

This is the peer reviewed version of the following article:

Individual factors and school-based policies related to adherence to physical activity recommendations in Spanish adolescents.

Galán, I., Boix, R., Medrano, M. J., Ramos, P., Rivera, F., & Moreno, C. (2014). Individual factors and school-based policies related to adherence to physical activity recommendations in Spanish adolescents. *Prevention science : the official journal of the Society for Prevention Research*, 15(4), 588–599.

which has been published in final form at:

<https://doi.org/10.1007/s11121-013-0407-5>

Individual factors and school-based policies related to adherence to physical activity recommendations in Spanish adolescents

Galán I^{a,b}, Boix R^a, Medrano MJ^a, Ramos P^c, Rivera F^d, Moreno C^c

^a *Centro Nacional de Epidemiología. Instituto de Salud Carlos III* [National Centre of Epidemiology, Carlos III Institute of Health], Madrid (Spain)

^b *Departamento de Medicina Preventiva y Salud Pública. Facultad de Medicina. Universidad Autónoma de Madrid* [Department of Preventive Medicine and Public Health, Faculty of Medicine, Autonomous University of Madrid], Madrid (Spain)

^c *Departamento de Psicología Evolutiva y de la Educación. Facultad de Psicología. Universidad de Sevilla* [Department of Developmental and Educational Psychology, Faculty of Psychology, University of Seville], Seville (Spain)

^d *Departamento de Psicología Clínica, Social y Experimental. Facultad de Psicología. Universidad de Huelva* [Department of Clinical, Social and Experimental Psychology, Faculty of Psychology, University of Huelva], Huelva (Spain)

Corresponding author:

Iñaki Galán

Centro Nacional de Epidemiología, Madrid (Spain)

c/ Monforte de Lemos 5. CP: 28029

Telephone: +34 918222679

e-mail: igalan@isciii.es

ABSTRACT

Our objective was to identify individual and school-level contextual factors related to adherence to the recommendations for physical activity in adolescents. The study used a representative sample of 15,902 students from 328 schools aged 11-18 years participating in the Spanish Health Behaviour in School-aged Children (HSBC) survey 2006. In addition to the student questionnaire, the school management board completed a questionnaire about school-based policies related to physical activity. Adherence to the recommendations was defined as “having carried out moderate and/or vigorous physical activity for at least 60 minutes a day on five or more days during the last week”. Analysis was undertaken using multilevel logistic regression models. Individual factors associated in a statistically significant way with a higher non-compliance were: being female; being older; immigrants; tobacco smoking; being overweight or obese; low consumption of fruit and vegetables; low level of satisfaction with life; not having a high level of academic achievement; and spending a lot of time studying. The family variables were: not undertaking sports activities with the family; low socioeconomic status; and a low level of satisfaction with family relationships. Compared with schools that have a low level of policies to promote physical activities, those with a high level of promotion had an odds ratio of 0.76 (CI 95%: 0.61-0.94). In summary, irrespective of personal and family factors, students from schools with better policies of promotion of physical activity showed a higher compliance with the recommendations.

Keywords: Physical activity, adolescents, determinants, school policies, multilevel analysis

INTRODUCTION

It is estimated that physical inactivity causes 600,000 deaths per annum in Europe (Cavill et al. 2006). Active people have lower all-cause mortality rates (Bucksch 2005; Byberg et al. 2009), and the rate is especially lower for cardiovascular disease mortality (Barengo et al. 2004; Haapanen et al. 1996; Khaw et al. 2006).

There is sufficient evidence that healthy habits, which begin at an early age, are carried forward in time depicting behaviour in the first stage of adult life (Biddle et al. 2010; Telama 2009). Under these circumstances, acquiring some healthy habits at an early age, among which should be emphasised regular physical activity, can have important implications for adult health.

The World Health Organization (WHO) recommends that all children of 5-17 years of age take at least 60 minutes of daily moderate or intense physical activity (World Health Organization 2010). Higher amounts, as well as increasing the intensity of the activity, produce additional benefits (Martinez-Gomez et al. 2010). In Spain, as in other countries, compliance with the recommendations by the child and adolescent population is low (48% of individuals from 6 to 18 years), especially among girls, and decreases further as age increases (Butcher et al. 2008; Roman et al. 2008).

The theoretical framework of the ecology of human development (Bronfenbrenner and Morris, 2006) has received significant empirical support. According to this approach, human development is the result of the complex interplay of variables located at different levels. These variables include influences from the macrosystem (for example, the country's legal and economic system, cultural values, etc.) and from the exosystem (for example, support services for the family, health services, etc.) but, above all, they are the relationships established between the person's characteristics and the direct experiences that he or she has in the different contexts in which this particular person

develops (the microsystems, mainly the family, the school and peer groups, which form the primary unit around a child, directly influencing the child's development through these sources). In this context, there are numerous correlates of physical activity of children and adolescents: sociodemographic, psychological and behavioural factors, at the individual level; social support of family and friends; and social and physical environment at the contextual level (Jago et al. 2011; Jago et al. 2012; Macdonald-Wallis et al. 2011; Sallis et al. 2000).

In the literature, there is a broad consensus about the importance of the social support of family and friends in relation to levels of physical activity (Jago et al. 2012; Macdonald-Wallis et al. 2011). An increase in the number of friends and, especially, having a best friend who is active and engages in sports are both related to an increase in physical activity (Jago et al. 2011; Jago et al. 2012). Furthermore, parental influence on adolescent preventive health behaviours, including physical activity, has recently received much attention. Interventions to increase physical activity may be more successful if they include efforts to encourage parents to bring their children to and from activities, watch them participate in sports, provide positive reinforcement for participation, and take part in activities along with their children (Kahn et al. 2008).

Related to contextual factors, two recent systematic reviews, which analysed the evidence of the effectiveness of school-based interventions for promoting physical activity in children and adolescents, concluded that such interventions have a positive short-term impact on the health of students (De Meester et al. 2009; Dobbins et al. 2009). In contrast, the more traditional prevention strategies, based on health education activities directed at the individual, are not as effective as those that also include school-based policies for promoting physical activity, recognizing the importance of a more ecological approach based on the interaction between individuals and the school setting

(Naylor and McKay 2009). Bearing in mind that the adolescent population spends much of the day in schools, the school environment has been identified as a key setting for the design and implementation of strategies for promoting physical activity. However, although several factors have been identified that can favour the participation of students in sports activities at schools (Lagarde and LeBlanc 2010; Naylor and McKay 2009; Zhu et al. 2010), the information available is still scarce and it is unknown if this participation also influences overall physical activity.

