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Analysis of the Relationships between Sport Participation, Physical Activity, and Concurrent Substance Misuse in College Students: A Gender-Stratified Analysis in the Post-Pandemic Period

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Abstract

The COVID-19 pandemic resulted in increased substance use and misuse (SUM). The period in which one undergoes college education is known to be associated with a greater risk of SUM, and there is a need for greater awareness of the risks associated with concurrent SUM in the post-pandemic years. The aim of this study was to evaluate the gender-specific relationships between physical activity levels (PAL), sport participation, and concurrent SUM among college students in the first post-pandemic year. The participants were college students from Croatia and from Bosnia and Herzegovina (n=398) who were tested on sport factors (involvement in individual and team sports, time of involvement, frequency of training, sport achievement), physical activity levels (PALs), and concurrent SUM (simultaneous consumption of cigarettes and alcohol) by using structured anonymous previously validated questionnaires immediately after the pandemic period. Sport factors and PALs were not significantly associated with concurrent SUM in the total sample or in male students. In female students, higher competitive achievement in sports was shown to be associated with the risk of concurrent SUM (OR=1.45, 95%CI:1.11-1.98). The results evidenced an increased risk of concurrent SUM in female students who achieved greater success in sports. Therefore, it seems that public health authorities should develop specific educational and preventive programs in female athletes. The timing of this study was in the first post-pandemic year which could have at least partially influenced our findings.

Keywords: *substance use, sport participation, physical activity, healthy lifestyle, pandemic*

Introduction

Despite its decreased prevalence, cigarette smoking (smoking) remains the leading type of substance misuse (SUM) globally (Flor, Reitsma, Gupta, Ng, & Gakidou, 2021). It is well known that smoking has a significant negative impact on health, leading to increased healthcare resource use, lower quality of life, and higher healthcare costs. It is a major cause of various diseases, including cancer, cardiovascular disease, and respiratory conditions, and it is associated with adverse effects on pregnancy and newborns (Flor et al., 2021). Smoking

behavior is often related to stress, and the time in which one obtains a college education is considered a period of increased risk of heavy smoking (Fitzgeorge, Tritter, Fagan, Nagpal, & Prapavessis, 2018). In general, authors have emphasized the importance of psychological and socioenvironmental determinants of smoking behavior, and they have underscored the need for comprehensive smoking policies and effective education and prevention programs on college campuses (Fitzgeorge, Tritter, Fagan, Nagpal, & Prapavessis, 2018). In addition, factors influencing health-promotive behaviors, in-



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cluding self-efficacy and avoidance of environmental tobacco smoke were identified (Martinelli, 1999). Unsurprisingly, positive effects of policies of limiting smoking on college campuses on smoking rates and improved academic outcomes were reported (Cannonier et al., 2019).

Alcohol is considered the second most popular type of SUM in the world today (King et al., 2023). Unlike smoking, for which there is a clear consensus about the (exclusively) negative consequences of consumption, the consequences of alcohol consumption are not as straightforward. Collectively, it seems that mild consumption of alcohol is not recognized as a problem, but the likelihood of negative health consequences exponentially increases with higher rates of alcohol consumption. In brief, serious problems related to alcohol dependence, including mortality, psychiatric conditions, and neurological deficits, are generally emphasized (Cargiulo, 2007), but some authors have noted that moderate consumption of alcohol can have beneficial effects, particularly in preventing heart thrombosis (Grønbaek, 2009). The impact of heavy drinkers' alcohol consumption on others' health and wellbeing is also a concern (Livingston, Matthews, Barratt, Lloyd, & Room, 2010). Last but not least, Rehm et al. (2010) provided a comprehensive overview of the causal impacts of alcohol consumption on various diseases and injuries and highlighted the need for further research to understand the nature of these relationships. Again, this problem is particularly important among college students, since this period of life imposes significant stress on young people, and a higher likelihood of alcohol consumption is associated with higher levels of stress (Metzger et al., 2017).

