

Pain and Moderate to Vigorous Physical Activity in Adolescence: An International Population-Based Survey

Michael Steven Swain, MPhil,^{*,†}
Nicholas Henschke, PhD,^{*,‡}
Steven James Kamper, PhD,^{*,§} Inese Gobina, PhD,[¶]
Veronika Ottová-Jordan, PhD,^{||} and
Christopher Gerard Maher, PhD^{*}

^{*}Musculoskeletal Division, The George Institute for Global Health, Sydney Medical School, University of Sydney, Sydney, Australia; [†]Department of Chiropractic, Faculty of Science and Engineering, Macquarie University, Sydney, Australia; [‡]Institute of Public Health, Heidelberg Medical School, University of Heidelberg, Heidelberg, Germany; [§]Department of Epidemiology and Biostatistics, EMGO+ Institute, VU University Medical Center, Amsterdam, The Netherlands; [¶]Department of Public Health and Epidemiology, Riga Stradiņš University, Latvia; ^{||}Department of Child and Adolescent Psychiatry, Research Unit Child Public Health, University Medical Center Hamburg-Eppendorf, Hamburg, Germany

Correspondence to: Michael S. Swain, MPhil, The George Institute for Global Health, Sydney Medical School, University of Sydney, PO Box M201, Missenden Rd., Sydney 2050, Australia. Tel: +614 929 638; Fax: +61 2 9657 0301; E-mail: mswain@georgeinstitute.org.au.

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Abstract

Objective. To evaluate whether individual types of pain (headache, stomach-ache, and backache) or

multiple pains affect the odds of young people achieving the recommended 60 minutes of moderate to vigorous physical activity (MVPA) per day in a large representative sample.

Design. Multicenter cross-sectional survey.

Setting. Twenty-eight countries across Europe and North America.

Subjects. Adolescents (N = 242,103).

Methods. An analysis of data collected in two waves (2001/02 and 2005/06) of the health behavior in school-aged children (HBSC) study was performed. Survey questions included the HBSC symptoms checklist and the amount of regular physical activity. Multilevel logistic regression was used to account for clustering effect of MVPA within countries. Models investigated the relationship between pain and physical activity, adjusted for the HBSC study year. Six models were conducted separately for gender and age-group (11, 13, and 15 years) strata.

Results. In general, the presence of pain was associated with reduced physical activity. Headache alone was associated with reduced physical activity in all six strata (odd ratios 0.77–0.84), stomach-ache alone in five strata (0.77–0.92), and backache alone in four strata (0.86–0.96). In 11- and 13-year-old girls, headache, stomach-ache, and backache, individually and in combination, were associated with decreased odds of being physically active (odds ratios ranging from 0.73 to 0.91). Within the other four age and gender strata, the relationship was less consistent.

Conclusion. Pain is associated with reduced physical activity in adolescents but this association varies according to gender, age, and the type of pain experienced.

Key Words. Pain; Physical Activity; Adolescent; Epidemiology; Health Behavior in School-Aged Children

Introduction

The pandemic of physical inactivity in children and adolescents is an important priority for public health action [1]. Pain is a frequent experience during childhood and adolescence. Recent population-based studies [2,3] have found high prevalence rates of headache, stomach-ache, and backache in school-aged children; with higher rates found in girls and older children. Clustering of two or more pains also occurs frequently in young people [2], and tends to be the rule rather than the exception [4]. This is becoming a major public health concern as multiple pains in adolescence are a strong predictor of multiple pains in adulthood [5] and subsequent disability [6].

In the recent Global Burden of Disease study, various types of pain featured prominently as contributors to the number of years individuals live with disability [7]. In adolescence, physical and mental health, as well as school performance and quality of life can be affected by pain [2,8–12]. Studies that have assessed functional status via questionnaires have found that pain can also impair activities of daily functioning [13–15]. Physical inactivity has major health effects worldwide, causing noncommunicable diseases such as cardiovascular disease, diabetes, cancer, and depression [16].

Traditional fear-avoidance models of pain, as seen in acute/subacute backache assume disability will lead to reduced levels of physical activity [17,18]. However, cohort and cross-sectional studies published to date report conflicting evidence for the association between moderate to vigorous physical activity (MVPA) and low back pain in both adult populations and school children [19]. One possible consequence of pain in childhood and adolescence is that it can become a barrier to physical activity. The fact that more than 80% of adolescents (aged 13–15) do not meet the recommended 60 minutes of MVPA per day [20] is particularly alarming given that health behaviors in childhood are commonly retained in adulthood.

