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Snezana Knezevic *, Tamara Gajic, Nela Djonovic, Sara Knezevic, Dragan Vukolic, Tatjana Marinkovic, Nikoleta Janicijevic, Dragan Vasiljevic, Slavica Djordjevic, Dragan Marinkovic, Dalibor Stajic *

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Sex-Specific Impact of Lifestyle Factors on Sick Leave in Serbian Working Population: Findings from the National Health Survey

Snezana Knezevic [1,2,*], Tamara Gajic [3,4], Nela Djonovic [5], Sara Knezevic [6], Dragan Vukolic [7], Tatjana Marinkovic [1], Nikoleta Janicijevic [5], Dragan Vasiljevic [5], Slavica Djordjevic [8], Dragan Marinkovic [9] and Dalibor Stajic [5,*]

[1] Academy of Applied Studies Polytechnic, 11000 Belgrade, Serbia
[2] Doctoral Academic Studies-Medical Sciences, Faculty of Medical Sciences, University of Kragujevac, 34000 Kragujevac, Serbia
[3] Geographical Institute "Jovan Cvijić", Serbian Academy of Sciences and Arts, 11000 Belgrade, Serbia
[4] Institute of Environmental Engineering, Peoples' Friendship University of Russia (RUDN University), 101000 Moscow, Russia
[5] Department of Hygiene and Ecology, Faculty of Medical Sciences, University of Kragujevac, 34000 Kragujevac, Serbia
[6] Doctoral Academic Studies-Intelligent Software Engineering, Faculty of Technical Sciences, Singidunum University, 11000 Belgrade, Serbia
[7] Faculty of Tourism and Hotel Management, University of Business Studies,78000 Banja Luka, Bosnia and Herzegovina
[8] Department of the High School of Health, Academy of Applied Studies Belgrade, 11000 Belgrade, Serbia
[9] Faculty of Special Education and Rehabilitation, University of Belgrade, 11000 Belgrade, Serbia
* Correspondence: lesta59@yahoo.com (S.K.); stajicdalibor@yahoo.com (D.S.)

Abstract: Sick leave is influenced by various modifiable lifestyle factors and sex differences. This study examines the impact of body mass index, fruit and vegetable consumption, physical activity, smoking, and alcohol consumption on sick leave among Serbia's working population, focusing on sex differences. Data from the 2019 National Health Survey of Serbia were analyzed, focusing on a representative sample of 4,652 individuals aged 18-65. Chi-square tests and logistic regression models assessed the relationships between lifestyle factors and sick leave, adjusting for sociodemographic, work-related, and health-related variables. Among respondents, 15.8% reported sick leave in the past 12 months, with higher rates among women in both, short-term (13.9% vs. 10.6%) and long-term sick leave (3.4% vs. 2.2%). For men, obesity (OR = 2.6), poor dietary habits (fruit OR = 2.1; vegetables OR = 2.8), smoking (OR = 1.9), and risky alcohol consumption (OR = 4.1) significantly increase the likelihood of sick leave. In women, smoking (OR = 1.8) and risky alcohol consumption (OR = 3.1) are major predictors, while BMI and physical activity show less impact. Fruit and vegetable consumption and physical activity have inconsistent effects on sick leave, indicating the need for further research. This study identifies obesity, poor dietary habits, smoking, and alcohol consumption as key predictors of sick leave in men. In women, smoking and risky alcohol consumption are major predictors. Smoking is a risk factor for both sexes, while risky alcohol consumption emerges as a prominent predictor and is a significant predictor overall. These findings highlight the need for targeted public health interventions to address these lifestyle factors and reduce sick leave rates. Further research is needed to clarify the roles of dietary habits and physical activity in influencing sick leave.

Keywords: sick leave; work; healthy lifestyle; lifestyle risk factors; Serbia

1. Introduction

Sick leave poses a significant challenge in occupational and public health, with various modifiable lifestyle factors playing a significant role. Lifestyle behaviors such as smoking, alcohol

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consumption, obesity, diet habits, and low physical activity contribute to lost work years due to disability and premature mortality [1]. Unhealthy behaviors account for 15–30% of all sick leave [2–4], and 20% of long-term sick leave cases [5]. Expo-sure to multiple health-related lifestyle factors is associated with an increased risk of both short-term and long-term sick leave [5]. Despite well-established associations between modifiable lifestyle factors and sick leave, there is a significant gap in comprehensive re-search examining their combined effects across various populations and occupational settings. This gap highlights the urgent need for more in-depth studies to identify at-risk groups and create targeted interventions to reduce sick leave and enhance workforce health outcomes. Additionally, the sex gap in sick leave, as noted by Østby et al. [6], re-mains an important and largely unexplained issue that warrants further investigation.

High body mass index (BMI) is strongly linked to increased sick leave [5–8]. Both overweight and obese are at significant risk for sick leave in both sexes, with those having a BMI of 25 kg/m² or higher showing higher rates of sick leave compared to non-obese individuals [7]. Central obesity, characterized by excess abdominal fat, further exacerbates sick leave due to associated health problems [9]. In Europe, higher BMI is particularly as-sociated with increased sick leave in southern and western countries, like Malta, Italy, Spain, and France, while the lowest impact was observed in Romania [1]. Changes in weight, including both weight gain and loss, are significant predictors of sick leave [10].

While obesity plays a significant role in sick leave, the influence of dietary factors alone is less pronounced [5]. High-quality diets, rich in fruits and vegetables, may reduce sick leave, but their effect is minimal without additional lifestyle changes [5,6]. While some research suggests that such diets can significantly lower sick leave [9], the overall evidence is limited, and dietary habits generally have a minor impact on sick leave [4,5]. Despite the Mediterranean diet's known benefits for disease prevention, a Spanish study found no significant link between this diet and reduced sick leave [11]. Poor dietary habits may in-crease sick leave, particularly when combined with low physical activity [5].

Low physical activity is strongly linked to increased sick leave [11–14]. The relation-ship between physical activity and sick leave is complex, showing both positive and negative associations [9,12,15]. For example, a Spanish study found that high levels of lei-sure-time physical activity reduced sick leave, especially among women [16]. However, findings vary due to differences in outcome measures, job types, and working conditions [10,17]. Intensive physical activity is associated with significantly shorter sick leave com-pared to those who are sedentary or lightly active [11].

Tobacco use is a significant lifestyle factor linked to increased sick leave [14,17]. Daily smokers face a 30% higher risk of frequent and prolonged sick leave compared to non-smokers [17]. This strong association persists across various demographics and study conditions, although some studies report inconsistent results [12,15,18]. The impact is especially pronounced in men, likely due to higher smoking rates [17]. Despite some variability, daily smoking consistently correlates with higher rates of sick leave [19].

Alcohol consumption is a significant lifestyle factor influencing sick leave [14,17]. The relationship between alcohol use and sick leave varies by outcome and sex. High alcohol consumption is sometimes linked to fewer sick leave days compared to non-drinkers [17], but this effect is more pronounced for long-term sick leave among men [20]. However, findings are inconsistent, with some studies showing no significant link between alcohol use and sick leave [11,17]. Overall, the impact of alcohol consumption on sick leave is complex and varies, particularly affecting long-term sick leave in men [20].

Unhealthy lifestyle behaviors vary across occupational and socioeconomic groups, with skilled manual workers, self-employed individuals, and those working long hours at higher risk [21,22]. These groups are more likely to smoke, drink heavily, and be physically inactive, contributing to increased sick leave rates [20]. While office workers tend to be more inactive and drink heavily, they smoke less [21]. Agricultural workers generally have lower risks for these behaviors, whereas shift workers are more prone to smoking [21]. Some research finds no significant differences in lifestyle behaviors across occupational groups, highlighting the need for more nuanced studies [21].

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Sex differences in sick leave are notable, with women generally exhibiting higher absenteeism rates than men [1,23]. Lifestyle factors like smoking, obesity, and alcohol use impact sick leave differently by sex. Overweight and obese women tend to have higher sick leave rates compared to men [7,25,26]. However, some studies suggest that sex differences in the effects of these lifestyle factors on sick leave may be less pronounced [5,24]. Alcohol consumption particularly influences long-term sick leave in men, contributing significantly to the disparities in sick leave rates between manual and non-manual workers [20].

