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Socio-economic effects on meeting PA guidelines: comparisons among 32 countries

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Abstract

Purpose—This study examined the relationship between age and gender with physical activity (PA) and how meeting of PA guidelines (PAGL) is related to socio-economic-status.

Methods—Data were collected from 11-, 13-, and 15-y.o. students in 32 countries participating in the Health Behaviour in School-aged Children (HBSC) survey 2001/2002. A self-completed questionnaire assessed moderate-to-vigorous physical activity (MVPA) for the past seven days and MVPA for a typical week. Socio-economic status (SES) was assessed using the Family Affluence Scale (FAS).

Results—None of the countries averaged enough MVPA to meet PAGL. The pattern of MVPA across gender and age was consistent among all countries. In all countries girls were significantly less active than boys (mean hours/week of MVPA 3.52 ± 1.88 vs 4.13 ± 1.95) and were more likely to not meet the PAGL; older children were less active when compared to the youngest. SES was significantly associated with the amount of reported MVPA. SES and PAGL were significantly related in seven countries and a significant decrease in the influence of age was observed in these countries compared to other countries.

Conclusions—Levels of MVPA during adolescence showed consistent patterns across countries in relation to age, gender and social-class. The limited effect of age on PA in countries where the influence of social class was less strong, suggesting the possibility of a moderating effect of context in the development of habits acquired in childhood

Keywords

Health Behaviour in School-aged Children (HBSC); adolescence; international survey; PAGL determinants; children habits

Introduction

Paragraph 1: The increase in prevalence of overweight and obesity in children and adolescents in industrialized countries is a serious public health issue (31); these conditions impact morbidity and mortality in adulthood (30,38). Lower levels of moderate to vigorous physical activity (MVPA) and high levels of sedentary behaviour (SB) during childhood and adolescence are associated with concurrent obesity (9,22) and with increased risk of obesity during young adulthood even when controlling for genetic effects (23). There is increasing evidence that many conditions associated with lack of MVPA (e.g., adiposity, metabolic syndrome, poor bone health, cardiovascular risk) develop precociously in childhood and adolescence and may become chronic illnesses in adulthood (2,13,32). When individuals acquire good habits with regard to MVPA at an early age, they are more likely to maintain those habits in adulthood (13,28).

Paragraph 2: Population studies demonstrate that many youngsters do not meet established recommendations for daily MVPA (20,27,32). In order to define the profile of population subgroups at risk, it is useful to describe the variation in MVPA levels according to age, gender and social class. There is also growing interest in whether or not SBs have a significant role in causing young people to avoid regular MVPA (22).

Paragraph 3: Adding to this concern is that MVPA declines during the pre-adolescent and adolescent years (2,20,27). Males are more active than females, and these differences in level of MVPA remain constant as age increases (2,27,36). However, there is disagreement regarding the association between socioeconomic conditions and level of MVPA in youngsters; some authors conclude that it is not possible to establish a clear relation, and hence that further observations are needed (2,27), while others affirm that higher socio-economic and educational levels of parents are positively associated with levels of MVPA in adolescents (4). Conflicting results also emerge from studies on sedentary habits and their relationship to MVPA levels in young people. The increasing amount of time spent by adolescents in sedentary activities points to these behaviours as competing with MVPA (10). However, there is evidence that sedentary pastimes are not necessarily an obstacle to performing recommended amounts of MVPA (33); in fact, the two types of behaviour occur at different times of the day (18) and have different determining factors (2,27).

Paragraph 4: This study examines the patterns of MVPA and SB in youths from 32 countries participating in the Health Behaviour in School-aged Children (HBSC) 2001/2002 international survey. The goals of this study are to examine the relation between MVPA and SB and to determine whether the meeting of MVPA guidelines is related to socio-economic status. Potential cultural differences in these relationships are also explored.

Materials and methods

Paragraph 5: Analyses were based on the Health Behaviour in School-aged Children (HBSC) 2001/2002 survey, a World Health Organization (WHO) cross-national survey. HBSC was established in 1982 by a team of Finnish, Norwegian and English researchers (1) and designed to collect data every four years. Since its beginning, the number of participating countries has increased to 35* in the 2001 (6th survey) (see Table 1), spanning Europe, Israel and North America (25). The HBSC study aims to gain new insight into, and increase understanding of, adolescent health behaviour, health and well-being in their social context, and to collect high quality comparable cross-national data (7,25).

*In this paper the French and Belgium Flemish were combined into Belgium, and England, Scotland and Wales constituted the United Kingdom

Ethics

Paragraph 6: Information about the study was sent to school directors in order to contact parents or guardians of all participating children, giving them the opportunity to exclude their children from participation. Active consent was obtained through all sampled schools. The study and the questionnaire were approved by local Ministerial or ethics committees in each of the participating countries. Data were collected by means of an anonymous self-completion questionnaire administered in the classroom. Standard protection measures were taken to ensure that individual data remained confidential (7). Only group-level data are reported.

Sample

Paragraph 7: Survey questions covered a wide range of health indicators and health-related behaviours as well as life circumstances of young people. The core questions provided information on demographic factors; family and social background, including socio-economic status (SES); health behaviour, including MVPA, sexual behaviour and other risk behaviours; and lifestyle factors, such as sedentary behaviours and well-being indicators.

Paragraph 8: The sampled population consisted of students, aged 11, 13, and 15. Cluster sampling was used, the primary sampling unit being school class. Participant countries, following the methodology detailed in the international protocol, drew their representative sample of the three ages reaching the recommended minimum size of 1526 subjects for each group, with item prevalence estimates having a 95 percent confidence interval of ± 3 percent. Study methods are described in greater depth elsewhere (7). The entire database has undergone a centralized cleaning process, leading to a final sample of 162,305 cases. Children not responding to MVPA questions, age or gender were excluded; a total of 153,028 cases were used.

