

Socioeconomic Effects on Meeting Physical Activity Guidelines: Comparisons among 32 Countries

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ABSTRACT

BORRACCINO, A., P. LEMMA, R. J. IANNOTTI, A. ZAMBON, P. DALMASSO, G. LAZZERI, M. GIACCHI, and F. CAVALLO. Socioeconomic Effects on Meeting Physical Activity Guidelines: Comparisons among 32 Countries. *Med. Sci. Sports Exerc.*, Vol. 41, No. 4, pp. 749–756, 2009. **Purpose:** This study examined the relationship between age and gender with physical activity (PA) and how meeting of PA guidelines (PAGL) is related to socioeconomic status (SES) and sedentary behaviors (SB). **Methods:** Data were collected from 11-, 13-, and 15-yr-old students in 32 countries participating in the Health Behaviour in School-aged Children (HBSC) survey 2001/2002. A self-completed questionnaire assessed weekly moderate-to-vigorous physical activity (MVPA) and SB for the past 7 d and MVPA for a typical week. 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 age and gender was consistent among all countries. In all countries, older children were less active when compared with the youngest children; girls were significantly less active than boys were (mean hours per week of MVPA 3.52 ± 1.88 vs 4.13 ± 1.95) and were more likely to not meet the PAGL. SES was significantly associated with the amount of reported MVPA. SES and PAGL were not significantly related in seven countries, and a significant decrease in the influence of age was observed in these countries compared with 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 suggests the possibility of a moderating effect of context in the development of habits acquired during childhood. **Key Words:** HEALTH BEHAVIOUR IN SCHOOL-AGED CHILDREN (HBSC), ADOLESCENCE, INTERNATIONAL SURVEY, PHYSICAL ACTIVITY GUIDELINE DETERMINANTS, CHILDREN'S HABITS

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 behavior (SB) during childhood and adolescence are associated with concurrent obesity (10,22) and with increased risk of obesity during young adulthood even when controlling for genetic effects (23). There is an increasing evidence that many conditions associated with a 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 about MVPA at an early age, they are more likely to maintain those habits in adulthood (13,28).

Population studies demonstrate that many youngsters do not meet established recommendations for daily MVPA (20,27,32). 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 SB have a significant role in causing young people to avoid regular MVPA (22).

Adding to this concern is that MVPA declines during the preadolescent 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, further observations are needed (2,27), whereas others affirm that higher socioeconomic and educational levels of parents are positively associated with levels of MVPA in adolescents (5). Conflicting results also emerge from studies on SB and their relationship to MVPA levels in young people. The

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Submitted for publication May 2008.

Accepted for publication October 2008.

0195-9131/09/4104-0749/0

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DOI: 10.1249/MSS.0b013e3181917722

increasing amount of time spent by adolescents in sedentary activities points to these behaviors as competing with MVPA (4). 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 behavior occur at different times of the day (18) and have different determining factors (2,27).

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 were to examine the relationship between MVPA and SB and to determine whether the meeting of MVPA guidelines (PAGL) is related to age, gender, and socioeconomic status (SES). Potential cultural differences in these relationships are also explored.

MATERIALS AND METHODS

Analyses were based on Health Behaviour in School-aged Children (HBSC) 2001/2002 survey, a World Health Organization cross-national survey. HBSC was established in 1982 by a team of Finnish, Norwegian, and English researchers (1) and was designed to collect data every 4 yr. Since its beginning, the number of participating countries has increased to 35* in the 2001 survey (sixth survey; Table 1), spanning Europe, Israel and North America (25). The HBSC study aims to gain additional insight into, and increase understanding of, adolescent health behavior, health, and well-being in their social context and to collect high-quality comparable cross-national data (8,25).

Ethics

Information about the study was sent to school directors 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 using an anonymous self-completion questionnaire administered in the classroom. Standard protection measures were taken to ensure that individual data remained confidential (8). Only group-level data are reported.

Sample

Survey questions covered a wide range of health indicators and health-related behaviors as well as life circumstances of young people. The core questions provided information on demographic factors; family and social background, including socioeconomic status (SES); health behavior, including

MVPA, sexual behavior, and other risk behaviors; and lifestyle factors, such as SB and well-being indicators.