Few studies have investigated the association between individual or multiple pains and health behavior, specifically MVPA, in adolescents. The aim of this study is to evaluate whether individual (headache, stomach-ache, and backache), or multiple pains affect the odds of achieving the recommended 60 minutes of MVPA per day in a large representative sample of school-aged children.

Methods

Study Design, Setting, and Participants

A secondary analysis of data from two consecutive survey years (2001/02 and 2005/06) of the health behavior in school-aged children (HBSC) study [21], a multinational cross-sectional survey, was performed. The

HBSC network conducts a large-scale four-yearly survey which collects health data from nationally representative samples of adolescents in Europe and North America. The necessary approvals from health/education authorities and research ethics Institutional Review Boards were negotiated at the national level by country team members. The level of consent in schools varied in accordance with national requirements. A list of participating researchers, countries, and selected reports can be found at <http://www.hbsc.org>.

All countries followed data collection procedures outlined in a standardized research protocol, which enables international comparison [22]. The HBSC study is a school-based survey in which data is collected via a self-completed questionnaire in the classroom setting. Cluster sampling was used in which the sample unit was the class (or the school when the class sample unit was not available). The target participants were adolescents aged 11, 13, and 15 years, which coincides with onset and early adolescence; a time of rapid physical and emotional change. For each survey year, the desired sample size per country was approximately 1,500 participants in each age-group (750 per gender). A single response rate is difficult to obtain given the use of multistage sampling (school, class, and student). For example, it was estimated across 35 countries that the 2001/2002 response rate at the level of the school was above 80% with additional nonresponse at the student-level ranging from 2.4% to 26.0% [23]. The combined and weighted response rates in 2001/2002 and 2005/06 both exceed 70% in the majority of countries [23,24].

Variables and Measures

Health and health related behavior data from the HBSC survey in 28 countries across Europe and North America was accessed along with demographic information (gender, age, and country).

The frequency of headache, stomach-ache, and backache, were measured by the pain items in the HBSC symptoms checklist. For each type of pain, respondents were required to specify the frequency of pain in the last 6 months on a five point scale: 1) about every day; 2) more than once a week; 3) about every week; 4) about every month; or 5) rarely or never. For the purposes of our analyses, pain frequencies were dichotomized as follows: 0 = pain rarely or never and 1 = pain at least every month. To facilitate investigation into the clustering effect of symptoms, discrete and combined pain groups were created: 1) no pain; 2) headache only; 3) stomach-ache only; 4) backache only; 5) headache and stomach-ache; 6) headache and backache; 7) stomach-ache and backache; and 8) headache, stomach-ache, and backache. No details regarding the duration or intensity of pain were available.

The frequency of MVPA was measured using the question: *Over the past 7 days (week), on how many days*

were you physically active for a total of at least 60 min per day? The question was preceded by explanatory text which defined MVPA as “any activity that increases your heart rate and makes you get out of breath some of the time” [25] with some examples of specific activities given. For the current analyses, responses were dichotomized (0–6 days = underactive, 7 days = active) to reflect the world health organisation’s (WHO) recommendations on physical activity for children and young people, i.e., that people aged 5–17 years should accumulate at least 60 minutes of MVPA per day [26].

Statistical Analysis

Only participants with complete data for pain and physical activity measures were included in the analyses. Descriptive statistics of participants were stratified by age-group and gender, proportions related to individual and multiple pains, and physical activity, are reported. Risk differences and the unadjusted relative risk of adolescents with pain not meeting the MVPA guidelines were calculated. Multilevel logistic regression was used to account for assumed clustering effect (potentially correlated observations) of MVPA within countries. Multilevel models were constructed to investigate the relationship between pain groups and MVPA, adjusted for HBSC data collection wave. The multilevel models considered individuals as first-level units which are grouped into second-level units of country. Odds ratios and 95% confidence intervals were calculated separately for the different gender and age-groups to account for established differences. Prior to examining the relationship between pain and MVPA, the intraclass correlation coefficient (ICC) was calculated [27] in the null model to estimate how much of the total variation in adolescents meeting the recommended amount of MVPA is accounted for by country. All statistical analyses were performed using statistical analysis system version 9.4.

Results

Pain and MVPA Characteristics

After combining two waves (2001/02 and 2005/06) of HBSC data, a total of 242,103 adolescents (median age 13.6 years, interquartile range 3.4 years) from 28 countries were included in this analysis (Table 1). Across countries, there was variation in the proportion of young people that were physically active (range: 12.8–41.7%) and that reported no pain (range: 14.9–52.4%) (Supplemental Data Table S1).

