

# Patterns of physical activity in Portuguese adolescents. Evaluation during physical education classes through accelerometry

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**Objectives:** School Physical Education (SPE) is an excellent way to improve moderate and vigorous physical activity (MVPA). To improve health and fitness, the guidelines recommend that at least 50% of class time should be spent in MVPA, though few studies on this assumption have been conducted. The objective of this study was to quantify the amount of MVPA undertaken during a SPE class, according to age and gender. **Methods:** This study was conducted in three randomly selected Portuguese public schools. A random sample of 191 teenage volunteers aged between 12 and 17 years, composed of 98 males ( $14.51 \pm 1.75$  years) and 93 females ( $14.59 \pm 1.83$  years) was recruited. An accelerometer was used by each subject to assess MVPA. **Results:** The mean time spent in MVPA during SPE class (MVPA/SPE) was  $25.36 \pm 15.69$  minutes, which corresponds to 28.18% of the total time spent in SPE class. Males spend significantly more time in MVPA/SPE than females (28.95 vs. 21.58 minutes;  $p < 0.05$ ). As age increased, time spent in MVPA/SPE tended to decrease; the 12-year-old adolescents tended to spend more time in MVPA/SPE compared with the 17-year-olds (30.40 vs. 20.80 minutes). **Conclusion:** The proportion of MVPA during SPE class time fell short of the 50% recommended by guidelines to improve health. Males spend significantly more time in MVPA/SPE than females and, in both genders, as age increases, time spent in MVPA/SPE tends to decrease.

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**Key Words:** exercise; school; accelerometers

## INTRODUCTION

Children's physical inactivity has been categorized as a modifiable risk factor for lifestyle-related diseases (36), and it has been suggested that physical inactivity during youth is linked to several health-related risks in adulthood. Some studies indicate that physical activity (PA) levels in school are very low (15). The benefits of promoting regular PA participation throughout childhood have become increasingly important for public health (44), because PA provides immediate health benefits, positively affecting body composition (17) and reducing the presence of coronary heart disease risk factors (12). The measurement of PA at early ages is a key factor in lifestyle evaluation and a tool for its control. Targeting children's patterns of PA is especially important given that increasing PA in childhood might be essential for encouraging a lifetime of regular PA (38). Current health-related PA

guidelines suggested that schoolchildren should accumulate at least 60 minutes of moderate to vigorous PA (MVPA) per day for a reduced risk of developing chronic diseases (24).

Schools have been recognized as a key setting to promote and achieve PA guidelines because children and adolescents spend a large amount of their day in school (13). School physical education (SPE) is recognized as the most widely available tool for promoting PA (30), and as a privileged space to develop regular and structured habits of PA in the daily lives of children and adolescents (6). According to the United States Department of Health and Human Services (40), 50% of SPE class time should be spent engaged in MVPA to promote health enhancement in young people. SPE should involve appropriate amounts of PA during lessons (31). However, in Portuguese adolescents, few studies have been made using objective measures of physical activity in SPE.

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Recent reviews, however, highlight that accelerometers provide an objective, practical, accurate and reliable means of quantifying the amount and intensity of habitual PA in schoolchildren (27).

With this in mind, the aim of this study was to determine the amount of MVPA undertaken during SPE class by using the accelerometer, and to verify if the recorded values are in line with the recommended guidelines.

## Material and Methods

### Participants

This study was conducted in three Portuguese public schools in the district of Castelo Branco, Portugal, during the academic year 2007/2008. A randomly selected sample of 191 volunteer adolescents aged between 12 and 17 years (mean:  $14.55 \pm 1.79$ ), with 98 males and 93 females, was recruited. Informed written consent was obtained from the children's parents or guardian and the school director. Study procedures were supported by the Portuguese Foundation for Science and Technology.

### Protocol to Assess Physical Activity

MVPA in SPE was measured using the Actigraph accelerometer, model GTM1 (Pensacola, FL, USA). This accelerometer is a small, lightweight, uniaxial device (weight 42.5g, dimensions 5.1x4.06x1.52cm<sup>3</sup>) calibrated to measure vertical accelerations ranging between 0.05 and 2 Gs and a reduced-frequency response ranging from 0.25 to 2.50Hz. The acceleration signal is digitized by an analog/digital converter that records 10 times per second and adds as many times as necessary to be able to find a value for the registration period (epoch) previously determined. The epoch period was set to 15s. This accelerometer produces "raw" output in activity counts per minute (cpm), which gives information about the total amount of PA (14). The subjects used the accelerometer during one SPE class and only the time spent in MVPA in that SPE class was analyzed. All subjects were instructed on accelerometer placement: placing the device firmly at the waist by means of an elastic belt, to avoid slippage, and positioning it on the opposite side of the dominant hand (22) with the notch facing up.

