Physical Activity awareness of European Adolescents: The HELENA Study

Running Head: Physical activity and awareness

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Abstract

The aim of this study was to assess physical activity (PA) awareness of adolescents and to identify anthropometric and psychosocial factors that can lead to under or overestimation of PA. This study included 2044 adolescents. Participants wore a uniaxial accelerometer for 7 days to measure PA and completed a self-rated questionnaire about PA. Adolescents were classified into four PA awareness subgroups (realistically active, overestimators, underestimators, and realistically inactive) according to the self-rated and objective assessment of PA. Characteristics and psychosocial factors of the self-rated physically active groups were compared using bivariate and multivariate mixed logistic regression models. Forty-five percent of adolescents reported their PA levels correctly (34.8% realistically active and 10.1% realistically inactive). Among the 59.4% who were objectively inactive, 82.9% tended to overestimate their PA level. Adolescents who overestimated their PA level were older ($P < .05$), had more support from mother and a best friend ($P < .05$), and had higher cardiorespiratory fitness ($P < .001$) compared with those who were realistically active. A significant number of adolescents believe that they are physically active when they are not. Improving awareness, especially in the high-risk groups identified here, might help to bring about behavioral changes in physically inactive adolescents.

Introduction

Physical activity (PA) is recognized as an important determinant of health in children and adolescents. Increasing participation in moderate-to-vigorous PA (MVPA) has important health benefits, such as decreasing risk factors for obesity, cardiovascular and pulmonary diseases, cancer, and depression, and improving bone health (Halla, Victora, Azevedo, & Wells, 2006). Physical inactivity in children and adolescents is associated with low physical abilities and increase morbidity and mortality in adulthood (Garcia Cruz et al., 2014).

Adolescence is a crucial period for the development of healthy lifestyle habits. However, this period is marked by a decline in PA mainly by reducing the time spent in MVPA (Zook, Saksvig, Wu, & Young, 2014; Olds et al., 2009; Bélanger, Gray-Donald, O'Loughlin, Paradis, & Hanley, 2009; Van Mechelen, Twisk, Post, Snel, & Kemper, 2000; Telama & Yang, 2000). Moreover, interventions to promote PA in children and adolescents have had limited success (Dobbins, Husson, DeCorby, & LaRocca, 2013; Van Sluijs, McMinn, & Griffin, 2007). The hypothesis most often used to explain the limited effectiveness of interventions or promotion programs is the lack of awareness of adolescents about their health status (Hebert et al., 1997; Oenema & Brug, 2003). The perception of being physically active or inactive is difficult for children and adolescents to appreciate. Therefore, adolescents may think they are achieving healthy lifestyle habits, but overestimate their PA levels. Only two studies on PA awareness have been performed in children and adolescents, and these have shown that a substantial number of adolescents and children believe themselves to be more physically active than they really are (Corder et al., 2011; Corder et al., 2010). Data from adolescents are scarce and are limited to British adolescents.

The aim of the present study was to examine awareness of PA in a large sample of European adolescents and to identify anthropometric and psychosocial factors that can lead to a misreporting of PA.

Materials and Methods

Study Design

The current report is based on data from the Healthy Lifestyle in Europe by Nutrition in Adolescence (HELENA) study. The aim of the HELENA study was to obtain a broad range of standardized, reliable, and comparable nutrition- and health-related data from a random sample of European adolescents aged 12.5–17.5 years. Data were collected in 2006 and 2007 in 10 European cities: Vienna (Austria), Ghent (Belgium), Lille (France), Athens (Greece), Heraklion (Greece), Pecs (Hungary), Rome (Italy), Dortmund (Germany), Zaragoza (Spain), and Stockholm (Sweden). In total, 3528 adolescents (1844 girls and 1684 boys) meeting the inclusion criteria completed all examinations. A detailed description of the HELENA study methodology and sampling has been published elsewhere (Béghin et al., 2012; Moreno et al., 2008a; Moreno et al., 2008b).

