Relationship between extra-curricular physical exercise and physical fitness, lifestyle and academic performance

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Summary

Introduction: The practice of physical activity (PA) triggers positive adaptations on health. Extracurricular sport activities represent a strategy to increase hours of PA. The aim of this study was to evaluate the impact of extracurricular PA on physical condition (PC), health-related quality of life (HRQoL), screen time, and academic level.
Material and method: In collaboration with three educational centers of Soria, the participants of the study completed several validated questionnaires related to PA information and lifestyle. Different physical tests were conducted to assess pupils' PC and the centers provided information related to academics.
Result: A total of 199 students (51.3% females), mean age 9.9 (standard deviation [ED] 1.4) years, were included in the study. Average weekly of PA hours was 3.3 (DE 1.6), and 51.3% of the pupils performed extracurricular sport activities. The results of the study showed statistically differences (P <0.05) on body mass index, screening time, and academic records between those pupils that performed extracurricular sport activities and those that did not perform any extracurricular activity. We observed a moderate negative correlation between weekly PA hours and screen time (r = -0.46, P <0.001) and a moderate strong positive correlation for academic records (r=0.56, P <0.001). The multivariate logistic regression model revealed that boys had a higher likelihood (odds ratio [OR] 3.59, confidence interval [CI] 95% 1.17-11.05) of practicing extracurricular sport activities compared to girls. Moreover, practicing extracurricular sport activities was significantly associated with lower screen time (OR 0.68, CI 95% 0.57-1.81) and better performance on academics (OR 3.63, CI 95% 2.07-6.37).
Conclusion: Our results reinforce the need to develop strategies for the promotion and management of environments that promote extracurricular sport activities.

Key words:
Physical activity. Extracurricular. Screen time. Academic performance. Health-related quality of life. Physical condition.

Asociación entre la actividad física extraescolar con la condición física, estilo de vida y expediente

Resumen

Introducción: El deporte extraescolar representa una estrategia para aumentar las horas de actividad física (AF) y estimular hábitos saludables. El objetivo del estudio fue evaluar la asociación de la AF extraescolar con la condición física (CF), el estilo de vida, la calidad de vida relacionada con la salud (CVRS), y el expediente.
Material y método: Los participantes 199 escolares (51,3% niñas) con una edad media de 9,9 (desviación estándar [DE] 1,4) años de 3 colegios de Soria, cumplimentaron cuestionarios validados para recoger hábitos de práctica deportiva y el estilo de vida. Se realizaron diferentes pruebas para evaluar la CF y el centro proporcionó información sobre el expediente académico.
Resultado: La media de horas semanales de AF practicada por el total de la muestra fue de 3,3 (DE 1,6) horas, y el 51,3% de los escolares realizaban AF extraescolar. Los resultados del estudio demostraron diferencias significativas (p <0,05) en el índice de masa corporal, las horas de pantalla, y el expediente académico entre los alumnos de que realizan AF extraescolar y los que no la practicaban. Se observó una correlación negativa moderada entre las horas de AF semanales y las horas de pantalla semanales (r=-0,46, p <0,001) y positiva moderadamente fuerte para el expediente académico (r=0,56, p <0,001). El modelo logístico de regresión multivariada determinó que los niños tienen una probabilidad más elevada de practicar AF (*odds ratio* [OR] 3,59, intervalo de confianza [IC] 95% 1,17-11,05) que las niñas. Además, la realización de AF extraescolar, se asoció significativamente con un menor número de horas de pantalla semanales (OR 0,68, IC 95% 0,57-1,81) y con un mejor expediente académico (OR 3,63, IC 95% 2,07-6,37).
Conclusión: Estos resultados refuerzan la necesidad de establecer estrategias de promoción y de gestión de entornos, que favorezcan el aumento de la AF extraescolar.

Palabras clave:
Actividad física. Extraescolares. Horas de pantalla. Rendimiento académico. Calidad de vida relacionada con la salud. Condición física.

