

RESEARCH ARTICLE

The Impact of Distance Education during the COVID-19 Pandemic on Physical Activity and Well-Being of Czech and Polish Adolescents

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ABSTRACT

BACKGROUND: The aim of this study was to identify the changes in the structure of weekly physical activity (PA) and well-being among adolescent boys and girls between habitual education (HE) and distance education (DE) during the pandemic in secondary schools.

METHODS: The research was carried out in 12 Czech and 18 Polish schools during 2019 to 2020 academic session for HE and 2020 to 2021 academic session for DE. The research involved 723 girls and 626 boys aged 15 to 18 years. The structure of the weekly PA was assessed using the International Physical Activity Questionnaire-Long Form, while well-being was assessed using the World Health Organization-5 Well-Being Index.

RESULTS: There was a statistically significant decrease of PA among boys in school PA, transportation PA, recreation PA, vigorous PA, moderate PA, walking, and overall weekly PA during the DE resulting from the pandemic. In girls, during DE, a decrease was observed in school PA, vigorous PA, and overall PA. During DE, a high level of well-being was reported by only 34.9% of girls (43.8% during HE) and 50% of boys (65.6% during HE).

CONCLUSIONS: The observed low PA and high incidence of depressive symptoms in adolescents in distance education during pandemic constraints are a challenge for schools to change in supporting physical activity, eliminating similar negative impacts on school life in the future.

Keywords: physical activity recommendations; distance education; sedentary behavior; symptoms of depression; mental health; Covid-19.

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Before the coronavirus disease 2019 (COVID-19) pandemic (referred to as the pandemic), global criticism focused on insufficient physical activity (PA),¹ an increase in sedentary behavior,² and worsening mental health among adolescents.³⁻⁵ In this regard, some complaints were held against the existing level of physical education (PE) in elementary⁶ and secondary schools.⁷⁻⁹ The objections to PE encompassed an insufficient use of moderate to vigorous PA (MVPA),¹⁰

nonachievement of PA recommendations,^{11,12} and the decreasing trend in positive assessment.¹³ Moreover, the cognitive load on adolescents in secondary schools was not sufficiently compensated by PA in school, after school, or during weekends^{14,15}; this is confirmed by the occurrence of depression symptoms in 25% of Czech and Polish adolescents.¹⁶ Furthermore, only 48% of Czech girls and 50% of Czech boys meet the recommendations for weekly PA at least

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5 × 60 minutes moderate to vigorous PA.¹⁷ Data by the United Nations Educational, Scientific and Cultural Organization (UNESCO) also suggest that before the pandemic, PE in most countries had a lower perceived status than other subjects.¹⁸ Around a third of European countries were planning a PE reform before the pandemic.¹⁹

These and other deficiencies of school PE and PA in adolescents before the pandemic have become more serious during the pandemic and are expected to continue—with a high probability—for a long time even after the pandemic.²⁰ The pandemic has had a strong negative impact on economic and social life as well as the physical and mental health and quality of life of the global population.²¹⁻²⁴ Furthermore, it has caused the largest disruption to education systems in history.²⁵ The changes in adolescents' lifestyles during the pandemic have been so substantial that the return to the original educational environment will be very difficult.²⁶ At the beginning of the pandemic, school PE was immediately prohibited in many countries, and DE was subsequently ordered in secondary schools. The decrease in PA during the pandemic²⁷⁻³³ and the increase in screen sedentary time^{29,34} has been widely documented. Slovenia, as one of the few countries with a longitudinal database of child physical fitness in the world, has reported the greatest decline in child physical fitness since systematic testing began more than 30 years ago.³⁵

According to a study by Kovacs et al.,³⁶ 81% of European students aged 6 to 18 years did not meet the recommendation of 60 minutes of PA per day during the pandemic. Physical inactivity is strongly associated with a higher risk for severe COVID-19 incidence.³⁷ Reducing PA during the pandemic is associated with depression and heightened anxiety levels²³ as well as low mental well-being.³⁸ Children and adolescents who are socially isolated are more likely to experience high rates of depression and anxiety during and after the end of the enforced isolation;³⁹ they are also more vulnerable to other negative impacts on their mental health and well-being.^{40,41} The provision of high-quality online PE in the Czech Republic, Poland, and other Central and Eastern European countries was quite exceptional and essentially uncontrolled. Schools, teachers, and students were not prepared for the new circumstances, where PE as a part of school curricula lost the last sense of an educational priority.