The proportion of young people with monthly or more frequent pain increased with age and the difference was more pronounced in girls (11 years 69.3% to 15 years 87.8%) than boys (11 years 61.1% to 15 years 69.5%). There was also an increase with age in the frequency of more than one type of pain in girls (11 years 40.1% to 15 years 64.7%) and boys (11 years 32.8% to 15 years

40.8%). Only 18.7% of participants met the recommended amount of 60 minutes of MVPA per day. Girls met the MVPA recommendations less often than boys; 14.4% vs 23.3%, respectively. The proportion of adolescents meeting MVPA recommendations was lower in older age-groups in boys (11 years; 28.2%, 15 years; 18.4%) and girls (11 years; 19.7%, 15 years; 10.2%). Table 1 reports the frequency of MVPA and pain (presented as discrete individual and combined pain clusters) in adolescent girls and boys.

Pain and Association with MVPA Among Girls

The largest proportion of girls, 21.9%, experienced all three pains together (headache, stomach-ache, and backache) followed by no pain, 20.6%. In descending order, the frequencies of other pain types were: stomach-ache and headache 20.1%, stomach-ache alone 10.9%, headache alone 10.5%, headache and backache 6.0%, stomach-ache and backache 5.1%, and lastly backache alone 4.8%.

The association between pain and level of physical activity is displayed in Figure 1. After adjusting for HBSC survey year; headache, stomach-ache as well as combined headache and stomach-ache were all negatively associated with adolescent girls meeting MVPA recommendations. Risk differences and unadjusted relative risks of not meeting the MVPA guidelines were calculated between girls with and without pain (Supplemental Data Table S2). The risk differences indicate that girls with pain have from 0.3% lower risk to a 4.3% higher risk of being underactive than those with no pain.

In girls aged 11 and 13 years, backache, combined backache and headache, combined backache and stomach-ache as well as combined backache, headache, and stomach-ache were also all negatively associated with MVPA. However, for girls aged 15 years, report of multiple pains was not associated with MVPA.

Pain and Association with MVPA Among Boys

The largest proportion of boys did not experience pain 34.6%, with the second largest proportion the combined headache, stomach-ache and backache group 14.4%. The frequencies of other pain types were: headache alone 12.2%, headache and stomach-ache 11.6%, backache alone 8.8%, stomach-ache alone 7.3%, headache and backache 6.9%, and stomach-ache and backache 4.2%.

After adjusting for HBSC survey year; boys reporting headache or combined headache and stomach-ache had decreased odds of meeting the recommended level of MVPA, regardless of age. Boys aged 11 years who experienced backache or backache in combination with headache and stomach-ache had reduced odds of being active. However, the effect of backache was not associated with MVPA in boys 15 years of age

Table 1 Frequency of pain clusters and MVPA in adolescent girls and boys

	Girls			Boys		
	11 Years N = 40,417% (95%CI)	13 Years N = 42,997% (95%CI)	15 Years N = 42,222% (95%CI)	11 Years N = 38,258% (95%CI)	13 Years N = 39,804% (95%CI)	15 Years N = 38,405% (95%CI)
Pain						
No pain	30.7 (30.3–31.1)	19.2 (18.8–19.6)	12.2 (11.9–12.5)	38.9 (38.4–39.4)	34.5 (34–35)	30.5 (30–31)
Headache (HA)	12.5 (12.2–12.8)	10.3 (10–10.6)	8.9 (8.6–9.2)	12.6 (12.3–12.9)	12.6 (12.3–12.9)	11.4 (11.1–11.7)
Stomach-ache (SA)	11.9 (11.6–12.2)	11.5 (11.2–11.8)	9.4 (9.1–9.7)	9.7 (9.4–10)	6.9 (6.7–7.1)	5.3 (5.1–5.5)
Backache (BA)	4.7 (4.5–4.9)	4.9 (4.7–5.1)	4.8 (4.6–5)	6.1 (5.9–6.3)	8.3 (8–8.6)	12.1 (11.8–12.4)
HA + SA	18.5 (18.1–18.9)	20.9 (20.5–21.3)	20.7 (20.3–21.1)	13.2 (12.9–13.5)	12 (11.7–12.3)	9.5 (9.2–9.8)
HA + BA	4.7 (4.5–4.9)	5.9 (5.7–6.1)	7.4 (7.2–7.6)	4.6 (4.4–4.8)	6.7 (6.5–6.9)	9.4 (9.1–9.7)
SA + BA	3.7 (3.5–3.9)	5.4 (5.2–5.6)	6.3 (6.1–6.5)	3.5 (3.3–3.7)	4.2 (4–4.4)	4.9 (4.7–5.1)
HA + SA + BA	13.2 (12.9–13.5)	21.9 (21.5–22.3)	30.3 (29.9–30.7)	11.5 (11.2–11.8)	14.8 (14.5–15.1)	17 (16.6–17.4)
MVPA						
Active	19.7 (19.3–20.0)	13.5 (13.2–13.8)	10.2 (9.9–10.5)	28.2 (27.8–28.7)	23.3 (22.9–23.7)	18.4 (18.0–18.7)
Underactive	80.3 (79.9–80.7)	86.5 (86.2–86.8)	89.8 (89.5–90.1)	71.8 (71.3–72.3)	76.7 (76.3–77.1)	81.6 (81.2–82.0)

