported a greater prevalence of multimorbidity in women in 16 out of 17 European countries.

Our study confirmed that the burden of multimorbidity is greater in socioeconomically deprived populations. The socioeconomically disadvantaged are more prone to having an unhealthy lifestyle that leads to the development of CD [22]. The importance of SE status for the development of multimorbidity is well documented in the research of Barnett et al. [3] who reported that multimorbidity occurs 10 to 15 years earlier in people living in the most deprived areas compared to the most affluent.

Multimorbidity disproportionately affects more people of lower SE status. This study included three indicators of SE status: level of education, employment, and income. All three indicators were significantly associated with multimorbidity, in both genders. There are several theories on how SE deprivation leads to multimorbidity, but the most frequently used are behavioral theories (health behaviors), materialist (access to health resources), and psychosocial (stress pathways) theories [23].

Multimorbidity prevalence was significantly higher in the least educated population. The educational level had an inverse association with multimorbidity after controlling for the effect of age and other covariates. A low level of education increases the risk of multimorbidity more in men than in women. These results are consistent with many other European studies [21, 24]. Education impacts health on several levels. It contributes to developing a range of skills important in using health care, making lifestyle choices, and in health-related behaviors. Individuals with higher levels of education tend to be more aware of health risks and are less likely to engage in risky behavior. They also have higher earnings, are wealthier, and have better access to social networks and support that improve health. Educated people are less likely to experience unemployment and economic problems. They also benefit from health-related characteristics of the environment in which they live, work, and study: access to healthy food, spaces and facilities for physical activity, access to health care, community economic resources, safer environments, and lesser exposure to environmental risk factors [25].

Differences in multimorbidity prevalences were also found for employment subgroups. According to employment status, the highest prevalence of multimorbidity was registered among retired persons, which could be explained by the fact that persons who left paid employment at working age have worse health than those who remained employed. The likelihood of having multimorbidity was 2.2 times higher among retired men and 2.9 times higher among retired women compared to their employed counterparts. An unemployed person had a higher prevalence of multimorbidity than an employed person, which is consistent with other studies [26, 27]. Unemployed women had a 5% higher chance for multimorbidity compared to employed women. After adjustment for other significant variables, unemployed men had a 1% lower chance of having multimorbidity compared to employed men, which was unexpected since unemployment is associated with worse health [28]. One of the reasons for unexpected results could be due to missing information on the duration of unemployment.

Our study showed that never-married men and women have lower odds of multimorbidity and that widowed and divorced men and women have higher odds of multimorbidity compared to their married counterparts. A Brazilian study also found that persons living with a partner had higher odds for multimorbidity compared to those living without a partner [29]. Contrary to our results, studies conducted in Europe, the UK, the US, and China demonstrated that persons who were not married (separated/divorced/widowed/never married) had higher odds of multimorbidity than those married. The authors also analyzed the duration of the marriage. Persons who had been married for 21 to 30 years had lower odds of experiencing multimorbidity than those whose marriage lasted less than ten years [30]. Research from Germany showed no association between marital status and multimorbidity [31]. Since results regarding the association between marital status and multimorbidity were heterogeneous across countries, there is a need for further research, for instance, the inclusion of cultural factors that influence the association between marital status and multimorbidity.

Results showed that the prevalence of multimorbidity increased with BMI, and it reached a value of 19.5% in obese men and 34.1% in obese women. Overweight and obesity were associated with higher odds of multimorbidity in both men and women. This is consistent with many other studies that reported that obesity increases the risk for co-occurrence of two or more diseases [32]. Obesity is a risk factor for many CDs, which develop as a result of endocrine and metabolic dysregulation, most notably type 2 DM, cardiovascular diseases, and malignant diseases [33]. Since every fifth man (21.1%) and every sixth woman (15.9%) of working age in RS is obese, this means that a significant proportion of the population is exposed to an increased risk of multimorbidity, which can lead to an overload of the health care system. Besides obese people, overweight people also have an increased risk of multimorbidity compared with individuals with optimal BMI. The number of overweight individuals in RS is even greater than the number of obese individuals, both in men and women, which emphasizes the importance of the overweight-multimorbidity association. On the other hand, weight loss is one of the best behavioral changes that one can make in order to prevent and manage many CDs (AH, DM type 2, CHD, malignant diseases, etc.) [34], and this could also be a potential strategic target for the prevention of multimorbidity.

Multimorbidity was measured based on information on 13 CCs, which included not only indicators of the physical aspect of health disbalance (cardiovascular, respiratory, endocrine, musculoskeletal diseases, etc.) but also an indicator of mental health conditions, such as depression. This is very important for understanding properly the epidemiology and implications of multimorbidity [35]. Most previous studies included the general or elderly population, and relatively few studies have specifically focused on the WAP. Furthermore, one of the advantages of the study is that conclusions were made based on the representative sample for the population of RS. Another advantage is that the data used for BMI calculations were measured, not self-reported.

One of the limitations of the study is that the association between exposure (demographic, SE variables, NS) and outcome (multimorbidity) is established cross-sectionally, so conclusions about causal relationships cannot be made. The data on CDs were self-reported, which may not accurately reflect health status, and multimorbidity prevalence could be underreported.

## Conclusion

Multimorbidity is an important public health problem among the WAP in RS due to its high prevalence, and vulnerable groups (women, poorly educated, lower income, etc.) carry a greater burden of multimorbidity. One of the possible strategic targets for multimorbidity prevention could be obesity since it is associated with higher odds of multimorbidity. Obesity prevention measures and health promotion activities should be more intensively promoted in the workplace, which will positively impact multimorbidity as well.

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