Variables and measurements

Physical activity—Paragraph 9: Two single-item measures assessed the number of days individuals had engaged in bouts of moderate-to-vigorous physical activity (MVPA) for at least 60 minutes during the past seven days and for a typical week. MVPA was defined as "an activity that usually increases your heart rate and makes you get out of breath some of the time". Each participating country was allowed to add examples appropriate to that country, such as running, brisk walking, soccer, basketball, football, or surfing. Children were asked to add up all the time spent in MVPA each day across all activities. Reports for the past seven days and for a typical week were averaged to form a composite measure. The measure yielded the average number of days per week in which the adolescent accumulated at least 60 minutes of MVPA. A score of five or more (days per week) classified respondents as meeting the MVPA guidelines (PAGL) (5,24). Studies have shown that a composite of these two items have reasonable reliability and validity in this age group (3,24).

Sedentary behaviours—Paragraph 10: Sedentary behaviours (SB) were assessed by means of three recall questions. Children were asked how many hours per day, during their leisure/free time, they usually spend in doing the following: watching television/videos (TV), doing homework (HW) outside of school hours and using computer or playing video games (PC). Questions were asked for the weekdays and for the weekend. Participants responded to each question using a 9-point scale from "none at all; about half an hour a day; about 1 hour a day; about 2 hours a day" and so on to "about 7 or more hours a day". The number of hours spent each week in each of the sedentary activities assessed was derived and a SB index score, similar to that used in other epidemiological studies (18,21), was computed by summing the three items' results as the number of hours spent in a 7-day week being physically inactive. In previous studies with similar age groups, the items have been shown to have good test-retest reliability and validity (29,35).

Socio-Economic Status (SES)—Paragraph 11: The participants' SES was assessed using the Family Affluence Scale (FAS). The FAS is a measure that reflects the material resources of the family, which is a proxy for family income that is available for the purchase of specific goods (items include family cars, computers, number of holidays, child's own bedroom) (6, 8). A composite FAS score (0–9 range) was calculated for each student based on his or her responses on these four items. The FAS scale has been used and validated in previous HBSC researches (6,8) and findings confirm that the FAS, reported by young people themselves, is a valid indicator of young people's material circumstances, and supports its use in cross-national surveys (37). Consistent with the international protocol, we used a three-point ordinal scale, where FAS 1 (score <2) indicated low affluence, FAS 2 (score 3–5) indicated medium affluence, and FAS 3 (score >6) indicated high affluence.

Statistical Analyses

Paragraph 12: First of all, we performed descriptive analyses on the average number of days the children declared to be involved in a total of at least 60 minutes of MPVA activities in each HBSC country by gender, age and FAS level. Descriptive tables report the mean and standard deviation (SD) of observed MPVA by gender, age and FAS level. For each of the 32 countries the last column reports the mean number of days that the total sample of children was involved in MPVA with the 95% Confidence Interval (CI) taking into account the intra-class correlation (Table 1, 2).

Paragraph 13: We then fitted a logistic regression model where MPVA was dichotomised according to PAGL (5,24) into 'less than' and 'equal to or more than' 5 days a week in which a minimum of 60 minutes was dedicated to MPVA activities. The first step of the regression analysis fitted the model, separately for each participating country, yielding the likelihood of not meeting the PAGL for each of the predictive variables included in the model. The model used age, gender, sedentary behaviours and FAS levels as predictive variable; CI 95% were estimated adjusting for intra-class correlation consistent with the cluster sampling procedure (Table 3).

Paragraph 14: In the second step of the regression analysis, a model was fitted in order to investigate the hypothesis that the variability of MPVA, might be explained by factors within a broader context. Therefore, a supra-individual dimension of the phenomenon was investigated (17,21). In these analyses, MPVA was considered as an outcome variable across the two groups of countries where FAS had, or did not have, an effect on the likelihood of adhering to PAGL. In this new model the classification in two groups of countries was based on the Odds Ratios (OR) 95%CI for FAS of overlapping/not overlapping one. Odds ratios were estimated by means of a logistic regression model using robust variance estimates to adjust for clustering by country. The model controlled for age, gender, SB and country. ORs have been considered statistically significant when their 95% CI did not overlap one. An alpha level of 5% was taken for all other statistical analyses: t-test for independent samples when comparing means of two groups and ANOVA test with Bonferroni correction for comparing means of more than two groups. Statistical analyses were conducted using Stata version 9.0[†] and R[‡]

Results

Paragraph 15: A total of 162,305 questionnaires were completed; 1329 (0.8%) were discarded due to missing information on gender or age. Analyses were performed on a total of 160,976 (99.2%) young adolescents, of which 48.5% were boys; 34.1% were 11 y. o. (mean age 11.6

[†]StataCorp LP. Stata statistical software: release 9. College Station, USA. 2005.

[‡]R is a free software environment for statistical computing and graphics:<http://www.r-project.org/>

± 0.40), 34.5% were 13 y.o. (mean age 13.5 ± 0.42) and 31.4% were 15 y.o. (mean age 15.5 ± 0.41).

Paragraph 16: Table 1 shows the mean number of days ($\pm$ SD) the participants engaged in bouts of MPVA for at least 60 minutes according to gender, age category and country of residence. There was consistency among all 32 countries in the distribution of MVPA across gender and age. Different durations of activity were found for boys and girls and for the three age groups. With only a few exceptions, girls reported being significantly less active than boys (3.52 ± 1.88 vs. 4.13 ± 1.95 ; $p < 0.001$). Independent of gender, the amount of MVPA decreased significantly with increasing age: 11 y.o. children were always more active than 13 y.o. and 15 y.o. children ($p < 0.001$), among whom we found the lowest reported MVPA (2.26 per day in Malta).

Paragraph 17: In no country the average of five days per week of 60 minutes of MVPA needed to meet the PAGL was reached. Adolescents in Ireland, Canada and USA, with respectively 4.4, 4.3, and 4.3 days with 60 minutes of MPVA per week, were the most active. Adolescents in Belgium and France were, on average, the least active, with a mean of 3.1 days with a minimum of 60 minutes of vigorous activity.

Paragraph 18: The distribution of reported MVPA level was also examined according to the individual FAS level. Table 2 reports the mean ($\pm$ SD) number of days the participants had engaged in MPVA for at least 60 minutes by FAS level and gender. Overall, the amount of time spent in MVPA decreased as the FAS level decreased. With the exception of Greenland, all countries had the same pattern: the amount of MVPA reported decreased progressively with a decrease in FAS level from high to low. Girls, within the same level of FAS, achieved fewer days of adequate MVPA duration than boys. Among the 32 countries, only the Irish children with high FAS met the PAGL.

