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Physical activity, sport participation, and cigarette smoking in university students after COVID-19 pandemic; Cross sectional analysis of the associations in south-eastern Europe

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Abstract

Cigarette smoking (CS) and low physical activity levels (PAL) are known to be risk factors for cardiovascular diseases. However, few studies have examined the associations between these factors in population of university students, and, to the best of our knowledge, no study examined this issue in period after the COVID-19 pandemic, despite the detrimental social and health consequences of the pandemic. The aim of this cross-sectional study was to examine associations between sport-participation, PAL and CS among university-level students in the first year after the COVID-19 pandemic. Participants were 761 students (411 females) from three universities in Bosnia and Herzegovina and Croatia, who were tested using semi-structured anonymous questionnaires at the beginning of the 2022/2023 academic year. Questions included queries on sociodemographic characteristics, CS, PAL, and sport-participation. Differences between genders were established by Chi-square test and gender-stratified logistic regressions were calculated to evaluate the associations between sport-participation and PAL, with binomized CS (smoking vs. non-smoking). One third of participants were daily smokers. Logistic regression showed no correlation between PAL and smoking prevalence for total sample (OR = 0.88, 95%CI: 0.75-1.05), males (OR = 0.95, 95%CI: 0.41-1.45), or females (OR = 0.90, 95%CI: 0.54-1.52). In addition, sport participation was not significantly associated with smoking. Results did not prove that sport and physical exercising are a way of reducing the likelihood of smoking; this finding could be a characteristic of the studied sample of participants, but could also be related to the period that was observed (the first year after the COVID-19 pandemic). Further studies examining the associations between PAL/sport participation and other types of substance misuse are warranted.

Keywords: *substance misuse, physical exercising, students, sport participation*

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Introduction

Physical activity is defined as any movement of the human body produced by skeletal muscles that requires energy expenditure (Caspersen, Powell, & Christenson, 1985); it comes in different forms and intensities, such as sports and structured exercise, fundamental movement skills, active play, leisure activities (walking, biking, dancing), active transport and household activities. Consistent and appropriate physical activity has numerous benefits. It develops a healthy cardiovascular and musculoskeletal system, neuromuscular coordination, movement control, and metabolic health, and assists in maintaining a healthy body weight (Hallal, Victora, Azevedo, & Wells, 2006; Whooten, Kerem, & Stanley, 2019).

Another important benefit of being physically active is that physical activity generally leads to adopting other healthy behaviors (i.e., healthy diet and avoiding tobacco, alcohol, and drugs) and social development and integration (Daskalopoulou et al., 2017). Collectively, an appropriate level of physical activity during adolescence and early adulthood contributes to the development and maintenance of a healthy adult lifestyle (Telama, 2009). Unfortunately, there is a lot of concern about the incidence of physical inactivity in the period of adolescence and early adulthood and >80% of adolescents worldwide do not meet the recommended guidelines of 60 minutes of moderate-to-vigorous physical activity a day; in early adulthood (age 18–21), the situation is even worse (Guthold, Stevens, Riley, & Bull, 2020).

Despite a decrease in prevalence globally, smoking remains the most common type of substance misuse in the world (Vink & Boomsma, 2011). Specifically, statistics and national data on substance use and abuse in the territory of south-eastern Europe and former Yugoslavia show that the prevalence of smoking is high (Modric, Zenic, & Sekulic, 2011; Sekulic, Ostojic, Ostojic, Hajdarevic, & Ostojic, 2012). Identifying protective and risk factors related to smoking will allow public health authorities to define specific and targeted preventive campaigns to emphasise and encourage these protective factors and to control risk factors (Kaleta, Korytkowski, & Makowiec-Dabrowska, 2013; Sekulic et al., 2012).

One potential protective factor against smoking is physical activity and sport participation (Grogan et al., 2022). However, physical activity (physical exercising) has not been consistently validated as a buffering factor against cigarette smoking. While some studies have indicated that sports and physical activity are protective, other studies have shown an increased likelihood of smoking among individuals who practice sports (Guo, Reeder, McGee, & Darling, 2011; Rodriguez Garcia, Lopez Villalba, Lopez Minarro, & Garcia Canto, 2013; Sekulic et al., 2012).

