DIFFERENCES IN PHYSICAL ACTIVITY LEVELS IN SCHOOL-BASED CONTEXTS – INFLUENCE OF GENDER, AGE, AND BODY WEIGHT STATUS

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Abstract:

The purposes of this study were to compare the objectively measured physical activity levels across physical education, school playtime and extra-curricular sport in secondary school students, as well as to examine the influence of gender, age, and body weight status on adolescents' objective physical activity levels in these contexts. A hundred and two secondary school students (age 12.53±1.56 years) participated in the present study. Students' objective physical activity levels were estimated by the multi-sensor device SenseWear Pro_2 Armband during a physical education, school playtime and extra-curricular sport session. The result of the one-way multivariate analysis of covariance indicated statistically significant higher values of steps/min, average metabolic equivalent of task, and time spent in moderate-to-vigorous physical activity in extra-curricular sport than in physical education and school playtime ($p<.001$). Additionally, metabolic equivalent of task values were statistically significantly greater in physical education than in school playtime ($p<.001$). On the other hand, the results of the two-way multivariate analyses of covariance showed an influence of gender and age on physical activity levels in these contexts ($p<.001$), whilst for body weight status no influence was found ($p>.05$). This preliminary evidence could inform and guide future policy regarding the promotion of physical activity among adolescents in these important school-based contexts. Since physical activity engagement in compulsory physical activity contexts, such as physical education lessons, is clearly insufficient, parents, teachers and institutions should encourage students to achieve health-related physical activity levels during their free time.

Key words: *physical education, school playtime, extra-curricular sport, SenseWear Pro_2 Armband, secondary school students, adolescents*

Introduction

During childhood and adolescence assuring an adequate physical activity (PA) habit is an important issue because young people can via it enhance their physical, psychological, and social well-being (Hallal, Victora, Azevedo, & Wells, 2006). Unfortunately, nowadays most young people do not meet the recommendation of 60 minutes of moderate-to-vigorous PA per day (MVPA) (Currie, et al., 2012), particularly among adolescents (Cocca, Liukkonen, Mayorga-Vega, & Viciana, 2014). For example, a current survey carried out by the World Health Organization revealed that 77-85% of European adolescents do not achieve 60 minutes of MVPA daily (Currie, et al., 2012).

Therefore, the promotion of adolescents' PA is an important public health priority (WHO, 2010). Schools have been considered as key environments for the adolescents' PA promotion (Ortega, Ruiz, Castillo, & Sjöströsm, 2008), as students spend a substantial proportion of their waking hours at school (Fox, Cooper, & McKenna, 2004). In particular, physical education (PE) may play an important role for students to achieve the recommended PA levels (Brusseau, Kulinna, Tudor-Locke, van der Mars, & Darst, 2011). Adolescents' total daily PA has been shown to be greater on PE days than on non-PE days (Brusseau, et al., 2011). In addition, at that age students should ideally accumulate at least 50% of the PE lessons in MVPA (United States Department of Health and Human Services, 2010).

However, PE potential is restricted by its limited curriculum time allocation (Viciana, Mayorga-Vega, & Cocca, 2013), especially during secondary school since frequency and duration of PE lessons are often reduced to the benefit of other curricular areas. In addition, several studies found that the mentioned target criterion was rarely met (e.g. Fairclough & Stratton, 2005; Nader, 2003). In this line, extra-curricular time such as school

playtime (SP) and extra-curricular organized sports (ES) could provide valuable school-based opportunities for adolescents to achieve recommended MVPA levels (Fox, et al., 2004). School playtime is a mandatory part of school days and, therefore, it offers an important amount of time when students might achieve a significant proportion of the recommended MVPA (Ridgers, Stratton, & Fairclough, 2006). In this line, previous studies have suggested that a recess may contribute up to 33% of daily recommended MVPA (Ridgers, et al., 2006). On the other hand, ES also plays a significant role in the promotion of adolescents' PA, accounting for up to 51% of recommended MVPA (Curtner-Smith, Sofo, Chouinard, & Wallace, 2007; Wickel & Eisenmann, 2007).