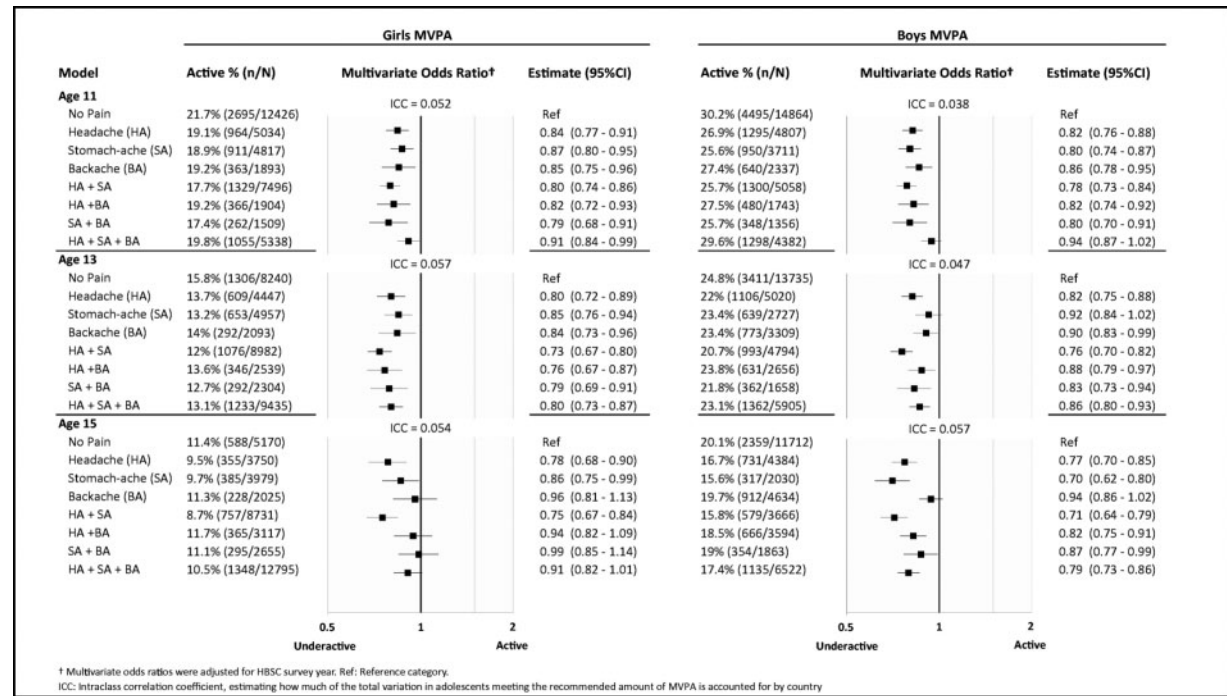


Figure 1 The association between pain and meeting the WHO’s recommended level of physical activity in 11-, 13-, and 15-year-old boys and girls.

(Figure 1). Risk differences and unadjusted relative risks of not meeting the MVPA guidelines between boys with and without pain are reported in Supporting Information Table S2. The risk differences indicate that boys with pain have from 0.4% to 4.6% higher risk of being underactive than those with no pain.

Multiple pains (combined headache, stomach-ache, and backache) were not associated with achieving the

MVPA guideline in boys aged 11 years. However, at 13 and 15 years of age, boys reporting multiple pains had decreased odds of meeting the recommended level of MVPA.

The calculated ICCs indicate that approximately 4–6% of the variability in boys and girls meeting the recommended amount of MVPA is accounted for by country in our study.

Discussion

In a large representative sample of school-aged children, we showed that adolescents who experience pain typically have lower odds of meeting the WHO recommendation of 60 minutes of MVPA per day. The association seems to be influenced by the type of pain and the child's age and gender. An unexpected finding was that around 75% of the adolescents reported pain at least monthly and that the most common presentation was multiple areas of pain.

