

# Levels of physical activity in spanish adolescents (aged 12 to 14) measured by accelerometry

ELENA RAMÍREZ RICO , EMILIA FERNÁNDEZ GARCÍA, JULIA BLÁNDEZ ÁNGEL

*Faculty of Education, Universidad Complutense of Madrid, Madrid, Spain*

## ABSTRACT

Ramírez-Rico E, Fernández E, Blández J. Levels of physical activity in spanish adolescents (aged 12 to 14) measured by accelerometry. *J. Hum. Sport Exerc.* Vol.8, No. 2, pp. 401-411, 2013. The purpose of this study is to determine whether Spanish adolescents studied attain a level of physical activity, which complies with current guidelines for this age group. 90 adolescents (54 girls and 36 boys) aged 12 to 14 took part in the study. Information was gathered on their activity for a week, using accelerometry. The results show that these young people do not attain the levels of physical activity currently recommended, the results for girls being lower. The results are somewhat better if we include other less demanding patterns of activity. The findings suggest that boys and girls of this age exhibit a level of physical activity, which is closer to the recommendations of the early 1990s than the levels currently recommended for the age group. **Key words:** PHYSICAL ACTIVITY, GENDER, ADOLESCENTS, ACCELEROMETRY.

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 **Corresponding author.** Facultad de Educación, Universidad Complutense of Madrid.

E-mail: e.ramirez@edu.ucm.es

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## INTRODUCTION

Regular physical activity has proven benefits for health (California Project Lean, 2006; U.S. Department of Health and Human Services, 2005). Although the literature underlines the importance of physical exercise in both childhood and adolescence (McMurray et al., 2005) and the connection between regular physical activity and the consolidation of a healthy lifestyle for these age groups (Cavill, et al., 2001), a number of studies show that both at the pre-school stage (Kelly et al., 2007), and in childhood (Howell et al., 1999) and adolescence (Armstrong & McManus, 1994), the amount and intensity of physical activity by boys and girls is insufficient, often being replaced by other sedentary activities which take up many hours in their lives (Biddle et al., 2009; Fernández et al., 2006; Reilly et al., 2004; Serra, 2006). A number of authors have also reported that a reduction in the time spent on sedentary activities leads to an increase in the amount of physical activity (Jago et al., 2005). Levels of inactivity are higher in girls than in boys (Dowda et al., 2007; Pieron et al., 2008) and this difference can be observed from infancy (Grontved et al., 2009).

In addition to this clear lack of activity, young people do not consider the benefits of physical activity important for their health (García et al., 1998), and demonstrate limited knowledge of the concept of physical activity (Trost et al., 2000). Both of these findings may be related to their lack of regular physical exercise.

A variety of instruments are used to measure physical activity by young people (Welk et al., 2000), the present tendency being to use instruments which incorporate monitoring. Although the results obtained from objective measurements, such as accelerometry, data are lower to those obtained from self-report procedures, such as questionnaires (Sallis et al., 1998); they are more reliable than other types of subjective evaluation (Janz et al., 1995; Pate et al., 2002). A number of studies have validated the use of accelerometry to measure physical activity by adults (Melanson & Freedson, 2002) and young people (Evenson et al., 2008; Janz, 1994). Various studies carried out using objective measurement confirm the conclusions referred to above, concerning the low levels of physical activity among adolescents and their failure to comply with recommended levels (Riddoch et al., 2004; Troiano et al., 2008).

In addition to the fall in the time spent on physical activity in this age range there is a decline in the levels of intensity of what activity there is. This is particularly pronounced in the case of vigorous physical activity (VPA) (Troiano et al., 2008), the results being worse for girls once again (Faucette et al., 1995; Peiro-Velert et al., 2008). The level of intensity of physical activity is a key factor. The intensity needs to be at least moderate to vigorous (Sallis & Patrick, 1994), while certain levels of duration and frequency are also necessary for the health benefits to be appreciated.

