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PHYSICAL ACTIVITY AMONG UNIVERSITY STUDENTS IN EASTERN SLOVAKIA FOLLOWING THE EASING OF COVID-19 RESTRICTIONS

Abstract: Prolonged physical inactivity reduces fitness and increases the risk of metabolic, cardiovascular, and oncological diseases. This study aimed to analyze the physical activity of students from universities in Eastern Slovakia after the COVID-19 pandemic using the International Physical Activity Questionnaire (IPAQ). A total of 253 responses from Pavol Jozef Šafárik University (UPJŠ) and the Technical University of Košice (TUKE) were evaluated, including sedentary time. Significant differences were found in vigorous physical activity ($p < 0.05$), while no differences were observed in moderate, low, or total activity levels. Students of UPJŠ reported significantly longer sedentary time on weekdays ($p < 0.05$) and weekends ($p < 0.001$) compared to TUKE students. The findings underscore the importance of promoting regular physical activity and fostering supportive conditions at universities as a crucial component of a healthy lifestyle in the post-pandemic era.

Keywords: physical activity, students, Slovakia, COVID-19, lifestyle

AKTYWNOŚĆ FIZYCZNA STUDENTÓW WYBRANYCH UCZELNI WE WSCHODNIEJ SŁOWACJI PO ZŁAGODZENIU OBOSTRZEŃ ZWIĄZANYCH Z PANDEMIĄ COVID-19

Streszczenie (abstrakt): Długotrwała bezczynność fizyczna obniża sprawność, zwiększa ryzyko chorób metabolicznych, sercowo-naczyniowych i onkologicznych. Celem badania była analiza aktywności ruchowej studentów uczelni we wschodniej Słowacji po pandemii COVID-19 przy użyciu kwestionariusza IPAQ. Uwzględniono 253 ankiety

studentów Uniwersytetu Pavla Jozefa Šafárika (UPJŠ) i Politechniki w Koszycach (TU-KE), badając także czas spędzany w pozycji siedzącej. Wyniki wykazały istotne różnice w intensywnej aktywności ($p < 0,05$), natomiast w umiarkowanej, niskiej i całkowitej aktywności nie stwierdzono różnic. Studenci UPJŠ spędzali znacznie więcej czasu w pozycji siedzącej zarówno w dni robocze ($p < 0,05$), jak i w weekendy ($p < 0,001$). Otrzymane dane podkreślają konieczność promowania regularnej aktywności fizycznej i tworzenia odpowiednich warunków do jej podejmowania w środowisku akademickim jako ważnego elementu zdrowego stylu życia po pandemii.

Słowa kluczowe: aktywność ruchowa, studenci, Słowacja, COVID-19, styl życia

Introduction

The COVID-19 pandemic changed daily routines and limited mobility worldwide. University students, among the first to shift to fully online learning, experienced significant declines in both perceived and measured physical activity (PA) (Bielec & Omelan, 2022; Kosendiak et al., 2022; Nowacka 2025, Sidebottom et al., 2021). In general, PA is considered a crucial component of a healthy lifestyle. Among others, it helps to maintain a healthy body weight, thus reducing the risk of obesity and strengthening the immune system (Kruk et al., 2022; Luan et al., 2019). Low physical exertion, physical inactivity and associated low energy expenditure increase the risk of a variety of chronic diseases such as hypertension, coronary heart disease, diabetes, and depression (Charansonney & Després, 2010; Marques et al., 2018).

Engaging in regular PA at an appropriate intensity level based on age and physical condition has numerous health advantages, including enhancing the musculoskeletal system and promoting overall physical and mental well-being. Multiple authors recommended preparing various interventions and preventive strategies to address the above problems and promote health consolidation. Compensating for sedentary time with PA of any form and intensity has numerous health benefits (Bergier et al., 2012; Lenková et al., 2022; Son et al., 2020).