The rapid spread of a novel coronavirus led to the declaration of the COVID-19 pandemic on March 11th, 2020 (Cucinotta & Vanelli, 2020). The main strategy for controlling the COVID-19 pandemic was the implementation of social distancing measures, which included the closures of schools, universities, cafe bars, restaurants, sports–recreational facilities and clubs, and other places of social gathering (Bedford et al., 2020). Such restrictions led to decreased opportunities for movement and studies regularly reported a decrease in physical activity levels (PAL) as a result of imposed social distancing measures and lockdown during the COVID-19 pandemic (Caputo & Reichert, 2020; Castañeda-Babarro, Arbillaga-Etxarri, Gutiérrez-Santamaría, & Coca, 2020; Giustino et al., 2020). Such a decline in PAL represents a major health concern, as even a small reduction of PAL can result in serious health consequences (Narici et al., 2020).

In the meantime, studies showed an increase in the cigarette smoking during the pandemic period. For example, a Californian study confirmed higher use of cigarettes during lockdown, which was explained by increased stress, changes in workplace, and increased opportunities for smoking or vaping (Gonzalez, Epperson, Halpern-Felsher, Halliday, & Song, 2021). Supportively, another US study noted an increase in smoking during the COVID-19 pandemic at the sample of adults from vulnerable populations, indicating unemployment and anxiety as factors which could contribute to greater risk of tobacco use (Wiley et al., 2023). Finally, a very comprehensive UK study discussed increased smoking as a coping mechanism to deal with anxiety, boredom, stress, and anger during the COVID-19 lockdown (Grogan et al., 2022).

It is globally accepted that low physical activity levels and cigarette smoking present serious health-threatening behaviors. In the period of the COVID-19 pandemic, physical activity decreased, whereas cigarette smoking increased. It is theorized that physical activity could be protective against cigarette smoking, but, to the best of our knowledge, no study has examined this issue, considering previously specified changes in patterns of physical activity and cigarette smoking in the period after the COVID-19 pandemic. As a result, the aim of this study was to examine correlations between physical activity levels, and CS among university-level students in the period after the COVID-19 pandemic. Initially, we hypothesized that lower physical activity would be associated with higher tendency toward cigarette smoking.

Methods

Participants

Participants in this study were university students aged from 18 to 21 years (n = 761, 411 females) from three universities in south-eastern Europe: one University from southern Croatia (n = 156; 81 females; aged 20.11±3.1 years), one university from northern Croatia (n = 373, 229 females; aged 20.98±2.2 years), and one university from Bosnia and Herzegovina (n = 232, 101 females; aged 21.32±2.9 years). The sample size was calculated on the basis of the basis of (i) the number of students at each University for the 2020 school year, (ii) a previously reported prevalence of appropriate PAL in Croatian, and Bosnian and Herzegovinian older adolescents (e.g. 30%), (iii) a confidence level of 95%, and (iv) a margin of error of 5%. The required sample size was 784. The sampling was performed by the multi-stage cluster sampling method. First, in each studied university, faculties (note that faculties are constitutional units of the universities in the studied region) were grouped into two clusters, according to size (i.e., small and large faculties). Next, one-half of faculties in each cluster was selected randomly. Finally, in each of the selected faculties, one group was tested in each academic year. Collaborating partners in each studied university visited faculties, explained the aims of the study to faculty authorities, and organized the dissemination of the consent forms. Only students who provided written consent

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were included in the study. All participants were informed about the study aims, risks, and benefits, that participation was voluntary and that no personal information would be known outside of the project personal. The study was approved by Ethical Board of the Faculty of Kinesiology, University of Split, Croatia.

Variables

Variables observed were gender (male, female, intersex) and age of participants, academic year (school year), physical activity level (PAL), sport participation, and cigarette smoking.