The aims and objectives were explained carefully to each adolescent and their parents. Written, informed consent was obtained from the adolescent and their parents. The HELENA study was approved by the local ethics committee for each country, and all procedures were performed in accordance with the ethical standards of the Helsinki Declaration of 1975 as revised in 2008 and with the European Good Clinical Practices (Béghin et al., 2008).

From the total population of 3528 adolescents, 2044 with complete data for self-rated PA and objectively assessed PA were included in the present study.

Measurements

Anthropometric Characteristics. Body weight was measured with the subjects wearing light clothes and without shoes to the nearest 0.1 kg using an electronic scale (SECA 871; SECA, Hamburg, Germany). Height was measured without shoes to the nearest 0.1 cm using a telescopic height-measuring instrument (SECA 225; SECA). Body mass index (BMI) was calculated as weight (kg)/height^2 (m^2). The nutritional status was assessed using the International Obesity Task Force scale (Cole, Bellizzi, Flegal, & Dietz, 2000). Body composition (fat mass) was assessed using the bioelectrical impedance method (BodyGram V. 1.31; Akern Bioresearch, Florence, Italy) as described previously (Vicente-Rodriguez et al., 2012).

Self-perception PA. Self-perception PA was assessed before the objective PA assessment. The adolescents answered a single question: "Do you think you are physically active?" The possible answers were "very inactive," "fairly inactive," "moderately active," "fairly active," and "very active." The adolescents were classified into two categories: inactive when the answer was "very inactive", "fairly inactive" or "moderately active" and active when the answer was "fairly active" or "very active" (Corder et al., 2011).

Objective PA Assessment. The ActiGraph GT1M® monitor (ActiGraph, Pensacola, FL, USA) was used to assess the participants' PA in free-living conditions. The device is a uniaxial accelerometer that measures 51 × 41 × 15 mm and weighs 43 g. Accelerometry assesses PA by measuring mechanical movement. This device has been validated against oxygen consumption and heart rate for the assessment of PA levels (Treuth et al., 2004). The interinstrument reliability of this device is high for both sedentary activities than for vigorous activities (Vanhelst, Baquet, Gottrand, & Béghin, 2012; McClain, Sisson, & Tudor-Locke, 2007). The epoch interval for the ActiGraph GT1M® monitor was set at 15 s. The adolescents wore the accelerometer on the lower back with an elastic belt and adjustable buckle. The adolescents were then asked to follow their normal daily routine. They were instructed to remove the accelerometer during swimming, showering, and bathing. The accelerometer recorded activity for 7 consecutive days and was taken off at night.

Data were uploaded from the monitor to a computer after the completed 7-day registration period. Participants who did not record at least 3 days of recording with a minimum of 8 h of activity per day were excluded from the analyses. Zero activity periods of 20 min or longer were interpreted as “not worn time,” and these periods were removed from the summation of activity. The assessment of time spent in sedentary, light, moderate, and vigorous PA was based on cutoff points of 0–500, 501–1999, 2000–2999, and >2999 counts/min, respectively (Riddoch et al., 2004; Ekelund et al., 2007). Adolescents were classified as active or inactive using the thresholds of 60 minutes per day of MVPA, according to the world health public recommendations on PA (Cale & Harris, 2001).

Psychosocial Factors. Parental educational level (PEL) was classified into one of four categories using a specific questionnaire adapted from the International Standard Classification of Education (ISCED) (http://www.uis.unesco.org/Library/Documents/isced97-en.pdf). PEL was scored as 1, primary and lower education (levels 0, 1, and 2 in the ISCED classification); 2, higher secondary (levels

3 and 4 in the ISCED classification); and 3, tertiary (levels 5 and 6 in the ISCED classification).

