Trends and Age-Related Changes of Physical Activity Among Portuguese Adolescent Girls From 2002–2014: Highlights From the Health Behavior in School-Aged Children Study

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Background: To examine the trends of moderate- to vigorous-intensity physical activity (MVPA) from 2002, 2006, 2010, and 2014 in a representative sample of Portuguese adolescent girls and to investigate MVPA changes during adolescence in surveys of each year and by generation. Methods: A nationally representative sample of 6018 girls between 11 and 13 years and 3838 girls between 15 and 17 years was drawn from the Health Behaviour in School-Aged Children surveys in 2002, 2006, 2010, and 2014. A questionnaire was used to collect data of MVPA. Data were assessed with analysis of variance, *t* test, chi square, and chi-square test for trend. Results: The percentage of 11- to 13-year-old girls reporting 60 minutes of daily MVPA was low and stable between 2002 (9.5%) and 2014 (11.1%) ($P = .21$), such as for girls aged 15–17 years (2002 = 5.6%, 2014 = 5%, $P = .81$). The percentage of girls reporting 60 minutes MVPA decreased significantly among age groups in all year surveys. A significant decrease in correlation with age across the same generation of adolescents was also found. Conclusion: This study points out that the prevalence of Portuguese girls meeting the PA guidelines is low, declines with age, and is stable from 2002–2014. Therefore, different strategies to prevent MVPA decline and promote MVPA are needed since childhood.

Keywords: exercise, gender, health behavior, youth, public health

For the benefit of health, children and adolescents aged 5–17 years should engage in at least 60 minutes per day of moderate- to vigorous-intensity physical activity (MVPA).[1] However, PA levels decline from childhood through adolescence,[2] and about four-fifths of adolescents report not to reach the recommended level of physical activity (PA).[3] With physical inactivity increasing the risk of many health conditions, this situation represents a major public health issue.[4] Thus, as PA habits established in youth are likely to be carried through adulthood,[5] it is urgent to promote PA and to prevent the PA decline in adolescence, especially in girls.[2,3] Compared with boys, girls are consistently less active[3] and the decline of their PA levels is greater and starts at younger ages.[2] As such, girls have been identified as a priority group for interviewing and increasing their PA.[3,6,7] In this regard, cross-national studies have shown that Portuguese adolescent girls are among the least active.[6,8] Indeed, only 16.0% of Portuguese girls aged 11 years and 5.0% of girls aged 15 years self-reported to engage in at least 60 minutes of daily MVPA.[6] Objective data obtained by accelerometry in a national representative sample also show that only 22.5% of girls aged 10–11 years and 1.2% of girls aged 16–17 years were considered sufficiently active.[9]

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To help evaluate the effectiveness of national policies on PA and to implement effective strategies to reverse this situation, it is important to monitor the trends of MVPA among Portuguese adolescents using systematic and robust data collection proce- dures.[10] Trend studies offer valuable insight on which evidence- based policy should be based.[11] In addition to MVPA trends, the focus on age-related changes of MVPA is important to better understand the Portuguese girls' situation and to target interven- tions in critical periods in life.[2,12]

Previous studies on trends of PA among Portuguese adolescent girls are scarce and, in general, provide evidence of their PA levels remaining low and stable over the years, and that PA declines with age during adolescence.[8,13,14] Specifically, despite covering the entire range years of adolescence (12–18 y), Fernandes's[13] study used 2 cohorts of nonnational representative samples that impact on the external validity of the findings. Moreover, these cohorts were separated by 10 years apart (2006–2016), an important time period to identify secular trends. Nevertheless, without any intermediate measure moments, this long period might limit the possibility of identifying specific time periods where changes in PA might have occurred. A national Health Behaviour in School-Aged Children (HBSC) trend study also included surveys from 2002–2010 but did not work with the MVPA prevalence based on World Health Organization guidelines,[14] which difficult cross-national compar- isons. A previous international HBSC trend study also points to no changes in the MVPA prevalence of Portuguese girls. However, only surveys between 2002 and 2010 were considered and age-related changes were not quantified.[8]

Based on this evidence, further research on MVPA trends is warranted; especially when considering the international definition

of PA recommendations, a nationally representative sample of adolescent girls and by involving several cohorts over a 10-year time period. Therefore, the present 4-cohort study sought to examine the trends of PA from 2002, 2006, 2010, and 2014 in a representative sample of Portuguese adolescent girls and to investigate PA changes during adolescence in surveys of each year and by generation. Based on previous studies,[8,9,13,14] we hypothesized that the prevalence of Portuguese adolescent girls meeting the PA recommendations is relatively stable between 2002 and 2014, and that it decreases as age increases in all generations.