Physical activity is a multidimensional and complex behavior that tends to vary considerably between students, for example, as a result of individual factors (Stratton, 1996). Therefore, in order to promote the recommended MVPA among adolescents, it is crucial to determine the influence of personal factors on PA in the school-based contexts to engage the recommended MVPA (Ridgers, Salmon, Parrish, Stanley, & Okely, 2012). Some previous studies have examined separately PA levels during PE lessons, SP periods and ES among children and adolescents, as well as the influence of individual factors such as gender, age, and body weight (BW) status in these settings (e.g. Fairclough & Stratton, 2006; Hohepa, Scragg, Schofield, Kolt, & Schaaf, 2009; Ridgers, et al., 2012; Slingerland, Borghouts, & Hesselink, 2012). Unfortunately, to our knowledge there are no studies comparing the adolescents' objective PA levels across PE lessons, SP periods and ES sessions, as well as examining the influence of gender, age, and BW status in each situation among the same sample. This information potentially can inform future policy concerning the promotion of the recommended MVPA levels in these important school-based opportunities (Ridgers, et al., 2012).

Consequently, the purposes of this study were: (a) to compare the objective PA levels across PE lessons, SP periods and ES sessions of secondary school students; and (b) to examine the influence of gender, age, and BW status on adolescents' objective PA levels during PE lessons, SP periods and ES.

Methods

Participants

A hundred and two Spanish secondary school students (age 12.53±1.56 years, BW 52.99±12.60 kg, and body height (BH) 157.71±9.09 cm) participated in the present study. Due to the objectives of the study, the established inclusion criterion demanded students' participation in an ES in their school center. The exclusion criteria were a failure to participate in some of the assessment sessions and/or if the data registered in any of the sessions were lower than 90% of the total time.

Measures

Body weight status. According to the body mass index (BMI) international cut-off values (Cole, Bellizzi, Flegal, & Dietz, 2000), participants' BW status was categorized as not-overweight and overweight (including obese). For this purpose, first the participants' BW and BH were measured and then BMI was calculated as BW/BH squared (kg/m^2). During the measurement of BW and BH participants were in shorts and T-shirts and barefoot. For the BW measure, the participants stood in the centre of the scale (Seca, Ltd., Hamburg, Germany; accuracy=.1 kg) without support and with their weight distributed evenly on both feet. For the BH assessment, the students stood with the feet together, their heels, buttocks and upper part of the back touching the scale (Holtain Ltd., Crymmych, Pembs, United Kingdom; accuracy=.1 cm), and their head placed in the Frankfort plane. The average of two measurements for both BW and BH was retained.

Physical activity levels. Students' objective PA levels were estimated by the SenseWear Pro$_2$ Armband (HealthWear Bodymedia, Pittsburgh, Penn., USA). The SenseWear Pro$_2$ Armband is a multi-sensor device (85x53x19 mm; 79 g) consisting of a skin temperature sensor, a near-body temperature sensor, a heat flux sensor, a galvanic skin response sensor, and a biaxial accelerometer. The skin and near-body temperature sensors consist of sensitive thermistors in contact with the skin relying on changes in resistance with changing temperature. The heat flux sensor uses the difference between skin and near-body temperature to assess heat loss. The galvanic skin response sensor measures the conductivity of the skin between two electrodes in contact to the skin. The biaxial accelerometer registers movements of the upper arm and provides information about body position (lying or being upright) by detecting gravity acceleration.

The SenseWear Pro$_2$ Armband device collects data from its multiple sensors and then this information, together with gender, age, BW and BH data, is incorporated into proprietary algorithms to estimate several PA parameters. These algorithms are activity-specific and are automatically applied on the basis of an analysis of the pattern of signals from the sensors. After students' sessions were monitored, data were copied into the computer. Then, the total number of steps, average metabolic equivalent of task (MET), time of MVPA (minutes≥3 MET), and PA duration (min) were calculated. In accordance with the manufacturer instructions, data download and the posterior PA estimations were performed using the InnerView Professional software version 5.1 for Windows. Subsequently, in order to stand-

ardize each variable for posterior data analyses, the average number of steps per minute and the percentage of MVPA time within the total session time were calculated. PA measurements using the SenseWear Pro_2 Armband have demonstrated an adequate validity among young people (Arvidsson, Slinde, Larsson, & Hulthén, 2007).