Paragraph 19: Table 3 shows the likelihood of not meeting PAGL, i.e., achieving less than 5 days per week of 60 minutes of MVPA. Results are reported as Odds Ratios with their 95% CI. We explored the likelihood of meeting PAGL in relation to gender, age, SBs and level of FAS. For gender, girls showed a significantly higher level of inactivity when compared to boys in all participating countries. Odds ratios range from 1.22 (CI 95%: 1.04;1.43) in the Netherlands to 2.50 in France (CI 95%: 2.15;2.94) and Malta (CI 95%: 1.98;3.17). In ten of the 32 countries girls had a two-fold odds of not meeting PAGL.

Paragraph 20: With regard to age differences, the likelihood of not achieving sufficient MVPA increased along with the participants' ages. All countries, with the exception of Belgium, had the same pattern of results; older children were always less likely to meet the PAGL. In 18 of the 32 participating countries, the odds for the 13 y.o. of not meeting PAGL compared with 11 y.o. was significantly higher, and the same was true in 24 out of the 32 participating countries when 15 y.o. were compared to 11 y.o.

Paragraph 21: In the overall sample, sedentary behaviours were not associated with the amount of reported MVPA. However, there were cross-country differences. In four countries, SBs had an influence on PA; that is, the likelihood of not meeting PAGL increased significantly with increased SB. In the remaining countries the amount of reported MVPA did not show any statistically significant association with SBs, with the exception of Portugal.

Paragraph 22: Socio-economic status seems to be significantly associated with the amount of MVPA declared. The higher the FAS level, the higher the association with vigorous MVPA. All countries show the same direction in the relationship between MVPA and level of FAS; with the exception of The Czech Republic, Greenland, Ireland, Macedonia, Malta, Switzerland and Ukraine, children with higher FAS level report a significantly higher level of MVPA with

respect to peers with lower FAS. In contrast, in the seven exceptions the individual socio-economic position does not seem to be associated with meeting PAGL.

Paragraph 23: The seven countries with no significant relationship between FAS and PAGL were grouped separately from the countries with a FAS-PAGL relationship and a new regression was run to compare the effect on PAGL level of the two clusters. It must be acknowledged that, by grouping countries on the basis of their FAS Odds Ratios 95% CI overlapping/not overlapping one, we ignore the impact of the effective sample size, which (e.g. Malta, where $n=1894$, and UK, where $n=13368$) may affect the estimates of the effect of FAS on the likelihood of not meeting the PAGL for MVPA. Table 4 shows the results (ORs and 95% CI) by gender and age category for the two sets of countries: the group of countries where meeting the PAGL does not seem to be influenced by FAS level (group A) and the group with all the other countries, in which meeting the PAGL showed a significant association with the FAS level (group B). The group of countries in which the influence of FAS on meeting PAGL was not significant (group A) showed a decrease in the influence of age on whether the amount of MVPA reported met the PAGL. As a result, the difference among the three age ranges involved in the analysis was significantly less in group A than in group B.

Discussion

Paragraph 24: Many studies have shown that becoming obese at an early age represents a risk factor for health in adulthood (30,38). More recently attention has been focused on the behaviours correlated with obesity, which could more easily be modified at an early age; among these, not doing regular MVPA and engaging in sedentary activities are the most frequently identified (2,9,22,23,28). The results presented in this study confirm the two aspects most frequently noted in the international literature: levels of MVPA decrease with increasing age, and girls do less MVPA than boys (Table 1).

Paragraph 25: With regard to the social class of the family of origin, and the levels of MVPA performed by adolescents, some studies have described this relationship, concentrating attention on either the family's economic level (11,16), parents' educational level (14), or neighbourhood resources and environment (4,12). However, recent reviews have concluded that further observations are needed, as the association between levels of MVPA performed by adolescents and the family's social class is not sufficiently clear (15,27). The data presented in this study demonstrate a consistent reduction in MVPA with decreasing FAS (an indicator of social class) (Table 2). In only seven of the 32 countries the family's socioeconomic position does not seem to influence the levels of MVPA reported by adolescents (Table 3).

Paragraph 26: Active or sedentary lifestyles are often seen as opposite sides of the same coin; the term "displacement hypothesis" has been used in the literature to suggest that sedentary behaviours, such as time spent watching TV or using the computer, take time away from MVPA (19,26). However the results of this study do not confirm this theory. In the countries involved in this survey, the risk of not doing enough MVPA, as recommended by the guidelines, does not increase along with an increase in time spent in sedentary activities (Table 3). These results are consistent with recent findings (2,27). One conclusion is that even though the two behaviours cannot be engaged in simultaneously, there is no real competition between them. A large study conducted in the USA and UK demonstrates, in the same age range and in both sexes, the coexistence of a cluster of subjects with high levels of both MVPA and use of TV, computer and telephone and another group in which high levels of MVPA are not accompanied by substantial amounts of time spent in "technological" activities (18). Other studies demonstrate that levels of MVPA, compared to percentage of time spent in sedentary activities, depend more on the environment in which adolescents live (2,21,27).

Paragraph 27: Levels of MVPA in adolescence thus appear to show consistent patterns of change in relation to gender, age, social class and geographical area. Table 1 shows how, while maintaining gender differences in MVPA levels, males and females move together both downwards or upwards, with few exceptions, across age or FAS levels. These patterns call attention to the supra-individual dimension of the phenomenon, even more evident in the data shown in table 4, where we observe how the reduction in MVPA with increased age become less evident in countries in which social class does not seem to influence the levels of MVPA reported by adolescents (21).

