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ORIGINAL ARTICLE

Physical activity and mental well-being of adolescents: Lessons learned from the COVID-19 lockdown in Serbia

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Abstract

The COVID-19 outbreak and svift policy response affected the everyday lives of youth in Serbia, challenging their mental well-being. Aiming to examine the relationship between physical activity level (PAL) and mental well-being of adolescents during the strictest lockdown in Serbia, in April 2020, we analyzed data collected through the national online survey (N = 3089). According to the self-reported moderate-to-vigorous physical activity (MVPA), participants were divided into three groups: 1) engaged in MVPA for at least 60 minutes every day; 2) engaged in MVPA for at least 60 minutes on 4-6 days per week; and 3) engaged in the same amount of MVPA on 0-3 days per week. Mental well-being measures included life satisfaction, self-rated health, and health complaints. An one-way ANOVA detected a significant effect of adolescents' PAL on their life satisfaction, $F(3,27) = 49.64$, $p = 0.000$. The Tukey test showed that the mean life satisfaction was significantly higher in the most active group ($M = 8.66$, $SD = 1.56$) than in the moderately active group ($M = 8.27$, $SD = 1.56$), and the least active group ($M = 7.93$, $SD = 1.76$). The chi-square tests revealed significant associations between adolescents' PAL and health complaints; less active adolescents were more likely to experience symptoms like headache, nervousness, feeling low, irritability, sleep difficulties, and dizziness ($p \leq 0.00$). They also experienced multiple health complaints more frequently and self-rated their health less favorably. Therefore, physical activity should be promoted as a protective factor for adolescents' mental well-being, particularly in emergencies.

Keywords: COVID-19 · students · primary school · secondary school · physical activity · mental health

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Introduction

The COVID-19 outbreak and svift policy response affected the everyday lives of youth in Serbia, challenging their mental well-being. Aiming to examine the relationship between physical activity level (PAL) and mental well-being of adolescents during the strictest lockdown in Serbia, in April 2020, we analyzed data collected through the national online survey (N = 3089). According to the self-reported moderate-to-vigorous physical activity (MVPA), participants were divided into three groups: 1) engaged in MVPA for at least 60 minutes every day; 2) engaged in MVPA for at least 60 minutes on 4-6 days per week; and 3) engaged in the same amount of MVPA on 0-3 days per week. Mental well-being measures included life satisfaction, self-rated health, and health complaints. An one-way ANOVA detected a significant effect of adolescents' PAL on their life satisfaction, $F(3,27) = 49.64$, $p = 0.000$. The Tukey test showed that the mean life satisfaction was significantly higher in the most active group ($M = 8.66$, $SD = 1.56$) than in the moderately active group ($M = 8.27$, $SD = 1.56$), and the least active group ($M = 7.93$, $SD = 1.76$). The chi-square tests revealed significant associations between adolescents' PAL and health complaints; less active adolescents were more likely to experience symptoms like headache, nervousness, feeling low, irritability, sleep difficulties, and dizziness ($p \leq 0.00$). They also experienced multiple health complaints more frequently and self-rated their health less favorably. Therefore, physical activity should be promoted as a protective factor for adolescents' mental well-being, particularly in emergencies.

Method

The Serbian Association of Physical Education and Sport Teachers (SAPEST), in collaboration with the Institute for the Improvement of Education, launched a national online survey on the health behaviors of adolescents in Serbia under the COVID-19 lockdown. Data were collected at one point in time, during the strictest restrictions on human mobility in April 2020. The anonymous survey employed the methodology of the Health Behaviour in School-aged Children (HBSC) study (Inchley et al., 2018), targeting 11-, 13- and 15-year-old students. The participants were recruited through the SAPEST professional network of physical education teachers, who emailed messages from the principal investigator and shared survey links with their students. This approach allowed us to reach even students living in remote areas and to efficiently collect data regardless of the restrictions imposed due to the COVID-19 emergency state. The study procedures were approved by the Institute for the Improvement of Education.