The objective of this study was to identify the personal and family factors related to non-compliance with the physical activity recommendations and, especially, to evaluate if school policies are related to the degree of compliance.

METHODS

Study design and population:

A representative sample was used of preadolescents and adolescents resident in Spain and enrolled in school from the 5th year of primary school to the last year of upper secondary school (11-18 years), who had been participants in the Health Behaviour in School-aged Children (HBSC) study of 2006 (Currie et al. 2009). A multistage stratified random sampling was carried out, taking into account age strata, region (autonomous community), school site (rural and urban), and type of school (public and private).

Initially, 480 schools were contacted of which 377 (103 private and 274 public schools) agreed to participate in the study, which represented a response rate of 78.5%. A total of 22,350 questionnaires were collected, although subsequently 539 were excluded because of non-response to questions about sex and age, and lack of response to more than 50% of the questionnaire. The sample size was 21,811 students distributed in 377

schools and 1,119 classes. The study sample reproduced the age and sex structure and geographical distribution of students enrolled in these courses.

To analyse the data of this study, responses from schools that did not complete the school management board questionnaire were excluded, because they had missing values for all the contextual variables. In the individual questionnaire, for those variables with a percentage of missing values of more than 4% a category of “no answer” was assigned, whereas if the percentage was below 4% it was excluded from the analysis. As a result of the treatment of missing values, where any individual with a lack of information in the questionnaires for any of the variables studied was excluded from the analysis, the number of centres was reduced to 328 and the students to 15,902, which represents 55.8% of the initial sample. The sample excluding missing values was similar to the original, taking into account the main socioeconomic variables and the compliance with the physical activity recommendations.

Questionnaire and study variables:

Two questionnaires were used to collect information. The administration of the questionnaire addressed to the students was carried out during school hours in the presence of a previously trained technician, who gave a classroom presentation about the study and resolved any doubts about its completion. In addition to the student questionnaire that contained information about personal and family variables, the school management board or the school guidance team completed a questionnaire about various aspects of the infrastructures, services and school-based policies related to physical activity.

Physical activity was measured using the question: “*in the last seven days, considering moderate and vigorous activity... On how many days did you feel you were physically active for a total of 60 minutes per day?*” The response categories were from 0 to 7

days. It was considered that the recommendations were complied with if the answer was 5 or more days per week. A total of twenty-one variables were studied, divided into individual-level and contextual variables.

Individual-level variables:

The personal variables were: sex; age (continuous variable, from 11 to 18 years); country of birth (Spain, other); current smoker (yes, no); alcohol consumption (never, rarely, monthly, weekly or daily); body-mass index from self-reported weight and height (weight in kg/height in m²), classified into three categories, normal and underweight combined, overweight, and obese, according to the international cut-off points proposed by Cole et al. (2000); consumption of fruit and vegetables (quartiles of the number of times per week: 25th percentile [4], 50th percentile [8.5], 75th percentile [12.5]); number of hours each day spent watching television and using computers or game consoles (quartiles according to amount of use: 25th percentile [2.4], 50th percentile [3.9], 75th percentile [5.8]); number of hours each day spent doing school homework (quartiles according to time spent: 25th percentile [1], 50th percentile [1.7], 75th percentile [2.7]); personal life satisfaction measured on the Cantril Ladder Scale “*In general, on which step of the ladder (scale from 0 to 10) do you feel you are at this time in your life?*” (on a score of 0-10 from lower to higher satisfaction); and self-reported academic achievement (very good, good, average, low).

The family variables were: employment status of the father (employed, unemployed, others); employment status of the mother (employed, unemployed, others); socioeconomic status by the Family Affluence Scale (Schnohr et al. 2009), an index estimated by four items (number of times that the adolescents have been on holiday with their family in the last 12 months, does the family own a car or van, does the student have his/her own bedroom, number of computers owned by the family);

undertaking physical activity with the family (most days, once a week, less than once a week, never); level of satisfaction with family relationships (on a score of 0-10 from lower to higher satisfaction).

Contextual variables:

The contextual variables were: school site (urban, rural); type of school (public, private); participation of the school in physical activity programmes (yes, no); training of teachers about physical activity in the last 3 years (yes, no); written school guidelines on how to increase physical activity during school hours (yes, no); number of compulsory physical education classes (3 or more, <3); satisfaction with sports facilities (suitability of the schools grounds and playgrounds to the needs of the school, suitability of the gymnasium/sports hall to the needs of the school, suitability of the sports equipment to the needs of the school; on the basis of the aggregate score for suitability, the schools were classified as having a low, average or high perceived suitability of facilities and infrastructures); organization by the school of physical activities during school hours and outside physical education classes (yes weekly, no); neighbouring facilities up to 2,000 metres from the school, such as skate parks, open-air playing fields, recreational equipment, tracks, green areas, water recreation areas (yes, no). An “Index of school-based policies for promoting physical activity” was created from the following variables, with a score ranging from 0 to 6 points: participation of the school in physical activity projects (yes=1 point, no=0 points); training of teachers about physical activity in the last 3 years (yes=1 point, no=0 points); written school guidelines on how to increase physical activity during school hours (yes=1 point, no=0 points); number of compulsory physical education classes offered by the school per week (3 or more=1 point, <3=0 points); satisfaction with the suitability of sports facilities at the school (high=1 point, average-low=0 points); organization by the school

of physical activities during school hours and outside physical education classes (yes weekly=1 point, no=0 points). The level of the school policies was classified as low, average or high if the score obtained was 0-1, 2-4, 5-6, respectively.

Statistical analysis:

The prevalence of students who did not comply with the recommendations and their 95% confidence intervals were calculated using the 'Survey Data' module of Stata V.11.0 for Windows (1984–2010 StataCorp, Texas, USA), which takes into account the complex sampling design of the study. The distribution of this prevalence was compared according to the categories of the individual and contextual variables using the Chi-squared test.

Subsequently, sequential multilevel logistic regression models were constructed. Initially, the null model (Model 1) was established to evaluate if undertaking physical activity varied in a statistically significant way between schools. Model 2 only included the contextual variables. Model 3 included the individual variables, both the personal and family ones. Finally, the individual and contextual variables were both introduced in Model 4. The prevalence odds ratios (OR) were estimated, with the value for statistical significance being set at $p < 0.05$. First order interactions were evaluated between the contextual variables and age and sex. All statistical analyses were carried out using Stata v.11.0 for Windows (1984-2010 StataCorp, Texas, USA).

RESULTS

Table 1 shows the description of the sample and the distribution of non-compliance with the recommendations of undertaking physical activity, according to personal and family variables. Of the population studied, 63.2% did not undertake moderate or vigorous

activity for at least 5 days during the last week, with this prevalence being higher in females (70.2%) than in males (54.9%) ($p < 0.001$).

