Does school physical education really contribute to accelerometer-measured daily physical activity and non sedentary behaviour in high school students?

Running title: Physical education and daily physical activity and sedentary behaviour

Daniel Mayorga-Vega[a]*, Alejandro Martínez-Baena[b] and Jesús Viciana[c]

[a] *Department of Physical Education and Sport, University of Granada, Granada, Spain*. Alfacar St., no number, 18011, Granada, Spain. Phone: (0034) 958 246 641. Email: dmayorgavega@gmail.com. ORCID: 0000-0002-4494-4113

[b] *Department of Physical Education and Sport, University of Valencia, Valencia, Spain*. Gascó Oliag St., number 3, 46010, Valencia, Spain. Phone: (0034) 963 864 339. Email: alejandro.martinez@uv.es. ORCID: 0000-0002-8692-8242

[c] *Department of Physical Education and Sport, University of Granada, Granada, Spain*. Alfacar St., no number, 18011, Granada, Spain. Phone: (0034) 958 246 641. Email: jviciana@ugr.es. ORCID: 0000-0002-5424-118X

* Corresponding author: Daniel Mayorga-Vega, Department of Physical Education and Sport, University of Granada, Alfacar St., no number, 18011, Granada, Spain. Phone: (0034) 958 246 641, Fax: (0034) 958 244 369, E-mail: dmayorgavega@gmail.com

Keywords: moderate-to-vigorous physical activity; objectively-measured physical activity; accelerometry; PE; adolescents.

Word count: 3,992

Does school physical education really contribute to accelerometer-measured daily physical activity and non sedentary behaviour in high school students?

Physical education has been highlighted as an important environment for physical activity promotion, however, to our knowledge there are no previous studies examining the contribution of physical education to daily accelerometer-measured physical activity and non sedentary behaviour. The purpose was to compare the accelerometer-measured physical activity and sedentary behaviour between physical education, non-physical education and weekend days in adolescents. Of the 394 students from a Spanish high school that were invited to participate, 158 students (83 boys and 75 girls) aged 13-16 years were analyzed (wear time ≥ 600 min). Participants' physical activity and sedentary behaviour were objectively-measured by GT3X+ accelerometers during physical education (one session), non-physical education and weekend days. Results indicated that overall adolescents had statistically significant greater physical activity levels and lower values of sedentary behaviour on physical education days than on non-physical education and weekend days (e.g., moderate-to-vigorous physical activity = 71, 54 and 57 min; sedentary = 710, 740 and 723 min) ($p < 0.05$). Physical education contributes significantly to reducing students' daily physical inactivity and sedentary behaviour. Increasing the number of physical education classes seems to be an effective strategy to reduce the high current prevalence of physical inactivity and sedentary behaviour in adolescence.

Keywords: moderate-to-vigorous physical activity; objectively-measured physical activity; accelerometry; PE; adolescents.

Introduction

Youth is a crucial period of life, since lifestyle is established during these years which may influence adult behaviour and health status (Longmuir, Colley, Wherley, & Tremblay, 2014). Engaging in regular physical activity (PA) is widely accepted as a key health issue in adolescents (Poitras et al., 2016). For instance, there is strong evidence that moderate-to-vigorous PA (MVPA) is favourably associated with adiposity, cardiometabolic biomarkers, physical fitness and bone health (Poitras et al., 2016). Recently, light and total PA has also been recognized as a potential marker of health among adolescents (Poitras et al., 2016), being the step output in gaining increased credibility as an indicator of daily total PA (Craig, Cameron, Griffiths, & Tudor-Locke, 2010). The World Health Organization (2014) recommends that adolescents should achieve daily at least 60 min of MVPA. Unfortunately, worldwide approximately 81% of adolescents do not meet the daily recommendation of MVPA (World Health Organization, 2014).

Sedentary behaviour (SB), defined as any waking behaviour that involves low levels of energy expenditure while in a sitting or reclining posture (Sedentary Behaviour Research Network, 2012), is also recognized as an important health risk factor (Carson et al., 2016). There is evidence showing that, independently of PA levels, among young people a high amount of SB is associated with an increased risk of numerous negative health outcomes such as unfavourable body composition, cardiometabolic risk, physical fitness or self-esteem (Carson et al., 2016). Therefore, adolescents that spend large amounts of time being sedentary may increase the risk of some health outcomes, even those who meet the daily recommendation of MVPA levels. However, nowadays adolescents also spend a substantial proportion of the day in SB (Ruiz et al., 2011).

Currently an important health priority of the most developed countries is to reduce the proportion of adolescents physical inactive and with a high quantity of SB (Department of Health, Physical Activity, Health Improvement and Protection, 2011; World Health Organization, 2014). Although strategies to improve adolescents' healthy behaviours must be developed and implemented through multiple sectors (World Health Organization, 2014), schools have been considered as key environments (World Health Organization, 2008). Schools are encouraged to ensure that the majority of physical education (PE) class time is spent in PA, contributing significantly to the overall students' daily MVPA (Association for Physical Education, 2015; U.S. Department of Health and Human Services, 2010; World Health Organization, 2008). Unfortunately, in most countries the number of weekly PE classes is limited, especially during secondary education (Hardman, Murphy, Routen, & Tones, 2014).

The Theory of Expanded, Extended, and Enhanced Opportunities is an framework that describes different mechanisms for promoting youth's PA (Beets et al., 2016). Particularly, the second mechanism (i.e., extension) is defined as allocating additional time for an existing PA opportunity (Beets et al., 2016). For instance, this could be achieved by adding another opportunity of the same type such as providing additional PE lessons per week. To our knowledge, however, there are no previous studies examining whether there is a real contribution of PE to the daily accelerometer-measured PA and SB in adolescents. Some previous studies with primary schoolchildren found that students were physically more active on PE days than on non-PE school days (Alderman, Benham-Deal, Beighle, Erwin, & Olson, 2012; Brusseau, Kulinna, Tudor-Locke, van der Mars, & Darst, 2011; Dauenhauer & Keating, 2011; Gao, Wang, Lau, & Ransdell, 2015; Tudor-

Locke, Lee, Morgan, Beighle, & Pangrazi, 2006). However, besides the differences in the participants' age group, in these studies PA was measured by pedometers that simply measure the total PA (i.e., number of steps), but not PA intensity and, therefore, it cannot be known if children meet the daily recommendation of MVPA or not. Additionally, the previous authors neither studied the time that children spent in SB.

Consequently, the main purpose of the present study was to compare the accelerometer-measured PA and SB between PE, non-PE and weekend days in adolescents. Secondarily, the purposes of the present study were: (a) to compare the percentage of adolescents achieving the daily recommendation of PA between PE, non-PE and weekend days, and (b) to examine the contribution of PE to the adolescents' daily PA.

Methods

Participants

A sample of 394 adolescents, 211 boys and 183 girls, of a high school (i.e. 13-16 years old) were invited to participate. All the students belonged to the same public-private high school, which was situated in the urban area of the city of Granada (Spain). The inclusion criteria were: (a) being enrolled in the first to fourth grades of the secondary education level; (b) participating in the normal PE classes; (c) being free of any health disorder which will make them unable to undergo PA, and (d) presenting the corresponding signed consent by their parents or legal guardians. The exclusion criteria were: (a) not having the 100% of the PE session recorded; (c) not reaching the valid wear time on the PE day; (d) not having at least two of the three non-PE days with the valid wear time, and (c) not having at least one of the two weekend days with the valid wear time.