The substantial evidence about the role of PA in overcoming the impact of the pandemic highlights the need to increase the role of PE as a school subject and promote a physically active school lifestyle among students as well as teachers. Even after the pandemic, any positive changes from an insufficient PA of adolescents will have to be addressed comprehensively to better understand the new PA correlates and determinants, and their potential synergistic effects on

health.⁴² Therefore, considering the limited research possibilities in the schools, we focused on investigating the associations between estimated PA and sedentary time combined with subjective well-being. These associations are also important in terms of gender differences between adolescent boys and girls.¹⁶ Research on the structure of weekly PA could also show how to address the negative effects of pandemic on organized PA in sports clubs and other leisure time institutions. The theoretical basis of the study is the review studies dealing with models of promoting healthy schools,⁴³ recommendations for PA in children and youth,^{11,44} and school health theory.⁴⁵

The main research question was whether the restrictions on school PA and PA associated with school, especially active transportation to and from school and extracurricular school programs, would be substituted during the pandemic by a different pattern of leisure and weekend PA. During the pandemic and DE, what would the associations between weekly PA and well-being be? Moreover, during the pandemic and DE, would there be any differences between boys and girls in PA and well-being? We also establish the hypothesis: There will be no significant differences between boys and girls in any type of weekly PA during pandemic DE. Dependent variable: PA types. Independent variable: Gender differences. Given that boys in both countries have more PA than girls,¹¹ eliminating gender differences in weekly PA in DE would highlight the greater negative effects of the pandemic on boys' PA. Accordingly, the aim of the study was to identify the changes in the structure of weekly PA and well-being among adolescent boys and girls between HE and DE in secondary schools before and during the pandemic, respectively.

METHODS

Participants

The research involved 723 girls and 626 boys aged 15 to 18 years (Table 1). This was a stratified and deliberate quota sample of schools and classes/student groups. During HE, the research sample included groups of participants whose usual school program included an information communication technology (ICT) class in the computer room. The participants were included in the study based on the informed consent including parental consent. Approximately 90% of students and their parents provided consent for participation in the research.

Procedure

The research was carried out in 6 Czech and 9 Polish schools during the 2019 to 2020 academic session for HE and at the same number and type of schools during the 2020 to 2021 academic session for DE.

Table 1. Sample characteristics

Characteristics	n	Age (years)		Weight (kg)		Height (cm)		Organized PA (hours)	
		M	SD	M	SD	M	SD	M	SD
Boys—habitual education	366	16.0	1.0	67.9	11.4	176.4	8.5	1.9	1.7
Boys—distance education	260	16.5	1.1	72.5	14.2	178.6	7.2	1.4	1.8
Girls—habitual education	333	16.1	1.1	57.5	9.0	165.4	6.6	1.5	1.6
Girls—distance education	390	16.0	1.1	58.6	9.6	165.7	5.8	1.6	1.8

PA, physical activity; M, mean; SD, standard deviation.

Unfortunately, due to the educational burden of students in schools, it was not possible to obtain consent for research in the same schools as before the pandemic. During DE, the school selected groups of participants according to the DE timetable subject to the participants' consent. We observed a significantly higher percentage of refusals to participate or incorrect completion of questionnaires during DE. The proportion of refusals for participation differed significantly between schools, ranging from a 5% to a 25% rejection rate. The main reason for the refusal was (according to both Czech and Polish students) the overload of daily tasks in distance education, which exceeded the time of a normal day in habitual education. The exact number of calls received to complete the questionnaires at the time of DE cannot be determined, and therefore the number of refusals can only be estimated as a percentage. We excluded a total of 115 respondents for not completing the questionnaire according to the requirements set out in the IPAQ scoring protocol.

Measures

The research was performed by the same research team across all the participating schools. During HE, the questionnaires were completed in a computer room. At the beginning, all participants registered on the International Database for Research and Educational Support (Indares, www.indares.com). Subsequently, they answered the International Physical Activity Questionnaire-Long Form (IPAQ-LF), which included questions about weekly PA.⁴⁶⁻⁴⁸ Both the Czech and Polish versions of the IPAQ-LF have been developed in accordance with the translation requirements⁴⁹ and have been used in numerous research studies.⁵⁰⁻⁵² Pearson's correlation coefficient of concurrent validity between weekly PA (METs-min) and weekly step counts (steps/week) in both versions of the questionnaire is in the range $r = 0.231-0.283$. Cronbach's alpha internal consistency reliability coefficients are $\alpha = 0.848$ for the Polish version and $\alpha = 0.845$ for the Czech version. The questionnaire included PA types (school, transport, housework, home, recreation, vigorous, moderate, and walking) and time spent sitting.