The minimum amount of PA recommended by the World Health Organization (WHO) (WHO, 2020) that all adults should undertake per week is 150-300 minutes of moderate-intensity or 75-150 minutes of vigorous-intensity PA, alternatively, some equivalent combination of moderate and vigorous-intensity aerobic PA. The COVID-19 pandemic, as mentioned at the beginning of this paper, has led to various measures all over the world, not excluding the Slovak Republic.

When considering the issue of inadequate PA in the Slovak Republic from a population health perspective, it is essential to mention the National Health Promotion Programme (UVZSR, 2022). This programme is aligned with the policy of the WHO and undergoes regular evaluation and approval by the Government of the Slovak Republic. One of the key factors identified in this document that can be influenced is the absence of PA.

University is the final phase during which students should engage in comprehensive PA efforts to promote, sustain, and regulate PA. This is the phase during which individuals can exert influence and establish accountability for both themselves and others, particularly

in relation to their health (Junger et al., 2016). Consequently, it is crucial to monitor the PA levels of students in every country closely.

Among the first and, in terms of earlier ways of life, very drastic measures were the significant restriction of people's mobility, not only within their own country but also within their place of residence. University students participating in online learning, who were generally not primarily concerned with securing all vital necessities of life, presented a unique demographic to investigate the potential impact of isolation measures on PA during the COVID-19 pandemic. A decline in PA participation was observed in most of them (Ács et al., 2020; Maltagliati et al., 2021; Osipov et al., 2021; Tan et al., 2021), pointing to the anticipated negative health impacts of the restrictions during COVID-19. By contrast, we also find studies where a proportion of the adult population increased their PA participation (Constandt et al., 2020; Gallo et al., 2020; Romero-Blanco et al., 2020).

Physical inactivity, not only among the youth, triggers significant changes in a person's body. Even a couple of weeks of decreased PA causes a decrease in a person's physical fitness. According to Krogh-Madsen et al. (2010) a week without exercise may incur a loss of 1.6 % in total body mass, and a loss of 2.8% in leg lean mass with 2 weeks of reduced daily activity, while approximately 3 months of strength training are required to rebuild muscle mass. Prolonged periods of inactivity, worsening dietary habits, and depression lead to obesity, as has been explicitly confirmed in the university population (Akinyemi et al., 2022). As early as the beginning of the pandemic, the WHO (WHO, 2020) identified the expected increase in obesity as a significant public health problem, with about 35% of adults aged 20 years and over being overweight and 11% being obese even before the pandemic.

The closure of educational institutions, especially physical exercise facilities during lockdown, did not allow or at least limited individuals to adhere to the WHO (2020) recommendation of moderate to vigorous PA. The closing of educational institutions changed students' daily routines as they no longer had to travel to schools to attend classes. This change dramatically reduced PA levels of students of all ages during COVID-19 (Ács et al., 2020; Maltagliati et al., 2021; Osipov et al., 2021; Tan et al., 2021).

Based on previous global measures and impacts, it is essential to continuously monitor their PA levels to prevent future adverse changes in students' lifestyles leading to deterioration in their physical fitness and overall health (Górski et al., 2017).

Problem and Aim

This study aims to assess the physical activity levels of students at two universities in Eastern Slovakia over an academic year, following the easing of COVID-19 pandemic restrictions, to understand the ongoing effects of pandemic-related inactivity and to identify differences among student groups using the IPAQ questionnaire.

Methods

Participants

The study is part of the VEGA project No. 1/0234/22 "The influence of the Covid-19 pandemic on readiness and organism reaction of university students to physical load".