Socioeconomic status was assessed according to the International Standard Classification of Occupations (ISCO: http://unstats.un.org/unsd/class/family/family2.asp?Cl=224). The ISCO categories of 1 (highest level) to 9 (lowest level) were scored as high (ISCO categories 1 and 2), medium (ISCO categories 3–5), and low (ISCO categories 6–9).

Encouragement by relatives and friends to be physically active was assessed in the questionnaire. The adolescents were asked the following question about the encouragement about PA they received from family members (father, mother, brothers, and sisters) and best friend: "How often does your relative encourage you to be physically active?" There were separate questions for father, mother, brothers, sisters, and best friend. Answers were also classified into two levels (categories) of encouragement: no, if the answer was "not at all." "not much," or "sometimes," and yes if the answer was "often" or "very often."

Cardiorespiratory fitness. 20m shuttle run test assesses the cardiorespiratory fitness. The adolescents performed the test as described earlier (Léger, mercier, Gadoury, & Lambert, 1988). Participants are required to run between two lines 20 m apart, while keeping pace with audio signals emitted from a pre-recorded CD. The initial speed is 8.5 $km \cdot h^{-1}$, which is increased by 0.5 $km \cdot h^{-1} \cdot min^{-1}$ (1 min equals one stage). Participants are instructed to run in a straight line, to pivot on completing a shuttle, and to pace themselves in accordance with the audio signals. The test is finished when the participant fails to reach the end lines concurrent with the audio signals on two consecutive occasions. Otherwise, the test ends when the participant stops because of fatigue. All measurements were carried out under standardized conditions on an indoor rubber-floored gymnasium. The participants were encouraged to keep running as long as possible throughout the course of the test. The last completed stage or half-stage at which the participant drops out was scored.

Statistical Analysis

The qualitative variables are expressed as frequency and percentage. The continuous variables are reported as mean ± standard deviation (SD).

To access the selection bias related to missing data on self-rated PA or objective PA assessment, the main patients' characteristics were compared using Student's t test for quantitative variables, Chi-Square test for qualitative nominal variables and Mantel-Haenszel trend test for qualitative ordinal variables between included and excluded adolescents. To evaluate the magnitude of differences between included and excluded adolescents, we calculated the absolute standardized differences; a standardized difference higher than 20% denotes meaningful imbalance.

Adolescents were classified into four PA awareness subgroups (realistically active, over-estimators, under-estimators, and realistically inactive) according to the comparison between their perception of PA and objectively assessed PA. We compared the characteristics and psychosocial factors of adolescents firstly between over-estimators and realistically inactive adolescents (active adolescent analysis), and secondly between under-estimators and realistically active adolescents (inactive adolescent analysis). Between-group comparisons were performed using mixed logistic regression models including center as a random effect. For both active and inactive adolescents analyses, variables associated with misreporting of PA with a $P < .10$ were considered as candidates predictors into multivariable logistic regression analysis, except brother and sister support PA since some adolescents were single children. Moreover, since fat mass, BMI and nutritional status were highly correlated, only nutritional status were considered as candidate. The full models were simplified with a backward selection procedure with a value of $P < .05$ used as the cutoff for retention in the model. To avoid case deletion in multivariable analyses due to missing data on candidate predictors, missing data were treated by multiple imputation using regression switching imputation (chained equations approach, with m = 10 imputations using all adolescent's and psychosocial characteristics except brother and sister support) with predictive mean matching method for continuous variables, logistic regression model for binary variables, and ordinal logistic regression for ordered categorical variables (Van Buuren et al., 2011). Odds ratios (ORs) with their 95% confidence intervals (95% CIs) were calculated using realistically active as the reference in the active adolescents analysis and realistically inactive as reference in the inactive adolescents analysis. We further evaluated the impact of brother and sister support PA on misreporting of PA in separate multivariable analyses including the independent predictors identified in backward stepwise regressions analyses.

All statistical tests were performed at the two-tailed α level of .05. Data were analyzed using SAS software (version 9.4; SAS Institute Inc., Cary, NC, USA).