The sampled population consisted of students, aged 11, 13, and 15 yr. 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 sample size of 1526 subjects for each group, with item prevalence estimates having a 95% confidence interval (CI) of $\pm 3\%$. Study methods are described in greater depth elsewhere (8). 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. 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 min during the past 7 d 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 7 d 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 min of MVPA. A score of five or more ($d \cdot wk^{-1}$) classified respondents as meeting the MVPA guidelines (PAGL) (6,24). Studies have shown that a composite of these two items have reasonable reliability and validity in this age group (3,24).

Sedentary behaviors. SB were assessed by 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 school hours, and using computer or playing video games (PC). Questions were asked for weekdays and the weekend. Participants responded to each question using a 9-point scale from “none at all; approximately $0.5 \text{ h} \cdot d^{-1}$, approximately $1 \text{ h} \cdot d^{-1}$, approximately $2 \text{ h} \cdot d^{-1}$,” and so on, to “approximately 7 h or more per day.” The number of hours spent each week in each of the sedentary activities assessed was derived, and an 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-d 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).

Socioeconomic status. The participants’ SES was assessed using the Family Affluence Scale (FAS). The FAS

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

TABLE 1. Mean (\pm SD) number of days with a total of at least 60 min of moderate-to-vigorous physical activity (MVPA) by country, gender, age category, and country total with adjusted 95% CI.

		11 yr		13 yr		15 yr		Total		Country Total,* Mean (95% CI)
		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)	
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)	
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)	
United States	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	25,382	4.28 (1.98)	25,437	4.19 (1.91)	22,842	3.90 (1.92)	74,401	4.13 (1.95)	3.82 (3.80–3.85)
	Girls	25,908	3.82 (1.92)	26,977	3.55 (1.83)	25,265	3.20 (1.86)	78,637	3.52 (1.88)	

* Country mean and SE was adjusted for (school classroom) intragroup correlation.

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) (7,9). A composite FAS score (0–9 range) was calculated for each student on the basis of his or her responses on these

four items. FAS has been used and validated in previous HBSC researches (7,9), 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 3-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.

TABLE 2. Mean (\pm SD) number of days with a total of at least 60 min of moderate-to-vigorous physical activity (MVPA) by country, gender, and FAS level.

		FAS 3		FAS 2		FAS 1		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)
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)
Netherlands	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)
	Girls	30	4.75 (2.18)	442	3.59 (1.99)	1662	3.18 (1.98)	2134	3.29 (1.99)
United Kingdom	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)
United States	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	22,973	4.29 (1.90)	31,628	4.12 (1.94)	17,961	3.95 (1.99)	72,562	4.13 (1.95)
	Girls	20,717	3.79 (1.85)	33,093	3.54 (1.87)	23,444	3.27 (1.91)	77,254	3.52 (1.88)

Statistical Analyses

First of all, we performed descriptive analyses on the average number of days the children reported a total of at least 60 min of MVPA activities in each HBSC country by age, gender, and FAS level. Descriptive tables report the mean and SD of observed MVPA by age, gender, 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 MVPA with the 95% CI taking into account the intraclass correlation (Tables 1 and 2).

We then fitted a logistic regression model where MVPA was dichotomized accordingly to PAGL (6,24) into “less than” and “equal to or more than” 5 d-wk⁻¹ in which a minimum of 60 min was dedicated to MVPA 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, SB, and FAS level as predictive variables; 95% CI were estimated adjusting for intraclass correlation consistent with the cluster sampling procedure (Table 3).

In the second step of the regression analysis, a model was fitted to investigate the hypothesis that the variability of MVPA might be explained by factors within a broader context. Therefore, a supraindividual dimension of the

phenomenon was investigated (17,21). In these analyses, MVPA 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 meeting PAGL. In this new model, the classification in two groups of countries was based on the odds ratios (OR) and 95% CI for FAS overlapping/not overlapping one. OR were estimated with a logistic regression model using robust variance estimates to adjust for clustering by country (Table 4). The model controlled for age, gender, SB, and country. An alpha level of 5% was taken for all statistical analyses: a *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 were used. Statistical analyses were conducted using Stata version 9.0 (Stata Statistical Software, release 9, 2005; StataCorp LP, College Station, TX) and R (a free software environment for statistical computing and graphics: <http://www.r-project.org/>).