Two factors that have been frequently observed to be protective against SUM are physical activity (physical exercise) and sport participation. A range of studies have explored the complex relationship of physical activity levels (PALs) and sport participation with smoking and drinking but with inconsistent results (Modric, Zenic, & Sekulic, 2011; Paavola, Vartiainen, & Haukkala, 2004; Zenic, Terzic, Rodek, Spasic, & Sekulic, 2015). While some studies noted higher rates of smoking and drinking among physically inactive individuals, others evidenced higher levels of SUM in athletic and more physically active individuals (Modric et al., 2011; Paavola et al., 2004; Zenic, Terzic, et al., 2015). For example, Poortinga found that sports activities and heavy drinking were more prevalent among sports club members (Poortinga, 2007). Meanwhile, Paavola et al. found that smoking and alcohol use were positively correlated, with smoking being negatively correlated with leisure-time PALs (Paavola et al., 2004), which actually supported the findings of Conway and Cronan (1992) who previously demonstrated that smoking was associated with lower PALs and lower physical endurance even after controlling for exercise activity. Further, Audrain-McGovern et al. (2003) and Aaron et al. (1995) both found that higher PALs reduced the odds of the progression of smoking and the initiation of alcohol use, respectively. Meanwhile, Rainey et al. found that athletic youth were less likely to smoke but more likely to use smokeless tobacco and engage in alcohol use (Rainey, McKeown, Sargent, & Valois, 1996).

There is a large body of evidence that the COVID-19 pandemic led to an increase in SUM and a decrease in PALs (Puen, Cobar, Dimarucot, & Camarador, 2021; Kuna, Duvnjak, & Kobic, 2023). In general, factors such as stress, job loss, reduced wages, and interruptions in addiction care were associated with an increase in SUM (Grossman, Benjamin-Neelon, &

Sonnenschein, 2020; Quadri et al., 2023). Studies that specifically examined college students found that the pandemic led to an increase in SUM, especially with regard to alcohol consumption (van Hooijdonk et al., 2022). It seems that the shift toward remote learning and increased anxiety have been linked to such trends (Fruehwirth, Gorman, & Perreira, 2021). In addition, the prevalence of mental health problems, including acute stress, anxiety, and depressive symptoms, was high among college students during the pandemic, and these all increased the likelihood of SUM (Li et al., 2021). At the same time, during the pandemic period, due to the imposition of social distancing and lockdown measures, PALs and sport participation decreased, and this was confirmed globally in various sociodemographic groups, including college students (Bertrand et al., 2021; Gilic, Zenic, Separovic, Jurcev Savicevic, & Sekulic, 2021).

Considering the increase in SUM rates, the simultaneous decrease in PALs, and the lack of sport activities during the pandemic period, researchers were interested in possible associations that may have existed between PALs and SUM among college students in the early post-pandemic period. A study carried out with college-/university-level students from the territory of southeastern Europe showed that neither PALs nor sport participation were associated with prevalence of smoking among the participants, which was at least partially the consequence of the studied period (the first year after the pandemic) and negative trends in PALs and SUM that occurred previously during the pandemic period (Drenjak, Pehar, Užičanin, Kontić, & Zenić, 2023). Meanwhile, in a study that explored associations between PALs and alcohol drinking, it was highlighted that an overall increase in PALs could be helpful in decreasing alcohol consumption among college/university students (Drenjak, Užičanin, & Zenić, 2023). However, previous studies were cross-sectional; therefore, the causality could not be interpreted. In addition, to the best of our knowledge, no study has shown associations that may exist between sport participation/PALs and concurrent SUM (simultaneous drinking and smoking) in college/university students in the early post-pandemic period.