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Introduction

Humans are designed to move. Even human body cells, as the basic units of life must move in order to keep their functionality and maintain their life cycle. Physical inactivity is unnatural behaviour and is something that has been progressively increasing to turn a sedentary lifestyle into a habit[1]. Furthermore, physical activity (PA) in the population in general is becoming increasingly less frequent, particularly with regard to children. These low levels of PA, together with unhealthy eating patterns, have caused an alarming increase in the incidence of chronic diseases and a decrease in the general state of health[2]. In this regard, the World Health Organisation (WHO) has reported that physical inactivity is the fourth leading risk factor for mortality in the world[3]. At present, a number of studies have reported that the global levels of PA in adolescents aged between 11-17 years do not meet the minimum recommendation established by the WHO[4] of at least 60 minutes of physical activity a day. Likewise, the results of the Spanish study ANIBES indicate that 73% of girls aged 9-17 years do not meet the recommendations of the WHO, while the percentage of boys is 45%[5].

In order to mitigate this serious public health problem there is a need to promote PA among the population and among young people in particular. This role could be assumed by schools given that they offer a suitable context for the promotion of PA[6]. The teaching of PA at school, with no gender-related stereotypes, is the start of a strategy to allow students to learn to develop an active and healthy lifestyle[7]. However, in Spain, the current development of study plans disregards the international recommendation on the number of hours of physical education in the official education system and, what is more, they are far from regulating extra-curricular time in order to promote a positive impact on PA8. Recently the European Commission indicated that Spain was in one of the lowest positions with regard to the number of teaching hours dedicated to PA and, despite this, there was no modification of the extra-curricular commitment regarding PA[8].

In view of this situation, extra-curricular PA should be regarded as a healthy practice which, as a complementary physical-recreational activity, makes it possible to promote healthy lifestyle strategies. PA would therefore be used to improve the physical fitness (PF), quality of life and health of school pupils now and in the future[9]. Moreover, PA serves to stimulate improvements in cognitive processes and academic performance[10].

Given this situation, we set out to conduct a cross-sectional study on boys and girls at different schools in the city of Soria, directed at evaluating the impact of the practice of extra-curricular PA and the relationship with PF indicators, lifestyle, including health-related quality of life (HRQOL), and the school environment. A knowledge of these relationships could be of great interest in establishing the links between PA practised on an extra-curricular basis and different variables relating to health and academic performance, thereby supporting the need to develop strategies to promote out-of-school PA, which could be designed, directed and implemented by specialists in sports medicine.

Material and method

Participants

A cross-sectional study was conducted on a sample of primary school students from Soria from years 2 to 6, during the first semester of academic year 2020-21. A document was sent to all schools in Soria, inviting them to participate. However, only three schools accepted the invitation. Likewise, a letter was sent to the parents of the participants to explain the nature and purpose of the study, and to request them to sign their informed consent to permit their children to take part in the study. This investigation was designed in accordance with the Declaration of Helsinki (2008), with the Revised Version (2013) (World Medical Association, 2013). The Ethics Committee of the Faculty of Health Sciences of the Soria Campus of the University of Valladolid, Soria, Spain, approved this study with internal number CCSS/2020/03.

Instruments

To collect information on the study variables, the questionnaire *"School Health Action Planning and Evaluation System"* (SHAPES) physical activity module was used to measure the weekly physical activity and weekly screen time. This questionnaire reports on participation in physical activities, sedentary activities (watching TV, playing video games, mobiles or tablets)[11]. KIDSCREEN-10 was also used, a questionnaire to evaluate the children's quality of life, comprising a series of 10 questions each rated from 1 to 5 in a Likert scale[12,13]. The academic performance was obtained from the academic management programme at the schools. Furthermore, height and weight were measured and the following PF tests were conducted: Hand-held dynamometer test (dynamometer Jamar Plus) (Eurofit Physical Fitness Test Battery)[14]; standing broad jump, with feet together[14] (Eurofit battery); abdominal strength (Fitnessgram battery)[15]; forward flexion of the trunk in the standing position[16]; Flamingo balance test (Eurofit Battery)[14]; coordination/agility circuit with hurdles starting from a lying down position[17]; measurement of the heart rate using the Polar® Vantage M heart rate sensor (Polar Electro, Kempele, Finland) after the coordination/aglity exercise.

