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Differences in the physical activity pattern between Portuguese and Spanish adolescents

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Objective: Physical activity (PA) occurs in a variety of contexts, and there is a need to understand the biocultural determinants of the active or inactive lifestyle. The aim of this study is to compare the PA patterns of adolescents living in two different countries from south Europe, exploring gender differences. ***Design:*** Five public schools entered the study: two in Porto (Portugal) and three in Huesca (Spain). There were 105 students (57% girls) from Porto aged 14.56±1.50 and 95 students (40% girls) from Huesca aged 13.66±1.15. PA was assessed with accelerometers over 7 consecutive days. The linear regression model was used to study the influence of the following factors: age, location, gender, and body mass index on the adolescents' moderate-to-vigorous PA amount on weekdays and weekend days. ***Results:*** Linear regression analysis reported that when controlling for age and BMI, city (Porto or Huesca) was considered a significant predictor ($p<0.001$) of the MVPA amount on weekend days and in the number of days the students complied with the PA guidelines (60 minutes of moderate-to-vigorous PA (MVPA) daily). Huesca adolescents had superior values of MVPA and consequently a higher rate of compliance to the PA guidelines. Gender differences in MVPA were more notable in the Spanish adolescents. ***Conclusion:*** The location of the adolescents' residence was found to influence the achievement of PA guidelines. These differences were more marked on weekends.

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Key Words: Physical activity guidelines, accelerometer, high school students

INTRODUCTION

Physical activity (PA) patterns in youth have important public health implications because low amounts of PA and high physical inactivity behaviors have important contributions to current and future health problems, such as the early onset of cardiovascular disease (CHD), osteoporosis, or adult obesity (1). Several studies showed that PA activity tracks over time (2, 3), and physical inactivity presents an even greater tracking effect. PA occurs in a variety of contexts, and there is a need to understand the biocultural determinants of the active or inactive lifestyle (2).

One approach to clarifying this issue is to determine the types and elements of PA that cause some youth to be more active than others. This may help identify patterns that facilitate long-term involvement or, alternately, identify groups that may be at risk of dropping out from a more active lifestyle (4). The measurement of PA across a lifespan is a difficult task. Most discussions refer to an estimated level of habitual PA derived from questionnaires, interviews, diaries, and heart rate monitors. Although PA is evaluated in

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terms of energy expenditure, it is essential to recognize that PA is a behavior that occurs in a variety of forms and contexts. Contextual factors are systemic norms rather than individual teachers, students, or intra-class interactions (5).

In general, youth have similar exposure and opportunities at school, but activity patterns and choices may be more variable; for example, a single strategy aimed at reducing sedentary behavior is unlikely to be effective across all of Europe as the target populations and behaviors of focus differ between countries (6). Research is needed to confirm these findings and to examine the consistency across different populations and cultures. Therefore, the aims of this study are as follows: 1) to describe the physical pattern of high school adolescents attending public schools in Portugal and in Spain and 2) to compare the differences between the two countries in PA patterns. Consequently, this study offers a unique opportunity to examine contributions of different culture settings and contexts of PA in southern Europe.

MATERIAL AND METHODS

Participants

The sample is comprised of adolescents attending 2 public schools in north Portugal (the city of Porto) and 3 public schools in north Spain (the city of Huesca). characteristics of the community, school district, or school, and the investigation might focus on variables such as physical plant, rules, policies, or informal For the study, 105 students agreed to participate (57% girls and 43% boys) from Porto, Portugal aged 14.56±1.50, and 95 (40% girls and 60% boys) from Huesca, Spain also agreed to participate aged 13.66±1.15. Only the students attending school on the day of the data collection were entered into the study. Each research team followed the ethical procedures of that country; the Portuguese Ministry for Science and Technology in Portugal provided permission for this study. The study was also approved by the Ethical Committee from the University of Zaragoza. Informed written consent was obtained from the youth's legal guardians and from individual school principals. We, therefore, had a convenient sample of adolescents living in two different countries from the northern part of the Iberian Peninsula with different physical and cultural environments but similar climates.

