IS PARTICIPATION IN PHYSICAL EDUCATION CLASSES RELATED TO PHYSICAL ACTIVITY AND SEDENTARY TIME IN ADOLESCENT BOYS AND GIRLS?

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Abstract

The aim of the study was to determine the relationship between adolescents' frequency of participation in physical education and physical activity and their amount of screen time. The study included 1,502 girls and 1,379 boys aged 14–16 years. We measured the participants' frequency of participation in physical education classes, physical activity, and sedentary behavior by means of a questionnaire-based survey. We found that participation in physical education classes was associated with higher levels of physical activity in boys and girls, less time spent on electronic devices in both genders, and less time devoted to watching TV in girls. Girls participated in physical education classes more often, had lower levels of physical activity, and spent less time on sedentary activities than boys. In conclusion, increasing the frequency of participation in physical education classes may be an effective strategy for reducing physical inactivity and sedentary lifestyles in adolescents.

Keywords*:* exercise, screen time, school, teenagers

Introduction

Insufficient physical activity is among the four key factors for noncommunicable diseases such as cardiovascular disease, chronic respiratory disease, diabetes, and cancer (WHO, 2018). Increasing sedentary behaviors and decrease in physical activity are also the main drivers of the global obesity pandemic (Blüher, 2019). Unfortunately, research findings have shown that young people engage in too little physical activity, eat unhealthily, and spend too much time sitting (Gaddad, Pemde, Basu, Dhankar, & Rajendran, 2018; Kantanista et al., 2020). Regular participation in high-quality physical education activities is critical for shaping positive habits, establishing interest in physical activity, and compensating the time spent in the sitting position among adolescents.

Physical activity among adolescents

Globally, the majority of adolescents do not meet current physical activity guidelines. Guthold, Stevens, Riley, & Bull (2020) used data from 298 school-based surveys from 146 countries, including 1.6 million students aged 11–17 years. The authors reported that in 2016, 81.0% of adolescents were insufficiently physically active (77.6% of boys and 84.7% of girls). Kędra and Czaprowski (2015) observed that among 1,089 Polish adolescents, about 35% were physically active only during physical education. Other studies showed that more than half of adolescents in investigated populations did not even reach a low level of physical activity (e.g. Frömel, Groffik, Chmelík, Cocca, & Skalik, 2018).

Sedentary behaviors among adolescents

Several studies have confirmed the relationship between a decrease in physical activity in adolescents and an increase in sedentary behavior, which is particularly associated with the availability of technology-based activities during leisure time (Gaddad et al., 2018). In the United States, 71% of teenagers have access to more than one social networking website, and 24% use the Internet almost continuously with mobile phones. It is alarming that young people spend much of their time on screen time activities.

In Europe, the consumption of screen-based media has also risen considerably in recent years (Bucksch et al., 2016). Poulain et al. (2019) observed a mean of 5.31 h per day of screen time among 850 German adolescents. In Poland, a study of 14,044 students aged 13–19 years old demonstrated that the average screen time duration increased with age (from 2.6 h among 13 years old to 3.2 h among 19 years old), and was significantly higher among boys in all age categories (Myszkowska-Ryciak et al., 2020).

Physical education of adolescents

Participation in physical education declines during adolescence (Inchley, Stevens, Samdal, & Currie, 2020). Wójcicki and McAuley (2014) found that

nearly 50% of American adolescents did not participate in physical education. According to The National Association for Sport and Physical Education (2004) adolescents should accumulate 225 minutes of physical education per week for secondary students, with at least 50% of class time spent on moderate-to-vigorous physical activity (MVPA). Unfortunately, Drake et al. (2012) in their study of 1718 adolescents showed that the intensity, quality, and quantity of physical education were insufficient.

In Poland, the number of hours of physical education per week is 4 h in primary school and is one of the highest in Europe (WHO, 2018). A study conducted in Poland among high school youths showed that 60–80% take part in physical education regularly. Unfortunately, a large percentage of young people avoid physical education lessons (Woynarowska, Mazur, & Oblacińska, 2015).

Relationships among participation in physical education, physical activity, and sedentary time among adolescents

Regular participation in physical education can have a positive effect on adolescents' level of physical activity and reduce their use of devices in leisure time (Cronholm, Rosengren, Karlsson, & Karlsson, 2018). However, there is no many research analyzing the direct relationship between participation in physical education and screen behavior among adolescents. Studies have shown that regular exercise during physical education reduces the amount of screen time indirectly (Mayorga-Vega, Martínez-Baena, & Viciana, 2018). Students participating in physical education spent more of their free time engaging in physical activity, allocating less of it to computer games and social media (Silva, Chaput, & Tremblay, 2019).

