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Amount and intensity of physical activity of a group of gymnasts

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Abstract

Introduction: Physical activity (PA) has many health benefits for children and adolescents and can contribute to adequate body mass, increase bone density, prevent as chronic noncommunicable diseases and improve cognitive skills. Accelerometers are valid and useful devices for assessing the intensity and volume of PA in children and adolescents. Therefore, accelerometry has become one of the most objective methods to measure PA in children and adolescents. The aim of our study was to investigate whether our sample of gymnasts achieved the daily recommendations of PA. We hypothesized that there would be differences in mean of moderate to vigorous physical activity (MVPA) between weekdays and weekends. We also hypothesized that our sample would be less sedentary than their peers, which has been found in several studies. *Methods:* Twenty-nine female gymnasts (Salto club) participated in our study, from which we obtained 25 useful data. The participants were aged between 8 and 16 years (12.26 ± 2.21 years; body height 152.08 ± 11.33; body mass 43.74 ± 8.69; BMI 18.70 ± 1.59). Participants were measured with an accelerometer (GT3X+, ActiGraph, USA) for 10 consecutive days between 3.10.2020 and 12.10.2020 (from Saturday to Monday). The variables obtained on the average amount and intensity of PA and sedentary time, were used for further analysis. *Results:* By analyzing the obtained results, we found that the participants achieved the daily recommendations of amount and intensity of PA during the week and at the weekend. On average, they participated in MVPA for 205.22 ± 62.19 minutes, which is equivalent to 3.42 ± 1.04 hours per day. They spent 156.62 ± 42.22 minutes at moderate intensity PA, while they spent 30.03 ± 15.35 minutes at vigorous PA. The dependent t-test showed that the participants spent statistically significantly more time in MVPA during the week than at weekends ($t(24) = 6.57$; $p < 0.001$). In addition, the sample of gymnasts tended to spend more than 9 hours per day in physical inactivity (sedentariness) during the week days and at the weekend, but the analysis did not show statistical significance (p = 0.07). *Discussion and conclusions:* The results of the present study show that the participants achieved daily recommendations for the amount and intensity of PA. In addition, sample of gymnasts tended to spend more than 9 hours sedentary, both during the week and at weekends. PA, especially gymnastics can help increase the recommended daily amount of PA and thus might reduce the consequences of a sedentarism.

Keywords: accelerometer ActiGraph GT3X+, children and adolescents, sedentarism

Introduction

Nowadays, children and adolescents are increasingly inactive due to modern lifestyle, that forces them to spend most of the day sedentary. At every turn, they use various technologies instead being physically active in their everyday, such as school time, homework and, unfortunately, leisure time. Physical activity (PA) has many health benefits for children and adolescents and can contribute to adequate body mass, increase bone density, prevent chronic non-communicable diseases and improve cognitive skills (Cooper et al., 2015; Duncan et al., 2018; Pfitzner et al., 2013).

WHO guidelines on PA and sedentary behavior (2020) suggest for children and adolescents (age 5–17 years) to be at least an average of 60 minutes per day of moderate- to vigorous-intensity (MVPA), mostly aerobic physical activity. Therefore, PA for children in adolescents should include at least 3 days a week as well as activities that strengthen muscles and bones. In addition, WHO recommends limiting the amount of time spent sedentary, especially in front of screens (e.g. TV, computers, video games etc.). Several studies have reported that most children and adolescents are not sufficiently active and that activity levels decrease with age in childhood (Chung et al., 2012; Cooper et al., 2015; Guthold et al., 2010; Nader et al., 2008). A study that examined PA of European children aged 2–11 years concluded that only 2–15 % of girls achieved the minimum MVPA recommendation (Konstabel et al., 2014a). Similarly, a study by Hallal et al. (2012) and Guthold et al. (2010), conducted on a sample of 13 to 15 year old youth, found that only 20 % (boys and girls) and 15.4 % (girls), respectively, met the 60-minute MVPA recommendation. Some studies that found that more than 95 % of 9-year-old and 82 % and 65 % of 15-year-old adolescents were sufficiently active, respectively, due to the use of age-specific intensity thresholds (Guthold et al., 2010).

Assessing PA of children and adolescents is key for monitoring their health status as well as to determining the effectiveness of exercise interventions (Duncan et al., 2020; Duncan et al., 2018). Within the last decades, researchers have begun to use different methods to assess adequate daily PA. As a results, accelerometry has become one of the most objective methods for measuring PA in children and adolescents (Borghese et al., 2017; Duncan et al., 2020; Freedson, Pober & Janz, 2005; Toftager et al., 2013). The devices are more reliable and valid methods for assessing the frequency, duration and intensity of PA in children and adolescents (Borghese et al., 2017; Duncan et al., 2020; Duncan et al., 2018; Toftager et al., 2013), instead of alternative methods such as self-reports (Duncan et al., 2020; Freedson et al., 2005; Huber et al., 2019).