Exposure to multiple health-related risk factors like low physical activity, poor diet, obesity, alcohol consumption, and smoking is strongly linked to higher sick leave rates [4,5,25]. Improving these lifestyle factors according to health recommendations could en-hance workability and reduce sick leave-associated costs [3,4,26]. Research indicates that workplace interventions targeting nutrition and physical activity can reduce sick leave, and improve work capacity [27]. However, evidence on how these factors interact with sick leave remains inconsistent. Some studies have found no association between obesity and sick leave across both sexes [15] or specifically among men [28]. Additionally, some research shows no significant link between physical activity and sick leave [15]. De Bortoli et al. [5] recently found no association between a healthy diet and reduced sick leave. Similarly, the impact of alcohol consumption on sick leave is uncertain, with some studies reporting no increased risk [15,17], while others found no significant effect of drinking attitudes on sick leave [29]. These varying results may be due to differences in job types [1,5,15,28]. Ultimately, sick leave is a multifactorial issue influenced not only by lifestyle factors but also by job characteristics [1,30,31], and the overall health status of the working population [3].

In Serbia, 16.4% of residents reported being on sick leave in 2019 [32]. Also, over half of the population was either overweight, including 36.0% who were pre-obese and 20.0% who were obese [33]. Daily fruit consumption was at 40.0%, while 50.0% consumed vegetables daily, with higher rates in Belgrade and among those with higher education and better socioeconomic status [32]. Only 11% of adults met the recommended 150 minutes of weekly aerobic physical activity [32]. Tobacco use is a significant concern, with 32.0% of individuals aged 15 and older smoking, more common among men [32]. Alcohol consumption is also notable, with around 50% of the population drinking alcohol, and 3.0% consuming it daily, primarily among men [32].

Despite the recognized link between lifestyle factors and sick leave, comprehensive research examining the interaction of these risk factors within the Serbian working population is notably lacking. This gap highlights the need for further investigation to identify at-risk groups and develop targeted interventions [3,5], aimed at reducing sick leave and improving workforce health in Serbia. Additionally, as highlighted by Østby et al. [6], the observed sex differences in sick leave remain largely unexplained, emphasizing the importance of exploring these disparities in greater detail. To the best of our knowledge, there is no specific research on the impact of modifiable lifestyle factors on sick leave in Serbia, despite the widespread prevalence of these risk factors within the Serbian population. The significant burden of obesity, smoking, physical inactivity, and unhealthy dietary habits among the Serbian working population has yet to be thoroughly examined concerning their impact on sick leave.

This study aims to investigate the associations between body mass index, dietary habits (fruit and vegetable intake), physical activity, smoking, alcohol consumption, and sick leave in Serbia, addressing this critical gap. Additionally, it will explore whether these associations differ between men and women, contributing to the development of targeted interventions to reduce sick leave and improve workforce health outcomes in Serbia.

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2. Materials and Methods

2.1. Study Design

This study involves a secondary analysis of data from the Serbian National Health Survey of the Republic of Serbia, conducted between October and December 2019. The survey was conducted by the Republic Bureau of Statistics, the Institute of Public Health of Serbia "Dr. Milan Jovanovic Batut," and the Ministry of Health of the Republic of Serbia. The European Health Survey-third wave (EHIS-wave 3) methodology and resources were used in the study [34]. Due to the COVID-19 pandemic, the release of the findings was delayed, with results becoming publicly available in 2021.

The study employed a cross-sectional design with a representative sample of Serbian residents, excluding those in Kosovo due to unavailable data. A stratified two-stage sampling method was employed, to ensure national and regional representation. The sample was stratified by geographical regions, including Belgrade Region, Vojvodina Region, Šumadija and Western Serbia, Southern Serbia, and Eastern Serbia. The study aimed to include 6,000 households, projected to cover around 15,000 individuals aged 15 and older. In total, 5,114 households were selected, with 13,178 responses from individuals aged 15 and over, resulting in a response rate of 97.0%. Of those who agreed to participate, 11,790 completed the self-completion form.

For this study, the final sample consisted of 4,652 working population, defined as those aged 18 to 63 for women and 18 to 65 for men. We focused on individuals residing in private homes, excluding those in collective homes or institutions. Individuals outside these age ranges, as well as those with incomplete surveys, were excluded. This sampling approach ensured that the analysis was representative of the working population within these specified age limits.

2.2. Ethical and Legal Aspects

Ethical approval was not necessary for this study since it used secondary data. Informed consent was obtained from all participants before data collection. The study complied with international ethical standards, including the Declaration of Helsinki, and adhered to Serbian legislation. Participants were provided with written information about the study's purpose, their rights, and contact details for any inquiries or concerns. Written consent was secured from each participant. To ensure the privacy and confidentiality of research participants, all necessary measures were implemented in compliance with the General Data Protection Regulation, and data were anonymized, securely stored, and reported in aggregate form, according to the methodology of the European Health Interview Survey - Wave 3 (EHIS - Wave 3) [34]. Permission for the use of secondary data was granted by the Institute of Public Health of Serbia "Dr. Milan Jovanović Batut," and the database was transferred to the University of Kragujevac, Medical Faculty, for further research.

2.3. Survey Instrument

The survey instruments for this study were based on the EHIS Wave 3 questionnaires [34], which adhere to internationally recognized standards and were adapted for the Serbian context. Data collection employed three types of questionnaires: a household questionnaire, an adult questionnaire for individuals aged 15 and older, and self-completion questionnaires for the same age group. The household questionnaire collected socio-economic information about all members of the household. The adult questionnaire, administered in person, gathered detailed information from individuals aged 15 and older. Additionally, self-completion questionnaires allowed respondents to provide personal data independently.

For this study, demographic variables (sex, age, region, marital status), socioeconomic factors (education level, wealth index), and lifestyle factors (body mass index, fruit and vegetable consumption, aerobic physical activity, smoking status, alcohol consumption). Participants' sex was self-reported, and the data were analyzed for sex-based differences in sick leave patterns. Age was categorized into five groups: 18-25, 26-35, 36-45, 46-55, and 56-65. Education levels were classified as college/university, secondary, and primary school. Regions of Serbia were divided into Belgrade

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(Capital), Northern, Central and Western, and Southern and Eastern Serbia. Marital status included categories such as married, single, divorced, and widowed. The Wealth Index categorizes households into five quintiles based on their economic status: poorest (Q1), poorer (Q2), middle (Q3), richer (Q4), and richest (Q5). These quintiles, each representing an equal portion of the population, are used to analyze socio-economic disparities among study participants. Occupations were classified according to ISCO08 [35] and EHIS Wave 3 questionnaire recommendation for data dissemination [34] into four groups: managers, professionals, technicians, and associate professionals; clerical support workers, service, and sales workers; skilled manual workers; and elementary occupations. Job physical effort was categorized into heavy (heavy labor or physically demanding work), moderate (tasks involving moderate effort, like walking), and light (mostly sitting or standing). Self-rated health was assessed as very good/good, fair, or bad/very bad.

Participants were categorized according to their body mass index (BMI) using the following classifications: underweight (BMI < 18.5 kg/m²), normal weight (BMI between 18.5 and 24.9 kg/m²), pre-obesity (BMI between 25 and 29.9 kg/m²), and obesity (BMI ≥ 30 kg/m²). These categories are based on the World Health Organization's guidelines [36]. Fruit and vegetable consumption was categorized as daily, 4 to 6 times per week, 1 to 3 times per week, or never/occasionally. Compliance with WHO recommendations for health-enhancing physical activity (HEPA) [37] was assessed by summing the weekly minutes spent cycling and engaging in leisure time sports, fitness, or recreational activities (aerobic physical activity). Based on guidelines recommending 150 minutes of moderate-intensity activity per week, participants were categorized as high (≥150 min/week), moderate (11-149 min/week), or low (0-10 min/week) in their aerobic physical activity levels. Smoking status was assessed with the question: "Do you smoke tobacco products?" Participants could choose from: "Yes, daily," "Yes, occasionally," "Not anymore," or "I have never smoked." Responses were classified into never smoker, former smoker, and current smoker. The AUDIT-C evaluated alcohol consumption by calculating daily intake based on participants' reported consumption [34]. According to Serbian guidelines, low-risk drinking was defined as ≤ 13 grams of pure alcohol per day for women and ≤ 26 grams per day for men [38]. The weekly intake was then calculated by averaging the total volume of alcohol consumed over the past 12 months, measured in grams of pure alcohol per week. Based on this, alcohol consumption was categorized into four groups: lifetime abstainers, former drinkers, non-weekly drinkers, and low-risk drinkers (women: 0–91 grams per week, men: 0–182 grams per week). Consumption above these thresholds was classified as risky drinking (women: >91 grams per week, men: >182 grams per week).

