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Original Investigation

Gender and Scientific Field as Predictors of Physical Activity Among Croatian Students: Insights During Covid-19 Pandemic

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Purpose: The aim of this paper is to examine whether gender and field of study can be considered predictors of university students' physical activity during the Covid-19 pandemic.
Methods: A total of 570 university students participated in the study by completing the International Physical Activity Questionnaire – Short Form (IPAQ-SF). We examined whether gender and field of study affect students' physical activity levels using a two-way factorial ANOVA.
Results: The results showed that students' activity levels varied significantly across academic disciplines ($P < .001$; partial eta squared $\eta^2 = .060$). However, gender had no significant effect on activity levels ($P = .874$; partial eta squared $\eta^2 = .001$), meaning that male and female students were equally active. These findings can be applied in practice to develop scientifically grounded physical activity programs aimed at educating students and reducing the effects of a sedentary lifestyle.
Conclusions: The results underscore the value of offering optional interdisciplinary courses in kinesiology within university curricula, regardless of students' chosen fields. By providing these opportunities, universities can empower students to adopt healthier, more active lifestyles, supporting their long-term
well-being and personal development.

Keywords: physical culture, integral development, pedagogy, study programs, physical education

Introduction

In today's digital age, nearly every part of our lives involves screens and technology. As a result, sedentary habits are becoming more common, particularly among children, adolescents, and university students. The World Health Organization[1] has even identified physical inactivity as the fourth leading risk factor for death worldwide. Despite the multiple pieces of evidence on the benefits of regular physical activity for both physical and mental health, an increasing number of people fail to reach the recommended level of activity. The sedentary lifestyle is increasingly present and is becoming dominant in children and young people,[2] which results in a decrease in the level of physical activity. Physical activity is any movement of one part of the body or the whole-body including muscle movement and increased energy expenditure.[3] Regular physical activity has a positive impact on the health of the cardiovascular, musculoskeletal, and metabolic systems, as well as on psychological well-being, reducing anxiety and depression, and improving cognitive functions.[4,5] Nevertheless, an increasing number of young adults fail to meet the minimum WHO recommendations, particularly in urban environments and within the academic context.[6,7] The sedentary lifestyle suppresses different levels of physical activity, which is negative at several levels. It affects health in general, and the cardiovascular system in particular, influences weight gain, and is associated with diabetes and other chronic diseases[3,4]. In addition to the physical consequences, physical inactivity has also a negative impact on people's psyche.[8] Research indicates that leading that a sedentary lifestyle increases the risk of depression, emotional instability, and reduced overall psychological well-being among young people, particularly in the context of high academic pressure.[9,10] The sedentary lifestyle is devastating for all, but children and the young most feel the negative and long-term consequences mentioned above.[11] Such a way of life is practiced also by contemporary students who, after enrolling at a faculty and taking over student duties, are subjected to frequent sitting and reduced physical activity. Given the key role of education in shaping life habits, it is essential to raise awareness about the importance of incorporating physical activity into the daily lives of both students and teachers. Educators play an important role in creating healthy educational environments that encourage movement and reduce sedentary behavior.[1] It is especially important for teachers to be aware of the importance of physical activity so that knowledge can be integrated in their pedagogical activity.[12] To monitor the effects of sedentary lifestyle on health, it is crucial to assess the person's physical activity levels.

During the COVID-19 pandemic, the level of physical activity

declined significantly worldwide. The shift to working and studying from home, the closure of sports facilities, and restrictions on movement resulted in a substantial increase in sedentary behavior across all age groups.[13,14] Physical activity received special attention during the Covid-19 pandemic as most countries have applied suggested epidemiological measures. The Covid-19 pandemic has changed education systems globally and the transition to online learning has been a special challenge for educators.[15] This also affected Croatian students who mostly attended classes online during 2021, while gyms and sports facilities were mostly closed.[16] Within the entire world population, such measures have significantly reduced physical activity[17]. It is known that students physical activity decreased by between 48% and 61% compared to years before the pandemic.[18,19] These figures confirm that students and young adults are among the most affected groups, with the drastic decline in physical activity being linked to increased sedentary behavior and potentially long-term negative consequences for physical and mental health.[9] Considering all abovementioned, this research was conducted to gain deep insight into students' physical activity during the pandemic in the Republic of Croatia.

