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Published in the USA

European Journal of Contemporary Education
E-ISSN 2305-6746
2022. 11(4): 1066-1078
DOI: 10.13187/ejced.2022.4.1066
<https://ejce.cherkasgu.press>

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The Problems of Contemporary Education

Physical Activity of Slovak Adolescents during the “Second Wave” of Covid-19 Pandemic: A Cross-Sectional Study

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Abstract

Introduction: An active participation in physical activity is associated with several elements of successful aging, including psychosocial health and well-being. Not getting enough physical activity and increased psychosocial health problems are observed worldwide especially during the first year of Covid-19 pandemic and for that reason, the present study was aimed at analyzing and comparing physical activity of Slovak adolescents during the second wave of Covid-19 pandemic.

Material and Methods: Standardized measure to estimate the habitual practice of physical activity (IPAQ-SF) was carried out through intentional sampling of 2375 Slovak adolescents (54.56 % of them adolescent girls), aged 17-19 years (mean 18.10 ± 0.60 years), attending the last year of grammar and vocational secondary schools of Slovakia. Basic descriptive statistics, chi-square test (χ^2) and Two -Sample T-Test were used to analyze and compare the data.

Results: During the last seven days, on average, 60.55 % (n = 1438) of Slovak adolescents engaged in high physical activity and 23.60 % (n = 560) of them engaged in moderate physical activity. Low physical activity was reported by 15.85 % (n = 377) of Slovak adolescents and total physical activity, expressed in MET-minutes/week, was significantly (p < 0.01) higher among the Slovak adolescent boys (2670 MET) than girls (1795 MET).

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Discussions: Physical activity levels of adolescents worldwide (1.3 billion) are reducing during the Covid-19 pandemic due to lockdown restrictions; however the Slovak adolescents' physical activity levels during the second wave of Covid-19 pandemic are similar to pre-pandemic times.

Keywords: adolescence, Covid-19 pandemic, cross-sectional study, IPAQ-SF, physical activity, Slovakia.

1. Introduction

After only three months of existence (December, 2019), the SARS-CoV-2 virus, responsible for the coronavirus disease (Covid-19), has spread across the globe, and without the exception of Slovakia, caused the global pandemic (Rossi et al., 2021), officially declared on March 11, 2020 by the World Health Organization (Olaimat et al., 2022). When the Covid-19 pandemic has affected all countries in the world with wavering intensity, all levels of government have acted in a context of uncertainty and under heavy economic, fiscal and social pressure. By spring 2020, more than 3.5 billion of the world's population had experienced a "lockdown" with various containment measures, including social distancing policies, closure of schools, shops and leisure opportunities (Stockwell et al., 2021; Strain et al., 2022). Without an exception, Slovakia had adopted some of the strictest precautions in Europa. When these measures were taken in advance to prevent and slow down the spread of Covid-19, they came with negative consequences as individual were only permitted to leave their homes to shop for necessities, medical needs, travel to and from work. Because of being forced to stay at home, an increase of risk of social isolation occurred and created a barrier to engage in physical activity, while at the same time, increased a sedentary time during the lockdown due to more time spent at home (Stockwell et al., 2021; Runacres et al., 2021; Christensen et al., 2022). Engaging in physical activity can be a challenge due to staying at home, however, it is possible and very important to stay active, because of social isolation. Not engaging in physical activity comes with health issues and financial costs (Su et al., 2020; Torres et al., 2022). An adequate physical activity is medically proven to help in preventing and managing noncommunicable diseases (NCDs), including heart disease, stroke, diabetes and several cancers. Existing evidence shows that an adequate physical activity also helps psychosocial and musculoskeletal health (Antunes, Frontini, 2021; de Abreu et al., 2022), and therefore the adequate physical activity is suggested to provide protective alternatives against the Covid-19 (Jacob et al., 2021; Clemente-Suárez et al., 2022).