A hard drive connected to a computer was used to download data collected by the accelerometers. The processing and analysis of the data was performed by a specialized software (MAHUffe; available at <http://www.mrc-epi.cam.ac.uk>), and time spent on MVPA ( $> 3\text{MET's}$ ) was calculated by adding the

minutes held in moderate, vigorous and very vigorous PA. The average time spent on MVPA was calculated from cpm through the use of cutoff points specifically designed for pediatric populations (10).

### Physical Education Classes

SPE classes form part of the regular school curriculum and are carried out two times a week (45 minutes and 90 minutes) by a specialized physical educator. The 45-minute class is very short and frequently utilized for theory expositions. Due to this, we only considered the 90-minute class in our research. Each session was held in outdoor space, and the predominant exercises were related to team ball sports, namely football, handball and basketball. The lesson comprised six exercises of 10 minutes each and the rest of the class time was spent in instruction/organization of the exercises, changing clothes and bathing.

### Statistical Analysis

A descriptive analysis was performed for all variables of interest. The variables' distribution was analyzed with the Kolmogorov-Smirnov test and histogram analysis. Since all variables presented a normal distribution, further data treatment was performed using parametric tests.

For data analysis, only the average time spent on MVPA during the SPE class was considered. Gender mean differences in MVPA were analyzed through a T-Test. For age mean differences of MVPA, an ANOVA with multiple comparison tests (post hoc) per Scheffé was used. All data were analyzed by statistical software SPSS® 17.0 for a significance level of 5%.

## RESULTS

Table 2 shows the means, standard deviations and percentual values of moderate and vigorous physical activity during school physical education (MVPA/SPE), according to gender and age.

According to the entire sample, the mean time spent in MVPA/SPE was  $25.36 \pm 15.69$  minutes, which corresponds to 28.18% of the total time spent in SPE. Males spent significantly more time in MVPA/SPE than females (28.95 vs. 21.58 minutes;  $p < 0.05$ ). As age increases, the time spent in MVPA/SPE tended to decrease, but no significant differences were found between ages ( $p > 0.05$ ).

Figure 1 illustrates the evolution of mean time spent in MVPA/SPE according to gender and age.

As long the age increases, there is a decrease in MVPA/SPE. At 15 and 17 years old, females spent significantly less time engages in MVPA than males ( $p$

**Table 1.** Moderate/vigorous physical activity during school physical education (MVPA/SPE) according to gender and age.

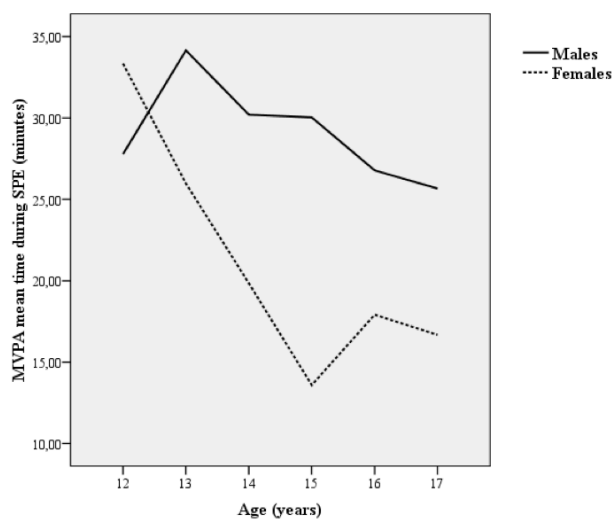
	Age (years)	MVPA/ SPE (minutes)	MVPA/ SPE (%)
All sample (N=191)	14.55 ± 1.79	25.36 ± 15.69	28.18
Males (N=98)	14.51 ± 1.75	28.95 ± 16.02*	32.17
Females (N=93)	14.59 ± 1.83	21.58 ± 14.48	23.98
12 (N=34)	-	30.40 ± 16.20	33.77
13 (N=33)	-	29.69 ± 18.92	32.99
14 (N=26)	-	25.82 ± 16.14	28.69
15 (N=27)	-	23.33 ± 13.37	25.93
16 (N=34)	-	22.35 ± 14.39	24.83
17 (N=37)	-	20.80 ± 12.89	23.12

Data are expressed as means and standard deviations. \* - males vs. females ( $p < 0.05$ ).

$< 0.05$ ). Only at 12 years did females engage in more MVPA/SPE than males.

## DISCUSSION

This study reports information about the participation of school adolescents in MVPA during a SPE class with the use of a direct observation technique, the accelerometer. The accelerometer allows a real time assessment of frequency, intensity and duration of PA for short or long time periods (26, 32, 39). This device has been used by a substantial number of authors because of its importance in the evaluation of PA patterns in a given context, allowing a critical comparison of results with other populations (4, 34, 37, 43).

**Figure 1.** Moderate/vigorous physical activity during school physical education (MVPA/SPE) according to gender and age. \* - males vs. females ( $p < 0.05$ ).

