

MINISTERUL EDUCAȚIEI ȘI CERCETĂRII
UNIVERSITATEA "DUNĂREA DE JOS" GALAȚI



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COMUNICĂRI ȘTIINȚIFICE**

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domeniul educației fizice și sportului
din România în perspectiva integrării
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par să pună accent pe armonia mișcării și îndemânare, iar cercetătorii par să pună accent pe tratarea globală a acestui concept, inclusiv a mișcărilor grosiere, necizelate.

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Physical activity levels in childhood and adolescence. Age and gender differences

Lopes Vitor P.¹, Vasques Catarina¹, Ferreira João C. V.², Maia, José A. R.³

¹School of Education, Polytechnic Institute of Bragança, Portugal

²School of Education, Polytechnic Institute of Viseu, Portugal

³Faculty of Sport Science, University of Porto, Portugal

INTRODUCTION

There is a strong agreement that physical activity (PA) positively influences individual health status. Regular PA is an important factor along the whole life cycle to promote a healthy life style. In childhood and youth, the main effects of physical activity are on the promotion of habits and attitudes that are thought to be carried out through the adult stage. In adulthood the benefits are of several levels, as documented in different epidemiological papers. PA is associated a) with longevity increase; b) with lower risks of cardiovascular diseases and c) with the decrease of some of the risk factors associated with cardiovascular diseases, such as obesity and hypertension (Blair, 1993; Mackelvie *et al.*, 2001; Vuori, 2001; Westerterp & Goran, 1997; Williams, 2001).

Childhood and adolescence are golden ages to promote and acquire PA habits. Physical activity promotion in childhood and adolescence is partially based on the assumption that PA habits are developed during these periods of life and are

maintained throughout adulthood. Physical activity is a complex behaviour that changes over the day, the week, the season, and over the year. In reality, no one has two equal days in PA. Nevertheless, to have a positive impact on health, PA must have a regular basis over the days.

The importance of evaluating PA in any population is due to the need of establishing (1) the current level of PA of that population and (2) to determine if its level is appropriate for health.

Most of the epidemiological studies in youth indicate that boys are more active than girls (Trost *et al.*, 2002). Longitudinal studies report that PA declines with age mainly between childhood and adolescence and during adult age (Kimm *et al.*, 2000a; Telama & Yang, 2000; van Mechelen *et al.*, 2000).

In Portugal most of the studies carried out with youth use self-report methods to assess PA. Although these studies contain important new knowledge about PA of Portuguese children and adolescents, it seems that a more precise and objective understanding about the PA characteristics of Portuguese children and adolescents population is necessary. Therefore, the purpose of this study was to evaluate age and gender differences in PA of children and adolescents, using accelerometry as an objective method of PA evaluation.

METHODS

Sample

The sample size comprises 158 individuals (81 female, 77 male) grouped as follows: group 1 aged 6 to 10 years, $n = 60$ (26 boys and 34 girls); group 2 aged 11 to 13 years, $n = 63$ (33 boys and 30 girls); and group 3 aged 16 to 18 years, $n = 35$ (21 boys and 14 girls).

Physical Activity Measure

PA was evaluated for 7 consecutive days with the MTI (Manufacturing Technology, Inc., Fort Walton Beach, FL, USA) actigraph (former CSA) model 7164 was used as an objective measure of PA. The MTI actigraph is a uniaxial accelerometer designed to detect vertical acceleration ranging in magnitude from 0.05 to 2.00 Gs with frequency of 0.25-2.50 Hz. These parameters values allow the detection of normal human motion and will reject motion from other sources such as riding in a car and machinery operation. The filtered acceleration signal is digitised and the magnitude is summed over a user-specified time interval (epoch). At the end of each interval, summed value or activity count is stored in memory, and the integrator is reset (Computer Science and Application, Inc., 1995). For this study, a 1-min epoch was used.

Several studies have shown the validity of the MTI actigraph using indirect calorimetry (Eston, Rowlands e Ingledeew, 1998; Puyau *et al.*, 2002; Trost *et al.*, 1998; Welk, Corbin e Dale, 2000) and doubly labelled water (Ekelund *et al.*, 2001) as criterion measures.

