Original research

Physical activity levels in Portuguese adolescents: A 10-year trend analysis (2006–2016)

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A B S T R A C T

Objectives: Previous studies have indicated that only a small proportion of Portuguese adolescents attain sufficient levels of physical activity for health. However, it is unknown whether the levels of moderate to vigorous physical activity (MVPA) have changed over a considerable time period in this country. Therefore, the aims of the present study were to examine the 10-year trend changes in self-reported MVPA among adolescents and also investigate differences by sex and age.

Design and method: This study compared two cross-sectional cohorts of youngsters aged 12–18 years, recruited in 2006 (N = 1010; 461 boys and 549 girls) and in 2016 (N = 1096; 461 boys and 635 girls), using identical procedures and instruments. The outcome variable, MVPA, was assessed by using the PACE+ screening measure.

Results: Main results showed a considerable decline in the overall levels of physical activity between 2006 and 2016 (−10.8%), as well as a small and declining proportion of adolescents achieving the international physical activity recommendations (2006: 10.7%; 2016: 8.1%). Age and sex-specific comparisons by time periods indicated that the 13- and 14-year-old male adolescents reported lower levels of MVPA in 2016 than their counterparts in 2006, and that the MVPA decline between the subgroups of 12- and 18-year-olds was higher in girls, in both 2006 and 2016.

Conclusions: This study provides evidence of a secular decrease in self-reported MVPA levels among Portuguese adolescents. These results reinforce the need for interventions and policies aimed at promoting a more active lifestyle throughout adolescence.

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1. Introduction

Physical activity is a multidimensional and multifactorial behavior that has been consistently associated with several positive youth health outcomes.[1] In order to achieve these health benefits, several national and international organizations/health authorities have issued guidelines that recommend a daily accumulation of a minimum of 60 min of moderate to vigorous physical activity (MVPA) by children and adolescents.[2] Despite these recommendations and several calls to action for increased physical activity, epidemiological studies have documented that more than half of young people worldwide do not meet the current recommendations.[3] More specifically, results from recent studies, using self-report measures, have shown that only a small proportion of Portuguese adolescents (less than 20% of the boys and 10% of the girls) attain sufficient levels of physical activity for health.[3,4] Moreover, one study using

accelerometer-based activity monitors also showed that a very small percentage of Portuguese adolescents achieved a total of 60 min of MVPA per day: 16.8% in youth aged 12–13 years declining to 4.1% in youth aged 16–17 years.[5] In addition, adolescence has been identified as one of the age periods of greatest decline in physical activity and sports participation, in cross-sectional,[6] longitudinal[7] and meta-analytic studies.[8,9] This age-related negative effect has been observed in different sexes, socioeconomic conditions, physical activity intensities, and countries.[9–11]

Trend analysis studies are of great significance into examining possible changes during specific time periods (i.e., comparison of birth-cohorts). This type of research provides further insight into the changes in the behaviors or socio-cultural circumstances that different birth cohorts experience during a specific period of time. From a public health perspective, monitoring trends in physical activity during adolescence is a crucial aspect for investigating and understanding the impact of programs and policies aimed at reducing physical inactivity in this population group. Moreover, an additional emphasis on the effects of sex and age on the

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adolescents' physical activity levels is of paramount importance to investigating specific group changes over time (i.e., aggregate change over time) and to identifying at-risk youth in need of further attention and intervention. Trend analysis studies on physical activity over a decade or more (i.e., secular trend) are scarce and further investigations are warranted, especially when considering the full age range of adolescence.[12–14] Thus, this study sought to address the limitations of previous research and extend previous findings by examining the physical activity levels in Portuguese adolescents over a 10-year time period.

Therefore, the aims of the present study were to examine secular trend changes (2006–2016) in self-reported MVPA among Portuguese adolescents (12–18 years old) and investigate differences by sex and age.

2. Methods

The study design is a repeated cross-sectional analysis of self-report data collected in two different time periods using the same instruments. Two large samples (n > 1000) were drawn from the same regions and during the same months of the year, in order to control for possible geographical and seasonal effects. A school-based survey was conducted in the central region of Portugal among adolescents aged 12–18 years. Data collection occurred at two different times separated by a 10-year interval: the first trimester of 2006 and 2016. To obtain a large sample size, a multistage sampling procedure was employed to select the study participants. First, specific geographic regions were selected, namely the districts of Aveiro, Viseu, Guarda and Castelo Branco. Secondly, a predetermined equal number of public schools were chosen in each district using a purposive sampling technique. Finally, random classes from 7th to 12th grades were selected in each school. The inclusion criterion was age between 12 and 18 years at the moment of data collection.