Social isolation and distancing (quarantine) measures are influencing the habits, in which individuals (adolescents) can engage in physical activity (Chtourou et al., 2020; Dor-Haim et al., 2021; Ghozy et al., 2021) and besides existing evidence shows a significant decrease of engaging in physical activity concurrent with an increase in sedentary time compared to pre-pandemic times (Bertrand et al., 2021; Gilbert et al., 2021; Luciano et al., 2021; Petersen et al., 2021; Stockwell et al., 2021; Ullah et al., 2021; Christensen et al., 2022; Dallolio et al., 2022; Elvén et al., 2022; Strain et al., 2022). Physical activity has been more important than ever during the global pandemic of Covid-19, however not engaging in physical activity is a global health problem and has been considered a global pandemic since 2012 (Kohl et al., 2012; Haseler, Haseler, 2022) and it is estimated that 1 in 3 adults and 3 in 4 adolescents worldwide did not meet the guidelines on physical activity before the Covid-19 pandemic and besides that 28 % of the world population remained physically inactive (Guthold et al., 2020). If the world's population physical activity levels continue to stagnate, even decrease during the Covid-19 pandemic, it will be a great challenge for the national agencies.

School physical education provides a context for regular physical and structured physical activity participation (Uddin et al., 2020) and for school-age children who do not engage in sports and are not engaging in any leisure-time physical activity, school physical education may play an important role in keeping them active (Bendíková, Nemček, 2017; Wiseman, Wier, 2017), however the global pandemic of Covid-19 has caused a global shutdown of school for months for more than 1 billion of school-age children (Hammerstein et al., 2021; Roe et al., 2021). And another existing evidence shows that 92 % of school-age children worldwide in more than 188 countries have been affected by shutdown of schools, the teaching process has continues through a distance learning (Korz et al., 2021; Roe et al., 2021). Physical education teachers directed educational activities remotely via digital devices, including Skype, Google Meet and Microsoft Teams, however there was a significant uncertainty around the distance learning of physical education during the social

isolation and social distancing (Mercier et al., 2021; Blain et al., 2022). Distance learning of physical education was provided by sharing pictures and video recordings and live broadcasting of exercise instructions, while physical education teachers were in person responsible for creating of contents and design of online physical education lessons. Distance learning of physical education during a shutdown of schools has been affected by various factors, including limited space, family atmosphere and inadequate equipment (Escomes et al., 2021). During the second wave of global pandemic (Covid-19), many countries were more hesitant to shut down schools, which was not the case of Slovakia and situation associated with the distance learning of physical education was repeating.

Specific population group, which is affected hard by strong restrictive measures is adolescence (1.3 billion – 16 % of world' population). Adolescence represents a unique stage of human development and an important time for laying foundations of good health. Adolescents' health is a very strong predictor of adults' health (Singh et al., 2020). Adolescence represents a crucial period of human development because of hormonal changes, other interests arise in form of restriction of engaging in physical activity, and therefore adolescence represents an important stage in life for improving attitudes towards physical activity habits (Sember et al., 2020). Because many gaps remain in the literature, in terms of Slovak scale, the present cross-sectional study was aimed at analyzing and comparing physical activity of Slovak adolescents during the second wave of Covid-19 pandemic.

2. Materials and methods

Procedure Sample and Participant Selection

In accordance with the study aim, the present cross-sectional study involved 2375 Slovak adolescents (54.56 % of them adolescent girls, $n = 1296$), aged 17-19 years (mean $18.10 \pm .60$ years), attending the last year of grammar and vocational secondary schools of Slovakia. Slovak adolescents – target population ($n = 2375$) consisted of a convenience sample, recruited through various available sources, including Facebook (Meta) and Instagram (Kühne, Zindel, 2020; Purewal et al., 2021). Recruitment process was adjusted regularly (every 2 weeks) during the second wave (August, 2020 – March, 2021) of Covid-19 pandemic and aiming for an intentional sampling, regarding age, gender and year of study. 2375 correctly filled-in debriefing questionnaire forms of *International Physical Activity Questionnaire – Short Form (IPAQ-SF)* were included in the cross-sectional study interpretation process, however 0.42 % ($n = 10$) of debriefing questionnaire forms did not meet the inclusion criteria: (i) the target population should not have health issues (e.g., being sick (ill) for a long time and medical exempt from physical education); (ii) the target population should attend the last year of grammar and vocational secondary schools with official language in Slovakia. After meeting the inclusion criteria, the study group consisted of 2375 Slovak adolescents ($n = 2375$), divided into adolescent boys (body height 180.67 ± 9.2 cm, body weight 75.19 ± 13.23 kg and body mass index 22.98 ± 1.05) and adolescent girls (body height 167.14 ± 6.52 cm, body weight 59.30 ± 9.28 kg and body mass index 21.12 ± 0.85).