Methods

Sample and Procedures

The present study is based on data from the HBSC Portuguese cross-sectional survey in 2002,[15] 2006,[16] 2010,[17] and 2014.[18] Specifically, the sample of these studies include only adolescents girls (n = 9856) aged 11, 12, 13, 15, 16, and 17 years (mean = 13.8, SD = 1.8) of nationally representative samples from 4 different cohorts: 2002 (n = 2615 girls; 26.5%), 2006 (n = 2110 girls; 21.4%), 2010 (n = 2349 girls; 23.8%), and 2014 (n = 2782 girls; 28.2%). Adolescent girls were grouped into 2 age groups (11–13 and 15–17 y), as in a previous study.[14] Table 1 presents the characteristics of adolescent girls from each year's survey.

The HBSC is a school-based survey of adolescents' health behaviors conducted every 4 years. The purpose of the HBSC is to gain an understanding of young peoples' health and well-being to inform the development of policies needed to improve the youth's lives. The survey is a self-administered questionnaire that is completed in public schools by students attending grades from years sixth, eighth, and tenth, which corresponds mainly to students aged 11, 13, and 15 years. The schools were randomly selected from a national list, which had been stratified by administrative regions. The methodological procedures of the HBSC study are well developed through an internationally standardized research protocol that allows cross-cultural comparisons. A detailed descrip- tion of the methods and instrument can be found elsewhere.[19,20] This research was conducted in accordance with the ethical com- mittee of Porto Medical School, the National Data Protection System, and the Code of Ethics of the World Medical Association (Declaration of Helsinki). All school administrators gave their consent; legal guardians gave written informed consent, and students provided assent. Adolescents' participation in the study was voluntary, anonymous, and there were no explicit incentives provided for participation. The administration of the surveys was conducted according to standard guidelines from the HBSC survey protocol[19,20] and carried out by school teachers who were in- structed on how to collect data during class time. Data collection took place between January and March for each time period.

Measures

To assess MVPA, participants were requested to rate the number of days over the past week they were physically active for a total of at least 60 minutes per day. The question was preceded by a definition of MVPA as "any activity that increases the heart rate and makes the person get out of breath some of the time," which includes physical education class time. Answers varied between none and 7 days. Seven days of MVPA recall is shown to be reliable and valid for use in research on PA in children and adolescents from different cultures.[21–25] These validation studies provide evidence of adequate reliability, with intraclass correlation coefficients for the all group ranging from .44[25] to .82.[24] An acceptable validity of this PA assessment question has also been supported, for example, by evidence of the measured correlation with accelerometer (eg, $r = .4$)[23] or other objective data (eg, physical fitness).[22]

A new variable was created concerning the prevalence of adolescents reporting daily MVPA of at least 60 minutes.[6] This variable intends to give a picture of overall PA in compliance with PA guidelines for children and adolescents.[1]

Data Analysis

Descriptive statistics were calculated for all variables (means, SD, and percentages) for the entire sample and according to HBSC survey years (2002, 2006, 2010, and 2014), and age groups into which girls were divided (11–13 and 15–17 y). One-way analysis of variance followed by Games-Howell post hoc test was used to assess the trends of MVPA in the last 7 days among HBSC survey