Regarding the contextual variables (Table 2), no differences were found for school site, school type or the presence of recreational facilities in the neighbourhood of the school, but were found for school policies related to physical activity. In those schools with a low level of implementation of these policies, the prevalence of non-compliance was 66.9%, falling to 61.0% for those schools with an average level, and to 52.6% in those with high implementation ($p < 0.001$).

The sequential multilevel models are described in Table 3. Initially, a statistically significant variability was observed for the prevalence of compliance with the recommendations between schools (Model 1). Model 2 shows the effect of the contextual variables when they were introduced simultaneously, with similar results to those for the bivariate analysis. The inclusion of these variables reduced the variability between schools by 12.6%, as compared to that shown in Model 1. This variability was reduced by 60.9% when the individual variables were introduced simultaneously (Model 3). Finally, in Model 4, the combined effect of all the variables is presented and, thereby, the effect of each variable adjusted for the remaining variables is estimated.

Sociodemographic variables:

In the analysis of the sociodemographic variables, females showed a higher probability of non-compliance with the recommendations as compared to males, OR of 1.92 (CI 95%: 1.79-2.06). As age increases, compliance with the physical activity recommendations decreases ($p = 0.046$). It is also lower among students born outside Spain, as compared to those born in Spain ($p = 0.001$).

Behavioural variables:

For lifestyle variables, the OR for non-compliance with the recommendations increased

to 1.21 (CI 95%: 1.08-1.36) for smokers. In contrast, regular consumers of alcohol showed a slight protective effect (OR: 0.87; CI 95%: 0.77-1.00). Overweight or obese individuals have a higher risk of non-compliance with the recommendations, with an OR of 1.21 (CI 95%: 1.09-1.34) and of 1.48 (CI 95%: 1.15-1.40), respectively. After adjusting for the remaining variables, the consumption of fruit and vegetables showed a protective effect, reaching an OR of 0.62 ($p < 0.001$) when the fourth quartile of amount consumed was compared to the first one. No clear relationship was seen between the level of non-compliance with the physical activity recommendations and the time spent on sedentary activities, such as watching television and the use of computers and game consoles. Individuals classified in the second and third quartiles for sedentary activities had a similar probability of non-compliance, but those in the fourth quartile (OR of 0.87, $p = 0.006$), as well as those who did not respond to these particular questions, appeared to benefit from a protective effect. In the opposite direction, students who spent more hours on school homework showed a higher probability of non-compliance with the recommendations ($p = 0.011$).

Individuals with a higher satisfaction with life undertook more physical activity, with an OR for non-compliance with the recommendations of 0.88 (CI 95%: 0.86-0.91) for each increase of a point on the scale of satisfaction.

Family variables:

When analysing the family variables, an increase in risk was found for the children of mothers who did not have paid employment ($p = 0.016$). Similarly, a relationship was also detected with socioeconomic status, with a lower probability of non-compliance found among students classified as having high socioeconomic status (OR: 0.88; CI 95%: 0.79-0.98) than among those with low status. Undertaking physical activity with the family showed a gradient effect that varied from an OR of 1.19 ($p = 0.007$), when

comparing the students who undertook physical activity once a week with those who undertook it everyday, to an OR of 1.41 and of 1.55 ($p < 0.001$) for those who undertook these activities less than once a week and never, respectively, when compared to those who undertook it everyday. The variable indicating the level of satisfaction with family relationships showed a protective effect, that is, the greater the satisfaction the higher the amount of physical activity undertaken, with the p value at the limit of statistical significance ($p = 0.052$). This protective effect increased with the level of satisfaction with friends, with an OR of 0.87 (CI 95%: 0.84-0.89).

Contextual variables:

Regarding the contextual variables, a relationship was found with the implementation of school-based policies about physical activity, although the magnitude of the relationship was reduced when the individual variables were introduced simultaneously. Compared with the schools that had a low level of implementation, those schools with an average level had an OR of 0.93, although this did not reach statistical significance. For schools with a high level of policy implementation the OR was lower, 0.76 (CI 95%: 0.61-0.94). No relationship was detected with school site (urban or rural), type of school or recreational facilities in the neighbourhood of the school.

Inclusion of the individual variables together with the contextual ones reduced the variability between schools by 66.7% in comparison with that seen in Model 1.

No statistically significant interactions were found between the contextual variables and age and sex.

DISCUSSION

The main results of this study clearly show that most adolescents do not comply with the recommendations for undertaking physical activity, with important differences

being detected for several individual variables, both personal and family ones, as well as with the policies for promoting physical activity implemented by the schools. These results are in accordance with the theoretical framework of the ecological model, where the number and quality of the connections between the settings in which a young child spends more time have a great influence on his/her development.

Regarding sociodemographic variables, studies clearly show a strong association with sex (Sallis et al. 2000; Seabra et al. 2011; Van Der Horst et al. 2007), as it has been seen that more physical activity is undertaken by boys than by girls. In part, these differences are dependent on the type and intensity of the activity undertaken, with a higher participation by the boys in activities of a sporting nature and of vigorous intensity, whereas the girls prefer low intensity leisure-related activities. Biological differences, as well as those relating to sociocultural environment and body image, underlie these relationships (Eisenmann and Wickel 2009; Slater and Tiggeman 2011; Vilhjamsson and Kristjansdottir 2003).

Age is also considered to be an important determinant of physical activity in adolescence, being related in a negative way (Nader et al. 2008; Seabra et al. 2011). It has been estimated that between 9 and 15 years of age, the time spent in moderate-vigorous activities on a weekday declines by an average of 38 minutes per day each year (and by 41 minutes per day at weekends per year), with a similar decline for both boys and girls (Nader et al. 2008). In our study, it was also seen that there was an increase in non-compliance with the recommendations as age increased, although the magnitude of the association was lower than that found for sex, and was at the limit of statistical significance. Moreover, it appears that the type of activity is involved in this relationship with age, with a reduction of more vigorous activities as age increases, and sports activities are substituted by more sedentary leisure-related activities (Crespo et

al. 2001). It should also be recognized that the amount of time spent in sports activities, as a compulsory school subject, also plays a part, as this declines from 3 to 2 hours per week during the transition from primary to secondary education, while there is a simultaneous increase in the time spent on school homework, which competes with the undertaking of physical activity.

We found a positive effect of socioeconomic status (measured by income, level of educational attainment, occupation, or combinations of variables) on physical activity, the higher the status the more physical activity undertaken. Results in the same direction have been consistently observed in adults, but is still a matter of debate for the adolescent population (Sallis et al. 2000; Seabra et al. 2011; Van Der et al. 2007). A recent review carried out in this population subgroup has added a little more information in this context, showing that, although the results are not uniform, it can be accepted that there is a similar effect to that found for adults (Stalsberg and Pedersen 2010).

