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Development of the 'Sigue la Huella' physical activity intervention for adolescents in Huesca, Spain

Berta Murillo Pardo[1], José A. Julián Clemente[1], Luis García González[1], Enrique García Bengoechea[2,3], and Eduardo Generelo Lanaspa[1,*]

[1]Department of Music, Plastic and Bodily Expression, University of Zaragoza, Spain, [2]Participatory Research at McGill, Department of Family Medicine, McGill University, Montréal, QC, Canada and [3]Institute of Sport, Exercise and Active Living, Victoria University, Melbourne, Australia

*Corresponding author. E-mail: generelo@unizar.es

Summary

Engaging in physical activity (PA) on a regular and adequate basis generates considerable benefits for health. In developed countries, the time spent doing PA is decreasing, whilst sedentary time (ST) is increasing. A multicomponent school-based intervention programme, called 'Sigue la Huella' (Follow the Footprint), was developed to reduce sedentary lifestyles and increase PA levels. This programme has proven to be effective in increasing the daily levels of moderate to vigorous PA, in decreasing ST and in improving motivational outcomes in secondary education students, in the city of Huesca (Spain). The study design was quasi-experimental, longitudinal and by cohorts, and it was carried out in four schools, two as an experimental group ($n = 368$) and two as a control group ($n = 314$). During the 25 months' intervention, this programme adopted a holistic approach aiming to create favourable environments to engage in PA, and the empowerment of students to get actively involved in the design and execution of the activities, assuming responsibility for managing and optimizing their own PA. The programme is theoretically based on the social-ecological model and self-determination theory, and it provided evidence for four actions or components that can be used in school-based PA promotion: tutorial action, Physical Education at school, dissemination of information and participation in institutional programmes and events. The aim of this article is to describe the main characteristics of the intervention programme that have proved to be effective with respect to the objectives proposed.

Key words: physical activity, sedentary time, adolescent, social ecological model, intervention

INTRODUCTION

Adolescents should participate in at least 60 minutes of moderate to vigorous physical activity (MVPA) every day to improve their health and control their weight (Strong *et al.*, 2005). However, over the last 20 years, the levels of regular physical activity (PA) among adolescents have decreased (Hallal *et al.*, 2012). At the same time, over the last few years the amount of time that adolescents spend on sedentary activities has increased (Biddle *et al.*, 2009).

Currently, the broad connotations of the term physical activity (PA) make it a concept that is more related

to promoting active lifestyles than with the simple concept of physical exercise (Sallis *et al.*, 2006). The aim is to promote PA, broadly understood, for health and for all through the lifespan (Devis, 2001). Thus, nowadays, the behaviour of engaging in PA is analysed from broad, ecological and multi-level perspectives that highlight the interaction of interpersonal, social-cultural, environmental and policy levels (Spence and Lee, 2003), thus combining multiple individual and contextual factors (institutions, community and public policies), which have an influence on PA behaviour (Sallis *et al.*, 2008). Recent studies have incorporated components of self-determination theory (SDT) (Deci and Ryan, 2002) into the social-ecological model (De Bourdeaudhuij *et al.*, 2011). The SDT is a macro-theory that helps understand behaviours via the motivation of the individual, and it has been extensively applied in the field of PA (Teixeira *et al.*, 2012). Deci and Ryan (2002) argued that well-being and the process of internalizing behaviours and regulations are facilitated by the satisfaction of three basic psychological needs (perception of competence, autonomy and relatedness or belonging when interacting with the environment).

A central question within SDT concerns how to motivate students to value and carry out on their own activities that are not designed to be intrinsically interesting or motivating. According to Ryan and Deci (2000), the primary reason students are likely to engage in such activities and other non-intrinsically interesting behaviours is because they are valued by individuals to whom they feel (or would like to feel) connected. This suggests that to facilitate internalization of behaviours and values it is necessary to create a sense of belongingness or connectedness to the people prescribing an activity or behaviour and to other people participating in the same activity, or what in SDT is referred to as *relatedness*. The internalization process is also facilitated when students have the necessary skills and resources to participate in activities, that is, when they have a sense of efficacy or *competence* in regards to the adoption of goals and successful completion of tasks. Likewise, the internalization process is also promoted by a sense of *autonomy*, characterized by an internal perceived locus of causality that help students understand the relevance of academic goals and make them feel that they are at the origin of their own decisions and behaviours (Ryan and Deci, 2000; Deci and Ryan, 2002).