The recommendations for weekly PA corresponded to those documented in similar studies:⁵³⁻⁵⁵ at least 3×20 minutes of VPA, at least 5×30 minutes of walking, at least 5×60 minutes of MVPA, and the most stringent recommendation of at least 5×60 minutes of MVPA and 3×20 minutes of VPA combined. The recommendations were defined such that they matched the generally accepted recommendations as closely as possible.^{44,56,57} The achievement of the recommendations was determined based on an estimate of weekly PA in a single type of PA; although this is a very stringent criterion, it eliminates, to a certain extent, the known overestimation of time and frequency of PA types in the IPAQ-LF.⁵⁸

The data were processed in accordance with the IPAQ scoring protocol.⁵⁹ To avoid overestimation of time spent by PA and to not disrupt the proportional structure of weekly PA that is as objective as possible, the following adjustments to the data processing were made based on previous study:⁵² (a) all types of PA above 180 min/day were recoded to the maximum value of 180 minutes; (b) The MET-min for VPA were multiplied by a coefficient of 6 METs (instead of original 8); (c) the maximum limit of the aggregate time of reported PA was 600 min/day; (d) the maximum week limit of the overall sum of MET-min was set as 20,000 MET-min/week. According to the questionnaire, the average daily sitting time on school days and weekends was calculated as the average day of the week (min/day).

To determine the level of well-being and depression symptoms, the Czech and Polish versions of the WHO-5 Well-Being Index (<https://www.psykiatri-regionh.dk/who-5/Pages/default.aspx>) were used. This index is a simple and suitable tool to compare well-being between groups in research studies.⁶⁰ We did not consider the integrated approach to identifying the associations between well-being and PA, which is in addition to the more indicative approach recommended by Gill et al.,⁶¹ as being limiting in the exceptional pandemic period. The stratification of the groups according to the results of the well-being questionnaire was in line with the recommendation: achieving <13 points—lower well-being, ≥ 13 points—higher well-being.

Body mass index (BMI) was calculated from the participants' self-reported height and weight. Age and gender-adjusted BMI (zBMI) was used as an indicator for being overweight or obese. Only two groups were defined—underweight/normal and overweight/obese. The calculation was performed according to the WHO guidelines.⁶²

Data Analysis

Statistical analyses were performed using Statistica 13 (StatSoft, Prague, Czech Republic) and SPSS version 25 (IBM Corp., Armonk, NY). Basic descriptive statistics were applied to characterize the sample, and the Kruskal-Wallis test was used to identify the differences between the HE and DE groups. One-way analysis of variance and Scheffe's posthoc test were used to assess the differences in participants weight between the HE and DE groups. The differences in meeting the PA recommendations were assessed by the crosstabulation and percentage difference tests. The differences in the responses were assessed by the Mann-Whitney *U* test. Data distribution in the assessment of weekly PA and well-being were presented by means of bagplots. The η^2 and *r* effect size coefficients were evaluated as follows: $0.01 \leq \eta^2 < 0.06$ ($0.1 \leq r < 0.3$) indicated a small effect size, $0.06 \leq \eta^2 < 0.14$ ($0.3 \leq r < 0.5$)

indicated a medium effect size, and $\eta^2 \geq 0.14$ ($r \geq 0.5$) indicated a large effect size.^{63,64}

RESULTS

PA and Sedentary Behavior before and during the Pandemic

At the time of the pandemic and during DE, a statistically significant decrease was observed among boys in school PA, transportation PA, recreation PA, vigorous PA, moderate PA, walking, and overall weekly PA (Table 2). In girls, a decrease was observed in school PA, vigorous PA, and overall PA. In both boys and girls, a statistically significant increase was reported in sitting time during DE compared with HE. Boys scored significantly higher, compared to girls during HE, in school PA ($p < .001$), recreation PA ($p = .037$), vigorous PA ($p < .001$), moderate PA ($p < .001$), and overall PA ($p < .001$). During DE, no statistically significant differences in PA were observed between boys and girls.

The significant finding was that on average, before the pandemic, 24.3% of boys and 12.9% of girls were overweight/obese; during the pandemic, these percentages increased to 30.8% for boys and 14.1% for girls. The increase in the weight of boys during the pandemic was statistically significant ($p < .001$).