Instruments

Physical activity and sedentary behaviour. Participants' PA and SB were objectively-measured by GT3X+ accelerometers (ActiGraph, LLC, Pensacola, FL, USA). The GT3X+ accelerometer is a compact (4.6 x 3.3 x 1.5 cm), lightweight (19 g), and triaxial monitor designed to record time varying accelerations. Data were downloaded and analyzed using the *ActiLife Lifestyle Monitoring System Software* version 6.9.2. To avoid biases because of reactivity, the first day with the data obtained was considered as a familiarization day and it was not used for statistical analyses (Dössegger et al., 2014; Shephard & Tudor-Locke, 2016); and the PE day was monitored at least two days after the familiarization session. Since young people's behaviour patterns are characterized by short bursts of rapidly changing activity, a one-second *epoch* was used (Cain, Sallis, Conway, Van Dyck, & Calhoon, 2013). A minimum wear time of 600 min per day was set (Migueles et al., 2017). Non-wear periods were set with a minimum length of 60 min of consecutive zero-count *epochs* with up to two minutes spike tolerance (Oliver, Badland, Schofield, & Shepherd, 2011). To determine the percentage of time engaged in sedentary (i.e., 0-100 *counts*/ min), light (i.e., 101-2,295 *counts*/ min) and MVPA (i.e., ≥ 2,296 *counts*/ min) Evenson's cut-off points were used (Evenson, Catellier, Gill, Ondrak, & McMurray, 2008). According to the cross-validation study performed by Trost, Loprinzi, Moore, and Pfeiffer (2011), these cut-off points have been found to be the most valid for estimating PA intensity with one-second *epochs* among children and adolescents. Sedentary behaviour variables were calculated with a minimum length of 10 min and counts levels of ≤ 100 (Treuth et al., 2004; Trost et al., 2011). Steps were assessed by within-instrument processing of the number of cycles in the accelerometer signal or *cycle counts* (Tudor-Locke, Ainsworth, Thompson, & Matthews, 2002). ActiGraph accelerometer-measured PA and SB has shown a high reliability and validity among adolescents (e.g., sedentary, ROC-AUC = 0.90, Se = 1.00, Sp = 0.79; MVPA, ROC-AUC = 0.90, Se = 0.88, Sp = 0.92) (Santos-Lozano et al., 2013; Trost et al., 2011).

Anthropometric. Participants' body mass and height were first measured and then the body mass index was calculated as body mass divided by body height squared (kg/m^2). Participants' body mass and height were measured in shorts, T-shirts, and barefoot. For the body mass measure, the adolescent stood in the centre of the scale (Seca, Ltd., Hamburg, Germany; accuracy = 0.1 kg) without support and with the weight distributed evenly on both feet. For the body height assessment, participants stood with the feet together with the heels, buttocks and upper part of the back touching the stadiometer (Holtain Ltd., Crymmych, Pembs, United Kingdom; accuracy = 0.1 cm), and with the head placed in the Frankfort plane. Two measurements of both body mass and height were performed and then the average of each was calculated (International Society for the Advancement of Kinanthropometry, 2001).

Procedure

The research protocol was first approved by the Ethical Committee of the University of Granada. The principal and the PE teacher of a high school centre chosen by convenience were contacted. They were informed about the project and the permission to conduct the study was requested. After the approval of the school was obtained, students and their legal guardians were fully informed about all the features of the study, and written informed consent was obtained from all the participants' legal guardians to take part in the study. Data collection was done during the months of March to June of 2014.

The accelerometers were fitted on the right hip by using an elastic waistband. Participants were instructed to wear the accelerometer for seven consecutive days. Participants were asked to wear the accelerometer from waking to bedtime and to take the accelerometer off only when engaged in aquatic activities or taking a shower. Adolescents were urged to maintain their normal PA habits. The monitored PE session was standardized for all the students following the program designed by the teacher, who was also urged to follow his normal teaching habits. Table 1 shows a scheme of the monitored PE session. Of the 60 minutes of classroom timetable, the PE session had an available learning time of approximately 50 minutes and consisted of about 10-minute warm-up, 35-minute main part, and 5-minute cool-down. During the main part of the session, students performed introduction exercises of technical and tactical skill development in basketball. During a PE class time of the next week, anthropometric measurements were taken in an ordinary classroom. Participants' gender and age were taken from the school reports.

Table 1 near here

Statistical analyses

Descriptive statistics of the studied participants were calculated. The chi-squared analysis was carried out to test the ratio differences of gender between analyzed and excluded participants. One-way analyses of variance (ANOVA) were conducted to examine potential differences between analyzed boys and girls and between analyzed and excluded participants in terms of body mass, body height and body mass index. Then, the repeated measures ANOVA was used to examine the differences on PA levels between PE, non-PE and weekend days. Subsequently, the *post-hoc* with the Bonferroni adjustment was used for pairwise comparisons. PA's effect sizes were estimated using the partial eta squared (η^2_p) and Cohen's *d* for the overall and pairwise comparisons, respectively (Field, 2013). Afterward, the Cochran Q test was used to compare the percentage of students that achieved the daily recommendations of PA, and the *post-hoc* with the McNemar test was used for pairwise comparisons. Previously, MVPA and steps variables were dichotomized in meeting or not meeting the daily PA recommendations: 60 min of MVPA (World Health Organization, 2010) and 10,000 steps (Parra Saldías, Mayorga-Vega, & Viciana, 2018; Tudor-Locke et al., 2011). Finally, since most of the SB variables did not follow a normal distribution, the Friedman test, followed by the Wilcoxon test for the pairwise comparisons, was used. SB's effect sizes were estimated using the Kendall's W (*W*) and *r* for the overall and pairwise comparisons, respectively (Field, 2013). To avoid potential bias due to differences in the length of total time of valid wear time, time-based standardized scores were used (except for the Cochrane Q analyses due to the nature of the purpose). All statistical analyses were performed using the SPSS Version 21.0 for Windows (IBM® SPSS® Statistics). The statistical significance level was set at $p < 0.05$, except for the pairwise comparisons with the McNemar and Wilcoxon tests that were set at $p < 0.017$.

Results

General characteristics

Of the 394 students (211 boys and 183 girls) who were invited to participate in the present study, 345 students (190 boys and 155 girls) agreed to participate and met the inclusion criteria. Of these students, further 187 participants (107 boys and 80 girls) were eliminated due to meeting one or more of the exclusion criteria, leaving 158 students in the final sample (83 boys and 75 girls) (i.e., a non-compliance rate of 54.2%). The chi-square analyses showed that the analyzed and excluded participants had a balanced representation of boys and girls ($p > 0.05$). Additionally, the one-way ANOVA results did not show statistically significant differences in terms of body mass, body height and body mass index between the analyzed and excluded participants ($p > 0.05$).

Table 2 shows the general characteristics of the analyzed participants. The one-way ANOVA results showed that boys were statistically significantly heavier and taller than girls ($p < 0.05$). However, statistically significant differences in terms of body mass index between boys and girls were not found ($p > 0.05$).

Table 2 near here

Physical activity

Table 3 shows descriptive statistics and repeated measures ANOVA results for the comparison of accelerometer-measured PA between PE, non-PE and weekend days. The repeated measures ANOVA results indicated statistically significant differences in the average of all the PA variables between PE, non-PE and weekend days ($p \leq 0.001$). Then, the *post-hoc* pairwise comparisons with the Bonferroni adjustment showed statistically significant higher values of MVPA, vertical axis, vector magnitude and steps on PE days than on non-PE (d = 0.82-

1.31) and weekend days (d = 0.53-1.05) ($p < 0.05$). On the other hand, the *post-hoc* pairwise comparisons showed statistically significant lower values of vector magnitude on non-PE days than on weekend days for the whole sample and boys and girls separately [d = -0.67-(-0.53)] ($p < 0.05$), as well as in the vertical axis for the whole sample (d = -0.32) ($p < 0.05$). Regarding the light PA, the *post-hoc* pairwise comparisons showed statistically significant higher values on PE (d = 0.35-0.98) and weekend days (d = 0.40-1.04) than on non-PE days ($p < 0.01$). For the rest of pairwise comparisons statistically significant differences were not found ($p > 0.05$).