In recent decades various individual experts and organisations have drawn up a range of recommendations and specifications concerning physical activity for adolescents. In the 1990s the emphasis was on a pattern of physical activity of 3 or more days each week, including at least 20 minutes of moderate to vigorous physical activity (MVPA) (Sallis & Patrick, 1994) but this criterion has subsequently been extended to all the days in the week for 60 minutes each day (Biddle et al., 1998). The recommendations include a progressive increase in physical activity from 30 to 60 minutes a day for young people who are inactive or whose level of activity is low. Currently the recommendation is 60 minutes of MVPA every or nearly every day of the week (Cavill et al., 2001). This pattern has been accepted and applied by various organisations such as the USA Centers for Disease Control and Prevention (CDC, 2008) and by authors such as Aznar and Webster in Spain (Aznar & Webster, 2006). It is also recommended that this exercise should be

complemented by 20 minutes of VPA 3 days or more each week (U.S. Department of Health and Human Services, 2005).

In Spain the activity levels of young people have normally been measured by self-report. According to the HSBC 2005-2006 international study, only 20% of young people in Spain aged 11 to 18 report that they do 60 minutes of MVPA every day in the week (HBSC, 2008). In Serra's study (2008), also using self-report, we find much lower figures. Only 0.2% of boys and no girls in the 12 to 17 age group in Aragon complied with recommended levels of activity.

However, there are hardly any Spanish studies which use objective tools to measure physical activity by adolescents. The work of Hernández (2009) is an exception. In a study of boys and girls aged 10 to 14 he records an average of four hours a week of physical activity for boys and nearly three hours for girls in the sample analysed, clearly below recommended levels.

The aim of this paper is to determine whether the level of physical activity among Spanish youth studied complies with current guidelines on its benefits for their health, in particular the recommendation of MVPA for 60 minutes every day or most days in the week (Cavill et al., 2001) and VPA for 20 minutes three or more days each week (U.S. Department of Health and Human Services, 2000). The study also takes the differences between boys and girls into account.

## **MATERIAL AND METHODS**

### *Participants*

The participants were adolescents aged 12 to 14. The choice of schools was random and the choice of participants in each school was also on a random basis, once the consent of the schools, the pupils and their families had been obtained. The total number of participants was conditioned by the number of accelerometers available and the cost of time for taking measurements.

The study was conducted with 111 adolescents (62 girls and 49 boys). Of these 90 (54 girls and 36 boys) were finally selected, according to the criteria set to improve the reliability of the results, as detailed in the section on data reduction.

### *Measures*

Measurements were made using CSA accelerometers to establish an objective record of daily physical activity based on changes in acceleration which were classified and measured over a period of time. The model used was the Computer Science Applications GT1M accelerometer. This is a small (8.5 x 3.8 x 1.5 cm), light (48g) single axis (vertical) model which records acceleration in the 0.05 to 200 G range with a frequency of 0.25 to 2.50 Hz. The relevant software is also required. With this equipment it was possible to collect data over 14 consecutive days and download it onto a computer for analysis with the software. The use of this tool with young people and adolescents has been validated in various studies (Janz, 1994; Trost et al., 1998).

### *Data reduction*

For this study the data gathered from the participants is for periods of 1 minute, the results being expressed in counts per minute (0.01664Gs). The classification of the counts by level of intensity is in accordance with the classification established by Freedson et al. (1998), differentiating between Light Physical Activity (LPA), between 100-1953 counts; Moderate Physical Activity (MPA), between 1953-5724 counts; Vigorous

Physical Activity (VPA), between 5724-9498 counts; and Very Vigorous Physical Activity (VVPA), above 9498 counts.

The results were also filtered applying two selective criteria to consider a subject as valid. In line with Penpraza et al. (2006) a daily minimum information requirement of 10 hours was set for each subject. At the same time the criterion proposed by Janz et al. (1995) was applied, the results for the subject only being considered valid when data was available for at least 4 days.

### Procedures

The cooperation of the schools in the study was agreed and approval of the families of these 12 to 14 year olds was requested. When their approval had been confirmed a random selection was made from eligible students. Subsequently the participants were given an information-motivation session, with verbal and written instructions on the regular use of the CSA device. Each student wore the device on his/her waist for a week. When the time arranged for the removal of the accelerometer came, the details were recorded and the participants' observations noted.