Physical education lessons are often the only form of physical activity for adolescents who do not engage in voluntary physical activity. Hoffmann, Bryl, Marcinkowski, Strazynska and Pupek-Musialik, (2011) found that about 52.5% of rural teenagers reported that compulsory physical education was their only form of physical activity. Thus, school-based physical education is one of the few options that can effectively increase physical activity in children and adolescents.

The high frequency of physical education during the school week might develop the habit of undertaking physical activity (Poulain et al., 2019). Students present in the physical education classes were more likely to enjoy playing sports. Silva et al. (2019) showed that engagement in physical education is associated with a higher level of physical activity among adolescent boys and girls. Moreover, a higher number of teaching units involving physical exercise was associated with an increase in students' participation in extracurricular activities.
In relation to the above considerations, the aim of the present study was to determine the relationship between adolescents' frequency of participation in physical education and physical activity and their screen time.

Methods

Participants

The study included a total of 2,881 individuals, including 1,502 girls and 1,379 boys aged 14–16 years (M_{girls} = 15.02, SD = 0.82, M_{boys} = 15.10, SD = 0.80). We recruited the participants from 12 junior high schools in Poznan, Poland, a major city with approximately 550,000 inhabitants. The sample was selected using one-stage cluster sampling.

In girls, mean body height (cm) was 164.0 (SD = 6.0), mean body weight (kg) was 55.4 (SD = 10.0), and mean body mass index (BMI; kg/m^2) was 20.5 (SD = 3.3). In boys, mean body height (cm), mean body weight (kg), and mean BMI (kg/m^2) were 172.0 (SD = 8.0), 61.6 (SD = 12.7), and 20.6 (SD = 3.5), respectively. Weight was measured with a Seca 761 scale in light clothing (without shoes) to the nearest 0.5 kg, while height was measured with an anthropometer to the nearest 0.5 cm. The body height and weight of the participants were used to calculate BMI.

Written assent from all participants and consent from parents or legal guardians was obtained. The protocol for the study was approved by the Local Bioethics Committee of Karol Marcinkowski University of Medical Sciences.

Measures of physical education participation, physical activity, and sedentary time

Participation rates in physical education classes were determined based on the answers to the question, "How often have you participated in physical education classes at school during the last few months?" The possible answers ranged from "I have participated in every or nearly every physical education class" to "I have not participated in physical education classes at all". Based on the answers, three categories of participation in physical education classes were created: participation in 1) all or nearly all, 2) about half, and 3) almost none or no physical education classes.

MVPA was determined using the Physical Activity Screening Measure proposed by Prochaska, Sallis and Long (2001). This measure corresponds to the average number of days per week with at least 60 min of various forms of physical activity, during which, in the participants' subjective opinion, their heart rates accelerated and they experienced shortness of breath (higher breath rate). MVPA was calculated based on the following formula: MVPA = (P1 + P2)/2, where MVPA is the physical activity index; P1 is the number of physically active days during the last 7 days; and P2 is the number of physically active days during a typical (average) week. According to Prochaska et al. (2001), the

measure is reliable (ICC = .77) and significantly correlated (r = .40, p < .001) with accelerometer data.

Sedentary time was determined based on answers to three questions obtained from the Health Behavior in School-Aged Children Study questionnaire (Currie et al., 2008). These questions asked about time spent watching television, videos, and DVDs, using the computer, and using game consoles. Possible answer categories ranged from "none at all" (0 h) to "at least 7 hours per day" (with the possibility of filling in the number of hours if higher than 7). School days and weekends were treated separately.

Statistical analysis

Basic statistical methods were used to describe the continuous variables (mean, standard deviation, and 95% confidence intervals [CI]) and categorical variables (percentage distribution). T-tests (for continuous variables) and tests for the difference between two independent sample proportions (for categorical variables) were used to examine the differences in the analyzed variables for boys and girls. A one-way ANOVA was used to analyze the differences in physical activity and time spent on sedentary activities by girls and boys in relation to their frequency of participation in physical education classes. Scheffé post hoc tests were performed to assess the significance of differences between pairs of measurements. Partial eta-squared (η^2) was calculated to determine the effect size. The threshold for statistical significance was set at $p < .05$. All calculations were performed using Statistica 13.0 (StatSoft, Inc.).

