



## ORIGINAL ARTICLE

## The importance of physical education classes in pre-school children

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**Aim:** The purpose of this study was to analyse differences between total physical activity (TPA) and moderate-to-vigorous PA (MVPA) of pre-school children during daily school hours when they attended the physical education class (PED) and school days without PE class (NPED) and to assess the contribution of PE classes to TPA in school hours.

**Methods:** The sample was composed of 193 pre-school healthy children (96 girls) aged from three to five years old and was conducted between February and December of 2008. Children wore accelerometers for at least four consecutive days during school hours. Data were analysed with specific software, age-specific counts-per-minute cut-off points and a 5 s epoch were used. Independent and general linear model repeated measures were used to assess differences between gender and differences between different days within each gender, respectively.

**Results:** Boys engaged more MVPA than girls ( $P < 0.05$ ). During PED, pre-school children engaged significantly more in TPA and MVPA than during NPED ( $P < 0.05$ ). PE class contributed, on average, 27.7% for the TPA and 32.8% of daily MVPA during PED in both gender.

**Conclusion:** The results of this study suggest that structured PA such as a PE class increased the daily TPA and MVPA level of pre-school children.

**Key words:** accelerometry; physical activity; physical education class; pre-schoolers.

### What is already known on this topic

- 1 The benefits of reducing a sedentary lifestyle and promoting physical activity have become increasingly important for public health.
- 2 Targeting children's patterns of physical activity is especially important given that increasing physical activity in childhood might be essential for the lifetime of regular physical activity.
- 3 Schools have long been recognized as key settings to promote and to contribute to physical activity guidelines because children spend a large amount of their day in school.

### What this paper adds

- 1 Present study suggested that in both genders, Physical Education Day were effective in increasing Total and Moderate to Vigorous Physical Activity levels.
- 2 Quality Physical Education can make important contributions to public health.
- 3 According to our data, Physical Education represented a good opportunity for children to accumulate Physical Activity.

## Introduction

Children's physical inactivity has been categorised as a modifiable risk factor for lifestyle-related diseases, and many of the known risk factors for chronic diseases are also presented in youth.<sup>1–3</sup> Furthermore, it has been suggested that physical inactivity during youth is linked to several health-related risks in adulthood.<sup>4</sup> Some studies indicate that levels of total energy expenditure and physical activity (PA) levels in pre-school children are very low<sup>5–9</sup> and levels of sedentary behaviour (SB)

exceptionally high.<sup>6,7,10,11</sup> The benefits of reducing a sedentary lifestyle and promoting PA have become increasingly important for public health.<sup>12,13</sup> Hence, the measurement of the PA at early ages is a key factor in lifestyle evaluation and a tool for its control. On the other hand, targeting children's patterns of PA is especially important given that increasing PA in childhood might be essential for the lifetime of regular PA.<sup>4,14</sup> Additionally, there is a need to understand the factors that influence PA in pre-schoolers and to learn how to help them to be more active.

Current health-related PA guidelines suggested that pre-school children should accumulate at least 120 min of PA per day (60 min daily of structured and 60 min daily of unstructured of PA)<sup>15</sup> for a healthy lifestyle. Some studies in children and adolescents have described daily patterns of PA, describing differences between defined time blocks within days.<sup>16,17</sup>

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Although in some countries, most PA for children occur outside of the school environment,<sup>18</sup> schools have long been recognised as key settings to promote and to contribute to PA guidelines because children spend a large amount of their day in school.<sup>19</sup> School physical education (PE) is recognised as the most widely available tool for promoting PA among children and adolescents.<sup>20</sup> However, limited attention has been given to pre-school children PE activities at school as well as to the contribution that kindergarten school PE to the overall daily total PA (TPA) and moderate-to-vigorous PA (MVPA) participation. Indeed, previous studies of PA in young children have been limited by the lack of adequate measures of PA. It is well known that at this age, children are unable to self-report their PA accurately,<sup>21,22</sup> and surrogate reports by parents and other adults have limited validity.<sup>23</sup> Recent reviews have concluded that accelerometer provides an objective, practical, accurate and reliable means of quantifying the amount and intensity of habitual PA in pre-school children.<sup>24,25</sup> Thus, little is known about the activity patterns of pre-school children, and no information is available whether there are substantial differences in days where children are involved in PE classes at school compared with those where they are not. This might be an important topic since further strategies of PA promotion targeting early childhood should be developed based on substantial pre-school population data.

Therefore, the purposes of this cross-sectional study were to analyse differences in TPA and MVPA of pre-school children during daily school hours when they attended the PE class (PED) compared with school days without PE class (NPED) and to assess the contribution of PE classes to the TPA in school hours.