Statistical analyses

For the statistical analyses, the means and standard deviations were calculated for the continuous variables and frequencies, and percentages for the categorical variables. The Student t-test was used to compare the continuous variables, and the chi square test (χ^2) for the categorical variables. The correlations were estimated with Spearman's rank correlation coefficient. Multivariate logistics regression models were made with their corresponding *odds ratio* (OR) and 95% confidence interval (CI) in order to study the relationship between the different study variables and PA A two-tailed p-value <0.05 was considered to be statistically significant. All the analyses were made using the STATA version 15 (STATA Corp., TX, USA) statistical package.

Results

The results of Table 1 describe the characteristics of the 119 students included in the study, 58 boy pupils (48.7%) and 61 girl pupils (51.3%) aged 8-12 years (mean age 9.9 years, standard deviation [SD] 1.4), corresponding to five primary education years from 3 schools of the provincial capital of Soria. The students do an average of 3.3 hours of PA a week (SD 1.6), they spend 25.1 hours (SD 3.6) in front of a screen and have an average grade of 7.1 (SD 1.1) in their academic record. As was to be expected, those students practising extra-curricular PA do significantly more hours of PA per week compared to those who do no out-of-school PA (4.5 *vs*. 2.0 hours, p <0.001), and they also have a lower body mass index (BMI) (17.4 Kg/m^2 *vs*.18.7 Kg/m^2, p = 0.017), a better average grade in their academic record (7.7 *vs*. 6.5, p <0.001), and they spend fewer hours per week in front of a screen (23.5 *vs*. 26.8, p <0.001). Stratified by gender, it can be seen that girls spend significantly fewer hours per week in front of a screen than boys (24.2 *vs*. 26.0, p <0.001).

Table 2 shows the correlations between the total number of hours of PA per week and PF, lifestyle, and academic environment for the total of the sample and by sex. The correlations between PA and the physical

Table 1. Characteristics of the study population stratified by out-of-school physical activity and by the sex of participants (n=119).

Characteristics	Total	Extra-curricular physical activity			Sex		
	(n=119)	No (n=58)	Yes (n=61)	p-value	Girls (n=58)	Boys (n=61)	p-value
Age. years, mean (SD)	9.9 (1.4)	10.1 (1.3)	9.8 (1.4)	0.259	9.9 (1.3)	9.9 (1.4)	0.961
Weekly hours of physical activity, mean (SD)	3.3 (1.6)	2 (0)	4.5 (1.5)	**<0.001**	3.2 (1.5)	3.4 (1.8)	0.508
BMI. kg. m^2, mean (SD)	18.0 (2.9)	18.7 (3.1)	17.4 (2.5)	**0.017**	18.0 (3.0)	18.1 (2.8)	0.795
Primary education, n (%)				0.575			0.920
2nd year	17.6	13.8	21.3		17.2	18.0	
3rd year	26.9	27.6	26.2		25.9	27.9	
4th year	18.5	15.5	21.3		19.0	18.0	
5th year	21.0	25.9	16.4		24.1	18.0	
6th year	16.0	17.2	14.8		13.8	18.0	
Type of school, n (%)				0.405			0.642
State	51.3	55.2	47.5		53.5	49.2	
Private, state subsidised	48.7	44.8	52.5		46.5	50.8	
Weekly screen hours, mean (SD)	25.1 (3.6)	26.8 (3.2)	23.5 (3.3)	**<0.001**	24.2 (3.7)	26.0 (3.3)	**0.007**
Academic performance, marks, mean (SD)	7.1 (1.1)	6.5 (1.0)	7.7 (0.9)	**<0.001**	7.0 (1.1)	7.2 (1.1)	0.250

SD: standard deviation; BMI: body mass index.
The bold type shows statistically significant values at p-value <0.05.