Procedures

The protocol of the present study was approved by the Ethical Committee of the University of Granada. The principal and the PE teacher of a secondary school center were contacted by a researcher. Then they were informed about the project and the permission to conduct the study was requested. After the school approval was obtained, students and their legal guardians were fully informed about all the features of the study, and written informed consent to take part in the research was obtained from all participants' legal guardians. Because of the objective of the present study, only the students who were involved in any ES in the same school center were invited to participate.

Data collecting was carried out within two weeks. In the first week, BW and BH measurements were taken during a regularly scheduled PE class. In the second week, students' objective PA levels were evaluated during a PE lesson, SP time and ES session. Previously, all the participants were instructed how to correctly place the PA measuring device and then they were familiarized with it. Students were instructed to place the device on the arm in a sitting position at the beginning of each monitored session. The armband was worn on the back of the upper right arm attached with an adjustable strap.

Physical education, SP, and ES sessions were performed in the same ES facilities and under the same environmental conditions for each student. Additionally, during the PE classes and ES sessions the same content was taught by the same teacher. Nevertheless, PE lessons had an educational approach and the ES sessions had a technical-tactical approach. On the other hand, SP was an unstructured and free-choice period and, therefore, students were allowed to do each activity they usually do. The PE teacher and students were urged to maintain what they usually do in each situation.

Statistical analyses

Descriptive statistics (mean and standard deviation) for all the variables were calculated. A one-way multivariate analysis of covariance (MANCOVA), with gender, age and BMI values as covariables, was used to examine the differences in PA levels (steps/min, METs, and MVPA) across the PE, SP, and ES sessions. Multivariate analyses were followed up with the univariate analyses of covariance (ANCOVA). Subsequently, the *post-hoc* with the Bonferroni adjustment was used to compare pairs of means. Afterward, a two groups (boys, girls) × three situations (PE, SP, ES) MANCOVA, with age and BMI values as covariates, was used to test the influence of gender on PA levels (steps/min, METs, and MVPA). A significant multivariate interaction was followed up with ANCOVAs. Subsequently, a *post-hoc* with the Bonferroni adjustment was used for both the between- and within-groups pairwise comparisons. Similarly, to examine the influence of age and BW status on PA levels, the other two factor values (i.e. gender and BMI, and gender and age, respectively) were used as covariables. Beforehand, participants' age was categorized as younger (11-13 years) and older (14-16 years) and students' BW status was established as not-overweight (BMI<overweight cut-point) and overweight (BMI≥overweight cut-point) (Cole, et al., 2000). Effect sizes were estimated using the partial eta squared (η^2_p). All statistical analyses were performed using the SPSS Version 20.0 for Windows (IBM® SPSS® Statistics). The statistical significance level was set at $p<.05$.

Results

The overall total time (mean and standard deviation) of PA registered under each school-based context was: 52.9±4.2 min for PE, 28.3±2.7 min for SP, and 52.4±4.0 for ES. Means, standard deviations, and MANCOVAs results for PA levels in each context for the whole sample, as well as for gender, age and BW status categories are represented in Table 1. The one-way MANCOVA result indicated overall statistically significant differences in PA levels between PE, SP and ES sessions (Wilks' $\lambda=.383$; $F=24.938$; $p<.001$). Then, the follow-up ANCOVAs revealed statistically significant differences in steps/min, METs and MVPA values. Subsequently, the *post-hoc* pairwise comparison with the Bonferroni adjustment showed statistically significant higher steps/min, MET and MVPA values in ES than in PE and SP ($p<.001$). Additionally, MET values were statistically significantly greater in PE than in SP ($p<.001$). However, for steps/min and MVPA values statistically significant differences between PE and SP were not found ($p>.05$).

