



# Associations of Sedentary Behavior, Physical Activity, Cardiorespiratory Fitness, and Body Fat Content With Pain Conditions in Children: The Physical Activity and Nutrition in Children Study

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**Abstract:** We investigated the cross-sectional associations of sedentary behavior, physical activity, cardiorespiratory fitness, and body fat content with pain conditions in prepubertal children. The participants were a population sample of 439 children aged 6 to 8 years. Sedentary behavior, physical activity, and pain conditions were assessed using questionnaires, cardiorespiratory fitness using maximal cycle ergometer test, and body fat percentage using dual-energy X-ray absorptiometry. The associations of sedentary behavior, physical activity, cardiorespiratory fitness, and body fat percentage with the risk of pain conditions were analyzed using multivariate logistic regression. Children in the highest sex-specific third of sedentary behavior had 1.95 (95% confidence interval [CI], 1.20–3.17;  $P = .007$  for trend across thirds) times higher odds of any pain than children in the lowest third. Children in the highest sex-specific third of cardiorespiratory fitness had 46% (odds ratio [OR] = .54; 95% CI, .32–.91;  $P = .019$ ) lower odds of any pain and 50% (OR = .50; 95% CI, .28–.87;  $P = .015$ ) lower odds of headache than children in the lowest third. Children in the highest sex-specific third of body fat percentage had 44% (OR = .56; 95% CI, .34–.93;  $P = .023$ ) lower odds of any pain, 49% (OR = .51; 95% CI, .30–.86;  $P = .011$ ) lower risk of multiple pain, and 48% (OR = .52; 95% CI, .31–.86;  $P = .010$ ) lower odds of lower limb pain than children in the lowest third. Physical activity was not associated with pain conditions. These findings suggest that prepubertal children with high levels of sedentary behavior, low levels of cardiorespiratory fitness, and low body fat content have increased likelihood of various pain conditions. This information could be used to develop strategies to prevent chronic pain in childhood.

**Perspective:** Our findings suggest that low cardiorespiratory fitness, high levels of sedentary behavior, and low body fat content are associated with increased likelihood of various pain conditions among prepubertal children. This information could be used to develop strategies to prevent chronic pain in childhood.

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**Key words:** Children, pain, sedentary behavior, physical activity, cardiorespiratory fitness, adiposity.

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Pain among children and adolescents is an important and increasing public health problem in developed countries<sup>21</sup> including Finland.<sup>7,31</sup> We have found that more than half of children 6 to 8 years of age from the city of Kuopio in Finland have experienced pain during the previous 3 months.<sup>31</sup> Our study together with other studies have shown that the most common pains among children are those occurring in lower limbs, head, and abdomen.<sup>19,31</sup> Pain has been observed to restrict school attendance, participation in hobbies, and maintenance of social contacts, to reduce appetite and sleep quality,<sup>21</sup> to impair psychosocial and cognitive function,<sup>35</sup> to increase anxiety and depression,<sup>18</sup> and to increase the use of health services<sup>21</sup> in children and adolescents. Therefore, it would be important to identify children with risk factors for pain conditions to prevent pain and its consequences beginning in childhood.

Children in developed countries are becoming physically less active and are increasingly adopting a sedentary lifestyle.<sup>29</sup> These lifestyle changes have increased the prevalence of overweight and obesity and have decreased cardiorespiratory fitness during the past 2 decades in children.<sup>20,22,27,32</sup> All of these lifestyle-related factors could be associated with pain conditions among children. Overweight and obesity have been observed to be associated with musculoskeletal pains in children and adolescents<sup>1,4</sup> and with headache in children.<sup>1,9</sup> Most obese children and adolescents treated in an obesity clinic were also reported to suffer from back pain and lower limb pain.<sup>25</sup> Moreover, overweight has been related to increased prevalence of multiple pain in Finnish adolescents.<sup>16</sup> Furthermore, using computer and watching TV have been associated with neck, shoulder, and low back pain and headache<sup>8,28</sup> and sitting has been related to musculoskeletal pain in multiple sites<sup>11</sup> among adolescents. However, there are no studies on the associations of various types of sedentary behavior with pain conditions in children, although different sedentary behaviors may be differentially related to pain. Whereas some studies have observed an inverse association of physical activity with any pain<sup>23</sup> and musculoskeletal pain<sup>33</sup> in children, the results of other studies have suggested that high levels of physical activity are related to widespread pain in children<sup>11</sup> and musculoskeletal pain in multiple sites among adolescents.<sup>16</sup> However, there are few if any studies on the association between cardiorespiratory fitness and pain in children or adolescents. Sexual maturation during puberty is known to increase body fat content and improve physical performance<sup>3</sup> and may also increase sedentary behavior and decrease physical activity.

There are few studies on the associations of these lifestyle-related factors with pain conditions in children,<sup>1,9,11</sup> and the results of these studies have been inconsistent. Moreover, there are no studies on these lifestyle-related factors with pain conditions among prepubertal children. We therefore investigated the associations of various types of sedentary behavior and physical activity, cardiorespiratory fitness, and body fat content with different pain conditions in a population sample of prepubertal children.

## Methods

### *Study Design and Study Population*

The present analyses are on the basis of the baseline data of the Physical Activity and Nutrition in Children (PANIC) study, which is an ongoing physical activity and diet intervention study in a population sample of primary school children from the city of Kuopio, Finland. The study was primarily conducted at the Institute of Biomedicine, University of Eastern Finland. Altogether 736 children 6 to 8 years of age were invited to participate in the study by letters delivered to the parents via public schools. Of the invited children, 512 (70%) participated in the baseline examinations that were conducted from 2007 to 2009. The participants did not differ in sex distribution, age, or body mass index (BMI) standard deviation score from the nonparticipants on the basis of available school health examination data (data not shown). Complete data on variables used in the analyses were available for 439 children (212 girls, 227 boys). These 439 children did not differ in any variable used in the analyses from 73 children who had incomplete data and were excluded (data not shown). All participating children and their parents gave their informed consent. The study protocol was approved by the Research Ethics Committee of Hospital District of Northern Savo in 2006.

### *Assessment of Pain*

We assessed pain using a questionnaire filled out by the parents. We designed the questionnaire to assess the prevalence of pain conditions in general populations of children using some of the questions of the pain questionnaire of the Finnish Association for the Study of Pain.<sup>31</sup> The parents filled out the questionnaire during their child's clinical dental examination or at home after the study visit and returned the questionnaire by mail. The parents were first asked 'Did your child have pain within the past 3 months (yes or no)' and then 'How often your child had pain within the past 3 months (never, seldom, once a month, several times a month, more than once a week, daily, or continuously).' Thereafter, the parents were asked whether the pain was located in head, neck-shoulder, abdomen, chest, pelvis, back, upper limbs, or lower limbs. Pain within the past 3 months was defined frequent if it existed more than once a week overall. Pain existing in at least 2 different areas of the body during the past 3 months, regardless of its frequency, was defined as multiple pain.<sup>19</sup> Moreover, the parents were asked about their child's use of medication because of pain (yes or no). Data on pain medication were available for 201 children (106 girls, 95 boys).

### *Assessment of Sedentary Behavior*

Sedentary behavior, excluding sedentary behavior at school, was assessed using the PANIC Physical Activity Questionnaire filled out by the parents.<sup>6,30</sup> The questionnaire included items on screen-based sedentary behavior (watching TV and videos, using computer, playing video games, using mobile phone, playing mobile

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