Methods

Participants

Prior to the research, required sample size was calculated following contemporary literature[13] based on IPAQ SF scores in similar research.[20-22] For a type-I error of $\alpha = .05$ and a power of .85, an overall sample size of 65 to 91 was identified as optimal for detecting meaningful effects. So the research was conducted among 570 (Table 1) university students although 31 participants were removed due to the invalid or incomplete data provided. The respondents' age had mean value of 21.73 ± 3.35 years, with a minimum of 17 and a maximum of 55 years. All participants were clearly informed on the aim of the research, and they were given a option to stop participating in the research without explanation needed and without any kind of penalties. Each student was assigned to the particular field of study: science, technical sciences, social sciences, and kinesiology (i.e., sport sciences, physical culture). Kinesiology was analysed separately from its field due to the specificity of the study program, which includes many obligatory physical activities.

Methodology

Physical Activity Questionnaire – Short Form (IPAQ – SF)[23] was used to examine the implementation of activities of different intensity levels: walking, moderate and vigorous. Vigorous physical activity includes activities such as aerobics, fast cycling, weightlifting, digging, etc. Playing tennis, regular cycling, and similar fall under moderate physical activity. Walking for at least 10 minutes in the last 10 days has been considered as "walking". When completing the questionnaire, the participants were asked to assess their activity in the previous 7 days compared to the day of completion of the questionnaire. Responses refer to activities that lasted at least 10 minutes. Participants were also asked on gender and field of study.

A previous study showed that the IPAQ-SF has appropriate psychometric properties, with the validation study reporting a test–retest reliability median value of approximately .80, indicating moderate to high reliability.[23] Furthermore, internal consistency of the questionnaire using Cronbach's alpha varies from .63 to .85.[24]

Guidelines for Data Processing and Analysis of the International Physical Activity Questionnaire (IPAQ) (2005) were used for data analysis. From the received answers it was calculated Continuous Score Expressed as MET-min per week (MET – *Metabolic Equivalent of Task)*: MET level × minutes of activity/ day × days per week. All variables derived from the questionnaire are therefore expressed in MET-min/week (questionnaire scoring; a.u. = arbitrary units). Categorical Score- three levels of physical activity: high (7 or more days of any combination of walking, moderate- or vigorous-intensity activities accumulating at least 3000 MET-minutes/week), moderate (5 or more days of any combination of walking, moderate-intensity or vigorous intensity activities achieving a minimum of at least 600 MET-minutes/week) and low (no activity is reported or some activity is reported but not enough to meet high or moderate categorical).

Design

This study used a cross-sectional design to assess physical activity levels among university students in Croatia during the COVID-19 pandemic. Data were collected in October 2021 via an anonymous online survey created with Google Forms. A total of 570 students from natural sciences, technical sciences, social sciences, and kinesiology participated. The survey was

Table 1. Frequency of respondents

		N	*%*
GENDER	Female	475	80.37
	Man	115	19.62
FACULTY	Natural Sciences, Biomedicine and Health, Pharmacy, Food Technology	34	5.8
	Technical Sciences	29	4.9
	Social Sciences, Law and Economics	379	64.7
	Kinesiology	129	22.0
	Humanities	12	2.0
	Interdisciplinary	3	0.5
AVERAGE GRADE FOR THE FINAL YEAR OF STUDY	First-year students	71	12.1
	< 3.4	55	9.4
	3.5 – 4.0	120	20.5
	4.1 – 4.5	228	38.9
	4.6 >	112	19.1

Note. N – number of participantes

distributed through official student mailing lists, social media, and university communication channels.

Prior to completing the questionnaire, participants received comprehensive information about the study's purpose and objectives. Their anonymity was rigorously protected, and researchers clearly communicated that participation was entirely voluntary, with the option to withdraw consent at any time without repercussions. Completion of the questionnaire was regarded as implied consent. The study utilized the validated *International Physical Activity Questionnaire-Short Form* (IPAQ-SF) to assess a broad spectrum of physical activity levels among both general and student populations. After data collection, statistical analysis was used.