Participants

The study population consisted of adolescents enrolled in the 5th and 7th grades of primary school and 1st grade of secondary school in the Republic of Serbia. Only students from regular public schools were included. Through the SAPEST physical education teachers' network, a total of 3983 students (1639 boys) from the regions of Belgrade, Vojvodina, Šumadija and Western Serbia, and Southern and Eastern Serbia were invited to participate. Only those who completed the questionnaire were included in the final analysis.

Measures

The present study analyzes data on physical activity and mental well-being that were collected within the wider national survey on the health behavior of adolescents in Serbia during the COVID-19 lockdown. Selected questions from the HBSC survey were used (Inchley et al., 2018).

Physical activity. After a short introductory text describing physical activity, participants were asked to report on how many days they were engaged in moderate-to-vigorous physical activity (MVPA) for a total of at least 60 minutes per day. The response options were: 0 days; 1 day; 2 days; 3 days; 4 days; 5 days; 6 days; 7 days. According to their self-reported physical activity level, participants were divided into three groups: 1) 7 days (the most active adolescents, e.g., those who met general physical activity guidelines); 2) 4-6 days (moderately active adolescents); and 3) 0-3 days (the least active group).

Mental well-being. Mental well-being measures included in the survey were life satisfaction, health complaints, and self-rated health.

Life satisfaction. This item provided an 11-step Cantril ladder as a visual aid for participants to assess how satisfied they were with their lives. The bottom of the ladder represented the worst possible life (0), and the top represented the best (10).

Health complaints. Participants were asked how often they had experienced the following symptoms in the last month (the period of time that corresponded with the lockdown): headache, stomach-ache, feeling low, feeling irritable or bad-tempered, feeling nervous, sleep difficulties, and feeling dizzy. A seven-point scale included responses from "about everyday" to "rarely or never". For each complaint, two aggregated

variables were formed: 1) experienced up to once a week; 2) experienced more frequently than once a week. In addition, we analyze the proportion of participants with multiple health complaints (two or more) more than once a week.

Self-rated health. Participants were asked to rate their health as excellent, good, fair, or poor.

Statistical analysis

All the analyses were performed using the Statistical Package for Social Sciences (SPSS, version 23.0; SPSS Inc, Chicago), and the level of significance was set at $p \leq 0.05$. Categorical data are presented as frequencies and percentages. For quantitative data, mean values and standard deviations were calculated. The effect of physical activity on students' mental well-being was tested by chi-square tests for categorical data and by univariate analysis of variance (ANOVA) for quantitative data.

Results

Participants

Out of 3983 students invited to participate in the survey, 3189 responded and completed the survey (80%). The basic characteristics of the final sample (gender, grade, region, urbanization level, physical activity level, and mean life satisfaction) are presented in Table 1.

Table 1. Basic characteristics of participants (N = 3189)

Characteristic	n	%	Chi-square
Gender			
Female	1759	55.2	$p = 0.00$
Male	1430	44,8	
Grade			
5th grade (primary school)	1066	33.4	$p = 0.77$
7th grade (primary school)	1078	33.8	
1st grade (secondary school)	1045	32.8	
Region			
Belgrade	464	14.6	$p = 0.00$
Vojvodina	1327	41.6	
Šumadija and Western Serbia	839	26.3	
Southern and Eastern Serbia	559	17.5	
Urbanization level			
Rural	1258	39.4	$p = 0.00$
Semi-urban	491	15.4	
Urban	1440	45.2	
Physical activity level			
Most active*	1178	36.9	$p = 0.00$
Moderately active**	1209	37.9	
Least active***	802	25.2	
	M	SD	
Mean life satisfaction (total)	8.33	1.64	
5th grade (primary school)	8.67	1.61	
7th grade (primary school)	8.31	1.63	
1st grade (secondary school)	8.00	1.60	

Note. * Participants who reported having at least 60 minutes of MVPA every day; ** participants who reported having at least 60 minutes of MVPA on 4-6 days a week; *** participants who reported having at least 60 minutes of MVPA on 0-3 days a week.

As it can be seen from the table, the sample is characterized by a significantly higher proportion of females and students from the Vojvodina region. Around one-third of all participants (36.9%) met general physical activity guidelines, and mean life satisfaction reached 8.33/10.00 for the whole sample.