We observed a higher probability of non-compliance among those adolescents born outside Spain. Although other authors have also found differences with regard to ethnic groups (Gordon-Larsen et al. 1999; Gordon-Larsen et al. 2000), more in-depth studies are required to analyse this relationship, focusing on the identification of patterns according to country of birth, length of time in the country, as well as if this relationship is maintained in those young people born in Spain, but with foreign-born parents.

It is well known that lifestyle factors, such as smoking, alcohol consumption, a low level of physical activity and an unbalanced diet, tend to cluster together (Dodd et al. 2010; Keller et al. 2008; Sanchez et al. 2007). Of all these factors, smoking is the individual factor that is most commonly involved in these clusters, and the negative

effects on physical activity have been thoroughly documented (Kaczynski et al. 2008). Similarly, a low consumption of fruit and vegetables has been associated with a decline in physical activity, with the clustering of these two factors being the most prevalent cluster among adolescents (Sanchez et al. 2007). However, the association with alcohol consumption is inconsistent and several authors have found in adolescents, as in our study, a positive relationship with this risk factor (Buscemi et al. 2011; Moore and Werch 2008; Peltzer 2010). A recent review supports that alcohol consumers of all ages were more physically active than non-drinking peers. Furthermore, several studies have suggested a dose-response relationship between alcohol and being physically active, indicating that as drinking increases, so does the level of physical activity. Future research should place specific emphasis on identifying why alcohol consumers exercise at higher levels than non-alcohol consumers (Piazza-Gardner et al. 2012).

Studying the relationship between body-mass index and physical activity is a complex task, given the bidirectionality of the association, especially in cross-sectional studies. It is not clear if low levels of physical activity cause excess weight or if people who are overweight or obese tend to undertake less physical activity. In prospective studies, there is no evidence that a higher level of physical activity causes a reduction in adiposity (Wilks et al. 2011). Therefore, the findings of our study, showing a gradient effect of greater non-compliance with the recommendations among overweight and obese young people, could be interpreted as a greater difficulty in complying with the recommendations, for example, because of functional limitations arising from overweight and obesity.

In our study, no clear relationship was found between the level of non-compliance with the physical activity recommendations and the amount of time spent on sedentary activities, such as watching television, playing with game consoles or using the

computer. Indeed, those adolescents who spent more time on these activities had a lower probability of non-compliance with the physical activity recommendations. It is now recognized that the relationship between physical activity and screen-based sedentary behaviour is more complex than was previously thought, with a tendency to differentiate between the two components in their relationship with obesity. High levels of physical activity are not mutually exclusive with high levels of sedentary behaviour. For instance, over the course of the day, young people have sufficient time to perform both more than 90 minutes of moderate-intensity to vigorous-intensity physical activity (*highly active*) and spend more than 2 hours in sedentary activities (*highly sedentary*), particularly on weekends (Wong and Leatherdale 2009). Other authors, analysing the two variables separately, did not find that the time spent on sedentary activities was related either positively or negatively with undertaking physical activity (Feldman et al. 2003; Nilsson et al. 2009).

Another important result of our study is the effect of the relationships with family members and friends. Those young people who have better relationships with friends and family and, regarding the latter, when they also undertake sporting activities with the family, have a higher probability of complying with the recommendations. In this context, there is a broad consensus in the literature about the importance of the social support of family and friends in relation to levels of physical activity (Jago et al. 2011; Jago et al. 2012; Macdonald-Wallis et al. 2011). An increase in the number of friends and, especially, having a best friend who participates in sports are both related to an increase in physical activity (Jago et al. 2011; Jago et al. 2012). Furthermore, the social support of parents is one of the main influences on the undertaking of physical activity, which could be due to the following mechanisms: the so called instrumental ones, such as material resources and organizing supervised activities; and the intangible ones,

related with motivational aspects like verbal encouragement to participate in physical activities and praise for involvement and effort, as well as the provision of information about how to perform and why one should be active (Beets et al. 2010). Finally, the influence of parental modelling, through the transmission of health-related behaviours, can also have a positive effect that leads to higher levels of activity (Jose et al. 2011; Kahn et al. 2008).

The environmental factors related to physical activity can be classified into those linked to the home, the school and the community setting. Of these, the school setting is considered to be the main site for the design and implementation of interventions for promoting physical activity. Although it is not possible to directly compare our results with those of other research studies, given that we have not found references in the literature relating to work using an additive index for policies, we could make comparisons indirectly for specific factors. Haug et al. (2010), also using information from participants in the HSBC study, observed an increase in the undertaking of physical activity among students of secondary schools with written policies, and in those schools that provided facilities on a regular basis for extracurricular activities. Similarly, positive moderate gradients have been found for the undertaking of physical activity with the number of school recreational facilities (Haug et al. 2008; Nichol et al. 2009). Finally, a positive influence has been seen regarding participation in daily classes of physical education within the academic curriculum on the undertaking of a higher level of total moderate and vigorous physical activity (Gordon-Larsen et al. 2000).

Regarding the lack of a relationship between the level of non-compliance with the physical activity recommendations and the type of school and school site (urban, rural), our study concurs with the results of available studies, which were unable to determine

any associations (Ferreira et al. 2007). Similarly, current evidence of the lack of a relationship between the undertaking of physical activity and accessibility and facilities for its practice in the residential neighbourhood of the students is consistent with the results of our study.

Limitations

To improve the interpretation of the data, several limitations should be mentioned. The cross-sectional design of the study does not make it possible to establish causal relationships between the factors analysed and non-compliance with the physical activity recommendations. Another limitation is that the information was collected in a subjective way, so that the possibility cannot be ruled out of a measurement bias. It is known that the estimation of physical activity using questionnaires obtains moderate correlations when compared to objective measurements (Adamo et al. 2009). Hence, it is important to point out that the variable used for estimating physical activity has been previously validated in an adolescent population of Spain, obtaining an acceptable level of validity when compared with measurement using accelerometers (Martinez-Gomez et al. 2009). Moreover, it is worth mentioning that the variable “policies implemented by schools” was constructed by integrating in an additive way the variables that measure different aspects of the policies, as has been previously proposed for other aspects of health behaviour (Maes and Lievens 2003). Furthermore, there is no current consensus on how to define school-based policies for promoting physical activity, which makes comparison between studies difficult. Finally, the degree of implementation of the policies could not be evaluated in a direct way.

The main strength of the study is that it is based on a broad representative sample of the adolescent population, and the contextual variables have been adjusted for numerous individual variables, so that their independent contribution could be evaluated.