Statistical analysis

In order to inspect psychometric characteristics of the IPAQ-SF, prior to the analysis, subsample od $N = 57$ participants were asked to fill questionnaire two times with time delay of 3 weeks. As a measures of reliability Pearson's correlation coefficient and t-test for dependent samples were used. All data were presented as mean±standard deviation and expressed in MET-min/week. Furthermore, to identify can gender and field of study be considered as predictor of students' physical activity during the Covid-19 pandemic, two way 2×4 (factor *Gender*: male and female and factor *Field of the study:* science, technical sciences, social sciences and kinesiology i.e. physical education, sport science) between-between factorial ANOVA was applied. Partial eta squared (partial η^2) was considered as effect size measure. Bonferroni post hoc correction was applied to identify particular differences. Kolmogorov-Smirnov test was applied to inspect normality of the distribution. All calculations were done by using software package Statistica (TIBCO Software Inc. 2020. Data Science Workbench, version 14). Type one error was set at $\alpha = 5\%$.

Results

Correlation analysis ($R = .816$; $P < .001$) together with results of t-test ($P > .05$) revealed moderate to high reliability whilst Kolmogorov-Smirnov test did not identify significant deviations from normality ($P > .20$). Table 2. shows the descriptive indicators of the variable, expressed in MET-min/week.

From Table 2. it can be seen that the values range from the low activity to high physical activity. The mean values of the results show that students, regardless of gender and field of the study, have moderate or high physical activity.

ANOVA revealed that main effect of factor *Gender* appeared not to be significant ($F_{1,562} = .025$; $\eta^2 = .001$; $P = .874$) whilst factor *Field of the study* reached statistical significance ($F_{3,562} = 11.773$; $\eta^2 = .059$; $P < .001$). On the other side, interaction effect *Gender* × *Field of the study* appeared not to be significant ($F_{3,562} = 1.608$; $\eta^2 = .009$; $P = .186$). Furthermore, Bonferroni post hoc correction of main effect of factor *Field of the study* has identified significant differences between Kinesiology students and all 3 other groups ($P < .05$).

Discussion

The COVID-19 pandemic significantly altered physical activity habits among the student population, primarily due to the closure of sports facilities, the shift to online education, and the overall reduction in opportunities for organized physical activity. However, despite these challenges and restrictions, the results of this study indicate that students in the Republic of Croatia maintained a satisfactory level of physical activity. This finding highlights the remarkable resilience and adaptability demonstrated by young people when confronted with extraordinary circumstances. It also points to the potential impact of intrinsic motivation, access to digital exercise resources, and a heightened personal awareness of the importance of safeguarding one's health during times of crisis. In this study, the lack of statistically significant gender differences indicates that the pandemic may have fostered more equitable conditions, allowing personal adaptability and resilience to take precedence over established behavioral patterns. This highlights the capacity of individuals to respond to challenging circumstances in ways that transcend traditional expectations. This finding further emphasizes the need to avoid generalized assumptions and to adopt more nuanced, context-sensitive approaches when interpreting gender-related data on physical activity. Notably, previous research often reports that male participants tend to be more physically active than their female counterparts,[25-27] making the present results particularly significant and deserving of deeper exploration. This is not consistent with the data obtained in this study but aligns with the findings of Bertrand, where female participants engaged more frequently in moderate to vigorous physical activity during the COVID-19 pandemic.[28] Research also confirms that significant reductions in vigorous physical activity and walking occurred during the pandemic, which may explain why women appeared more active than men in certain samples.[18,29] Therefore, it can be concluded that gender-based generalizations regarding physical activity are not universally applicable and depend on the specific characteristics of the sample.

Results show that or variables physical activity, the ranks are higher (the scale value is higher) in participants who study kinesiology. Such data can be linked to potential educational content taught in respective faculties. These groups of students were taught, from different perspectives, about the importance

Table 2. Descriptive indicators of the IPAQ-SF(m) (Mean, SD, Min, Max)

	Field of study	Nature	Technical	Social	Kinesiology
Men	***M ± SD*** (MET-min/week, a.u.)	2598.57 ± 1444.37	2065.83 ± 2456.03	5637.11 ± 5056.10	7226.42 ± 6738.75
Men	***Min – Max*** (MET-min/week, a.u.)	820 - 4500	0 -7400	0 - 18000	160 - 39840
Female	***M ± SD*** (MET-min/week, a.u.)	4084.33 ± 3796.89	3051.18 ± 2160.20	3528.01 ± 4138.79	7347.63 ± 7248.21
Female	***Min – Max*** (MET-min/week, a.u.)	330 -13800	180 - 8400	0 - 34600	0 - 37260