Empirical evidence has suggested a complex interplay among PALs and sports, smoking, and drinking, thus demonstrating the clear necessity of further research on this problem, especially while considering concurrent SUM (Zenic, Rezić, Zovko, Vlahovic, & Sattler, 2020). Further, considering the increase in SUM and decrease in PALs that occurred during the pandemic, there is a clear need to explore these associations in the post-pandemic period. Finally, considering that SUM is generally correlated with (increased) stress, while college students face a range of stressors (e.g., academic pressure, interpersonal issues, and family-related stress), this population should be considered as a group of particular interest with regard to the evaluation of the factors associated with SUM in the post-pandemic period (Yikealo, Yemane, & Karvinen, 2018). Finally, research has consistently shown that the misuse of multiple substances (concurrent SUM) is associated with more severe physical and mental health outcomes than single SUM, and this is particularly concerning in young adulthood (Phillips, 2000; Marshall, 2006; Quek et al., 2013). These findings underscore the need for greater awareness of the risks associated with concurrent SUM. Therefore, the aim of this study was to evaluate the gender-specific associations between PAL, sport participation, and concurrent SUM among college students (students) from southeastern Europe in the

first post-pandemic year. Initially, we hypothesized that higher PALs and sport participation would be associated with a lower likelihood of concurrent SUM, irrespective of gender.

Methods

Participants and study design

The participants in this cross-sectional investigation were college/university students from Bosnia and Herzegovina (B&H) and Croatia. At the time of testing, all participants were aged from 18 to 21 years, and the total sample comprised 412 participants (52% females). The participants were selected from three convenient universities at which the investigators were engaged as teachers. A multi-stage sampling procedure was performed to select the subjects. In the first stage, the faculties (i.e., organizational units of the universities) were divided into two groups (small and large) on the basis of the number of full-time students in each faculty. Second, 50% of the faculties in each group were randomly selected. One academic year was then included by relative proportion in the sampling. It must be noted that the authors did not specify necessary requirements regarding the study program, meaning that each study program was (theoretically/statistically) proportionally represented. Prior to the study, approval was obtained from the Ethical Board of the Faculty of Kinesiology, University of Split, Croatia (EBO: 2181-205-05-02-05-14-005, 11 May 2017)

The participants were analyzed one to two months after the COVID-19 pandemic ended in Croatia and in Bosnia and Herzegovina. One month prior to testing, all participants were contacted by college authorities and asked for their participation in the study. Initially, we contacted 600 potential participants, who were randomly selected from the pool of the observed universities. Throughout the initial contact, the participants were informed about the purpose and objectives of the study, and they were informed about the study's importance. They were informed that if they agreed to participate, no personal information would be asked of them, and their responses would not be personally connected to them. An online survey was conducted on an internet-based platform. All participants who agreed to participate received a link to the survey by email. On the basis of the data obtained we calculated the intracluster correlation (ICC) between universities, which showed a proper within-university (within-cluster) variance (ICC=0.11).

Variables

Variables were collected with previously used and validated questionnaires: (i) the Alcohol Use Disorder Identification Test (AUDIT), (ii) the Questionnaire of Substance Use (QSU), and (iii) the International Physical Activity Questionnaire (IPAQ). All three questionnaires have already been extensively presented in the previous literature (Tahiraj et al., 2016; Zenic, Ostojic, et al., 2015; N. Zenic et al., 2020), so the tools used will be only briefly presented in the following.

The QSU collects data on sport factors, sociodemographic factors, and the misuse of substances. In this study, we specifically observed gender (responses included male, female, and other), age (in years), and country of origin (B&H and Croatia). The sport factors included in this study were assessed via four questions that examined different facets of involvement in sports, namely, (i) involvement in team sports, (ii) involvement in individual sports (both responses were on a scale that included "never been involved", "quit", and "currently involved"), (iii) the highest competitive achievement in sports

(responses included "never competed/did not participate in sports", "local competitions", "national-competitions", and "international-level competitions"), (iv) time of involvement in sports (including "never involved", "<1 year", "2–5 years", and ">5 years"), and (v) the number of training sessions per week ("never participated, 1–2, 3–5, 6–7, >7 per week"). Although the QSU is used to examine the consumption of a variety of substances, in this study, we observed only smoking (please see the following for the evaluation of alcohol consumption). The participants were questioned about smoking on a five-point scale, which included the following responses: never smoked, quit, smoked but not daily, smoked daily). The responses were later dichotomized, and the participants were considered as nonsmokers (first two responses) or smokers.