Table 2. Weekly Physical Activity (METs-min/week) and Daily Inactivity/Sedentary Time (min/day) in Boys and Girls during Habitual Education (Before the Pandemic) and Distance Education (During the Pandemic)

PA and inactivity	Gender	Habitual education		Distance education		H	p	η^2
		Mdn	IQR	Mdn	IQR			
School PA	Boys	1311	3600	0	563	172.11 ^{†,‡,§}	<.001	.126**
	Girls	360	2028	0	840			
Transportation PA	Boys	743	1518	461	1160	22.44 [†]	<.001	.014*
	Girls	495	1518	557	1403			
Home PA	Boys	416	1350	328	840	3.90	.273	.001
	Girls	340	840	385	855			
Recreation PA	Boys	881	2453	446	1708	29.43 ^{†,§}	<.001	.020
	Girls	693	1640	516	1485			
Vigorous PA	Boys	1080	3000	60	1080	115.17 ^{†,‡,§}	<.001	.083**
	Girls	240	1620	0	720			
Moderate PA	Boys	1606	3180	715	1736	56.80 ^{†,§}	<.001	.040*
	Girls	780	1735	670	1390			
Walking	Boys	1526	2937	858	1568	31.70 [†]	<.001	.021*
	Girls	1238	2525	1155	2327			
Total PA	Boys	5422	7075	2220	3947	97.43 ^{†,‡,§}	<.001	.070**
	Girls	3444	5059	2769	3764			
Sedentary time	Boys	365	214	429	231	46.82 ^{†,‡}	<.001	.033*
	Girls	351	197	410	191			

* $0.01 \leq \eta^2 < 0.06$, small effect size.

** $0.06 \leq \eta^2 < 0.14$, medium effect size.

PA, physical activity; Mdn, median values; IQR, interquartile range; H, Kruskal-Wallis test; η^2 , effect size; p, significance level.

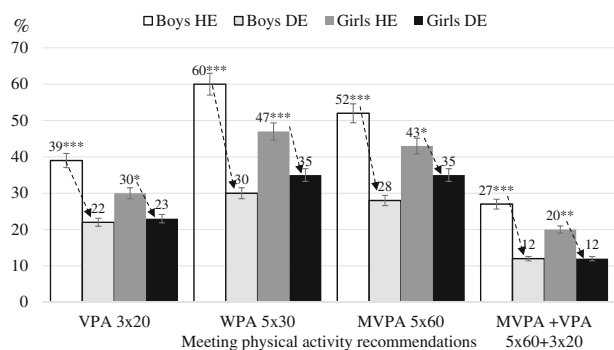
[†] Differences between boys' HE and DE.

[‡] Differences between girls' HE and DE.

[§] Differences between boys' HE and girls' HE.

^{||} Differences between boys' DE and girls' DE.

Figure 1. Differences in Meeting the Weekly Physical Activity Recommendations by Boys and Girls During Habitual Education (HE) and Distance Education (DE). PA, physical activity; VPA, vigorous PA 3 × 20 minutes; WPA, walking PA 5 × 30 minutes; MVPA, moderate to vigorous PA 5 × 60 minutes; MVPA+VPA, combined MVPA 5 × 60 minutes and 3 × 20 minutes VPA; * $p < 0.05$; ** $p < 0.01$; * $p < 0.001$.**



As these are subjectively recorded somatometric data, we do not use them in further analyses.

Achievement of PA Recommendations before and during the Pandemic

All weekly PA recommendations were met more by boys and girls during HE than during DE; this difference was statistically significant (Figure 1). The most significant decrease (by 30%) in the achievement of PA recommendations during DE as opposed to HE was reported by boys in walking.

Well-Being in Boys and Girls before and During the Pandemic

One of the most consequential findings was that during DE, only 34.9% of girls reported a good level of well-being, as compared to 43.8% during HE, indicating that 65.1% of girls had some symptoms of depression during the pandemic ($\chi^2 = 6.08$, $p < .014$, $r = .091$). Unlike girls, 50% of boys reported a good level of well-being during DE in the pandemic as compared to 65.6% of boys during HE ($\chi^2 = 15.25$, $p < .001$, $r = .155$). The differences in the level of well-being between boys and girls were statistically significant for both HE ($\chi^2 = 33.30$, $p < .001$, $r = .217$) and DE ($\chi^2 = 14.77$, $p < .001$, $r = .147$).