## Materials and Methods

### Participants and setting

The participants of this study derived from the Preschool Physical Activity, Body Composition and Lifestyle Study (PRESTYLE) carried out in 2008. A random sample of 495 children aged two to five years old was recruited from six kindergartens in the District of the Metropolitan area of Porto in Portugal, while only 202 children wore accelerometer for five consecutive days during school time. In this study, we included only children aged three to five years old who had at least four complete school days of accelerometer data and that attended to at least one PE class, weight and height. The final sample included 193 healthy pre-school children (96 girls) aged three to five years old ( $\bar{X} = 4.8 \pm 0.8$  years old). Mean body height was  $107.5 \pm 6.6$  cm and mean body mass was  $19.8 \pm 3.6$  kg. These values were within the normal ranges for children of this age.<sup>6,10,26</sup> Informed written consent was obtained from the children's parents or guardian and the school principal. Study procedures were approved by the Portuguese Foundation for Science and Technology and by the ethics committee of Physical Activity and Health PhD programme of our faculty.

### Anthropometric measures

Body height and body weight were determined by standard anthropometric methods. Height was measured to the nearest

mm in bare or stocking feet with the adolescents standing upright against a Holtain portable stadiometer. Weight was measured to the nearest 0.10 kg, lightly dressed (underwear and t-shirt) using a portable digital beam scale (Tanita Inner Scan BC 532; Tanita B.V., Hoofddorp, The Netherlands).

### PA

Daily PA was measured using Actigraph accelerometer, model GTM1 (Pensacola, FL, USA). This is a small, lightweight, uniaxial device. This accelerometer produces 'raw' output in activity counts per minute (cpm), which gives information about the total amount of PA.<sup>27</sup> Alternatively, accelerometer output can be interpreted using age-specific cut-off points, which describe different intensities of PA. Data reduction, cleaning and analyses of accelerometer data were performed using a specially written programme (MAHUFFe; available at <http://www.mrc-epid.cam.ac.uk>), described and used previously.<sup>28,29</sup> Data were analysed using specific paediatric cut-points, which have been validated for young children.<sup>30</sup> The age-specific cpm cut-offs for three-, four- and five-year-old children with regard to different activity intensities (cpm) were, respectively: sedentary –  $\leq 1204$ ,  $\leq 1452$ ,  $\leq 1592$ ; light PA –  $> 1205$ ,  $> 1453$ ,  $> 1593$ ; MVPA –  $\geq 2457$ ,  $\geq 3245$ ,  $\geq 3561$ . These cut-points were used and recommended by Sirard<sup>30</sup> and Alhassan.<sup>10</sup>

For the purpose of this study, the epoch duration or sampling period was set to 5 s (5-s) in order to detect more accurately the spontaneous and intermittent activities of the children.<sup>31,32</sup>

### Protocol

The study was conducted on five consecutive school days (Monday to Friday) between February and December of 2008 to account seasonal variation, during school hours for a minimum of 6 h per day. Teachers were instructed to place the accelerometer on the respective child on the arrival at school and remove it before they went home. The accelerometer was firmly adjusted at the child's right hip by an elastic waist belt under clothing (own clothes and school coat). A data sheet was given to the children's teachers, who were instructed to record the time when the monitor was attached in the morning and detached in the evening. They were also instructed to note every time the children performed any activity such as swimming, gymnastics, walking, gardening and simply going to the recess. Activities were not prescribed or directed by the teachers and researchers. The children participated in normal activities with their classmates.

### PED

PE class formed part of the regular school curriculum and was carried out once a week by a specialised PE teacher. Each session lasted 50 to 60 min and the sessions provided different kind of activities such as ball games, callisthenics, gymnastics and exercises to improve co-ordination, flexibility and fundamental motor skills (jumping, throwing, etc. . . .). These activities were

not reported by the authors, but each teacher was asked about the class content, which was not modified due to the realisation of the study.

### Statistical analysis

All data were checked for normality prior to statistical analysis. Descriptive statistics were used in order to characterise and describe the sample. The daily school time spent in MVPA was calculated by summing the minutes of moderate and vigorous PA for each day. To examine the patterns of PA participation, data from the school time were divided into two groups: PED and school days without PE class (NPED). Gender differences in TPA and MVPA between PED and NPED were tested with independent sample *t*-test and general linear model (GLM) – repeated measures were used to analyse differences in TPA and MVPA between PED and NPED within each gender and interaction between genders. All statistical analysis was performed

using SPSS 15.0 for Windows (SPSS Inc., Chicago, IL, USA). The level of significance was set at  $P < 0.05$ .

### Results

Table 1 summarises PA patterns of the entire sample and of each gender. On average, the boys were more active than the girls ( $P < 0.05$ ).

Class duration ranged between 50 and 60 min. Mean values for TPA and MVPA and for the PED and NPED are shown in Figure 1.