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Subjects were instructed to wear the MTI actigraph during waking hours. Monitors were attached to an elastic belt worn firmly over the waist. Subjects were instructed not to remove the device, except for bathing, swimming or sleeping. Each subject had to register the time that they wore the monitor on a sheet.

The stored activity counts were downloaded to a computer for subsequent data reduction and analysis. The MTI actigraph data was reduced to bouts (20, 10, and 5 min.) of sustained moderate, and vigorous PA, as well as to minutes spent in moderate-to-vigorous (3-5.9 METs) PA (MVPA), vigorous (6-8.9 METs) PA (VPA), and very vigorous (≥ 9 METs) PA (VVPA), with a specific software. The age-specific count ranges corresponding to the above intensity levels were derived from the energy expenditure prediction equation developed by (Freedson *et al.*, 1997):

$$\text{METs} = 2.757 + (0.0015 * \text{counts} * \text{min}^{-1}) - (0.08957 * \text{Age}[\text{yrs}]) - (0.000038 * \text{counts} * \text{min}^{-1} * \text{Age}[\text{yrs}])$$

Statistical Analysis

Factorial ANOVA (gender*age group) was used to test gender and age group differences in PA variables. VVPA was excluded from the analysis because mean scores are zero or close to zero in all groups. All statistical analysis were done in SPSS 10.0. Statistical significance was set at $P \leq 0.05$.

RESULTS

In Figures 1 and 2 are displayed the means and standard deviations for daily MVPA and VPA respectively. ANOVA results indicate no gender*age group interaction effects both in MVPA and VPA. Significant differences were found in daily MVPA and VPA both in boys and girls and among age groups, with daily MVPA and VPA exhibited a significant inverse relationship with age groups (MVPA - $F(2, 152)=105.068, p<0.001$; VPA - $F(2, 152)=28.333, p<0.001$).

For MVPA, the group difference relative to the previous age group was, in girls, about 50% in both cases. In boys the difference are of less magnitude: between group 1 and group 2 was 32%, and between group 2 and group 3 was 47.8%. For VPA in girls the difference between group 1 and group 2 was 43.5%, and between group 2 and group 3 was 68.3%. In boys the difference between group 1 and group 2 was 42.9%, and between group 2 and group 3 was 32.8%.

maintained throughout adulthood. Physical activity is a complex behaviour that changes over the day, the week, the season, and over the year. In reality, no one has two equal days in PA. Nevertheless, to have a positive impact on health, PA must have a regular basis over the days.

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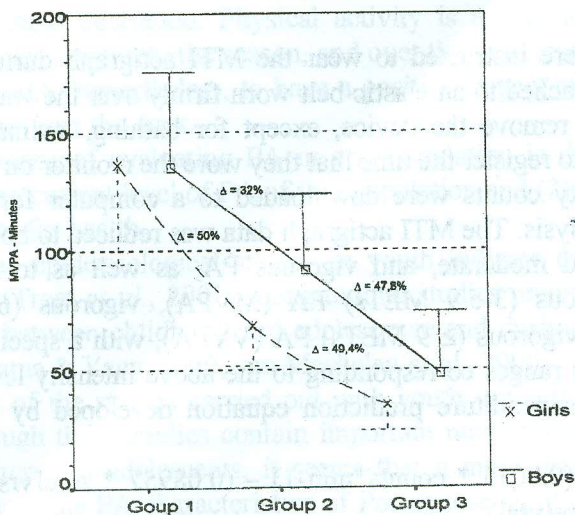


Figure 1 - Mean ± SD for daily MVPA by gender and age group

Significant differences were found between boys and girls both in MVPA and VPA (MVPA: $F(1, 152)=5.119, p=0.025$; VPA: $F(1, 152)=15.093, p<0.001$). Except for MVPA in group 1 where the differences between boys and girls was only 1%, boys of all age groups were more active than girls. The magnitude of the difference was for MVPA in group 2 34.7% and in group 3 39%. For VPA the difference in group 1 was 44.3%, in group 2 was 45.8% and in group 3 was 200%.