The lowest degree of well-being during DE was reported for Question 4 of the WHO-5 Well-Being Index: “I woke up feeling fresh and rested” (girls and boys Mdn = 1). The greatest decrease between HE and DE was observed for Question 3, “I have felt active and vigorous,” in both boys ($U = 5.26$, $p < .001$, $\eta^2 = .076$) and girls ($U = 4.74$, $p < .001$, $\eta^2 = .067$).

PA, Sedentary Behavior, and Well-Being (Lower and Higher) Before and During the Pandemic

Boys with both lower and higher levels of well-being had statistically significantly more school PA, vigorous PA, and total PA during HE compared with DE (Table 3). However, boys having higher well-being had more transportation PA, recreation PA, moderate PA, and walking during DE compared with boys having lower well-being. The differences in PA between boys reporting lower and higher well-being were not statistically significant during HE or DE. Moreover, during DE, boys with higher well-being reported less sedentary time than boys with lower well-being.

Girls reporting lower well-being had statistically significantly more school PA, recreation PA, and total PA during HE than DE, compared with girls reporting higher well-being. Girls reporting higher well-being had more school PA, vigorous PA, and total PA during DE than girls indicating lower well-being. Girls reporting both lower and higher well-being reported more sedentary time during DE as compared to HE; however, girls indicating higher well-being reported less sedentary time during both HE and DE than girls reporting lower well-being.

The bagplots show the distribution of raw data in a weekly PA continuity with well-being in boys and girls before and during the pandemic (Figure 2). This confirms the decrease in both overall weekly PA and levels of well-being in boys and girls during DE.

DISCUSSION

The aim of this study was to identify the changes in the structure of self-reported weekly PA and well-being among adolescents in HE and DE in secondary schools before and during the pandemic, respectively. One of the most serious findings was the statistically significant decrease in school PA, vigorous PA, and total weekly PA in DE during the pandemic among both boys and girls. It appears that the assessment of the structure of weekly PA has a higher response relevance compared with the cumulative assessment of the volume of weekly PA. Such low levels of the different types of weekly PA (school PA, transportation PA, home PA, and recreation PA) have been reported for the first time among studies conducted in the central European region focusing on adolescents.^{50,54,65} The considerable drop in weekly PA in boys as opposed to girls decreased the differences in weekly PA between genders. However, this trend has not been confirmed across different populations; for example, among Canadian adolescents, girls were less physically active than boys even during the pandemic.²⁹ As in the case of American boys, the greater decrease in boys’ PA as compared to girls’ PA in our study sample was probably influenced by the

Table 3. Associations Between Weekly PA (METs-Min/Week) with the Lower and Higher Well-Being of Boys and Girls During Habitual Education and Distance Education

PA and Inactivity	Gender	Habitual Education				Distance Education				H	p	η^2
		Lower well-Being		Higher well-Being		Lower well-Being		Higher well-Being				
		Mdn	IQR	Mdn	IQR	Mdn	IQR	Mdn	IQR			
School PA	Boys	1155	3162	1386	3862	0	606	0	540	116.22 ^{†,‡}	<.001	.182 ^{***}
	Girls	453	2028	185	2130	0	720	17	1053	28.99 [†]	<.001	.036 [*]
Transportation PA	Boys	718	1535	748	1592	452	1019	462	1179	20.90 [†]	<.001	.029 [*]
	Girls	495	1535	495	1518	477	1205	594	1662	3.72	.294	.001
Home PA	Boys	528	1330	406	1443	343	920	283	815	3.32	.344	.001
	Girls	340	840	338	840	330	860	443	853	4.72	.194	.002
Recreation PA	Boys	796	2145	977	2600	310	1568	568	1941	23.33 ^{†,‡}	<.001	.033 [*]
	Girls	666	1649	717	1627	428	1248	792	2055	14.05 [—]	.003	.015 [*]
Vigorous PA	Boys	780	2520	1080	3210	0	780	60	1080	63.81 ^{†,‡}	<.001	.098 ^{**}
	Girls	360	1740	195	1560	0	480	90	1065	31.46 ^{†, —}	<.001	.040 [*]
Moderate PA	Boys	1505	3495	1725	3060	580	1780	780	1800	33.68 ^{†,‡}	<.001	.049 [*]
	Girls	695	1500	890	2100	598	1395	835	1650	10.69	.014	.011 [*]
Walking	Boys	1254	2904	1650	2846	875	1716	858	1551	30.99 [†]	<.001	.045 [*]
	Girls	1370	2723	1155	1980	990	1980	1238	2516	6.16	0.104	0.004
Total PA	Boys	4866	7169	5599	7015	2237	3629	2205	4083	69.10 ^{†,‡}	<.001	.106 ^{**}
	Girls	3498	4400	3371	6239	2532	3567	3512	4314	20.29 ^{†, —}	<.001	.024 [*]
Sedentary time	Boys	386	189	343	227	480	197	386	217	36.91 ^{†, —}	<.001	.055 [*]
	Girls	369	180	317	197	429	180	377	156	36.33 ^{†,‡,§,}	<.001	.046 [*]