Results

Table 1 shows the main characteristics and differences between girls and boys. Girls participated in physical education classes more often but had a lower level of MVPA. Boys spent more time on computers, mobile phones, and game consoles on weekdays and weekends compared to girls. There were no significant differences between girls and boys in time spent watching TV.

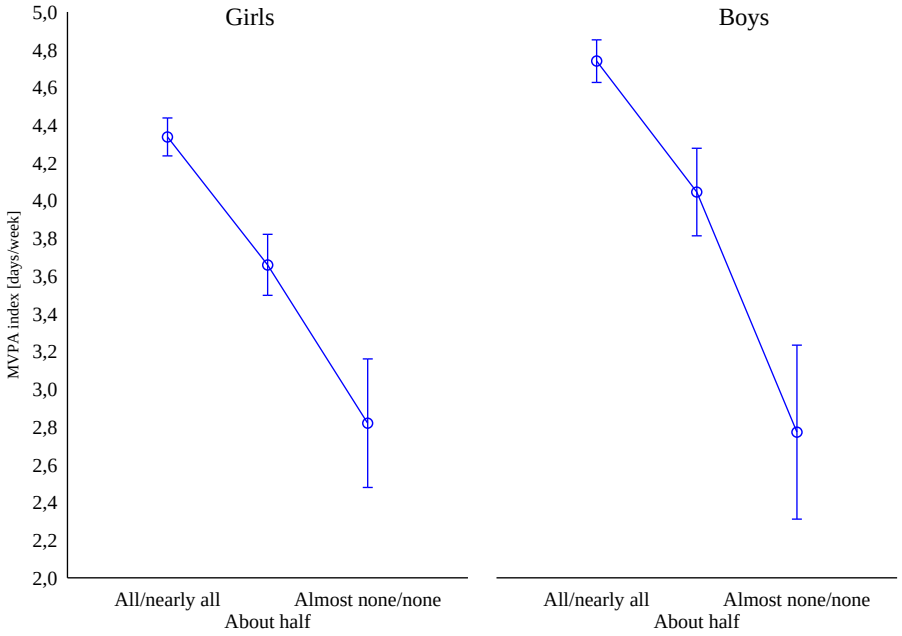
Table 1. Main characteristics and differences between girls and boys in examined variables

Variables	Girls		Boys		*p*
	Mean (SD)	CI (95%)	Mean (SD)	CI (95%)	
Height (m)	1.64. (0.06)	1.63–1.64	1.72 (0.08)	1.72–1.73	0.000
Weight (kg)	55.38 (10.00)	54.88–55.89	61.56 (12.68)	60.88 –62.21	0.000
BMI (kg/m^2)	20.55 (3.34)	20.38–20.71	20.59 (3.47)	20.41–20.77	0.738
Physical education classes active participation*					
All/nearly all	77.1		67.8		0.000
About half	18.3		26.3		0.019
Almost none/none	4.6		5.9		0.054
MVPA [days/week]	4.07 (1.69)	3.98–4.16	4.47 (1.90)	4.37–4.57	0.000
Time spent on TV watching on week days [h/day]	2.47 (1.47)	2.39–2.54	2.53 (1.60)	2.45–2.62	0.251
Time spent on TV watching on weekend days [h/day]	3.47 (1.75)	3.38–3.56	3.55 (1.88)	3.45–3.65	0.221
Time spent on computer/mobile phones/game consoles on week days [h/day]	2.47 (1.57)	2.40–2.55	2.98 (1.79)	2.88–3.07	0.000
Time spent on computer/mobile phones/game consoles on weekend days [h/day]	3.53 (1.81)	3.44–3.62	4.15 (1.93)	4.05–4.25	0.000

Note: Girls, n = 1,502; boys, n = 1,379. *Expressed as a percentage.

A one-way ANOVA showed differences in the MVPA of girls (F (2, 1,502) = 51.86, $p < 0.001$, η^2 = 0.064) and boys (F (2, 1,379) = 42.97, $p < 0.001$, η^2 = 0.059) according to their frequency of participation in physical education classes. The post hoc tests indicated differences in MVPA both in girls and boys. The highest MVPA index included boys (4.69 days/week) and girls (4.34 days/week) who participated in all or nearly all physical education classes; the lowest MVPA index included boys (2.76 days/week) and girls (2.82 days/week) participated in nearly none or none physical education classes (Fig.1).