The dependent variable is sick leave, assessed based on participants' reports of missing work due to health reasons in the previous 12 months. Responses were categorized into three groups: no sick leave, short-term sick leave (up to 30 days), and long-term sick leave (over 30 days), reflecting Serbian norms, where the National Health Insurance Fund provides financial assistance to employers following 30 consecutive days of sick leave [39].

2.4. Statistical Methods

Chi-square tests (χ^2) assessed associations between categorical variables, with significance set at $p<0.05$. Logistic regression models evaluated the impact of independent variables on sick leave, with results presented as odds ratios (ORs) and 95% confidence intervals (CIs). Multivariate models were selected based on theoretical relevance and practical importance, with multicollinearity addressed using variance inflation factors (VIF), with all values below the critical threshold of 5. Model fit was confirmed by the Hosmer-Lemeshow test ($p > 0.05$) and residual analyses showed no significant outliers. Model fit was assessed using Nagelkerke R^2, and accuracy was confirmed by ROC curve analysis. Cross-validation demonstrated model stability across different data subsets. Outliers and influential data points were checked using Cook's distance and other metrics, with adjustments made where necessary to maintain model validity. All analyses were conducted with IBM SPSS Statistics, Version 20.0 (IBM Corp., Armonk, NY).

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3. Results

The research included 4,652 respondents, with an average age of 42.68 years, categorized by sex. Chi-square tests reveal statistically significant differences across several variables. Women were the most represented in the 36-45 age group (30.8%) ($\chi^2 = 17.604$, $p = 0.001$). In terms of education, the highest proportion of women had completed college or university (34.8%) compared to men (24.6%), while the majority of men had completed middle school (68.0% vs. 58.1% for women) ($\chi^2 = 59.007$, $p < 0.001$). Regionally, both sexes were most concentrated in Central and Western Serbia, with men having a higher prevalence (32.9%) compared to women (29.4%) ($\chi^2 = 11.964$, $p = 0.008$). Marital status data indicate that a higher percentage of women were married (73.1%) compared to men (68.0%) ($\chi^2 = 145.876$, $p < 0.001$). Regarding the wealth index, women were more represented in the richer class (31.2%) compared to men (27.9%) ($\chi^2 = 14.735$, $p = 0.005$). Occupational data indicate that men were predominantly engaged in skilled manual work (42.1%), while women were the most represented in managerial or professional roles (38.4%) ($\chi^2 = 241.120$, $p < 0.001$). In terms of job physical effort, the highest percentage of women were in jobs requiring light or no physical effort (49.6%), whereas men were the most involved in jobs requiring moderate physical effort (43.0%) ($\chi^2 = 246.003$, $p < 0.001$). Finally, self-rated health data show that a higher percentage of men reported very good or good health (84.5%) compared to women (80.2%) ($\chi^2 = 14.611$, $p = 0.001$) (Table 1).

Table 1. Sociodemographic description of participants.

Variables	Sex				Pearson Chi-Square/df/p *
	Male		Female		
	N	%	N	%	
Age					
18-25	206	7.9	109	5.3	17.604/4/0.001
26-35	584	22.5	450	21.9	
36-45	721	27.7	633	30.8	
46-55	668	25.7	556	27.1	
56-65	420	16.2	305	14.9	
Education					
College/University	638	24.6	714	34.8	59.007/2/0.000
Middle school	1767	68.0	1193	58.1	
Primary school	192	7.4	146	7.1	
Region of Serbia					
Belgrade (Capital)	645	24.8	589	28.7	11.964/3/0.008
Vojvodina	625	24.0	508	24.7	
Central and Western Serbia	855	32.9	603	29.4	
Southern and Eastern Serbia	474	18.2	353	17.2	
Marital status					
Married	1762	68.0	1495	73.1	145.876/3/0.000
Single	696	26.9	316	15.5	
Divorced	121	4.7	167	8.2	
Widowed	13	0.5	67	3.3	
Wealth index (class)					
Richest	726	27.9	640	31.2	14.735/4/0.005
Richer	640	24.6	531	25.9	
Middle	540	20.8	418	20.4	
Poor	413	15.9	297	14.5	
Poorest	280	10.8	167	8.1	
Occupations					
Managers, professionals, and technicians	710	27.6	779	38.4	241.120/3/0.000
Clerical support, service, and sales workers	621	24.1	623	30.7	
Skilled manual workers	1086	42.1	421	20.7	
Elementary occupations	160	6.2	207	10.2	
Job physical effort					
Heavy	517	21.2	104	5.3	246.003/2/0.000
Moderate	1050	43.0	889	45.1	
None/light	877	35.9	979	49.6	
Self-rated health					
Very good/good	2067	84.5	1583	80.2	14.611/2/0.001
Fair	322	13.2	328	16.6	

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Bad/very bad	56	2.3	63	3.2		

* Statistical significance was set at $p < 0.05$.

In total, in the twelve months before the study, 15.8% of respondents had sick leave due to personal health issues, with a higher rate among women (18.2%) compared to men (13.9%). Women also had higher rates of both, short-term (13.9%) and long-term sick leave (3.4%) compared to men (10.6% and 2.2%, respectively). Age is significantly associated with sick leave, with men aged 56-65 years having the highest proportion of long-term sick leave (46.4%) ($\chi^2 = 44.649$, $p < 0.001$). Education levels also show a significant relationship with sick leave, with men holding a middle school education exhibiting the highest prevalence of both short-term (68.0%) and long-term sick leave (64.3%) ($\chi^2 = 15.872$, $p = 0.003$). Regional disparities were evident, with men from Vojvodina showing the highest prevalence of short-term sick leave (32.4%), while those from Central and Western Serbia exhibited the highest prevalence of long-term sick leave (35.7%) ($\chi^2 = 13.322$, $p = 0.038$). Marital status and wealth class did not show statistically significant associations with sick leave, although married men from the richest class had a slightly higher prevalence of long-term sick leave (35.7%). Occupational categories did not show significant differences, however, skilled manual workers had the highest prevalence of long-term sick leave (44.6%). Job physical effort was marginally non-significant ($p = 0.057$). Finally, self-rated health was strongly associated with sick leave ($\chi^2 = 167.279$, $p < 0.001$), with men reporting bad or very bad health showing a 17.9% prevalence of long-term sick leave. Men with very good or good self-rated health had significantly higher both short-term (68.3%) and long-term sick leave (48.2%) (Table 2).

Table 2. Prevalence of sick leave by sociodemographic characteristics, male.