The results of our study show that during an SPE class, adolescents spend a reduced amount of time engaged in MVPA. Only 25.7% of the total class time was spent on MVPA (see Table 1), not meeting the recommended 50% of lesson time criterion (5, 40). This proportion is slightly lower compared with the percentages of 32.8% and 37.9% reported in other studies (19, 41). Our study showed large standard deviations suggesting wide individual variations in MVPA values; in other words, some students spend a great deal of class time engaging in MVPA while others stay mostly inactive. Such variation in activity levels reflects the influence of SPE-specific contextual and pedagogical factors (i.e. lesson objectives, content, environment, teaching styles, etc.) (35).

Divided by gender, males spent significantly more time engaged in MVPA than females during the class period (see Table 1). It is possible that the characteristics and aims of some SPE activities did not encourage the girls to engage in whole body movement as much as the boys. Although PA is what makes SPE unique from other disciplines, some girls may not see it as such an integral part of their experience. Moreover, there is evidence (11) to suggest that some females may dislike overly exerting themselves during SPE (7). It is important that this perception is clearly recognized if lessons are to be seen as enjoyable and relevant, while at the same time contributing meaningfully to physical activity levels. It is also possible that the females were less motivated than the males to physically exert themselves. This view is supported by negative correlations reported between females' SPE enjoyment and MVPA levels (8). SPE at this young age might be an interesting and valuable strategy to stimulate motor development. Children with better developed motor skills may find it easier to be active and engaged in more PA (45). According to age, females tend to engage in more MVPA at younger ages, and engagement in MVPA

markedly decreases as age increases (see Figure 1). It is common that females' level of activity participation begins to decline at an earlier age (2, 18).

Findings suggest that children's activity levels may be influenced by environmental factors such as class size, location and lesson contexts. These findings hold important policy implications for SPE class organization and emphasize the need for strategies that maximize children's MVPA (33). Many factors influence physical activity levels during PE classes. McKenzie et al. (20) found that 31% of the 45-minute PE scheduled time was wasted in changing clothes, and only 69% of the scheduled time (Mean=34min, SD=5.1) was used for SPE. Wang et al. (42) found that more than 30% of SPE scheduled time had been wasted mainly in changing clothes and bathing. McKenzie et al. (21) also reported that activity levels varied according to the content of SPE classes. The lesson contents, class size, playground size, facilities, discipline and management can all play an important role in the levels of indoor SPE (42). Inadequate organization of exercises that limits time spent in motor activity, like the placement of students in lines, is one of the methods that reduces the possibilities of young people to be physically active during SPE.

The quality of SPE classes depends on the learning opportunities created, on the clarity and enforcement of given instructions and on the ability to offer content that provides challenges to students. A successful SPE class should include: i) the preparation of lessons to facilitate learning; ii) the maximum participation and opportunity to practice the performance of motor tasks; iii) regular practice to evaluate and reinforce learning; iv) the inclusion of all participants in the proposed activities; v) after-school protocols to enhance the motor skills acquired in school; vi) education for fitness in order to help participants to understand, improve or maintain their physical wellness; vii) adequate equipment to facilitate PA; and viii) creation of opportunities to apply social and cultural benefits inherent to PA practice (25).

Some schools have reduced the time spent in SPE due to the imposition of curricular requirements in other disciplines. This action demonstrates the need to adopt curricula that support the quality and quantity of PA in order to improve adolescents' health and enhance motor development. Furthermore, the quality and quantity of PA organized by physical educators is variable, as is the priority given to the discipline by other teachers.

Some limitations of the study should be recognized. The study included a small number of adolescents from one specific geographic place and includes observations of one SPE class, which makes it difficult to generalize these findings. Further, it is not possible to infer causal relationships with a cross-sectional design. However, an advantage of our study was the

use of scheduled class time. We found that many studies use the effective SPE class time to express the percentage of SPE class time being physically active. For example, a recent study in Hong Kong showed that a 35-minute SPE lesson was reduced to only 22 minutes of effective class time, and thus children actually spent 32.4% of effective (or 19.7% of scheduled) class time at the recommended level of physical activity (16). The percentage is higher when the effective class time was considered (42). But the effective SPE class time is also changeable and incomparable; it does not count all the time wasted in SPE classes (such as the time spent in changing clothes, bathing, etc.). In agreement with this assumption, the intensity objective of 50% of class time is still far from being met.

## CONCLUSIONS

The proportion of MVPA/SPE fell short of the 50% recommended by guidelines, and males spent significantly more time engaged in MVPA/SPE than females. As age increased, the time spent in MVPA/SPE tended to decrease. These findings hold important policy implications for PE class organization and emphasize the need for strategies that maximize children's MVPA. The apparent disparity between recommended physical activity levels and the limited curriculum for SPE time serve to highlight the complementary role that education, along with other agencies and voluntary organizations, must play in providing young people with opportunities for PA.

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