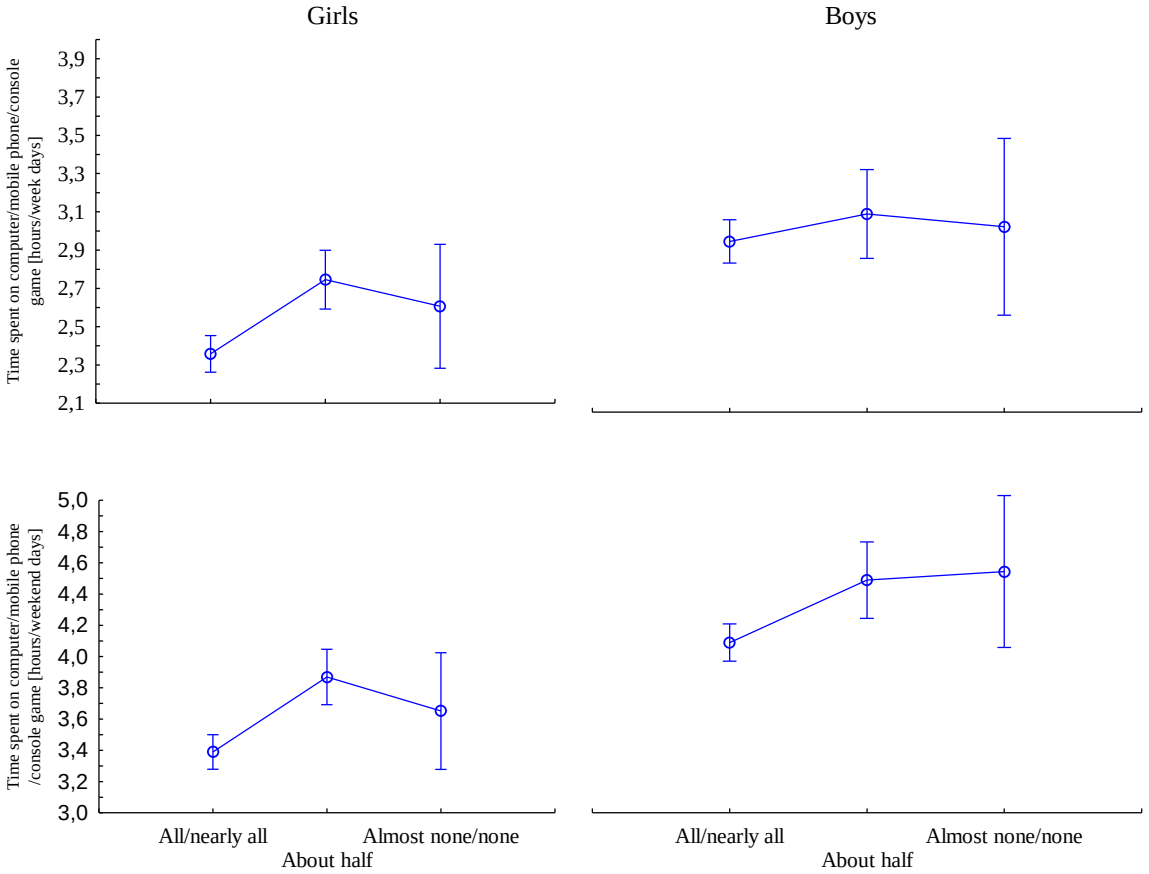
Figure 1. Physical activity of girls and boys in relation to their frequency of participation in physical education classes



Time spent on computers, mobile phones, and gaming consoles during weekdays and weekends in girls and boys is presented in Figure 2. In girls, a one-way ANOVA showed differences in the time spent on computers, mobile phones, and gaming consoles during weekdays (F (2, 1,502) = 9.17, p < 0.001, η^2 = 0.012) and weekends (F (2, 1,502) = 10.39, p < 0.001, η^2 = 0.014) according to the frequency of participation in physical education classes. The post hoc tests indicated that girls who participated in all or nearly all physical education classes spent less time (2.36 h/weekday and 3.39 h/weekend day) on these devices than girls who participated in about half (2.74 h/weekday and 3.87 h/weekend day) and in nearly none or none (2.61h/weekday and 3.65 h/weekend day) of the physical education classes.

In boys, one-way ANOVA showed differences in the time spent on computers, mobile phones, and gaming consoles during weekends (F (2, 1,379) = 5.25, p < 0.01, η^2 = 0.0009) but not during weekdays (F (2, 1,379) = 0.61, p = 0.541, η^2 = 0.007) according to the frequency of participation in physical education classes. The post hoc tests indicated that boys who participated in all or nearly all physical education classes spent less time (4.06 h/weekend day) on the devices than boys participated in nearly none or none (4.50 h/weekend day) of the physical education classes.

