

BRIEF ORIGINAL**RELATIONSHIP BETWEEN DAILY PHYSICAL ACTIVITY, RECESS PHYSICAL ACTIVITY, AGE AND SEX IN SCHOLAR OF PRIMARY SCHOOL (*)****Yolanda Escalante (1), Karianne Backx (2), Jose M Saavedra (1), Antonio Garcia-Hermoso (1) and Ana M Dominguez (1).**

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ABSTRACT

Background. Sedentary behavior has negative effects on health. School recess playgrounds provide important settings and opportunities for children to engage in physical activity. The aim of this study was to describe the daily physical activity (PA) and physical activity during recess of Primary School children and the relationship with sex and age.

Method. 783 children (379 boys and 359 girls; age=8.5±1.7 years; range 6 to 11) participated in the study. Daily PA of each child was measured using a validated questionnaire that was completed by the parents of each child, whilst playground recess PA was measured using accelerometry. An ANOVA was used to determine differences by sex in each age group with confidence intervals and effect sizes. Also MANOVA was used to analyse the main and interaction effects of age and sex on variables. The Scheffe post-hoc test was used for comparisons.

Results. Boys reported higher daily PA levels than girls across all age groups. The differences was bigger in seven (47,6±6,5 vs 42,6±6,4 MET/day; p<0,001), eight (48,5±8,6 vs 41,9±4,6MET/day; p<0,001) and nine years old (49,8±8,3 vs 44,1±5,9 MET/day; p<0,001). Measured recess PA was higher for boys compared to girls at age nine (28,4±12,0 vs 23,7±11,8 motion counts; p<0,039), ten (28,5±10,8 vs 23,7±10,0 motion counts; p<0,014) and eleven years old (24,6±12,2 vs 20,7±9,3 motion counts; p<0,047).

Conclusion. Daily PA is higher in boys compared to girls across all age groups (six to eleven years old). On the other hand, recess PA was higher only in boys between nine and eleven years.

Key word: Childhood. Physical activity. Exercise. Health. Sedentary lifestyle. Spain.

RESUMEN**Relación entre actividad física diaria, actividad física en el patio escolar, edad y sexo en escolares de educación primaria**

Fundamento. El sedentarismo tiene efectos negativos sobre la salud. El recreo escolar puede ser una oportunidad para realizar actividad física. El objetivo de este estudio fue describir la actividad física realizada diariamente y durante el recreo por escolares de Educación Primaria en función del sexo y la edad.

Métodos. Participaron 738 escolares (379 niños y 359 niñas; 8,5±1,7 años; rango de 6 a 11 años). Se evaluó la actividad física diaria a través de cuestionario validado cubierto por los padres y la actividad física en el patio durante el recreo a través de acelerometría. Se realizó un ANOVA de una vía para conocer las diferencias entre niños y niñas en cada grupo edad, calculando, además, los intervalos de confianza y el tamaño del efecto. También se realizó un MANOVA para analizar los efectos de la edad y el sexo con post hoc de Sheffé.

Resultados. Los niños mostraron mayores niveles de actividad física diaria que las niñas en todos los grupos de edad, siendo mayor esta diferencia a los siete años (47,6±6,5 vs 42,6±6,4 MET/día; p<0,001), a los ocho (48,5±8,6 vs 41,9±4,6 MET/día; p<0,001) y a los nueve (49,8±8,3 vs 44,1±5,9 MET/día; p<0,001). La actividad física en el patio fue mayor en niños que en niñas a los nueve (28,4±12,0 vs 23,7±11,8 motion counts; p<0,039), diez (28,5±10,8 vs 23,7±10,0 motion counts; p<0,014) y once años (24,6±12,2 vs 20,7±9,3 motion counts; p<0,047).

Conclusión. En relación a la actividad física diaria, los niños son más activos que las niñas en todas las edades estudiadas (seis a once años). Por su parte, en la actividad física en el patio escolar sólo existen diferencias, a favor de los niños entre los nueve y once años.

Palabras clave: Actividad física. Ejercicio. Salud. Estilo de vida sedentario. Infancia.