The patterns of PA in adult age are often established in adolescence (Telama *et al.*, 2005), thus making this period important for the promotion of PA. In light of this, several interventions have been developed in schools to promote PA among adolescents. These have been aimed at modifying the formal curriculum, such as Physical Education (PE) lessons (McKenzie *et al.*, 2004) and school sport (Dudley *et al.*, 2010), and the school environment (Pate *et al.*, 2005) and making links with the community (Webber *et al.*, 2008). Collectively, these three components comprise a framework of Health Promoting Schools (Senior, 2012), that purports to intervene in the students' lives through multiple levels of influence, in a coherent and integrated manner (Okely *et al.*, 2011).

Many authors seek a way of adapting the intervention to the structure of the school (Bond *et al.*, 2001) but to achieve this, the best approach is to consider the school as another agent that interacts with and that adapts to the programme (Bond *et al.*, 2001). The school thus operates like an ecosystem: it uses different strategies to achieve its goals depending on needs and own resources (Patton *et al.*, 2003). In recent PA promotion studies (Okely *et al.*, 2011), this is achieved by means of an active learning model, whereby the actual school coordinates small groups or committees that assume responsibility for establishing the priorities and putting them into practice through a general plan of action for the school. This process involves conducting a baseline measurement (diagnosis) with respect to the social and physical environment of the school in order to develop a plan of action that gives priority to where and how the change must be made (Okely *et al.*, 2011). In this model, researchers act as critical individuals that support the school working groups or committees (Okely *et al.*, 2011). In several cases, plans of action and programmes have been designed for the schools, which have been assessed later on by external researchers (Okely *et al.*, 2011). But, if what we want is a more realistic and sustainable situation where schools take action in the long-term, they must be given more autonomy right from the start of that process (Haerens *et al.*, 2006), motivating them, involving them and empowering them for them to know how to adapt the intervention to the school culture and its own resources (Felton *et al.*, 2005). This model fosters the empowerment process of the participants at different levels. Firstly, it is important to empower the students for them to be able to control their own behaviour, thus obtaining more opportunities to promote current and future PA (Felton *et al.*, 2005; Pate *et al.*, 2005). Secondly, it is important to foster the empowerment of the school organisation, seeking the participation and commitment of the entire educational community (Minkler *et al.*, 2008). Only in this way, will we achieve an effective intervention that will increase physical activity levels (PAL) (Okely *et al.*, 2011) and guarantee the sustainability of the intervention

throughout time. Furthermore, some authors argue that the effectiveness of an intervention depends on the total duration of that intervention (Evenson and Mota, 2011), hence the importance of longitudinal intervention designs (at least one or two years' long).

Thus, the increase in engagement in PA and the decrease in sedentary time (ST) must be linked to changes in other important factors such as psychological ones (e.g. perceptions of competence, autonomy and relatedness; motivation and enjoyment of PA); factors related to the school (Kriemler *et al.*, 2011; Golden and Earp, 2012); and the family and peer environment (Camacho-Miñano *et al.*, 2011).

Although intervention studies have been published over the last few years and it is a growing research field, systematic reviews of literature warn of the complexity of intervening in PA during the adolescent stage (Kriemler *et al.*, 2011). Furthermore, these reviews show that there is still little information about the key strategies or guidelines to design an effective PA promotion intervention. In this sense the Sigue la Huella programme has created a multi-component school intervention, based on promising strategies and intervention guidelines for the school environment in the promotion of PA that have been identified in the literature (Murillo Pardo *et al.*, 2013).

Therefore, the aim of this article is to describe in greater detail the development and characteristics of an intervention programme that has proved to be effective in terms of a number of outcomes outlined below, and is framed within the parameters that have been mentioned: social-ecological model; SDT; holistic approach with a view to creating favourable environments; promotion of autonomy, empowerment; multi-component strategies and long term duration.

DESIGN AND EVALUATION OF THE INTERVENTION

Intervention design and participants

This quasi-experimental, longitudinal and cohort intervention was conducted over a three-school year period totaling 25 months (Figure 1), with adolescents from four secondary (Spanish acronym ESO) schools in the city of Huesca (Spain) ($n = 930$). The selection criteria for the four schools were: (i) for public and private sectors to be represented; (ii) for there to be an equilibrium between the characteristics of the school, facilities, teaching staff, etc.; (iii) for there to be pre-disposal to collaborate with the University in different education innovation projects and studies; and (iv) for them not to be involved in the Aragonese Network of Health Promoting Schools (Spanish acronym RAEPS) at the start of the study. After choosing the four schools, we had to select the two that would make up the experimental group, in agreement with the following criteria: (i) both state and state-subsidised private schools had to be equally represented; (ii) equilibrium between the size of the schools and (iii) positive attitude towards the study topic. In the end, two schools (one state-subsidised private school and one state school) were assigned to the experimental group ($n = 368$, 41.6% girls) and two schools (one state-subsidised private school and one state school) to the control group ($n = 314$, 51% girls),