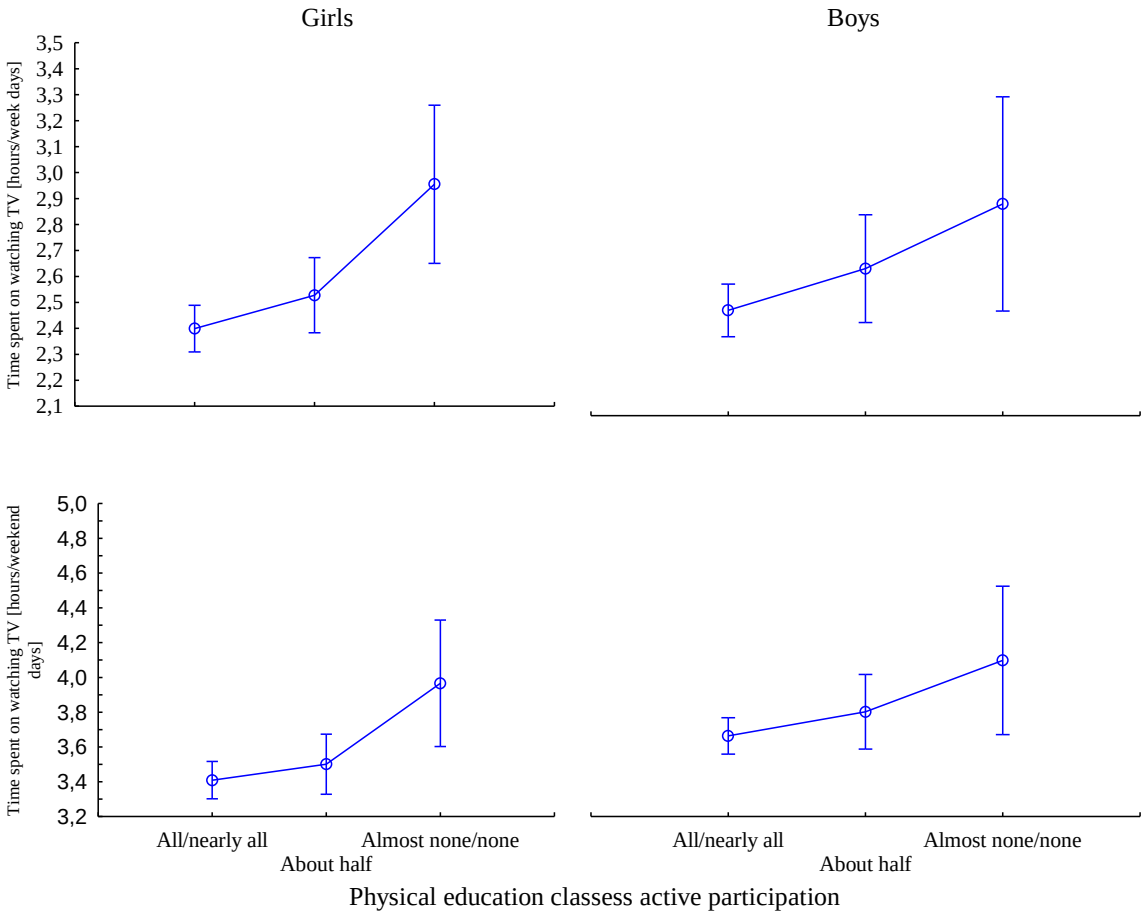
Figure 2. Physical activity of girls and boys in relation to time spent on computers, mobile phones, and gaming consoles during weekdays and weekends



Time spent on TV watching during weekdays and weekends in girls and boys is presented in Figure 3. In girls, one-way ANOVA showed differences in time spent on TV watching during weekdays (F (2, 1,502) = 6.37, p < 0.01, η^2 = 0.008) and weekends ((2, 1,502) = 4.25, p < 0.05, η^2 = 0.006) according to the frequency of participation in physical education classes. The post hoc tests indicated that girls who participated in all or nearly all physical education classes spent less time (2.40 h/weekday and 3.41 h/weekend day) watching TV than girls who participated in about half (2.53 h/weekday and 3.50 h/weekend day) and those who participate in none or nearly none (2.95 h/weekday and 3.97 h/weekend day) of the physical education classes.

In boys, one-way ANOVA showed no differences in the time spent watching TV during weekends ((2, 1,379) = 2.48, p = 0.084, η^2 = 0.004) and weekdays (F(2, 1,379) = 2.33, p = 0.098, η^2 = 0.003) according to the frequency of participation in physical education classes.