Table 1 Participants' Characteristics at Each Year Survey

	Survey years				
	2002	2006	2010	2014	Total
Age, mean (SD)	13.8 (1.8)	14.0 (1.8)	13.9 (1.8)	13.7 (1.7)	13.8 (1.8)
Age, n (%), y					
11	629 (24.1)	486 (23.0)	554 (23.6)	700 (25.2)	2369 (24.0)
12	366 (14.0)	141 (6.7)	162 (6.9)	293 (10.5)	962 (9.8)
13	690 (26.4)	557 (26.4)	595 (25.3)	845 (30.4)	2867 (27.3)
15	530 (20.3)	654 (31.0)	786 (33.5)	640 (23.0)	2610 (26.5)
16	337 (12.9)	217 (10.3)	214 (9.1)	254 (9.1)	1022 (10.4)
17	63 (2.4)	55 (2.6)	38 (1.6)	50 (1.8)	206 (2.1)
Total	2615 (100.0)	2110 (100.0)	2349 (100.0)	2782 (100.0)	9856 (100.0)
Age groups, n (%), y					
11–13	1685 (64.4)	1184 (56.1)	1311 (55.8)	1838 (66.1)	6018 (61.1)
15–17	930 (35.6)	926 (43.9)	1038 (44.2)	944 (33.9)	3838 (38.9)
Total	2615 (100.0)	2110 (100.0)	2349 (100.0)	2782 (100.0)	9856 (100.0)

Note: A total of 1188 girls aged 10 (n = 31), 14 (n = 1138), 18 (n = 17), and 19 (n = 2) years were not included in the present study and respective analyses

waves in each age group. The trends of the percentage of girls reporting 60 minutes of MVPA daily over the survey waves by age group were tested with chi-square test for trend (extended Mantel– Haenszel chi-square test). To assess, respectively, MVPA in the last 7 days and MVPA prevalence differences between age groups in each year survey, student's t test for independent samples and chi-square test of independence were used. Student's t test and chi-square test of independence were also used to assess MVPA in the last 7 days and MVPA prevalence among younger and older adolescent girls from the same generation but from different survey waves (generation 1: adolescents aged 11–13 y in 2002 and 15–17 y in 2006; generation 2: adolescents aged 11–13 y in 2006

and 15–17 y in 2010; generation 3: adolescents aged 11–13 y in 2010 and 15–17 y in 2014). This approach is valuable because it allows analyzing if MVPA behavior has changed among young and older adolescents of the same generation (ie, same birth cohort). All statistical analyses were performed using IBM SPSS Statistics 24.0 (New York City, NY) and OpenEpi 3.01 (Atlanta, GA) The level of significance was set at .05.

Results

Figure 1 presents the trends of MVPA in the last 7 days over time for each age group. For 11- to 13-year-old girls, girls from 2014 reported to do significantly more MVPA (3.5 [1.8]; F3 = 8.656, $P < .001$; $\eta 2 = .004$) than their peers from 2002 (Games-Howell than girls aged 15–17 years (3.2 [1.9] vs 2.6 [1.7]; t1 = 7.458, $P < .001$; Cohen d value = 0.32). The percentage of adolescent girls reporting 60 minutes of daily MVPA was low and also decreased significantly ($P < .05$) among age groups in all year surveys.

The MVPA results from 3 generations are presented in Table 3. As for MVPA in the last 7 days and the percentage of adolescent girls reporting at least 60 minutes of daily MVPA, there was a significant decrease with age in all generations of adolescents ($P < .05$). For example, girls aged 11–13 years in 2002 and other group of girls aged 15–17 years in 2006 (generation I) reported to do MVPA, respectively, 3.2 (1.4) and 2.6 (1.7) days a week (t2570 = 7.804, $P < .001$; Cohen d value = 0.33). For generation III, the percentage of 11- to 13-year-old girls in 2010 reporting daily MVPA was 9.9% and decreased to 5.0% for other girls aged 15 to 17 in 2014 ($\chi 2 = 22.008$, $P < .001$).

Discussion

The present study analyzed the MVPA trends and changes with age among a 4-cohort sample of Portuguese adolescents girls from 2002,15 2006,16 2010,17 and 2014.18 It was found that the percent- age of girls reporting 60 minutes of daily MVPA was low and stable between 2002 and 2014, decreased with age in each year survey, and across the same generation. Despite methodological

differences, these results are in line with those from previous studies concerning Portuguese adolescent girls' MVPA levels9,14 = .001; 95% con

(Games-Howell post hoc P < .001; 95% CI, 0.09–0.45), and 2010 (Games-Howell post hoc P < .001; 95% CI, 0.09–0.43). Regarding the 15- to 17-year-old age groups, girls from 2010 were signifi- cantly (F3 = 3.152, P = .02; η2 = .003) more active than those from 2006 (Games-Howell post hoc P = .04; 95% CI, 0.01–0.39).