RESULTS

A total of 162,305 questionnaires were completed; 1329 (0.8%) were discarded because of missing information on age or gender. Analyses were performed on a total of 160,976 (99.2%) young adolescents, of which 48.5% were

TABLE 3. Odds of not achieving a total of at least 5 d-wk⁻¹ of 60 min of moderate-to-vigorous physical activity (MVPA) by gender, age category, sedentary behaviors (SB), and FAS level for each country.

	OR ^b (95% CI)					
	F vs M	13 vs 11 yr	15 vs 11 yr	TV, PC, HW ^a	FAS 2 vs FAS 3	FAS 1 vs FAS 3
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 (1.30–1.78)	1.23 (1.03–1.47)	1.24 (1.02–1.52)	1.06 (1.00–1.13)	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 (1.40–2.24)
Czech Republic ^c	1.87 (1.61–2.20)	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)	1.20 (0.99–1.47)	1.41 (1.15–1.71)	1.06 (1.00–1.13)	1.36 (1.13–1.61)	1.38 (1.07–1.78)
Estonia	1.47 (1.24–1.76)	1.60 (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 (1.31–1.80)	2.14 (1.79–2.55)	3.00 (2.52–3.58)	1.12 (1.05–1.18)	1.27 (1.07–1.52)	1.53 (1.23–1.89)
France	2.50 (2.15–2.94)	0.85 (0.71–1.01)	0.99 (0.81–1.20)	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 (1.00–1.55)	1.25 (1.00–1.55)	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 (0.91–1.40)	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 ^c	1.51 (1.08–2.10)	1.04 (0.70–1.54)	1.53 (1.00–2.37)	1.00 (0.92–1.08)	0.91 (0.51–1.65)	0.91 (0.52–1.61)
Hungary	2.01 (1.69–2.40)	1.50 (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 ^c	1.96 (1.61–2.38)	1.13 (0.89–1.43)	2.15 (1.71–2.73)	1.07 (0.99–1.16)	1.18 (0.96–1.47)	1.20 (0.92–1.59)
Israel	2.09 (1.79–2.45)	1.30 (1.09–1.55)	1.90 (1.56–2.31)	0.97 (0.92–1.03)	1.07 (0.90–1.28)	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 (1.10–1.56)	1.71 (1.42–2.03)	1.02 (0.96–1.08)	1.22 (0.95–1.58)	1.42 (1.12–1.80)
Macedonia ^c	1.44 (1.20–1.71)	1.05 (0.85–1.30)	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 ^c	2.50 (1.98–3.17)	1.40 (1.07–1.85)	2.38 (1.78–3.20)	1.01 (0.93–1.09)	1.39 (0.98–1.98)	1.36 (0.96–1.94)
Netherlands	1.22 (1.04–1.43)	0.92 (0.75–1.11)	1.07 (0.88–1.30)	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)	1.40 (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 (1.60–2.11)	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)	1.60 (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 (1.17–1.80)	1.08 (1.02–1.15)	1.26 (1.03–1.53)	1.71 (1.25–2.35)
Switzerland ^c	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 ^c	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	2.20 (1.92–2.53)	1.17 (1.00–1.37)	1.30 (1.09–1.55)	1.05 (0.99–1.11)	1.10 (0.94–1.29)	1.28 (1.03–1.59)
United States	1.70 (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 (1.12–1.80)

^aNumber of hours spent per day in watching TV, using a computer, and doing homework.

^bOR are mutually adjusted for all the variables considered in the model.

^cThe effect of FAS level on MVPA is not statistically significant (Czech Republic, Greenland, Ireland, Malta, Switzerland, Ukraine, and Macedonia).

TABLE 4. OR (and 95% CI) of not achieving a total of at least 60 min of moderate-to-vigorous physical activity (MVPA) every day of the week (according to physical activity guidelines) by gender and age category.