*.01 ≤ η^2 < .06, small effect size.

** .06 ≤ η^2 < .14, medium effect size.

*** η^2 ≥ .14, large effect size.

PA, physical activity; Mdn, median values; IQR, interquartile ranges; H, Kruskal-Wallis test; η^2 , effect size; p, significance level; lower well-being <13 points, higher well-being ≥13 points in WHO-5 Well-Being Index.

[†] Significant differences in PA in HE and DE, lower WB.

[‡] Significant differences in PA in HE and DE, higher WB.

[§] Significant differences in PA, lower and higher WB in HE.

^{||} Significant differences in PA, lower and higher WB in DE.

lower willingness of boys to participate in PA outside of teams.⁶⁶ Czech and Polish boys prefer and play team sports more than girls.⁵⁵ Two studies in France by Genin et al.²⁷ and Chambonniere et al.⁶⁷ reported decreases in PA in 42% of children and 58.7% of adolescents, and 45.6% of children and 65.9% of adolescents, respectively. Moreover, in Polish schools, 50.4% of adolescents reported a decrease in PA.⁶⁸

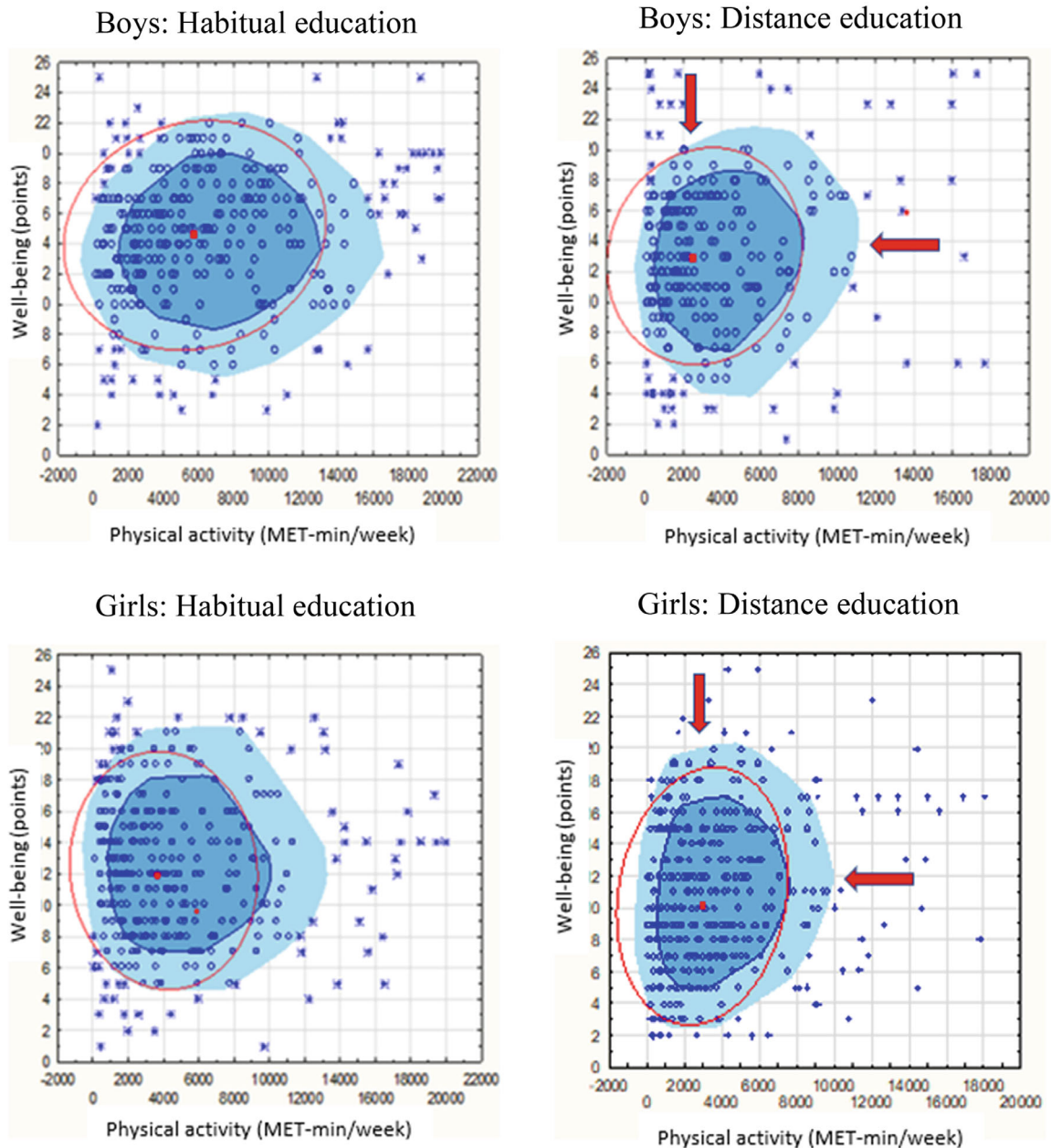
The results of our study confirmed the hypothesis that “There will be no significant differences between boys and girls in any type of weekly PA during pandemic DE”. The elimination of gender differences in weekly PA in DE also highlights the greater negative effects of the pandemic on boys’ PA.