Conclusion

To conclude, numerous personal and family factors have been identified that are related to a low adherence to the physical activity recommendations. From a contextual perspective, students who attend schools with better policies about physical activity have a higher level of total physical activity. These results have important public health implications. First, the identification of personal factors would facilitate interventions addressing high-risk groups. Second, preventive activities should also be prioritized to increase family support, as this support constitutes one of the main influences on the undertaking of physical activity in adolescence. Third, school policies on physical activity need to be strengthened and developed further, not only because such policies increase physical activity in school, but also because they positively influence the level of compliance with preventive recommendations.

Funding acknowledgement:

This study has been funded by the *Consejo Superior de Deportes* [National Sports Council] and the *Ministerio de Sanidad y Política Social* [Ministry of Health and Social Policy].

Conflict of Interests: None

Table 1. Description of the sample and distribution of non-compliance with the physical activity recommendations according to individual variables. Spanish HBSC Study 2006.

Variables	Categories	N (15902)	%*	CI 95%	P value
Dependent variable					
<i>Not Undertaking moderate-intense physical activity on 5 or more days/week</i>		10045	63.2	61.6-64.7	
Individual-level independent variables					
<i>Sex</i>	Male	7508	54.9	52.7-57.0	<0.001
	Female	8394	70.2	68.0-72.3	
<i>Born in Spain</i>	Yes	14873	63.0	61.4-64.5	0.114
	No	1029	66.4	62.3-70.6	
<i>Smoking</i>	No	13242	61.3	59.7-63.0	<0.001
	Yes	2660	71.8	69.5-74.1	
<i>Consumption of alcohol</i>	Never	7197	58.5	56.4-60.6	<0.001
	Rarely	3603	66.1	63.6-68.6	
	Monthly	2077	70.6	67.3-73.8	
	Weekly or daily	3025	65.0	62.3-67.8	
<i>Body-mass index</i>	Normal or underweight	11117	62.3	60.7-64.0	0.010
	Overweight	2088	62.2	59.1-65.3	
	Obese	329	67.5	59.9-75.1	
<i>Consumption of fruit and vegetables</i>	No answer	2368	67.4	64.1-70.7	<0.001
	Quartile 1	4394	67.6	65.5-69.7	
	Quartile 2	3380	65.2	62.4-68.1	
	Quartile 3	3913	63.7	61.0-66.3	
	Quartile 4	4215	56.4	53.9-58.9	
<i>Time spent: TV, computers and consoles</i>	Quartile 1	3659	64.3	61.7-66.9	0.181
	Quartile 2	3923	64.3	61.9-66.7	
	Quartile 3	3923	62.9	60.7-65.2	
	Quartile 4	3776	62.0	59.5-64.4	
	No answer	621	58.2	52.2-64.3	
<i>Time spent: studying/ school homework</i>	Quartile 1	3389	60.8	58.4-63.1	0.002
	Quartile 2	3338	60.9	58.5-63.3	
	Quartile 3	4671	63.5	61.1-66.0	
	Quartile 4	4173	66.3	63.8-68.9	
	No answer	331	66.6	60.4-72.9	
<i>Academic achievement</i>	Very good	2583	54.6	51.5-57.7	<0.001
	Good	6683	63.4	61.1-65.8	
	Average	5308	66.0	64.3-67.7	
	Low	1328	68.4	64.7-72.2	
<i>Employment situation of father</i>	Employed	14608	63.1	61.4-64.7	0.726
	Unemployed	623	65.2	59.5-70.9	
	Others	671	64.2	58.5-69.9	
<i>Employment situation of mother</i>	Employed	11148	62.3	60.4-64.1	0.026
	Unemployed	4571	65.6	63.3-68.0	
	Others	183	57.5	48.0-66.9	
<i>Socioeconomic status</i>	Low	2428	67.5	64.2-70.7	<0.001
	Average	7469	64.1	62.3-66.0	
	High	6005	60.2	57.8-62.5	
<i>Undertakes physical activity with the family</i>	Most or all days	1967	47.7	43.6-51.8	<0.001
	Once a week	2444	56.1	53.1-59.1	
	Less than once a week	3545	63.4	61.2-65.6	
	Never	7946	68.4	66.5-70.2	

N: Total number of individuals.

NA: not applicable

*: Prevalence of non-compliance with the physical activity recommendations

Table 2. Description of the sample and distribution of non-compliance with the physical activity recommendations according to contextual variables. Spanish HBSC Study 2006.

Variables	Categories	N (15902)	%*	CI 95%	P value
<i>School site</i>	Rural	5653** (122)***	63.3	60.6-66.0	0.884
	Urban	10249 (206)	63.1	61.2-64.9	
<i>Type of school</i>	Private	5188 (86)	63.4	60.3-66.5	0.832
	Public	10714 (242)	63.1	61.3-64.8	
<i>Level of school-based policies about physical activity</i>	Low	3505 (68)	66.9	64.3-69.5	<0.001
	Average	8319 (172)	61.0	58.9-63.2	
	High	646 (13)	52.6	47.3-58.0	
	No answer	3432 (75)	65.2	62.2-68.3	
<i>Recreational facilities in school neighbourhood</i>	No	2410 (52)	61.6	58.6-64.7	0.485
	Yes	11493 (238)	63.7	61.9-65.5	
	No answer	1999 (38)	61.7	56.5-66.9	

*: Prevalence of non-compliance with the physical activity recommendations

* Number of individuals

** Number of schools

Table 3. Multilevel models. Individual and contextual factors associated to non-compliance with the physical activity recommendations. Spanish HBSC Study 2006.