The AUDIT questionnaire measures the consumption of alcohol and contains 10 items. Each item is scored on a scale ranging from 0 to 4, and the AUDIT score is later expressed as a summarized score of all items that ranges from a minimum of 0 to a maximum of 40. Later, the scores were dichotomized into harmful drinking (scores of 11 and higher) and non-harmful drinking (scores lower than 11).

If participants reported smoking (see the previous explanation) and HD (scores of 11 or higher on the AUDIT scale), they were categorized into the group with concurrent SUM.

The short version of the International Physical Activity Questionnaire (IPAQ) was used to assess PALs. The short version of the IPAQ applied here has been used in many studies around the world, and its validity and reliability in the local languages (i.e., Croatian, Bosnian, and Herzegovinian) were confirmed (Maric et al., 2020; Sekulic et al., 2021; Zenic et al., 2021). Shortly, the IPAQ assesses physical activity undertaken during leisure time, yard activities, work-related activities, and transport. The IPAQ contains questions about walking, moderate-intensity activities, vigorous-intensity activities, and sitting (sedentary time) to assess the frequency and duration of each activity. In this study, we observed PALs as the energy expenditure in METs.

Statistics

Kolmogorov–Smirnov tests were conducted to define the normality of the distributions for all variables, and the descriptive statistics included means and standard deviations (for normally distributed variables), as well as counts and percentages (for ordinal and nominal variables).

Differences between genders were established with a t-test (for the AUDIT score) and Chi-square test (for smoking and concurrent SUM).

The associations of sport factors and PALs (predictors) with concurrent SUM were established by calculating logistic regressions (see the following), but in the first stage, participants who were positively classified with concurrent SUM and those who did not report concurrent SUM were compared in terms of predictors by using a Chi-square test (for nominal predictors) and Mann–Whitney test (for ordinal predictors).

Logistic regressions were calculated for binarized concurrent SUM (Yes or No). Each predictor was independently correlated with concurrent SUM, and the odds ratio (OR) with a 95% confidence intervals (95%CI) was calculated. The logistic regressions were stratified by gender due to evidenced differences between genders in concurrent SUM (please see previous analyses, and later text for more details). The significance level of $p < 0.05$ was applied, and Statistica ver. 13.5 (Tibco Inc., Palo Alto, CA, USA) was used for all calculations.

Results

Males and females significantly differed in AUDIT score with higher scores in males (4.75±2.04 and 2.77±1.90 for males and females, respectively; t-test=3.72, p<0.001).

The prevalence of HD was higher in males than in females (20% and 5% for males, and females, respectively; Chi square=11.86, p<0.001). Smoking prevalence was similar in males and females (30% male and 27% female smokers; Chi square=0.04, p=0.83).

Concurrent SUM was higher among males, than among females (12% and 4.3% concurrent SUM among males and females, respectively; Chi square=4.22, p<0.05).

Table 1 presents descriptive statistics for sport factors, and differences between groups based on concurrent SUM. As presented, Mann Whitney coefficients indicated significant differences between groups in “Experience in sport” (Mann Whitney Z=2.11, p<0.05), “Competitive achievement” (Mann Whitney Z=2.77, p<0.05), and “Number of training/competitions sessions per week” (Mann Whitney Z=2.11, p<0.05). When observing more specifically, it is evident that experience in sport was higher in those participants who reported concurrent SUM. Also, those college students who reported concurrent SUM achieved better results in sport, and had more training sessions per week.

