

Heart-healthy physical activity level in primary school physical education: expectations and some evidence

Nivel de actividad física cardiosaludable en educación física en educación primaria: expectativas y algunas evidencias

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Abstract

The high sedentary rate of children and youth in Spain encourages us to identify possibilities and propose alternatives to reverse this situation. The ex-post facto, retrospective and comparative cross-sectional study basically consisted of identifying and comparing the level of physical activity (PA) achieved in Physical Education (PE) by 43 children and 37 girls of 6th grade Primary (11.86 ± 0.34 years) randomly selected from 26 centers of the Community of Madrid, according to the recommended level. For the PA analysis, the heart rate (HR) was continuously recorded by means of Polar® monitors during the PE classes in a school week, deriving from the recorded HR data the amount of time spent in an effort of ≥50% HR reserve which is equivalent to a cardio-healthy PA of moderate to vigorous intensity (MVPA).

The main results of the statistical analysis, whose level of significance was established at $p < 0.05$, showed that the subjects accumulated in MVPA an average time equivalent to $21.3 \pm 18.1\%$ of the programmed weekly PE time, being similar in boys, $21.1 \pm 18.9\%$, and in girls, $21.5 \pm 17.5\%$ ($p = 0.77$). In the literature, a great diversity of results is observed. However, our findings are similar to some studies that, like ours, show that the level of PA reached by schoolchildren is lower than recommended: ≥50% of the PE time. The results show that the boys and girls of the sample invested in MVPA a similar proportion of PE time, a level that, in addition, is considered insufficient to generate benefits in cardiovascular health.

Although it is necessary to continue deepening in this field, the results suggest revising and adapting the current school PE programs to the idiosyncrasy of each school and its school population with a view to increasing the level of PA of the students.

Keywords

Physical education; cardiovascular effort; physical activity; recommendation; gender.

Resumen

El preocupante nivel de sedentarismo infanto-juvenil en España nos anima a identificar posibilidades y proponer alternativas que permitan revertir esta situación. El estudio transversal *ex post facto*, retrospectivo y comparativo consistió básicamente en identificar y comparar el nivel de actividad física (AF) alcanzado en Educación Física por 43 niños y 37 niñas estudiantes de 6º de Primaria (11,86±0,34 años) aleatoriamente seleccionados de 26 centros de la Comunidad de Madrid, según el nivel recomendado. Para el análisis de la AF, se registró de forma continuada la frecuencia cardíaca (FC) en las clases de EF de una semana escolar mediante monitores Polar®, derivando de dicho registro la cantidad de tiempo invertido en un esfuerzo de $\geq 50\%$ FC de reserva (FCres) y equivalente a una AF cardiosaludable de moderada a vigorosa intensidad (AFMV). Los principales resultados del análisis estadístico, cuyo nivel de significación se estableció en $p < 0,05$, mostraron que los sujetos acumularon en APMV un promedio de tiempo equivalente al 21,3±18,1% del tiempo de EF programado siendo similar en los niños, 21,1±18,9%, y en las niñas, 21,5±17,5% ($p=0,77$). En la literatura se observa una gran diversidad de resultados. No obstante, nuestros hallazgos son similares a los informados en algunos estudios que, como el nuestro, muestran que el nivel de AF alcanzado es inferior al recomendado: $\geq 50\%$ del tiempo de EF. Los resultados muestran que los niños y niñas de la muestra invirtieron en APMV una similar proporción de tiempo de EF, un nivel de AF que, además, es considerado insuficiente para generar beneficios en la salud cardiovascular. Aunque es necesario seguir profundizando en este campo, los resultados sugieren revisar y adaptar los actuales programas de EF escolar a la idiosincrasia de cada centro y su población escolar con vistas a incrementar el nivel de AF de los estudiantes.

Palabras clave

Educación física; esfuerzo cardiovascular; actividad física; recomendación, género.

Introduction

Obesity and type 2 diabetes are two of the diseases with the highest incidence among the population of developed countries and are closely linked to a sedentary lifestyle and inappropriate eating habits. The Spanish population is not immune to this circumstance, which also begins to affect subjects of developmental age, given the obesity and overweight rates (Sánchez-Cruz, Jiménez-Moleón, Fernández-Quesada & Sánchez, 2013), and sedentary lifestyle of children and adolescents (Estudio ALADINO 2013, 2013). In this last point, it is observed in Spain that around 80% of school-age children only participate in physical activities at school (European Commission / EACEA / Eurydice, 2013). This, among other factors, has motivated a growing interest in the last two decades to study and increase the PA levels of

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children and adolescents in different contexts and periods: in free time, during weekends or during the time they remain in school.