Cigarette smoking was evidenced on a five-point scale including "never smoked", "quit", "from time to time, but not daily", "daily smoking". For statistical purposes participants were additionaly grouped as "non-smokers" (first three responses) and "daily smokers" (last response). Sport participation was assessed on a three-point scale that consisted of the answers "never participated in sport", "quit", "currently participating". These scales have previously been used in studies in the region and have been confirmed as being reliable and valid (Maric, Bianco, Kvesic, Sekulic, & Zenic, 2021; Sekulic et al., 2017; Zenic et al., 2017).

The assessment of PAL was carried out by the short version of the International Physical Activity Questionnaire (IPAQ) (Fogelholm et al., 2006; Hagstromer, Oja, & Sjostrom, 2006). The IPAQ was developed to measure health-related physical activity. The short version of the IPAQ has been tested extensively and is now used in many international studies. In brief, IPAQ assesses physical activity undertaken across leisure time, domestic and gardening (yard) activities, work-related and transport-related activity; it also asks about three specific types of activity undertaken (walking, moderate-intensity activities and vigorous-intensity activities) and about sitting, in terms of its frequency and duration. Although the IPAQ calculates the energy expenditure in METs, for the purpose of this study, participants were grouped into three groups, (i) inactive, (ii) minimally active, and (iii) health-enhancing physical activity (HEPA) active, as previously suggested (Fogelholm et al., 2006).

Testing was done using a digital platform. All participants scanned the printed QR code with their smartphones, which directed them to Google form containing the questionnaire. Testing was done during school hours in the presence of one of the investigators (authors of the study).

Statistics

All variables were checked for normality by the Kolmogorov–Smirnov test. Consequently, means and standard deviations were calculated for normally distributed variables, while frequencies and percentages were calculated for remaining variables.

To evaluate differences between universities in the categorization of PAL and cigarette smoking, a Chi-square test was performed. Analysis of variance was used to establish the differences in normally distributed variables. To evaluate correlations between (i) PAL and binomized cigarette smoking, and (ii) sport participation and binomized cigarette smoking, logistic regressions were calculated, and odds ratio and 95% confidence intervals (CI) were reported. Analysis of differences and correlations was done on the total sample, and then separately for males and females (owing to small number of responses, the calculations were not done separately for intersex).

Statistica 13.5 (Tibco Inc., Palo Alto, California, USA) was used for all calculations, and the p-level of 95% was applied.

Results

There was no difference in the age of the participants between the three studied universities (F-test = 1.01, $p > 0.05$).

Descriptive statistics for smoking prevalence are presented in Table 1 (total sample), Table 2 (males), and Table 3 (females). In brief, almost one third of studied university students were daily smokers. The prevalence of daily smoking wqw similar across genders (32%–38% in males, and 30%–39% in females). Chi-square did not reveal significant differences between universities in smoking prevalence for total sample (chi-

Table 1. Smoking prevalence in studied university students (total sample) with Chi square differences among studied universities (F – frequencies; % - percentages)

	Croatia South		Bosnia and Herzegovina		Croatia North	
	F	%	F	%	F	%
Never smoked	48	31	78	34	96	26
Quit	16	10	21	9	23	6
From time to time, but not daily	50	32	77	33	142	38
Daily smoking	42	27	56	24	111	30

Chi square: 9.36; p = 0.15

Table 2. Smoking prevalence in studied university students (males only) with Chi square differences among studied universities (F – frequencies; % - percentages)

	Croatia South		Bosnia and Herzegovina		Croatia North	
	F	%	F	%	F	%
Never smoked	18	25	37	28	30	21
Quit	5	7	8	6	5	4
From time to time, but not daily	25	32	46	38	51	35
Daily smoking	27	36	37	28	58	40

Chi square: 5.83; p = 0.44

Table 3. Smoking prevalence in studied university students (females only) with Chi square differences among studied universities (F – frequencies; % - percentages)

	Croatia South		Bosnia and Herzegovina		Croatia North	
	F	%	F	%	F	%
Never smoked	30	37	40	39	68	30
Quit	11	13	13	13	18	8
From time to time, but not daily	25	32	29	30	90	39
Daily smoking	15	18	19	18	53	23

Chi square: 8.94; p = 0.17

square = 9.36, p = 0.16), males (chi-square = 5.83, p = 0.44), or females (chi square = 8.94, p = 0.17).