Table 1. Descriptive statistics (F – counts, % - percentages) for sport-factors in total sample, and separately in groups based on prevalence of concurrent substance misuse (Concurrent SUM), with differences between groups calculated by Mann Whitney test (* denotes significant differences between groups at p<0.05)

	Concurrent SUM						Mann Whitney test
	Total		No		Yes		
	F	%	F	%	F	%	
Individual sport participation							1.86
Yes. still participating	16	4.0	15	3.8	1	4.0	
Yes. but quit	203	51.0	181	47.0	22	67.9	
No. never	179	45.0	170	44.0	9	28.1	
Missing	0	0.0	0	0.0	0	0.0	
Team sport participation							0.10
Yes. still participating	48	12.0	48	12.3	3	10.0	
Yes. but quit	206	51.8	180	46.7	23	71.3	
No. never	144	36.2	138	35.8	6	18.8	
Missing	0	0.0	0	0.0	0	0.0	
Experience in sport							2.11*
Never participated	97	24.4	95	24.6	2	6.3	
< 1 year	94	23.6	85	22.0	9	28.1	
2-5 years	111	27.9	100	25.9	11	34.4	
> 5 years	96	24.1	86	22.3	10	31.3	
Missing	0	0.0	0	0.0	0	0.0	
Competitive achievement							2.77*
Never participated/Never competed	201	50.5	192	52.5	9	28.1	
Local rank	165	41.5	146	39.9	19	59.4	
National rank	25	6.3	22	6.0	3	9.4	
International rank	4	1.0	3	0.8	1	3.1	
Missing	3	0.8	3	0.8	0	0.0	
Number of training/competitions per week							2.11*
Never participated	96	24.4	94	26.0	2	6.3	
1-2 per week	115	28.9	106	29.0	9	28.1	
3-5 per week	146	36.7	131	35.8	15	46.9	
6-7 per week	34	8.5	30	8.2	4	12.5	
> 7 per week	6	1.5	4	1.1	2	6.3	
Missing	0	0.0	0	0.0	0	0.0	

Differences between groups based on concurrent SUM in PAL are presented in Figure 1. As evidenced, no significant differences were found when t-test was calculated for total sample, and in gender-stratified analyses.

Results of the logistic regression calculated for criterion concurrent SUM in male college students are presented in Figure 2. In general, no significant association between sport factors, and PAL with concurrent SUM in males was found.

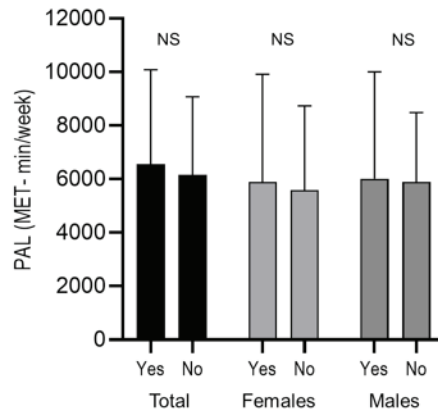


FIGURE 1. Physical activity levels obtained by IPAQ (presented as Mean + SD) and differences between groups based on concurrent substance misuse obtained by t-test for independent samples in total sample and gender-stratified (NS – non-significant differences between groups)

Correlations between sport factors and physical activity levels, and concurrent SUM (criterion) in female students calculated by logistic regression are presented in Figure 3. In brief, the only significant association was found be-

tween “Competitive achievement” and criterion (OR=1.25, 95%CI:1.05-1.45), with higher likelihood for concurrent SUM in females who achieved higher competitive success in sport.

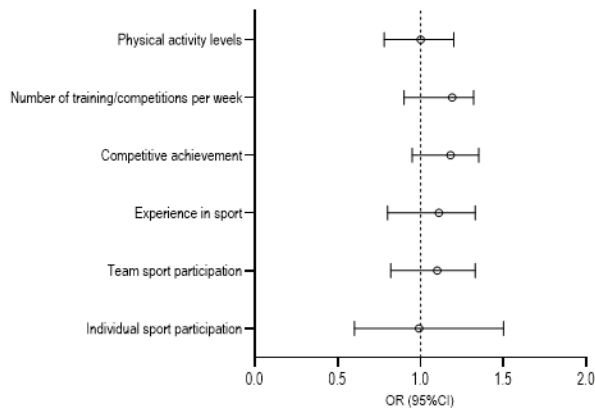


FIGURE 2. Logistic regression results; correlations between sport factors and physical activity levels, and concurrent SUM in males (OR – Odds Ratio, 95%CI – 95% Confidence Interval)