Variables	**Total**		**Sick leave**						
	N	%	No		Short-term		Long-term		Pearson Chi-Square/df/p *
			N	%	N	%	N	%	
Age									
18-25	203	7.9	186	8.3	15	5.5	2	3.6	
26-35	576	22.4	505	22.6	66	24.3	5	8.9	
36-45	712	27.7	629	28.1	73	26.8	10	17.9	44.649/8/0.000
46-55	660	25.7	578	25.8	69	25.4	13	23.2	
56-65	415	16.2	340	15.2	49	18.0	26	46.4	
Education									
College/University	635	24.8	568	25.4	53	19.5	14	25.0	
Middle school	1741	67.9	1520	68.0	185	68.0	36	64.3	15.872/4/0.003
Primary school	188	7.3	148	6.6	34	12.5	6	10.7	
Region of Serbia									
Belgrade (Capital)	636	24.8	554	24.8	67	24.6	15	26.8	
Vojvodina	619	24.1	521	23.3	88	32.4	10	17.9	13.322/6/0.038
Central and Western Serbia	847	33.0	752	33.6	75	27.6	20	35.7	
Southern and Eastern Serbia	464	18.1	411	18.4	42	15.4	11	19.6	
Marital status									
Married	1735	67.8	1498	67.1	196	72.3	41	73.2	
Single	690	27.0	618	27.7	62	22.9	10	17.9	7.975/6/0.240
Divorced	121	4.7	105	4.7	11	4.1	5	8.9	
Widowed	13	0.5	11	0.5	2	0.7	0	0.0	
Wealth index (class)									
Richest	718	28.0	623	27.8	75	27.6	20	35.7	
Richer	636	24.8	561	25.1	61	22.4	14	25.0	12.648/8/0.125
Middle	529	20.6	448	20.0	70	25.7	11	19.6	

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Poor	411	16.0	374	16.7	31	11.4	6	10.7	
Poorest	272	10.6	232	10.4	35	12.9	5	8.9	
Occupations									
Managers, professionals, and technicians	707	27.8	626	28.2	66	24.4	15	26.8	5.579/6/0.472
Clerical support, service, and sales workers	613	24.1	538	24.2	63	23.2	12	21.4	
Skilled manual workers	1069	42.0	926	41.7	118	43.5	25	44.6	
Elementary occupations	157	6.2	129	5.8	24	8.9	4	7.1	
Job physical effort									
Heavy	512	21.1	432	20.6	72	26.5	8	14.3	9.171/4/0.057
Moderate	1044	43.0	906	43.1	116	42.6	22	39.3	
None/light	873	35.9	763	36.3	84	30.9	26	46.4	
Self-rated health									
Very good/good	2060	84.8	1848	87.9	185	68.3	27	48.2	167.279/4/0.000
Fair	316	13.0	226	10.8	71	26.2	19	33.9	
Bad/very bad	53	2.2	28	1.3	15	5.5	10	17.9	

* Statistical significance was set at $p < 0.05$.

Among women, age is significantly associated with sick leave, with women aged 46-55 years showing the highest proportion of short-term sick leave (35.8%) and those aged 36-45 years having the highest proportion of long-term sick leave (31.9%) ($\chi^2 = 25.890$, $p = 0.001$). Education levels did not show a statistically significant relationship with sick leave, though women with higher education (24.6%) had a slightly higher prevalence of long-term sick leave compared to those with primary school education (11.6%) ($\chi^2 = 5.126$, $p = 0.275$). Regional disparities were evident, with women from Central and Western Serbia showing the highest prevalence of short-term sick leave (35.5%), while women living in Belgrade (the capital) had the highest prevalence of long-term sick leave (34.8%) ($\chi^2 = 24.143$, $p = 0.000$). Marital status also showed a significant association with sick leave, with married women having the highest prevalence of both short (71.6%) and long-term sick leave (84.1%) ($\chi^2 = 18.935$, $p = 0.004$). The wealth index demonstrated a significant relationship, with women from the richest class having the highest prevalence of both short (37.9%) and long-term sick leave (34.8%) ($\chi^2 = 17.746$, $p = 0.023$). Occupational categories did not show significant differences. Job physical effort was marginally significant, with women reporting light physical effort having the highest prevalence of short-term sick leave (49.6%) and those with moderate physical effort showing the highest prevalence of long-term sick leave (44.9%) ($\chi^2 = 10.319$, $p = 0.035$). Finally, self-rated health was strongly associated with sick leave ($\chi^2 = 141.699$, $p < 0.001$). Women reporting bad or very bad health had a 20.3% prevalence of long-term sick leave. Women reporting very good or good self-rated health had a higher prevalence of both, short-term (67.0%), and long-term sick leave (44.9%) (Table 3).

Table 3. Prevalence of sick leave by sociodemographic characteristics, female.

Variables	Total		Sick leave						
	N	%	No		Short-term		Long-term		Pearson Chi-Square/df/p *
			N	%	N	%	N	%	
Age									
18-25	108	5.3	99	5.9	9	3.2	0	0.0	25.890/8/0.001
26-35	440	21.7	382	22.8	40	14.2	18	26.1	
36-45	626	30.9	511	30.5	93	33.0	22	31.9	
46-55	551	27.2	431	25.7	101	35.8	19	27.5	
56-65	303	14.9	254	15.1	39	13.8	10	14.5	
Education									
College/University	702	34.6	581	34.6	104	36.9	17	24.6	5.126/4/0.275

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Middle school	1183	58.3	981	58.5	158	56.0	44	63.8	
Primary school	143	7.1	115	6.9	20	7.1	8	11.6	
Region of Serbia									
Belgrade (Capital)	579	28.6	456	27.2	99	35.1	24	34.8	24.143/6/0.000
Vojvodina	502	24.8	430	25.6	54	19.1	18	26.1	
Central and Western Serbia	600	29.6	483	28.8	100	35.5	17	24.6	
Southern and Eastern Serbia	347	17.1	308	18.4	29	10.3	10	14.5	
Marital status									
Married	1474	73.0	1214	72.7	202	71.6	58	84.1	18.935/6/0.004
Single	314	15.5	278	16.7	33	11.7	3	4.3	
Divorced	166	8.2	125	7.5	35	12.4	6	8.7	
Widowed	66	3.3	52	3.1	12	4.3	2	2.9	
Wealth index (class)									
Richest	632	31.2	501	29.9	107	37.9	24	34.8	17.746/8/0.023
Richer	526	25.9	444	26.5	67	23.8	15	21.7	
Middle	411	20.3	342	20.4	60	21.3	9	13.0	
Poor	292	14.4	251	15.0	31	11.0	10	14.5	
Poorest	167	8.2	139	8.3	17	6.0	11	15.9	
Occupations									
Managers, professionals, and technicians	766	38.2	624	37.7	112	39.9	30	43.5	7.314/6/0.293
Clerical support, service, and sales workers	617	30.8	521	31.5	76	27.0	20	29.0	
Skilled manual workers	418	20.8	352	21.3	55	19.6	11	15.9	
Elementary occupations	205	10.2	159	9.6	38	13.5	8	11.6	
Job physical effort									
Heavy	103	5.3	76	4.7	18	6.4	9	13.0	10.319/4/0.035
Moderate	884	45.3	729	45.5	124	44.0	31	44.9	
None/light	965	49.4	796	49.7	140	49.6	29	42.0	
Self-rated health									
Very good/good	1568	80.2	1348	84.1	189	67.0	31	44.9	141.699/4/0.000
Fair	325	16.6	227	14.2	74	26.2	24	34.8	
Bad/very bad	61	3.1	28	1.7	19	6.7	14	20.3	

* Statistical significance was set at $p < 0.05$.

Table 4 presents the prevalence of sick leave among men based on lifestyle factors. Among BMI categories, the highest prevalence of both, short-term (46.6%), and long-term sick leave (43.8%) was found in those classified as pre-obese ($\chi^2 = 1.375$, $p = 0.967$), though these differences were not statistically significant. For fruit consumption, the highest prevalence of short-term sick leave was observed among men consuming fruit 4 to 6 times a week (38.3%), while the highest prevalence of long-term sick leave was seen in those consuming fruit at least once a day (37.7%) ($\chi^2 = 9.432$, $p = 0.151$), although these differences were not statistically significant. In contrast, men who consumed vegetables at least once a day exhibited the highest prevalence of both short-term (45.2%) and long-term sick leave (58.9%) ($\chi^2 = 13.805$, $p = 0.032$). Leisure-time aerobic physical activity levels did not show significant differences in sick leave prevalence ($\chi^2 = 6.501$, $p = 0.165$). Smoking status revealed that never-smokers had the highest prevalence of short-term sick leave (43.8%), while current smokers had the highest prevalence of long-term sick leave (38.1%) ($\chi^2 = 12.797$, $p = 0.012$). Finally, alcohol consumption patterns indicated that non-weekly drinkers had the highest prevalence of both short-term (35.9%) and long-term sick leave (40.5%) ($\chi^2 = 22.491$, $p = 0.004$).