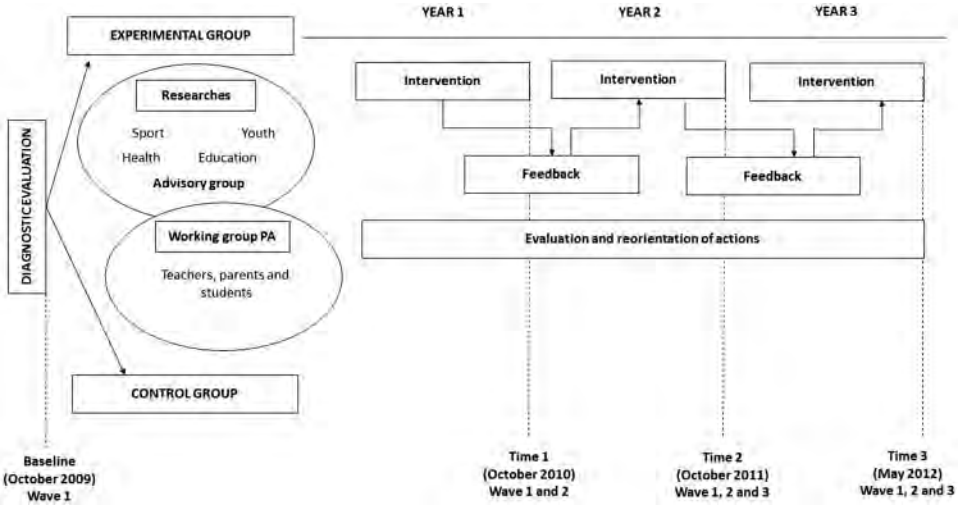

Fig. 1: Diagram of the intervention design.

after obtaining the baseline measurements. There were no significant differences between the groups at the start of the study in any of the sociodemographic variables. This shows that the choice of the schools, regarding demographic factors and other factors related to the school, before the randomised assignment, was carried out correctly. At the start of the study, there were no significant differences between the groups, either, regarding levels of MVPA and ST. The Sigue la Huella intervention began in winter 2009 and lasted until spring 2012 (three school years), after collecting the diagnostic assessment data in autum 2009. The experimental group schools received the Sigue la Huella intervention, whilst the control group schools did not receive any type of intervention, only the monitoring of the PA-related measurements. Participants were grouped into three waves-cohorts in each school. Wave 1 ($n = 229$, 47.2% girls) forms part of the study in academic years 2009–2010, 2010–2011 and 2011–2012 (1st to 3rd year ESO students). Wave 2 ($n = 227$, 40.5% girls) forms part of the study in academic years 2010–2011 and 2011–2012 (1st and 2nd year ESO students). Finally, wave 3 ($n = 226$, 50% girls) was set up in academic year 2011–2012 (1st year ESO students). The data were collected in one-year time intervals (October 2009, October 2010, October 2011), except for the last data compilation period (May 2012), which took place before the end of the academic year corresponding to the third and final year of the intervention.

Measurements

Social-demographic data and anthropometric measurements were collected in autumn 2009, before the start of the intervention programme, and they were repeated in autumn 2010 and 2011, and in spring 2012. Furthermore, the students completed a questionnaire comprised of five psychosocial variables (perceptions of physical competence, enjoyment of PA, motivation in PE, psychological need satisfaction in PE and importance attached to PE in the school). This process was repeated in autumn 2009, 2011 and spring 2012. Finally, the students wore the accelerometers to measure the different PA intensities during the four measurement periods throughout the three school years (autumn 2009, 2010 and 2011, and spring 2012). Students had to wear the accelerometer 8 days during their waking hours (Trost *et al.*, 2005). To be included in the study, participants had to wear the accelerometer for at least 4 days (3 weekdays and 1 weekend day) (Trost *et al.*, 2005) registering at least 10 hours per day (Rowlands *et al.*, 2008). The variables and instruments used for the comprehensive assessment carried out during the study are shown in Table 1.

Diagnostic assessment

The diagnostic assessment is a critical step to develop interventions whose aim is to change behaviours, as is the case of engagement in PA. This process permits obtaining detailed information about the programme application context. To inform the researchers about the design of the Sigue la Huella intervention programme, the diagnostic assessment was carried out in October and November 2009 to determine the PAL (accelerometry) and factors that influence adolescents' engagement in PA (based on assessments of perceptions of competence in PA, enjoyment of PA, basic psychological needs in PE, self-determined motivation in PE and importance of PE), and the perceptions of families, teachers and students, through focus groups.