### Statistical analysis

The results for the participants finally selected after the above criteria had been applied were subjected to a descriptive analysis using percentages, contingency tables, the calculation of average scores, and standard deviation. By means of inference analysis, applying the chi-square test ( $\chi^2$ ), gender differences were determined for the number of days per week of physical activity and compliance with the recommended amount of physical activity. The Student T test was used to analyse the differences recorded in the average amount and intensity of physical activity for boys and girls, after having tested for homoscedasticity using the Levene test. All the analyses were carried out using the SPSS Version 17 statistics package, with a significance level of  $p=0.05$ . To determine compliance with the recommendation of 60 minutes MVPA every day or nearly every day a cut-off point of 5 days a week was established, in line with the HBSC study (2004).

## RESULTS

### Amount and intensity of physical activity

The average number of counts is shown in Table 1, together with results by gender. The T test revealed differences between the two groups ( $T=4.12$ ;  $p<.001$ ), boys engaging in more physical activity each week ( $M=390758.90$ ;  $DT=911$ ) than girls ( $M=301286.77$ ;  $DT=91184.62$ ).

**Table 1.** Amount of physical activity by sex. Average, Levene and Student T test.

		N	AVERAGE	DT	MINIMUM	MAXIMUM	LEVENE	T TEST AND SIG
COUNTS	GIRLS	54	301286.77	91184.62	1318.14	450287.00	F= 1.493	T= 4.123
	BOYS	36	390758.90	113953.84	193549.33	793419.80	p= 0.225	p= 0.000***
	TOTAL	90	337075.62	109548.66				

\* $p \leq .05$ , \*\* $p \leq .01$  y \*\*\* $p \leq .001$

The results for intensity of activity (Table 2) show that LPA is the most frequent among these adolescents ( $M= 1304.09$ ,  $DT= 35.16$  in girls and  $M =1287.06$ ,  $DT =47.05$  in boys). Very low levels were recorded for

both sexes for MPA (M= 43.34, DT= 12.39 in girls and M= 1.44, DT= 23.80 in boys) and VPA (M= 1.44, DT= 2.36 in girls and M=2.36, DT=2.40 in boys).

**Table 2.** Intensity of physical activity by sex. Average, Levene and Student T test.

		N	AVERAGE	DT	MINIMUM	MAXIMUM	LEVENE	T TEST AND SIG
LIGHT	GIRLS	54	1304.09	35.16	1226.00	1424.50	F= 1.735	T=-1.964
	BOYS	36	1287.06	47.05	1171.20	1412.16	p= 0.191	p= 0.053
	TOTAL	90	1297,28	40.95				
MODERATE	GIRLS	54	43.34	12.39	14.50	75.42	F= 8.722	T= 4.271
	BOYS	36	61.76	23.80	27.33	150.0	p= 0.004	p= 0.000***
	TOTAL	90	50.71	19.91				
VIGOROUS	GIRLS	54	1.44	1.52	0	6	F=7.116	T=2.038
	BOYS	36	2.36	1.52	0	10.80	p=0.009	p=0.046*
	TOTAL	90	1.81	1.96				

\*p ≤ .05, \*\*p ≤ .01 y \*\*\*p ≤ .001

The T test (Table 2) shows that, although it is not the case with LPA (p>.05), there are significant differences between boys and girls in MPA (p<.001) and VPA (p<.05), with boys spending more minutes each week on this type of physical activity.

*Days when the subjects engaged in MVPA and VPA*

Most of the subjects engaged in MVPA for 60 minutes on 2 or 4 days a week. The percentage falls progressively as the number of days rises above four. The  $\chi^2$  test showed differences (RV=24.425; p<.001) by gender, the largest number of girls (25.9%) recording two days of activity and the largest number of boys (25%) four days (Table 3).

**Table 3.** Days per week on which subjects engaged in physical activity for 60 minutes, by sex. Percentages and  $\chi^2$  test.