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Table 4. Prevalence of sick leave according to lifestyle factors, male.

Variables	Total		Sick leave						
	N	%	No		Short-term		Long-term		Pearson Chi-Square/df/p *
			N	%	N	%	N	%	
Body mass index									
Underweight	17	0.8	16	0.9	1	0.4	0	0.0	1.375/6/0.967
Normal weight	579	28.0	496	27.8	68	28.8	15	31.3	
Pre-obese	972	47.1	841	47.2	110	46.6	21	43.8	
Obese	497	24.1	428	24.0	57	24.2	12	25.0	
Fruit consumption									
At least once a day	867	37.2	766	37.6	81	33.3	20	37.7	9.432/6/0.151
4 to 6 times a week	178	30.1	158	29.3	15	38.3	13	24.5	
1 to 3 times a week	703	25.1	597	25.3	93	22.2	15	28.3	
Never/occasionally	585	7.6	516	7.8	54	6.2	5	9.4	
Vegetable consumption									
At least once a day	1155	47.6	999	47.5	123	45.2	33	58.9	13.805/6/0.032
4 to 6 times a week	736	30.3	649	30.9	71	26.1	16	28.6	
1 to 3 times a week	462	19.0	393	18.7	64	23.5	5	8.9	
Never/occasionally	76	3.1	60	2.9	14	5.1	2	3.6	
Leisure-time aerobic physical activity									
High	216	8.9	191	9.1	23	8.8	2	3.8	6.501/4/0.165
Moderate	428	17.7	374	17.8	50	19.2	4	7.7	
Low	1776	73.4	1542	73.2	188	72.0	46	88.5	
Smoking status									
Never smoker	893	48.2	788	49.2	91	43.8	14	33.3	12.797/4/0.012
Former smoker	236	12.7	194	12.1	30	14.4	12	28.6	
Current smoker	723	39.0	620	38.7	87	41.8	16	38.1	
Alcohol consumption									
Lifetime abstainers	401	24.0	366	25.2	29	15.8	6	16.2	22.491/8/0.004
Former drinking	153	9.1	131	9.0	19	10.3	3	8.1	
Non-weekly drinking	680	40.6	599	41.3	66	35.9	15	40.5	
Low-risk drinking	367	21.9	295	20.3	60	32.6	12	32.4	
Risky drinking	72	4.3	61	4.2	10	5.4	1	2.7	

* Statistical significance was set at $p < 0.05$.

Table 5 presents the prevalence of sick leave among women based on lifestyle factors. Among BMI categories, the highest prevalence of both short-term (55.3%) and long-term sick leave (38.7%) was observed in women classified as normal weight ($\chi^2 = 17.300$, $p = 0.008$). For fruit consumption, the highest prevalence of both short-term (46.5%) and long-term sick leave (56.5%) was found among women consuming fruit at least once a day ($\chi^2 = 14.154$, $p = 0.028$). Regarding vegetable consumption, women who consumed vegetables at least once a day had the highest prevalence of both short-term (60.6%) and long-term sick leave (76.8%) ($\chi^2 = 18.851$, $p = 0.004$). Leisure-time aerobic physical activity levels showed that women with low levels of physical activity had the highest prevalence of both short-term (86.4%) and long-term sick leave (85.5%) ($\chi^2 = 10.452$, $p = 0.033$). Smoking status revealed that never-smokers had the highest prevalence of short-term sick leave (46.2%), while current smokers had the highest prevalence of long-term sick leave (55.4%) ($\chi^2 = 18.746$, $p = 0.001$). Finally, alcohol consumption patterns indicated that non-weekly female drinkers had the highest prevalence of short-term sick leave (43.9%), while lifetime abstainers had the highest prevalence of long-term sick leave (41.3%). However, the overall differences in alcohol consumption patterns were not statistically significant ($\chi^2 = 11.451$, $p = 0.177$).

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Table 5. Prevalence of sick leave according to lifestyle factors, female.

Variables	Total		Sick leave						
	N	%	No		Short-term		Long-term		Pearson Chi-Square/df/p *
			N	%	N	%	N	%	
Body mass index									
Underweight	45	2.7	39	2.9	5	2.1	1	1.6	17.300/6/0.008
Normal weight	938	56.5	784	57.6	130	55.3	24	38.7	
Pre-obese	464	28.0	381	28.0	62	26.4	21	33.9	
Obese	212	12.8	158	11.6	38	16.2	16	25.8	
Fruit consumption									
At least once a day	859	44.0	689	43.0	131	46.5	39	56.5	14.154/6/0.028
4 to 6 times a week	987	50.6	832	52.0	130	46.1	25	36.2	
1 to 3 times a week	90	4.6	69	4.3	18	6.4	3	4.3	
Never/occasionally	16	0.8	11	0.7	3	1.1	2	2.9	
Vegetable consumption									
At least once a day	1093	56.0	869	54.3	171	60.6	53	76.8	18.851/6/0.004
4 to 6 times a week	579	29.7	496	31.0	71	25.2	12	17.4	
1 to 3 times a week	240	12.3	204	12.8	32	11.3	4	5.8	
Never/occasionally	39	2.0	31	1.9	8	2.8	0	0.0	
Leisure-time aerobic physical activity									
High	166	8.6	144	9.0	19	7.2	3	4.3	10.452/4/0.033
Moderate	225	11.1	191	11.9	17	6.4	7	10.1	
Low	1553	80.3	1265	79.1	229	86.4	59	85.5	
Smoking status									
Never smoker	812	53.9	689	56.0	102	46.2	21	37.5	18.746/4/0.001
Former smoker	152	10.1	116	9.4	32	14.5	4	7.1	
Current smoker	543	36.0	425	34.6	87	39.4	31	55.4	
Alcohol consumption									
Lifetime abstainers	598	46.0	500	46.8	79	42.2	19	41.3	11.451/8/0.177
Former drinking	113	8.7	93	8.7	12	6.4	8	17.4	
Non-weekly drinking	509	39.1	412	38.6	82	43.9	15	32.6	
Low-risk drinking	75	5.8	59	5.5	13	7.0	3	6.5	
Risky drinking	6	0.5	4	0.4	1	0.5	1	2.2	

* Statistical significance was set at $p < 0.05$.

When analyzing men, the body mass index significantly impacts sick leave across all models. Individuals with obesity exhibit more than three times the odds of sick leave compared to those classified as underweight, with an odds ratio (OR) of 3.007 in Model 1a (CI: 1.607-6.119). Although this effect diminishes in Model 4d (OR = 2.613), it remains statistically significant, indicating that obesity continues to be a substantial predictor of sick leave even after adjusting for socio-demographic, occupational, and health factors. Overweight individuals also show a significant impact, with OR values ranging from 2.607 to 2.802, suggesting increased odds of sick leave compared to underweight individuals. Normal weight (BMI = 18.5-24.9) has a similar, though slightly lesser, impact compared to overweight and obesity, with OR values between 2.333 and 2.452, underscoring the significant role of body weight in determining sick leave risk.

Fruit and vegetable consumption has distinct effects on sick leave. Consuming fruit never/occasionally is associated with a significant impact sick leave likelihood of sick leave among men (OR = 1.713 in Model 1a, OR = 2.188 in Model 4d), suggesting that regular fruit consumption may act as a protective factor. Similar findings are shown in vegetable consumption. Men who rarely or never consume vegetables exhibit higher odds of sick leave, with OR values ranging from 1.501 to 2.828.

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Low or moderate leisure-time aerobic physical activity is associated with increased chances of sick leave compared to individuals with high physical activity. Odds ratios (OR) for low physical activity range from 1.801 to 1.651, suggesting that insufficient physical activity may contribute to a higher risk of health problems leading to sick leave among men.

Current male smokers have significantly higher odds of experiencing sick leave compared to non-smokers, with an odds ratio (OR) of 2.016 (CI: 1.207-3.404) in Model 1a, decreasing slightly to 1.915 (CI: 1.161-3.376) in Model 4d. This indicates that smoking is a significant risk factor for sick leave among men across all models, even after accounting for additional sociodemographic, work-related, and health-related factors. Former male smokers also show increased odds of sick leave, with OR values ranging from 1.713 to 1.909.