Table 2. Correlations between the number of physical activity hours and physical fitness, lifestyle and academic environment.

Characteristics	Number of hours of physical activity					
			Sex			
	Total		Male		Female	
	r	p-valor	r	p-valor	r	p-valor
Physical fitness						
Dynamometer	0.07	0.475	0.04	0.743	0.08	0.541
Standing jump	**0.19**	**0.036**	0.04	0.790	**0.32**	**0.011**
Abdominal strength	**0.27**	**0.003**	**0.27**	**0.038**	**0.27**	**0.034**
Flexibility (standing position)	-0.13	0.157	-0.18	0.188	-0.09	0.506
Balance (Flamingo test)	-0.05	0.587	-0.13	0.333	0.02	0.890
Coordination (faults)	-0.05	0.621	0.02	0.890	-0.09	0.494
Heart rate (after exercise)	0.01	0.971	0.01	0.952	-0.01	0.999
Lifestyle						
Quality of life (Kidscreen test)	-0.04	0.651	-0.05	0.730	-0.02	0.855
Screen time	**-0.46**	**< 0.001**	**-0.44**	**< 0.001**	**-0.54**	**< 0.001**
Academic performance						
Marks	**0.56**	**< 0.001**	**0.51**	**< 0.001**	**0.60**	**< 0.001**

Correlations (r) are based on the Spearman's rank correlation coefficient.
The bold type shows statistically significant values at p-value <0.05

condition variables are weak or very weak, only observing one positive and statistically significant correlation for the standing jump (r = 0.19, p = 0.036) and abdominal strength (r = 0.19, p = 0.003). However, a moderate negative correlation between the total number of hours of PA per week and the weekly screen hours (r =-0.46, p <0.001) and a moderately strong positive correlation for academic performance (r = 0.56, p <0.001), being significant in both cases.

Stratified by gender, the correlations follow the same pattern, observing slightly stronger correlations for girls. We would emphasise the correlation of the total weekly hours of PA and weekly screen hours in which a moderate negative correlation can be seen for boys (r = -0.44, p <0.001) and moderately stronger for girls (r = -0.54, p <0.001), being statistically significant in both cases (Figure 1).

We would also highlight the fact that the greater relationship between the study variables was observed for the total weekly hours of PA and academic performance, where the correlations are positive and moderately strong for both boys (r = 0.51, p <0.001) and girls (r = 0.60, p <0.001), being significant in both cases (Figure 2).

Figure 1. The dispersion graph shows the weekly screen hours vs. the number of weekly physical activity hours, stratified by gender. Each participant in the study (n=119) is represented by a point. The shaded grey area represents the confidence interval at 95% (CI 95%). The line inside the shaded area represents the correlation fit line.