Figure 3. Physical activity of girls and boys in relation to time spent watching TV during the weekdays and weekend



Discussion

The aim of the presented study was to assess the relationship between adolescents' participation in physical education and their engagement in physical activity and sedentary behaviors. The differences between these behaviors in girls and boys were also analyzed. We found that girls and boys who participated in all or nearly all physical education classes engaged in MVPA most frequently and exhibited the least weekly screen time. Adolescents who avoided physical education presented the lowest level of physical activity (and this level was insufficient according to WHO guidelines), and significantly higher rates of screen time. These results show that frequent participation in physical education lessons might have a positive effect on undertaking physical activity and reducing sedentary screen time among adolescents. This is in line with Silva et al. (2019) who noticed that participation in physical education was positively associated with a higher level of physical activity in both sexes and lower level of sitting time in boys. Sandercock, Ogunleye and Voss (2012) registered a negative association between higher screen time and school or free-time physical activity. Moreover, students reporting less than 2 h of screen time were more often active in physical education during school lunch breaks and in their free time.

It is easy to understand the fact that time outside of school hours allocated on screen time may displace physical activity, but it turned out that it is also associated with lower physical activity during school (Mooses et al., 2017). Sandercock et al. (2012) discussed that high screen time might indirectly lead to lower physical activity at other times via habit, opportunity, or choice. Heavy screen time users have sedentary habits and might miss out on opportunities for physical activity during physical education, school breaks, and after lessons. Authors noted (similar to the present study) that adolescents who spent more than 2 h engaged in computer-related screen time avoided physical education lessons. However, this relationship may have the opposite direction. Regular participation in physical education leads to the development of motor skills and physical fitness (Gråstén, Watt, Liukkonen, & Jaakkola, 2017). High motor skills proficiency might contribute to more frequent physical activity outside of school hours among

adolescents (Barnett, Van Beurden, Morgan, Brooks, & Beard, 2009).

The results of the present paper confirm that frequent participation in physical education lessons can significantly affect the weekly level of physical activity among adolescents. According to Mosses et al. (2017), each additional minute of MVPA in physical education was associated with 1.4 more daily MVPA minutes. On days with physical education, students had 12.8 min more MVPA compared with days without physical education. Mayorga-Vega et al. (2018) observed that adolescents had greater physical activity levels on physical education days than on non-physical education and weekend days.

It should be stressed that both boys and girls in the study spent more than 2 h per day on computers, mobile phones, and gaming consoles, which is more than WHO recommends. Boys engaged in more screen time than girls, which is consistent with other studies (Tadiotto et al., 2019). Online communication has become a dominant part of adolescents' lives (Best, Manktelow, & Taylor, 2014). In a study of 1,100 Polish adolescents, the percentage of participants who daily, or almost daily, spent time on a computer was 60% and 70%, respectively (Wojtyla-Buciora et al., 2014). In the present study, the average amount of daily screen time among adolescents is high and may lead to negative health effects, especially among students who participate in about half of physical education classes or less.

In the current study, significantly more girls than boys participated in all or nearly all physical education classes. However, males achieved MVPA more often than their female peers. It is possible that boys undertook physical activity more often in their free time outside the school (Long et al., 2013). Our study shows that adolescents who regularly participate in physical education have higher levels of physical activity and spend less time on sedentary activities. It seems that increasing the frequency of participation in physical education classes may be an effective strategy to reduce the high prevalence of physical inactivity and sedentary lifestyles in adolescents.

Limitations and Strengths

This study has some limitations linked to the usage of self-assessment methods to measure physical education participation, physical activity, and sedentary time. There are additional limitations related to self-reported data, including differences between how students report their behavior and how they actually behave (Bellmore, Ma, You, & Hughes, 2012).

The main strengths of this study lie in its expanded exploration of the problem of physical activity and sedentary behavior of adolescents within the context of physical education. Second is use the cluster sampling method and a large study population of adolescents. It should also be noted that the direct measurements of weight and height used in our research allowed for accurate BMI calculations.

Conclusions and Future Directions

Our results suggest that regular participation in physical education might be a factor reducing screen time among adolescents and increasing their involvement in physical activity. Specifically, it is important for physical education teachers to organize physical education that will be enjoyable for students and will encourage them to participate regularly in classes (Gråstén & Yli-Piipari, 2019). Moreover, future studies should analyze the relationships between physical education, screen time, and physical activity to determine their causal relationship.