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INTRODUCTION

Well documented research demonstrates the negative effects of high levels of inactivity and the beneficial effects of physical activity on health and well-being in the long term¹. Sedentary lifestyle is one of the leading causes of chronic diseases, including cardiovascular disease, type 2 diabetes, osteoporosis, and other. Evidence is accumulating that health and well-being in adulthood originates from childhood behavior and lifestyle¹. Current guidelines recommend that children and youth people (5-17 years) should engage in 60 minutes or more of daily physical activity mainly aerobic and moderate or vigorous in intensity. Furthermore it is also recommended that children participate in activities that strengthen the musculoskeletal system at least three times a week². Worryingly, the international Health Behavior in School-aged Children study², reports that only 27% of all girls and 40% of all boys follow these recommendations. Physiological determinants of physical activity in children and teenagers include race, sex, and age³. A recent study shows that Caucasian boys under 10 years old are more active than girls of any age, Caucasian boys over 12 years of age and black children of any age⁴. However there are studies that confirm how physical activity of schoolchildren can be influenced by physical activity of friends⁵, siblings⁶ and parents⁷ or by parental support³.

There is evidence that supports the benefits of physical activity in childhood⁸. In order to increase participation in physical activity among schoolchildren it is important to know

where, when and how these patterns evolve with age. So, the school is an appropriate and convenient environment for the promotion of physical activity and health⁹, because the children spend a large portion of their day in school¹⁰. School has an important role in the development of society¹¹. Physical education and recess provide the two main opportunities for school-based physical activity¹². Healthy People 2010¹³ recommend that physical education should be offered daily and consist of lessons that engage children in moderate to vigorous physical activity at least 50% of class time. Evidence suggests that schoolchildren who do not follow these recommendations¹⁴ do not obtain health benefits¹⁵. In the same way, recess is a good opportunity to increase the daily physical activity levels¹⁶. However, the studies that have attempted to evaluate it during recess have concentrated on specific age groups¹⁶⁻¹⁹, ethnic differences²⁰ in relationship with recommended guidelines²¹ or interventions for accumulating more physical activity²¹⁻²³. To our knowledge, no cross sectional study in schoolchildren exist that covers six years and investigates differences between sex. The aim of this study was to describe the daily physical activity and physical activity during recess of Primary School children and their relationship with sex and age.

SUBJECTS AND METHOD

Design. A descriptive and cross-sectional study was carried out, where the independent variables were age and sex, while the dependent variables were daily physical activity and physical activity during recess.

Subjects. Seven schools from Extremadura (Spain) were invited to take part in the study. The schools were selected by accessibility and convenience (sampling which consisted of selecting schools the easiness or disposal to participate in estudio²⁴). Initially, the parents of 913 children (84% of those invited) gave written informed consent to participate. 175 subjects were not included in the analysis due to failure to complete the general questionnaire (76 children), physical activity readiness questionnaire (63 children), or a problem with the accelerometers (36 children). The final sample therefore consisted of 738 children (8.5 ± 1.7 years, range 6 to 11 years).

Instruments. All participants were assessed for height and weight. Daily physical activity of each child was measured using a validated questionnaire that was completed by the parents of each child²⁵. The questionnaire measured all activities done (24 hours) during three days (Thursday, Friday and Saturday). These activities were divided into six categories: sleeping, very light activity (for activities such as computer or video games), light activities (e.g. cleaning), moderate activities (e.g. cycling), vigorous activity (e.g. running), very vigorous activities (e.g. playing football). To calculate the daily energy cost of each participant (MET/day) the hours used in each category were multiplied by the corresponding energy cost, according to reference tables²⁶. Finally, the total daily energy cost was calculated using the average of three days.