Table 3 near here

Figure 1 represents the comparison of the percentage of students that achieved the daily recommendation of 60 min of MVPA and 10,000 steps between PE, non-PE and weekend days. The Cochran Q test results indicated statistically significant differences in the percentage of students that achieved the daily recommendation of 60 min of MVPA and 10,000 steps between PE, non-PE and weekend days ($p < 0.001$). Then, the *post-hoc* pairwise comparisons with the McNemar test showed a statistically significant higher percentage of students that achieved the daily recommendation of 60 min of MVPA and 10,000 steps on PE days than on non-PE ($\Delta\%$ = 24.0-28.0) and weekend days ($\Delta\%$ = 27.7-30.7) ($p < 0.01$). However, statistically significant differences between the non-PE and weekend days were not found ($p > 0.017$).

Figure 1 near here

Figure 2 illustrates the contribution of PE to the daily recommendation of 60 min of MVPA and 10,000 steps, and to the total daily MVPA and steps. PE sessions contributed about the 24.9-32.6% of the recommended PA levels and about the 22.7-23.6% of the total daily PA. On average (± standard deviation), of the 71.0 min (boys 78.7 min and girls 62.5 min) that adolescents were engaged in MVPA during the whole PE day, 17.4 ± 7.7 min (boys 19.6 ± 8.1 min and girls 14.9 ± 6.4 min) were during the PE session (overall 34.8 ± 15.3%, boys 39.2 ± 16.2%, and girls 29.9 ± 12.8%). Adolescents were engaged in MVPA for 54.0 min (boys 62.2 min and girls 45.0 min) and 56.5 min (boys 65.5 min and girls 46.6 min) on the non-PE and weekend days, respectively. On the other hand, of the 11,036.1 steps (boys 11,868.3 steps and girls 10,110.9 steps) that adolescents performed during the whole PE day, 2,737.9 steps (boys 2,942.2 steps and girls 2,511.8 steps) were in the PE session. Adolescents performed 8,478.5 (boys 9,339.1 steps and girls 7,530.3 steps) and 8,816.6 steps (boys 9,620.6 steps and girls 7,927.5 steps) on the non-PE and weekend days, respectively.

Figure 2 near here

Sedentary behaviour

Table 4 shows descriptive statistics and Friedman test results for the comparison of accelerometer-measured SB between PE, non-PE and weekend days. The Friedman test results indicated statistically significant differences in all the SB variables between PE, non-PE and weekend days (except for the number and total time in sedentary bouts in boys) ($p \leq 0.001$). Then, the *post-hoc* pairwise comparisons with the Wilcoxon test showed statistically significantly lower values of sedentary time, number of sedentary bouts and total time in sedentary bouts on PE days than on non-PE days in the whole sample and girls only [r = -0.47-(-0.17)] ($p < 0.01$), and statistically significant lower sedentary time in boys (r = -0.33) ($p < 0.001$). Additionally, the *post-hoc* pairwise comparisons showed statistically significant lower sedentary time and average time in sedentary bouts on PE days than on weekend days [r = -0.32-(-0.22)] ($p < 0.01$).

Table 4 near here

On the other hand, the *post-hoc* pairwise comparisons with the Wilcoxon test showed statistically significantly higher values of sedentary time, number of sedentary bouts and total time in sedentary bouts on non-PE days than on weekend days in the whole sample and girls only (r = 0.17-0.38) ($p < 0.01$), meanwhile statistically significant differences were not found in boys ($p > 0.017$). However, on non-PE days there was a statistically significant lower average time in sedentary bouts than on weekend days [r = -0.27-(-0.21)] ($p < 0.017$). For the rest of pairwise comparisons statistically significant differences were not found ($p > 0.017$).

On average, of the 709.5 min (boys 706.6 min and girls 712.8 min) that adolescents spent on sedentary time during the whole PE day, 27.2 min (boys 24.8 min and girls 29.7 min) were during the PE session. Adolescents spent 738.9 min (boys 732.7 min and girls 745.8 min) and 722.6 min (boys 717.7 min and girls 728.0 min) on the non-PE and weekend days, respectively. On the other hand, of the 79.0 min (boys 78.3 min and girls 79.7 min) that adolescents spent on total time in sedentary bouts during the whole PE day, 0.5 min (boys 0.5 min and girls 0.5 min) were during the PE session. Adolescents spent 93.9 min (boys 76.9 min and girls 112.6 min) and 72.7 min (boys 67.1 min and girls 78.9 min) on the non-PE and weekend days, respectively.

Discussion

The main purpose of the present study was to compare the accelerometer-measured PA and SB between PE, non-PE and weekend days in adolescents. The results of this study revealed that overall adolescents achieved higher values of PA on PE days than on non-PE and weekend days, and greater values of vector magnitude and vertical axis on weekend days than on non-PE days. According to the results of the present study, mostly previous studies also found that children were physically more active on PE days compared to non-PE days. Brusseau et al. (2011), Gao et al. (2015) and Tudor-Locke et al. (2006) compared the pedometer-measured daily total steps on PE and non-PE days in primary schoolchildren (children aged 8-11 years old from the United States, 10-11 years old from Hong Kong, and 11-12 years old from the United States, respectively). All but one comparisons children were statistically significantly more active on PE days than on non-PE days (boys-girls: 12,979 vs. 11,809 steps/ day, boys-girls: 9,930 vs. 9,016 steps/ day, and boys: 17,389 vs. 15,579 steps/ day, respectively). Exceptionally, Tudor-Locke et al. (2006) did not find statistically significant differences among girls between PE days (12,463 steps/ day) and non-PE days (12,408 steps/ day). Similarly to previous studies, Alderman et al. (2012) compared the pedometer-measured daily total steps on PE and non-PE days in a sample of fifth-sixth-grade primary schoolchildren from the United States according to their PA levels. These authors found that the least, moderately and most active children were statistically significantly more active on PE days than on non-PE days.

On the other hand, Dauenhauer and Keating (2011) compared the pedometer-measured daily total steps on 30 min-PE, 60 min-PE and non-PE days in Hispanics and African American third-to-fifth-grade (8-11 years) primary schoolchildren. These authors also found that children were statistically significantly more active on 60 min-PE days (7,979 steps/ day) than on non-PE days (6,816 steps/ day). However, they observed that there were no statistically significant differences in children's total steps between 30-min PE (6,957 steps/ day) and non-PE days. The lack of PA differences between these days clearly could be explained due to the short PE class, especially if we notice that the academic learning time in PE is often significantly lower than the whole classroom timetable (Viciana, Lozano, Cocca, & Mayorga, 2012). Additionally, although interventions designed to increase MVPA in PE lessons are shown to be effective (Lonsdale et al., 2013), most previous studies reveal that in secondary school standard PE classes the recommendation of engaging at least the 50% of class time in MVPA levels is not commonly achieved (Fairclough & Stratton, 2005; Hollis et al., 2017). As regards the effect sizes, in the previous studies were found a lower magnitude in primary schoolchildren (*d* = 0.32-0.66) than in the present study with the secondary students (*d* = 0.95; Δ = 2557.6 steps).