Paragraph 28: The decrease in levels of MVPA with increasing age is often discussed as though young people are always free to choose between being sedentary or active lifestyles, forgetting that the increase in risk associated with a drop in socioeconomic status mirrors a narrowing of choice. This possibility of contrasting the decrease in MVPA with increasing age, present in countries where the influence of social class is less strong, suggests the possibility of a moderating effect of context in the development of habits acquired in childhood. Hence, we are faced with the need to broaden our observations from the individual characteristics of children and adolescents to the organization of the area where they live (4,12); this aspect has received less attention but is particularly important in an age group which has limited autonomy of choice and movement. It has already been shown that perception of lack of parks and access to green areas is associated with a reduction in transportation by foot or bicycle (34). It also appears that girls reduce their MVPA more quickly than boys when confronted with obstacles (venue access times, equipment costs, etc.) (36) and are also more sensitive to an increase in crime rates in an area (11), or a reduction in residential density (21), conditions which, by reducing perceptions of safety, also reduce levels of MVPA, even if only that involved in getting around on foot (2). However, above all, it is the complex relationship between social class and level of MVPA that calls for a broadening of viewpoints; a recent study has in fact shown how living in socially disadvantaged areas doubles adolescents' risk of engaging in low levels of MVPA, with only a small difference linked to individual characteristics (17). Therefore, we believe that research in this area should be expanded - searching in the broader context for determinants of adolescents' achieving recommended levels of daily MVPA.

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Table 1

Mean number of days ($\pm$ SD) with a total of at least 60 minutes of moderate-vigorous physical activity (MVPA) by country, gender, age category and country total with adjusted 95% CI.

		11 years			13 years			15 years			Total		Country Total* mean (95% CI)
		N	mean (SD)	N	mean (SD)	N	mean (SD)	N	mean (SD)	N	mean (SD)		
Austria	Boys	736	4.98 (1.81)	761	4.72 (1.76)	637	3.78 (1.89)	2134	4.52 (1.90)			4.21 (4.1;4.3)	
	Girls	759	4.46 (1.89)	783	3.94 (1.75)	630	3.17 (1.73)	2172	3.90 (1.87)				
Belgium	Boys	946	3.49 (1.92)	918	3.41 (1.95)	990	3.26 (2.04)	2854	3.39 (1.98)			3.11 (3.0;3.2)	
	Girls	1098	3.10 (1.78)	1101	2.75 (1.71)	967	2.72 (1.84)	3166	2.86 (1.78)				
Canada	Boys	728	4.63 (1.87)	693	4.66 (1.81)	517	4.51 (1.92)	1938	4.61 (1.86)			4.35 (4.3;4.4)	
	Girls	838	4.42 (1.84)	778	4.05 (1.83)	667	3.88 (1.91)	2283	4.14 (1.87)				
Croatia	Boys	754	4.48 (1.87)	772	4.40 (1.86)	616	3.83 (1.92)	2142	4.26 (1.90)			3.82 (3.7;3.9)	
	Girls	673	3.89 (1.89)	711	3.57 (1.76)	816	2.84 (1.78)	2200	3.40 (1.86)				
Czech Republic	Boys	826	4.49 (2.14)	780	4.67 (1.92)	806	4.53 (1.87)	2412	4.57 (1.98)			4.27 (4.2;4.4)	
	Girls	865	4.19 (2.01)	881	4.00 (1.90)	854	3.80 (1.89)	2600	4.00 (1.94)				
Denmark	Boys	706	4.14 (1.94)	698	4.00 (1.95)	619	3.76 (2.02)	2023	3.97 (1.97)			3.82 (3.7;3.9)	
	Girls	785	3.95 (1.94)	744	3.63 (1.90)	681	3.42 (1.88)	2210	3.67 (1.92)				
Estonia	Boys	674	3.93 (1.87)	689	3.59 (1.72)	618	3.44 (1.80)	1981	3.66 (1.81)			3.46 (3.4;3.6)	
	Girls	612	3.68 (1.75)	734	3.30 (1.67)	647	2.83 (1.68)	1993	3.26 (1.73)				
Finland	Boys	905	4.50 (1.99)	851	3.90 (1.91)	859	3.42 (1.88)	2615	3.95 (1.98)			3.81 (3.7;3.9)	
	Girls	904	4.36 (1.81)	823	3.44 (1.79)	870	3.18 (1.71)	2597	3.68 (1.84)				
France	Boys	1272	3.30 (2.03)	1369	3.65 (1.87)	1262	3.51 (1.83)	3903	3.49 (1.92)			3.09 (3.0;3.1)	
	Girls	1275	2.52 (1.73)	1447	2.91 (1.60)	1293	2.65 (1.58)	4015	2.70 (1.65)				
Germany	Boys	960	4.00 (1.77)	842	3.83 (1.73)	791	3.75 (1.70)	2593	3.87 (1.74)			3.66 (3.5;3.8)	
	Girls	961	3.52 (1.71)	866	3.31 (1.54)	861	3.19 (1.61)	2688	3.35 (1.63)				
Greece	Boys	615	4.38 (1.99)	594	4.59 (1.81)	641	4.02 (1.91)	1850	4.32 (1.92)			3.90 (3.8;4.0)	
	Girls	615	3.80 (1.97)	628	3.76 (1.76)	680	2.99 (1.83)	1923	3.50 (1.89)				
Greenland	Boys	116	4.38 (2.47)	149	4.12 (2.14)	97	4.13 (2.32)	362	4.20 (2.30)			3.93 (3.9;3.9)	
	Girls	151	4.12 (2.41)	184	4.04 (2.30)	130	3.30 (2.15)	465	3.84 (2.31)				
Hungary	Boys	596	4.38 (1.95)	633	4.22 (1.90)	491	3.57 (1.83)	1720	4.09 (1.94)			3.67 (3.6;3.8)	
	Girls	660	3.74 (1.87)	750	3.37 (1.65)	788	2.96 (1.71)	2198	3.33 (1.77)				
Ireland	Boys	486	5.02 (1.94)	433	5.07 (1.93)	336	4.44 (1.80)	1255	4.88 (1.92)			4.40 (4.3;4.5)	
	Girls	489	4.61 (1.99)	486	4.27 (1.97)	568	3.39 (1.99)	1543	4.05 (2.05)				