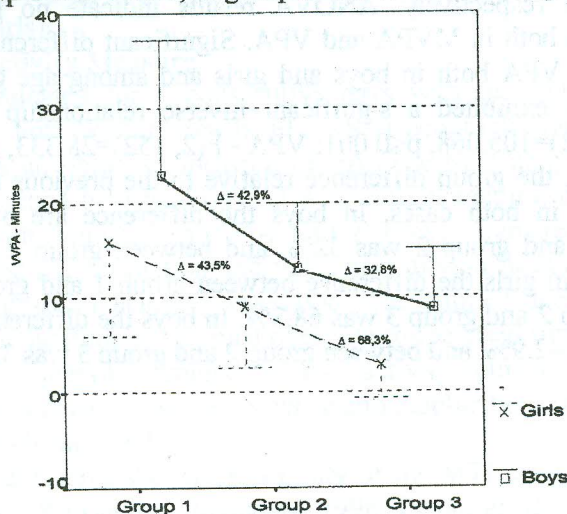


Figure 1 - Mean ± SD for daily VPA by gender and age group

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Means and standard deviations for the weekly number of 20-, 10-, and 5-min bouts of MVPA and VPA are shown in Table 1 and Table 2 respectively. There was a significant decrease in participation in bouts (20, 10, and 5-min.) of sustained MVPA with age (20-min bout: $F(2, 152)=24.365, p<0.001$; 10-min bout: $F(2, 152)=31.964, p<0.001$; 5-min bout: $F(2, 152)=71.988, p<0.001$). The decrease is in both boys and girls, there's no significant gender*age group interaction effect except in 5-min bouts but this is because girls who had higher mean value in age group 1 decreased (mean of 53% between adjacent groups) more than boys (mean of 41% between adjacent groups). Although there were significant gender differences (20-min: $F(1, 152)=17.33, p<0.001$; 10-min: $F(1, 152)=7.97, p=0.005$; 5-min: $F(1, 152)=3.973, p=0.048$), with boys of all age group showing significantly more bouts of sustained PA of any kind than girls, except in 5-min bouts in age group 1. In girls, only group 1 had a week mean of 3 bouts 20-min of sustained moderate PA, while in boys only group 3 did not have a week mean of 3 bouts 20-min of sustained moderate PA.

Table 1: Mean±sd of weekly 20-, 10-, and 5-min bouts of MVPA (≥ 3 METs) by gender and age groups

	Group 20-min bouts		10-min bouts		5-min bouts	
	Girls	Boys	Girls	Boys	Girls	Boys
1	3.15±3.09	6.19±3.94	12.76±7.19	15.23±7.13	38.74±13.99	36.50±14.95
2	1.09±1.38	2.90±2.58	6.52±4.89	9.17±6.63	16.52±6.24	25.90±11.00
3	0.86±1.66	1.48±1.69	2.64±1.69	5.95±4.19	8.57±3.65	12.38±8.26

For bouts (20, 10, and 5-min.) of sustained VPA there was a significant decrease with age, except in 20-min bouts, but the mean in both boys and girls of the three age groups have a mean near zero (10-min: $F(2, 152)=3.279, p=0.04$; 5-min: $F(2, 152)=15.341, p<0.001$). The boys and girls from group 3 exhibited a mean of zero or approximately zero. In fact, boys and girls from all age group have very few bouts of VPA over the week. There was a significant gender differences, except in 20-min bouts (10-min: $F(1, 152)=5.925, p=0.016$; 5-min: $F(1,$

152)=11,339, p=0,001), boys participate more in bouts of sustained VPA than girls, except in 20-min bouts in group 3.

Table 2: Mean±sd of weekly 20-, 10-, and 5-min bouts of VPA (≥6 METs) by gender and age groups

Group	20-min bouts		10-min bouts		5-min bouts	
	Girls	Boys	Girls	Boys	Girls	Boys
1	0.03±0.17	0.04±0.04	0.44±0.11	1.19±1.32	3.18±2.9	6.38±6.2
2	6.06E-02	0.17±0.20	0.42±0.96	0.37±0.86	1.52±1.7	2.43±2.9
3	2±0.35	75	66	61	5	4
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DISCUSSION/CONCLUSION