Distribution of the PAL results across the universities are presented in Table 4 (total sample), Table 5 (males), and Table 6 (females). About 50% of participants reached recommended PAL, with no significant differences between universities

Table 4. Physical activity of the studied participants (total sample) with Chi square differences among studied universities (F – frequencies; % - percentages)

	Croatia South		Bosnia and Herzegovina		Croatia North	
	F	%	F	%	F	%
Inactive	31	20	41	18	77	21
Minimally active	48	31	70	30	116	31
Health enhancing physical activity	77	49	121	52	180	48

Chi square: 8.94; p = 0.17

Table 5. Physical activity of the studied participants (males only) with Chi square differences among studied universities (F – frequencies; % - percentages)

	Croatia South		Bosnia and Herzegovina		Croatia North	
	F	%	F	%	F	%
Inactive	19	15	20	15	26	18
Minimally active	26	28	33	25	36	25
Health enhancing physical activity	29	57	78	60	82	57

Chi square: 0.46; p = 0.97

Table 6. Physical activity of the studied participants (females only) with Chi square differences among studied universities (F – frequencies; % - percentages)

	Croatia South		Bosnia and Herzegovina		Croatia North	
	F	%	F	%	F	%
Inactive	12	26	26	26	55	24
Minimally active	22	35	33	32	82	36
Health enhancing physical activity	48	39	42	42	92	40

Chi square: 9.23; p = 0.06

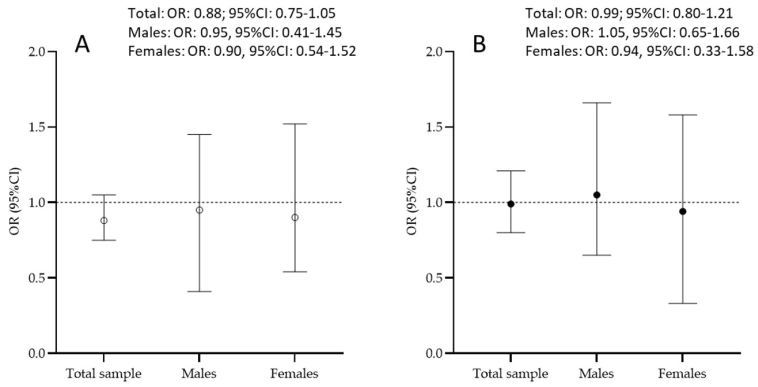

Figure 1. Logistic regression results; correlations between (A) physical activity levels, and (B) sport participation, and cigarette smoking (smoking vs. non-smoking) in university students for total sample and gender stratified (OR – Odds Ratio, 95%CI – 95% Confidence Interval)

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(chi-square = 1.13, p = 0.88). However, males are evidently more physically active than females, with 57%–60% of males - reaching recommended PAL; whereas only 39%–42% of females had sufficient PAL. Differences between universities were not established (none of the chi-square calculations reached statistical significance).

Figure 1 presents results of the logistic regressions calculated between PAL and sport participation as correlates of cigarette smoking.

Logistic regression showed no correlation between PAL and smoking prevalence for total sample (OR = 0.88, 95%CI: 0.75-1.05), males (OR = 0.95, 95%CI: 0.41-1.45), or females (OR = 0.90, 95%CI: 0.54-1.52) (Figure 1A). Also, no significant associations were found between sport participation and cigarette smoking (Total sample: OR = 0.99, 95%CI: 0.80-1.21; Males: OR = 1.05, 0.65-1.66; Females: OR = 0.88, 95%CI: 0.33-1.58) (Figure 1B).

Discussion

This study aimed to evaluate the association of PAL and sport participation with cigarette smoking in university students. Results showed that neither PAL nor sport participation are associated with prevalence of smoking in the studied university students. Therefore, our initial study hypothesis was not confirmed. Before discussing this issue, we will briefly look at the PAL results for university students.