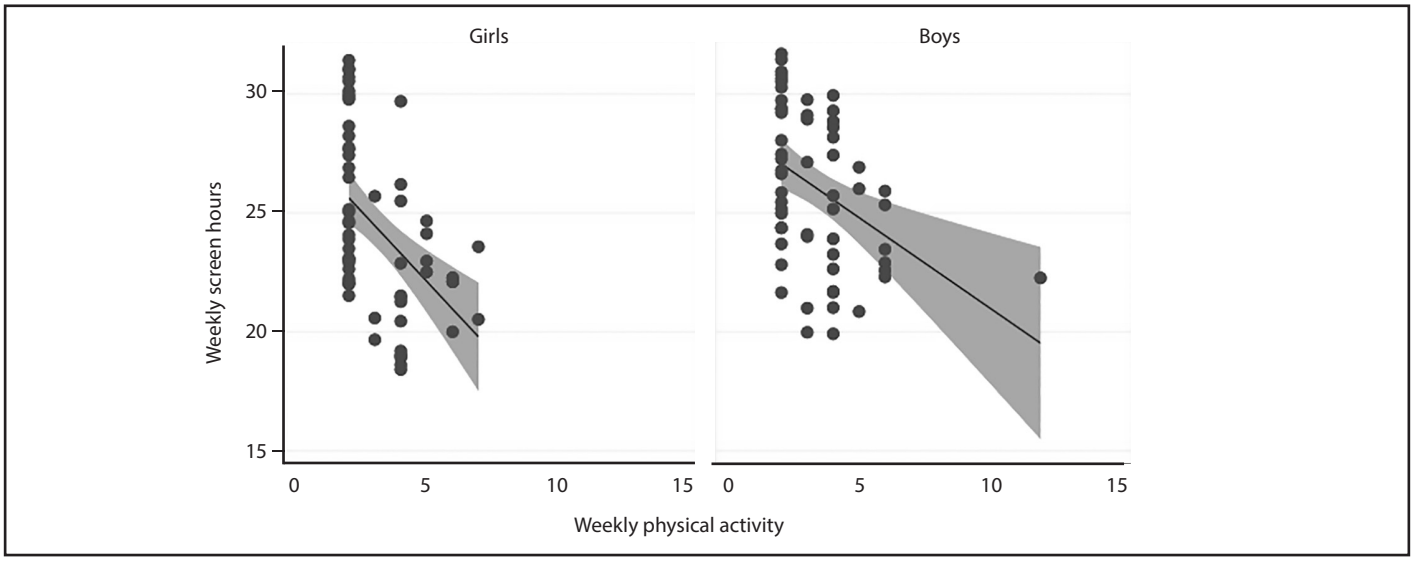

Figure 2. The dispersion graph shows the academic performance vs. the number of weekly physical activity hours, stratified by sex. Each participant in the study (n=119) is represented by a point. The shaded grey area represents the confidence interval at 95% (CI 95%). The line inside the shaded area represents the correlation fit line.