Variables	Model 1 Random effects	Model 2 Contextual variables OR* (CI 95%)	Model 3 Individual variables OR* (CI 95%)	Model 4 Individual and contextual variables OR* (CI 95%)	P value (Model 4)
Individual-level independent variables					
<i>Sex</i>					
Male	NA	NA	1 (ref)	1 (ref)	
Female	NA	NA	1.92 (1.79-2.06)	1.92 (1.79-2.06)	<0.001
Age	NA	NA	1.03 (1.00-1.05)	1.02 (1.00-1.04)	0.046
<i>Born in Spain</i>					
Yes	NA	NA	1 (ref)	1 (ref)	
No	NA	NA	1.28 (1.11-1.49)	1.29 (1.11-1.49)	0.001
<i>Smoking</i>					
No	NA	NA	1 (ref)	1 (ref)	
Yes	NA	NA	1.22 (1.09-1.36)	1.21 (1.08-1.36)	0.001
<i>Consumption of alcohol</i>					
Never	NA	NA	1 (ref)	1 (ref)	
Rarely	NA	NA	1.02 (0.93-1.13)	1.03 (0.93-1.13)	0.566
Monthly	NA	NA	1.08 (0.95-1.23)	1.09 (0.96-1.24)	0.189
Weekly or daily	NA	NA	0.86 (0.76-0.98)	0.87 (0.77-1.00)	0.043
<i>Body-mass index</i>					
Normal or underweight	NA	NA	1 (ref)	1 (ref)	
Overweight	NA	NA	1.21 (1.09-1.34)	1.21 (1.09-1.34)	<0.001
Obese	NA	NA	1.48 (1.15-1.89)	1.48 (1.15-1.89)	0.002
No answer	NA	NA	1.28 (1.15-1.41)	1.27 (1.15-1.40)	<0.001
<i>Consumption of fruit and vegetables</i>					
Quartile 1	NA	NA	1 (ref)	1 (ref)	
Quartile 2	NA	NA	0.91 (0.82-1.01)	0.91 (0.82-1.01)	0.067
Quartile 3	NA	NA	0.86 (0.78-0.95)	0.86 (0.78-0.95)	0.003
Quartile 4	NA	NA	0.62 (0.56-0.68)	0.62 (0.57-0.68)	<0.001
<i>Time spent: TV, computers and consoles</i>					
Quartile 1	NA	NA	1 (ref)	1 (ref)	
Quartile 2	NA	NA	0.98 (0.89-1.08)	0.98 (0.89-1.08)	0.672
Quartile 3	NA	NA	0.97 (0.87-1.07)	0.96 (0.87-1.06)	0.441
Quartile 4	NA	NA	0.87 (0.79-0.97)	0.87 (0.78-0.96)	0.006
No answer	NA	NA	0.84 (0.69-1.02)	0.83 (0.68-1.01)	0.066
<i>Time spent: studying/ school homework</i>					
Quartile 1	NA	NA	1 (ref)	1 (ref)	
Quartile 2	NA	NA	1.03 (0.92-1.14)	1.03 (0.92-1.14)	0.640
Quartile 3	NA	NA	1.06 (0.96-1.17)	1.06 (0.96-1.17)	0.241
Quartile 4	NA	NA	1.15 (1.03-1.27)	1.14 (1.03-1.27)	0.011
No answer	NA	NA	1.32 (1.01-1.72)	1.32 (1.02-1.72)	0.039
Personal life satisfaction	NA	NA	0.88 (0.86-0.90)	0.88 (0.86-0.91)	<0.001
<i>Academic achievement</i>					
Very good	NA	NA	1 (ref)	1 (ref)	
Good	NA	NA	1.13 (1.02-1.24)	1.13 (1.02-1.25)	0.015
Average	NA	NA	1.10 (0.98-1.22)	1.10 (0.99-1.22)	0.091
Low	NA	NA	1.13 (0.97-1.32)	1.13 (0.97-1.33)	0.117
<i>Employment situation of father</i>					
Employed	NA	NA	1 (ref)	1 (ref)	
Unemployed	NA	NA	0.90 (0.75-1.07)	0.89 (0.75-1.07)	0.217
Others	NA	NA	0.84 (0.70-0.99)	0.83 (0.70-0.99)	0.04
<i>Employment situation of mother</i>					
Employed	NA	NA	1 (ref)	1 (ref)	
Unemployed	NA	NA	1.10 (1.02-1.19)	1.10 (1.02-1.19)	0.016
Others	NA	NA	0.75 (0.55-1.03)	0.75 (0.54-1.03)	0.073
<i>Socioeconomic status</i>					
Low	NA	NA	1 (ref)	1 (ref)	
Average	NA	NA	0.92 (0.83-1.02)	0.92 (0.82-1.02)	0.101
High	NA	NA	0.88 (0.79-0.98)	0.88 (0.79-0.98)	0.022
<i>Undertakes physical activity with the family</i>					
Most or all days	NA	NA	1 (ref)	1 (ref)	
Once a week	NA	NA	1.19 (1.05-1.35)	1.19 (1.05-1.34)	0.007
Less than once a week	NA	NA	1.41 (1.25-1.59)	1.41 (1.25-1.59)	<0.001
Never	NA	NA	1.55 (1.39-1.74)	1.55 (1.38-1.74)	<0.001
Satisfaction with family relationships	NA	NA	0.97 (0.95-1.00)	0.97 (0.95-1.00)	0.052
Satisfaction with relationships with friends	NA	NA	0.87 (0.84-0.89)	0.87 (0.84-0.89)	<0.001
Contextual independent variables					
<i>School site</i>					
Rural	NA	1 (ref)	NA	1 (ref)	
Urban	NA	1.03 (0.93-1.13)	NA	1.05 (0.96-1.14)	0.275
<i>Type of School</i>					
Private	NA	1 (ref)	NA	1 (ref)	
Public	NA	0.94 (0.85-1.04)	NA	0.94 (0.86-1.03)	0.196
<i>Level of school-based policies about physical activity</i>					
Low	NA	1 (ref)	NA	1 (ref)	

Average	NA	0.83 (0.74-0.94)	NA	0.93 (0.84-1.03)	0.153
High	NA	0.59 (0.46-0.76)	NA	0.76 (0.61-0.94)	0.013
No answer	NA	0.91 (0.79-1.05)	NA	0.98 (0.87-1.12)	0.807
<i>Recreational facilities in school neighbourhood</i>					
No	NA	1 (ref)	NA	1 (ref)	
Yes	NA	1.00 (0.88-1.13)	NA	0.98 (0.88-1.10)	0.784
No answer	NA	1.04 (0.87-1.24)	NA	0.99 (0.85-1.15)	0.901
Random effects					
Variance (Standard Error)	0.087 (0.015)	0.076 (0.014)	0.034 (0.010)	0.029 (0.010)	

* Odds ratio for non-compliance with moderate-intense physical activity on 5 or more days/week. NA: not applicable

References

- Adamo, K.B., Prince, S.A., Tricco, A.C., Connor-Gorber, S., & Tremblay, M. (2009). A comparison of indirect versus direct measures for assessing physical activity in the pediatric population: a systematic review. *International Journal of Pediatric Obesity, 4*, 2-27.
- Barengo, N.C., Hu, G., Lakka, T.A., Pekkarinen, H., Nissinen, A., & Tuomilehto, J. (2004). Low physical activity as a predictor for total and cardiovascular disease mortality in middle-aged men and women in Finland. *European Heart Journal, 25*, 2204-2211.
- Beets, M.W., Cardinal, B.J., & Alderman, B.L. (2010). Parental social support and the physical activity-related behaviors of youth: a review. *Health Education & Behavior, 37*, 621-644.
- Biddle, S.J., Pearson, N., Ross, G.M., & Braithwaite, R. (2010). Tracking of sedentary behaviours of young people: A systematic review. *Preventive Medicine, 51*, 345-351.
- Bronfenbrenner, U., & Morris, P.A. (2006). The bioecological model of human development. In R.M. Lerner & W. Damon (Eds.). *Handbook of Child Psychology. Vol. 1, Theoretical models of human development* (6th edition, pp. 793-828). Hoboken, NJ: Wiley.
- Bucksch, J. (2005). Physical activity of moderate intensity in leisure time and the risk of all cause mortality. *British Journal of Sports Medicine, 39*, 632-638.
- Buscemi, J., Martens, M.P., Murphy, J.G., Yurasek, A.M., & Smith, A.E. (2011). Moderators of the relationship between physical activity and alcohol consumption in college students. *Journal of American College Health, 59*, 503-509.