Studies conducted on children and adolescents suggest different wearing duration for the accelerometer: a) at least 3 days (Cooper et al., 2015; Fairclough et al., 2012; Konstabel et al., 2014), b) some of them suggest at least 4 days (Hallal et al., 2012; Nader et al., 2008; Pfitzner, Gorzelniak, Heinrich, von Berg, et al., 2013), c) 5 days (Volmut et al., 2021) or even 7 days (Borghese et al., 2017; Chung, A. E., Cockrell Skinner, A., Steiner, M. J., Perrin, 2012; Fairclough et al., 2012; Guthold et al., 2010; Mâsse et al., 2005; McLellan et al., 2020; Nader et al., 2008; Pfitzner, Gorzelniak, Heinrich, von Berg, et al., 2013; Riddoch et al., 2007; Toftager et al., 2013) The duration of wearing the device during the day is also important to obtain valid data of PA and sedentary. Most studies conducted recommended at least 8 hours of valid recording time per day (Cooper et al., 2015; Konstabel et al., 2014) to avoid loss of data from participants who used minimum of 10 hours per day (Borghese et al., 2017; Fairclough et al., 2012; Hallal et al., 2012; McLellan et al., 2020; Pfitzner et al., 2013; Riddoch et al., 2007).

Despite the difference in waking wear time per day and wearing period (the number of days), some study used calculation only per weekday during specific period of the day (before school, during school, after school, early evening and evening) (Catellier et al., 2005; Fairclough et al., 2012; Konstabel et al., 2014a; McLellan et al., 2020), the other studies compare differences between weekday and weekend day (Borghese et al., 2017; Catellier et al., 2005; Konstabel et al., 2014; McLellan et al., 2020; Nader et al., 2008; Pfitzner et al., 2013; Toftager et al., 2013; Volmut et al., 2021).

The aim of our study was to investigate whether our sample of gymnasts achieves the daily recommendations of PA. We hypothesized that there would be differences in mean of MVPA between weekdays and weekends. We also hypothesized that our sample would be less more active and less sedentary than their peers, which has already been found in several studies.

Methods

Participants

The sample consisted of twenty-nine female gymnasts (Salto Club from the coastal region), from whom we obtained 25 useful data. The participants were aged between 8 and 16 years (12.26 ± 2.21 years; body height 152.08 ± 11.33; body weight 43.74 ± 8.69; BMI 18.70 ± 1.59). Prior to the experiment, we presented the study to the coaches and the parents or legal guardians of the participants. The parents or legal guardians of all participants gave written informed consent to participate in the study. The study was conducted in accordance with the Declaration of Helsinki and the experiment was approved by the National Medical Ethics Committee for Research on Children and Adolescents, obtained 23th of January 2018, (approval no: 0120-631/2017/2).

Study design

Participants were instructed by the researchers to wear an accelerometer (GT3X+, ActiGraph, USA) concurrently around their waist for 10 consecutive days between 3.10.2020 and 12.10.2020 (from Saturday to Monday). We instructed parents and gymnasts to put the device on immediately after waking up and asked them to remove the device only for aquatic activities, showering/bathing and sleeping. After the devices were returned, the data were downloaded in 30-s epoch lengths using ActiLife (Version 6.13.4; 2009-2015 ActiGraph LLC) and saved in raw format as GT3X files. Inclusion criteria for data validation were based on equal wearing time of participants putting the device on soon after waking up and to take off before going to bed. A compliant recording requires at least 10 hours of awake wear time per day, including at least 5 valid weekdays and at least 2 valid weekend days.

Statistical analysis

Statistical analysis was conducted with IBM SPSS Statistic 26 (IBM, New York, USA). We calculated descriptive statistics (mean value ± standard deviation, minimum and maximum value) for all descriptive parameters of the participants. The normality of the data distribution was checked with Shapiro-Wilk test. Differences between groups were assessed with the dependent-samples t-test. Hedges g effect sizes (ES) were calculated and interpreted as suggested suggestions by Rhea where: < 0.25 = trivial; 0.25-0.50 = small; 0.51-1.0 = moderate and > 1.0 = large (Rhea, 2004). The threshold for statistical significance was set at $p < 0.05$.

Results

From twenty-nine participants, we obtained 25 useful data from our sample. Descriptive statistic regarding participants are presented in Table 1.

Table 1: Descriptive statistic of participant`s parameters.

	Mean	*SD*	*Min*	*Max*
N (25)				
Age/years	12.26	2.21	8.11	16.40
BH/cm	152.08	11.33	127.00	171.00
BW/kg	43.74	8.69	24.40	57.00
BMI/kg m-2	18.70	1.59	14.90	22.30

SD–standard deviation; Min–minimum; Max–maximum; BH–body height; BW–body weight; BMI–body mass index

Table 2 presents descriptive statistic on participants` physical activity phenotypes.

Table 2: Descriptive statistic of PA phenotypes for 7 days.