Risky alcohol consumption has the strongest impact on sick leave among men, with odds ratios (OR) ranging from 4.004 in Model 2b to 4.111 in Model 4d. These values indicate that men engaging in risky drinking have significantly higher odds of sick leave compared to abstainers. Low-risky drinking among men also shows a substantial effect, with OR values between 3.510 and 3.770, suggesting that moderate alcohol consumption can also increase the risk of health issues leading to sick leave. Non-weekly drinking exhibits elevated risk, with OR values from 2.512 in Model 1a to 2.818 in Model 4d, suggesting that even non-weekly drinking can increase sick leave. Former alcohol consumers also exhibit elevated risk, with OR values from 3.117 in Model 1a to 3.327 in Model 4d, reflecting the lasting health consequences of previous excessive alcohol consumption.

Table 6. Unadjusted and adjusted odds ratio (OR) with 95% confidence interval (CI) for the association of lifestyle factors with sick leave - male.

Variables		Model 1 OR (95% CI)	Model 2 OR (95% CI)	Model 3 OR (95% CI)	Model 4 OR (95% CI)
Body mass index	Underweight	1	1	1	1
	Normal weight	2.501 (1.201-5.111)*	2.333 (1.115-4.754)*	2.411 (1.158-4.800)*	2.452 (1.202-5.103)*
	Pre-obese	2.802 (1.405-5.640)*	2.607 (1.318-5.211)*	2.730 (1.351-5.425*	2.662 (1.363-5.287)*
	Obese	3.007 (1.607-6.119)*	2.819 (1.568-5.659)*	2.850 (1.504-5.704)*	2.613 (1.414-5.200)*
Fruit consumption	At least once a day	1		1	1
	4 to 6 times a week	1.506 (0.912-2.705)	1.562 (0.901-2.805)	1.607 (0.951-2.904)	1.711 (1.001-3.119)
	1 to 3 times a week	1.819 (1.119-3.052)	1.852 (1.153-3.060)	1.850 (1.107-3.088)	1.808 (1.115-3.010)
	Never/occasionally	1.713 (1.139-2.576)*	2.050 (1.357-3.272)*	2.103 (1.488-3.334)*	2.188 (1.367-3.339)*
Vegetable consumption	At least once a day	1	1	1	1
	4 to 6 times a week	0.870 (0.570-1.328)	0.910 (0.592-1.399)	0.910 (0.591-1.401)	0.921 (0.593-1.431)
	1 to 3 times a week	0.949 (0.570-1.580)	0.947 (0.563-1.591)	0.983 (0.583-1.657)	0.986 (0.579-1.679)
	Never/occasionally	1.501 (0.901-2.702)*	2.744 (1.081-6.965)*	2.749 (1.079-7.000)*	2.828 (1.086-7.367)*
Leisure-time aerobic physical activity	High	1	1	1	1
	Moderate	1.514 (0.910-2.702)	1.631 (1.095-2.801)	1.552 (0.902-2.700)	1.601 (1.007-2.814)
	Low	1.801 (1.011-3.201)	1.751 (0.977-3.179)	1.704 (0.901-3.052)	1.651 (0.844-2.944)
	Never smoker	1	1	1	1

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Smoking status	Former smoker	1.909 (1.169-3.406)	1.861 (1.037-3.308)	1.809 (1.007-3.313)	1.713 (1.116-3.165)
	Current smoker	2.016 (1.207-3.404)*	1.910 (1.520-3.304)*	1.858 (1.109-3.305)*	1.915 (1.161-3.376)*
Alcohol consumption	Lifetime abstainers	1	1	1	1
	Former drinking	3.117 (1.837-5.620)*	3.129 (1.834-5.811)*	3.241 (1.915-6.005)*	3.327 (1.910-6.201)*
	Non-weekly drinking	2.512 (1.602-4.211)	2.613 (1.650-4.370)	2.659 (1.652-4.488)	2.818 (1.712-4.608)
	Low-risk drinking	3.510 (2.101-6.108)*	3.593 (2.271-6.271)*	3.613 (2.249-6.332)*	3.770 (2.262-6.412)*
	Risky drinking	4.153 (2.301-6.410)**	4.004 (2.958-6.405)**	4.001 (2.942-6.273)**	4.111 (2.829-6.884)**

Statistical significance: * - $p < 0.05$; ** - $p < 0.01$. Model 1 unadjusted odds ratio for lifestyle-related factors with sick leave. Model 2 adjusted the odds ratio for Model 1 with the addition of sociodemographic factors with sick leave. Model 3 adjusted the odds ratio for Model 2 with the addition of work-related factors with sick leave. Model 4 adjusted the odds ratio for Model 3 with the addition of health-related factors with sick leave.

In women, obesity has a positive but statistically non-significant effect on sick leave across all models. In Model 1a, the odds ratio (OR) is 2.215 (CI: 0.989-4.967), decreasing to 1.575 in Model 4d (CI: 0.687-3.611) as additional factors are included. Although these values are above 1, the broad confidence intervals indicate that the results are not statistically significant, suggesting that while obesity may increase sick leave risk, further research is needed to clarify this association. Overweight shows a similar pattern with OR values between 1.097 and 1.323, but these are also not statistically significant. This implies that women with overweight have a slightly higher risk of sick leave compared to underweight individuals, although this risk is not substantial. Normal weight demonstrates the least impact on sick leave, with OR values ranging from 1.084 to 1.215, indicating that normal weight does not significantly alter the risk of sick leave compared to underweight women.

In women, the consumption of fruit 4 to 6 times a week shows an unexpected effect. In Model 1a, the odds ratio (OR) is 0.915 (CI: 0.639-2.292), and in Models 2b, 3c, and 4d, the values remain below 1, suggesting that regular fruit consumption may reduce the risk of sick leave. However, the wide confidence intervals indicate that these results are not statistically significant. Conversely, occasional or rare fruit consumption (1 to 3 times a week or never/rarely) has OR values above 1, but the confidence intervals are too broad to be statistically significant. These findings suggest that further research is needed to better understand how fruit consumption affects health and sick leave.

In this analysis, vegetable consumption does not show a significant impact on sick leave among women. The odds ratios (OR) for women consuming vegetables less than once a day are below 1 across all models, but the wide confidence intervals suggest that the effect might not be strong or is difficult to detect with the available data. This indicates that vegetable consumption may not have a substantial effect on sick leave or that the effect is not easily observable in this dataset.

Women with low or moderate physical activity levels have increased odds of sick leave compared to those with high levels of physical activity. The odds ratios (OR) for low physical activity range from 1.551 in Model 1a to 1.361 in Model 4d, with similar OR values for moderate physical activity. Although these values are greater than 1, the wide confidence intervals suggest that the results are not statistically significant.

Current female smokers exhibit significantly higher odds of sick leave compared to non-smokers, with odds ratios (OR) ranging from 1.811 in Model 1a to 1.809 in Model 4d, indicating a consistently high risk. These results are statistically significant, highlighting the need for smoking cessation interventions to reduce sick leave. Former smokers also show increased odds of sick leave, with OR values between 1.803 and 1.967, suggesting that smoking has long-term negative effects on health that persist even after quitting.

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Risky alcohol consumption has the strongest impact on sick leave among women, with odds ratios (OR) ranging from 2.771 in Model 1a to 3.116 in Model 4d. These results suggest that women who engage in risky drinking have a significantly increased risk of sick leave compared to those who abstain from alcohol. However, the wide confidence intervals indicate the need for further research to confirm these findings. Low-risk alcohol consumption and former drinkers also show a slightly elevated risk of sick leave compared to non-drinkers, with OR values just above 1. Although these findings suggest a potential increased risk, the lack of statistical significance highlights the necessity for additional studies.

Table 7. Unadjusted and adjusted odds ratio (OR) with a 95% confidence interval (CI) for the association of lifestyle factors with sick leave - female.