Note. M – mean; SD – standard deviation; Min – minimum range; Max – maximum range; Values are expressed in MET-min/week (questionnaire-based scoring; a.u. = arbitrary units)

of physical activity, and these data suggest how they implement theoretical content in their lives. However, as a large proportion of respondents were teachers, it would be important to make other students aware of the importance of continuous physical activity regardless of the restrictions that were in force during the Covid 19 pandemic. Given that they are expected to encourage overall development in their work, encouraging physical activity should not be neglected. Therefore, it is extremely important to work in the continuous education of students about the importance of physical activity, but also to provide them with the same opportunities.

A special group of students considered susceptible to reduced physical activity are medical students[24]. This proved to be true in Croatian research, which showed that 54.8% of medical students do not usually engage in any sport.[30] In this research, the mentioned susceptibility has not proved to be accurate and medical students belong to the group of students (field of study) who are physically active within the sample. A study showed that, unlike their peers, medical students were more physically active during the COVID-19 pandemic.[31] It is interesting to compare the obtained results with the research by Soroka,[32] in whose sample students of tourism and recreation have shown an unsatisfactory level of physical activity, although it would be expected that students engaged in recreation show pronounced physical activity level. Physical activity, in addition to physical advantages, can also be associated with mental health benefits, more precisely subjective well-being, which ultimately contributes to overall health and previous research has also shown that engaging in sports activity in correlation with subjective well-being is differently related to the field of study.[33] By analysing the types of activities, the research showed that participants most often engaged in moderate and vigorous activities during the COVID-19 pandemic, while other findings indicate that individuals who engage in physical activity tend to consistently practice the same type of activity.[34] It was reported that physical activity in Spain decreased during the COVID-19 pandemic, while sedentary lifestyles increased.[35]This It is important to mention that the average sitting time in the USA was 8.40h per day,[36] in Malaysia 9.16h, and in Indonesia 7.85h.[14] Can be linked to the various restrictive measures adopted in each country, but also to some other causes such as different habits of participants coming from different countries.

Practical Applications

These findings underscore the importance of including physical activity topics across all university programs, not just kinesiology. Since there are no significant gender differences, it makes sense to direct interventions toward curriculum design instead of focusing on demographic factors. Offering optional physical activity modules could support students' well-being, especially during challenging times like pandemics. This is particularly relevant for teacher education, where encouraging active lifestyles can influence future generations. Universities should also develop long-term approaches to decrease sedentary behavior and encourage students to build lasting, independent exercise habits.

Conclusions

The obtained data show that students, despite the pandemic and the measures, engaged in physical activity at a satisfactory level. In addition to physical contributions, this is also important for mental health, especially subjective well-being, which is positively associated with physical activity in general. Gender-related differences in physical activity vary across different samples, highlighting the need for context-specific interpretations. The analysis of the data in this research reveals a higher representation of physical activity in students of kinesiology, which can potentially be explained by the content of study programs which relates to physical activity in the theoretical or practical sense. The research results support students' awareness of the importance of physical activity for the preservation of both physical and mental health. The results of the research can be an incentive for the creators of study programs to offer as many physical activities as possible, as an optional part of the program, which students could engage to use all the benefits that physical activities offer. This is especially important for teacher studies students, for whom it would be an additional incentive to encourage the same in their students. Also, the results of this research can be an incentive for scientist's further research that would answer which specific physical activities could be motivating for students to be offered through study programs, as well as the restrictions that are now present for greater physical activity.

Topic

Sport Science; Education

Conflicts of interest

The authors have no conflicts of interest to declare.

Author-s contribution

Conceptualization, I.B. and B.M.; methodology, I.B., B.M., P.M.; software, I.B.; formal analysis: I.B., B.M.; data curation, I.B., B.M.; writing—original draft preparation, I.B., B.M.; writing—review and editing, I.B., B.M. and P.M.; visualization, B.M. and P.M.; supervision, I.B. All authors have read and agreed to the published version of the manuscript.

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