According to the IPAQ, the achievement of PA recommendations is greatly limited and remains specific when it is determined by a single type of PA without any possibility of combining the different PA types. No study assessing weekly PA using the IPAQ has identified lower percentages of PA achievement than the present study.^{54,66} The most stringent recommendation for weekly PA, that is, at least 5 × 60 minutes of MVPA and at least 3 × 20 minutes of VPA, was met by only 12% of boys

and girls, being significantly lower than the previously identified values for the lowest achievement: 32% of boys and 21% of girls on average.⁵⁵ Similarly, the decrease in meeting the weekly PA recommendations clearly indicates a greater negative impact of DE on boys’ PA. Balancing gender differences in meeting the recommendations for VPA (22% boys, 23% girls) and walking (30% boys, 35% girls) and in meeting the recommendations for MVPA (60 min/day) by 35% of girls compared with 28% of boys is exceptional. An even greater decrease in meeting this PA recommendation was reported by Kovacs et al.,³⁶ who observed achievement by only 19% of students. In addition to the restrictions on PE, another major cause of these changes is the ban on participation in OPA during lockdown.

The results of the study emphasize the need for substantial changes in the concept of PE after the pandemic. The facts that home PA did not increase, and that school PA and active transportation to and from school were not replaced by other types of PA confirm that in the context of school education and PE, students had not been sufficiently prepared for coping with these unexpected life events. Lower

Figure 2. Distribution of physical activity (MET-min) and well-being (points) among boys and girls in habitual education (before the pandemic) and distance education (during the pandemic) in bagplots (median, bag, fence, and outlier data)



PA, more sedentary time, restrictions on structured and unstructured PA, and various measures limiting movement outside the home during the pandemic are likely to have a long-term impact after the pandemic and make it difficult to restore regular PA habits. In adolescents, these habits are ensured primarily by OPA, which have been stabilized, but were still low in the Czech Republic and Poland before the pandemic.⁶⁹ However, PA habits were disrupted during the pandemic.⁷⁰ Ensuring access of all youth to structured environmental settings that

support PA, as emphasized by Tassitano et al.,⁷¹ will not be possible after the pandemic without significant national and local support. Schools play an especially pivotal role in providing support for structured as well as unstructured PA for all children and adolescents as schools can easily respect and manage the socio-economic, ethnic, medical, behavioral, and other discrepancies in lifestyle habits and limitations of students. Therefore, the role of schools will be irreplaceable in the restoration of a physically active school lifestyle and overall healthy lifestyle in

adolescents; equally important will be the role of sports clubs and leisure organizations in promoting youth sports.⁷²