Our project's research sample consisted of 504 students from two universities in Eastern Slovakia: The Pavol Jozef Šafárik University in Košice (UPJŠ) and the Technical University of Košice (TUKE), who chose to attend the course of Sports Activities at UPJŠ and the course of Physical Education at TUKE. In terms of professional orientation, students of UPJŠ generally major in humanities, natural sciences, and medicine, and students of TUKE major in technical subjects. After removing incomplete and erroneous answers, 253 questionnaires were analyzed, of which 175 were completed by UPJŠ students and 78 by TUKE students. A more detailed overview of the participants is presented in Table 1. The study adhered to all pertinent national regulations and institutional guidelines, aligning with the principles of the Helsinki Declaration. Approval for the project was granted by the Pavol Jozef Šafárik University Ethics Committee in Košice under number EK No. 3/2023.

Table 1: Gender, number, and proportional representation of UPJŠ and TUKE undergraduates

	Females	Males	
University	UPJŠ	UPJŠ	TUKE
Number (n)	131	44	78
%	51.78	17.39	30.83

Procedure

The required data were obtained by completing the short version of the IPAQ (IPAQ, 2005), which was administered and distributed via the Google Forms online tool.

We asked students from two universities in Košice to participate in the research using an online platform. The questionnaire contained questions related mainly to the PA they performed during the last week of their school attendance. Other questions about PA were related to their different activities, such as housework, gardening, and walking while moving from place to place. We were further interested in the time students spent sitting in school, at home, while preparing for classes, and in their sedentary leisure time during the week and at the weekend. The survey was conducted in November 2022, with all participants reporting their physical activity for the same week (the last 7 days before the survey administration) to ensure consistency and account for potential variations in weather conditions throughout the month. The respondents completed the questionnaires at their universities during or shortly after class. As part of the analysis of the results, we also looked for differences in PA between the two universities.

The IPAQ assesses the types of intensity of physical activity and time spent sitting that people do as part of their daily lives to estimate total physical activity in MET-min/week and time spent sitting (Craig et al., 2017). This metric is calculated by multiplying the metabolic equivalent (MET-min/week) assigned to the type of activity (vigorous, moderate, or walking) by the duration in minutes spent on that activity, and the frequency of performing it per week. The IPAQ measures weekly energy expenditure in MET-min/week for vigorous, moderate, and walking physical activity, and also records sedentary time. According to the IPAQ scoring protocol, total physical activity is categorized as low, moderate, or high (IPAQ, 2005).

Statistical analysis

Microsoft Excel and RStudio software tools were used for statistical analysis. In addition to the mean (M) and standard deviation (SD), other descriptive statistics were used to describe the variables: percentage (%), median (Mdn), and interquartile range (IQR: 25th-75th percentile). The significance of differences in PA levels between student groups was examined using the Mann-Whitney U test at a significance level of $p < 0.05$.

Results

When analysing the PA of male students from UPJŠ University, we observed that among the weekly volume of 3834 ± MET-min/week, low-intensity PA (walking) constitutes the most significant proportion. At the same time, PA of moderate intensity is the least represented (Table 2).

It is much more notable and especially more effective at TUKE students (Table 2), where at the weekly volume of 4787 ± MET-min/week, the higher (vigorous) intensity PA has the largest representation. Yet again, moderate-intensity PA is the least performed. When comparing the PA level data across the two universities, males in engineering majors are almost one-quarter better off. However, a statistically significant difference is only observed when assessing vigorous PA ($p < 0.05$).

The intensity of the movement commonly performed is considered a low-level PA. This includes slow walking, recreational swimming, or other similar activities that do not lead to a significant increase in heart rate (Bull et al., 2020). At both universities, the results of the mean PA values measured in MET-min/week related to walking were comparable (Table 2). There was no statistically significant difference in this type of PA between the students of the two universities.

We observed a significantly higher proportion of moderate-intensity PA than in females from UPJŠ, which is similarly much higher compared to male students from both universities (Table 2). UPJŠ females overall reported PA levels of almost a third lower compared to their male counterparts. It is worth noting that in neither case was the difference statistically significant.