		0	1	2	3	4	5	6	7	$\chi^2$
GIRLS	%	22.2	20.4	25.9	13.0	16.7	1.9	0	0	
	RESIDUAL	2.1	0.8	1.7	0.7	-1.0	-2.9	-2.8	-1.2	$\chi^2$ (RV)=27.516
BOYS	%	5.6	13.9	11.1	8.3	25	19.4	13.9	2.8	p= 0.000***
	RESIDUAL	-2.1	-0.8	-1.7	-0.7	1.0	2.9	2.8	1.2	
TOTAL	%	15.6	17.8	20.0	11.1	20.0	8.9	5.6	1.1	

\*p ≤ .05, \*\*p ≤ .01 y \*\*\*p ≤ .001

Table 3 also shows a greater concentration of girls at the lower end of the range (from 0 to 2 days) while there were no girls at the top end (6 or 7 days). The boys show a more even distribution from 0 to 7, the largest number being concentrated between 4 and 6 days. We thus find a higher percentage of girls with a low number of days (0 to 3) and a higher percentage of boys with more days (5 to 7).

Most of the subjects engaged in MVPA for 30 minutes on 7 days a week (Table 4). The percentages rise as the number of days increases, the largest percentage of girls (29.6%) corresponding to 6 days a week and the largest percentage of boys (44.4%) to 7 days a week. In this case the  $\chi^2$  test shows no significant differences between boys and girls (RV=10.425;  $p>.05$ ). None of the boys were recorded as engaging in this type of activity between 0 and 3 days a week and none of the girls between 2 and 3.

**Table 4.** Days per week on which subjects engaged in physical activity for 30 minutes, by sex. Percentages and  $\chi^2$  test.

		0	1	2	3	4	5	6	7	$\chi^2$
<b>GIRLS</b>	%	3.7	3.7	0	0	16.7	27.8	29.6	18.5	
	RESIDUAL	1.2	1.2	0	0	0.7	0.3	1.1	-2.7	$\chi^2$ (RV)=10.425
<b>BOYS</b>	%	0	0	0	0	11.1	25.0	19.4	44.4	$p= 0.064$
	RESIDUAL	-1.2	-1.2	0	0	-0.7	-0.3	-1.1	2.7	
<b>TOTAL</b>	%	2.2	2.2	0	0	14.4	26.7	25.6	28.9	

\* $p \leq .05$ , \*\* $p \leq .01$  y \*\*\* $p \leq .001$

Results for 20 minutes per day of VPA (Table 5) only show 0 or 1 day, most of the adolescents recording 0 (88.9%). The  $\chi^2$  test shows no difference between boys and girls (RV=0.907;  $p>.05$ ).

**Table 5.** Days per week on which subjects engaged in physical activity for 20 minutes, by sex. Percentages and  $\chi^2$  test.

		0	1	$\chi^2$
<b>GIRLS</b>	%	88.9	11.1	
	RESIDUAL	-1.0	1.0	$\chi^2$ (RV)=0.907
<b>BOYS</b>	%	94.4	5.6	$p= 0.341$
	RESIDUAL	1.0	-1.0	
<b>TOTAL</b>	%	92.2	7.8	

\* $p \leq .05$ , \*\* $p \leq .01$  y \*\*\* $p \leq .001$

*Compliance with recommendations for physical activity*

Results show that only 1.9% of girls and 36.1% of boys comply with the first guideline recommendation of 60 minutes of MVPA on 5 or more days per week. The  $\chi^2$  test revealed significant differences between the sexes ( $\chi^2= 19.300$ ;  $p<.001$ ) (Table 6).

**Table 6.** Compliance with 60 min. and 30 min. per day recommended levels of physical activity. Total sample and by sex.

	TOTAL	GIRLS	BOYS	$\chi^2$
<b>N</b>	90	54	36	
<b>COMPLIANCE WITH 60 MIN PER DAY RECOMMENDATION</b>	NO	98.1%	63.9%	$\chi^2=19.300$
	YES	1.9%	36.1%	$p= 0.000^{***}$
<b>COMPLIANCE WITH 30 MIN PER DAY RECOMMENDATION</b>	NO	24.1%	11.1%	$\chi^2 (RV)=10.425$
	YES	75.9%	88.9%	$p= 0.061$

\* $p \leq .05$ , \*\* $p \leq .01$  y \*\*\* $p \leq .001$

The degree of compliance with the recommendation of 30 minutes of MVPA on 5 or more days each week was also calculated (Table 6). The percentage who comply with this recommendation (75.9% of girls and 88.9% of boys) is greater than the percentage of those who do not (24.1% of girls, 11.1% of boys). In this case the  $\chi^2$  test rules out the existence of differences linked to sex ( $RV=10.425$ ;  $p>.05$ ).