- Butcher, K., Sallis, J.F., Mayer, J.A., Woodruff, S. (2008). Correlates of physical activity guideline compliance for adolescents in 100 U.S. cities. *Journal of Adolescent health, 42*, 360-368.
- Byberg, L., Melhus, H., Gedeberg, R., Sundstrom, J., Ahlbom, A., Zethelius, B., et al. (2009). Total mortality after changes in leisure time physical activity in 50 year old men: 35 year follow-up of population based cohort. *British Medical Journal, 338*, b688. doi: 10.1136/bmj.b688.
- Cavill, N., Kahlmeier, S., & Racioppi, F. (2006). Physical Activity and Health in Europe: Evidence for action. WHO Regional Office for Europe. Available at: http://www.euro.who.int/_data/assets/pdf_file/0011/87545/E89490.pdf
- Cole, T.J., Bellizzi, M.C., Flegal, K.M., & Dietz, W.H. (2000). Establishing a standard definition for child overweight and obesity worldwide: international survey. *British Medical Journal, 320*, 1240-1243.
- Crespo, C.J., Smit, E., Troiano, R.P., Bartlett, S.J., Macera, C.A., & Andersen, R.E. (2001). Television watching, energy intake, and obesity in US children: results from the third National Health and Nutrition Examination Survey, 1988-1994. *Archives of Pediatrics & Adolescent Medicine, 155*, 360-365.
- Currie, C., Nic, G.S., & Godeau, E. (2009). The Health Behaviour in School-aged Children: WHO Collaborative Cross-National (HBSC) study: origins, concept, history and development 1982-2008. *International Journal of Public Health, 54 Suppl 2*, 131-139.
- De Meester, F., van Lenthe, F.J., Spittaels, H., Lien, N., & De Bourdeaudhuij, I. (2009). Interventions for promoting physical activity among European teenagers: a systematic review. *International Journal of Behavioral Nutrition Physical Activity, 6*, 82. Available at: <http://www.ijbnpa.org/content/6/1/82>.

- Dobbins, M., De, C.K., Robeson, P., Husson, H., & Tirilis, D. (2009). School-based physical activity programs for promoting physical activity and fitness in children and adolescents aged 6-18. *Cochrane Database of Systematic Reviews*, CD007651.
- Dodd, L.J., Al Nakeeb, Y., Nevill, A., & Forshaw, M.J. (2010). Lifestyle risk factors of students: a cluster analytical approach. *Preventive Medicine*, 51, 73-77.
- Eisenmann, J.C., & Wickel, E.E. (2009). The biological basis of physical activity in children: revisited. *Pediatric Exercise Science*, 21, 257-272.
- Feldman, D.E., Barnett, T., Shrier, I., Rossignol, M., & Abenhaim, L. (2003). Is physical activity differentially associated with different types of sedentary pursuits? *Archives of Pediatrics & Adolescent Medicine*, 157, 797-802.
- Ferreira, I., van der Horst, K., Wendel-Vos, W., Kremers, S., van Lenthe, F.J., & Brug, J. (2007). Environmental correlates of physical activity in youth - a review and update. *Obesity Reviews*, 8, 129-154.
- Gordon-Larsen, P., McMurray, R.G., & Popkin, B.M. (1999). Adolescent physical activity and inactivity vary by ethnicity: The National Longitudinal Study of Adolescent Health. *Journal of Pediatrics*, 135, 301-306.
- Gordon-Larsen, P., McMurray, R.G., & Popkin, B.M. (2000). Determinants of adolescent physical activity and inactivity patterns. *Pediatrics*, 105, E83.
Available at: <http://pediatrics.aappublications.org/content/105/6/e83.long>.
- Haapanen, N., Miilunpalo, S., Vuori, I., Oja, P., & Pasanen, M. (1996). Characteristics of leisure time physical activity associated with decreased risk of premature all-cause and cardiovascular disease mortality in middle-aged men. *American Journal of Epidemiology*, 143, 870-880.

- Haug, E., Torsheim, T., & Samdal, O. (2008). Physical environmental characteristics and individual interests as correlates of physical activity in Norwegian secondary schools: the health behaviour in school-aged children study. *International Journal of Behavioral Nutrition Physical Activity*, 5, 47. Available at: <http://www.ijbnpa.org/content/5/1/47>.
- Haug, E., Torsheim, T., & Samdal, O. (2010). Local school policies increase physical activity in Norwegian secondary schools. *Health Promotion International*, 25, 63-72.
- Jago, R., Macdonald-Wallis, K., Thompson, J.L., Page, A.S., Brockman, R., & Fox, K.R. (2011). Better with a buddy: influence of best friends on children's physical activity. *Medicine & Science in Sports & Exercise*, 43, 259-265.
- Jago, R., Page, A.S., & Cooper, A.R. (2012). Friends and Physical Activity during the Transition from Primary to Secondary School. *Medicine & Science in Sports & Exercise*, 44, 111-117.
- Jose, K.A., Blizzard, L., Dwyer, T., McKercher, C., & Venn, A.J. (2011). Childhood and adolescent predictors of leisure time physical activity during the transition from adolescence to adulthood: a population based cohort study. *International Journal of Behavioral Nutrition Physical Activity*, 8, 54. Available at: <http://www.ijbnpa.org/content/8/1/54>.
- Kaczynski, A.T., Manske, S.R., Mannell, R.C., & Grewal, K. (2008). Smoking and physical activity: a systematic review. *American Journal of Health Behavior*, 32, 93-110.
- Kahn, J.A., Huang, B., Gillman, M.W., Field, A.E., Austin, S.B., Colditz, G.A., et al. (2008). Patterns and determinants of physical activity in U.S. adolescents. *Journal of Adolescent Health*, 42, 369-377.