Assessments and Measures

A single-measure descriptive cross-sectional study was carried out and in order to determine physical activity levels among Slovak adolescents, a research instrument of standardized questionnaire (*IPAQ-SF*) was used. A standardized measure assesses the types of intensity of physical activity and sitting time that a target population (15 years of age and older) do as part of their daily lives are considered to estimate total physical activity in MET-min/week and time spent sitting (Masala et al., 2018; Tran et al., 2018; Lavelle et al., 2020). Metabolic equivalent of task (MET) is used to estimate an energy expenditure as reflected by oxygen consumption (metabolic cost) of physical activity – resting metabolic rate (Ács et al., 2020; Meh et al., 2022). All study data of physical activity was converted (MET-minutes/week) and multiplied the number of exercise minutes per day by number of exercise days per week by exercise intensity coefficient – MET: (i) vigorous physical activity – 8 MET; (ii) moderate physical activity – 4 MET; (iii) walking physical activity – 3.3 MET. 1 MET is equivalent to approximately 3.4 ml oxygen kg – 1 body weight/minute – 1. Standardized questionnaire of *IPAQ-SF* was scored according to already established methods, obtained at online available website of *IPAQ-SF* (www.ipaq.ki.se). According to established methods, the study group ($n = 2375$) was categorized into 3 groups, in terms of following criteria: (i) *High physical activity* – when total energy expenditure exceeds 1500 MET-

minutes/week, 3 or more days of vigorous physical activity of approximately 30 minutes/day, or almost every day of 30 minutes of moderate physical activity and walking (≥ 3000 MET-min/week); (ii) *Moderate physical activity* – when total energy expenditure ranges from 600 to 1500 MET-minutes/week, 3 or more days of intense physical activity of approximately 20 minutes, 5 and more days of moderate physical activity of approximately 30 minutes or combination of vigorous and moderate physical activity and walking (≥ 600 MET-min/week); *Low physical activity* – when total energy expenditure does not reach 600 MET-minutes/week.

IPAQ-SF is a dimension-based instrument, structured to capture physical activity in 4 generic dimensions, including vigorous and moderate physical activity, walking and sitting. *IPAQ-SF* was used purposely and consisted of 2 sections: (i) demographic information (basic) (age, gender, year of study, type of school and somatometry); (ii) open-ended questions surrounding Slovak adolescents' last 7 days of physical activity, concerned with (ii-i) physical activity associated with an occupation performed or at school; (ii-ii) physical activity at a home and around a house; (ii-iii) moving to different places and mobility during leisure time.

Procedures

A single-measure descriptive cross-sectional study was carried out. During the unlimited time of single session the study group ($n = 2375$) inscribed the standardized (online) questionnaire (*IPAQ-SF*), which was available from August, 2020 to March, 2021 (the second wave of Covid-19 pandemic in Slovakia). Online feedback achieved from the unlimited time of single session did not indicate any potential issues with the cross-sectional design (technical) and *IPAQ-SF* (language). In case of not being full-age Slovak adolescent (boy/ girl), the debriefing questionnaire forms of *IPAQ-SF* were distributed (face-to-face) by authors after meeting the parental consent requirements in official language in Slovakia. Debriefing questionnaire forms of *IPAQ-SF* were not detecting personal information about the identity of study group ($n = 2375$). Incentives were not given for active participation (voluntary), however the study group ($n = 2375$) received the report with their personal results afterwards. Online version of *IPAQ-SF* was selected because of cost effectiveness, time saving, easy accessibility and constantly changing situation associated with the second wave of Covid-19 pandemic. Online creation and distribution was carried out by free online portal – Microsoft Forms, Office 365 (Microsoft Corp., Redmond, WA, USA).

Data Processing

All study data collected through correctly filled-in debriefing questionnaire forms of *IPAQ-SF* was tabulated (figure) in database designed precisely for cross-sectional design (study). In terms of incidence of responses, each item of study group ($n = 2375$) was analyzed, compared and evaluated by using the program of Tap3 – Gamo (Banská Bystrica, Slovakia). All study data of study group ($n = 2375$) was polled after cleaning, analyzed and compared by using the basic descriptive statistics, including median (\bar{x}), multiplicity (n), arithmetic mean (\bar{x}) and percentage frequency analysis (%). Statistical differences between the Slovak adolescent boys (45.44 %, $n = 1079$) and girls (54.56 %, $n = 1296$) was evaluated by methods of inductive statistics, including chi-square test (χ^2) and Two-Sample T-Test Assuming Unequal Variances, of which the significance level (α) was .01 and .05 (McHugh, 2013).