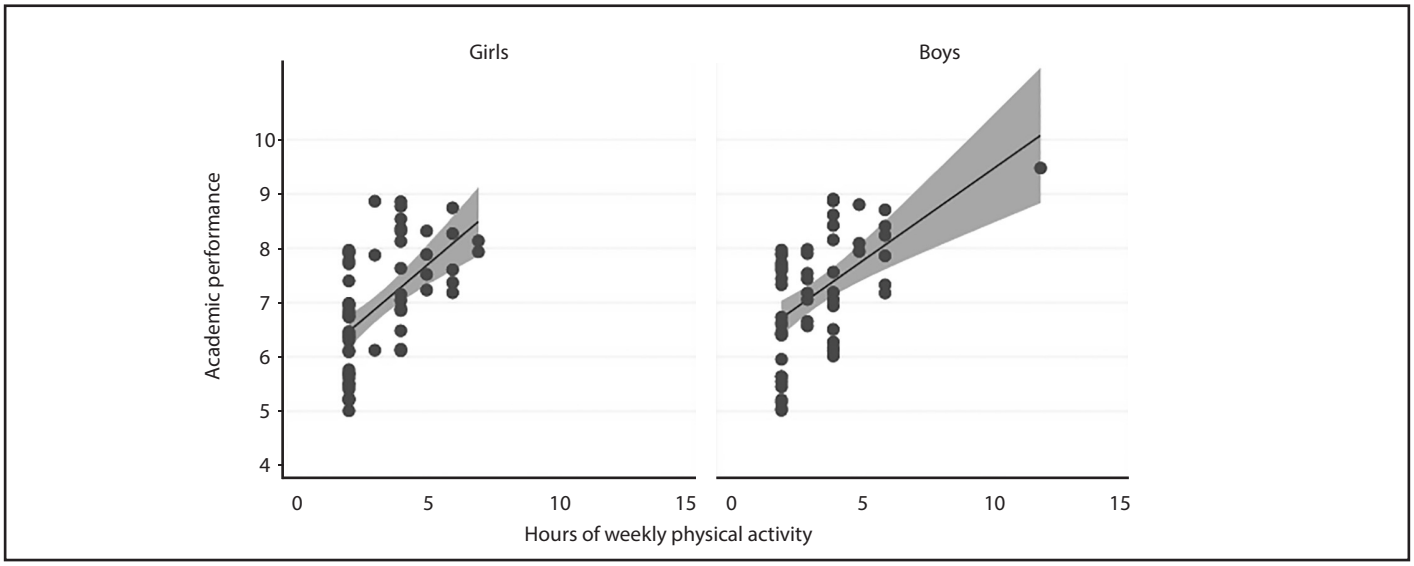

Table 3. Characteristics of the study participants associated with out-of-school physical activity. *Odds Ratio* (OR) and confidence intervals 95% (CI 95%).

Characteristics	Total		Boys		Girls	
	OR (CI 95%) Crude	OR (CI 95%) Multivariate[1]	OR (CI 95%) Crude	OR (IC 95%) Multivariate[1]	OR (CI 95%) Crude	OR (CI 95%) Multivariate[1]
Sex						
Girls	1.00 (ref.)	--	--	--	--	--
Boys	1.56 (0.75-3.21)	**3.59 (1.17-11.05)**	--	--	--	--
Age, years	0.86 (0.65-1.12)	0.94 (0.61-1.44)	0.71 (0.47-1.07)	0.57 (0.30-1.09)	0.99 (0.69-1.43)	1.81 (0.79-4.16)
Type of school						
Private, state subsidised	1.00 (ref.)	--	1.00 (ref.)	--	1.00 (ref.)	--
State	1.36 (0.66-2.79)	1.92 (0.69-5.40)	0.47 (0.16-1.36)	0.26 (0.06-1.20)	0.94 (0.34-2.58)	1.18 (0.23-6.04)
BMI., kg/m^2	0.85 (0.74-0.97)	0.94 (0.75-1.19)	0.92 (0.76-1.11)	1.06 (0.78-1.44)	0.79 (0.64-0.96)	0.72 (0.45-1.16)
Weekly screen hours	0.75 (0.66-0.85)	**0.68 (0.57-0.81)**	0.75 (0.62-0.91)	**0.67 (0.50-0.88)**	0.63 (0.49-0.81)	**0.62 (0.46-0.85)**
Academic performance	3.65 (2.24-5.95)	**3.63 (2.07-6.37)**	2.87 (1.52-5.41)	**2.82 (1.37-5.84)**	4.72 (2.20-10.15)	**4.34 (1.71-10.97)**

CI: Confidence Interval; BMI: Body Mass Index; OR: Odds Ratio; Ref: reference
[1]Multivariate model: adjusted for all the variables in the table.
The bold type shows statistically significant values at p-value <0.05.

The results of the multivariate logistic regression analysis give a diagnostic/predictor model for practising extra-curricular PA comprising three variables: sex, screen time and academic performance (Table 3). Thus, boys have a greater probability of practising extra-curricular PA than girls (OR 3.59, CI 95% 1.17-11.05). Likewise, the practice of out-of-school PA by students was associated with fewer weekly screen hours (OR 0.68, CI 95% 0.57-1.81) and with better academic performance (OR 3.63, CI 95% 2.07-6.37). Estimates of the relationships were similar when stratified by gender, highlighting the greater probability of better academic performance of girls practising extra-curricular PA compared to girls that do not do so (OR 4.34, CI 95% 1.71-10.97).