Results

Of 3528 adolescents meeting the inclusion criteria, 2044 (57.9%) were finally included in the statistical analysis after excluding those with missing data on self-rated PA or objective PA assessment. Characteristics of the population studied are presented in Table 1. We found differences between included and excluded adolescents on characteristics but with no meaningful differences regarding the absolute standardized differences.

Forty-five percent of the adolescents estimated their PA correctly: 34.8% realistically active and 10.1% realistically inactive (Table 2). By contrast, 55% of the adolescents perceived their PA levels incorrectly, mostly by overestimating their PA. Of the 59.4% of adolescents who were inactive, 82.9% overestimated their PA levels (49.3% of all participants). Very few of the adolescents who were active underestimated their PA levels (5.8% of all participants).

Among the active adolescents, compared with those classified as realistically active, those who underestimated their PA level were older, had a greater nutritional status, fat mass and BMI, had lower ISCO mother status, received less encouragement about PA from their father, mother, brother, sister and best friend and had lower cardiorespiratory fitness (Table 3). In multivariable analysis, having a greater nutritional status, a lower ISCO mother status and not receiving encouragement about PA from their mother and best friend were independently associated with PA underestimation (Table 4). For adolescents who have a brother, not receiving encouragement about PA from them was associated with underestimation (OR= 0.39; 95%CI = 0.16 – 0.96; p = 0.040). For adolescents who have a sister, not receiving encouragement about PA from them was not associated with underestimation (OR = 0.48; 95%CI = 0.20 – 1.16; p = 0.10).

Among the inactive adolescents, compared with those classified as realistically inactive, those who overestimated their PA level were, received more encouragement about PA from their father, mother, sister and best friend and had higher cardiorespiratory fitness (Table 5). In multivariable analysis, having a higher cardiorespiratory fitness, being older and receiving more encouragement about PA from their mother and best friend were independently associated with PA overestimation (Table 6). For adolescents who have a brother, receiving encouragement about PA from them was not associated with overestimation (OR = 0.98; 95%CI = 0.56 – 1.72; p = 0.95). For adolescents who have a sister, receiving encouragement about PA from them was not associated with overestimation (OR = 1.22; 95%CI = 0.63 – 2.37; p = 0.55).

Discussion

To our knowledge, only one study has addressed PA awareness in adolescents (Corder et al., 2011). Our study is the first to investigate this topic in a large sample of European adolescents and to try to identify the anthropometric and psychosocial factors that may lead to their misreporting PA. The results of the present study show that >50% of adolescents have an overestimation of their PA habits.

The high rate of misperception about their PA levels may be explained by social desirability (the tendency to respond in such a way as to avoid criticism) and social approval (the tendency to seek praise), which can bias answers in structured questionnaires (Hebert et al., 1997). Our findings support the previous observations in the literature, which suggest that adolescents have a worst perception of their PA than are children (Corder et al., 2010). The European adolescents included in our study appeared to overestimate their PA levels compared with the British adolescents included in an earlier study (Corder et al., 2011). In our study, 50% of inactive European adolescents believed themselves to be physically active compared with 60.3% and 64.8% in the British adolescents girls and boys, respectively (Corder et al., 2011). These differences might be actual or explained by differences in sample size (larger in our study) and/or methodology to assess PA (cutoffs for PA intensity).

Indeed, methodological issues relating to calibration of the accelerometer might explain the discrepancies we found in the present study. Several studies showed clearly that the differences in accelerometer cut-points in the published references can lead to a large discrepancy in the assessment of PA patterns (Vanhelst et al., 2014; Trost, Loprinzi, Moore, & Pfeiffer, 2011; Guinhouya et al., 2006). The percentages of adolescents relative to the total population studies fulfilling the recommendation of 60 min of MVPA per day can to vary between 5.9% to 37% according to the method used (Vanhelst et al., 2014).