Within school time, Physical Education (PE) classes have also received attention for the potential they have to promote healthy physical activity (PA) (Abarca-Sos, Murillo, Julián, Zaragoza, & Generelo, 2015; Slingerland & Borghouts, 2011) either directly by contributing to the daily accumulation of PA (Frago, 2015) and providing satisfactory learning experiences (Julián, 2012); or indirectly by promoting PA outside the school context, helping students acquire and consolidate an active lifestyle (González-Cutre, Sicilia, Beas-Jiménez, & Hagger, 2014). Driven by this interest and the few studies carried out in Spain that have analyzed the patterns of PA in children and adolescents from the continuously recorded heart rate (HR) during PE classes (Moral, 2015), the present paper analyzed the level of heart-healthy PA that a group of Primary students from different school centers, reached during the PE classes of a school week comparing it with the recommended levels and analyzing the relationship with the sexual phenotype.

Method

Study design. The study has used the ex-post facto relational methodology, observing the MVPA retrospectively, and analyzing gender as a possible associated factor.

Participants. The population corresponded to the students who attend the 6th grade of Primary Education for the first time in some school center of the Community of Madrid. The sample was selected by a simple random sampling balanced with respect to gender from 26 centers of the Community of Madrid with a mid-socioeconomic level. Finally, valid data were collected from 43 boys and 37 girls (11.9 ± 0.3 years).

Instruments. The body weight was measured with the same mechanical medical scale Seca model 710® (Seca GmbH and Co.KG, Hamburg, Germany), approved, calibrated, with a stable surface and with an accuracy of ± 100 gram. To register the height, we used the same standard height measuring rod Seca model 220® (Seca GmbH and Co.KG, Hamburg, Germany), telescopic, stable and with an accuracy of ± 1.00 millimeter.

Various models of Polar® HR monitors (Polar Electro Oy, Kempele, Finland), a Polar IrDA USB® interface and the Polar ProTrainer 5® program (v.5.35.161) were used, which, installed on a laptop, enabled the subsequent HR data analysis.

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Process. The anthropometric data were recorded according to the guidelines and procedures recommended by the Spanish Cineantropometry Group (GREC).

The HR registration was carried out during the PE classes of a school week as described in another study (see Moral, 2015). The data stored in the wrist unit was downloaded to a laptop computer using the Polar IrDA USB® interface. The Polar ProTrainer 5® program (v.5.35.161) made its analysis possible. The PA was analyzed from the average time accumulated by each subject in HR of at least 50% of the reserve HR ($\geq 50\%$ HR_{res}) sustained for three or more minutes. This level of cardiovascular effort is equivalent to PA of moderate to vigorous intensity (MVPA) (Ekelund et al., 2001).

Analysis of data. The data were subjected to a descriptive statistical analysis and normality tests (Kolmogorov-Smirnov and Shapiro-Wilks tests) and homoscedasticity (Levene test). Next, we compared the MVPA results of the sample with the recommended levels (US Department of Health and Human Services, 2010): to spend in MVPA at least 50% of the PE class time (one-sample t-Test). Subsequently, an analysis of the linear relationship between MVPA and gender was performed (Spearman correlation test). Finally, it was checked whether or not the differences observed were due to chance (Mann-Whitney test for two independent samples). For the statistical analysis, the SPSS Statistics® software (v.17.0.0) was used. The level of significance was established at $p < 0.05$.

The study has been carried out following the deontological norms recognized by the World Medical Association in the Helsinki Declaration of Human Rights (Asociación Médica Mundial, 2008).

Results

Table 1 introduces the results of age, height, weight and body mass index of the participants that do not show significant gender association ($p > 0.05$).

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Table 1. Features of the sample (total sample and by gender).