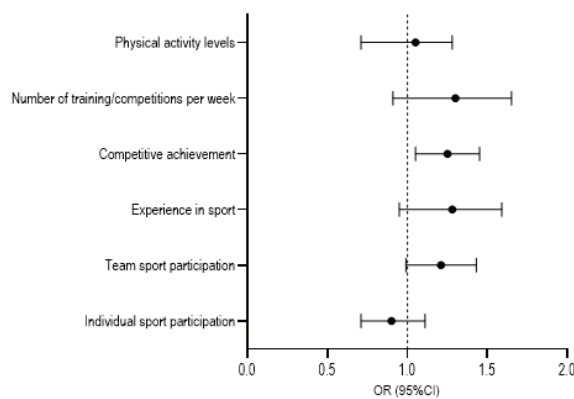


FIGURE 3. Logistic regression results; correlations between sport factors and physical activity levels, and concurrent SUM in females (OR – Odds Ratio, 95%CI – 95% Confidence Interval, * denotes significance of $p < 0.05$)

Discussion

Considering the study’s aims, the two most important findings will be discussed in the following. First, when observing the total sample of college students and when observing males, sport participation and PALs were not significantly associated with concurrent SUM. However, in females, competitive achievement in sports was associated with concurrent

SUM, with a higher likelihood of concurrent SUM in female students who achieved better success in sports. Therefore, our initial hypothesis was rejected.

The problem of the association of sports/PALs with SUM is frequently studied, mostly because of the overall perception that sports and, consequently, higher PALs are related to a healthy lifestyle and, therefore, could be protective against

SUM (as an unhealthy habit) (Gilic et al., 2021; Zenic et al., 2021). However, the findings of empirical studies, including those in which authors specifically observed college-/university-level students, are generally controversial. Some studies have highlighted the potentially protective effects of sport participation and higher PALs on SUM (Zenic et al., 2021; Zenic, Ostojic, et al., 2015). Meanwhile, some authors found that extrinsically motivated athletes were at higher risk for SUM, and this was particularly evident among students engaged in team sports (Rockafellow & Saules, 2006; Ford, 2007). This was actually a confirmation of earlier findings of Leichliter et al. (1998) and a later study by Green et al. (2014), who also found a link between participation in sports and alcohol use. When examining this relationship more specifically, some authors studied the links between sport participation and the consumption of different substances. For example, some studies confirmed that participation in sports is linked to higher alcohol consumption, but it is also associated with lower levels of smoking and illegal drug use (Veliz, Boyd, & McCabe, 2015; Williams et al., 2020).

Even studies in which the authors specifically observed PALs (not necessarily in connection with sport participation) showed different findings. In general, while some authors highlighted that a positive association in which PALs were protective against SUM, others highlighted a higher risk of SUM in more physically active participants (Collingwood, Reynolds, Kohl, Smith, & Sloan, 1991; Zschucke, Heinz, & Ströhle, 2012). Therefore, our findings on the non-significant correlation between sports/PALs and concurrent SUM are not surprising. Namely, while we observed concurrent SUM, there is a certain possibility that sport participation and PALs were differentially associated with facets of concurrent SUM (e.g., smoking and harmful alcohol consumption), as suggested in previous studies (Zenic et al., 2021; Zenic et al., 2023). Altogether, this could logically result in a non-significant association between predictors and concurrent SUM as a criterion in college students.