When evaluating (summary) the physical activity (high level of physical activity, moderate level of physical activity and low level of physical activity), and in terms of adolescent boys and girls (Figure 1), we used the chi-square test (χ^2), of which the significance level (α) was 0.01 and 0.05. When evaluating median values and physical activity levels, in terms of adolescent boys and girls; MET-min/week (Figure 2), average time of physical activity/ day (Figure 3), number of days of physical activity (Figure 4), we used the homogeneity test of two-sample t-test assuming unequal variances, of which the significance level (α) was 0.01 and 0.05.

3. Results

In accordance with the study aim, Figure 1 illustrates the physical activity levels of Slovak adolescents (boys and girls) during the second wave of Covid-19 pandemic, expressed in Metabolic equivalent of task (MET-minutes/week) using the standardized *IPAQ-SF* questionnaire data (%). During the last seven days, on average 60.55 % ($n = 1438$) of Slovak adolescents exhibited high

physical activity levels and 23.60 % (n = 560) of them exhibited moderate physical activity levels. 15.85 % (n = 377) of Slovak adolescents exhibited low physical activity levels.

Deeper analysis of physical activity levels (Figure 1) showed increasingly larger number of Slovak adolescent boys who exhibited high physical activity levels (65.25 %, n = 704), compared to adolescent girls (55.86 %, n = 723) and another analysis showed decreasing lower number of adolescent boys who exhibited low physical activity levels (11.02 %, n = 119), compared to adolescent girls (20.68 %, n = 268). According to these results, the Slovak adolescent boys were more physically active than adolescent girls. Moderate physical activity levels revealed almost the same percentage values among the Slovak adolescent boys (23.73 %, n = 256) and girls (23.48 %, n = 304).

Taking into account the physical activity levels of Slovak adolescents during the second wave of Covid-19 pandemic, expressed in MET-min/week and using the *IPAQ-SF*, the intergroup difference of Slovak adolescents (n = 2375) revealed the statistical significance ($p < 0.01$).

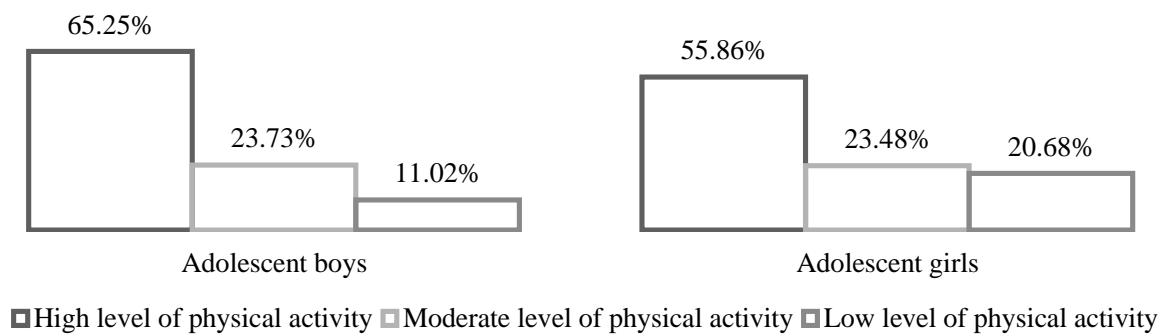


Fig. 1. Physical activity levels of Slovak adolescents during the second wave of Covid-19 pandemic, expressed in MET-min/week and using the *IPAQ-SF* (%)

Notes: ** – Statistical significance at the $p < 0.01$ level ($\chi^2_{(2)} = 42.29$; $p = 6.567 \text{ E-}10$)

Physical activity levels of Slovak adolescents during the second wave of Covid-19 pandemic, expressed in MET-min/week illustrates Figure 2. Continuous indicator, expresses as median for physical activity/week by Slovak adolescent boys (n = 1079) was on level of 2670 MET-min/week, which was increasingly larger number (+ 875 MET-min/week), compared to adolescent girls (1795 MET-min/week). Taking into account the median value (total) (walking, moderate and vigorous –intensity activity), expressed in MET-min/week of Slovak adolescents during the second wave of Covid -19 pandemic, the intergroup difference of Slovak adolescents (n = 2375) revealed the statistical significance ($p < 0.01$).