Two members of the research group participated, together with the project coordinator, in compiling the data. The results of the diagnostic assessment were used to guide the design and development of the intervention. The data indicated that the majority of adolescents are very far from satisfying the international PA recommendations. Significant differences were also found in terms of gender, in favour of boys. We found that gender and some psychological variables, such as the perception of physical competence in PA, the perception of autonomy in PE and the importance assigned to this subject are some of the factors that have the most influence on PA (Murillo *et al.*, 2016). Finally, the results of the focus groups showed that families, teachers and students agree with the need to intervene, involving adolescents and their close social environment (Murillo *et al.*, 2014a). The school is a key organisational structure to implement this intervention, supported by professionals and by the community (Murillo *et al.*, 2014b).

Considerations and ethical procedure

The intervention was carried out in agreement with the principles of the 'Declaration of Helsinki' and subsequent revisions (Word Medical Association). The protocol was approved by the Clinical Research Ethics Committee of Aragon. Furthermore, before carrying out the intervention, a meeting was held with the school management teams in order to inform them about its objectives, importance and repercussions. The results of the diagnostic assessment were presented to the school management teams, who in turn passed them on to the teaching staff by means of an information sheet. This document described the content of the intervention and

Table 1: Study variables and instruments

Variables	Levels of the variable	Indicator	InstrumentValidation in Spanish population	Internal consistency reliability coefficient (Chronbach's alpha)
Social Economic Level	Low	Score = 0, 1 and 2	Family affluence scale (FAS) (Boyce *et al.*, 2006)	
	Medium	Score = 3, 4 and 5		
	High	Score = 6, 7, 8 and 9		
Body Mass Index	Low Weight	Less than percentile 5	According to CDC criteria (Kuczmarski *et al.*, 2000)	
	Normal Weight	From percentile 5 to 85		
	Overweight	Percentile 85 and less than percentile 95		
	Obese	Percentile 95 or over		
PA Levels	Sedentary	PA between 0 and 99 intensity counts	Accelerometer (Actigraph)	
	Light	PA between 100 and 2291 intensity counts		
	Moderate	PA between 2292 and 4007 intensity counts		
	Vigorous	AF ≥4008 intensity counts		
Perception of Competence in PA		The individual's belief in his or her capacity to organise, carry out and manage situations, in this case, the capacity to carry out some type of PA or sport.	Physical self-concept questionnaire (CAF) (Spanish version) (Goñi *et al.*, 2006)	Cohort 1: 0.83; 0.82; 0.85. Cohort 2: 0.75; 0.55; 0.85. Cohort 3: 0.83; 0.77.
Basic Psychological Needs in PE	Competence Need	The individual's need to effectively interact in the environment, to experience the competence generated by the desired results and avoid undesired outcomes.	Questionnaire on Basic Psychological Needs adapted to PE (Spanish version) (Moreno *et al.*, 2006)	Cohort 1: 0.73; 0.77; 0.82. Cohort 2: 0.74; 0.82; 0.84. Cohort 3: 0.76; 0.74.
	Need for Autonomy	The desire to commit to activities based on one's own initiative, the result of one's own behaviour.		Cohort 1: 0.57; 0.65; 0.65. Cohort 2: 0.54; 0.49; 0.55. Cohort 3: 0.48; 0.50.
	Need to Interact and Connect with Others	The feeling of belonging to a given social environment.		Cohort 1: 0.48; 0.56; 0.72. Cohort 2: 0.59; 0.62; 0.69. Cohort 3: 0.64; 0.67.
Motivation in PE	Intrinsic Motivation	Search for pleasure and satisfaction in engagement in PA	Sport motivation questionnaire (SMS) (Spanish version) (Núñez *et al.*, 2006)	Cohort 1: 0.86; 0.80; 0.85. Cohort 2: 0.91; 0.71; 0.95. Cohort 3: 0.82; 0.90.
	Extrinsic Motivation	Participation in the activity as a means to achieve an external objective		Cohort 1: 0.83; 0.86; 0.81. Cohort 2: 0.86; 0.85; 0.88.