Discussion

PA is an essential starting point to ensure that girls and boys learn life competencies and acquire the commitment to implement a healthy and active lifestyle[8]. Furthermore, it is considered that PA practised in and out of schools is the right environment to stimulate the cognitive functions of young people, with no gender distinction, so that they can successfully address the exacting demands of learning[8]. For this reason, the objective of this study was to evaluate the impact of extra-curricular PA on important variables relating to health, PF and academic performance.

Given that our results show that the girls and boys practising extra-curricular PA have a significantly lower BMI, increasing the number of PA hours could be the most effective mechanism to combat obesity[19]. In this way, the relationship between BMI and the PA time is inversely proportional, demonstrating that the higher the number of weekly PA hours the lower the BMI. These results are in line with other investigations that have studied the relationship between BMI and PA time in school children[20-22].

With regard to the relationship between the number of PA hours and PF, evaluated through different physical tests, our results show very weak almost non-existent correlations. These results may be due to the fact that the number of hours of PA dedicated by the school children in the study are insufficient to show improvements in PF. In this regard, the average number of weekly hours of PA dedicated by the boys and girls at the schools in Soria, are far lower than the minimum recommendations given by the WHO, which established at least 1 hour a day of moderate or strenuous PA[23]. It has been demonstrated that compliance with these recommendations leads to improvements in muscle strength, speed, agility and flexibility[24]. The practice of PA by our school children from Soria would be in line with the recommendations of Spain's Ministry of Eduction and Ministry of Health, both of which recommend 30 minutes a day[25], considerably less than the recommendations given by the WHO[3]. Our results indicate that the guidelines established by the Spanish government are insufficient to bring about improvements in the PF of school children. There is therefore a pressing need to bring these recommendations into line with the guidelines established by the professionals in the area of PA, who suggest doubling the times[8]. In this regard, the design and supervision of new PA recommendations would best be performed by sports medicine specialists, given their expertise and knowledge in the promotion of the health of the general public by encouraging a physically active lifestyle.

PF has a direct influence on the HRQOL in childhood and adolescence alike[26]. PA increases muscle strength in relation to body weight, and strength of the lower body, testosterone secretion, improvement in neuro muscular coordination, speed/agility, optimal gynoid redistribution of adipose tissue in women, increased cardiorespiratory values and aerobic capacity[27,28]. These positive changes to the different physiological capacities have resulted in clear improvements in HRQOL[9]. Our results show no relationship between the hours of PA and the HRQOL measured by the KIDSCREEN-10 questionnaire, which provides a subjective global

assessment of the perception of physical, psychological and social well-being, contrary to other studies conducted on schoolchildren aged 8-12 years[28] and adolescents aged 12-18 years[30]. The insufficient number of hours of weekly PA could be the reason why schoolchildren in Soria show no overall improvement in PF and, therefore, there is no relationship with HRQOL. This serves to confirm that the number of hours of PA for the boys and girls in Soria is inadequate. The promotion of extra-curricular PA by regional and municipal schools could be a strategy to encourage school children in Soria to practice sport and to improve their physical capacities. Some models of campaigns to practice PA are available, such as those conducted in the years prior to the Barcelona Olympics of 92[31] and the plans for the prevention / treatment of drug addiction[32] that have achieved improvements in PF and in HRQOL. A successful model that could be taken as a reference is the campaign conducted by the Sociedad Española de Medicina del Deporte (SEMED - Spanish Society of Sports Medicine) "Physical Fitness, Sport and Health" in 2016. This campaign was based on three fundamental pillars, advocated by sports medicine specialists: Practice sport for reasons of health and to improve physical fitness, so that it becomes a permanent habit.