- Keller, S., Maddock, J.E., Hannover, W., Thyrian, J.R., & Basler, H.D. (2008). Multiple health risk behaviors in German first year university students. *Preventive Medicine, 46*, 189-195.
- Khaw, K.T., Jakes, R., Bingham, S., Welch, A., Luben, R., Day, N., et al. (2006). Work and leisure time physical activity assessed using a simple, pragmatic, validated questionnaire and incident cardiovascular disease and all-cause mortality in men and women: The European Prospective Investigation into Cancer in Norfolk prospective population study. *International Journal of Epidemiology, 35*, 1034-1043.
- Lagarde, F. & LeBlanc, C. (2010). Policy options to support physical activity in schools. *Canadian Journal of Public Health, 101 Suppl 2*, S9-13.
- Macdonald-Wallis, K., Jago, R., Page, A.S., Brockman, R., & Thompson, J.L. (2011). School-based friendship networks and children's physical activity: A spatial analytical approach. *Social Science & Medicine, 73*, 6-12.
- Maes, L. & Lievens, J. (2003). Can the school make a difference? A multilevel analysis of adolescent risk and health behaviour. *Social Science & Medicine, 56*, 517-529.
- Martinez-Gomez, D., Martinez-De-Haro, V., Del-Campo, J., Zapatera, B., Welk, G.J., Villagra, A., et al. (2009). [Validity of four questionnaires to assess physical activity in Spanish adolescents]. *Gaceta Sanitaria, 23*, 512-517.
- Martinez-Gomez, D., Ruiz, J.R., Ortega, F.B., Casajus, J.A., Veiga, O.L., Widhalm, K., et al. (2010). Recommended levels and intensities of physical activity to avoid low-cardiorespiratory fitness in European adolescents: The HELENA study. *American Journal of Human Biology, 22*, 750-756.

- Moore, M.J., & Werch, C. (2008). Relationship between vigorous exercise frequency and substance use among first-year drinking college students. *Journal of American College Health, 56*, 686-690.
- Nader, P.R., Bradley, R.H., Houts, R.M., McRitchie, S.L., & O'Brien, M. (2008). Moderate-to-vigorous physical activity from ages 9 to 15 years. *JAMA, 300*, 295-305.
- Naylor, P.J., & McKay, H.A. (2009). Prevention in the first place: schools a setting for action on physical inactivity. *British Journal of Sports Medicine, 43*, 10-13.
- Nichol, M.E., Pickett, W., & Janssen, I. (2009). Associations between school recreational environments and physical activity. *Journal of School Health, 79*, 247-254.
- Nilsson, A., Andersen, L.B., Ommundsen, Y., Froberg, K., Sardinha, L.B., Piehl-Aulin, K., et al. (2009). Correlates of objectively assessed physical activity and sedentary time in children: a cross-sectional study (The European Youth Heart Study). *BMC Public Health, 9*, 322. Available at: <http://www.biomedcentral.com/1471-2458/9/322>.
- Piazza-Gardner, A.K., Barry, A.E. (2012). Examining physical activity levels and alcohol consumption: are people who drink more active? *American Journal of Health Promotion, 26*:e95-104.
- Peltzer, K. (2010). Leisure time physical activity and sedentary behavior and substance use among in-school adolescents in eight African countries. *International Journal of Behavioral Medicine, 17*, 271-278.
- Roman, B., Serra-Majem, L., Ribas-Barba, L., Pérez-Rodrigo, C., & Aranceta, J. (2008). How many children and adolescents in Spain comply with the

- recommendations on physical activity?. *Journal of Sports Medicine and Physical Fitness*, 48, 380-387.
- Slater, A., & Tiggemann, M. (2011). Gender differences in adolescent sport participation, teasing, self-objectification and body image concerns. *Journal of Adolescence*, 34, 455-463.
- Sallis, J.F., Prochaska, J.J., & Taylor, W.C. (2000). A review of correlates of physical activity of children and adolescents. *Medicine & Science in Sports & Exercise*, 32, 963-975.
- Sanchez, A., Norman, G.J., Sallis, J.F., Calfas, K.J., Cella, J., & Patrick, K. (2007). Patterns and correlates of physical activity and nutrition behaviors in adolescents. *American Journal of Preventive Medicine*, 32, 124-130.
- Schnohr, C.W., Kreiner, S., Due, E.P., Currie, C., Boyce, W., & Diderichsen, F. (2009). Differential item functioning of a Family Affluence Scale: Validation study on data from HBSC 2001/02. *Social Indicators Research*, 89, 79-95.
- Seabra, A.F., Mendonca, D.M., Thomis, M.A., Malina, R.M., & Maia, J.A. (2011). Correlates of physical activity in Portuguese adolescents from 10 to 18 years. *Scandinavian Journal of Medicine & Science in Sports*, 21, 318-323.
- Stalsberg, R., & Pedersen, A.V. (2010). Effects of socioeconomic status on the physical activity in adolescents: a systematic review of the evidence. *Scandinavian Journal of Medicine & Science in Sports*, 20, 368-383.
- Telama, R. (2009). Tracking of physical activity from childhood to adulthood: a review. *Obesity Facts*, 2, 187-195.
- Van Der Horst, K., Paw, M.J., Twisk, J.W., & Van Mechelen, W. (2007). A brief review on correlates of physical activity and sedentariness in youth. *Medicine & Science in Sports & Exercise*, 39, 1241-1250.

- Vilhjalmsson, R., & Kristjansdottir, G. (2003). Gender differences in physical activity in older children and adolescents: the central role of organized sport. *Social Science & Medicine*, *56*, 363-374.
- Wilks, D.C., Besson, H., Lindroos, A.K., & Ekelund, U. (2011). Objectively measured physical activity and obesity prevention in children, adolescents and adults: a systematic review of prospective studies. *Obesity Reviews*, *12*, e119-e129. doi: 10.1111/j.1467-789X.2010.00775.x.
- Wong, S.L., & Leatherdale, S.T. (2009). Association between sedentary behavior, physical activity, and obesity: inactivity among active kids. *Preventive Chronic Disease*, *6*, A26. Available at: http://www.cdc.gov/pcd/issues/2009/Jan/07_0242.htm.
- World Health Organization. (2010). Global recommendations on physical activity for health. World Health Organization. Available at: http://whqlibdoc.who.int/publications/2010/9789241599979_eng.pdf.
- Zhu, W., Welk, G.J., Meredith, M.D., & Boiarskaia, E.A. (2010). A survey of physical education programs and policies in Texas schools. *Research Quarterly for Exercise & Sport*, *81 Suppl 3*, S42-S52.