(continued)

Table 1: (Continued)

Variables	Levels of the variable	Indicator	InstrumentValidation in Spanish population	Internal consistency reliability coefficient (Chronbach's alpha)
	Amotivation	Lack of motivation or of intentionality to continue engaging.		Cohort 3: 0.85; 0.81. Cohort 1: 0.46; 0.63; 0.64. Cohort 2: 0.64; 0.58; 0.62. Cohort 3: 0.72; 0.64.
Enjoyment of PA		The extent to which participants enjoy and find physical activity pleasant and interesting.	PACES questionnaire (Spanish version) (Moreno *et al*., 2008)	Cohort 1: 0.82; 0.89; 0.90. Cohort 2: 0.79; 0.78; 0.88. Cohort 3: 0.86; 0.87.
Importance of PE		The importance that the student grants to PE, due, among other reasons, to the relationship established between this variable and the generation of a habit to engage in PA.	Questionnaire on importance of PE (IEF) (Spanish version) (Moreno *et al*., 2009)	Cohort 1: 0.63; 0.70; 0.67. Cohort 2: 0.67; 0.65; 0.79. Cohort 3: 0.63; 0.71.

they were invited to collaborate for the three school years that the project was going to last. On the other hand, the results of the diagnostic assessment were also presented to the school management teams of the control group and they were invited to continue collaborating during the two and a half years that the research was going to last. They were also presented to the education authorities of the autonomous community of Aragon. All of this gave rise to proceeding with the work in the schools and beginning to intervene and compiling the data obtained. All the data and documents generated during the intervention (questionnaires completed throughout the study phases, accelerometry data, documents obtained from the intervention process: photos, recordings, reflections and field notes, etc.) were protected and were considered strictly confidential. Throughout the study, the data obtained were disseminated to the schools, and compared with current recommendations, so that participants and schools were able to assess the results themselves and take subsequent decisions.

CHARACTERISTICS AND COMPONENTS OF THE SIGUE LA HUELLA PROGRAMME

Sigue la Huella is a multi-component intervention, lasting for three school years and based on the school environment. The intervention was created based on promising intervention strategies and guidelines to promote PA within the school environment, identified in the literature (Murillo Pardo *et al*., 2013). Follow the Footprint adopted a whole school approach to involve the entire educational community in fostering a more favourable environment to engage in PA. One key principle was to provide students with resources so that they could become actively involved in the design and execution of the strategies, and assume responsibility for organising and increasing their own engagement in PA. Furthermore, the aim of the strategies and activities was also to help students develop skills and competencies to manage their own engagement in PA and reduce the amount of time spent on sedentary behaviours.

One characteristic of the intervention was to search for an explicit connection between the school and the community environments. To this end, the research team took two decisions. The first was to create, right from the very start, a multi-sectoral group of experts (representatives from the municipal and regional agencies, and from services in the areas of health, education, youth and sports), comprised of the main players involved in promoting PA in the city, in order to give advice about questions related to the intervention. Secondly, another key characteristic in the design of this programme was the assignment of a facilitator in each school where the intervention was carried out. This person came from outside the school and was a member of

the research team that led and coordinated the intervention, fostering a collaborative approach with the working groups of students, teachers and families in the design, implementation and assessment of the intervention (see Figure 1). Over the duration of the intervention, one of the achievements was the establishment of a strategic plan for each one of the years (1st, 2nd and 3rd), which was enriched with more general crosscutting actions, which affected the entire school.

Based on the data from the diagnostic assessment, the social-ecological model and the principle of fostering empowerment, the intervention resulted in the following four actions or components (Table 2): (i) Tutorial action, (ii) Physical Education, (iii) Information dissemination and (iv) Participation in institutional programmes and events. These four areas were used as intervention channels in order to design strategies to have an impact on the study variables.

Tutorial action

At the time of intervention, the students in the participating schools had about 25–30 sessions during the school year to address different topics on ethical aspects, human rights, civic values, healthy habits, group problems, etc. These sessions were led by a teacher from the school who acts as a tutor. Several sessions with respect to the promotion of PA were included for the intervention (Supplementary Table S1). The Tutorial Action turned out to be the main component of the intervention programme and six strategies were distinguished therein: (i) guide comprised of 14 work sessions, to inform teachers and give guidance to the school in the promotion of PA in adolescents; (ii) curricular material prepared (stickers and magnets C30–D30, which encouraged individuals to 'take 30 minutes of PA and drop 30 minutes of sedentary activity'), which were given out among the participants, to foster engagement in PA, with the mission of raising the awareness of the entire educational community; (iii) organisation and involvement of the students in PA activities within school hours (fun breaks), to increase the PAL; (iv) preparation of sets of material containing sport equipment to share with other schools (inter-centre sets); (v) activities outside school hours, at one of the city's public facilities, in order to exchange the sets with other schools and discover other spaces in the city to engage in PA; and (vi) training project at schools, which helped extend the training and involvement of the staff, considering the promotion of PA as a need of the entire school.

From the point of view of the tenets of SDT, the tutorial action plan sessions served several motivational purposes. Notably, by adopting a student-centred approach in which students were encouraged to share their views on PA and sedentary behaviours, and identify and discuss barriers to PA participation, the sessions contributed to foster a sense of autonomy and competence among students. In addition, preparation and implementation of fun breaks and inter-centre sets contributed to foster enjoyable PA participation and promote a sense of relatedness among students within intervention schools and, also, with students from other schools who took part in the exchange of sets of material containing sports equipment.