	Total (n=80)		Boys (n=43)		Girls (n=37)		Sig.
	Mean	SD	Mean	SD	Mean	SD	
Age (decimal years)	11.86	0.34	11.89	.34	11.82	.33	.65
Height (m)	1.51	.06	1.50	.07	1.52	.06	.21
Weight (kg)	45.70	8.46	45.26	9.35	46.21	7.38	.62
BMI (kg/m ²)	19.87	2.73	19.88	3.07	19.85	2.33	.97

The weekly time programmed for PE reaches an average close to 152 minutes, the HR an average close to 122 bpm, and the percentage of the HRres is close to 39% (see Table 2). The tests show no statistically significant differences between boys and girls (see Table 2).

Table 2. Results of the PE classes studied (total sample and by gender).

	Total		Boys		Girls		Sig.
	Mean	SD	Mean	SD	Mean	SD	
Time (min/school week)	151.82	43.20	155.94	53.24	147.03	27.28	.36
HR (bpm)	121.54	16.17	119.77	17.66	123.59	14.20	.29
HRres (%)	38.67	10.53	38.39	11.17	39.00	9.88	.80
LSPA (min/school week)	119.95	48.55	124.70	59.17	114.43	32.08	.33
MVPA (min/school week)	31.87	28.89	31.24	28.03	32.59	30.24	.84
VPA (min/school week)	10.01	13.85	11.39	14.62	8.40	12.91	.34
LSPA (% PE)	78.92	18.01	79.30	18.59	78.47	17.55	.84
MVPA (% PE)	21.08	18.01	20.70	18.59	21.53	17.55	.84
VPA (% PE)	6.62	8.59	7.64	9.45	5.44	7.44	.25

LSPA: light and sedentary physical activity (<50%FCres)

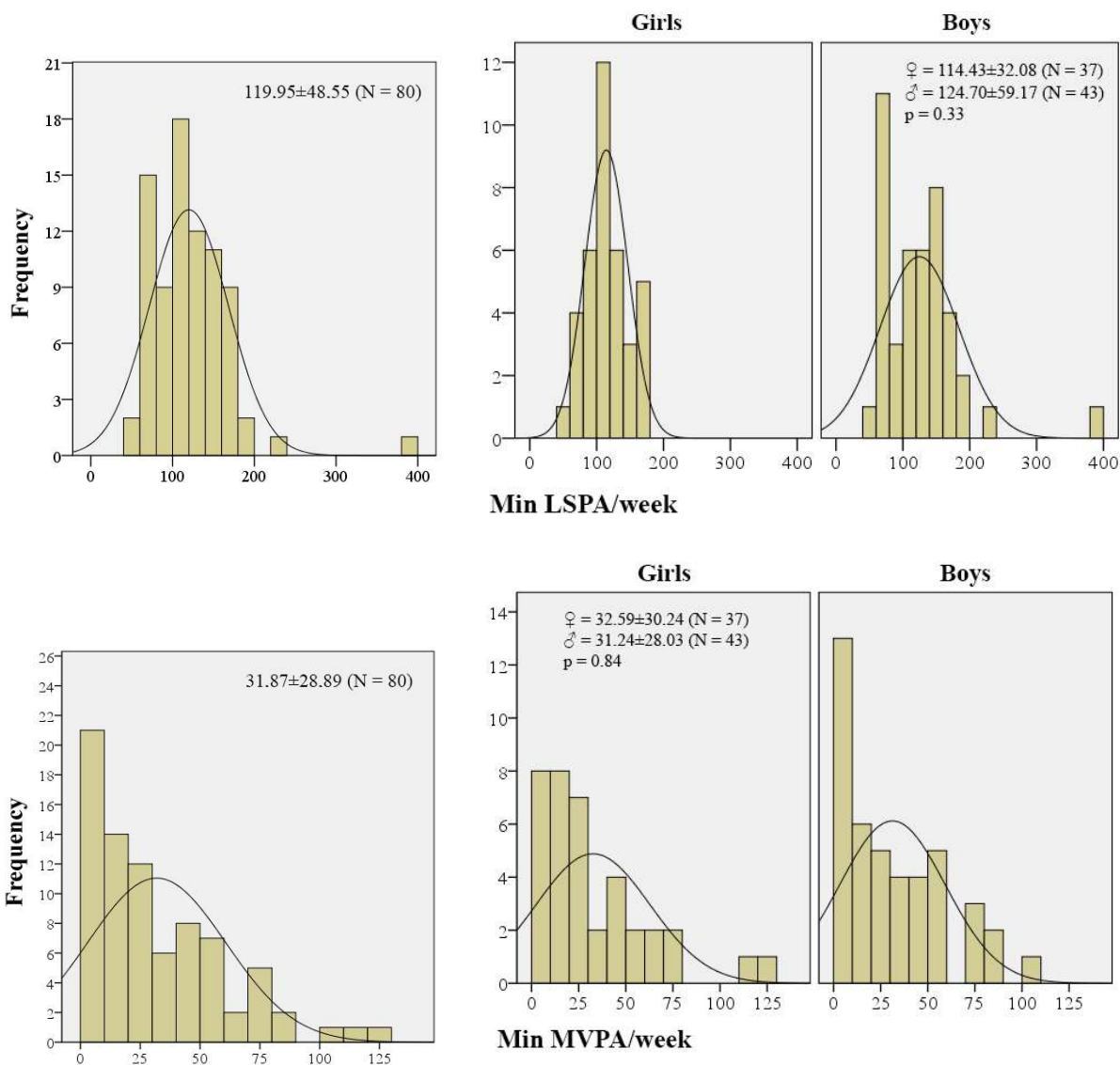
MVPA: moderate to vigorous physical activity (≥50%FCres)