Variables		Model 1 OR (95% CI)	Model 2 OR (95% CI)	Model 3 OR (95% CI)	Model 4 OR (95% CI)
Body mass index	Underweight	1	1	1	1
	Normal weight	1.215 (0.556-2.487)	1.112 (0.446-2.324)	1.084 (0.451-2.287)	1.125 (0.489-2.414)
	Pre-obese	1.323 (0.609-2.873)	1.119 (0.493-2.538)	1.097 (0.479-2.518)	1.154 (0.505-2.642)
	Obese	2.215 (0.989-4.967)	1.759 (0.767-3.732)	1.701 (0.748-3.738)	1.575 (0.687-3.611)
Fruit consumption	At least once a day	1		1	1
	4 to 6 times a week	0.915 (0.639-2.292)	0.972 (0.664-1.472)	0.998 (0.679-1.436)	0.968 (0.644-1.346)
	1 to 3 times a week	1.245 (0.590-2.593)	1.456 (0.678-3.218)	1.523 (0.694-3.331)	1.258 (0.567-2.763)
	Never/occasionally	2.315 (0.468-11.465)	2.594 (0.517-12.915)	2.738 (0.558-13.527)	2.703 (0.535-14.872)
Vegetable consumption	At least once a day	1	1	1	1
	4 to 6 times a week	0.840 (0.534-1.321)	0.867 (0.545-1.380)	0.822 (0.513-1.316)	0.920 (0.566-1.493)
	1 to 3 times a week	0.639 (0.344-1.185)	0.668 (0.354-1.262)	0.655 (0.345-1.244)	0.716 (0.371-1.381)
	Never/occasionally	1.055 (0.303-3.677)	1.369 (0.380-4.929)	1.472 80.397-5.456)	1.280 (0.323-5.076)
Leisure-time aerobic physical activity	High	1	1	1	1
	Moderate	1.512 (0.872-2.621)	1.479 (0.856-2.578)	1.461 (0.847-2.583)	1.187 (0.702-2.011)
	Low	1.551 (0.891-2.701)	1.482 (0.859-2.612)	1.432 (0.820-2.511)	1.361 (0.775-2.387)
Smoking status	Never smoker	1	1	1	1
	Former smoker	1.950 (1.151-3.310)*	1.803 (1.045-3.019)*	1.917 (1.106-3.302)*	1.967 (1.167-3.384)*
	Current smoker	1.811 (1.261-2.601)*	1.879 (1.341-2.635)*	1.812 (1.302-2.602)*	1.809 (1.221-2.651)*
Alcohol consumption	Lifetime abstainers	1	1	1	1
	Former drinking	1.611 (0.721-3.521)	1.591 (0.707-3.501)	1.581 (0.702-3.481)	1.681 (0.747-3.781)
	Non-weekly drinking	1.512 (0.872-2.621)	1.523 (0.879-2.652)	1.552 (0.878-2.651)	1.575 (0.912-2.741)
	Low-risk drinking	1.462 (0.689-3.101)	1.459 (0.688-3.095)	1.491 (0.703-3.211)	1.561 (0.735-3.411)

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Risky drinking	2.771 (0.721-15.482)*	2.931 (0.815-16.431)*	3.051 (0.851-17.501)*	3.116 (0.872-18.112)*

Statistical significance: ∗ - $p < 0.05$; ∗∗ - $p < 0.01$. Model 1 unadjusted odds ratio for lifestyle-related factors with sick leave. Model 2 adjusted the odds ratio for Model 1 with the addition of sociodemographic factors with sick leave. Model 3 adjusted the odds ratio for Model 2 with the addition of work-related factors with sick leave. Model 4 adjusted the odds ratio for Model 3 with the addition of health-related factors with sick leave.

4. Discussion

This research aimed to analyze the modifiable lifestyle factors associated with sick leave among Serbia's working population, with a particular focus on sex differences and their impact on sick leave. The study included 4,652 respondents, with an average age of 42.68 years, categorized by sex. The results of the first study show significant differences in sociodemographic variables. Women were more represented in the 36-45 age group and had higher educational attainment, with 34.8% completing college or university compared to 24.6% of men. Men were predominantly engaged in skilled manual work, while women were more often in managerial roles. Regional concentration was highest in Central and Western Serbia for both sexes. Additionally, a higher percentage of men reported very good or good health (84.5% vs. 80.2% for women).

Our study reveals that 15.8% of respondents reported sick leave due to personal health issues in the past year, with a higher prevalence among women compared to men. Serbia's rates are between those of Spain (8.8% for men and 11.9% for women) and the United Kingdom (7.9% for men and 12.3% for women) [1]. Germany reports the highest rates (20.4% for men and 22.9% for women), while Turkey and Romania have much lower rates (Turkey: 2.1% for men and 0.9% for women; Romania: 0.7% for men and 0.4% for women) [1]. The findings reveal significant associations between age, education level, and self-rated health with sick leave. For men, the highest rates of long-term sick leave were observed in those aged 56-65, with significant regional disparities, especially in Vojvodina and Central and Western Serbia. Men with middle school education experienced the highest overall sick leave rates. Poor self-rated health was strongly linked to long-term sick leave, indicating a need for targeted interventions for older men, those with lower education levels, and individuals with poor health. For women, significant factors associated with sick leave included age, marital status, wealth index, and self-rated health. Women aged 46-55 had the highest rates of short-term sick leave, while those aged 36-45 had the highest rates of long-term sick leave. Regional disparities were also evident, with Central and Western Serbia showing the highest short-term sick leave rates and Belgrade having the highest long-term sick leave prevalence. Additionally, married women and those from higher wealth classes had more frequent sick leave, and light physical job effort was linked to higher short-term sick leave, whereas moderate effort was associated with long-term sick leave. Women with poor self-rated health had the highest rates of long-term sick leave. Our findings align with previous studies [1,23,40] that emphasize the impact of socio-demographic factors and self-rated health on sick leave. For instance, Lidwall [41] noted sex segregation in occupational sick leave patterns. Contrary to past research suggesting that women in lower wealth classes have higher sick leave rates [31], our results show that women from higher wealth classes reported more frequent sick leave. This discrepancy calls for further investigation into how wealth index classes affect sick leave. Additionally, while Mensah et al. [30] found that men reported poorer self-rated health compared to women across 30 European countries, our study found that females more frequently rated their health as less than very good. These inconsistencies suggest potential variations in health perception and reporting. Our results highlight the need for sex-specific health interventions in Serbia, including better access to healthcare, flexible workplace policies, and enhanced social support for women. Targeted strategies are essential for addressing the needs of older male workers, those with lower education levels, and individuals with poor health. A comprehensive approach that considers both sex-specific and broader demographic factors is crucial for developing effective interventions to reduce absenteeism and improve health outcomes.

The analysis of lifestyle factors revealed interesting patterns in the prevalence of sick leave, though many of these differences were not statistically significant. The regression analysis reveals

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notable associations between BMI and sick leave for both sexes, though patterns differ. For men, obesity significantly affects sick leave, with those classified as obese having over three times the odds of taking sick leave in an unadjusted model compared to underweight individuals. This effect remains statistically significant even after adjusting for sociodemographic, occupational, and health factors. Pre-obese male participants also have increased odds of sick leave. For women, the association between obesity and sick leave is positive but not statistically significant. This indicates that while there is an increased risk of sick leave for obese women, the evidence is not strong enough to be conclusive. Pre-obese women also show a slightly increased risk of sick leave compared to underweight, but this finding is not substantial. Overall, while obesity is a clear predictor of sick leave among men, the relationship for women is less pronounced and requires further investigation to clarify underlying factors. These findings align with many previous research indicating a strong link between obesity and sick leave [7,8,42,43], although some studies suggest varying results due to differences in job types [15,28]. Such discrepancies may arise from differences in the occupations of the study populations.