Gender. The two-way MANCOVA results indicated overall statistically significant interaction effect on PA levels (Wilks' $\lambda=.671$; $F=7.598$; $p<.001$). Then, the follow-up ANCOVAs revealed statistically significant interaction effect on steps/min and MET values ($p<.001$), but not on MVPA ($p=.322$). Subsequently, the *post-hoc* between-group pairwise comparisons with the Bonferroni adjustment showed statistically significant higher values for boys in steps/min and METs in PE, SP and ES (except for METs in PE) ($p<.05$). However, for the MVPA values statistically significant differences between genders were not found for any context

Table 1. Descriptive statistics and multivariate analysis of covariance (MANCOVA) results for physical activity levels for the whole sample, as well as for gender, age and body weight status categories

		Physical education (1)	School playtime (2)	Extra-curricular sport (3)	MANCOVA[a]			*Post-hoc* pairwise comparisons[b]		
		M±SD	M±SD	M±SD	F	p	η^2_p	1-2	2-3	1-3
Entire sample					24.938	<.001	.617			
Total (n=102)	Steps/min	50.5±13.3	48.3±27.3	63.8±12.8	49.928	<.001	.338	.581	<.001	<.001
Total (n=102)	METs	4.7±1.1	4.3±1.6	5.8±1.1	72.250	<.001	.424	<.001	<.001	<.001
Total (n=102)	MVPA	73.9±18.2	69.6±29.2	90.8±9.6	70.708	<.001	.419	.950	<.001	<.001
Gender					7.598	<.001	.329			
Boys (n=52)	Steps/min	53.1±15.8*	57.8±30.3***	66.9±13.6**	10.504	<.001	.097	.256	<.001	<.001
Girls (n=50)		47.7±9.5	38.4±19.6	60.6±11.2				.001	<.001	<.001
Boys (n=52)	METs	4.8±1.2	4.9±1.8***	6.0±.9*	10.208	<.001	.094	1.000	<.001	<.001
Girls (n=50)		4.7±0.9	3.8±1.1	5.7±1.3				<.001	<.001	<.001
Boys (n=52)	MVPA	73.9±19.4	73.4±29.5	91.7±8.1	1.132	.322	.011	1.000	<.001	<.001
Girls (n=50)		73.8±17.1	65.7±28.6	89.9±10.9				.041	<.001	<.001
Age[c]					31.198	<.001	.668			
Younger (n=82)	Steps/min	54.9±9.6***	56.8±23.1***	65.5±13.3	30.171	<.001	.235	1.000	<.001	<.001
Older (n=20)		32.1±10.5	13.3±8.8	56.9±6.8				<.001	<.001	<.001
Younger (n=82)	METs	5.0±.9***	4.8±1.4***	5.6±1.1***	71.839	<.001	.423	.134	<.001	<.001
Older (n=20)		3.6±.8	2.4±0.7	6.7±.8				<.001	<.001	<.001
Younger (n=82)	MVPA	79.8±11.2***	80.5±19.7***	89.8±10.2**	69.495	<.001	.415	1.000	.001	<.001
Older (n=20)		49.5±21.3	24.9±16.3	95.2±4.7				<.001	<.001	<.001
Body weight status[d]					2.092	.061	.119			
Not-overweight (n=64)	Steps/min	52.7±11.6**	52.5±27.8**	67.1±14.0***	1.382	.254	.014	1.000	<.001	<.001
Overweight (n=38)		46.7±15.3	41.2±25.1	58.3±7.8				.151	<.001	<.001
Not-overweight (n=64)	METs	5.0±1.1***	4.7±1.7**	6.0±1.1**	1.029	.351	.010	.005	<.001	<.001
Overweight (n=38)		4.2±.9	3.8±1.3	5.5±1.2				.035	<.001	<.001
Not-overweight (n=64)	MVPA	76.9±18.2*	72.3±28.6	92.0±8.8	.702	.487	.007	.159	<.001	<.001
Overweight (n=38)		68.7±17.3	65.1±30.0	88.8±10.5				.959	<.001	<.001