References

Barnett, L. M., Van Beurden, E., Morgan, P. J., Brooks, L. O., & Beard, J. R. (2009). Childhood motor skill proficiency as a predictor of adolescent physical activity. *Journal of Adolescent Health, 44*(3), 252-259. doi: 1016/j.jadohealth.2008.07.004

Bellmore, A., Ma, T. L., You, J. I., & Hughes, M. (2012). A two-method investigation of early adolescents' responses upon witnessing peer victimization in school. *Journal of Adolescence, 35*(5), 1265-1276. doi: 10.1016/j.adolescence.2012.04.012

Best, P., Manktelow, R., & Taylor, B. (2014). Online communication, social media and adolescent wellbeing: A systematic narrative review. *Children and Youth Services Review, 41*, 27-36. doi: 10.1016/j.childyouth.2014.03.001

Blüher, M. (2019). Obesity: Global epidemiology and pathogenesis. *Nature Reviews Endocrinology, 15*(5), 288-298. doi: 10.1038/s41574-019-0176-8

Bucksch, J., Sigmundova, D., Hamrik, Z., Troped, P. J., Melkevik, O., Ahluwalia, N., ... & Inchley, J. (2016). International trends in adolescent screen-time behaviors from 2002 to 2010. *Journal of Adolescent Health, 58*(4), 417-425. doi: 10.1016/j.jadohealth.2015.11.014

Cronholm, F., Rosengren, B. E., Karlsson, C., & Karlsson, M. K. (2018). A comparative study found that a seven-year school-based exercise programme increased physical activity levels in both sexes. *Acta Paediatrica, 107*(4), 701-707. doi: 10.1111/apa.14172

Currie, C., Gabhainn, S.N. Godeau E., Roberts, C. Smith, R. Currie D., ... & Barnekow, V. (2008). *Inequalities in young people's health: HBSC international report from the 2005/2006 survey.* Copenhagen, Denmark: WHO Europe.

Drake, K. M., Beach, M. L., Longacre, M. R., MacKenzie, T., Titus, L. J., Rundle, A. G., & Dalton, M. A. (2012). Influence of sports, physical education, and active commuting to school on adolescent weight status. *Pediatrics, 130*(2), e296-e304. doi: 10.1542/peds.2011-2898

Frömel, K., Groffik, D., Chmelík, F., Cocca, A., & Skalik, K. (2018). Physical activity of 15–17 years old adolescents in different educational settings: A Polish-Czech study. *Central European Journal of Public Health, 26*(2), 137-143. doi: 10.21101/cejph.a4521

Gaddad, P., Pemde, H. K., Basu, S., Dhankar, M., & Rajendran, S. (2018). Relationship of physical activity with body image, self-esteem sedentary lifestyle, body mass index and eating attitude in adolescents: A cross-sectional observational study. *Journal of Family Medicine and Primary Care, 7*(4), 775-779. doi: 10.4103/jfmpc.jfmpc_114_18

Gråstén, A., & Yli-Piipari, S. (2019). The patterns of moderate to vigorous physical activity and physical education enjoyment through a 2-year school-based program. *Journal of School Health, 89*(2), 88-98. doi: 10.1111/josh.12717

Gråstén, A., Watt, A., Liukkonen, J., & Jaakkola, T. (2017). Effects of school-based physical activity program on students' moderate-to-vigorous physical activity and perceptions of physical competence. *Journal of Physical Activity and Health, 14*(6), 455-464. doi: 10.1123/jpah.2016-0244

Guthold, R., Stevens, G. A., Riley, L. M., & Bull, F. C. (2020). Global trends in insufficient physical activity among adolescents: A pooled analysis of 298 population-based surveys with 1.6 million participants. The *Lancet Child & Adolescent Health, 4*(1), 23-35. doi: 10.1016/S2352-4642(19)30323-2

Hoffmann, K., Bryl, W., Marcinkowski, J. T., Strazynska, A., & Pupek-Musialik, D. (2011). Estimation of physical activity and prevalence of excessive body mass in rural and urban Polish adolescents. *Annals of Agricultural and Environmental Medicine, 18*(2), 398-403.