Anthropometry

Height was measured to the nearest mm in bare or stocking feet with the child standing upright against a Holtain portable stadiometer. Weight was measured to the nearest kg with the student lightly dressed (underwear and tee shirt), using a portable digital beam scale (Tanita Inner Scan BC532). BMI was calculated from the ratio weight/height2 (Kg/m2).

Table 1. Descriptive characteristics for participants in the study, mean (SD).

	Huesca		Porto	
	Girls	**Boys**	**Girls**	**Boys**
Age	13.55 (1.06)**	13.73 (1.21)**	14.53 (1.59)	14.60 (1.39)
Weight (Kg)	51.38 (9.41)**	52.97 (14.05)**	58.03 (10.70)a	65.54 (11.67)
Height (m)	1.60 (.07)	1.62 (.11)**	1.62 (.059)a	1.72 (.085)
BMI (Kg/m^2)	19.82 (2.42)**	19.87 (3.30)**	22.13 (3.57)	22.20 (3.53)
PA (min/day)				
MVPA (Weekdays)	51.61 (14.91)b	92.14 (76.18)**	55.34 (21.37)	62.46 (24.35
MVPA (Weekend)	40.71 (26.05)**b	75.75 (94.28)**	16.88 (19.74)a	32.36 (28.03)
Light (Weekdays)	112.08 (25.43)	116.61 (43.36)	105.28 (33.25)	106.52 (34.32)
Light (Weekend)	116.34 (35.72)**	180.18 (242.28)**	72.85 (44.50)	73.19 (43.63)
Moderate (Weekdays)	25.16 (7.44)a	28.92 (10.38)	27.67 (12.33)	27.72 (12.72)
Moderate (Weekend)	20.34 (13.04)**a	26.35 (16.51)**	9.89 (11.86)	13.99 (12.01)
Vigorous (Weekdays)	18.70 (6.88)b	26.62 (11.44)	21.37 (11.22)	25.26 (12.26)
Vigorous (Weekend)	13.95 (11.56)**a	19.60 (17.14)*	5.58 (7.92)b	12.43 (12.94)
Number of days with >= 60 min MVPA)	2.18 (1.52)b	3.88 (1.63)**	2.07 (1.64)	2.56 (1.66)

PA – physical activity; MVPA – moderate-to-vigorous PA. [a] Significant gender difference (within city) $p<0.05$; [b] Significant gender difference (within city) $p<0.01$.[*] Significant city difference (within gender) $p<0.05$; [**] Significant city difference (within gender) $p<0.01$