		11 years			13 years			15 years			Total			Country Total* mean (95% CI)
		N	mean (SD)	N	mean (SD)	N	mean (SD)	N	mean (SD)	N	mean (SD)	N	mean (SD)	
Israel	Boys	791	4.29 (2.08)	842	4.15 (2.00)	679	3.36 (2.13)	2312	3.97 (2.11)	3.48 (3.4;3.6)				
	Girls	845	3.52 (1.91)	1134	3.03 (1.94)	817	2.62 (2.05)	2796	3.06 (2.00)					
Italy	Boys	766	3.89 (1.83)	775	3.94 (1.78)	541	3.34 (1.83)	2082	3.76 (1.83)	3.47 (3.4;3.6)				
	Girls	722	3.46 (1.79)	830	3.29 (1.69)	679	2.82 (1.86)	2231	3.20 (1.79)					
Latvia	Boys	553	4.19 (1.82)	549	4.04 (1.86)	472	4.00 (1.77)	1574	4.08 (1.82)	3.73 (3.6;3.8)				
	Girls	582	3.76 (1.78)	571	3.37 (1.68)	617	3.13 (1.70)	1770	3.41 (1.74)					
Lithuania	Boys	935	4.80 (1.93)	943	4.59 (1.86)	967	4.50 (1.78)	2845	4.63 (1.86)	4.27 (4.2;4.3)				
	Girls	901	4.30 (1.98)	912	3.91 (1.89)	913	3.50 (1.87)	2726	3.90 (1.94)					
Macedonia	Boys	618	3.81 (2.01)	652	3.90 (1.89)	666	3.84 (1.90)	1936	3.81 (1.93)	3.60 (3.5;3.7)				
	Girls	625	3.42 (1.96)	686	3.47 (1.86)	720	3.30 (1.87)	2031	3.39 (1.90)					
Malta	Boys	248	4.56 (2.11)	312	4.29 (2.10)	307	3.66 (2.11)	867	4.16 (2.14)	3.61 (3.4;3.8)				
	Girls	337	3.89 (2.03)	337	3.34 (2.10)	346	2.26 (1.99)	1020	3.13 (2.14)					
Netherlands	Boys	679	4.25 (2.00)	748	4.25 (1.86)	605	3.99 (1.90)	2032	4.17 (1.92)	4.06 (4.0;4.2)				
	Girls	750	3.99 (1.89)	717	4.00 (1.88)	626	3.85 (1.94)	2093	3.95 (1.90)					
Norway	Boys	839	3.75 (2.01)	850	3.57 (1.83)	787	3.41 (1.90)	2476	3.58 (1.92)	3.46 (3.4;3.5)				
	Girls	746	3.45 (1.89)	833	3.40 (1.62)	813	3.17 (1.69)	2392	3.34 (1.74)					
Poland	Boys	1037	4.46 (1.84)	1062	4.22 (1.82)	1013	4.09 (1.87)	3112	4.26 (1.85)	4.02 (4.0;4.1)				
	Girls	995	4.17 (1.76)	1016	3.78 (1.71)	1099	3.44 (1.72)	3110	3.78 (1.76)					
Portugal	Boys	543	3.99 (1.96)	439	4.01 (1.83)	373	3.36 (1.76)	1355	3.82 (1.89)	3.41 (3.3;3.5)				
	Girls	560	3.39 (1.74)	497	2.89 (1.58)	416	2.69 (1.68)	1473	3.02 (1.70)					
Russia	Boys	1149	4.14 (1.86)	1284	4.13 (1.86)	1053	3.88 (1.77)	3486	4.06 (1.84)	3.72 (3.6;3.8)				
	Girls	1206	3.70 (1.86)	1372	3.38 (1.80)	1251	3.19 (1.72)	3829	3.42 (1.81)					
Slovenia	Boys	687	4.92 (1.92)	651	4.45 (1.92)	530	4.17 (1.91)	1868	4.54 (1.94)	4.17 (4.1;4.3)				
	Girls	686	4.22 (1.89)	697	3.65 (1.85)	502	3.43 (1.83)	1885	3.80 (1.89)					
Spain	Boys	1013	4.12 (2.08)	963	4.14 (1.93)	808	4.05 (1.89)	2784	4.10 (1.98)	3.80 (3.7;3.9)				
	Girls	1001	3.46 (1.92)	948	3.67 (1.80)	919	3.40 (1.74)	2868	3.51 (1.83)					
Sweden	Boys	678	4.26 (1.91)	564	3.94 (1.66)	577	3.93 (1.77)	1819	4.06 (1.80)	3.92 (3.8;4.0)				
	Girls	665	4.00 (1.75)	549	3.75 (1.69)	576	3.56 (1.78)	1790	3.78 (1.76)					
Switzerland	Boys	677	4.28 (1.86)	754	4.09 (1.81)	766	4.03 (1.85)	2197	4.13 (1.84)	3.84 (3.8;3.9)				
	Girls	714	3.59 (1.81)	840	3.60 (1.81)	722	3.48 (1.88)	2276	3.55 (1.83)					

		11 years		13 years		15 years		Total		Country Total [*] mean (95% CI)
		N	mean (SD)	N	mean (SD)	N	mean (SD)	N	mean (SD)	
Ukraine	Boys	560	4.40 (2.00)	585	4.18 (1.93)	723	4.05 (1.83)	1868	4.19 (1.92)	3.71 (3.6;3.8)
	Girls	610	3.70 (2.06)	703	3.43 (1.90)	867	2.88 (1.96)	2180	3.29 (2.00)	
United Kingdom	Boys	2644	4.67 (1.89)	2412	4.60 (1.84)	1959	4.28 (1.82)	7015	4.53 (1.86)	4.17 (4.1;4.2)
	Girls	2504	4.18 (1.78)	2410	3.83 (1.74)	2069	3.34 (1.86)	6983	3.81 (1.82)	
USA	Boys	645	4.68 (2.02)	870	4.77 (2.08)	736	4.68 (2.05)	2251	4.72 (2.05)	4.35 (4.3;4.4)
	Girls	774	4.21 (2.00)	1009	4.11 (2.06)	861	3.78 (2.21)	2644	4.03 (2.10)	
All countries	Boys	25382	4.28 (1.98)	25437	4.19 (1.91)	22842	3.90 (1.92)	74401	4.13 (1.95)	3.82 (3.80;3.85)
	Girls	25908	3.82 (1.92)	26977	3.55 (1.83)	25265	3.20 (1.86)	78637	3.52 (1.88)	

* Country mean SE was adjusted for (school classroom) intra-group correlation

Table 2

Mean number of days ($\pm$ SD) with a total of at least 60 minutes of moderate-vigorous physical activity (MVPA) by country, gender and FAS level.