Figure 2 shows that the trends of the percentage of 11 to 13-year-old girls (χ2 for trend = 1.55, P = .21) and 15- to 17-year- old girls (χ2 for trend = 0.06, P = .81) reporting 60 minutes of daily MVPA remained low and stable over the years.

Table 2 provides evidence that, in each year survey, MVPA in the last 7 days decreased significantly (P < .05) with age. For example, in 2006, girls aged 11 to 13 were significantly more active promoting MVPA and attenuating MVPA decline as early years among Portuguese girls should be considered a high public health priority.

At a cross-national level, different results concerning the PA time trends have been found. For example, some positive trends between 2002 and 2010 in the self-reported MVPA prevalence among girls in 10 out of 32 countries have been identified.8 Important lessons might be learned from these successful countries in improving girl's MVPA. Conversely, negative trends over the years among specific PA contexts (eg, active commuting, sport) and countries have also been found.3,8,26 These inconsistent find- ings across studies have been partly explained due to differences in

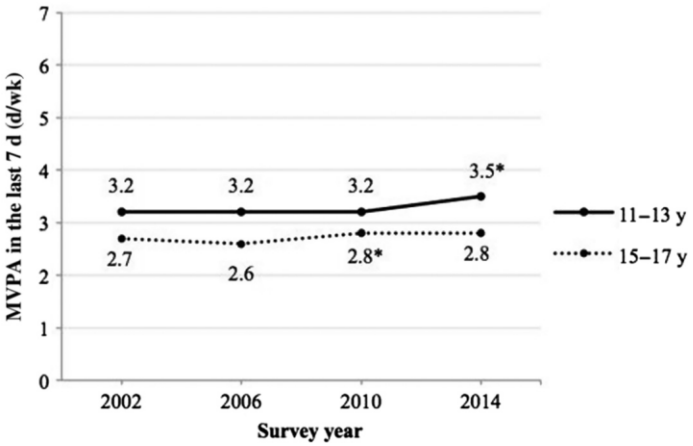


Figure 1 — Trends of girls' physical activity in the last 7 days (mean values) over the survey waves by age group (*P < .05, tested with 1-way analysis of variance and Games-Howell post hoc test). MVPA indicates moderate- to vigorous-intensity physical activity.

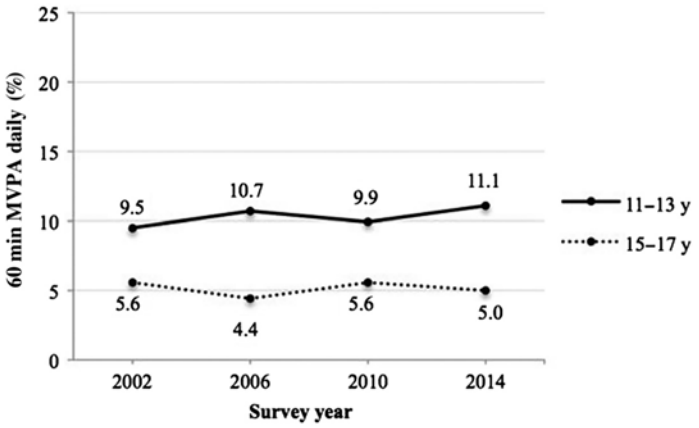


Figure 2 — Trends of the prevalence of girls' reporting 60 minutes of MVPA daily over the survey waves by age group (*P < .05, tested with chi square for trend). MVPA indicates moderate- to vigorous-intensity physical activity.

Table 2 Girls' Physical Activity of 11- to 13- and 15- to 17-Year-Old Age Groups at Each Survey Wave