Note. M=mean; SD=standard deviation; MVPA=moderate-to-vigorous physical activity (percentage of time≥3 MET to total time session); [a] Two-way MANCOVA followed by two-way univariate analysis of covariance (except for the sample where one-way MANCOVA followed by one-way univariate analysis of covariance was applied); [b] *Post-hoc* pairwise comparisons with Bonferroni adjustment for the within-groups analyses; [c] Age categories were computed as younger (11-13 years) and older (14-16 years); [d] Body weight status categories were established according to Cole et al. (2000) by BMI, age and gender.

*p<.05, **p<.01, ***p<.001 *post-hoc* pairwise comparisons with Bonferroni adjustment for the between-groups analyses.

(and neither for METs in PE) (p>.05). Regarding the within-group pairwise comparisons, boys achieved significantly higher steps/min, METs, and MVPA scores in ES than in PE and SP (p<.001). However, for boys no statistically significant differences between PE and SP were found (p>.05). As regards the within-group results for girls, the pairwise comparisons showed significantly greater values of steps/min, METs, and MVPA in ES than in PE and SP (p<.001), as well as significantly higher values in PE than in SP (p<.05).

Age. The two-way MANCOVA results indicated overall statistically significant interaction effect on PA levels (Wilks' λ=.332; F=31.198; p<.001). Then, the follow-up ANCOVAs revealed statistically significant interaction effect on steps/min, MET and MVPA values (p<.001). Subsequently, the *post-hoc* between-group pairwise comparisons showed significantly higher values for younger students in steps/min, METs and MVPA in PE and SP (p<.05). Contrary, the older students showed significantly greater values of METs and MVPA in ES than the younger students (p<.01). For the steps/min values during ES significant differences were not found between age categories (p=.062). Regarding the within-group pairwise comparisons, the younger adolescents scored significantly better in steps/min, METs, and MVPA in ES than in PE and SP (p≤.001). However, for the younger students statistically significant differences between PE and SP were not found (p>.05). As regards the within-group results for the older adolescents, the pairwise

comparisons showed significantly greater values of steps/min, METs, and MVPA in ES than in PE and SP ($p<.001$), as well as greater in PE than in SP ($p<.001$).

Body weight status. The two-way MANCOVA did not find overall statistically significant interaction effect on PA levels (Wilks' $\lambda=.881$; $F=2.092$; $p=.061$), nor did the follow-up ANCOVAs reveal statistically significant interaction effect on steps/min, MET and MVPA values ($p>.05$). However, the subsequent *post-hoc* between-group pairwise comparisons showed significantly higher values for not-overweight participants in steps/min and METs in each situation ($p<.001$), as well as in MVPA values during PE ($p<.05$). For MVPA values during SP and ES statistically significant differences were not found between BW status categories ($p>.05$). Regarding the within-group pairwise comparisons, both the not-overweight and overweight participants scored significantly better in steps/min, METs and MVPA in ES than in PE and SP ($p<.001$). Also, they as achieved significantly higher METs values in PE than in SP ($p<.05$). However, for both the not-overweight and overweight participants statistically significant differences between PE and SP were not found in steps/min and MVPA values ($p>.05$).

Discussion and conclusions

The first purpose of this study was to compare the objective PA levels across PE lessons, SP periods and ES sessions in secondary school students. The results of the present study revealed that, for the entire sample, the students achieved higher PA levels during ES (i.e. steps/min, MET and MVPA values) than during PE and SP. Additionally, for the whole sample PA levels measured as METs were greater during PE than SP, but no differences in steps/min and MVPA values were obtained.

Adolescence is a crucial period of life since lifestyle and healthy/unhealthy behaviors seem to be established during these years that may also influence adult behavior and health status (Ortega, et al., 2008). In this line, although during adolescence PA levels drop drastically (Cocca, et al., 2014), to our knowledge there is no study comparing PA levels across these important school-based contexts with regard to the recommended daily PA levels.