Sample 1 was recruited in 2006 and consisted of 1010 adolescents (461 boys and 549 girls) aged between 12 and 18 years ($M = 15.04$, $SD = 1.87$). Sample 2 was recruited in 2016 and comprised 1096 adolescents (461 boys and 635 girls) with ages ranging from 12 to 18 years ($M = 14.53$, $SD = 1.67$). No significant difference was found in terms of distribution by sex across time periods ($\chi^2_{(1)} = 2.74$, $p > 0.05$). On the other hand, the mean age of the participants was significantly higher in 2006 ($F_{(1,2104)} = 44.42$, $p < 0.001$), showing a small effect ($d = 0.29$). When examined separately by sex, age differences were also found in boys (2006: 14.87 ± 1.95; 2016: 14.40 ± 1.66; $F_{(1,920)} = 15.71$, $p < 0.001$) and girls (2006: 15.18 ± 1.78; 2016: 14.62 ± 1.66; $F_{(1,1182)} = 31.31$, $p < 0.001$) across the time periods, albeit small ($d = 0.26$ and $d = 0.32$, respectively). When examined separately by time periods, a higher mean age was found in girls in 2006 (girls: 15.18 ± 1.78; boys: 14.87 ± 1.95; $F_{(1,1008)} = 4.51$, $p = 0.034$, $d = 0.17$) and in 2016 (girls: 14.62 ± 1.66; boys: 14.40 ± 1.66; $F_{(1,1094)} = 6.70$, $p = 0.01$, $d = 0.13$), in comparison to boys. Due to these age differences, age was used as a covariate in subsequent analysis.

Demographic characteristics were assessed via self-report in terms of the adolescents' sex and age. Physical activity was assessed by using a self-report screening measure (PACE+ Adolescent Physical Activity Measure).[15] This 2-item single measure aims to assess the number of days individuals had accumulated at least 60 min per day of MVPA over the previous 7 days or during a typical/usual week, not including physical education or gym class. Physical activity is defined as "any activity that increases your heart rate and makes you get out of breath some of the time" (p. 559), which can be done in a number of settings (sports, playing with friends, or walking to school).[15] Responses are given on a 0–7 days scale for each item and averaged to create a composite measure. With

this in mind, the authors of this instrument also suggested that a score of less than 5 would indicate that the adolescent did not met the guideline of accumulating MVPA (i.e., 60 min) at least 5 days per week, which was also adopted in our study. The seminal study[15] presented evidence supporting the reliability (test-retest) and concurrent validity of this measure against accelerometer data. Although initially developed for use in primary care settings, several studies have provided further evidence for the validity and usefulness of the PACE+ self-report measure for assessing physical activity patterns among youth.[16,17] In the present study, the construct validity and internal consistency of this measure was also determined. Separate principal-component analyses with varimax rotation were performed on each data set (2006 and 2016). Results showed that the two items loaded highly (>0.90) onto one factor explaining 88.9% of the total variance in the 2006 data and 89.6% of the total variance in the 2016 data. Inter-item Pearson correlations were similar across data sets (0.78 in 2006 and 0.79 in 2016). Consequently, the reliability of this two-item scale was determined using the Spearman-Brown coefficient. High internal consistency values were obtained for this measure (0.87 in 2006 and 0.88 in 2016).

All phases of the study have received research ethics approval from the Institutional Ethics Committee of the University of Trás-os-Montes and Alto Douro and all procedures were conducted in compliance with the Helsinki Declaration. After obtaining the ethics committee's approval, school directors and teachers were contacted via post or electronic mail and informed about the study's aims and procedures. Following the schools' permission to conduct the study, written informed consent was obtained from all the students' parents/legal guardians or from all students aged 18 years. The administration of the questionnaire was carried out by school teachers who received information on standard procedures to follow. The measures were completed individually by students at the beginning or end of a lesson, in a quiet classroom condition. Completion of the questionnaire required an average of 15 min. The confidentiality and anonymity of the participants were guaranteed and participation was voluntary. No compensation was given to the adolescents for participation in the study.

In terms of statistical analysis, both data sets were initially inspected for input errors, missing values and extreme cases (i.e., outliers). Descriptive statistics included the means, standard deviations (SD), 95% confidence interval (CI), adjusted means (adjusted for age differences in the ANCOVA), percentages (%), range and interquartile range. Percentage of change was calculated as: (end value – initial value)/initial value × 100. The chi-square test was employed for the comparison of proportions between variables. The analysis of variance (ANOVA) was applied in order to investigate the effects of sex and age on physical activity levels. The analysis of covariance (ANCOVA) was used to examine the differences between groups (time period and sex) on self-reported physical activity levels, while controlling for age. Estimates of effect size (Cohen's d and partial eta squared: η^2) were used to interpret the magnitude of the differences between groups. Effect size estimates were considered to be small ($d > 0.2$, $\eta^2 > 0.01$), medium ($d > 0.5$, $\eta^2 > 0.06$) or large ($d > 0.8$, $\eta^2 > 0.14$).[18]

3. Results

The variation in the physical activity levels during the years of adolescence is presented in Fig. 1 for both samples (2006 and 2016).

ANCOVA results indicated that the adolescents of the 2006 sample reported higher age-adjusted mean levels of physical activity participation than their counterparts in 2016 (2.14 vs. 1.91, respectively; $F_{(1,2103)} = 10.99$, $p = 0.001$, $\eta^2 = 0.10$). On the other hand, age-specific comparisons between time periods only indicated significant differences in the subgroups for ages 13 and