Deeper analysis of physical activity levels (Figure 2) proved increasingly larger number of Slovak adolescent boys who exhibited vigorous-intensity activity (960 MET-min/week), moderate-intensity activity (480 MET-min/week) and walking (594 MET -min/week), compared to adolescent girls (vigorous-intensity activity – 720 MET-min/week, moderate-intensity activity – 320 MET-min/week and walking – 495 MET-min/week). Median values difference of Slovak adolescent boys and girls was ranging from 99 (walking) to 240 MET-min/week (vigorous-intensity activity). Taking into account the median values (individual) (walking, moderate and vigorous-intensity activity), expressed in MET-min/week of Slovak adolescents during the second wave of Covid-19 pandemic, the intergroup difference of Slovak adolescents (n = 2375) revealed the statistical significance ($p < 0.01$).

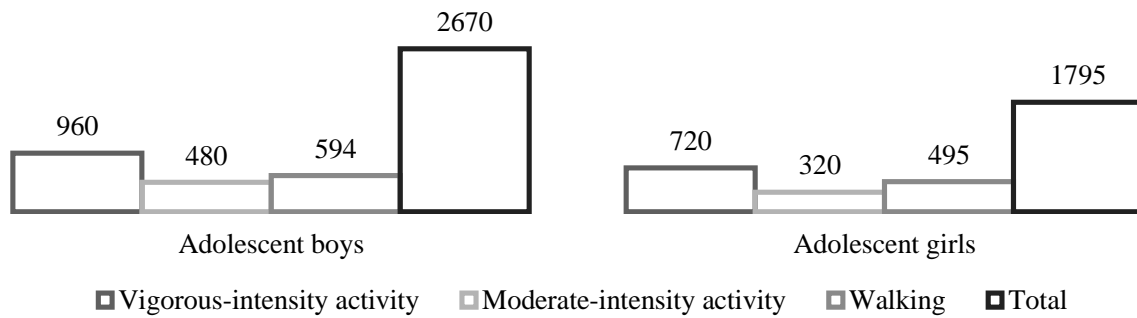


Fig. 2. Physical activity levels of Slovak adolescents during the second wave of Covid-19 pandemic, expressed in MET-min/week

Notes: ** – Statistical significance at the $p < 0.01$ level (Vigorous-intensity activity – **, $p < 0.01$; $p = 2.50 \text{ E-}22$; Moderate-intensity activity – **, $p < 0.01$; $p = 2.07 \text{ E-}15$; Walking – **, $p < 0.01$; $p = 3.54 \text{ E-}10$; Total – **, $p < 0.01$ $p = 2.81 \text{ E-}32$)

Median values in relation to time (min/day) spent in different physical activity levels of Slovak adolescents during the second wave of Covid-19 pandemic illustrates Figure 3. Comprehensive analysis of median values in relation to time spent in different physical activity levels proved increasingly larger number of Slovak adolescent boys who exhibited vigorous-intensity activity ($\bar{x} = 60$ min/day), moderate-intensity activity ($\bar{x} = 60$ min/day) and walking ($\bar{x} = 60$ min/day), compared to adolescent girls ($\bar{x} = 30$ min/day – vigorous-intensity activity, $\bar{x} = 30$ min/day – moderate-intensity activity and $\bar{x} = 45$ min/day – walking). Taking into account the median values (walking, moderate and vigorous-intensity activity) expressed in min/day of Slovak adolescents during the second wave of Covid-19 pandemic, the intergroup difference of Slovak adolescents ($n = 2375$) revealed the statistical significance ($p < 0.01$).

Deeper analysis of sitting position (Figure 3) revealed an increased incidence of sedentary behaviors because the median value of Slovak adolescent boys ($n = 1079$) was on level of 300 min/day, which was comparatively lower number (– 50 min/day), compared to adolescent girls ($\bar{x} = 350$ min/day). Taking into account the median values in relation to time (sitting position), expressed in min/day of Slovak adolescents during the second wave of Covid-19 pandemic the intergroup difference of Slovak adolescents ($n = 2375$) did not reveal the statistical significance ($p > 0.05$).