We identified some characteristics and psychosocial factors as associated with the overestimation of PA. First, we found that age influences the overestimation of PA. Adolescents who overestimated their PA level were older than those realistic about their inactivity. This finding is in agreement with previous studies performed in British children and adolescents separately (Corder et al., 2011; Corder et al., 2010). Authors found in children aged 9 to 10 years that 40% of inactive children perceived themselves as actives while in adolescents aged 14 to 15 years, 60% of inactive adolescents perceived themselves as actives (Corder et al., 2011; Corder et al., 2010). Therefore, the adolescents appear to be less aware than children about their PA levels. Our results with previous studies show the age might have an impact on the PA awareness. The first possible explanation could be due to social desirability bias, more important in adolescent compared to the children who can be unaware of PA benefits on health. Another explanation could be the fact that the PA declines with age (Ortega et al., 2013; Corder et al., 2015).

Adolescents were more likely to overestimate their PA levels when they had more support from their best friend and their mother. Our results are in agreement with the previous study performed in British adolescents (Corder et al., 2011).

Although several studies highlighted the positive role of social encouragement on adolescents' PA levels (Martin-Matillas et al., 2011; Sallis, Prochaska & Taylor, 2000), our data unexpectidely show that peer and parent support are negatively associated with PA awareness. We have no clear explanation for these findings but on a practical point of view, this should be taken into account when designing interventions involving family and friends where the positive influence on PA levels could be counterbalance by a negative PA awareness.

Adolescents who overestimated their PA levels reported higher cardiorespiratory fitness than those realistic about their inactivity. Like peer support, although a higher cardiorespiratory fitness appears to be associated with a lack of PA awareness, the aerobic fitness has other health benefits, such as reduced risk factors for cardiovascular disease, to have fewer mental, nutritional, gastroenterological, cardiac, and respiratory diseases (Ortega, Ruiz, Castillo, & Sjöström, 2008). Our data show that cardiorespiratory fitness was positively associated with overestimation of PA while a good agreement between cardiorespiratory fitness measured objectively and self-reported physical fitness has been previously reported in adolescents (Ortega et al., 2011; Marsh et al., 1993). This finding suggest that overestimators might assume that they are enough active due to their favorable physical fitness.

Our finding that 50% of the adolescents misreported their PA level emphasizes the importance of improving awareness of PA as the first step in interventions to improve PA and the need to focus on the risk factors identified. If adolescents feel they are physically active when in fact they are not, they may be less sensitive to interventions aiming to increase PA. In this respect, the use of new technology (e.g., smartphone applications) may help (Nolan, Mitchell, & Doyle-Baker, 2014; Wu, Dasgupta, Ramirez, & Norman, 2012).

The current study has strengths and limitations. The strengths of the study are the large sample size of adolescents with gender-specific information in 10 European cities, the use of standardized procedures, the strong methodology to assess PA objectively (accelerometry), and the assessment of cardiorespiraory fitness which was not included in previous studies. The limitations of the study include the cross-sectional design and that the observed associations cannot be interpreted to reflect causal relationships. Missing data on self-rated PA or objective PA assessment led to exclusion of 42% of adolescent enrolled in HELENA study. Although there was no meaningful differences between included and not included adolescents, we could not exclude that missing data could introduce a selection bias. In addition, the thresholds used for the PA assessment might have affected the results, as previously described (Vanhelst et al., 2014). Variations in weather (wind, rain and sunshine) during the PA assessment were not recorded in our study and might also have affected our results. Moreover, the PA was assessed during one week while the questionnaire provided no time interval. We did not inform the adolescents about PA recommendations before the questionnaire was applied. This can lead to a misunderstanding on the assessment of the awareness. Then, as this study was performed ten years ago (2006-2007), we can not be sure our results represent the present situation.