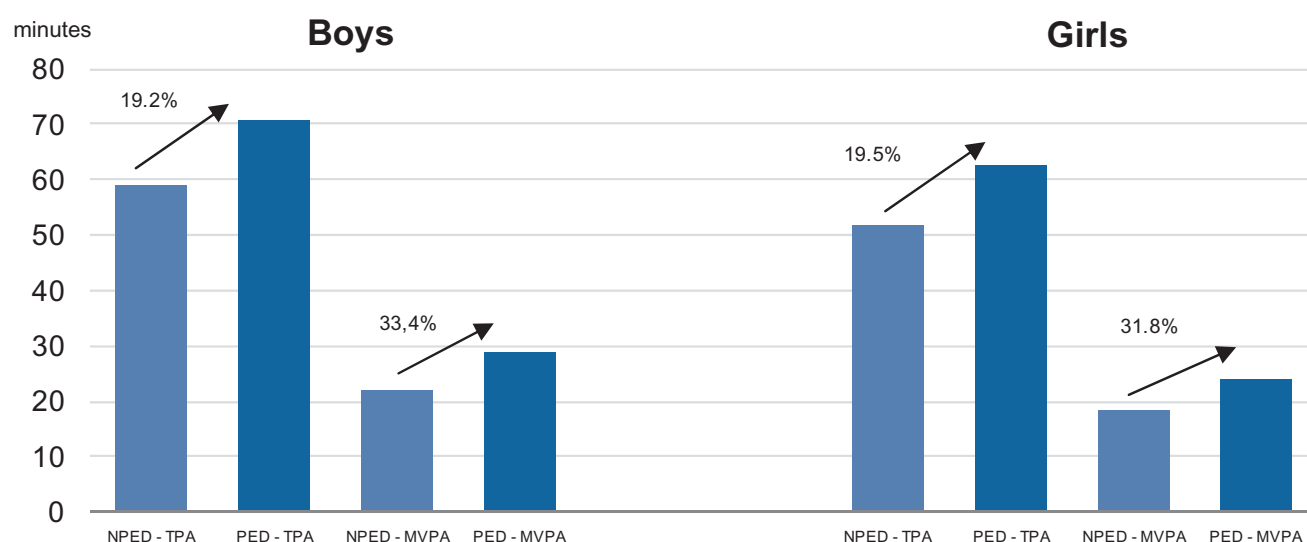
Using GLM repeated measures, NPED had a significantly lower mean than TPA and a lower mean than MVPA and than PED in both genders ( $P < 0.05$ ). During PED, the pre-school children engaged significantly more in TPA and MVPA (66.40 min; 26.55 min) than during NPE (55.45 min; 20.16 min) ( $P < 0.05$ ). This represents an increased TPA and MVPA participation of 19.5% and 31.8% in girls and 19.2% and 33.4% in boys, respectively, during the PED.

**Table 1** PA patterns among gender between physical education class day (PED) and between average of the school days without PE class (NPED)

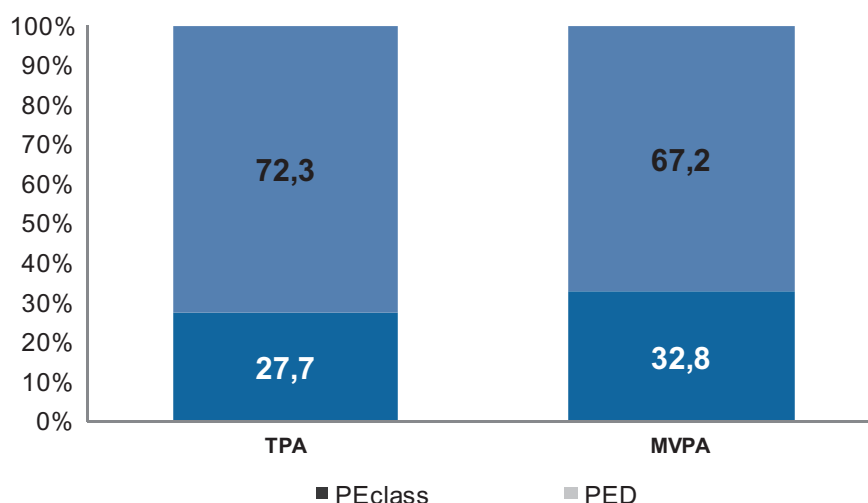
	All ( <i>n</i> = 193)	Boys ( <i>n</i> = 97)	Girls ( <i>n</i> = 96)	<i>P</i>
TPA				
PED (minutes)	66.40 ± 22.08	70.49 ± 24.28	62.28 ± 19.38	0.009
NPED (minutes)	55.45 ± 17.17	59.14 ± 17.25	52.14 ± 16.06	0.006
MVPA				
PED (minutes)	26.55 ± 12.18	29.39 ± 13.14	24.08 ± 11.11	0.005
NPED (minutes)	20.16 ± 9.12	22.03 ± 9.14	18.27 ± 8.28	0.003

All data expressed as mean ± SD.