VPA: vigorous physical activity (≥70%FCres)

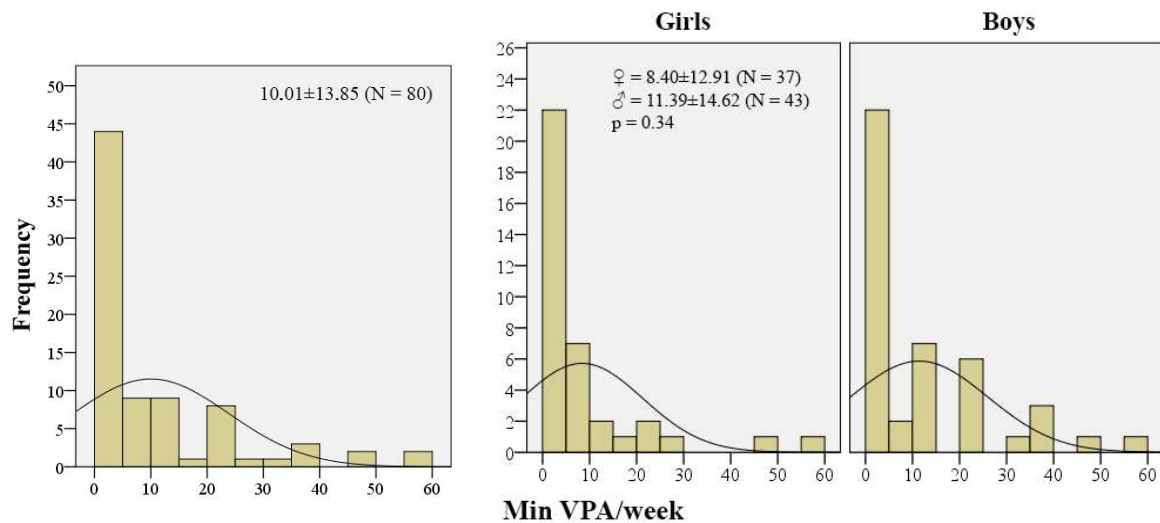
The time spent in light and sedentary PA reaches an average close to 120 minutes which means an average close to 79% of the scheduled PE time. In the case of the MVPA and the VPA, the averaged time is respectively around 32 and 10 minutes, corresponding to slightly more than 21% and 6% of the programmed PE time, respectively. The tests performed do not show a significant association with gender (see Table 2). Figure 1 shows the graphic distribution of the frequency of cases according to the time spent in each type of PA.

Figure 1. Distribution of the subjects (total and by gender) according to the weekly time spent in physical activity of different intensities during Physical Education.