For the last couple of years, interest about physical activity and PAL in the countries of southeastern Europe has increased, but studies have mostly investigated children and adolescents (Gilic, Ostojic, Corluka, Volaric, & Sekulic, 2020; Sekulic, Rodek, & Sattler, 2020; Stefan, Kasovic, & Zvonar, 2020). This trend was particularly evident during the period of COVID-19, when authors published series of studies examining the changes in PAL which occurred as a result of lockdown among adolescents, and the factors that were correlated with these changes (Geets Kesic et al., 2021; Gilic et al., 2020; Gilic, Zenic, Separovic, Jurcev Savicevic, & Sekulic, 2021; Sekulic et al., 2021). However, this issue has rarely been examined in a population of university students, and therefore our results are hardly comparable to those other reports in the region before the COVID-19 pandemic.

The closest comparison that could therefore be done is with the results of high school students, their PAL being established by same measurement tool that we used in this study. Croatian study evaluated the PAL of high school students, and showed 59% of high-school students to be sufficiently active, which is more than we established herein (note that 50% of our participants reached sufficient PAL) (Ajman, Novak, & Mišigoj-Duraković, 2019). Furthermore, 54% of high school girls reached appropriate PAL, whereas, in our study only, 39% females were at that level; the difference is similar for boys/males (65% vs. 57% in high-school and university students, respectively) (Ajman et al., 2019). Although samples of participants observed are not absolutely identical, some explanations could be offered for the evident differences.

First, one of the important determinants of PAL in adolescence is (mandatory) physical education (PE) classes in high school. Although the PE curriculum in the territory is often criticized for being insufficient in frequency, it still provides an important source of physical activity in the elementary and high-school education period (until the age of 18 years) (Škegro & Čustonja, 2014). Meanwhile, PE is only sporadically included in university curricula in Croatia and Bosnia and Herzegovina, the countries we studied in this investigation (Bagarić, Špehar, & Zvonarek, 2005; Caput-Jogunica, Neljak, & Ćurković, 2013). Unfortunately, the number of universities that provide opportunity for their students to be physically active is also decreasing, although some examples of good practice emerge (Onofre et al., 2012). Taking this into account, the higher PAL in high-school students than in university students is easily explainable.

The second explanation is related to the period when this investigation was done: the first year after the COVID-19 pandemic (note that during 2022, when study was undertaken, the pandemic was not officially over, but generally there were no strict lockdowns in the studied countries). In brief, studies in the region regularly confirmed a decrease in PAL as a result of the COVID-19 pandemic and the imposed measures of social distancing (Geets Kesic et al., 2021; Gilic et al., 2021; Sekulic et al., 2021). It is well known that physical activity is a habitual behavior and that good habits should be developed (Saris, 1986). Therefore, it is logical to expect that those individuals who decreased their PAL during the period of COVID-19 pandemic did not adopt behaviors of increased physical activity, in the first year after the pandemic, and consequently did not reach pre-pandemic PAL.

For more than 50 years a clear link between cigarette smoking and lung cancer has been known, but smoking still remains the most prevalent type of substance misuse in the world (Hecht, 2002; World Health Organization, 2018). The territory of south-eastern Europe is particularly endangered in this regard, and studies regularly show alarmingly high numbers for smoking in the region (Mayer et al., 2015; Milosevic Georgiev, Kotur-Stevuljevic, & Krajnovic, 2019; Samardzic, Marvinac, & Prlic, 2009). The high prevalence of smoking in the territory is mostly explained by (i) culture and traditional background, (ii) lack of a clear ban of smoking in public places in most of the territory, and (iii) relatively cheap tobacco products (Idrizovic, Zenic, Tahirajl, Rausavljevic, & Sekulic, 2015). Therefore, the high levels of smoking prevalence in our sample are not surprising and are in line with previous reports (Idrizovic et al., 2015; Sekulic et al., 2017; Zenic et al., 2017). For the purpose of this study, the lack of association between sport and physical activity and smoking behaviors in university students is more important.