		FAS High			FAS Medium			FAS Low			Total		
		N	mean (SD)		N	mean (SD)		N	mean (SD)		N	mean (SD)	
Austria	Boys	800	4.57 (1.87)		984	4.52 (1.89)		315	4.39 (2.00)		2099	4.52 (1.90)	
	Girls	681	4.07 (1.84)		1048	3.91 (1.84)		397	3.57 (1.90)		2126	3.90 (1.86)	
Belgium	Boys	1032	3.56 (1.95)		1289	3.29 (1.97)		437	3.29 (2.03)		2758	3.39 (1.98)	
	Girls	1087	3.08 (1.78)		1448	2.80 (1.76)		543	2.55 (1.79)		3078	2.85 (1.78)	
Canada	Boys	984	4.68 (1.82)		709	4.56 (1.88)		191	4.38 (2.00)		1884	4.61 (1.86)	
	Girls	1087	4.37 (1.79)		902	3.99 (1.90)		239	3.73 (1.99)		2228	4.15 (1.87)	
Croatia	Boys	340	4.54 (1.90)		966	4.33 (1.86)		843	4.06 (1.95)		2149	4.26 (1.91)	
	Girls	252	3.87 (1.94)		900	3.57 (1.85)		1047	3.13 (1.82)		2199	3.40 (1.86)	
Czech Republic	Boys	321	4.75 (1.86)		1176	4.63 (1.96)		861	4.41 (2.03)		2358	4.57 (1.98)	
	Girls	243	4.18 (1.89)		1211	4.11 (1.89)		1122	3.83 (1.99)		2576	4.00 (1.94)	
Denmark	Boys	851	4.17 (1.90)		940	3.85 (2.00)		227	3.76 (2.05)		2018	3.98 (1.97)	
	Girls	823	3.94 (1.87)		1040	3.50 (1.90)		334	3.59 (2.00)		2197	3.68 (1.92)	
Estonia	Boys	345	4.00 (1.79)		920	3.74 (1.76)		691	3.39 (1.85)		1956	3.66 (1.81)	
	Girls	221	3.55 (1.70)		869	3.35 (1.67)		888	3.08 (1.77)		1978	3.25 (1.73)	
Finland	Boys	933	4.11 (1.94)		1209	3.92 (1.97)		426	3.69 (2.09)		2568	3.95 (1.98)	
	Girls	814	3.98 (1.82)		1275	3.60 (1.84)		480	3.35 (1.80)		2569	3.68 (1.84)	
France	Boys	1687	3.70 (1.86)		1569	3.40 (1.92)		572	3.18 (1.98)		3828	3.50 (1.91)	
	Girls	1578	2.95 (1.60)		1701	2.68 (1.65)		674	2.23 (1.63)		3953	2.71 (1.64)	
Germany	Boys	1047	3.98 (1.68)		1129	3.78 (1.74)		347	3.82 (1.83)		2523	3.87 (1.73)	
	Girls	982	3.63 (1.59)		1160	3.28 (1.63)		481	2.91 (1.62)		2623	3.34 (1.63)	
Greece	Boys	485	4.64 (1.87)		889	4.35 (1.89)		462	3.95 (1.97)		1836	4.32 (1.92)	
	Girls	372	4.06 (1.87)		927	3.49 (1.88)		611	3.19 (1.85)		1910	3.50 (1.89)	
Greenland	Boys	38	4.24 (1.90)		115	4.27 (2.35)		192	4.18 (2.31)		345	4.22 (2.28)	
	Girls	37	3.72 (2.14)		167	3.88 (2.23)		244	3.84 (2.40)		448	3.84 (2.31)	
Hungary	Boys	392	4.62 (1.91)		741	4.10 (1.90)		619	3.73 (1.93)		1752	4.09 (1.94)	
	Girls	349	3.95 (1.80)		931	3.44 (1.71)		919	2.97 (1.73)		2199	3.33 (1.77)	
Ireland	Boys	414	5.00 (1.83)		599	4.83 (1.89)		227	4.81 (2.10)		1240	4.88 (1.91)	
	Girls	453	4.27 (1.98)		737	4.03 (2.07)		344	3.85 (2.08)		1534	4.06 (2.05)	