None of the subjects complied with the recommendation of 20 minutes VPA per day on 3 or more days per week.

## DISCUSSION AND CONCLUSIONS

Using objective measurement by means of accelerometry, this study is intended to determine whether the amount of physical activity of young people in Spain complies with current guidelines for its health benefits for adolescents: 60 minutes of MVPA every day or nearly every day of the week and 20 minutes of VPA 3 days or more each week.

As reflected in previous research, both international (Cale & Almond, 1992; Riddoch, 2004) and in Spain (Serra, 2008), the adolescents in our study (boys and girls) are a long way from complying with the two guidelines referred to, the difference being more pronounced in the case of the girls. The findings of the study also show that the difference is even more alarming in the case of the current international recommendation for 20 minutes of VPA on 3 or more days each week, as none of the subjects comply with this guideline. International studies of adolescents give somewhat more positive results for this recommendation, with 17% complying (Heath et al., 1994), although the percentage is still very low.

In view of the results an analysis was also made of the less demanding guideline of 30 minutes of MVPA. In this case the results showed that most of the boys and girls achieved this level of activity 5 days or more each week, differing substantially from the results for 60 minutes of MVPA. Pate et al. (1994) also suggest that with these less demanding criteria 80% of adolescents comply with the recommendation. In Spain,

Serra (2008), reports less satisfactory percentages with 45.90% of boys and 36.88% of girls engaging in at least 30 minutes of physical activity 3 days or more each week. The study by Reilly et al. (2004) shows that the 30 minute minimum set for MVPA is the reason why many adolescents do not comply with the recommendation, as the study's subjects engaged in 20 to 25 minutes' MVPA each day.

The results for the group of adolescents studied in our case are closer to the recommendations normally made in the 1990s of 30 minutes of MVPA every day or nearly every day of the week than the currently recommended level of 60 minutes of MVPA every day or nearly every day with an additional 20 minutes of VPA 3 or more days every week.

Analysis of the amount and intensity of physical activity by the participants in the study shows that the total physical activity of the boys is greater than that of the girls and that their levels of MPA and VPA are higher than those for girls. In the case of LPA, although the figure for the girls is slightly higher, there is no statistically significant difference from that for boys. Martínez-Gómez et al. (2005) corroborate all these differences in their study of a sample of 214 Spanish adolescents of similar ages.

The gender differences detected in this study for MPA and VPA indicate that in both cases activity levels for boys are higher than those for girls. Previous studies by López et al. (2007) record this difference for VPA but do not show any significant difference between boys and girls for MPA, although the figures for boys are slightly higher.

The results for the sample in our study show that the most frequent intensity of activity for adolescents is LPA, while the frequency of MPA is very low and that of VPA almost non-existent. These results are similar to those obtained by Troiano et al. (2008), which are based on a large sample of 4867 adolescents. If we apply the categories used by Aznar & Webster (2006), adapted from the Department of Health classification (2004) for adults, for the intensity of physical activity by young subjects, we can see that the Spanish adolescents participating in this study record low levels of physical activity, which need to be increased for them to achieve a satisfactory standard of health.

The main finding of our study is the low level of physical activity of the subjects, in terms of both quantity and intensity, the levels being higher for boys, confirming the results obtained in various previous studies of Spanish adolescents (Peiró-Velert, 2008; Vázquez et al., 2000).

The low level of participation in physical activity by the Spanish adolescents in this study and the low degree of compliance with current recommendations on physical activity for this age group point to the need for further objectively measured studies to be conducted with different age groups and different samples to confirm its results. There is also a need for initiatives to offset the negative effect on physical activity of the transition from childhood to adolescence, with special emphasis on encouraging girls to be more physically active.

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