	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 yr old	1	—	1	—
13 yr old	1.13	(1.10–1.19)	1.25	(1.22–1.29)
15 yr old	1.41	(1.37–1.49)	1.54	(1.50–1.58)

OR 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).

boys; 34.1% were 11 yr old (mean age = 11.6 ± 0.40 yr), 34.5% were 13 yr old (mean age = 13.5 ± 0.42 yr), and 31.4% were 15 yr old (mean age = 15.5 ± 0.41 yr).

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

In no country that the average of $5 \text{ d}\cdot\text{wk}^{-1}$ of 60 min of MVPA needed to meet the PAGL was reached. Adolescents in Ireland, Canada, and United States, with 4.4, 4.3, and 4.3 d, respectively, of 60 min of MVPA per week, were the most active. Adolescents in Belgium and France were, on average, the least active, with a mean of 3.1 d with a minimum of 60 min of vigorous activity.

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 MVPA for at least 60 min 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 did. Among the 32 countries, only the Irish children with high FAS met the PAGL.

Table 3 shows the likelihood of not meeting PAGL, i.e., achieving less than $5 \text{ d}\cdot\text{wk}^{-1}$ of 60 min of MVPA. Results are reported as OR with their 95% CI. We explored the likelihood of meeting PAGL in relation to age, gender, SB, and FAS level. For gender, girls showed a significantly higher level of inactivity when compared with boys in all participating countries. OR range from 1.22 (95% CI, 1.04–1.43) in the Netherlands to 2.50 in France (95% CI,

2.15–2.94) and Malta (95% CI, 1.98–3.17). In 10 of the 32 countries, girls had a twofold odds of not meeting PAGL.

About 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-yr-old children of not meeting PAGL compared with the 11-yr-old children was significantly higher, and the same was true in 24 of the 32 participating countries when 15-yr-old children were compared with 11-yr-old children.

In the overall sample, SB were not associated with the amount of reported MVPA. However, there were cross-country differences. In four countries, SB 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 SB, with the exception of Portugal.

Socioeconomic 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 level. In contrast, in the seven exceptions, the individual socioeconomic position does not seem to be associated with meeting PAGL.

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 should be noted that, by grouping countries on the basis of their FAS OR and 95% CI overlapping/not overlapping one, we ignore the impact of the effective sample size, which (e.g., Malta, where $n = 1894$, and United Kingdom, where $n = 13,368$) may affect the estimates of the effect of FAS on the likelihood of not meeting the PAGL for MVPA. Table 4 shows the results (OR and 95% CI) by age and gender categories 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 reported MVPA 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

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 behaviors 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 (2,10,22,23,28). 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 do (Table 1).

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 SB, 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 although the two behaviors cannot be engaged in simultaneously, there is no real competition between them. A large study conducted in the United States and United Kingdom demonstrates, in the same age range and in both genders, 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 with percentage of time spent in sedentary activities, depend more on the environment in which adolescents live (2,21,27).

About 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 neighborhood resources and environment (5,12). However, recent reviews have concluded that further observations are needed because 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).

Levels of MVPA in adolescence thus seem to show consistent patterns of change in relation to age, gender, social class, and geographical area. Table 1 shows how, while maintaining

gender differences in MVPA levels, males and females move together both downward or upward, with few exceptions, across age or FAS level. 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).

The decrease in levels of MVPA with increasing age is often discussed as though young people are always free to choose between being sedentary and having 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 (5,12); this aspect has received less attention but is particularly important in an age group that has limited autonomy of choice and movement. It has already been shown that the perception of lack of parks and access to green areas is associated with a reduction in transportation by foot or bicycle (34). It also seems that girls reduce their MVPA more quickly than boys do 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.

The authors thank the helpful collaboration of Dr. Paola Berchiolla in carrying out part of the statistical analysis of the data. The study has been supported through a grant from the Piedmont Region and from the University of Turin (i.e., 60%). Preparation of this article was partially supported by the Intramural Research Program of the Eunice Kennedy Shriver National Institute of Child Health and Human Development.

The results of the presented study do not constitute endorsement by ACSM.

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