Physical activity level (PAL) and life satisfaction

An one-way ANOVA showed that there was a significant effect of adolescents' PAL on their life satisfaction, $F(3,27) = 49.64$, $p = 0.000$. The post hoc Tukey test indicated that the mean life satisfaction was significantly higher in the most active group of adolescents ($M = 8.66$, $SD = 1.56$) than were those in the moderately active group ($M = 8.27$, $SD = 1.56$) and in the least active group ($M = 7.93$, $SD = 1.76$). The pairwise comparison of the moderately active group with the least active group was significant, too. In all three cases the level of significance was $p = 0.000$.

Physical activity level (PAL) and health complaints

In order to establish the relationship between students' PAL and the occurrence of the specific health complaint more than once a week, a set of chi-square tests of independence were used (Table 2).

Table 2. Results of Chi-square test for health complaints by students' physical activity level

	Physical activity level					
Prevalence of individual health complaint experienced more than once a week (n, %)	Variable	Least active (n = 802)	Moderately active (n = 1209)	Most active (n = 1178)	Total (n = 3189)	χ^2 (2, n =3189)	p
	Headache	62 (7.7%)	86 (7.1%)	56 (4.8%)	204 (6.4%)	8.73	0.013
	Feeling nervous	190 (23.7%)	227 (18.8%)	193 (16.4%)	610 (19.1%)	16.62	0.000
	Feeling low	61 (7.6%)	51 (4.2%)	49 (4.2%)	161 (5.0%)	14.62	0.001
	Feeling irritable	151 (18.8%)	144 (11.9%)	111 (9.4%)	406 (12.7%)	39.17	0.000
	Sleep difficulties	128 (16.0%)	167 (13.8%)	140 (11.9%)	435 (13.6%)	6.77	0.034
	Feeling dizzy	32 (4.0%)	34 (2.8%)	25 (2.1%)	91 (2.9%)	6.02	0.049

More active adolescents were more likely to experience health issues less frequently, including headache, feeling nervous, feeling low, feeling irritable or bad tempered, sleep difficulties, and feeling dizzy. The proportion of students who reported stomach-ache did not differ by PAL, $\chi2$ (2, $N = 3189$) = 1.04, $p = 0.595$. The total number of participants who experienced stomach-ache more than once a week reached 117 (3.7%).

In addition, a lower level of physical activity was associated with multiple health complaints experienced more than once a week during the COVID-19 lockdown, $\chi2$ (2, $N = 3189$) = 21.76, $p = 0.000$. In the most active group, 163 (13.8%) students reported multiple (two or more) health complaints more than once a week during the COVID-19 lockdown, which was the case with 201 (16.6%) and 175 (21.8%) students in the moderately and least active group, respectively. Total percentage of students who reported multiple health complaints reached 16.9% (n=539).

Self-rated health

A chi-square test of independence was performed to examine the relationship between students' PAL and self-rated health (Table 3).

Table 3. Results of Chi-square test for self-rated health by physical activity level

	Physical activity level					
Self-rated health (n, %)	Variable	Least active (n = 802)	Moderately active (n = 1209)	Most active (n = 1178)	Total (n = 3189)	χ^2 (2, n =3189)	p
	Poor/Fair/Good	362 (45.1%)	391 (32.3%)	220 (18.7%)	973 (30.5%)	160.66	0.000
	Excellent	440 (54.9%)	818 (67.7%)	958 (81.3%)	2216		

The relation between these variables was significant, $\chi2$ (2, $N = 3189$) = 160.66, $p = .000$. The more active students were, the more likely they were to rate their health as excellent. The proportion ranged from 54.9% and 67.7% in the least active and moderately active group, respectively, to 81.3% in the most active group.

Discussion

After the COVID-19 outbreak, the Serbian government swiftly responded by introducing comprehensive countermeasures. In April 2020, the longest curfew lasted for 84 hours; schools, parks, and playgrounds were closed, as were sports and fitness clubs; most of the parents stayed at home. This was the background of our online survey of adolescents' health behaviors. This article reports on the relationship between adolescents' PAL and their mental well-being under the strictest COVID-19 lockdown in Serbia.