Table 2: PA of UPJŠ and TUKE male undergraduates in MET-min/week

Intensity of PA	University	M	SD	Mdn	IQR
Vigorous	TUKE	2323	2937	1440	2340
	UPJŠ	1361	1659	640	4699
Moderate	TUKE	937	1319	480	1170
	UPJŠ	942	1351	480	1221
Walking	TUKE	1527	1537	1188	1683
	UPJŠ	1531	1990	891	1260
Total PA	TUKE	4787	4066	3797	4828
	UPJŠ	3834	3678	2660	2220

Note: Total PA – the sum of scores for walking, moderate activity, and vigorous activity in MET-min/week; M – mean; SD – standard deviation; Mdn – median; IQR – interquartile range

The PA levels of female students from the UPJŠ were measured along with those of male students. Vigorous PA had a mean of 1144 MET-min/week (SD = 2169). Moderate PA showed a mean of 537 MET-min/week (SD = 757). Walking PA had a mean of 1078 MET-min/week (SD = 1058). The total PA had a mean of 2759 MET-min/week (SD = 2943).

Measuring inactivity is essential for monitoring the effect of promoting healthy life-styles to encourage the youth to be less sedentary and more engaged in PA (Son et al., 2020). When assessing the mean time spent sitting during weekdays and weekends, UPJŠ students were the ones with the longest sedentary time. The difference across universities is statistically significant in both indicators – weekdays and weekends (Table 3). The average time spent sedentary by female students from the UPJŠ was measured in hours per day. On weekdays, the average sedentary time was 7.08 hours per day, while on weekends, it was 6.41 hours per day.

Table 3: Average time spent sedentary on weekdays and weekends of UPJŠ and TUKE male undergraduates in hours per day

University	UPJŠ (n=44)	TUKE (n=78)	p-value
weekdays	7.05	5.50	**0.0209***
weekends	6.28	4.11	**0.0005***

Note: p-value – the value of the Mann-Whitney test, statistically significant differences ($p \leq 0.05$) were marked in bold

Discussion

While our study provides a cross-sectional snapshot of university students' PA levels, its results align with global research indicating varied outcomes after the lifting of COVID-19

lockdown measures. The variability observed in other research suggests that changes in PA following these restrictions are not universally predictable or consistent. Additionally, results vary widely depending on the methods used for data collection and analysis.

The 2015 study conducted by Bergier et al. (2018) involved a total of 2,497 students from the Visegrad Four countries, namely the Czech Republic, Poland, Slovakia, and Hungary. Before the COVID-19 pandemic, female students from these countries exhibited significantly lower levels of PA compared to males. Specifically, males engaged in a total of 6023 MET-min/week of PA, while females engaged in 5190 MET-min/week. Within our study group, the level of PA among males at TUKE and UPJŠ was 4787 MET-min/week and 3834 MET-min/week, respectively. For females at UPJŠ, the level was 2759 MET-min/week. These findings suggest that students from V4 countries exhibited a higher level of physical fitness before the COVID-19 pandemic compared to our sample of students from Eastern Slovakia after the pandemic measures were lifted.

Líška et al. (2021) conducted a study on PA using the IPAQ. The study found the median values of MET-min/week for three countries: Slovakia with a median value of 4459.9 MET-min/week, the Czech Republic with a median value of 3838.8 MET-min/week, and Poland with a median value of 3567.1 MET-min/week. The analysis of energy expenditure during walking showed that students from the Czech Republic and Slovakia had higher median MET-min/week scores (Czech Republic: 2284.1; Slovakia: 2467.1) in comparison to their Polish peers (1536.1). Slovakia exhibited the highest median level of PA, as measured in MET-min/week, while Poland displayed the lowest level. When comparing the studies conducted before COVID-19 in Slovakia and other V4 countries (Bergier et al., 2018; Junger et al., 2016), it is evident that the overall PA levels among university students in the studied groups have not returned to the levels seen before the pandemic. Even after the relaxation of COVID-19 measures, students continue to be less active (Líška et al., 2021).