In the five previous studies, besides the differences in participants' age group, it should also be noticed that PA was measured by pedometers instead of accelerometry, like in the present study. Pedometers present some limitations compared to accelerometers (Baumgartner, Jackson, Mahar, & Rowe, 2015). For instance, pedometers can only measure total PA, but they cannot provide specific information regarding PA intensity. Therefore, in the previous studies the children's PA levels such as MVPA could not be compared. Since sensor motions need to be put on every day (e.g., after waking up in the morning), inadequate compliance (i.e., non-wear periods) can adversely affect data collection. For example, children may forget to put on the motion sensor or decide against wearing it. Although this fact can be identified by the accelerometer used in the present study, pedometers do not record this information. Therefore, these previous studies were not able to find out whether participants wore the pedometer during the whole day, half day or just for some hours. For instance, although Brusseau et al. (2011) asked children every day to complete Previous Day's Activity Surveys to check the compliance with wearing the pedometer, this depends on the accuracy of children's reply. Also it should be noted that to know the daily total step counts pedometers must be manually reset every day and again children's forgetfulness or unwillingness to do it could affect data collection. On the other hand, asking participants every day to record their PA levels, it could do them more conscious and, therefore, participants could react by increasing their PA levels. All of these issues would clearly produce bias in PA data collection of the two previous studies.

Although previous studies comparing PE and/ or non-PE days with weekend days were not found, there is strong empirical evidence that children and adolescents are more active on weekdays than on weekend days (Brooke, Corder, Atkin, & van Sluijs, 2014). Brooke et al. (2014) performed a meta-analysis comparing the accelerometer-measured total (vertical axis) and MVPA levels between weekdays and weekend days in youth. These authors found that young people have a greater total and MVPA on weekdays than on weekend days [*d* (95 % confident interval): vertical axis, $d = 0.14$ (0.08-0.20), 31 counts/ min; and MVPA, $d = 0.42$ (0.35-0.49), 14 min/ day]. Although in the present study adolescents had considerably higher values of vertical axis during the PE days than the weekend days ($d = 0.65$, 81.1 counts/ min), during the non-PE days adolescents had lower values ($d = -0.32$, -40.66 counts/ min). Regarding the

MVPA, in the present study it was higher on PE days than on non-PE days (d = 0.86; Δ = 17 min) and weekend days (d = 0.73; Δ = 14.5 min), while between non-PE and weekend days differences were not found.

Although these differences could appear relatively small, for instance, the PE contribution of 15-17 min of MVPA equates to about 25% of adolescents' daily recommendation (World Health Organization, 2014). Also noting that meanwhile differences between the non-PE and weekend days were not found, the percentage of students achieving the daily PA recommendations was considerably higher on PE days than on non-PE (Δ% = 24.0-28.9) and weekend days (Δ% = 25.3-30.79). Therefore, according to the results of the present study and the preceding evidence (Brusseau et al., 2011; Dauenhauer & Keating, 2011), it must be highlighted that PE has a positive contribution on young people's daily PA levels. Consequently, as important international institutions such as World Health Organization (2008) and UNESCO (Hardman et al., 2014) have pointed out, to reduce the high current prevalence of children and adolescents physically inactive (Guinhouyaa, Samoudab, & de Beaufortc, 2013), policy-makers are strongly encouraged to increase the number of school PE classes.

As regards the results separated by genders, although both boys and girls showed the same trend, because of the higher effect sizes among girls it seems they benefit more from the daily PA contribution of PE than boys (PE days compared to non-PE days, Δd = 0.29-0.63; PE days compared to weekend days, Δd = 0.00-0.37). Previous related literature shows mixed outcomes. Meanwhile Dauenhauer and Keating (2011) found out that girls had higher effect sizes than boys when the total steps on 60-min PE days were compared with the non-PE days (d = 0.81 and 0.58, respectively; i.e., Δd = 0.23), Brusseau et al. (2011) and

Tudor-Locke et al. (2006) observed the contrary finding (girls, *d* = 0.36; boys, *d* = 0.46, i.e., Δ*d* = -0.10; girls, *d* = 0.02; boys, *d* = 0.32, i.e., Δ*d* = -0.30).

Regarding the SB, the results of the present study indicated that overall adolescents had lower values of sedentary time, number and total time in sedentary bouts on PE days than on non-PE days. Also adolescents showed lower values of sedentary time and average time in sedentary bouts on PE days than on weekend days. However, meanwhile adolescents had higher values of sedentary time, number and total time in sedentary bouts on non-PE days than on weekend days, they showed a lower average time in sedentary bouts on non-PE days than on weekend days. It also seems girls benefited more from the daily contribution of PE than boys [PE days compared to non-PE days, Δ*d* = -0.45-(-0.14); PE days compared to weekend days, Δ*d* = -0.09-(-0.02)]. Despite of the fact that in school days the predominant requirement to be seated during class time would push students to have a greater SB than on weekend days (Brooke et al., 2014), PE seems to contribute significantly to inverting this trend. Thus, besides some recommendations such as limiting recreational screen time, encouraging leisure-time PA or promoting active transport, daily PE should be established during school days.

Brusseau et al. (2011), Dauenhauer and Keating (2011), Gao et al. (2015), Tudor-Locke et al. (2006) and Alderman et al. (2012) did not compare the time that children spent in SB between PE and non-PE days, as well as any other related study was found. However, Yli-Piipari et al. (2016) compared the accelerometer-measured school-time PA levels on PE and non-PE days in a sample of first-to-third-grade primary schoolchildren from the United States and Finland. Similarly to the present study, besides the higher students' MVPA levels on PE days, these authors also found that schoolchildren were statistically significantly less sedentary during the school time on PE days than on non-PE days. On the other hand, the findings about the comparison of young people's SB between weekdays and weekend days are inconclusive. Meanwhile some studies found that young people spend significantly more time in sedentary during weekdays compared with weekend days (Nilsson et al., 2009; Uvacsek, Tóth, & Ridgers, 2011), other studies observed that children accumulate less time in sedentary on weekdays compared to weekend days (Stone, Rowlands, & Eston, 2009) or even that there were no differences (Sirard, Kubik, Fulkerson, & Arcan, 2008). These divergent findings could be due to lack of control of PE or non-PE days, so when most of the weekdays were recorded on PE days the findings could be favourable to weekdays and vice versa. On the other hand, since previous studies compared the absolute time spent in sedentary intensity instead of expressing it relatively to the total wear time (except Sirard et al., 2008), a difference in total valid wear time between weekdays and weekend days as some studies reported (Nilsson et al., 2009; Uvacsek et al., 2011) would drastically bias the results. Finally, mentioned that strictly speaking previous studies compared the sedentary time (i.e., time spent in a low number of counts per min regardless the participants' position), but not the SB (i.e., time spent in a low number of counts per min while in a sitting or reclining posture; see Sedentary Behaviour Research Network, 2012).

The main strength of the present study was accelerometer-measured daily PA and SB. Unlike the self-report instruments (Sternfeld & Goldman-Rosas, 2012), ActiGraph accelerometers have shown to be highly reliable and valid monitors for assessing PA and SB among adolescents (Santos-Lozano et al., 2013;

Trost, Loprinzi, Moore, & Pfeiffer, 2011). However, the present study has some limitations that should be also acknowledged. The first limitation was related to the relatively small sample used. Examining the adolescents' PA and SB with small samples provides a lower generalization power than large-sized studies. Additionally, the current study was focused on a single school with particular characteristics of being allocated in the city centre and situated in a middle-high socioeconomic neighbourhood. This will limit the generalization of the obtained outcomes to the particular studied population and context. Secondly, the high non-compliance rate has been acknowledged as one of the most important methodological limitations with accelerometry (Howie & Straker, 2016). Howie and Straker (2016) found that in previous studies of accelerometer-measured habitual PA among children and adolescents, on average, the non-compliance rate was 23%, but previous studies have reached up to 68%. Therefore, although the non-compliance rate of the present study could seem to be high, it is common in this kind of study. Additionally, since the exploratory analyses showed that the analyzed and excluded participants did not differ in their general characteristics, the non-compliance rate did not bias the findings of the present study. On the other hand, although different strategies to promote compliance such as asking participants to complete an activity monitoring log, making reminder calls/ SMS messages or providing participants with tips could be effective (Trost, McIver, & Pate, 2005), participants would also be more aware of the monitoring and, thus, react by increasing their PA levels (Shephard & Tudor-Locke, 2016). Finally, another limitation of the present study was the fact that accelerometers had to be taken off when participants engaged in aquatic activities such as swimming, which would bias the outcomes.