Sport and physical-activity in general are associated with pro-social behavior (De Martelaer & Struyven, 2012; Florić & Ninković, 2013). Moreover, cigarette smoking directly alters physical capacities, which are important factors in active participation in sport and physical exercise (Mundal et al., 1997). Logically, it would be expected that those individuals who practice sport and are physically active will be less oriented toward cigarette smoking. However, findings on that matter are not straightforward. In some cases, authors have confirmed lower prevalence of smoking in those who practice sports (and consequently were more physically active), whereas other studies have shown higher smoking rates in athletic samples (Guo et al., 2011; Rodriguez Garcia et al., 2013; Sekulic et al., 2012). Therefore, even our results of a non-significant association between PAL and sport-participation and smoking in university students are not as surprising as it may appear at first glance.

The first explanation for the lack of a correlation is related to the social character of sport and physical exercise, especially

in the period of early adulthood (i.e., university students). It cannot be ignored that sport participation and general activities that increase PAL (i.e., fitness centers) are "social activities". Therefore, social gatherings are common, especially after participation (i.e., after sport games or exercising in fitness centers). These gatherings often happen in bars and restaurants, where different kinds of substances are consumed. As previously stated, cigarette smoking is not strictly prohibited in public places in the region (Maric et al., 2021). Therefore, physical activity increases the overall possibility of smoking, irrespective of the fact that sport itself should present a certain barrier against smoking as an unhealthy behavior. What additionally aggravates the possibility of smoking is the fact that the sport participants in the studied age group are rarely "competitive athletes", since, in the previous period of life (i.e., 17–18 years of age), a significant drop-out from competitive sports occurs. As a result, it is not likely that university students who participate in sports will be concerned about the eventual negative consequences of smoking on their physical capacities and the deterioration in their sport-performance.

A second explanation is again related to the period when our participants were tested. As mentioned earlier, the COVID-19 pandemic introduced numerous negative changes to everyday life and habits, globally. One of such negative change was an increase in substance misuse, including increased figures of smoking cigarettes (Gonzalez et al., 2021; Wiley et al., 2023). This is indirectly confirmed even in our study: the numbers of daily smokers in our study are somewhat higher than previously reported numbers for similar age groups in the region (Zenic et al., 2017). Similar to previously discussed changes in PAL as a result of the pandemic, (negative) changes in smoking habits are hard to reverse immediately after the pandemic stopped. Moreover, as we know that smoking is an addiction, it is unreasonable to expect that people who smoked during the pandemic period will quickly get rid of the habit.

Limitations and strengths

The main limitation of the investigation comes from the fact that it is cross-sectional study. Therefore, although associations can be evaluated, causality remains unclear. Therefore, in future studies a prospective approach is needed. In addition, this study examined one specific sample of participants, university students, and therefore the generalizability of the findings is limited solely to similar samples. However, the sample was selected intentionally simply because of the fact that university students are an understudied population with regard to PAL and substance misuse.

This is one of the first studies examining the PAL and smoking behaviors in the period after the COVID-19 pandemic, and is probably the first one to investigate the associations between PAL/sport participation and smoking in university students in south-eastern Europe. Furthermore, the fact that we observed participants from two countries is another important strength of the investigation.

Conclusion

Our results suggest that the COVID-19 pandemic and its imposed measures of social distancing resulted in similar changes in PAL and smoking in Croatia and Bosnia and Herzegovina, at least as far as university students are concerned. This was not surprising, considering the similarity of (i) cultural and traditional frameworks in the studied countries (which almost certainly resulted even in a similar prevalence of smoking), (ii) public health policies (no strict prohibition of smoking in public places), and (iii) status of physical education at the universities, the role of sport and the acceptance of recreational physical exercising in the studied countries.

Despite our initial considerations, PAL/sport participation was not associated with cigarette smoking in university students in the post-pandemic year. The most likely reasons for the lack of correlation could be found in (i) the social nature of sport participation in this age group and (ii) negative changes in PAL and smoking which occurred during the pandemic years. However, it must be mentioned that figures (and associations) could change, and therefore future studies are warranted.

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