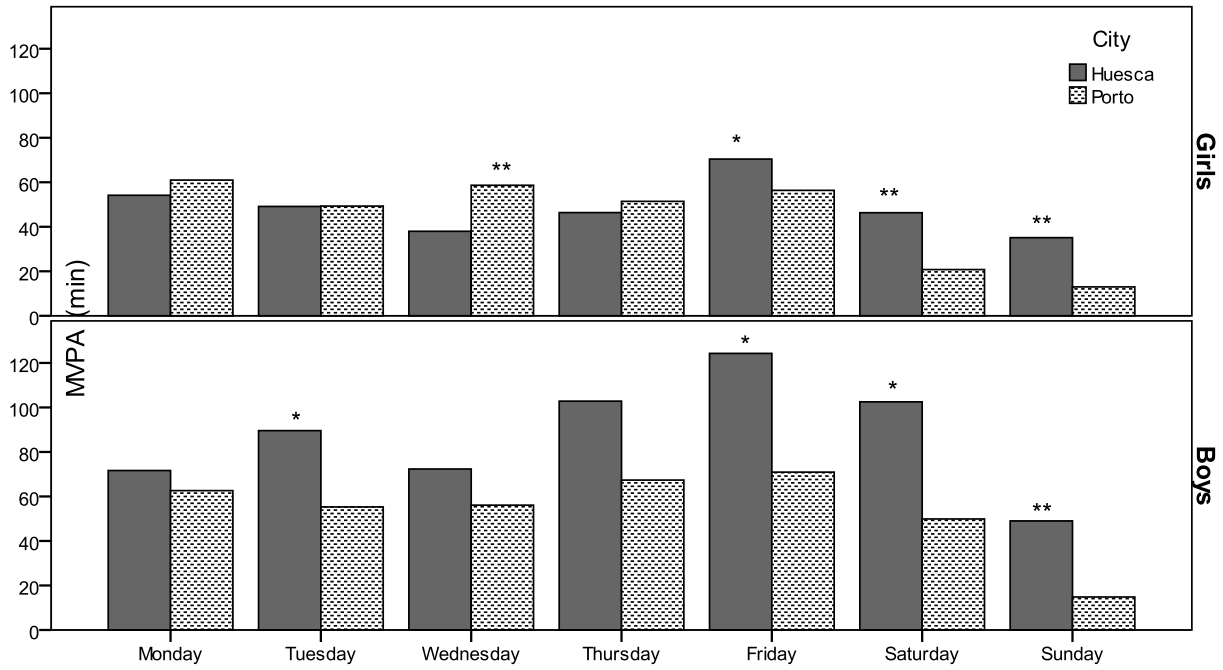

Figure 1 –Differences between the two cities in mean MVPA (min) by day of the week. * p<0.05 ** p<0.001

Assessment of physical activity

PA was assessed similarly in both cities within the closest (as possible) timeframe (month) of the data collection. The Actigraph accelerometer (model GT1M) was used; this device is a small and lightweight accelerometer designed to measure and record acceleration in the vertical axis, ranging in magnitude from 0.05 to 2.00 G, with a frequency response from 0.25 to 2.50 Hz. The filtered acceleration signal is digitized, and the magnitude is summed over a user-specified period of time (an epoch interval).

Adolescents wore the accelerometer in an elastic waistband on the right hip during the daytime, except while bathing or during other aquatic activities. Therefore, data from swimming activities was omitted. A data sheet was given to the students who were instructed to record the time when the monitor was attached in the morning and detached in the evening. The Actigraph was worn over 7 consecutive days in order to obtain a reliable picture of the habitual PA (7); a 7-day monitoring protocol provides reliable estimates of usual PA behavior in the children and adolescents and accounts for potentially important differences in weekend versus weekday activity behavior as well as differences in activity patterns within a given day (8).

For the study, 600 minutes (10 hours) was established as the minimum monitored time for a valid day. One study reported that a monitored period of 7 days with 10 hours/day produced high reliability (9). The epoch (sampling period) was setup to one minute, similar to other studies (10, 11). The age-specific count ranges corresponding to the intensity levels developed by Freedson (12) were adopted. The availability of age-specific count cutoffs that take into consideration age-related differences in economy and resting metabolism allows for the estimation of daily participation in moderate and vigorous PA (13). Time spent in moderate and vigorous PA (>3MET) was calculated by summing the minutes of moderate, vigorous, and very vigorous PA for each day. This variable was used to verify the participant's compliance to the PA guidelines—more than 60 minutes of MVPA (moderate-to-vigorous PA) per day. To analyze the accelerometer data, Kinesoft software, developed specifically for the Actical and Actigraph accelerometers, was used. The outcome variables were expressed in time (min/d) spent at different PA-intensity categories.

Statistics

Descriptive statistics were used to describe participants' characteristics and the activity data.

Table 2. Linear regression model for the PA response variables, using City, Gender, Age, and BMI as explanatory variables.