MVPA, moderate-to-vigorous physical activity; NPED, days without PE class; PED, physical education class day; TPA, total physical activity.



**Fig. 1** Mean values for total physical activity (TPA) and for moderate-to-vigorous physical activity (MVPA) for the physical education class day (PED) and days without PE class (NPED) for boys and girls.



**Fig. 2** Physical education class contributed for the total physical activity (TPA) and for moderate-to-vigorous physical activity (MVPA) in the physical education class day (PED) on average in both gender.

There wasn't a significant interaction between the genders for TPA ( $F = 0.410$ ;  $P = 0.523$ ) and MVPA ( $F = 0.768$ ;  $P = 0.382$ ), therefore PE class was analysed taking into consideration the whole sample. Thus, PE class contributed on average 27.7% for the TPA and 32.8% for daily MVPA during PED in both gender (Fig. 2).

## Discussion

This study reports information about the participation of pre-school children in MVPA during school hours period, comparing PED and NPED.

The data of the present study suggested that in both genders, PED were effective in increasing TPA and MVPA levels. Indeed, during PED, pre-school children engaged significantly more in TPA and MVPA (66.40 min; 26.55 min) than during NPE (55.45 min; 20.16 min) ( $P < 0.05$ ). This represents an increased TPA and MVPA participation of 23.5% and 39% in girls and 24.2% and 43% in boys, respectively, during PED. To the best of our knowledge, no data have focused its attention on the kindergarten PE class contribution to health-related daily PA recommendations. Therefore, comparison of results are difficult. However, such data are valuable for the designing of interventions to increase PA as well as for tailoring individual exercise prescription as described in other specific groups.<sup>33</sup> Furthermore, in the context of increasing levels of PA since early childhood, these findings are worthy to comment. Indeed, general guidelines suggested that pre-school aged children should accumulate at least 120 min of PA per day (60 min daily of structured and 60 min daily of unstructured of PA).<sup>15</sup> This might be particularly important because physical inactivity is an important contributing factor to the maintenance of childhood obesity<sup>34,35</sup> and recent data showed high rates of obesity even in such a young age group.<sup>26,36,37</sup>

Quality PE can make important contributions to public health.<sup>20</sup> According to our data, PE represented a good opportunity for children to accumulate PA.

Our data highlight that PE class contributed, on average, 27.7% for the TPA in PED. Moreover, during PED, MVPA

increased, on average, 32.8% compared with NPE, which is important even though the PA recommendations do not make reference to intensity of PA for these ages. Whereas some children take this opportunity, others do not and significant individual differences in PA levels were evident. In fact, our study showed large standard deviations records suggesting wide individual variations in PA. This high variability in TPA and MVPA levels occurred during the day because children may have too many opportunities where they could freely choose to be sedentary or to participate in physical activities of various intensities.<sup>38</sup>

Based on our outcome, we can suggest that structured PA, such as PE classes are important contributors of daily TPA and MVPA. Thus, PE at this young age might be an interesting and valuable strategy not only to increase TPA but also to stimulate motor development. Children with better developed motor skills may find it easier to be active and engaged in more PA.<sup>39</sup>

The strengths of this study are the focus on patterns of PA in pre-schoolers and the fact that it addresses differences between PED and NPED using an objective PA measure, which has not been carried out so far, and using age-specific PA cut-points thresholds.<sup>25,30,40</sup> Some limitations of the study should be recognised. The study included pre-school children from one metropolitan area only, which makes it difficult to generalise these findings. Further, it is not possible to infer causal relationships with cross-sectional design. Nevertheless, this study focuses on the assessment of TPA and MVPA levels in a pre-school sample using an objective measure with a high compliance rate during school hours. This enhances the confidence in our findings because it was suggested that objective measures such as accelerometers provide more valid PA assessment in children.<sup>25</sup> The 5-s epoch used in this study, it is preferable as it captures larger amounts of data, has already been shown in other study<sup>31,32</sup> and it is more accurate to assess MVPA.<sup>41</sup> Additionally, the large standard deviations suggest wide individual variations addressing the importance of the participants' intra-individual variability in PA behaviour. However, other studies should be carried out to replicate our data. The acknowledgement that children spend a large amount of their

day in school and in PE class was effective in increasing TPA and MVPA levels so future longitudinal studies should examine its association with some health indicators, such as obesity.

## Conclusion

In conclusion, the results of this study suggest that structured PA such as a PE classes may increase the daily TPA and MVPA levels in pre-school children, emphasising the importance of PE classes at these ages.

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