Conclusions

A high proportion of adolescents believe that they are physically active when they are not really. The adolescents with a higher cardiorespiratory fitness, receiving more support by their peers and being older more frequently inaccurately estimate they are active. The results from our study suggest the health promotion programs should consider adolescents' awareness of their PA level and that this may not necessarily be accurate. Increasing their awareness of PA might help to bring about behavioral changes and might have positive effects on their health status. Our results support the idea that the first step of any intervention program on PA should focused on awareness, especially in the at risk groups we defined. Any intervention without first being aware of actual PA levels should fail.

Conflict of interest

The authors do not have any competing interests.

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Table 1. Comparison of main characteristics between the included and non-included adolescents

	Included	Not included	P-value	Absolute standardized difference (%)
Number of adolescents	2044	1484		
Gender (%*boys*)	46.1	49.9	0.028	7.5
Age (*yr*)	14.8 ± 1.2	14.9 ± 1.3	0.025	7.8
Height (*cm*)	165.7 ± 9.2	166.0 ± 9.0	0.22	4.2
Body mass (*kg)*	58.2 ± 12.0	60.5 ± 13.5	<0.0001	17.9
BMI ($kg \cdot m^{-2}$)	21.1 ± 3.5	21.8 ± 4.0	<0.0001	19.0
Nutritional status (%*UW/%NW/%OW/%O*)[a]	6.6/72.6/16.1/4.7	5.3/68.3/19.5/6.9	<0.0001	14.1
Pubertal status (%*II/%III/%IV/%V*)[b]	6.4/21.9/39.3/32.4	5.7/23.2/46.7/24.4	0.014	19.2
Father education level (%*I/%II/%III*)[c]	35.8/27.8/36.4	40.8/27.7/31.5	0.001	12.0
Mother education level (%*I/%II/%III*)[c]	33.7/30.7/35.6	36.9/32.3/30.8	0.006	10.9

[a] Nutritional status: underweight (UW), normal weight (NW), overweight (OW), obese (O)
[b] Pubertal status staging according to Tanner
[c] Education level: lower education (I); higher secondary education (II); higher education or university degree (III).

Table 2. Classification of 2044 adolescents into 4 physical activity awareness groups according to adolescent perception and the objective assessment

		Objectively assessed physical activity	
		830 Active (40.6%)	**1214 Inactive (59.4%)**
Adolescent perception of physical activity	Very active (n=1191) Fairly active (n=527)	711 realistically active (34.8%)	1007 over-estimators (49.3%)
	Moderately active (n=256) Fairly inactive (n=47) Very inactive (n=23)	119 under-estimators (5.8%)	207 realistically inactive (10.1%)

Table 3. Comparison of adolescent's characteristics and psychosocial factors between adolescent classified as realistically active and under-estimators

	Under-estimator	Realistically active	P
Number of adolescents	119	711	
Age (y)	15.0 ± 1.2	14.7 ± 1.2	**0.045**
Girls (%)	41.2	35.4	0.33
Nutritional Status			
Undernourished (%)	7.6	5.6	
Lean adolescent (%)	63.9	[illegible]	**0.006**
Overweight (%)	19.3	14.8	
Obese (%)	9.2	2.5	
Fat mass (*kg*)	14.7 ± 10.1	12.5 ± 7.0	**0.003**
BMI (*kg/m²*)	21.6 ± 4.3	20.8 ± 3.1	**0.025**
Father Education Level			
Low (%)	40.6	37.4	
Middle (%)	22.6	25.6	0.92
High (%)	36.8	37.0	
Mother Education Level			
Low (%)	38.1	36.1	
Middle (%)	33.6	28.9	0.43
High (%)	28.3	35.0	
ISCO father			
Low (%)	41.7	44.3	
Middle (%)	28.7	28.9	0.37
High (%)	29.6	26.8	
ISCO mother			
Low (%)	57.8	47.2	
Middle (%)	32.7	34.9	**0.021**
High (%)	9.5	17.9	
Father support PA (%)	42.1	57.6	**0.008**
Mother support PA (%)	40.9	55.3	**0.005**
Brother support PA (%)	11.3	30.2	**0.004**
Sister support PA (%)	11.7	26.3	**0.018**
Best friend support PA (%)	22.1	36.5	**0.006**
Cardiorespiratory fitness ($ml.kg^{-1}.min^{-1}$)	41.9 ± 8.6	44.7 ± 7.7	**0.007**
MVPA ($min.day^{-1}$)	80.0 ± 19.0	81.4 ± 19.0	0.37