		FAS High		FAS Medium		FAS Low		Total	
		N	mean (SD)	N	mean (SD)	N	mean (SD)	N	mean (SD)
Israel	Boys	865	4.20 (2.03)	956	4.02 (2.11)	611	3.55 (2.14)	2432	3.97 (2.10)
	Girls	798	3.37 (2.01)	1232	3.15 (1.94)	847	2.64 (2.02)	2877	3.06 (2.00)
Italy	Boys	589	3.94 (1.79)	990	3.78 (1.81)	475	3.48 (1.88)	2054	3.75 (1.83)
	Girls	554	3.56 (1.84)	1031	3.20 (1.75)	630	2.88 (1.77)	2215	3.20 (1.80)
Latvia	Boys	197	4.37 (1.78)	588	4.24 (1.77)	760	3.84 (1.84)	1545	4.06 (1.82)
	Girls	126	3.56 (1.81)	545	3.63 (1.64)	1075	3.27 (1.75)	1746	3.41 (1.73)
Lithuania	Boys	279	4.82 (1.87)	1131	4.68 (1.82)	1294	4.54 (1.90)	2704	4.63 (1.87)
	Girls	161	4.29 (1.91)	953	4.07 (1.87)	1541	3.74 (1.97)	2655	3.89 (1.94)
Macedonia	Boys	324	3.87 (1.93)	949	3.88 (1.92)	706	3.73 (1.92)	1979	3.83 (1.92)
	Girls	205	4.00 (1.78)	825	3.38 (1.88)	1022	3.27 (1.91)	2052	3.39 (1.90)
Malta	Boys	118	4.52 (2.01)	390	4.15 (2.12)	367	4.07 (2.19)	875	4.17 (2.14)
	Girls	106	3.74 (2.24)	463	3.09 (2.12)	450	3.04 (2.13)	1019	3.13 (2.14)
Netherland	Boys	963	4.30 (1.85)	882	4.07 (1.96)	140	4.01 (2.11)	1985	4.17 (1.92)
	Girls	880	4.12 (1.81)	954	3.93 (1.95)	226	3.46 (1.99)	2060	3.96 (1.91)
Norway	Boys	1440	3.67 (1.89)	865	3.51 (1.96)	137	3.14 (2.00)	2442	3.58 (1.92)
	Girls	1330	3.55 (1.73)	899	3.12 (1.68)	140	2.78 (1.85)	2369	3.34 (1.74)
Poland	Boys	494	4.25 (1.88)	1400	4.34 (1.81)	1236	4.16 (1.88)	3130	4.26 (1.85)
	Girls	339	4.21 (1.81)	1333	3.91 (1.74)	1459	3.57 (1.73)	3131	3.78 (1.76)
Portugal	Boys	374	4.06 (1.86)	606	3.84 (1.85)	330	3.51 (1.93)	1310	3.82 (1.88)
	Girls	322	3.20 (1.69)	664	3.08 (1.71)	456	2.83 (1.66)	1442	3.03 (1.70)
Russia	Boys	313	4.56 (1.84)	1334	4.19 (1.82)	1817	3.88 (1.83)	3464	4.06 (1.84)
	Girls	206	3.86 (1.88)	1259	3.59 (1.81)	2358	3.29 (1.78)	3823	3.42 (1.80)
Slovenia	Boys	661	4.80 (1.89)	873	4.50 (1.88)	347	4.14 (2.09)	1881	4.54 (1.94)
	Girls	539	4.03 (1.85)	930	3.78 (1.86)	413	3.51 (1.96)	1882	3.79 (1.89)
Spain	Boys	882	4.34 (1.89)	1337	4.06 (1.98)	530	3.87 (2.07)	2749	4.11 (1.97)
	Girls	780	3.75 (1.85)	1341	3.53 (1.79)	731	3.24 (1.83)	2852	3.51 (1.83)
Sweden	Boys	929	4.24 (1.75)	719	3.90 (1.84)	150	3.79 (1.85)	1798	4.07 (1.80)
	Girls	851	3.98 (1.73)	741	3.71 (1.71)	164	3.13 (1.93)	1756	3.79 (1.76)
Switzerland	Boys	1008	4.23 (1.80)	1027	4.06 (1.85)	236	4.02 (1.99)	2271	4.13 (1.84)
	Girls	868	3.61 (1.74)	1087	3.57 (1.86)	367	3.38 (1.92)	2322	3.56 (1.83)
Ukraine	Boys	97	4.39 (1.69)	493	4.32 (1.87)	1208	4.12 (1.95)	1798	4.19 (1.92)

		FAS High		FAS Medium		FAS Low		Total	
		N	mean (SD)	N	mean (SD)	N	mean (SD)	N	mean (SD)
United Kingdom	Girls	30	4.75 (2.18)	442	3.59 (1.99)	1662	3.18 (1.98)	2134	3.29 (1.99)
	Boys	2686	4.71 (1.80)	3041	4.46 (1.88)	931	4.23 (1.94)	6658	4.53 (1.86)
	Girls	2336	3.97 (1.77)	3133	3.75 (1.83)	1241	3.59 (1.87)	6710	3.80 (1.82)
	Boys	1085	4.94 (1.96)	812	4.61 (2.07)	276	4.28 (2.23)	2173	4.73 (2.05)
	Girls	1307	4.24 (1.97)	945	3.90 (2.15)	339	3.61 (2.31)	2591	4.04 (2.10)
All countries	Boys	22973	4.29 (1.90)	31628	4.12 (1.94)	17961	3.95 (1.99)	72562	4.13 (1.95)
	Girls	20717	3.79 (1.85)	33093	3.54 (1.87)	23444	3.27 (1.91)	77254	3.52 (1.88)

Table 3

Odds of not achieving a total of at least 5 days a week of 60 minutes of moderate-vigorous physical activity (MVPA) by gender, age-category, sedentary behaviours (SB) and FAS level, for each country.

	F vs M		13yo vs 11yo		15yo vs 11yo		TV; PC; HW*		FAS mid vs high		FAS low vs high	
	OR	(CI95%)	OR	(CI95%)	OR	(CI95%)	OR	(CI95%)	OR	(CI95%)	OR	(CI95%)
Austria	1.96	(1.64;2.33)	1.49	(1.23;1.81)	3.26	(2.62;4.04)	1.04	(0.98;1.10)	1.14	(0.95;1.36)	1.35	(1.07;1.71)
Belgium	1.71	(1.47;2.01)	1.26	(1.03;1.53)	1.17	(0.96;1.43)	0.99	(0.93;1.05)	1.20	(1.00;1.43)	1.30	(1.03;1.64)
Canada	1.52	(1.3;1.78)	1.23	(1.03;1.47)	1.24	(1.02;1.52)	1.06	(1;1.13)	1.21	(1.01;1.44)	1.33	(1.04;1.72)
Croatia	2.08	(1.74;2.48)	1.21	(0.99;1.47)	1.96	(1.61;2.38)	1.00	(0.94;1.06)	1.24	(0.98;1.56)	1.77	(1.4;2.24)
Czech Republic[‡]	1.87	(1.61;2.2)	0.98	(0.82;1.17)	1.19	(0.99;1.41)	1.04	(0.98;1.10)	1.08	(0.87;1.34)	1.20	(0.95;1.51)
Denmark	1.47	(1.23;1.74)	1.2	(0.99;1.47)	1.41	(1.15;1.71)	1.06	(1;10.13)	1.36	(1.13;1.61)	1.38	(1.07;1.78)
Estonia	1.47	(1.24;1.76)	1.6	(1.29;1.98)	1.72	(1.38;2.13)	1.01	(0.95;1.07)	1.11	(0.87;1.44)	1.52	(1.18;1.96)
Finland	1.54	(1.31;1.8)	2.14	(1.79;2.55)	3	(2.52;3.58)	1.12	(1.05;1.18)	1.27	(1.07;1.52)	1.53	(1.23;1.89)
France	2.5	(2.15;2.94)	0.85	(0.71;1.01)	0.99	(0.81;1.2)	0.96	(0.91;1.02)	1.24	(1.05;1.44)	1.58	(1.28;1.97)
Germany	1.75	(1.47;2.09)	1.24	(1;1.55)	1.25	(1;1.55)	1.02	(0.96;1.08)	1.26	(1.06;1.50)	1.34	(1.06;1.69)
Greece	2.05	(1.72;2.45)	1.13	(0.91;1.4)	1.71	(1.38;2.13)	0.99	(0.93;1.05)	1.43	(1.18;1.74)	1.95	(1.54;2.47)
Greenland[‡]	1.51	(1.08;2.1)	1.04	(0.7;1.54)	1.53	(1;2.37)	1.00	(0.92;1.08)	0.91	(0.51;1.65)	0.91	(0.52;1.61)
Hungary	2.01	(1.69;2.4)	1.5	(1.21;1.87)	2.23	(1.79;2.76)	0.99	(0.93;1.05)	1.70	(1.34;2.15)	2.37	(1.87;2.99)
Ireland[‡]	1.96		1.13		2.15		1.07		1.18		1.20	