Conclusions

PE contributes significantly to reducing adolescents' daily physical inactivity and SB. Adolescents had a greater daily PA levels, higher compliance of the PA recommendations and lower SB on PE days than on non-PE and weekend days. Although both boys and girls showed the same trend, girls seem to benefit more from the contribution of PE. Therefore, increasing the number of school PE classes seems to be a good cost-effective strategy to reduce the high current prevalence of physical inactivity and SB in adolescence. Complementarily or even when increasing the number of school PE classes is not feasible, applying additional PA opportunities such as substituting seatwork with active learning or increasing portable equipment options during the school recess, could also help to reduce the prevalence of physical inactivity and SB in adolescence.

Acknowledgments

Authors thank Anna Szczesniak for the English revision.

Funding

This work was supported by the Research Own Plan of the Vice President of Research and Transfer of the University of Granada.

Disclosure statement

The authors report no conflicts of interest.

References

Alderman, B., Benham-Deal, T., Beighle, A., Erwin, H., & Olson, R. (2012). Physical education's contribution to daily physical activity among middle school youth. *Pediatric Exercise Science*, *24*(4), 634–648.

Association for Physical Education. (2015). *Health Position Paper*. United Kingdom.

Baumgartner, T., Jackson, A., Mahar, M., & Rowe, D. (2015). *Measurement for evaluation in kinesiology* (9th ed.). Burlington, USA: Jones and Bartlett Learning.

Beets, M., Okely, A., Weaver, R., Webster, C., Lubans, D., Brusseau, T., … Cliff, D. (2016). The theory of expanded, extended, and enhanced opportunities for youth physical activity promotion. *International Journal of Behavioral Nutrition and Physical Activity*, *13*, 120. doi: 10.1186/s12966-016-0442-2

Brooke, H., Corder, K., Atkin, A., & van Sluijs, E. (2014). A systematic literature review with meta-analyses of within- and between-day differences in objectively measured physical activity in school-aged children. *Sports Medicine*, *44*(10), 1427–1438. doi: 10.1007/s40279-014-0215-5

Brusseau, T. A., Kulinna, P. H., Tudor-Locke, C., van der Mars, H., & Darst, P. W. (2011). Children's step counts on weekend, physical education, and non-physical education days. *Journal of Human Kinetics*, *27*, 123–134. doi: 10.2478/v10078-011-0010-4

Cain, K. L., Sallis, J. F., Conway, T. L., Van Dyck, D., & Calhoon, L. (2013). Using accelerometers in youth physical activity studies: A review of methods. *Journal of Physical Activity & Health*, *10*, 437–450.

Carson, V., Hunter, S., Kuzik, N., Gray, C., Poitras, V., Chaput, J., … Tremblay, M. (2016). Systematic review of sedentary behaviour and health indicators in school-aged children and youth: An update. *Applied Physiology, Nutrition, and Metabolism*, *41*(6), S240-265. doi: 10.1139/apnm-2015-0630

Craig, C., Cameron, C., Griffiths, J., & Tudor-Locke, C. (2010). Descriptive epidemiology of youth pedometer-determined physical activity: CANPLAY. *Medicine and Science in Sports and Exercise*, *42*(9), 1639–1643. doi: 10.1249/MSS.0b013e3181d58a92

Dauenhauer, B., & Keating, X. (2011). The influence of physical education on physical activity levels of urban elementary students. *Research Quarterly for Exercise and Sport*, *82*(3), 512–520. doi: 10.1080/02701367.2011.10599784

Department of Health, Physical Activity, Health Improvement and Protection. (2011). *Start Active, Stay Active: A report on physical activity from the four home countries' Chief Medical Officers*. United Kingdom.

Dössegger, A., Ruch, N., Jimmy, G., Braun-Fahrländer, C., Mäder, U., Hänggi, J., … Bringolf-Isler, B. (2014). Reactivity to accelerometer measurement of children and adolescents. *Medicine and Science in Sports and Exercise*, *46*(6), 1140–1146. doi: 10.1249/MSS.0000000000000215

Evenson, K. R., Catellier, D. J., Gill, K., Ondrak, K. S., & McMurray, R. G. (2008). Calibration of two objective measures of physical activity for children. *Journal of Sports Sciences*, *26*(14), 1557–1565.

Fairclough, S., & Stratton, G. (2005). Physical activity levels in middle and high school physical education: A review. *Pediatric Exercise Science*, *17*(3), 217–236.

Field, A. (2013). *Discovering statistics using IBM SPSS Statistics* (4th ed.). London: SAGE Publications.

Gao, Y., Wang, J., Lau, P., & Ransdell, L. (2015). Pedometer-determined physical activity patterns in a segmented school day among Hong Kong primary school children. *Journal of Exercise Science & Fitness*, *13*(1), 42–48. doi: 10.1016/j.jesf.2015.03.002

Guinhouyaa, B., Samoudab, H., & de Beaufortc, C. (2013). Level of physical activity among children and adolescents in Europe: A review of physical activity assessed objectively by accelerometry. *Public Health*, *127*(4), 301–311. doi: 10.1016/j.puhe.2013.01.020

Hardman, K., Murphy, C., Routen, A., & Tones, S. (2014). *UNESCO-NWCPEA: World-wide survey of school physical education*. Paris.

Hollis, J., Sutherland, R., Williams, A., Campbell, E., Nathan, N., Wolfenden, L., … Wiggers, J. (2017). A systematic review and meta-analysis of moderate-to-vigorous physical activity levels in secondary school physical education lessons. *International Journal of Behavioral Nutrition and Physical Activity*, *14*(1), 52. doi: 10.1186/s12966-017-0504-0

Howie, E., & Straker, L. (2016). Rates of attrition, non-compliance and missingness in randomized controlled trials of child physical activity interventions using accelerometers: A brief methodological review. *Journal of Science and Medicine in Sport*, *19*(10), 830–836. doi: 10.1016/j.jsams.2015.12.520

International Society for the Advancement of Kinanthropometry. (2001). *International Standards for Anthropometric Assessment*. Underdale:

International Society for the Advancement of Kinanthropometry.

Longmuir, P., Colley, R., Wherley, V., & Tremblay, M. (2014). Risks and benefits of childhood physical activity. *Lancet. Diabetes and Endocrinology*, *2*(11), 861–862. doi: 10.1016/S2213-8587(14)70221-9

Lonsdale, C., Rosenkranz, R. R., Peralta, L. R., Bennie, A., Fahey, P., & Lubans, D. R. (2013). A systematic review and meta-analysis of interventions designed to increase moderate-to-vigorous physical activity in school physical education lessons. *Preventive Medicine*, *56*(2), 152–161. doi: 10.1016/j.ypmed.2012.12.004

Migueles, J., Cadenas-Sanchez, C., Ekelund, U., Delisle Nyström, C., Mora-Gonzalez, J., Löf, M., … Ortega, F. (2017). Accelerometer data collection and processing criteria to assess physical activity and other outcomes: A systematic review and practical considerations. *Sports Med*. doi: 10.1007/s40279-017-0716-0

Nilsson, A., Anderssen, S., Andersen, L., Froberg, K., Riddoch, C., Sardinha, L., & Ekelund, U. (2009). Between- and within-day variability in physical activity and inactivity in 9- and 15-year-old European children. *Scandinavian Journal of Medicine and Science in Sports.*, *19*(1), 10–18. doi: 10.1111/j.1600-0838.2007.00762.x

Oliver, M., Badland, H. M., Schofield, G. M., & Shepherd, J. (2011). Identification of accelerometer nonwear time and sedentary behavior. *Research Quarterly for Exercise and Sport*, *82*(4), 779–783.