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LSPA: light and sedentary physical activity (<50%FCres)

MVPA: moderate to vigorous physical activity (≥50%FCres)

VPA: vigorous physical activity (≥70%FCres)

Discussion

The percentage of the weekly PE time spent in MVPA by the participants was just over 21%, far below the recommended 50% (Table 2). In this regard, studies with similar results appear in the literature (Hollis et al., 2016, Lonsdale et al., 2013; Matthews-Ewald, Moore, Harris, Bradlyn, & Frost, 2013; Meyer et al., 2013; Nettlefold et al., 2011; Romar, Fagerström, & Granlund, 2011), but also others that show much higher rates, for example, of 58.7% (Jago et al., 2009) and of 42.6% in North American schoolchildren (Rauh, 2013), between 38.7% and 63% in English schoolchildren (Merish & Fairclough, 2010), of 40.76% in Swiss schoolchildren (Cheval, Courvoisier, & Chanal, 2016) or of $46.7 \pm 20\%$ in a study conducted in the Netherlands with a similar methodology to our study (Slingerland, Oomen, & Borghouts, 2011). According to the reviews consulted, schoolchildren can spend in MVPA between 9% and 33% of PE time (Nettlefold et al., 2011), an average of $40.4 \pm 13.8\%$ of the PE time when PA is measured by HR (Fairclough & Stratton, 2006), or 11.4 and 88.5% when the procedure used is direct observation and accelerometry, respectively (Hollis et al., 2016).

The few studies carried out in Spanish school population are also inconclusive and show different results as well. A study carried out in Madrid shows that the participating schoolchildren spent in PA an average of 57.6% of the PE time (del Campo, Martínez, Moya, & Hernández, 2010). In another study conducted in Zaragoza, students invested in MVPA (50-

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85% HRres) an average of 39.25% of the PE class time (Sarradel et al., 2011). In another study conducted on 36 sixth graders of Toledo province, the participants reached an average of 9.25% (Martínez, Contreras, Aznar, & Lera, 2012). In a recent study, the 220 elementary school students from Zaragoza produced in MVPA an average of 22% of the PE class time (Frago, 2015).

Despite the disparity of results, PE is still the subject that most promotes PA in the school day (Moral, 2015) and is often the only opportunity that children have to make a minimum of PA throughout the day (Meyer et al., 2013). For this reason and despite the fact that healthy PA is only one of the objectives for PE to achieve (Frago, 2015) and the limited resources of many schools (Slingerland & Borghoust, 2011), we must insist on increasing the intensity of the classes and reducing the time that the subjects remain inactive (Moral, 2015). Regarding the first aspect, students tend to perform more VPA and MVPA in games & team sports-centered classes focused on overcoming opponents and improving physical fitness, than in technical sessions dedicated to the reproduction of movements (Chinchilla & López, 2010; Mersh & Fairclough, 2010; Sarradel et al., 2011). In this regard, teachers can play an important role (Ramos, Valdemoros, Sanz, & Ponce, 2007) especially when they generate learning environments that favor the perception of competence (Murillo, Julián, García-González, Abarca-Sos, & Zaragoza, 2013). In this sense, the teacher's gender can be influential as well since men and women propose their educational practice differently (Vázquez, Fernández-García y Ferro, 2000), something that also affects their co-educational approach to the contents (Piedra, García-Pérez, Fernández-García, & Rebollo, 2014).

In terms of class time dedicated to tasks other than those strictly related to PE, for example, to move from the classroom to the school sport facilities or to call the roll, this can reach 30% of the allotted time (Frago, 2015; Mersh & Fairclough, 2010; Smith, Lounsbury & McKenzie, 2014). In spite of the drawbacks, it is possible to make the committed motor time close to or greater than 50% of the time programmed by producing simple changes in the class management, such as developing planned objectives related to the promotion of PA and specific strategies to improve the interest and intrinsic motivation of students, purposely organizing the time to minimize administrative routine, the number and duration of transitions between activities and theoretical discourses, adjusting the choice of activities to the level of the students' ability that also helps teachers reactivate the activity of the students and create a climate of positive affectivity in the classroom (Escalante, 2012, Hellín, García, García, & Yuste, 2013,

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Jago et al., 2009, Lonsdale et al. ., 2013, Slingerland & Borghouts, 2011, Vasiliadou, Derri, Galanis, & Emmanouilidou, 2009).