The results of the study also show that the most physically active schoolchildren spend less time in front of a screen, observing a statistically significant negative correlation between the hours of PA performed and screen time. These results are in line with those reported by other studies on young people aged 6-17 years[33-35]. Therefore, the practice of out-of-school sport could minimise the negative impact of excessive screen time. Although the study made by Abarca *et al.*[36] reports the absence of a relationship between PA and screen time, it was categorical in stating that both (PA and screen time) are health-related habits of life that can be changed[18]. In this regard, schoolchildren, with no gender differences, by dedicating more time to electronic media would have less time for other activities relating to a healthy lifestyle, particularly PA and sleep, which could result in a lower perception of quality of sleep and of HRQOL[37].

As for the number of hours dedicated to PA and academic performance, we observed a statistically significant positive correlation. With regard to the school children from Soria taking part in this study, this relationship is greater for girls than for boys. It is important to point out that the time spent by the school children from Soria on PA had a positive impact on academic performance, as opposed to the negative impact reported by other studies[38,39]. Academic performance is conditioned by three factors: personal, school-related and psychosocial[40]. The positive relationship between PA and academic performance has already been described[41], in school[10,42-44] and out of school[45,46]. In our study, the difference of more than one point in the academic performance of those practising extra-curricular PA compared to those pupils who do not, not only serves to encourage students to comply with the recommendations to practice PA but also to exceed them. These results could include PA as the fourth factor relating to the academic performance of students[10]. Therefore, consideration should be given to the promotion and implementation of PA schemes, paying particular attention to the inclusion of the female gender, due to the greater relationship with PA observed in this study.

The results, evaluated using the multivariate logistic regression model, show sex, screen time, and academic performance as independent factors relating to the practice of extra-curricular PA. These results indicate that, for each additional hour of screen time, the probability of practising PA drops by 32% while, for each additional point of academic performance, the probability of practising PA is 3 times higher. When stratified by gender, the results are similar to those of the total sample. Therefore, based on the overall results obtained for screen time and academic performance, recommendations could be established with regard to the hours of sedentary leisure and promoting a habit of greater physical activity. In other words, schemes could be designed for the purpose of replacing sedentary screen time with extra-curricular PA time, in order to improve the health profiles of school children in Soria.

One significant aspect derived from the data collected from the sample of pupils at the schools in the provincial capital of Soria is that the probability of boys doing extra-curricular PA is 3 times greater than for girls. Scientific literature has reported that the percentage of girls practising sport is 20% lower than for boys[47]. This situation is probably a result of the distribution of spaces for sports and of the fact that stereotypes promoted by society conspire to reduce the interest and facilities to allow girls to practice sport48. In order to reverse this situation of inequality, the institutions or associations that organise sports activities must create schemes that positively discriminate in favour of the female gender in order to stimulate the involvement and active participation of girl pupils in any physical or sporting activity. This would make it possible to enhance sports practices in relation to those that are traditionally associated with the female cultural model, by stimulating critical competition in the face of PA stereotypes and sport.

One of the greatest strengths of the study is the quantity of measurements taken by the investigators. Notwithstanding this, the study does have a few limitations, such as the small sample size, that could limit the statistical power. However, the current healthcare situation makes it difficult to collect data and obtain the parents' consent. Another limitation relates to the fact that the HRQOL and PA and screen times were self-reported by the pupils. The self-reported measurement could have memory or social desirability biases. However, the validity of the questionnaires used has been demonstrated given that most of them have been validated and used in a number of studies[11-13].

In conclusion, the study makes it clear that the extra-curricular PA of pupils in Soria does not comply with the recommendations given by the WHO. Furthermore, extra-curricular PA is related to a lower BMI, better academic performance and less screen time. Notwithstanding this, the weekly extra-curricular PA hours are insufficient to improve the PF and HRQOL. All this information reported in our study reinforces the need to establish and strengthen future policies for intervention strategies directed at increasing the PA of schoolchildren in this context, particularly those policies that are directed at combating discrimination and making it possible to implement specific actions in favour of equality and the incorporation of the gender perspective.

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Conflict of interest

The authors declare that there is no conflict of interest.

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