	2002			2006			2010			2014		
Variables	11–13 y (n = 1654)	15–17 y (n = 923)	Δ	11–13 y (n = 1164)	15–17 y (n = 918)	Δ	11–13 y (n = 1301)	15–17 y (n = 1035)	Δ	11–13 y (n = 1717)	15–17 y (n = 906)	Δ
MVPA in the last 7 d[a]												
Mean (SD)	3.2 (1.8)	2.7 (1.9)**	−0. 5	3.2 (1.9)	2.6 (1.7)**	−0.6	3.2 (1.8)	2.8 (1.7)**	−0.4	3.48 (1.84)	2.8 (1.7)**	−0.7
95% CI	3.1–3.3	2.6–2.8		3.1–3.3	2.5–2.7		3.1–3.3	2.7–2.9		3.39–3.57	2.7–3.0	
60 min of daily MVPA[b]												
%	9.5	5.6*	−3.9	10.7	4.4**	−6.4	9.9	5.6**	−4.3	11.1	5.0**	−6.1
95% CI	8.1–11.0	4.3–7.4		9.05–12.7	3.2–5.9		8.4–10.7	4.3–7.2		9.64–12.67	3.7–6.7	

Abbreviations: CI, confidence interval; MVPA, moderate- to vigorous-intensity physical activity; Δ, physical activity change.

[a]Tested with *t* student test for independent samples. Cohen *d* effect size values for 2002 = 0.28, 2006 = 0.32, 2010 = 0.22, and 2014 = 0.36. [b]Tested with chi-square test of independence. *P < .01. **P < .001.

Table 3 Girls' Physical Activity Over the Years Among Three Different Generations of Adolescents

	Generation 1			Generation 2			Generation 3	
	11–13 y in 2002 15–17 y in 2006			11–13 y in 2006 15–17 y in 2010			11–13 y in 2010 15–17 y in 2014	
Variables	(n = 1685)	(n = 926)	Δ	(n = 1184)	(n = 1038)	Δ	(n = 1311)	(n = 944)

MVPA in the last 7 d[a]									
Mean (SD)	3.2 (1.8)	2.6 (1.7)*	−0.6	3.2 (1.9)	2.8 (1.6)*	−0.4	3.2 (1.8)	2.8 (1.7)*	−0.4
95% CI	3.1–3.3	2.5–2.7		3.1–3.3	2.7–2.9		3.1–3.3	2.7–3.0	
60 min of daily MVPA[b]									
%	9.5	4.4*	−5.1	10.7	5.60*	−5.1	9.9	45.0*	−5.0
95% CI	8.1–11.0	3.2–5.9		9.0–12.7	4.3–7.2		8.4–1.7	3.7–6.7	

Abbreviations: CI, confidence interval; MVPA, moderate- to vigorous-intensity physical activity; Δ, physical activity change.

[a]Tested with *t* test for independent samples; Cohen *d* effect size values for generation 1 = 0.33, generation 2 = 0.22, and generation 3 = 0.22. [b]Tested with chi-square test of independence.*$P < .001$.

methodological issues.27 Nevertheless, recent available evidence does not firmly support the notion that the percentage of physically active youth has declined in recent decades,27,28 as the present study's results corroborate. As MVPA of Portuguese girls were already at low levels for both age groups, this might also explain why a decrease trend over years was not found. The low MVPA prevalence for both age groups are in line with previous research on PA of Portuguese adolescents,9,13 and suggest that Portuguese programs and policies to promote PA among adolescent girls are having limited success.

Two other major findings of the present study were that MVPA levels in the past 7 days and the percentage of girls achieving PA guidelines decreased significantly with age and across the same generation. Considering all year surveys, the average decreased difference between girls aged 11–13 and 15–17 years varied from

0.4 to 0.7 days per week and from 3.9% to 6.3% of girls doing 60 minutes of daily MVPA. Due to methodological differences, it is difficult to directly compare these results with other studies results. However, the MVPA decline throughout adolescence is one of the most consistent findings in the literature.2,12,29 In a systematic review, mostly by considering PA assessed by questionnaire, the mean percentage decline per year across all studies was estimated to be 7.0% and the decline among girls was greater at younger ages (9–12 y).2 Data from objectively measured PA provide evidence that PA declines starts even earlier (6–7 y).12,29 By looking at national objective data, a major decrease in the percentage of girls meeting PA guidelines is found between the age groups 10–11 and 12–13 years, changing from 22.5% to 7.4%, and ending in 1.2% at age 16–17 years.9

Based on this evidence, as well as on the finding that in the current study, a large proportion of girls fell well short of the PA guidelines at ages 11–13 years in all survey years; more effective strategies for promoting MVPA and preventing the MVPA decline are needed since childhood. Thus, the transition from primary school (fourth grade—9/10 y) to middle school (fifth grade—11/ 12 y) might be a critical period for a PA decline among Portuguese girls, and further research on this issue is needed.30