Model	MVPA Week			MVPA Weekend			Guidelines (# Days)		
	B	**SE**	***Sig.***	***B***	**SE**	***Sig.***	***B***	**SE**	***Sig.***
(Constant)	48.60	18.19	0.008	75.16	23.62	0.002	2.20	1.29	0.090
City	-5.72	3.65	0.119	-24.06	4.74	0.000*	-0.720	0.259	0.006*
Gender	15.22	3.35	0.000*	17.83	4.34	0.000*	1.03	0.237	0.000*
Age	0.918	1.26	0.467	-2.76	1.63	0.092	0.055	0.089	0.537
BMI	-0.197	0.513	0.701	0.226	0.670	0.734	-0.020	0.036	0.583

Independent t-tests were used to verify gender differences within the two countries, and Mann-Whitney tests were used when the variables did not present a normal distribution. A linear regression model was used to study the influence of the following factors: age (continuous variable), city (Huesca and Porto), gender, and BMI on the adolescents' moderate-to-vigorous physical activity (MVPA) amount on weekdays, weekends, and the number of days with PA guidelines compliance. All analyses were performed by using the Statistical Package for Social Sciences (SPSS, version 17.0), and the level of significance was set at $P < 0.05$.

RESULTS

The participant's physical characteristics are summarized in Table 1. Portuguese boys were taller and heavier ($p < 0.05$) than Portuguese girls, while no significant statistical differences were found within the Spanish sample. No significant statistical differences for BMI were found between the genders in both cities. However, there were significant differences between the two cities within each gender in all the anthropometric variables with the exception of height in girls.

PA intensities by day type (i.e., weekdays and weekends) are presented in Table 1. In both cities, boys had higher values than girls in all variables although not all reached statistical significance. Huesca boys had significantly more minutes of MVPA, moderate PA, and vigorous PA than Huesca girls on both the weekdays and weekend days. The gender differences in Porto were only significant in MVPA and vigorous PA on the weekend days.

Comparing differences between the cities, girls from Huesca were significantly ($p<0.01$) more active than girls from Porto in all PA intensities during the weekend; the same situation occurred for boys. Moreover, boys from Huesca were also significantly ($p<0.01$) more active than boys from Porto in MVPA during the weekdays. Significant differences were also verified regarding the compliance with the current PA guidelines (60 minutes of MVPA per day). Huesca adolescents had superior values of MVPA and consequently higher rates of compliance with the PA guidelines.

Figure 1 shows the daily MVPA values by gender between the two cities. For both genders, significant differences were found in the four days of the week as stated earlier. On weekend days, the Huesca students had significantly ($p<0.01$) higher values than the Porto students. Moreover, Huesca boys had more than 60 minutes of MVPA almost every day (with the exception of Sunday). During the weekdays, the difference was not as notable in girls. They had very similar values on Monday, Tuesday, and Thursday. The Porto girls presented higher values than the Huesca girls, but this was only statistically significant on Wednesday. On the other hand, Huesca boys had higher MVPA values on every day of the week with statistical significance ($p<0.05$) on Tuesday, Friday, Saturday, and Sunday ($p<0.01$).

The relevance of the different variables (city, gender, age, and BMI) to the MVPA amount is demonstrated in Table 2. City and gender were significant predictors ($p<0.001$) of the MVPA amount on weekend days and for the number of days the students complied with the PA guidelines (60 minutes of MVPA daily); gender was a significant predictor of MVPA on weekdays ($p<0.001$).

DISCUSSION

This study examined the weekly PA patterns of two convenient samples of adolescents living in two different countries. Our findings showed that gender differences in MVPA were more noticeable in the Spanish adolescents' group and that Spanish boys recorded higher values than Portuguese boys did. The weekend was the period of the week when the

differences between the two cities were more pronounced.

Gender is the most studied variable in PA-pattern differences (14, 15). The higher values in MVPA found reported in other studies (11, 13, 16, 17) as well as in studies of Portuguese youth and adolescents (18-21). Although gender differences in PA amount were different within the two cities, they were more marked in Huesca than in Porto.