	Mean	*SD*	*Min*	*Max*
N (25)				
Sedentary/min	608.14	75.93	480.95	759.17
Light/min	80.74	14.47	53.10	105.00
Moderate/min	156.62	22.40	120.55	207.90
Vigorous/min	30.03	8.17	14.67	50.33
Very V/min	18.57	10.97	5.57	49.98
MVPA/min	205.22	32.79	144.64	278.38
Overall PA/cpm	1316.50	387.39	683.21	2329.84

SD–standard deviation; Min–minimum; Max–maximum; V–vigorous; PA–physical activity; MVPA–moderate to vigorous PA

Table 3 summarises the differences between the recommendations on PA and sedentary behaviour between weekdays and weekend days. The dependent t-test showed that participants spent statistically significantly more time in MVPA during the week than on weekends ($p < 0.001$; ES = 1.06), but the differences in sedentary time were not statistically significant (ES = 0.35).

Table 3: Differences between week and weekends in MVPA and sedentary.

	Week		*Weekends*			
Outcomes	*Mean*	*SD*	*Mean*	*SD*	*p*	*ES*
N (25)						
MVPA/min	217.49	27.59	172.11	52.87	0.000**	1.06
SED/min	613.95	82.57	584.51	84.91	0.065	0.35

*SD–standard deviation; ES–effect size (Hedges); MVPA–moderate to vigorous physical activity; SED–sedentary; * $p < 0.05$; ** $p < 0.001$*

Discussion

The purpose of the present study was to find out whether young gymnasts achieve the daily physical activity (PA) recommendation and how long they spend in the individual PA phenotype. We hypothesized that there would be differences in mean of moderate to vigorous physical activity (MVPA) between weekdays and weekends. We also hypothesized that our sample would be less sedentary than their peers, which has been found in several studies.

In addition, there are a few studies conducted on children and adolescents that have found differences between weekdays and weekends in MVPA and sedentary. According to our analysis, our participants spent an average of 217.49 minutes in MVPA on weekdays and 172.11 minutes on weekends, which is a statistically significant difference ($p < 0.001$). Trost et al. (2000) found significant differences between weekdays and weekend for girls. In the youngest age group, girls had significantly greater MVPA scores at weekend. In studies that looked at the different phenotypes of PA on weekdays and weekends, gender differences were found (McLellan et al., 2020; Pfitzner, Gorzelniak, Heinrich, von Berg, et al., 2013). Another survey by Pfitzner et al. (2013) did not detect statistically significant differences between weekdays and weekend days in boys and of borderline significance in girls. Another study have shown that MVPA decreases with age on both weekdays and weekend days (Nader et al., 2008). Unfortunately, due to the difference in downloaded and processed accelerometer data, we cannot compare our results with those of other studies that have found differences between weekdays and weekends. Different methods resulted from the different wearing period, ranging from 5 (Volmut et al., 2021) to 7 days (Borghese et al., 2017; Evenson et al., 2008; Konstabel et al., 2014; McLellan et al., 2020; Nader et al., 2008; Pfitzner et al., 2013; Toftager et al., 2013) and the varying compliant recording, ranging from at least 2 weekdays and 1 weekend day (Volmut et al., 2021), to 3 weekdays and at least 1 weekend day (Konstabel et al., 2014; McLellan et al., 2020), with some studies even recommending 5 weekdays and 2 weekend days (Nader et al., 2008; Toftager et al., 2013) of at least 10 hours of awake wearing time per day (Borghese et al., 2017; Konstabel et al., 2014; McLellan et al., 2020). In our study, we used 10 consecutive days of wearing with the required compliant recording as in the studies by Nader et al. (2008) and Toftager et al. (2013) and we used date of at least 10 hours. Second, in methodology, various studies refer to different data collection at a sampling rate of 30 Hz (Pfitzner, Gorzelniak, Heinrich, von Berg, et al., 2013) as we have used, or even of 80 Hz (Borghese et al., 2017; McLellan et al., 2020) and downloaded in different epoha lengths from 5-s (McLellan et al., 2020), to 30-s (Evenson et al., 2008; Toftager et al., 2013) or even 60-s (Borghese et al., 2017; Konstabel et al., 2014; Pfitzner et al., 2013; Volmut et al., 2021), which is the most commonly used epoch.

Our sample of gymnasts engage in training activities every day during the weekdays and also one day at the weekend (Saturday). Unfortunately, they still tend to spend more than 9 hours sedentary. The results regarding sedentary time showed no statistically significant differences between weekdays and weekend ($p = 0.065$). To our knowledge, some studies have obtained similar results showing that children and adolescents spend about 8 hours sedentary (Borghese et al., 2017; McLellan et al., 2020) or even 10 hours (Pfitzner, Gorzelniak, Heinrich, von Berg, et al., 2013), which increases with age (Cooper et al., 2015; Nader et al., 2008; Toftager et al., 2013). A study conducted on children and adolescents from different countries around the word found that children spend 3 or more hours sedentary, excluding time spent sitting at school and doing homework (Guthold et al., 2010).

Conclusions

Our findings suggest that gymnasts who are training almost every day (except on Sunday) were more physically active and achieve WHO` recommendation of PA and were less sedentary during weekdays in comparison with weekend days. Nevertheless, they sped more than 9 hours in sedentary, which is worrying. These observations highlight the importance of gymnastic training, which can help increase the recommended daily amount of PA while minimizing negative consequences of a sedentariness.

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