Playground recess physical activity was measured using accelerometry. This method is commonly used in

pediatric population²⁷. Both longitudinal and cross-sectional studies have been conducted previously, to measure levels of physical activity in school cohorts²⁸ and to assess levels of physical activity in overweight and normal weight children²⁹. The accelerometer used was a Caltrac (Hemokinetics, Madison, WI, USA) which was programmed to function as a physical activity monitor³⁰. The Caltrac is an accelerometer that contains a piezoelectric bender element which assesses the movement in the vertical plane. The Caltrac adds and integrates the absolute values of acceleration versus curves and derives this into a numerical value (motion counts). This uniaxial accelerometer has been showed to be highly correlated with the triaxial accelerometer³¹. This methodology is similar to that used in other studies³²⁻³⁴.

Procedure. After initial contact with schools and the acceptance to participate in the study by the Head Teachers and School, an informed consent was given to parents/guardians. Those who signed the consent form were included in the study. The children were measured (height and weight) at the start of the day. Approximately ten minutes before recess, two researchers entered the classroom and distributed accelerometers to the participants who were seated at their desks. Each accelerometer was fixed to the waistband of the child's skirt or trousers before recess; the screen of the accelerometer was covered using black tape to prevent observation of the accelerometer measurement. Teachers and researchers monitored the recess ensuring that physical activity was not different from usual activities in order to prevent the manipulation of

the accelerometer measurement. Upon returning to the classroom after recess time, students placed their accelerometers in a plastic collection container. The recess in all schools was of 30 minutes duration, was performed outdoors on sunny days and all age groups participated simultaneously, 40 children were assessed during each recess period. The study was approved by the Commission of Bioethics at the University Extremadura and complied with the principles of the Declaration of Helsinki.

Data Analysis. The normality of the distributions was assessed by means of the Kolmogorov-Smirnov test and Levene test. A one-way analysis of variance (ANOVA) was used to test hypotheses about the equality of the means between groups for daily PA and recess physical activity. The Scheffé post-hoc test was used for comparisons between groups, age and sex. MANOVA was used to analyse the main and interaction effects of age and sex on variables. Additionally, pair-wise comparisons between groups were made through simple contrasts. A P-value $< .05$ was considered to be statistically significant. Confidence intervals and effect sizes of the differences were calculated³⁵. The Statistical Package for Social Sciences (SPSS for Windows, version 15.0) was used for all analyses.

RESULTS

Table 1 describes the characteristics of the sample. All variables met the criteria of normality ($0.643 \geq z \leq 1.328$; $p > 0.05$) and homocedidad ($0.207 \geq F \leq 2.322$, $p > 0.05$).

With regard to daily physical activity, boys reported higher levels than

girls across all age groups, this difference was higher at seven years (47.6 ± 6.5 vs 42.6 ± 6.4 MET/days, $p < 0.001$), eight years (48.5 ± 8.6 vs. 41.9 ± 4.6 MET/day, $p < 0.001$) and nine years (49.8 ± 8.3 vs 44.1 ± 5.9 MET/day, $p < 0.001$) (Table 2). Whilst physical activity for boys did not vary across age groups ($p = 0.190$), there were lower levels of physical activity levels reported in 6, 7, and 8 year old girls (42.1 ± 4.8 METs/day, 42.6 ± 6.4 MET/day, 41.9 ± 4.6 MET/day, respectively) compared to eleven year old girls (45.0 ± 8.1 MET/day, $p < 0.001$). The largest mean difference between boys and girls was in eight year olds (48.5 ± 8.6 vs. 41.9 ± 4.6 METs, $p < 0.001$, reported by boys and girls respectively). With regard to age in the whole sample, there were differences among schoolchildren in ten years compared with six (47.5 ± 9.4 vs 44.2 ± 6.4 MET/day, $p < 0.001$) and eight years (47.5 ± 9.4 vs 45.0 ± 7.5 MET/day; $p < 0.001$) (Table 2).