Differences in MVPA between weekdays and weekend days were clear. Several studies using objective measures of PA in youth have documented marked differences in weekday and weekend PA behavior (8, 22, 23), and recommendations to measure both types of days have also been Similar findings from other European countries (27) show that more Spanish and Portuguese students achieved PA guidelines on weekdays. This finding highlights the importance of considering weekdays when implementing PA intervention programs for youth and the need to promote more PA opportunities during the weekends. The current PA guidelines highlight that youth should fulfill at least 60 minutes of moderate to vigorous PA daily (26). Our data clearly showed that the majority of the adolescents did not reach those standards. Boys from Porto had a mean of 2.56 days with at least 60 minutes of MVPA, and boys from Huesca achieved 3.88 days. Girls had an even worse scenario: From Porto, girls achieved 2.07 days, and girls from Huesca achieved 2.18 days. Taking into consideration each day of the week, only the Huesca boys had on average more days achieving a minimum of 60 minutes of MVPA on weekdays and weekend days. This data is in line with other studies that show that adolescents, particularly girls, are far from reaching the recommended daily levels of MVPA (16, 23, 28). For instance, in a study that included Portuguese students, only 25.4% youngsters engaged in at least 60 minutes of MVPA for 5 or more days per week (29). Another study also found similar values of MVPA; only 17.4% of boys and 12% of girls engaged in at least 60 minutes of MVPA for 5 or more days per week (17).

In a review, Armstrong and Welsman (15) showed the habitual PA of children and adolescents from European Union countries. They stated that boys of all ages participated in more PA than girls did, and this difference was more marked when vigorous activity was considered. These authors also highlighted the potential weakness in national comparisons using surveys and the difference in the season of the year of when the questionnaire was administered. A strong point of our study was the use of objective measures of PA and a similar season and year of data collection. However, we acknowledge that the sample size is not a national representative. Efforts in using this kind of PA assessment are currently being put into practice worldwide. This study attempts to contribute to those efforts. Moreover, some studies with accelerometry have been published in Portugal although with small and local samples (20, 21). Spanish studies with accelerometry are also scarce (30).

One important study with European children and adolescents, the European Youth Heart Study (16), used accelerometers and showed differences in the PA levels between countries. Although, in that sample, the Portuguese participants belonged to the Portuguese island of Madeira, and Spanish participants were not included. The authors, similar to our study, also indicated some small but statistically significant differences between countries ($p< 0.05$), but the main impression is one of consistency in activity levels between countries. Although our study showed the same consistency in relation to the gender differences in activity amount, the magnitude of the differences between genders was different within each city.

Given that Porto and Huesca differ in geography, socioeconomic circumstances, and culture, this suggests that PA habits in youth may be determined by environmental factors as much as by biological factors. We acknowledge as a limitation of this study the absence of the socioeconomic characteristics of the participants. Although the detailed assessment of the environmental context was not an objective of this study, this study revealed that place of residence was a significant predictor of the amount of MVPA. In a review study of environmental correlates of PA in youth, variables of the home and school environments were especially associated with youths' PA. In children, the most consistent positive correlates of PA were the father's PA, time spent outdoors, and school PA-related policies and for adolescents, the correlates were support from significant others, mother's education level, family income, and non-vocational school attendance (31). Therefore, monitoring individual levels and microenvironment social inequalities in PA is crucial for evaluating the effects of programs and policies and for providing an insight into whether current efforts should be continued or modified (32). It is fundamental to understand the trends and contexts of youth physical activity behaviors (33); objective measures of PA such as the accelerometer provide an opportunity to assess patterns of PA (i.e., bouts of activity) within a given day or over several days and can be put in the context of location. We see as a future direction the complementation of this kind of data with qualitative data, such as the characterization of settings and contexts of PA behavior.

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