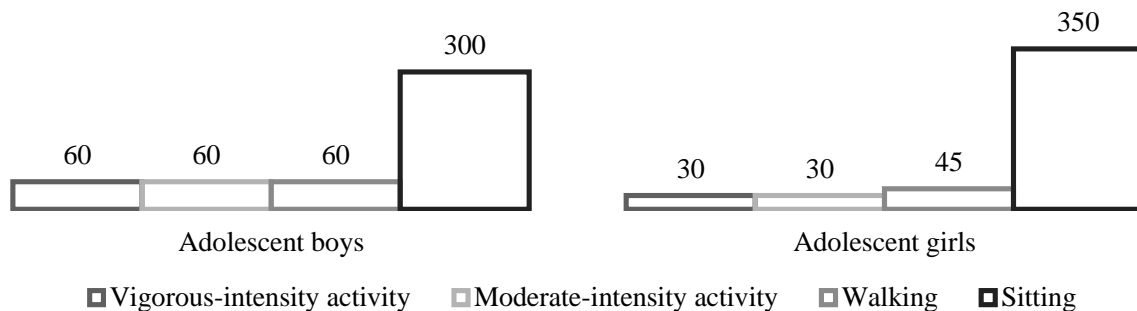


Fig. 3. Median values in relation to time (min/day) spent in different physical activity levels of Slovak adolescents during the second wave of Covid-19 pandemic

Notes: ** – Statistical significance at the $p < 0.01$ level (Vigorous-intensity activity – **, $p < 0.01$; $p = 9.29 \text{ E-}26$; Moderate-intensity activity – **, $p < 0.01$; $p = 7.81 \text{ E-}20$; Walking – **, $p < 0.01$; $p = 5.22 \text{ E-}05$; Total – **, $p > 0.05$ $p = 0.22$)

Median values in relation to time (day/week) spent in different physical activity levels of Slovak adolescents during the second wave of Covid-19 pandemic illustrates Figure 4. Comprehensive analysis of median values in relation to time spent in different physical activity levels proved increasingly larger number of Slovak adolescent boys who exhibited vigorous-

intensity activity 3 days/week (60 min/day; \bar{x}), compared to adolescent girls (3 days/week; 30 min/day; \bar{x}). Median values in relation to time spent in walking and moderate-intensity activity reached the same values, equally among the Slovak adolescent boys and girls (\bar{x} = 2 days/week of moderate-intensity activity and \bar{x} = 4 days/week of walking). Despite that median values in relation to time, expressed in min/day, of walking and moderate-intensity activity of Slovak adolescent boys and girls was not equal, ranging from 15 min/day of walking to 30 min/day of moderate-intensity activity, in favor of Slovak adolescent boys. Taking into account the median values (walking, moderate and vigorous-intensity activity), expressed in day/week, of Slovak adolescents during the second wave of Covid-19 pandemic, the intergroup difference of Slovak adolescents (n = 2375) revealed the statistical significance ($p < 0.01$).

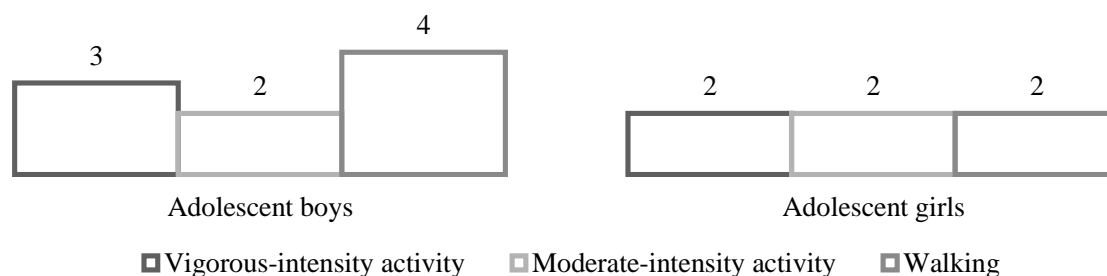


Fig. 4. Median values in relation to time (day/week) spent in different physical activity levels of Slovak adolescents during the second wave of Covid-19 pandemic

Notes: ** – Statistical significance at the $p < 0.01$ level (Vigorous-intensity activity – **; $p < 0.01$; $p = 8.96 \text{ E-}11$; Moderate-intensity activity – **; $p < 0.01$; $p = 1.17 \text{ E-}09$; Walking – **; $p < 0.01$; $p = 8.05 \text{ E-}04$)