We detected a significant effect of adolescents' PAL on their life satisfaction, health complaints, and self-rated health, favoring more active adolescents, particularly those who meet general physical activity guidelines. In general, adolescents demonstrated considerable resilience when challenged by the COVID-19 pandemic and the restrictive measures enforced in order to control the pandemic in Serbia.

To begin with, adolescents' physical activity behavior seems not to be affected during the COVID-19 lockdown in Serbia. The proportion of Serbian adolescents who met general physical activity guidelines reached 33.6% in 2018 (Gudelj Rakić & Kilibarda., 2018), and 36.9% in our study, conducted during the COVID-19 lockdown in April 2020. A shift to online schooling and the closure of music and language schools, as well as sports clubs, might influenced leisure time activities in children and adolescents, providing them with more free, unstructured time for some kind of physical activity. Some adolescents resorted to online fitness activities for the first time, and physical education classes were organized in an online format as well, motivating and educating students on how to remain active under new circumstances. In addition, despite the curfew, adolescents residing in rural areas had access to outdoor activities and demonstrated a higher level of physical activity (Marković & Mirčić, 2023) which might have affected the overall physical activity level of the participants in our study.

Furthermore, adolescents in the present study reported high life satisfaction during the first phase of the COVID-19 pandemic, with an overall score of 8.33 out of 10. The average life satisfaction score of adolescents across Europe and Canada reached 7.8 in the pre-COVID-19 period (Inchley et al., 2020) and 7.5 in the late phase of the COVID-19 pandemic (Cosma et al., 2023). Although significant regional variations were seen, it seems that adolescents in Serbia demonstrated higher life satisfaction in comparison to the international sample, regardless of the COVID-19 situation. Mean life satisfaction during the COVID-19 emergency state in April 2020 appears to be comparable to corresponding data from HBSC surveys conducted in June 2018 and April-September 2022 in Serbia (Cosma et al., 2023; Gudelj Rakić & Kilibarda, 2020). It can be noticed that in both HBSC surveys, participants from Serbia reported higher life satisfaction in comparison to the HBSC averages.

A similar pattern can be observed with regard to self-rated health: two-thirds (66%) of Serbian adolescents rated their health as "excellent" in 2018 (Gudelj Rakić & Kilibarda, 2020), as compared to 69.5% in our study (April, 2020). Results from the HBSC 2021/22 survey show that proportions of Serbian adolescents who most favorably rated their health were substantially above the averages for HBSC countries, reaching up to 70% or more in 11-year-old girls and boys of all ages (Cosma et al., 2023) in comparison to the HBSC average of 36% for the total sample.

Concerning the prevalence of individual health complaints, we established that the most common complaints among adolescents during the strictest COVID-19 lockdown in Serbia were: feeling nervous (19%), having sleep difficulties (14%), and feeling irritable or bad-tempered (13%), all of which are related to psychological wellbeing. At the same time, somatic complaints were less prevalent: headache (6%), stomach-ache (4%), and dizziness (3%). The only exception to this pattern was feeling low, which 5% of Serbian students complained about. The HBSC 2021/22 survey average results are quite similar in terms of ranking, yet the observed prevalence rates are higher (Cosma et al., 2023): feeling nervous (33%), feeling irritable or bad-tempered (33%), having sleep difficulties (29%), feeling low (25%), headache (20%), stomach-ache (14%), and dizziness (15%). In addition, the Serbian sample results varied by age and gender but were consistently lower than the corresponding HBSC averages, except for the nervousness.

In our study, two or more health symptoms were experienced more than once a week by 17% of adolescents, which was the case with 44% of participants in the current HBSC survey (Cosma et al., 2023). The results confirm a previously identified pattern of more favorable mental well-being indicators in Serbian school-aged adolescents,

both before and during the COVID-19 pandemic, when compared to the HBSC averages.

These country-specific findings could probably be explained by some country-level factors not included in our analysis. For example, adolescents from Serbia reported feeling very strong family support and having easy communication with both of their parents (Inchley et al., 2020). Furthermore, 69% of adolescents in Serbia live with both biological parents (2022 Census of Population, Households and Dwelings: Families, 2023), which has been reported to be associated with higher levels of life satisfaction in children when compared with living with a single parent or parent–step-parent (Bjarnason et al., 2011). Since family adult support, school adult support, and school peer support are all independently associated with children's and adolescents' mental well-being (Butler et al., 2022), family could have been the main source of emotional support under the COVID-19 restrictive measures that prevented children and adolescents from regularly meeting peers and adults in school. Therefore, tight family bonds among Serbian adolescents might have contributed to their mental well-being before and during the COVID-19 pandemic.