However, it is impossible to estimate whether the negative impact of the decrease in PA during the pandemic will be easier or more difficult to overcome than the impact of the pandemic on adolescents' mental health. Crucially, the latter comes at a time when the global prevalence of mental health disorders has increased markedly during late adolescence, reaching a peak at 20 to 24 years of age.⁷³ The low levels of well-being and symptoms of depression reported by the study participants may represent even more serious health implications, especially for girls. So far, symptoms of depression have been observed in about 25% of adolescents in the Czech Republic and Poland.¹⁶ The fact that girls reporting higher well-being were better at coping with the decrease in weekly PA than girls reporting lower well-being calls for changes in PE and school lifestyles. Positive correlations between PA and the level of psychological health and well-being during the pandemic have been reported in numerous studies.⁷⁴⁻⁷⁶ Like the results of our study, Chinese girls reported more significant mood disturbances during the pandemic than boys.²⁸

The focus needs to be on eliminating the negative impact of the pandemic on adolescents' PE and PA, and using the positive aspects brought about by the pandemic instead. The clear increase in information literacy and information technology skills should be used in PE to broaden its effect on adolescents (for instance, through improving online PE, increased technology use in PE lessons, better offers of home PA, calls for PA cooperation among students, etc.), and substantially transform the objectives, content, and methods of PE curricula. The fight to promote long-term effects in adolescents' education and health using short-term and visible educational effects will be more challenging. Even after overcoming the major negative impact of the pandemic on adolescents' lives, physical inactivity, and sedentary behavior caused by the pandemic will, likely, continue.^{77,78}

Strengths and Limitations

The strength of the study lies in its comparison of PA and well-being in completely different time periods—HE before the pandemic and DE during the pandemic—in Czech and Polish secondary schools. Another strength is its use of identical research methods based on the Indares web-based application.

A limitation of this research was the inability to include identical schools in both research years. Almost half of the schools were only of the same type and in the same location. The challenging and unique conditions of the pandemic made it impossible to use more objective ways of PA monitoring. However, these

objective tools could have served as an undesirable motivating factor causing a change in PA behavior. The differences in PA were certainly influenced by the time of the research before the pandemic (mainly in September, October, and November) and during the pandemic (mainly in January, February, and March).

Conclusions

The usual school PA was not replaced with other types of PA, and the pandemic restrictions caused a decrease in all types of PA, especially in boys. During the pandemic, in addition to the decrease in weekly PA, the level of well-being also dropped. The presence of depression symptoms, especially in girls, could have impacted their mental health considerably. It turned out that similar to students, parents, and communities, schools were not ready for online PE and PA, and were unable to eliminate the impact of significant national and regional restrictions in everyday life.

IMPLICATIONS FOR SCHOOL HEALTH

Although the focus of this study was on identifying the changes in physical activity and well-being between habitual and distance education during the pandemic in secondary schools, our findings opened other important needs for school health:

- At least in Central European countries, but also in general, we should promote the use of online PE as an integral part and significant complement to habitual PE. It is also beneficial to extend the approaches to individual fitness testing through distance platforms (ie, Indares web-based application or FitnessGram). Together with the use of wearables as an important part of school lifestyle, we should support the physical literacy in secondary school students.
- In the context of PE, implement a system of individual PA compensation programs developed by students in collaboration with classmates based on the effective use of monitoring devices (wearables) and information technology.

According to other findings, it is necessary to coordinate different forms of school and non-school organized PA, considering the health, educational, and socio-economic specificities as well as the principle of equality in the participation of all students. This should be done through main principles:

- We should focus more on those PA types that induce a feeling of well-being and make participants aware of the benefits of combining physical and mental activities. This should be in accordance to abolish all special exemptions from PE and absence from PE for students who participate in the school programs.

- Innovation in these approaches should lead to compensating for educational strain within a comprehensive school-based physical activity program and PE. This would also need to focus more on improving physical literacy to support the use of PA in home settings and physical environments and to compensate for the educational strain.
- The difficult status of PE and school PA programs within the pandemic raised awareness of the benefits of individual PA and individualization in team PA which might support and improve the settings for outdoor physical activity in schools.

Given that the majority of schools discarded PE as first from distance learning, these tips to promote more active approach to school PA programs even in online form should support teachers and school managers not to refuse the important health and compensative function of PA and PE in secondary schools.

Human Subjects Approval Statement

The study was conducted in line with the Declaration of Helsinki and was approved by the Ethical Committee of the Faculty of Physical Culture, Palacký University, Olomouc, Czech Republic under reg. no. 37/2013, and The Jerzy Kukuczka Academy of Physical Education in Katowice, under reg. no. 2/2008. All participants gave signed informed consent to participate in the research.

Conflict of Interest

The authors declare no conflicts of interest.

Data Availability Statement

Supplemental material for this article is available upon request from the corresponding author.

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