The results of the study reveal distinct patterns regarding fruit and vegetable consumption and their impact on sick leave, with notable differences between sexes. The results of the study reveal distinct patterns regarding fruit and vegetable consumption and their impact on sick leave, with notable differences between male and female participants. Among men, consuming fruit never or occasionally is associated with increased odds of sick leave, suggesting that regular fruit consumption may serve as a protective factor. Similar trends are observed with vegetable consumption, highlighting the importance of a balanced diet in maintaining health and reducing the risk of sick leave. These findings align with previous research by Canerva et al. [12], which emphasizes the role of fruit and vegetable intake in promoting overall health. For women, the relationship between fruit and vegetable consumption and sick leave appears complex. Women who consume fruit and vegetables daily report higher prevalence rates of both short-term and long-term sick leave, suggesting that those with healthier dietary habits may be more proactive in managing underlying health conditions that require time off work. Despite this, the data does not show a strong protective effect of daily fruit and vegetable consumption on reducing sick leave. Notably, while regular fruit consumption (4 to 6 times a week) seems to indicate a potential reduction in sick leave risk in regression analysis, this finding is not statistically significant. Similarly, vegetable consumption does not show a significant impact on sick leave, with results indicating that any effect might be weak or difficult to detect. These findings highlight the need for further research to fully understand the influence of fruit and vegetable consumption on sick leave among women. Overall, while regular fruit and vegetable consumption seems to help reduce sick leave among men, the relationship for women is more complex and may be influenced by other factors that need further exploration. This variation in findings is not surprising, as some studies, like those by Fitzgerald et al. [9], have demonstrated a positive impact of a healthy diet on reducing sick leave, while others, including De Bortoli et al. [5], found no significant association.

The results of the study show that, among men, low or moderate levels of leisure-time aerobic physical activity are associated with higher chances of sick leave compared to high physical activity levels. Specifically, men with low physical activity levels face an increased risk of health problems that may lead to more frequent sick leave. Similarly, for women, those with low and moderate levels of leisure-time aerobic physical activity also show a higher prevalence of sick leave. This finding is consistent with several studies indicating that insufficient physical activity is linked to increased sick leave [11,16,42]. Although our results indicate that women with low or moderate physical activity levels have higher odds of sick leave compared to those with high physical activity levels, these results were not statistically significant. This suggests that further research with more precise measurements or larger sample sizes is needed to clarify these associations. Overall, these findings underscore the importance of regular physical activity in potentially reducing sick leave. They highlight the role of an active lifestyle in maintaining overall health and suggest that promoting higher levels of physical activity could help decrease sick leave rates.

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Our study reveals that smoking status is a significant determinant of sick leave, with notable differences between current smokers, former smokers, and never-smokers. Current smokers exhibit a significantly higher prevalence of long-term sick leave, consistent with the established health risks associated with smoking. This suggests that smoking cessation programs could be particularly effective in reducing long-term sick leave among both men and women. For men, current smokers have notably higher odds of sick leave compared to never-smokers, reinforcing smoking as a major risk factor for sick leave even when adjusted for sociodemographic, work-related, and health-related factors. Former smokers also show increased odds of sick leave, indicating that the negative health effects of smoking may persist over time, though their risk is lower compared to current smokers. Similarly, among women, current smokers have significantly higher odds of sick leave, with the data highlighting smoking as a major risk factor for long-term sick leave. Former female smokers demonstrate even more elevated odds of sick leave, suggesting that smoking's adverse health effects can continue to impact health even after quitting. These findings underscore the importance of targeted smoking cessation interventions to mitigate sick leave. Our results align with previous research showing a strong association between smoking and increased sick leave [3,42], emphasizing the need for effective smoking cessation strategies to improve overall health outcomes and reduce absenteeism.

For men, results from regression analysis revealed that risky drinking is particularly impactful, with men engaging in risky alcohol use showing the highest odds of sick leave. Low-risk drinking among men also shows a substantial effect on sick leave, indicating that any level of weekly alcohol consumption can raise health risks leading to sick leave. Former drinkers also display an elevated risk, highlighting the lasting health effects of previous alcohol consumption. For women, the pattern is different. Risky drinking is associated with an increased risk of sick leave, but the results are less conclusive, with broad confidence intervals suggesting a need for further study. Low-risk drinking and former alcohol use show only a slight elevation in sick leave risk compared to non-drinkers, and these findings are not statistically significant, indicating that alcohol's impact on sick leave among women may be less pronounced or more complex. Some authors [15,17] have found that alcohol consumption does not elevate the risk of sick leave; the other no drinking attitudes differences in the influence on sick leave [29], however, many more studies [20,40,44] confirm the association between alcohol consumption and increased sick leave risk in both men and women.

This analysis underscores the significant impact of lifestyle factors such as BMI, dietary habits, smoking, and alcohol consumption on the likelihood of sick leave among men in Serbia. The findings highlight the importance of targeted interventions to reduce sick leave rates and improve health outcomes in male workers. In contrast, the analysis of sick leave among women presents a more complex picture, with mixed associations between lifestyle factors and sick leave. While factors like smoking and risky alcohol consumption are associated with increased sick leave, others, such as BMI, fruit and vegetable consumption, and physical activity, show less consistent patterns. This suggests that the effects of these lifestyle factors on sick leave in women may be more nuanced and require further investigation to fully understand. The lack of a significant association between alcohol consumption and sick leave among women is particularly surprising and indicates that alcohol's impact may be more relevant to short-term rather than long-term sick leave. Overall, understanding these modifiable lifestyle factors is crucial for developing effective strategies to reduce sick leave and enhance productivity in both men and women.

Understanding modifiable lifestyle factors is essential for developing effective interventions to reduce sick leave and improve productivity. To address the factors influencing sick leave, several targeted strategies could be employed. Firstly, implementing comprehensive workplace wellness programs that focus on weight management can be beneficial. These programs could include offering nutritional guidance and promoting physical activity. Secondly, establishing smoking cessation initiatives can support employees who wish to quit smoking, thereby reducing related health issues. Additionally, improving access to healthier food options and providing nutrition education within the workplace could enhance fruit and vegetable consumption. For alcohol-related concerns, increasing awareness about its health impacts and providing resources for those struggling with

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alcohol use could be effective. Regular health screenings can further assist in early detection and prevention of health problems. These approaches aim to improve overall employee health, reduce the incidence of sick leave, and boost productivity.

Strengths and Limitations

This study has several limitations, including the potential bias from self-reported health behaviors and the use of specific cut-points for health behaviors and sick leave that may not align with other studies. The 30-day sick leave threshold complicates comparisons with studies using different cut-points, and missing data and non-participation may affect the findings. Despite this, the data were deemed representative. Additionally, the higher prevalence of self-completion questionnaires due to the sensitivity of questions on smoking and alcohol use could influence results. Participants were also more likely to be married, have a middle school education, and belong to higher occupational classes, which may lead to conservative findings.

On the other hand, the study's strengths include its representative sample of Serbia's working population, achieved through a rigorous stratified two-stage sampling method. The study follows the European Health Interview Survey methodology, ensuring international comparability. Using a national census framework supports the reliability of the findings, and including reserve, households helps address non-response bias.

5. Conclusions

This research highlights the significant impact of lifestyle factors on sick leave within the Serbian working population, with a particular emphasis on sex differences. For male respondents, key factors such as obesity, dietary habits, smoking, and alcohol consumption consistently predict the likelihood of sick leave. Effective interventions targeting weight management, diet habits improvement, smoking cessation, and reducing risky alcohol consumption are likely to lower sick leave rates. Such measures not only promise to enhance individual health but also offer benefits for healthcare systems and employers by alleviating associated burdens. Further research with a diverse population and extended follow-up is essential to elucidate the mechanisms through which these factors affect health and to refine public health strategies accordingly.

In contrast, the findings for women reveal that smoking and risky alcohol consumption are the most substantial predictors of sick leave. These results underline the urgent need for public health initiatives aimed at mitigating these risks. Although BMI and physical activity are associated with sick leave, their impact in this study is not statistically significant, suggesting the possibility of other more influential factors or the need for further investigation. The role of fruit and vegetable consumption remains ambiguous, with wide confidence intervals indicating that more research is needed to clarify its impact on health and sick leave. Overall, the study emphasizes the necessity of tailored interventions and ongoing research to better understand and address the diverse factors affecting sick leave across different populations.

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Data Availability Statement: Due to privacy and ethical restrictions, the data used in this study are not available for public access. The rights to the data are held by the Institute of Public Health of Serbia, "Milan Jovanović Batut." The database was officially transferred to the University of Kragujevac to conduct further research.

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