Despite knowing that PA decline with age can vary by type and intensity of activity—it is greater in nonorganized activities and vigorous activities,31 it is due to biological factors, as sex and sexual maturation and behavioral, psychosocial and environmental factors.30,32,33 Specifically, higher levels of previous PA and posi- tive experiences, self-efficacy, perceived behavioral control, social support from parents and friends, and access to facilities and programs of PA have been associated with higher PA levels and lower PA declines in childhood and adolescence.32–35 Thus, strate- gies to promote PA and to halt PA decline might need to take into account these factors associated with PA. Nevertheless, further cross-sectional and longitudinal studies with a stronger focus on objective measures and determinants of PA change using national representative sample are needed to better inform the design of PA interventions.10 In addition, more qualitative studies might be useful for giving youth a stronger voice and actively involving them in the development of meaningful opportunities for adopting and maintaining a healthy lifestyle throughout life.6,34

For an effective promotion of PA among children and adoles- cents, systemic approaches involving all different society sectors, such as families, health care providers, community organizations, government agencies, and schools, are needed.4,32 The fundamental role that schools can play in promoting active lifestyles has been acknowledged.36,37 Overall, school-based interventions to increase preadolescent and adolescent girls PA show small but significant effects.7,37,38 Stronger effects were found in interventions that were educational, multicomponent (eg, PA and diet together or sedentary behavior), and for girls only.7,37,38

To the best of our knowledge, only a few evidence-based interventions have been implemented in Portuguese schools.39–42 These interventions were mainly focused on PA and nutrition, involved children,39 adolescents,42 and overweight and obese pedi- atric

populations.40,41 Positive changes have been found to be associated with interventions that were multicomponent39,40,42; integrated within the school community and project39,42; supported by several school members, parents, and peers39,42; implemented by an interdisciplinary team and qualified teachers39,41,42; and that enhance the PA opportunities in the school context.39,40,42 However, interventions focusing, specifically, on girls aged 6–10 years are lacking and needed in the Portuguese context.

The results of the present study highlight the need for a greater

emphasis of PA in childhood and not only on adolescence. Childhood is a critical period for developing fundamental move- ment skills that are associated with PA, and PA behaviors devel- oped in early years track into adolescence and adulthood.5,29 Thus, in Portugal, it seems critical to consider the role that primary schools and physical education might play in promoting children, namely girls, to have fundamental motor skills, PA, and healthy lifestyles.36,37 Despite being mandatory, some Portuguese adoles- cents reported to not have experienced physical education during primary school years.43 This retrospective study, based on the youth's voice, showed that physical education in primary school and PA early experiences were fundamental in explaining the different trajectories toward an active lifestyle in adolescence.43 Therefore, quality physical education implementation in early years might be useful for preventing decline and increasing girls' PA behaviors.

This study is not without limitations. PA was self-reported and based on a single-item measure that only assess the past 7 days of PA, not accounting for other possible influencing factors (eg, season, contexts of PA practice). Despite self-reported mea- sures might be subject to recall bias, they are acceptable and reliable in epidemiological studies,21,27 where the use of objective measures with large samples is not often possible.44 The analysis that focused on PA change among each generation is not a genuine within-subject design, precluding the identification of individual PA changes with age. Longitudinal studies are needed.10 It would be important to have comparable data for children less than 11 years and include out-of-school children and adolescents. The samples of the current study are representative of adolescents from the various geographical Portuguese regions and involved adolescents from diverse socioeconomic status. However, future studies can consider focusing mainly on the socioeconomic influ- ences on PA levels, as previously recommended.6,35

The current study has also several strengths, namely the use of

a large and representative sample of girls with several ages from different successive cohorts, covering a 12-year period; a rigorous and systematic procedures across surveys that make the data comparable; an international definition of MVPA1 that facilitates the comparison with international studies.

In conclusion, the prevalence of girls meeting the PA guide- lines is low, stable from 2002–2014, and decreases with age in all survey waves and across the same generation of adolescents. These results suggest that to get more Portuguese girls complying with the PA recommendations during childhood and adolescence it is fundamental to promote the MVPA in early years, and to prevent the MVPA decline with age.

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