In addition to the lack of related literature on adolescents, only a few previous studies have been found that compare PA levels across PE, SP and/or ES among primary schoolchildren. Wickel and Eisenmann (2007) carried out a study on PA levels during PE, SP and ES among boys aged 6-12 years. These authors found that the children of this age achieved a similar MVPA level during ES and SP, but it was slightly lower during PE. Afterward, Nettlefold et al. (2011) found that the average 8-to-11-year-old children spent half time in MVPA during PE compared with SP. Unfortunately, these previous studies did not perform any statistical test to examine these differences (i.e. they were merely descriptive). Contrary to the present results, the preceding studies have revealed how children achieved higher levels of PA in unstructured contexts, such as SP, than during PE. Psychological features such as the motivation for PA or PE could probaly explain these differences. In this line, Mayorga-Vega and Viciana (2014) found a relationship between the motivation for PE and adolescents' PA levels in these contexts. Additionally, the authors of the previous studies found how the differences in PA levels between the adolescents' motivation profiles were substantially greater during SP (Mayorga-Vega & Viciana, 2014). Previous studies have also shown how the motivation for PA decreases through childhood (Gao, Lee, Solmon, & Zhang, 2009).

In summary, as children become older, they become less motivated to participate in PA tasks and, therefore, their PA levels decrease. In this line, it is clear that when PA depends entirely on their choice, such as during SP, their PA levels drop further than during PE and ES, where the teacher is in charge of the session and PA rate. Therefore, it seems that the school-based programs for PA promotion among adolescents should especially focus on unstructured contexts such as SP. In addition to the lack of previous studies on this topic, our findings highlight the importance of examining more deeply PA habits, specifically among adolescents.

The second purpose of the present study was to examine the influence of gender, age and BW status on adolescents' objective PA levels during PE, SP periods and ES. The results of the current study showed a gender-related influence on steps/min and MET values, finding higher levels during PE, SP and ES for boys (except for METs in PE) than for girls. In this line, most previous studies carried out with secondary school students found that boys were more active than girls during PE lessons (e.g. Slingerland, et al., 2012; Fairclough & Stratton, 2005) and ES (e.g. Slingerlan, et al., 2012). However, no study on PA during SP, carried out with secondary school students, was found. In line with the present study, most preceding studies on primary schoolchildren also found that during SP boys were more active than girls (e.g. Nettlefold, et al., 2011; Ridgers, et al., 2006).

As regards the within-group pairwise comparisons, both boys and girls demonstrated greater steps/min and MET levels in ES than in PE and SP. However, while no differences between PE and SP were found for boys, girls also achieved greater steps/min and MET levels during PE than during SP. Similarly, although Slingerland et al. (2012) did not perform any statistical test, they found that both boys and girls had considerably greater PA levels in ES than in PE lessons. Sarkin, McKenzie, and Sallis (1997), in their study with elementary school-

children, found that although boys' levels of PA were not significantly different between PE and SP, girls were more physically active during PE than at recess. Whilst the reasons behind these gender differences are not widely established, it has been suggested that boys may view both school contexts as opportunities to compete, while girls might view them as opportunities to socialize with friends, especially in the unstructured contexts such as SP (Blatchford, Baines, & Pellegrini, 2003). Additionally, a lower motivation for PA in girls than in boys, or gender-sport stereotypes, could explain these differences (Boiché, Plaza, Chalabaev, Guillet-Descas, & Sarrazin, 2014), especially during SP.