4. Discussion

When it comes to determining the physical activity levels of adolescents before and during the Covid-19 pandemic, the level of incidence is relatively strong, with an amazingly high number of carried out studies (see 1. Introduction). Existing evidence shows that globally, physical activity levels of adolescents have reduced during the Covid-19 pandemic because of various lockdown restrictions (Ferrante et al., 2021; Grimes et al., 2022; Kovacs et al., 2022), however different degrees of lockdowns in different countries, even regions within a country, across different dates and waves occurred, which is making it challenging to objectively evaluate it (Stockwell et al., 2021). Since the Covid-19 pandemic and various lockdown restrictions have caused closure of schools (e.g. physical education) and not engaging in organized sports, one would have expected lower levels of physical activity among the Slovak adolescents, however their physical activity levels have been comparable to pre-pandemic times. If an increase (slight) of physical activity levels has been determined, it occurred via engaging in outdoor play and unstructured activities (Lafave et al., 2021; Pelletier et al., 2021). Adolescents constitute one of the most vulnerable groups under the Covid-19 pandemic confinement measures in Slovakia. When compared with pre-pandemic physical activity levels of adolescents as reported by several authors (Kayapinar, 2012; Bergier et al., 2014; Bednarek et al., 2016; Nikolić et al., 2020), the Slovak adolescents exhibited similar levels of physical activity. During the last seven days, on average 60.55 % (n = 1438) of Slovak Adolescents exhibited high physical activity levels and 23.60 % (n = 560) of them exhibited moderate physical activity levels, which was not anticipated due to lockdown restrictions during the second wave of Covid-19 pandemic. Before the Covid-19 pandemic, comparable study carried out in Poland revealed that 35.55 % of adolescents (48.77 % of male and 31.35 % of female) exhibited high physical activity levels (Bergier et al., 2012). After a short time, the same author repeated the study and revealed that 71.98 % of Polish adolescents (76.18 % of male and 67.77 % of female) exhibited high physical activity levels (Bergier et al., 2014). Only 18.9 % of Serbian adolescents exhibited high physical activity levels (Nikolić et al., 2020). Strong restrictive measures to avoid the Covid-19 pandemic have negatively affected various life domains among the

adolescents worldwide and lowered their physical activity levels; in particular, 35.5 % of Nigerian adolescents (43.6 % of male and 21.2 % of female) exhibited high physical activity levels, which was lower by 25.05 %, compared to the Slovak adolescents (Ugwueze, Agbaje, 2022). An expected difference of 11.13 % of high physical activity levels was documented among the Italian adolescents before (41.76 %) and during (30.63 %) the Covid-19 pandemic (Maugeri et al., 2020).

Total physical activity, expressed in MET-min/week, of Slovak adolescent boys was 2670 MET-min/week, which was significantly larger number (+ 875 MET-min/week), compared to adolescent girls (1795 MET-min/week) ($p < 0.01$). Before the Covid-19 pandemic, total physical activity of Ukrainian adolescents was 3560 MET-min/week, while the Lithuanian adolescents' total physical activity was close to 5000 MET-min/week (Bergier et al., 2012, 2014). During the Covid-19 pandemic, total physical activity of Chinese adolescents was lower (1193.02 MET-min/week) than before the Covid-19 pandemic (Zhang et al., 2020). Similar tendency of lower total physical activity was documented among the Italian adolescents (1730 MET-min/week) (Tornaghi et al., 2020). 3 in 4 adolescents worldwide did not the guidelines on physical activity before the Covid-19 pandemic (Guthold et al., 2020). In 2020, the World Health Organization (WHO) guidelines and recommendations provided details for different age and population groups on how much physical activity is needed for good health. For substantial health benefits, the Slovak adolescents aged 17-19 years (mean $18.10 \pm .60$), should do at least: (i) 150-300 minutes of moderate-intensity aerobic activity; (ii) 75-150 minutes of vigorous-intensity aerobic activity; (iii) an equivalent combination of moderate- and vigorous-intensity aerobic activity/week. 65.25 % ($n = 704$) of Slovak adolescent boys reached the minimum of 75 minutes of vigorous-intensity aerobic activity throughout the week (3 days/week of 60 min/day; \bar{x}), while the adolescent girls did not reach the guidelines on physical activity. When compared with the Serbian adolescents (Nikolić et al., 2020), the majority of them reached the level of at least 30 minutes of moderate-intensity aerobic activity/5 days of week. On average, 94 % of Polish adolescents (96 % of male and 92 % of female) and 40 % of Turkish adolescents (79 % of male and 28 % of female) reached, even exceeded the minimum of 75 minutes of vigorous-intensity aerobic activity/week (Bednarek et al., 2016).