Inchley, J. C., Stevens, G. W., Samdal, O., & Currie, D. B. (2020). Enhancing understanding of adolescent health and well-being: The health behaviour in school-aged children study. *Journal of Adolescent Health, 66*(6), S3-S5. doi: 10.1016/j.jadohealth.2020.03.014

Kantanista, A., Tarnas, J., Borowiec, J., Elegańczyk-Kot, H., Lubowiecki-Vikuk, A., Marciniak, M., Król-Zielińska, M. (2020). Physical activity of children and adolescents from the Czech Republic, Hungary, Poland, and Slovakia: A systematic review. *Annals of Agricultural and Environmental Medicine*. doi: 10.26444/aaem/125557

Kędra, A., & Czaprowski, D. (2015). Sedentary behaviours of 10-19-year-old students with and without spinal pain. *Problemy Higieny i Epidemiologii, 96*(1), 143-148.

Long M.W., Sobol A.M., Cradock A.L., Subramanian S.V., Blendon R.J., & Gortmaker S.L. (2013). School-day and overall physical activity among youth. *American Journal of Preventive Medicine, 45*(2), 150-157. doi: 10.1016/j.amepre.2013.03.011

Mayorga-Vega, D., Martínez-Baena, A., & Viciana, J. (2018). Does school physical education really contribute to accelerometer-measured daily physical activity and non-sedentary behaviour in high school students? *Journal of Sports Sciences, 36*(17), 1913-1922. doi: 10.1080/02640414.2018.1425967

Mooses, K., Pihu, M., Riso, E. M., Hannus, A., Kaasik, P., & Kull, M. (2017). Physical education increases daily moderate to vigorous physical activity and reduces sedentary time. *Journal of School Health, 87*(8), 602-607. doi: 10.1111/josh.12530

Myszkowska-Ryciak, J., Harton, A., Lange, E., Laskowski, W., Wawrzyniak, A., Hamulka, J., & Gajewska, D. (2020). Reduced screen time is associated with healthy dietary behaviors but not body weight status among Polish adolescents. Report from the Wise Nutrition—Healthy Generation Project. Nutrients, 12(5), 1323. doi: 10.3390/nu12051323

National Association for Sport and Physical Education (2004). *Moving into the Future: National Standards for Physical* Education 2nd Edition: McGraw-Hill Education.

Poulain, T., Vogel, M., Ludwig, J., Grafe, N., Körner, A., & Kiess, W. (2019). Reciprocal longitudinal associations between adolescents' media consumption and psychological health. *Academic Pediatrics, 19*(1), 109-117. doi: 10.1016/j.acap.2018.08.009

Prochaska, J. J., Sallis, J. F., & Long, B. (2001). A physical activity screening measure for use with adolescents in primary care. *Archives of Pediatrics & Adolescent Medicine, 155*(5), 554-559. doi: 10.1001/archpedi.155.5.554

Sandercock, G. R., Ogunleye, A., & Voss, C. (2012). Screen time and physical activity in youth: Thief of time or lifestyle choice? *Journal of Physical Activity and Health, 9*(7), 977-984. doi: 10.1123/jpah.9.7.977

Silva, D. A. S., Chaput, J. P., & Tremblay, M. S. (2019). Participation frequency in physical education classes and physical activity and sitting time in Brazilian adolescents. *PloS One, 14*(3), e0213785. doi: 10.1371/ journal.pone.0213785

Tadiotto, M. C., Corazza, P. R., Junior, F. J. M., de Moraes Junior, F. B., de Jesus, I. C., de Souza, A. L. K., ... & Leite, N. (2019). Higher screen time and lower physical activity in adolescent boys than in adolescent girls. *Journal of Exercise Physiology Online, 22*(4), 58-68.

Wojtyla-Buciora, P., Stawinska-Witoszynska, B., Wojtyla, K., Klimberg, A., Wojtyla, C., Wojtyla, A., ... & Marcinkowski, J. T. (2014). Assessing physical activity and sedentary lifestyle behaviours for children and adolescents living in a district of Poland. What are the key determinants for improving health? *Annals of Agricultural and Environmental Medicine, 21*(3), 606-612. doi: 10.5604/12321966.1120611

World Health Organization (2018). Factsheets on health-enhancing physical activity in the 28 EU Member States of the WHO European Region. Retrived 11/12, 2020, from www.euro.who.int/en/health-topics/disease-prevention/physical-activity/data-and-statistics/physical-activity-fact-sheets

Woynarowska, B., Mazur, J., & Oblacińska, A. (2015). Participation of students in physical education lessons in schools in Poland. *Hygeia Public Health, 50*(1), 183-190.

Wójcicki, T. R., & McAuley, E. (2014). II. Physical activity: Measurement and behavioral patterns in children and youth. *Monographs of the Society for Research in Child Development, 79*(4), 7-24. doi: 10.1111/mono.12128

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