	F vs M OR (CI95%)	13yo vs 11yo OR (CI95%)	15yo vs 11yo OR (CI95%)	TV; PC; HW* OR (CI95%)	FAS mid vs high OR (CI95%)	FAS low vs high OR (CI95%)
Israel	(1.61;2.38) 2.09 (1.79;2.45)	(0.89;1.43) 1.3 (1.09;1.55)	(1.71;2.73) 1.9 (1.56;2.31)	(0.99;1.16) 0.97 (0.92;1.03)	(0.96;1.47) 1.07 (0.9;1.28)	(0.92;1.59) 1.47 (1.18;1.81)
Italy	1.65 (1.38;1.97)	1.08 (0.89;1.32)	1.58 (1.28;1.97)	1.02 (0.96;1.08)	1.35 (1.11;1.64)	1.78 (1.41;2.26)
Latvia	1.91 (1.57;2.33)	1.27 (1.02;1.58)	1.56 (1.24;1.98)	1.02 (0.96;1.08)	1.15 (0.84;1.57)	1.53 (1.13;2.04)
Lithuania	1.76 (1.53;2.01)	1.31 (1.1;1.56)	1.71 (1.42;2.03)	1.02 (0.96;1.08)	1.22 (0.95;1.58)	1.42 (1.12;1.8)
Macedonia[‡]	1.44 (1.2;1.71)	1.05 (0.85;1.3)	1.15 (0.93;1.43)	0.95 (0.90;1.01)	1.05 (0.81;1.36)	1.16 (0.89;1.48)
Malta[‡]	2.5 (1.98;3.17)	1.4 (1.07;1.85)	2.38 (1.78;3.2)	1.01 (0.93;1.09)	1.39 (0.98;1.98)	1.36 (0.96;1.94)
Netherland	1.22 (1.04;1.43)	0.92 (0.75;1.11)	1.07 (0.88;1.3)	1.03 (0.97;1.09)	1.02 (0.86;1.22)	1.45 (1.10;1.90)
Norway	1.53 (1.29;1.83)	1.37 (1.12;1.66)	1.4 (1.14;1.69)	1.04 (0.98;1.10)	1.31 (1.10;1.56)	1.84 (1.27;2.67)
Poland	1.63 (1.42;1.87)	1.38 (1.18;1.61)	1.61 (1.38;1.89)	0.98 (0.92;1.04)	1.18 (0.96;1.43)	1.50 (1.24;1.83)
Portugal	2.43 (1.96;3.02)	1.32 (1.03;1.71)	2.02 (1.53;2.65)	0.93 (0.88;0.99)	1.16 (0.90;1.50)	1.44 (1.07;1.92)
Russia	1.84 (1.6;2.11)	1.08 (0.93;1.27)	1.45 (1.24;1.69)	1.02 (0.96;1.08)	1.45 (1.14;1.83)	1.86 (1.47;2.35)
Slovenia	2.11 (1.77;2.53)	1.6 (1.32;1.95)	2.18 (1.76;2.71)	1.03 (0.97;1.09)	1.31 (1.08;1.59)	1.53 (1.22;1.94)
Spain	1.84 (1.57;2.15)	0.99 (0.83;1.18)	1.16 (0.96;1.37)	0.99 (0.93;1.05)	1.27 (1.09;1.49)	1.47 (1.20;1.78)
Sweden	1.38 (1.15;1.64)	1.43 (1.16;1.78)	1.45 (1.17;1.8)	1.08 (1.02;1.15)	1.26 (1.03;1.53)	1.71 (1.25;2.35)

	F vs M OR (CI95%)	13yo vs 11yo OR (CI95%)	15yo vs 11yo OR (CI95%)	TV; PC; HW* OR (CI95%)	FAS mid vs high OR (CI95%)	FAS low vs high OR (CI95%)
Switzerland[‡]	1.67 (1.42;1.95)	1.06 (0.87;1.29)	1.12 (0.93;1.37)	1.02 (0.96;1.08)	1.08 (0.91;1.29)	1.10 (0.86;1.38)
Ukraine[‡]	2.06 (1.72;2.45)	1.38 (1.12;1.73)	1.78 (1.47;2.17)	1.00 (0.94;1.06)	1.09 (0.71;1.68)	1.22 (0.81;1.84)
United Kingdom	2.2 (1.92;2.53)	1.17 (1;1.37)	1.3 (1.09;1.55)	1.05 (0.99;1.11)	1.10 (0.94;1.29)	1.28 (1.03;1.59)
USA	1.7 (1.45;1.99)	0.98 (0.82;1.17)	1.03 (0.85;1.25)	1.03 (0.97;1.09)	1.31 (1.12;1.53)	1.42 (1.12;1.8)

* Number of hours spent per day in watching TV, using a computer, and doing homework

[‡]FAS effect on MVPA is not statistically significant

Table 4

Odds Ratio (and 95% CI) of not achieving a total of at least 60 minutes of moderate to vigorous physical activity (MVPA) every day of the week (according to Physical Activity guidelines), by age and gender category. ORs are stratified by two sets of countries, one where meeting MVPA guidelines does not seem to be influenced by FAS level (Group A), and another where meeting MVPA guidelines seems to be significantly influenced by FAS level (Group B).

	Group A (n=7)		Group B (n=25)	
	OR	95% CI	OR	95% CI
Male	1	-	1	-
Female	1.74	(1.69;1.85)	1.72	(1.68;1.76)
11 years old	1	-	1	-
13 years old	1.13	(1.10;1.19)	1.25	(1.22;1.29)
15 years old	1.41	(1.37;1.49)	1.54	(1.50;1.58)