With regard to gender, boys and girls in the sample spent in MVPA a similar percentage of PE time: $20.7 \pm 18.6\%$ in boys and $21.5 \pm 17.5\%$ in girls ($p = 0.84$). This finding coincides with what is shown in other studies consulted (Fairclough & Stratton, 2006, Hollis et al., 2016, Martínez et al., 2012, Nettlefold et al., 2011, Rauh, 2013, Slingerland, Oomen & Borghouts, 2011; Yuste, García-Jiménez, & García-Pellicer, 2013). For example, in a study recently published and carried out in Zaragoza (Frago, 2015), participating male students accumulated in MVPA 22.34% of the PE class time compared to 21.83% in girls ($p > 0.05$). A study conducted in a subsample of schoolchildren aged 10-12 in Switzerland, offered slightly better results than ours: an average of 39.93% of the PE class time spent in MVPA by boys and of 41.64% reached by girls; however, the study coincides with ours in not observing a significant association with gender ($p > 0.05$) (Cheval et al., 2016).

Nevertheless, in the literature there are quite a few studies that show boys to be significantly more active in PE than girls for the same activities (Fairclough & Stratton, 2005, Howells, 2011, Jago et al., 2009; et al., 2011; Slingerland, Oomen & Borghoust, 2011; Smith, Lounsbery & Mckenzie, 2014; Yuste, López, Lucas, García, & Somoza, 2012). For example, in a study conducted in English pre-adolescents, boys accumulated an average of 15.98% of the PE class time compared to 13.0% achieved by girls ($p < 0.05$) (Waring et al., 2007). In another study involving 75 Finnish elementary schoolchildren aged 11 to 12, boys spent an average of 28.1% of the PE class time in MVPA compared to 22.3% accumulated by girls ($p < 0.01$) (Romar et al., 2011).

The absence of a significant difference between boys and girls would suggest that this educational scenario offers both genders similar opportunities for PA practice, cushioning the effect of the different orientation that both genders show towards PA (achievement-oriented vs. task-oriented), which is directly related to the different motivation they exhibit towards physical exertion (Fairclough & Stratton, 2005), and, in general, the higher level of motor skills shown by boys (Fairclough & Stratton, 2005) that results in a greater confidence in their own ability and self-perception of competence and enjoyment (Casas, García, & Velandrino, 2009). PE teachers have to be aware of the role they play in promoting this type of perceptions in students that, together with other aspects such as a frequently directive teaching style (Erwin, Stellino, Beets, Beighle & Johnson, 2013) or an excessively sport-centered PE syllabus (Abarca-Sos,

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Bois, Zaragoza, Generelo & Julian, 2013), contribute to the learning environment of PE classes that is, as a whole, ego-oriented, individual and competitive. This type of environment has been shown to be more inviting to boys than to girls who seem to be more attracted to cooperation and to interaction with their peers (González-Cutre, Sicilia, & Moreno, 2008).

Conclusions

The level of physical activity reached in the Physical Education classes by the 6th grade primary schoolchildren who participated in the study is far from the recommended level that proposes at least 50% of the PE class time be spent in MVPA to generate heart-healthy benefits (Fairclough & Stratton, 2006; Lonsdale et al., 2013). Moreover, the level of PA achieved by the participants does not show a significant association with the gender.

The conclusions are circumscribed to the context, students and school centers involved, in which the study has been performed due basically to its methodological characteristics. However, it is a warning sign to make an in-depth analysis of the current role that Physical Education has in Primary Education, especially in regard to Health Oriented Physical Activity and Physical Fitness, a role that may be anachronistic, excessively ambitious, out of context and alien to one of the main purposes that PE should be focused on and be worried about: the prevention of sedentarism and the promotion of healthy active habits (Jago et al., 2009).

Similarly, it would be advisable to review the curriculum, the school policies that the different responsible institutions design and deploy for PA promotion and the teaching practice itself to introduce individual and collective solutions adapted to each school center and target student group. In this sense, the improvement in the daily levels of PA can be supported by five key areas (President's Council on Fitness Sports & Nutrition, 2013): PE classes, PA during the school day, the involvement of all school professionals, the PA before and after the school day, and the commitment of families and the community.

The limitations of the study are basically focused on two interrelated aspects: the small size of the sample and the methodology applied to collect the PA data, which demands much time and material. Both factors make generalization of the conclusions impossible and the obtained results difficult to compare with those shown in other studies. In addition to correcting the indicated limitations, future studies could also better control and/or study the influence of other factors that, such as gender or age, are frequently associated with PA in children and youth, such as seasonality (Hjorth et al., 2013), geographic location or climate (Goodman,

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Paskins, & Mackett, 2012), the tradition and culture of the school (Rickwood, 2013) and the different conception and way PE is addressed in the educational stages (Hardman, 2008).

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