However, there is a certain possibility that the period in which the study was conducted influenced our findings. Our study specifically focused on the first post-pandemic year. In the previous pandemic period, PALs and sport participation decreased as a consequence of the imposition of social distancing and lockdown measures (Gilic et al., 2021). On the other hand, there is evidence that SUM increased during the same period (Grossman et al., 2020; Quadri et al., 2023). As a result, it is possible that such changes even influenced the relationships between the variables. Namely, the quantitative changes in study variables could almost certainly result in qualitative changes (changes in the associations between the observed indicators).

Gender-stratified approaches to studying eventual relationships between sports/PALs and SUM are not common. While a great deal of studies have explored this problem among adolescents and young adults (Modric et al., 2011; Zenic, Ostojic, et al., 2015) researchers have rarely decided to evaluate these relationships specifically for each gender. However, more recent studies highlighted the necessity of such a method, especially in countries in which genders significantly differ in terms of their sport participation (Zenic et al., 2023; Zenic et al., 2021). In addition, a gender-stratified analysis appeared to be more convenient, since empirical evidence has underlined a sport-specific influence on SUM (i.e.,

with a higher risk of SUM in some typically male sports, such as rugby or football). Our results showed significant associations between sport participation and concurrent SUM in female students, but no association was shown for males, which clearly confirmed the appropriateness of separate analyses for males and females. As presented previously, among females, greater competitive success in sports was associated with a higher likelihood of concurrent SUM. From our perspective, the mechanisms of this association are both contextual and sociocultural. Therefore, in the following, we will provide an overview of both mechanisms.

The sociocultural context of sport participation in south-eastern Europe (the territory of former Yugoslavia) is somewhat specific. There are no clear sociocultural barriers to female participation in sports at any level. Research on female sports in Croatia has identified several factors that influence women's engagement in sports; these are evidently general and not gender-specific, and they include the type of sport, educational level, marital status, and place of living (Sindik, Mikic, Dodigovic, & Ćorak, 2016). Although we could not find any studies that directly investigated similar problems in B&H, considering the similarity of the cultural backgrounds of these two countries, we are convinced that evidence from Croatia is easily transferable to B&H. However, as long-term professionals in sports, the authors of this study are of the opinion that there is still a need for comprehensive implementation of a regulatory framework with a gendered perspective in the field of sports. Therefore, despite the proclaimed "equality" in the availability of sports for both men and women, we are still witnessing huge differences in sport participation between genders, with men being evidently more involved in sports than women, which was confirmed in this research.

The literature from around the world has offered a variety of reasons for women being less involved in sports than men (e.g., women generally have less interest in sports, have lower competitiveness, and take fewer risks than men) (Deaner, Balish, & Lombardo, 2016). Meanwhile, in our region, another reason deserves attention. Namely, there is no doubt that in Croatia and in Bosnia and Herzegovina, typical female sports (i.e., aesthetic sports such as dance and gymnastics) are less represented than typical male sports (i.e., martial arts and team sports). Because of the characteristics of martial arts, girls rarely participate in them, which is mostly due to their sociocultural backgrounds (e.g., family constraints, stereotyping), as well as hygienic reasons (the menstrual cycle is a significant obstacle to female participation in sports in which physical contact is inevitable); therefore women are more oriented toward team sports. This was confirmed in our study, where the majority of the studied females who were involved in sports participated in team sports. This low female participation in sports probably generated a specific environment for (concurrent) SUM among females.

In brief, research has frequently—although not exclusively—presented an increased risk of SUM among athletes who play team sports. For example, attraction to one's team was found to predict alcohol and marijuana use among intercollegiate athletes (Grossbard, Hummer, LaBrie, Pederson, & Neighbors, 2009). Further, participation in team sports was associated with increased binge drinking and smokeless tobacco use among Canadian adolescent girls, while female soccer athletes were identified as being at the greatest risk of substance use (Boyes, O'Sullivan, Linden, McIsaac, & Pickett, 2017; Ford,

2007). To explain these trends, several of the most important reasons should be highlighted.