Physical education at school

The main objective of PE at school was to empower students for them to be able to self-manage their own engagement in PA, create more opportunities for PA and increase this behaviour. The two strategies that made up this component were: (i) training programme to improve the teaching style, whose aim was to improve the teachers' capacity to motivate and have an influence on the students' behaviour. The teaching style was based on the recommendations of SDT, i.e. fostering autonomy, the perception of competence and relatedness in PE by the teachers, based on the work of Ntoumanis, for example (Ntoumanis, 2001); and (ii) the Get Active Project, which is a didactic unit (interdisciplinary nature) whose aim was to provide students with autonomy and competence for them to develop a PA programme according to the characteristics of healthy PA. Specifically, teachers were trained to foster the students' sense of autonomy by allowing for student decision-making during PE lessons and by acknowledging and valuing the students' perspective and opinion. PE teachers were also trained to provide informational feedback to students focused on individual improvement rather than social comparison to support students' sense of efficacy or competence. Teachers were also encouraged to design activities allowing students to progress at their own pace and to interact positively with others in a variety of heterogeneous grouping arrangements. The Get Active Project aligned with broader curricular guidelines by helping students to demonstrate competencies necessary to (i) develop and carry out a plan for regular participation in PA, as part of a broader healthy lifestyle, (ii) understand and participate in the cultural heritage represented by physical activities performed in a variety of contexts (recreational, artistic, competitive) and (iii) interact with others in PA contexts in a manner consistent with principles and values of responsible and respectful citizenship.

Table 2: Components and strategies of the 'Sigue la Huella' intervention programme

Components of the Intervention Programme	Strategies	Brief Explanation of the Strategy
Tutorial Action	Tutorial Action Guide	Guide comprised of 14 work sessions, to inform teachers and give the school guidance in the promotion of PA in the adolescent population.
	Stickers and Magnets C30–D30	Curricular material prepared, which was given out among the participants, to foster engagement in PA, with the mission of raising the awareness of the entire educational community.
	Fun Breaks	Organisation and involvement of students in PA activities within school hours (recess break) to increase their physical activity levels.
	Inter-school Sets	Preparation of sets of material with sport equipment to share with other schools.
	Exchange of Sets	Activities outside school hours, at one of the city's public facilities, in order to exchange the sets of material with other schools and discover other spaces in the city to engage in PA.
	School Training Project	It permitted extending the training and involvement of the staff, considering the promotion of PA as a need of the entire school.
School Physical Education	Programme to Improve Teaching Style	Its aim was to improve the teaching staff's capacity in terms of motivating and influencing the students' behaviour.
	Get Active Project	This is a didactic, interdisciplinary type unit, whose aim is to provide students with autonomy for them to develop a PA programme with one or several of the activities practised in class, with their peers and always respecting the characteristics of healthy PA.
Information Dissemination	Periodic Meetings	Periodic meetings with families, teachers, management team and reference group to pool the results of the programme and monitor the physical activity levels and sedentary time.
	Reports and Letters	Reports to the management team and letters to families to inform participants of the results.
	e-Dissemination	e-Dissemination includes several computer-based elements used during the intervention (post a link to the programme on the school website, put up a screen at the entrance to the school with images and messages, and create a school blog, exclusive for the programme), to further enrich the programme and help disseminate it.
	Publications in Local Newspapers	Weekly publications in local newspapers (ECOS) with some of the results and contents of the intervention, establishing a connection between the school environment and the community environment.
Participation in Institutional Programmes and Special Activities or Events	Participation in Institutional Programmes	Participation in institutional programmes within the Aragonese Network of Health Promoting Projects, and on the other hand advise schools to participate in the Aragonese Network of Health Promoting Schools, in order to foster multidisciplinary work and exchange experiences at all levels.
	Participation in Special Activities and Events	Connect the initiatives related to the PA of our community to our daily activity, as another promotion strategy within our programme, reinforcing the link between schools and the closest areas that also promote PA.

Information dissemination

The main objective of this component was to disseminate the concepts, strategies and results of the programme to the entire educational community, to thus facilitate a change in mindset and foster the involvement of all players and agents in the different intervention strategies. Four intervention strategies arose within this component: (i) regular meetings with families, teachers, school management team and advisory group to pool the results of the programme and monitor the PAL; (ii) reports to the school management team and letters to the families to inform the participants of the results; (iii) e-Dissemination consisting of several computer elements used throughout the intervention (link to the programme on the school website; multimedia screen at the entrance to the school with images and messages; and an

exclusive school blog on the programme), to further enrich the programme and help disseminate it; and (iv) weekly publications in local newspapers with some of the results and contents of the intervention, establishing a connection between the school environment and the community environment.