As regards the influence of students' age, the results of our study showed that the younger students had higher PA levels in PE and SP than the older students. On the contrary, the older students showed greater values of MET and MVPA in ES than the younger students. For the within-group pairwise comparisons, both the younger and older adolescents achieved greater PA levels in ES than in PE and SP. However, while for the younger adolescents differences between PE and SP were not found, the older adolescents also achieved greater PA levels during PE than in SP. Similarly to this study, Hohepa et al. (2009) in their study with 12-to-18-year-old students found that the younger students self-reported to be more active during SP than the older students. However, recently, in a systematic review among primary schoolchildren, Ridgers et al. (2012) concluded that evidence for age-related differences in PA were inconclusive since no association was found for grade levels. Kremer, Reichert, and Hallal (2012) studied the proportion of class time that primary and secondary school students spent in MVPA during PE lessons. In contrast to our results, these authors did not find any difference between age groups and school grades. Moreover, Levin, McKenzie, Hussey, Kelder, and Lytle (2011) found that younger primary schoolchildren had lower PA levels than their older co-students. For the ES context no study was found on primary and secondary students, as well as no study was found that compared PA levels between these school-based contexts for each age group. Higher PA levels in PE and SP among younger students could be due to different reasons, such as a descent of motivation for both PE and PA throughout adolescence (Gao, et al., 2009; Mayorga-Vega & Viciana, 2014), or a change in social interest toward habits related to adulthood. Moreover, the last reason may also explain why in ES (where the context has a technical-tactical approach instead of educational one) the older students seem to be more active.

As regards the influence of the students' BW status, the results of the current study did not find an overall interaction effect on PA levels. In this line, not any previous study found any difference between children of different BW status during PE classes (e.g. Fairclough & Stratton, 2006; Kremer, et al., 2012) and SP (Ridgers, et al., 2012). Unfortunately, for ES no previous research study was found. Previous studies have found an influence of BW status on the performance of physical fitness components such as cardiorespiratory fitness and muscular strength (Mayorga-Vega, Brenes Podadera, Rodríguez Tejero, & Merino Marban, 2012), the very important components for PA performance.

The present study has some limitations that should be acknowledged. The main limitation is related to the purposes of the present study. Unlike PE and SP, ES is a school-based context for PA in which not all adolescents are enrolled. Therefore, in order to examine also this important school-based context for PA, the inclusion criterion of the present study was that students participated in ES. The participants with higher motivation might have been selected and, therefore, the results of this study should only be generalized to active adolescents. In order to be able to test the results in a more representative sample of *all* adolescents, future studies should examine PA levels in leisure-time instead of ES.

Another limitation of this study could be the use of a single session monitored in each context. Despite the fact that various assessments would provide more reliable data, it is sometimes not practical to use objective PA measurements. However, in the current study some measures were objectively taken in order to obtain more valid PA data; for instance, a familiarization session was carried out with the PA measuring device, no researcher was present during the monitored sessions to avoid the observer effect, the study was conducted with students from the same school, teacher, and ES facilities for each situation. Lastly, a relatively low number of participants did not allow us to examine the influence of individual factors through a fully hierarchical analysis approach where we would have analyzed the overall interactions (e.g. PA of the overweight young girls). However, other factors were used as control variables instead and, therefore, we can be reasonably unconcerned of the potential confounders.

In conclusion, to our knowledge the present study is the first to compare adolescents' objective PA levels across PE lessons, SP periods and ES sessions, as well as to examine the influence of gender, age and BW status across contexts on the same sample. The results revealed that, overall, during ES students demonstrated higher PA levels than during PE and SP. Additionally, MET scores were greater during PE than SP. Regarding the influence of individual factors, boys showed higher PA levels during PE, SP and ES than girls; younger students had higher PA levels in PE and SP than older students, but older students showed greater PA levels

in ES. Furthermore, both boys and girls (younger and older students alike) achieved greater PA levels in ES than in PE and SP. However, while both girls and older students also achieved greater PA levels during PE than during SP, boys and younger students did not. As regards the students' BW status, the results of the current study did not find any influence on PA levels. This preliminary evidence could inform and guide future policy regarding the promotion of PA in the important school-based contexts among adolescents. Since PA engagement in compulsory PA contexts, such as PE lessons, is clearly insufficient, parents, teachers and institutions should encourage students to achieve healthy PA levels during their free time. Additionally, the necessity of a better promotion of PA during PE and SP should be also highlighted, especially among girls and older students.

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