Parra Saldías, M., Mayorga-Vega, D., & Viciana, J. (2018). How many daily steps are really enough for adolescents? A cross-validation study. *Retos*, *33*, 241–

246.

Poitras, V., Gray, C., Borghese, M., Carson, V., Chaput, J., Janssen, I., … Tremblay, M. (2016). Systematic review of the relationships between objectively measured physical activity and health indicators in school-aged children and youth. *Applied Physiology, Nutrition, and Metabolism*, *41*(6), S197-239. doi: 10.1139/apnm-2015-0663

Ruiz, J., Ortega, F., Martínez-Gómez, D., Labayen, I., Moreno, L., De Bourdeaudhuij, I., … Sjöström, M. (2011). Objectively measured physical activity and sedentary time in European adolescents: The HELENA study. *American Journal of Epidemiology*, *174*(2), 173–184. doi: 10.1093/aje/kwr068

Santos-Lozano, A., Santin-Medeiros, F., Cardon, G., Torres-Luque, G., Bailon, R., Bergmeir, C., … Garatachea, N. (2013). Actigraph GT3X: Validation and determination of physical activity intensity cut points. *International Journal of Sports Medicine*, *34*(11), 975–982. doi: 10.1055/s-0033-1337945

Sedentary Behaviour Research Network. (2012). Letter to the editor: Standardized use of the terms “sedentary” and “sedentary behaviours.” *Applied Physiology, Nutrition, and Metabolism*, *37*(3), 540–542. doi: 10.1139/h2012-024

Shephard, R., & Tudor-Locke, C. (Eds.). (2016). *The objective monitoring of physical activity: Contributions of accelerometry to epidemiology, exercise science and rehabilitation*. Switzerland: Springer.

Sirard, J., Kubik, M., Fulkerson, J., & Arcan, C. (2008). Objectively measured physical activity in urban alternative high school students. *Medicine and*

Science in Sports and Exercise, *40*(12), 2088–2095. doi: 10.1249/MSS.0b013e318182092b

Sternfeld, B., & Goldman-Rosas, L. (2012). A systematic approach to selecting an appropriate measure of self-reported physical activity or sedentary behavior. *Journal of Physical Activity & Health*, *9*(S1), S19-28.

Stone, M., Rowlands, A., & Eston, R. (2009). Characteristics of the activity pattern in normal weight and overweight boys. *Preventive Medicine*, *49*(2–3), 205–208. doi: 10.1016/j.ypmed.2009.06.012

Treuth, M. S., Schmitz, K., Catellier, D. J., McMurray, R. G., Murray, D. M., Almeida, M. J., … Pate, R. (2004). Defining accelerometer thresholds for activity intensities in adolescent girls. *Medicine and Science in Sports and Exercise*, *36*(7), 1259–1266.

Trost, S. G., Loprinzi, P. D., Moore, R., & Pfeiffer, K. A. (2011). Comparison of accelerometer cut points for predicting activity intensity in youth. *Medicine and Science in Sports and Exercise*, *43*(7), 1360–1368. doi: 10.1249/MSS.0b013e318206476e

Trost, S., McIver, K., & Pate, R. (2005). Conducting accelerometer-based activity assessments in field-based research. *Medicine and Science in Sports and Exercise*, *37*(11), S531-543.

Tudor-Locke, C., Ainsworth, B., Thompson, R., & Matthews, C. (2002). Comparison of pedometer and accelerometer measures of free-living physical activity. *Medicine and Science in Sports and Exercise*, *34*(12), 2045–2051.

Tudor-Locke, C., Craig, C., Beets, M., Belton, S., Cardon, G., Duncan, S., … Blair, S. (2011). How many steps/day are enough? for children and adolescents. *International Journal of Behavioral Nutrition and Physical Activity, 8,* 78. doi: 10.1186/1479-5868-8-78

Tudor-Locke, C., Lee, S., Morgan, C., Beighle, A., & Pangrazi, R. (2006). Children's pedometer-determined physical activity during the segmented school day. *Medicine and Science in Sports and Exercise*, *38*(10), 1732–1738.

U.S. Department of Health and Human Services. (2010). *Strategies to improve the quality of physical education*. United States of America.

Uvacsek, M., Tóth, M., & Ridgers, N. (2011). Examining physical activity and inactivity in 9-12 years old children. *Acta Physiologica Hungarica*, *98*(3), 313–320. doi: 10.1556/APhysiol.98.2011.3.8

Viciana, J., Lozano, L., Cocca, A., & Mayorga, D. (2012). Influence of the organizational system on motor engagement time in physical education on high school students. *Procedia Social and Behavioral Sciences*, *69*, 1160–1167. doi: 10.1016/j.sbspro.2012.12.046

World Health Organization. (2008). *School policy framework: Implementation of the WHO global strategy on diet, physical activity and health*. Geneva.

World Health Organization. (2010). *Global recommendations on physical activity for health*. Switzerland: World Health Organization.

World Health Organization. (2014). *Global status report on noncommunicable diseases 2014*. Geneva.

Yli-Piipari, S., Kulmala, J. S., Jaakkola, T., Hakonen, H., Fish, J. C., & Tammelin, T. (2016). Objectively measured school day physical activity among elementary students in the United States and Finland. *Journal of Physical Activity & Health*, *13*(4), 440–446. doi: 10.1123/jpah.2015-0335

Table 1. Scheme of the monitored physical education session

Phase	Exercises
Warm-up (10 min)	Jogging (3 min)
	Joint mobility (8 exercises, 10 repetitions each one)
	Static stretching (8 exercises, 10 seconds each one)
	Bouncing the ball freely in the court (3 min)
Main part (35 min)	Bouncing the ball while walking/ running: dominant hand, non-dominant hand and alternating hands (5 min)
	Passing the ball to a partner while walking/ running: chest pass, bounce pass and overhead pass (5 min)
	Protect-steal the ball in a 1 x 1 situation (5 min)
	2 x 2 game passing the ball the maximum number of times without the opposite team steals the ball (10 min)
	3 x 3 match in hall court and with one basket (10 min)
Cold-down (5 min)	Static stretching (8 exercises, 20 seconds)

Table 2. General characteristics (mean ± standard deviation) of the analyzed participants and differences between boys and girls

	Total	Boys	Girls	One-way ANOVA[a]	
	(n = 158)	(n = 83)	(n = 75)	F	p
Age (years)	14.58 ± 1.18	14.52 ± 1.16	14.64 ± 1.19	-	-
Body mass (kg)	57.51 ± 12.37	59.68 ± 13.08	55.01 ± 11.06	5.512	0.020
Body height (cm)	162.15 ± 8.41	164.91 ± 9.46	159.00 ± 5.60	21.167	< 0.001
Body mass index (kg/m^2)	21.74 ± 3.71	21.80 ± 3.69	21.68 ± 3.76	0.040	0.842

[a] Significance level of the one-way analysis of variance comparing boys and girls