First (i), sports are a social activity, with team sports being particularly social. After sessions of playing team sports (e.g., training, competitions), gatherings are very common, and in such circumstances, substances (mostly alcohol and cigarettes) are frequently consumed (Drenjak, Užičanin, et al., 2023). Second (ii), athletes often travel for competition or training. In the period of adolescence, (female) athletes are less likely to be under the proper control of responsible adults (e.g., coaches, officials, physicians). Therefore, studies have confirmed that there is an earlier initiation of SUM for athletes than for their non-athletic peers (Zenic et al., 2020). Third (iii), athletes are competitive in nature. Because of that, they have a tendency to compete in SUM (especially in alcohol consumption) (Sekulic, Bjelanovic, Pehar, Pelivan, & Zenic, 2014). Fourth (iv), athletes have a certain tendency toward risk-taking, which unfortunately increases the risk of SUM (Cherpitel, 1993). The problem is even more aggravated among more successful (female) athletes simply because (i) post-sport gatherings in which success is celebrated are more common, (ii) they travel more often and further, (iii) they are more competitive than their less successful and non-athletic peers, and (iv) they almost certainly have a greater tendency toward risk-taking.

One could argue that the previous explanations are plausible for males as well; therefore, similar associations between sport factors and concurrent SUM should appear not only among females, but also among males. However, (concurrent) SUM is more frequent among males than among females. Consequently, the previously specified risks of higher SUM are not as influential on males as they are on females. Taken together, these reasons likely explain the fact that correlations between sport factors and concurrent SUM were solely found among females.

Regardless of the previous explanations of the established relationships, it seems that the COVID-19 pandemic did not significantly influence the associations between the study variables. Most probably, because the studied participants were young adults/college students, relative stability was found in all observed variables, since the trends in concurrent SUM, PALs, and sport participation did not change considerably over the course of the study. However, this points to another important problem, which goes beyond the aims of this study and should be investigated in more detail in the future.

Limitations and strengths

All variables observed in this study were collected with questionnaires, which was certainly the most considerable limitation. Therefore, it is possible that the participants did not respond honestly to some of the questions, especially those

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Conflict of Interest

The author declares that there is no conflict of interest.

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related to SUM. However, since we did not evaluate the consumption of illegal substances, we believe that the results are plausible. In addition, apart from the basic sociodemographic data, physical activity levels, and sport factors, other variables that were potentially related to concurrent SUM were not observed. Therefore, in some cases, we lack some important information that could hopefully help us create a more profound interpretation of the results.

On the other hand, this is one of the first studies to examine the associations between studied variables among college students after the pandemic period. Considering that this population is burdened with a great deal of stress and that SUM is known to be associated with stress, this is an important strength of this study. In addition, this is one of the rare studies in which PALs and sport participation were studied separately, and the sport factors included various indices related to sports. This allowed us to discuss the correlations more specifically, especially when considering the gender-stratified analysis.

In future investigation it would be therefore important to prospectively observe the problem in order to precisely evaluate causality between study variables. Also, investigations in other age-groups are warranted.

Conclusion

The results showed the specific associations between sport participation and concurrent SUM among female students; those who achieved greater success in sports had a higher risk of concurrent SUM. Most probably, the specific sociocultural context of female sport participation influenced these relationships. Therefore, public health authorities should develop effective strategies for the prevention of SUM, especially among female athletes.

Sport factors were not shown to be related to concurrent SUM among male students. Therefore, there is no proof that sport participation is a factor with any influence on SUM among young adult males. It is important to note that practically all of the participants in the study were urban residents (full-time college students residing in urban centers); therefore, specific limitations related to sport participation in association with urban/rural differences in sport availability did not influence our results to a great extent.

Despite the previous conclusions and explanations, there is a certain possibility that the results were influenced by the specific period in which the study was performed (first post-pandemic year). Consequently, negative changes that occurred in the study variables during the pandemic could have influenced the relationships between variables in the post-pandemic period. Therefore, further studies are needed in order to explore the problem more accurately.

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