When assessing PA based on median scores, the scores of the UPJŠ students are comparable to those of Malaysian and Indonesian students (Tan et al., 2021). For comparison, we present the results in walking where UPJŠ students reported slightly lower values after the pandemic (Mdn = 891 MET-min/week) than Indonesian students (Mdn = 990.00 MET-min/week) and Malaysian students (Mdn = 1386.00 MET-min/week) during the pandemic. The two latter performed better also compared to TUKE students (Mdn = 1188 MET-min/week).

Also, in the work by Roggio et al. (2021) the PA level of students after one year of the pandemic was considerably low. They found a high percentage of inactive participants, with 48.1%, 10.9% and 10.5% respectively reporting to perform low, moderate, and high levels of PA. According to the authors, PA levels of less than 150 minutes/week may predispose students to be more likely to suffer from a variety of musculoskeletal pains (neck and lower back pain).

The study by Vučković et al. (2022) describes the PA of university students (n = 493) in the summer of 2021, after COVID-19 in Slovenia. The results showed that their students, like our undergraduates, spent the most minutes doing intensive PA and performed such activity more often than any other activity in the last 7 days of study.

Slightly more positive results are reported by Zalewska et al. (2023), who present a view of PA in university students in Poland and Portugal in the second year of COVID-19. Comparing basic statistical characteristics, the authors report a higher total PA in Polish students (6118 MET-min/week) and an even higher PA in Portuguese students (7534 MET-min/week). These values are significantly higher compared to the results of our university undergraduates. The global measures that were in place during the lockdown resulted in a change in the ratio between PA and sedentary time. Several authors have addressed this issue (Ács et al., 2020; Luciano et al., 2021; Osipov et al., 2021), who found a reduction in total PA while walking time and time spent resting increased in all participants. Even participants with higher PA reported long sedentary time (around 10 hours). Slightly lower values obtained in the same lockdown period were reported by Tan et al. (2021), in which Malaysian students spent 9.16 hrs/day sitting down and Indonesian students 7.85 hrs/day. It is noteworthy that students at UPJŠ displayed comparable levels of inactivity even one year after the initial easing of pandemic measures, indicating persistent difficulties in sustaining PA in the face of the long-lasting effects of COVID-19. Male engineering students exhibited marginally superior results, as shown in Table 3.

The differences between universities can be attributed to the structure of the groups of undergraduates and the requirements placed on the mastery of the chosen curriculum. This is confirmed by the results concerning the sedentary time, where higher values during the working week are observed in students (both male and female) of the UPJŠ due to the greater representation of medically oriented programmes, which require rather more permanent preparation for classes. Although we cannot look for broad generalisations and recommendations derived from our results, based on them and especially on our personal experience in teaching, we would still like to appeal for adherence to the WHO (WHO, 2020) recommendations regarding minimum PA values for a given population to consolidate health and increase their fitness and performance.

Conclusions

The results of our study did not confirm that the levels of PA among the students who participated in this study were higher than those reported in other studies following the relaxation of the COVID-19 pandemic restrictions, which primarily restricted mobility beyond residential confines. As such, the results confirm and emphasize the necessity of designing and especially adhering to interventions to support and promote PA, targeting the student population in the aftermath of the COVID-19 pandemic. Particular attention should be paid to the conditions that colleges and universities should create for the implementation of PA by students, but even more, focus should be placed on increasing students' awareness of the importance and necessity of PA in their healthy lifestyles.

This study has limitations. One of the limitations of our research is the fact that although the data were obtained from the internationally used and cited IPAQ questionnaire, it also has its limitations, mainly because of its structure, and the way the questions are asked in the online version makes it rather tricky for subjective understanding and filling in the required details. This study's reliance on a self-reported survey questionnaire may introduce bias and limit the ability to establish causality due to the single time point of data collection.

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