The large representative sample and standardized methods of the HBSC survey have enabled us to account for the considerable cross-regional variations in physical activity and pain. Health and physical activity differences in young boys and girls have been established in previous reports [28,29] and were also identified in our analysis. Perhaps of greatest concern is the dramatic increase in multiple pains experienced by girls between the ages of 11 and 15 years. By isolating pain clusters, we were able to see different frequencies in individual and multiple pains across age-groups in boys and girls. Our results suggest girls have a substantially lower probability than boys of remaining pain free, which is driven mostly by the increase in girls reporting multiple pains.

One limitation of the cross-sectional study design is the ability to only establish bidirectional associations without determining cause. Moreover, unlike studies that are restricted to pain specific disciplines, the HBSC study does not provide definitional boundaries to aspects of pain location, intensity, and duration. There are practical limitations to the nature of measures used to explore pain and physical activity in very large samples across different regions. It is plausible that acute vs chronic pain or high intensity pain may influence physical activity levels differently in adolescents and this was not explored in our study. In this study, the feasibility of self-reported items needs to be considered alongside adolescents' ability to accurately recall monthly pain and weekly physical activity. While the physical activity items used in this study are thought have acceptable reliability, aspects of validity are less clear [30,31]. Given these considerations, the associations identified in this study should be approached with caution at this time.

Galán et al. [32] recently analyzed a Spanish subset of 2006 HBSC survey data and found that increasing frequency of MVPA was associated with fewer health complaints, high life satisfaction, and better self-reported health. They found the benefits of MVPA were especially pronounced in boys. Our analysis differentiates the effect of individual and combined pain clusters. It suggests that the various pain experiences affect physical activity behavior in girls and boys differently across the adolescent life-span. One example is that multiple pains (headache, stomach-ache, and backache) tends to decrease the odds of meeting

recommended levels of MVPA aged 11–15 years in boys, but not girls.

A systematic review by Sitthipornvorakul et al. [19] found conflicting evidence for the association between physical activity and low back pain in school children. Our findings may explain this conflict by illustrating the fact that the magnitude of the association between back pain and physical activity is quite small and influenced by age. There is an association between backache and insufficient MVPA in younger, but not older adolescents. While the effect of backache on meeting MVPA was lower in the older age-groups in our study, the longitudinal relationship between backache and physical activity from early to late adolescence remains unclear.

The concept that pain is a barrier to physical activity in children is of public health interest and has implications for clinicians and policymakers alike. Presumably primary prevention strategies can be initiated during childhood and adolescence. However, there is a lack of effective management strategies for pain in children and adolescents [33–35], with few randomized studies and numerous methodological limitations [33]. Given our findings, it is reasonable to speculate that pain might affect children's physical activity, this means identifying effective pain management strategies in adolescents is of even greater importance.

The research priorities for child and adolescent physical activity and sedentary behaviors have now been established via expert consensus [36]. The third ranked research priority from this Delphi procedure was future prospective and longitudinal studies to evaluate the independent effects of physical activity and sedentary behavior on health. Wedderkopp et al. [37] prospectively followed 9-year-old children and found that those with low levels of physical activity had higher odds of backache at 12 years of age. High physical activity seemed to protect against backache in this study. Our analysis did not assess whether higher levels of physical activity, such as vigorous physical activity (VPA) are associated with pain. Notwithstanding the limitation of a cross-sectional study design, our analysis suggests pain may be implicated in reducing physical activity, particularly in early adolescence. Longitudinal study designs which evaluate the effect of pain (individual and combined) on MVPA as well as VPA in both early and late adolescence remain an area for future research.

Pain and physical inactivity continue to be two important public health issues. This study has established an association between the two in a large representative sample of adolescents. Our study showed that most adolescents do not meet the WHO recommendations for healthy levels of physical activity and that those with pain are even less likely to meet these goals. Public health initiatives to address physical inactivity in children and adolescents arguably need to consider pain as a barrier to uptake of physical activity.

Supplementary Data

Supplementary Data may be found online at <http://painmedicine.oxfordjournals.org>.

Table S1 Cross regional variation in moderate to vigorous physical activity and pain.

Table abbreviations: MVPA=moderate to vigorous physical activity; ha = headache; sa = stomach-ache; ba = backache.

Table S2. Risk of not meeting moderate to vigorous physical activity guidelines by pain experience.

Table abbreviations: Ref=reference category; HA = headache; SA = stomach-ache; BA = backache.

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