ISCO: International Standard Classification of Occupations; PA: Physical Activity

Table 4. Multivariate analysis of independent factors associated with underestimation of physical activity among the active adolescents

	Odds-ratio	95% CI	P
Nutritional Status	1.61	1.16 – 2.22	0.004
Mother Support PA	0.60	0.39 – 0.92	0.021
ISCO mother	0.72	0.54 – 0.97	0.028
Best friend Support PA	0.58	0.34 – 0.98	0.041

Calculated from backward-stepwise mixed logistic regression after handle missing data on adolescent's characteristics. Candidate variables included in the model were age, nutritional status, ISCO mother, father, mother and best friend support PA and cardiorespiratory fitness.

Table 5. Comparison of adolescent's characteristics and psychosocial factors between adolescent classified as realistically inactive and over-estimators

	Over-estimator	Realistically inactive	P
Number of adolescents	1007	207	
Age (y)	14.8 ± 1.2	14.7 ± 1.1	0.06
Girls (%)	64.9	70.5	0.13
Nutritional Status			
Undernourished (%)	6.2	11.1	
Lean adolescent (%)	71.6	66.7	0.19
Overweight (%)	16.2	18.8	
Obese (%)	6.0	3.4	
Fat mass (*kg*)	15.1 ± 8.5	14.4 ± 7.5	0.59
BMI (*kg/m²*)	21.3 ± 3.6	20.9 ± 3.7	0.18
Father Education Level			
Low (%)	33.9	36.4	
Middle (%)	29.7	29.2	0.20
High (%)	36.4	34.4	
Mother Education Level			
Low (%)	31.6	32.8	
Middle (%)	32.0	29.3	0.64
High (%)	36.4	37.9	
ISCO father			
Low (%)	43.0	44.9	
Middle (%)	28.7	26.0	0.78
High (%)	28.3	29.1	
ISCO mother			
Low (%)	43.0	46.2	
Middle (%)	39.6	32.7	0.98
High (%)	17.4	21.1	
Father support PA (%)	50.9	37.0	**0.0005**
Mother support PA (%)	57.6	43.0	**0.0001**
Brother support PA (%)	26.5	22.5	0.41
Sister support PA (%)	25.1	14.2	**0.018**
Best friend support PA (%)	28.1	15.0	**0.0006**
Cardiorespiratory fitness ($ml.kg^{-1}.min^{-1}$)	39.8 ± 6.6	38.5 ± 6.1	**0.010**
MVPA ($min.day^{-1}$)	42.7 ± 10.9	42.6 ± 10.4	0.95

ISCO: International Standard Classification of Occupations; PA: Physical Activity

Table 6. Multivariate analysis of independent factors associated with overestimation of physical activity among the inactive adolescents

	Odds-ratio	**95% CI**	**P**
Cardiorespiratory fitness*	1.43	1.15 – 1.77	0.001
Mother Support PA	1.67	1.20 – 2.32	0.002
Age	1.23	1.06 – 1.42	0.006
Best friend Support PA	1.81	1.14 – 2.88	0.012

Calculated from backward-stepwise mixed logistic regression after handle missing data on adolescent's characteristics. Candidate variables included in the model were age, father, mother and best friend support PA and cardiorespiratory fitness.
* Odds ratio calculated per one standard deviation increase (SD=7.5).