Participation in institutional programmes and special activities or events

In line with the social-ecological model adopted by Sigue la Huella, the main objective of this component was to inform and involve the entire community in the institutional programmes related to health and education, and foster their participation in school and out-of-school activities. There were two intervention strategies in this component: (i) participation in institutional programmes within the Aragonese Network of Health Promoting Projects, and on the other hand, advise schools for them to participate in the Aragonese Network of Health Promoting Schools, in order to foster multidisciplinary work and exchange experiences at all levels and (ii) connecting the initiatives related to PA of our community with our daily activity, as another promotion strategy within our programme, reinforcing the link between schools and the closest areas that also promote PA.

SUMMARY OF INTERVENTION OUTCOMES

Data analysis examining the impact of Sigue la Huella on objectively measured MVPA, ST and self-reported motivational variables included multilevel statistical models accounting for random and repeated effects, and capable of handling unbalanced data in a longitudinal design. After adjustment for relevant variables, including student socioeconomic status, the estimated difference between the experimental group and the control group was 13.51 minutes/day of MVPA in favour of the experimental group. Both boys and girls benefited from the intervention, although the former to a greater extent (Murillo *et al.*, 2014a). Regarding ST, Sigue la Huella had a protective effect in two of the three study cohorts, irrespective of gender and socioeconomic status. Although ST increased in the full sample, such tendency was not observed in the experimental group of cohort 2 and the increase was much lower in the experimental group of cohort 3 than the control group (Murillo *et al.*, 2014b). Finally, as expected, the intervention was also effective in improving student motivational outcomes relevant to participation in PA and, particularly, PE. Specifically, compared to the control group, and after adjustment for relevant variables, participants in the experimental group reported greater enjoyment of PA, intrinsic and extrinsic motivation in PE, perceived autonomy in PE, perceived competence in PE and perceived importance of PE over time. Participants in this group reported also lower amotivation in PE over time. In subsequent analyses, perceived importance of physical education predicted MVPA, while perceived autonomy in PE emerged as predictor of ST (Murillo *et al.*, 2016).

DISCUSSION

Sigue la Huella is one of the few evidence informed multi-component interventions in Europe based on the school environment with the support of the family and the community, whose aim is to increase the daily PAL of adolescents. Within the Sigue la Huella programme, we have implemented strategies from four different intervention channels to foster awareness-raising and empowerment of the participants, based on intervention guidelines and promising strategies for the school environment and the promotion of PA identified in literature (Murillo Pardo *et al.*, 2013). Furthermore, the intervention used accelerometers to objectively verify the improvements. The majority of studies that explored possible mediating variables of the intervention effects on young people have used self-reported measures of PA. To date, only a handful of studies have examined the effect of PA interventions on young people by means of objective measurement of PA (e.g. Okely *et al.*, 2011; Lytle *et al.*, 2009). Objective measurement with accelerometers, in particular, is considered the most precise and suitable manner to monitor PA (Hallal *et al.*, 2012).

A notable finding of the impact evaluation concerns the observed gender differences in growth rate of MVPA between the experimental and the control group. Previous studies found also that boys benefit more than girls from PA interventions (Webber *et al.*, 2008). Furthermore, in other studies, PA interventions were effective only in boys (De Bourdeaudhuij *et al.*, 2010; Sallis *et al.*, 2003). Although still successful in increasing daily MVPA levels of girls, the Sigue la Huella Intervention illustrates some of the challenges involved in designing and implementing PA interventions which are effective for both genders. On the other hand, the circumstance that the effects of the intervention on ST were independent of the gender of participants is encouraging considering that adolescent girls are one of the most sedentary demographic groups (Carson *et al.*, 2013), and that notable increases in ST of adolescent

girls (51 min/day from the 6th to 8th grade) have been previously reported (Treuth *et al.*, 2009). Since the largest increase in ST of adolescent girls has been observed during school hours (Carson *et al.*, 2013), schools represent a key context for the design of appropriate interventions. Further to this, the family context, particularly during the late afternoon and evening periods, remains influential for the development of patterns and the level of sedentariness of adolescents (Carson *et al.*, 2013). Consequently, actions, such as the ones included in Sigue la Huella by means of the tutorial action plan, are necessary as well to involve families in the creation of favourable social environments to decrease ST (Gruber and Haldeman, 2009).