The relationship between adolescents' physical activity and their mental well-being, which was the main focus of our study, turned out to be significant, with higher PAL being associated with more favorable mental well-being indicators. The most active group of adolescents, who had at least 60 minutes of MVPA every day during the COVID-19 lockdown, reported the highest level of life satisfaction, less health complaints, and they rated their health most positively when compared to the moderately active group (active for 4-6 days a week) and, particularly, the least active group (active for 0-3 days a week). For example, average life satisfaction was 8.66 out of 10 in the most active group, 8.27 in the moderately active group, and 7.93 in the least active group; prevalences of nervousness experienced more than once a week were 16%, 19%, and 24% in the most active, moderately active, and least active group, respectively; numbers for feeling irritable or bad-tampered were 9%, 12%, and 19%, respectively. More than 80% of adolescents in the most active group rated their health as excellent, which was the case with 68% of adolescents in the moderately active group and 55% in the least active group. PAL was also significantly associated with the prevalence of headache, feeling low, sleep difficulties, feeling dizzy, and having multiple health complaints, all in favor of the most active group of adolescents.

The results suggest that meeting general physical activity guidelines during the COVID-19 lockdown in Serbia could have been a protective factor for adolescents' mental well-being. Our findings are consistent with the previous research that analyzed adolescents' mental well-being during the COVID-19 pandemic.

The cross-sectional US national survey, which employed a sample of 1000 school-aged children, showed that 21% of them met the general physical activity guidelines during the COVID-19 pandemic and that more physical activity and less screen time were associated with better mental health (Tandon et al., 2021). Other studies confirmed the positive impact of physical activity and negative impact of recreational screen time on children' and adolescents' mental health and well-being during the COVID-19 pandemic, notably in terms of mood disturbance, depressive symptoms, anxiety, stress, insomnia, fatigue (Alves et al., 2021; Kang et al., 2021; Khozaei & Carbon, 2022; Li et al., 2023; Oliva et al., 2021; Xiang et al., 2022). While fear of Coronavirus was associated with negative psychological outcomes in adolescents, strong and positive association between physical activity and enhanced mental health suggests that physical activity could counteract the negative impact of Coronavirus fear on adolescents' mental health and well-being (Wright et al., 2021).

Although a decrease in physical activity during COVID-19 lockdown was associated with a higher total negative mood state, it is possible that the relationship is bidirectional, e.g., that experiencing a high negative mood could have affected individuals' level of physical activity (Ingram et al., 2020), and this probably applies to other adverse mental health consequences as well.

Children's PAL during the challenging COVID-19 period might have been negatively influenced by parents' stress, physical activity avoidance, and perceived risk levels of COVID-19, as reported by Khozaei and Carbon (2022). The study stresses the important role of parents in terms of their children's physical activity and wellbeing, particularly under pandemic circumstances when parents controlled a lot of children's everyday activities, physical activities included.

The present study limitations stem from a non-randomized sampling procedure we resorted to because of the constraints imposed by the COVID-19 emergency state. Also, although we used an internationally validated survey, self-reporting on physical activity and mental well-being has its disadvantages.

Strengths of the study are the unique timing of data collection since we conducted the online survey during the strictest COVID-19 lockdown in Serbia in April 2020; we were also able to provide a sizable sample; and the measures and survey applied have enabled comparison, both nationally and internationally, with data collected prior to COVID-19 and during 2022.

Bearing in mind our findings and the results of previous studies, recommendations can be made concerning the physical activity and mental well-being of adolescents under lockdown:

- Promote physical activity and shorten leisure screen time;

- Parents should be aware of their role in promoting or restricting children's physical activity;

- Promote autonomously motivated physical activity for leisure and/or transportation (Teychenne et al., 2020):

- Undertaking nature-based outdoor activities could be a promising strategy for mental health improvement (Coventry et al., 2021).

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