Our study revealed the gender difference, in which the Slovak adolescent boys were significantly more physically active than adolescent girls ($p < 0.01$), and that's in accordance with many previous studies (Mayo et al., 2020; Cowley et al., 2021; Pate et al., 2022; Ricardo et al., 2022). For more complete insight into the pattern of physical activity, it is required to separately analyze each physical activity domain. According to study results, among the Slovak adolescent girls dominated physical activity related with walking, while among the adolescent boys vigorous-intensity activity dominated. Several authors reported similar findings (Bergier et al., 2014; Bednarek et al., 2016; Maugeri et al., 2020; Nikolić et al., 2020; Zhang et al., 2020).

An insufficient level of physical activity recorded among the Slovak adolescents especially among the adolescent girls, suggests that it is necessary to pay attention to this specific population group, which was affected hard by strong restrictive measures during the second wave of Covid-19 pandemic. Therefore, there is an urgent need for national and global action aimed at increasing levels of physical activity; in particular with focus on adolescent girls.

5. Conclusion

Covid-19 pandemic, officially declared on March 11, 2020 by the World Health Organization (Rossi et al., 2021; Olaimat et al., 2020), has affected all countries in the world, including Slovakia, with wavering intensity, which was most noticeable within introducing a broad range of measures to limit physical contacts to prevent and slow down the Covid-19 pandemic. In accordance with the United Nations Report (2020), the Covid-19 pandemic has affected education systems worldwide (Tadesse, Muluye, 2020; Pokhrel, Chhetri, 2021) and caused the largest disruption to schooling in history. Despite of having administered one of the longest school closures globally, schooling in Slovakia was not adequately prepared for long-term teaching through remote access, which brought fundamental problems, including physical education. School physical education provides a context for regular and structured physical activity participation (Uddin et al., 2020) and represents the only opportunity of engaging in physical activity (Bali, 2016; Reif et al., 2021). According to results of present study, during the second wave of Covid-19 pandemic, on average, 60.55 % ($n = 1438$) of Slovak adolescents ($n = 2375$) engaged in high physical activity, with

increasingly larger number of Slovak adolescents boys (65.25 %, n = 704), compared to adolescent girls (55.86 %, n = 723), which we consider as a positive finding, however the *IPAQ-SF* overestimate physical activity levels to a greater extent (from 36 % to 173 %), compared to existing physical activity questionnaires (Lee et al., 2011; Roberts-Lewis et al., 2021), and therefore the absolute physical activity levels must be interpreted with a caution (Grimm et al., 2012; Wanner et al., 2016). When evaluating the absolute physical activity (median values), expressed in MET-min/week, median value (\bar{x}) of absolute physical activity among the Slovak adolescent boys (n = 1079) was on level of 2670 MET-min/week, which was increasingly larger number (+ 875 MET-min/week), compared to adolescent girls (1795 MET-min/week) and revealed the statistical significance ($p < 0.01$), in terms of comparing the intergroup difference of Slovak adolescents (n = 2375) and their median values of walking, moderate and vigorous-intensity activity. Results of present study revealed the significant difference ($p < 0.01$), in terms of time (min/day and day/week) spent in walking, moderate and vigorous-intensity activity and sitting position, within which the Slovak adolescent girls exhibited the increased levels of physical inactivity, compared to adolescent boys. During the last seven days, on average, 40 min/2x/week of Slovak adolescents (n = 2375) exhibited the vigorous-intensity activity, 50 min/2x/week of moderate-intensity activity, 55 min/3x/week of walking and sitting position of 330 min/day (\bar{x}). Leading a sedentary lifestyle is becoming a major public health issue. An increased sedentary behavior of adolescents worldwide contributes to obesity and overweight and affects the “social gradient of health”. In terms of regular engaging in physical activity, it is very necessary to pay a great attention to such a unique stage of human development and regularly identify their needs and attitudes in the current rapidly changing world.

6. Acknowledgments

Our study received no specific grant from any funding agency in the public, nor commercial or not-for-profit sectors.

7. Conflict of interest

The authors report no conflict of interest.

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