Another aspect of the intervention that merits attention concerns duration. Long-term interventions, such as Sigue la Huella, have been proposed as more effective than short-term interventions for the promotion of healthy lifestyle habits (e.g. Evenson and Mota, 2011). In addition, duration is important to consider because it is difficult to disseminate intensive programmes in schools given the competing demands for classroom time (Stice *et al.*, 2006). Contrary to expectations, a meta-analytic review of obesity prevention programmes for children and adolescents found that interventions with a relatively shorter duration produced significantly larger effects than did those that were longer in duration (Stice *et al.*, 2006). Similarly, a recent systematic review and meta-analysis of interventions targeting screen time reduction (Wu *et al.*, 2016) found that studies in which the duration of the intervention was shorter than 7 months were more effective than longer interventions. This is consistent in general with what we observed in Sigue la Huella when analysing the trajectories of the different cohorts, particularly in relation to ST, where significant differences in daily ST between the experimental and control groups, in favour of the former, were observed starting with cohort 2 and continued to increase in cohort 3 (Murillo *et al.*, 2014b). Stice *et al.* (2006) suggested that interventions that are long in duration are unappealing to participants, which may cause them to drop out of the intervention or to disengage from the program. In line with expectations set out in the design of the intervention, an alternative explanation to the cohort effects we noted in the evaluation of Sigue la Huella is that every new cohort interacted with a modified intervention context where the capacity of agents involved in the intervention had increased and where previous cohorts had contributed to create particular dynamics and momentum from which new cohorts did benefit (Murillo *et al.*, 2014b). Furthermore, with exception of ST in cohort 1, positive intervention effects were observed over time in all study cohorts in terms of MVPA, ST and motivational outcomes (Murillo *et al.*, 2014a; Murillo *et al.*, 2014b; Murillo *et al.*, 2016). This indicates that the intervention remained sufficiently appealing to participants in cohorts 1 and 2, who spent three and two school years, respectively, in the study.

Few studies have assessed the variables that influence the PA behaviour of young people in the context of interventions, and the results from Sigue la Huella will help provide knowledge about the behavioural change mechanisms in a large sample of adolescents (Murillo *et al.*, 2014a). Findings from the evaluation of Sigue la Huella (Murillo *et al.*, 2016) add to the limited evidence available indicating that appropriate interventions may have a positive impact on motivational outcomes relevant to PA, ST, and, in particular, student engagement in PE, a setting that presents ideal opportunities to promote PA (Sallis *et al.*, 2006). In addition, the findings fill a gap in the literature by identifying shared and unique determinants of MVPA and ST (Pearson *et al.*, 2014), and, therefore, indicating that specific intervention strategies are necessary to address each of these behavioural outcomes. Overall, findings provide support for the design of intervention strategies based on SDT aiming in particular to optimize the student experience and motivation in PE as an instrument to promote PA and reduce sedentary behaviour in adolescents.

As this is one of the first known interventions applied in the school environment to promote PA using a collaborative research approach (Okely *et al.*, 2011), it is hoped that the design and strategies used can inform other authors who carry out similar studies in the future. It is important to provide detailed descriptions of the intervention adopted and the study variables of the research. This is particularly valuable in a project such as Sigue la Huella that involved carrying out a practical and useful study. Although resources are required and numerous challenges must be faced, the success of the Sigue la Huella project has many valuable implications for understanding the promotion of PA and healthy lifestyles taking advantage of the opportunities afforded by school contexts, for improving the training of social agents involved (teachers, families, community members, etc.) and for bettering the health of young people.

CONCLUSIONS

Sigue la Huella is an intervention that purports to help schools to design and apply opportunities in order to increase PA and to reduce ST, establishing a connection with the community environment and empowering adolescents to assume responsibility for their own engagement in PA.

This article has described the processes and characteristics of a promising and feasible intervention to address the important and increasing problem of low PAL and sedentary lifestyle in adolescents. A commitment is required as well as the participation of all agents and players involved in the intervention. Hence the importance of multi-component interventions based on the school environment, which will foster the empowerment of the members of the school community. On the other hand, a key element in the development of interventions whose aim is to change behaviour is to consider a diagnostic phase, an implementation phase and a monitoring phase. To assess intervention impact, it is imperative to have a baseline that offers us a point of reference and later on the opportunity to engage in a continuous improvement process in terms of monitoring longitudinally the effects of the intervention and the variables that prove to be more influential. In this regard, the measurement of PA is a key aspect. More specifically, the objective measurement with accelerometers, due to their precision and suitability for monitoring PA. But we must bear in mind that the precision of the instruments is not the only important factor in the measurement of intervention effects. Characteristics of the intervention design are also important in this regard, as this article illustrates.

Supplementary material

Supplementary material is available at *Health Promotion International* online.

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