Table 3. Comparison of accelerometer-measured physical activity between physical education, non-physical education and weekend days

	PE days (1)	Non-PE days (2)	Weekend days (3)	One-way ANOVA[a]			Effects size (*d*)		
	M ± *SD*	*M* ± *SD*	*M* ± *SD*	*F*	*p*	η^2_p	1-2	2-3	1-3
Whole sample (*n* = 158)									
Moderate-to-vigorous (%)	8.04 ± 3.25†	6.10 ± 2.47	6.39 ± 3.60†	28.259	< 0.001	0.153	0.86	-0.13	0.73
Light (%)	11.13 ± 2.99†	9.77 ± 2.72†	11.25 ± 3.61	22.266	< 0.001	0.124	0.54	-0.59	-0.05
Vertical axis (counts/ min)	478.42 ± 175.76†	356.66 ± 133.45*	397.32 ± 198.02†	35.508	< 0.001	0.184	0.97	-0.32	0.65
Vector magnitude (counts/ min)	851.69 ± 256.54†	652.03 ± 197.85†	751.68 ± 305.48†	40.650	< 0.001	0.206	1.06	-0.53	0.53
Steps (steps/ min)	12.51 ± 4.44†	9.62 ± 3.36	9.94 ± 5.21†	30.656	< 0.001	0.163	0.95	-0.11	0.85
Boys (*n* = 83)									
Moderate-to-vigorous (%)	8.83 ± 3.56†	6.96 ± 2.54	7.36 ± 3.91#	9.998	< 0.001	0.109	0.82	-0.17	0.65
Light (%)	11.54 ± 3.39#	10.52 ± 3.04#	11.67 ± 3.92	7.219	0.001	0.081	0.35	-0.40	-0.05
Vertical axis (counts/ min)	526.73 ± 197.64†	408.43 ± 135.27	449.65 ± 217.40#	13.199	< 0.001	0.139	0.92	-0.32	0.60
Vector magnitude (counts/ min)	919.20 ± 288.59†	724.49 ± 186.66*	819.15 ± 330.34*	16.495	< 0.001	0.167	1.03	-0.50	0.53

Steps (steps/ min)	13.31 ± 4.94†	10.49 ± 3.57	10.77 ± 5.75†	12.604	< 0.001	0.133	0.86	-0.09	0.78
Girls (*n* = 75)									
Moderate-to-vigorous (%)	7.18 ± 2.64†	5.15 ± 2.01	5.32 ± 2.88†	23.044	< 0.001	0.237	1.11	-0.09	1.02
Light (%)	10.68 ± 2.42†	8.95 ± 2.04†	10.77 ± 3.18	16.034	< 0.001	0.178	0.98	-1.04	-0.05
Vertical axis (counts/ min)	424.96 ± 129.38†	299.36 ± 105.70	339.41 ± 156.04†	27.708	< 0.001	0.272	1.31	-0.42	0.90
Vector magnitude (counts/ min)	776.98 ± 191.23†	571.84 ± 178.99#	677.01 ± 257.50#	26.933	< 0.001	0.267	1.31	-0.67	0.64
Steps (steps/ min)	11.62 ± 3.65†	8.65 ± 2.84	9.01 ± 4.40†	19.945	< 0.001	0.212	1.20	-0.15	1.05

Note. PE = physical education; *M* = Mean; *SD* = standard deviation; [a] One-way repeated measures ANOVA followed by the *post-hoc* pairwise comparisons with Bonferroni adjustment (* $p < 0.05$, # $p < 0.01$ and † $p < 0.001$): Colum (1) PE days-Non-PE days, (2) Non-PE days-Weekend days and (3) PE days-Weekend days.

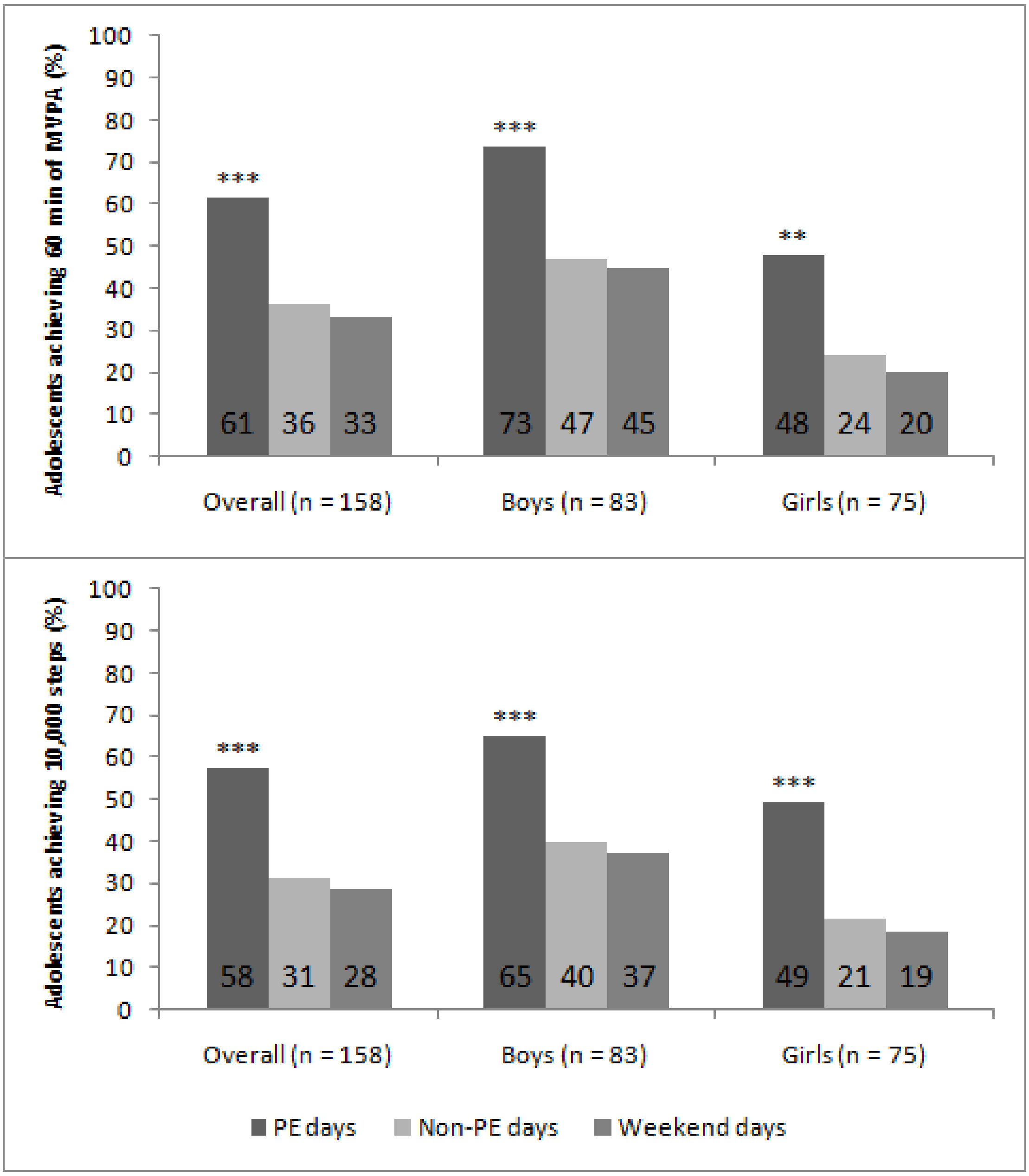

Figure 1. Comparison of the percentage of adolescents achieving the daily recommendation of 60 min of moderate-to-vigorous physical activity (above) and 10,000 steps (below) between physical education, non-physical education and weekend days. Results of the Cochran Q test (all $p < 0.001$) followed by the pairwise comparisons with the McNemar test: PE days vs. non-PE days/ weekend days (*** $p < 0.001$, ** $p < 0.01$), non-PE days vs. weekend days ($p > 0.017$).