The decrease of PA verified along the age is pronounced in both boys and girls, and is consistent with the preponderance of published empirical literature, supporting the idea that PA declines with age (Sallis, 2000). Through childhood and adolescence PA decreases rapidly in the same magnitude, indicating that the decline begins early in childhood, contrary to previous studies that report that the decline begin in adolescence (Telama & Yang, 2000; van Mechelen *et al.*, 2000). This contradictory results are, perhaps, due to the fact that only few of these studies include young children in samples. In a sample of 2309 of both gender, (Telama & Yang, 2000) have found a marked decline after 12 years of age. Also Kimm *et al.*, (2000b) report a decline in the transition between childhood and adolescence in a sample of 2379 children observed between 9 and 18 years of age. Yet, in a large study (n=3742) with children aged 6-10 years Lopes *et al.*, (2003) evaluated PA with a questionnaire and found no PA decline. It is possible that the questionnaire didn't have the ability to evaluate PA as accurate as accelerometry. The degree of the decline in the present study is of the same magnitude reported by Trost *et al.*, (2002). One limitation of the present study, and also some others about this issue, is that they are of cross-sectional nature, due to that we are unable to be absolutely confident that decline is of the magnitude registered.

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Literature reports that boys are more active than girls, that is, they engage more in vigorous and in competitive PA. (e. g. Janz, Witt & Mahoney (1995). The results of present investigations confirm this general idea. Across the three age groups, boys are consistently more active than girls, and the difference is more marked in VPA. In a longitudinal study between 13 and 27 years of age, van Mechelen *et al.* (2000) found that girls had more participation in moderate PA than boys, nevertheless, due to the low involvement of girls in vigorous PA, the boys had significant high values of total participation in PA. Also Mota & Esculcas (2002) found by means of a questionnaire that adolescent girls are significantly more inactive than boys. Despite the fact that we don't find significant gender*age group interaction, indicating no significant difference between boys and girls in PA decline, the results show that the overall PA decline was greater in girls than in boys, and this decline was even greater when we considered VPA. The consistency of these results heightens the need of special attention, in eventual intervention programs for the promotion of PA in girls of all ages.

Throughout the 7 days of observation, children and adolescents of the sample of this study, mostly the older, performed very few sustained bouts of PA. In fact, only group 1 performed 3 or more 20-min bouts of sustained MVPA. Participation in continuous 20-minutes bouts of VPA was near zero in both genders of all age groups. Hence, it seems that mainly the adolescents of the sample of this study, don't accomplish the PA recommendation of 30 minutes a day of MVPA (Cavill, Biddle & Sallis, 2001), or 20 minutes a day of VPA (Sallis & Patrick, 1994). Even so, there was a great participation in shorter bouts (10 and 5 minutes) of MVPA, and in younger boys there was also a remarkable participation in 5-min bouts of VPA. Perhaps these recommendations don't take into account the PA characteristics of children and youths. Children's typical pattern of PA is characterized by short, intermittent bouts of VPA with frequent rest periods of longer duration. Bailey *et al.* (1995) reported that in children 95% of VPA lasted less than 15 s and only 0.1% of bouts were longer than a minute, and no bouts longer of 10 minutes was recorded. The median duration of low and moderate PA was 6 s while the duration for VPA was 3 s. Maybe the criteria to define the duration and frequency of PA, which are based on more structured, adult-patterns of activity, are not appropriate for children. Welk, Corbin & Dale (2000) propose that a better criterion to define frequency would emphasize the accumulation of intermittent activity throughout the day. Depending on the approach used, an appropriate criterion for children might be the percentage that reports 2-3 bouts of short, intermittent activity totalizing 30-60 minutes on at least 5 days a week. The mode of PA is also different between older and younger subjects, older subjects are described as involved in more formal PA, while younger mostly chose informal PA whatever their level of PA (Mota & Esculcas, 2002).

In summary, we found that boys of all ages are more active than girls, the adolescents, which is the older group (16-18 years of age) of both gender do not comply with physical activity guidelines which recommend 20-min a day of MVPA. We also found that the older groups of both gender had significantly less PA than the older ones, however, due the cross-sectional design of this study we are unable to draw definitive conclusions concerning age-related trends in physical activity. Therefore, longitudinal objective monitoring studies with long-term follow-up are recommended.

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