Playground physical activity was higher for boys compared to girls at nine years (28.4 ± 12.0 vs 23.7 ± 11.8 motion counts, $p = 0.039$), ten years (28.5 ± 10.8 vs 23.7 ± 10.0 motion counts, $p = 0.014$) and eleven years (24.6 ± 12.2 vs 20.7 ± 9.3 motion counts, $p = 0.047$) (Table 2). Again, playground physical activity in boys does not vary across age group ($p = 0.156$), while in girls physical activity was higher among eight year olds compared to eleven year olds (28.0 ± 10.5 vs. 20.7 ± 9.3 motion counts, $p < 0.001$). Finally, in the whole sample there were differences between eight and eleven year olds (29.0 ± 11.7 vs 22.7 ± 11.0 motion counts, $p = 0.008$). There were no interactions between sex or age and daily physical activity or physical activity at recess.

Table 1
Characteristics of sample

Characteristics	Children (N=738)	Boys (n=379)	Girls (n=359)	p
Kineanthropometric				
Height (m)	1.37 ± 0,1	1.37 ± 0.3	1.37 ± 0.1	0.570
Weight (kg)	35.3 ± 10,6	35.4 ± 10.7	35.2 ± 10.6	0.649
BMI (kg/m ²)	18.3 ± 3,4	18.4 ± 3.2	18.3 ± 3.0	0.808
Practice sport out school (%)				
Yes	82.1	86.7	77.1	0.241
No	17.9	13.3	22.9	0.393
Passive leisure (TV, computer...) (h/week)	15.4 ± 10.4	16.1 ± 8.8	14.4 ± 9.8	0.005
Walking to school (%)				
Yes	60.6	61.1	58.2	0.439
No	39.4	38.9	41.8	0.531

Table 2
Daily physical activity (MET/day) and playground physical activity (motion counts) of children according to age and sex. P-value of ANOVA (difference by sex and age), interval confidence, effect size and p-value of MANOVA with Sheffe post-hoc.
Data are mean and standard deviation

Variable	6 years (a) (n=122)	7 years (b) (n=131)	8 years (c) (n=126)	9 years (d) (n=117)	10 years(e) (n=125)	11 years (f) (n=117)	p	Sheffé post-hoc
Daily PA (MET/day)								
Children (n=738)	44.2 ± 6.4	45.4 ± 6.9	45.0 ± 7.5	47.0 ± 7.8	47.5 ± 9.4	47.0 ± 8.5	<0.001	a, c <e
Boys (n=379)	46.2 ± 7.0	47.6 ± 6.5	48.5 ± 8.6	49.8 ± 8.3	49.5 ± 8.9	48.6 ± 8.6	0.190	-
Girls (n=359)	42.1 ± 4.8	42.6 ± 6.4	41.9 ± 4.6	44.1 ± 5.9	44.4 ± 10.0	45.0 ± 8.1	<0.001	a, b, c <f
Superior interval confidence	1.08	1.16	1.36	1.19	0.92	0.82		
Inferior interval confidence	0.26	0.38	0.57	0.38	0.15	0.04		
p-value, male vs. Female	0.001	<0.001	<0.001	<0.001	0.023	0.029		
Effect size	0.67	0.77	0.97	0.78	0.54	0.43		
Playground PA (motion count)								
Children (n=738)	25.0 ± 11.0	26.4 ± 12.3	29.0 ± 11.7	26.0 ± 12.1	26.2 ± 10.6	22.7 ± 11.0	0.008	c >f
Boys (n=379)	27.1 ± 10.4	27.3 ± 11.1	30.1 ± 12.9	28.4 ± 12.0	28.5 ± 10.8	24.6 ± 12.2	0.156	
Girls (n=359)	23.3 ± 9.9	25.4 ± 9.2	28.0 ± 10.5	23.7 ± 11.8	23.7 ± 10.0	20.7 ± 9.3	<0.001	c >f
Superior interval confidence	0.77	0.56	0.55	0.78	0.84	0.74		
Inferior interval confidence	-0.03	-0.19	-0.20	0.01	0.07	-0.04		
p-value, male vs. Female	0.125	0.294	0.315	0.039	0.014	0.047		
Effect size	0.37	0.19	0.18	0.39	0.46	0.35		

DISCUSSION

The results showed that boys did more daily physical activity than girls overall, as well as within each age group, this agrees with previous research^{3,5,16,36,37}. The major difference in age was observed at 8 years, where boys were more active than girls. These results are similar to a recent study³⁸, where the daily physical activity was measured with accelerometers. Some

studies have reported that maturity differences between sexes (females mature earlier than males) may be one reason why results consistently show that females are less active than males of the same chronological age³⁹. However this study observed less daily physical activity levels in girls at younger ages, which suggest maturity may not be the only factor for the lower physical activity levels reported by girls.