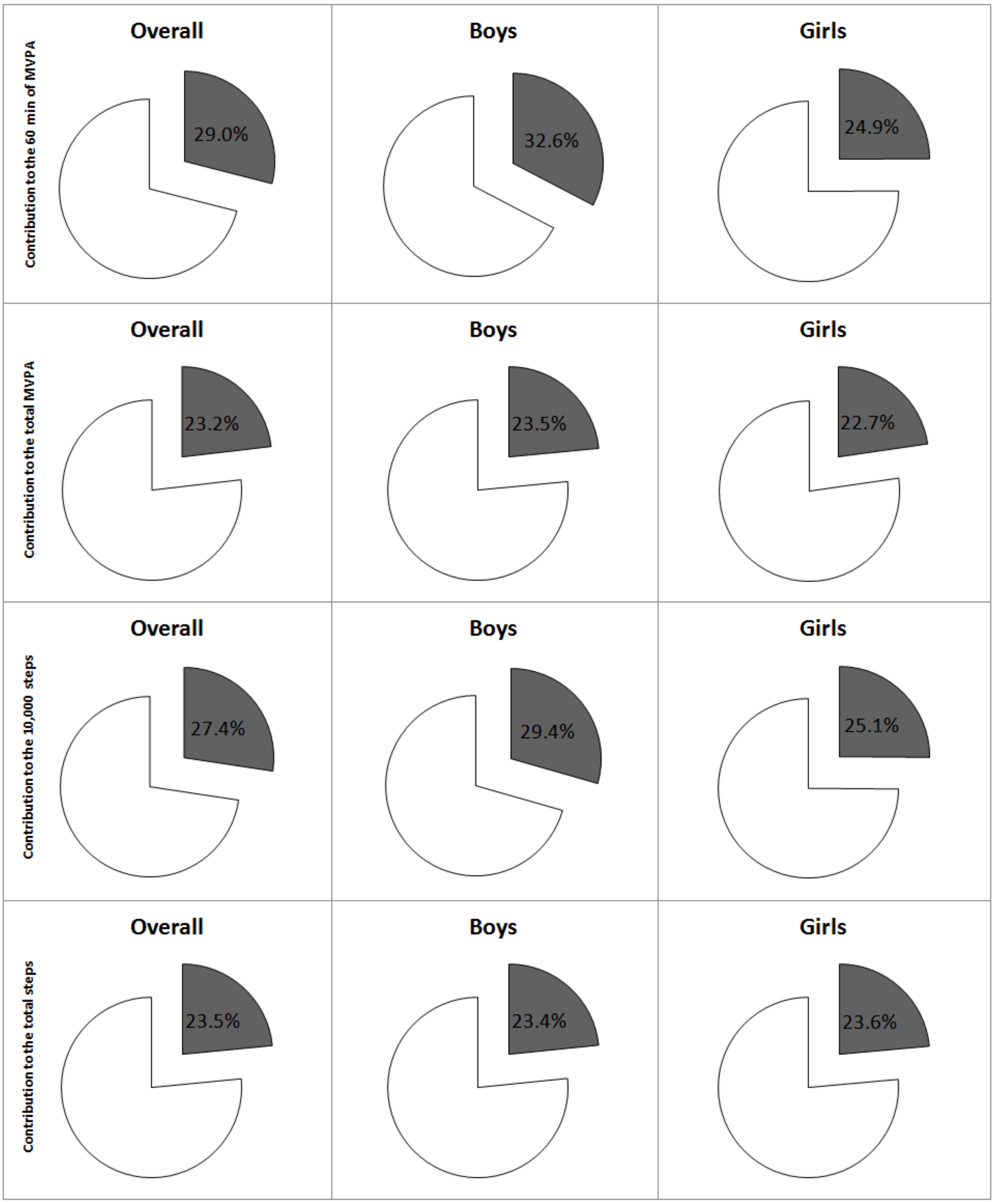

Figure 2. Contribution of physical education to daily physical activity (from top to bottom): (a) 60 min daily recommendation of moderate-to-vigorous physical activity (MVPA); (b) total daily MVPA; (c) 10,000 steps daily recommendation, (d) and total daily steps.

Table 4. Comparison of accelerometer-measured sedentary behaviour between physical education, non-physical education and weekend days

	PE days (1)	Non-PE days (2)	Weekend days (3)	Friedman test[a]			Effects size (*r*)		
	M ± *SD*	*M* ± *SD*	*M* ± *SD*	χ^2	*p*	*W*	1-2	2-3	1-3
Whole sample (*n* = 158)									
Sedentary (%)[b]	80.82 ± 5.25†	84.09 ± 4.42#	82.36 ± 6.35†	45.278	< 0.001	0.143	-0.39	0.17	-0.22
Sedentary bouts (bouts/ h)	0.35 ± 0.24#	0.40 ± 0.22†	0.32 ± 0.19	17.689	< 0.001	0.056	-0.17	0.26	0.09
Total time in sedentary bouts (min/ h)	5.45 ± 3.89†	6.48 ± 4.00†	5.05 ± 3.12	15.984	< 0.001	0.051	-0.22	0.23	0.05
Average time in sedentary bouts (min/ h)	0.98 ± 0.40	1.01 ± 0.26†	1.17 ± 0.52†	32.846	< 0.001	0.104	-0.13	-0.24	-0.29
Boys (*n* = 83)									
Sedentary (%)[b]	79.63 ± 5.81†	82.47 ± 4.60	80.97 ± 6.92#	22.843	< 0.001	0.138	-0.33	0.12	-0.22
Sedentary bouts (bouts/ h)	0.34 ± 0.26	0.32 ± 0.21	0.29 ± 0.21	2.410	0.300	0.015	0.00	0.12	0.11
Total time in sedentary bouts (min/ h)	5.33 ± 4.25	5.19 ± 3.73	4.63 ± 3.34	1.952	0.377	0.012	0.05	0.12	0.10
Average time in sedentary bouts (min/ h)	0.98 ± 0.45	0.96 ± 0.29#	1.17 ± 0.63†	19.108	< 0.001	0.115	0.09	-0.27	-0.27
Girls (*n* = 75)									

Sedentary (%)[b]	82.14 ± 4.19†	85.87 ± 3.43#	83.91 ± 5.30#	23.227	< 0.001	0.155	-0.47	0.22	-0.24
Sedentary bouts (bouts/ h)	0.36 ± 0.22†	0.49 ± 0.21†	0.34 ± 0.16	20.876	< 0.001	0.139	-0.35	0.38	0.06
Total time in sedentary bouts (min/ h)	5.59 ± 3.49†	7.91 ± 3.82†	5.50 ± 2.81	21.090	< 0.001	0.141	-0.40	0.34	0.01
Average time in sedentary bouts (min/ h)	0.97 ± 0.33	1.05 ± 0.20*	1.17 ± 0.38†	14.776	0.001	0.099	-0.18	-0.21	-0.32

Note. PE = physical education; *M* = Mean; *SD* = standard deviation; [a] Friedman test followed by the *post-hoc* pairwise comparisons with Wilcoxon test (* $p < 0.017$, # $p < 0.01$ and † $p < 0.001$): Colum (1) PE days-Non-PE days, (2) Non-PE days-Weekend days and (3) PE days-Weekend days; [b] Percentage of time below or equal to 100 counts per min regardless the participants' position and without any bouts of time imposed.