In the current study, no differences were found in daily physical activity or recess physical activity across age groups in boys. This finding is in contrast to studies that indicate that after age 9 there is a reduction in daily physical activity in boys³². On the other hand, 11-year old girls reported more daily physical activity than their 8-year old peers. However this difference was not reflected in their recess physical activity. This could be explained by physical activity for this age group occurring outside the playground⁴⁰. On the other hand playground physical activity levels in both sexes are low, which is in agreement with previous research³⁶. Another study³⁸ suggest a decline in objectively measured overall physical activity levels between the ages of 6 and 9 years. This decline might be explained by increased time spend in scheduled time in school and non-sporting extracurricular activities (e.g. extra tuition, music lessons). It is possible that increased screen time (television, computer, console) such as that reported in the present study could at least partly explain this decline in physical activity. Too much screen time has been shown to influence the appearance of diseases such as obesity⁴¹. Therefore, the family environment might be considered an area of intervention to increasing physical activity in this age group, although a lack of high quality evaluations of interventions in such a setting hampers conclusions concerning effectiveness¹⁴.

On the other hand, school playgrounds provide important settings and opportunities for children to engage in physical activity. In the present study, from the age of nine, boys were more active than girls during recess. Reasons that explain these differences

in playground physical activity are not completely clear^{42,43}. Differences have been observed between the type of activity in which boys and girls participate^{5,37,44}. For example boys often participate in team activities such as handball, football, and basketball of moderate to high intensity, which often contained a competitive element, whereas girls generally participated in lower intensity activity such as talking, walking or skipping¹⁶. Generally, boys take part in more competitive activities and girls showed a preference for activities of cooperative character and view recess time as an opportunity to socialize with friends²⁰. Another explanation of the differences found between the amount of physical activity engaged in during recess, might be that the accelerometer is more sensitive to the type and intensity of activities participated in by boys, this would exaggerate the differences found between sexes when using this measure⁴⁰. Furthermore, the type of physical activity engaged in during recess time, might also be affected by cultural and environmental factors⁴⁵. The analysis of recess PA revealed that there were no differences across age groups except among the group of schoolchildren aged 8 and 11. This finding is in disagreement with other studies that have found a decrease in physical activity levels from the age of nine^{23,32}. One study⁴⁰ explained this decrease in physical activity to a reluctance of wearing accelerometers. Likewise, according to previous research³⁸, gender differences in physical activities were most pronounced during school recess. These differences could also be due to the fact that some of the accelerometry studies focused on vigorous activity^{14,22}, whereas the present data and other studies

represent the total volume of physical activity accumulated during recess time, regardless of intensity¹⁶. Thus, this study suggests that strategies should be developed to increase physical activity at recess for girls over nine years of age. So, recess must be perceived not only as a leisure time, but also as an opportunity to promote a healthy and active lifestyle. Recess could be used by teachers to organize activities to suit the respective age, gender and interests groups of school-children.

The present study has some limitations. First, the use of accelerometers could influence the physical activity at the playground; however the teachers of the children denied that the behavior of the children differed from normal. Second, as discussed above, the assessment of physical activity during recess was done one day, so that physical activity may have been affected. However, the sample size and the lack of highlighted unusual activity by the teachers may decrease the importance of this limitation.

Thus, this study examined the differences in daily physical activity and playground physical activity in primary schoolchildren and their relationship with age and sex. This is the first cross-sectional study that examines physical activity levels during recess between the ages of 6 and 11 years. The conclusion can be drawn from this work in relation to daily physical activity is that boys are more active than girls across all age groups (six to eleven years old), while that in recess physical activity the differences was only in boys between nine and eleven years of age.

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