ASSOCIATIONS OF SELF-REPORTED PHYSICAL ACTIVITY AND SCREEN TIME WITH MUSCULOSKELETAL PAIN IN EIGHTH GRADERS

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Niska-hartiakivut ja alaselkäkivut ovat yleisimpiä tuki- ja liikuntaelimistön oireita nuorilla ja niiden esiintyvyys on kasvanut viimeisten vuosikymmenten aikana. Samaan aikaan vapaa-ajan fyysinen aktiivisuus on vähentynyt ja istumiseen käytetty aika erityisesti viihdemedian parissa on lisääntynyt. Tutkimusnäyttö fyysisen aktiivisuuden ja ruutuajan yhteydestä niska-hartiakipuihin ja alaselkäkipuihin on ollut ristiriitaista.

Tämän tutkimuksen tarkoituksena oli tutkia vapaa-ajan fyysisen aktiivisuuden ja ruutuajan yhteyksiä viikoittaisiin niska-hartia- ja alaselkäkipuihin. Fyysisen aktiivisuuden osalta tarkasteltiin vapaa-ajan fyysisen aktiivisuuden, ohjatun liikunnan ja aktiivisen kouluun kulkemisen määrää sekä pääasiallista kouluun kulkemisen tapaa. Tutkimusaineisto perustuu UKK-instituutin toteuttaman “Kasit liikkeelle!” -tutkimuskokonaisuuden alkukyselyyn, joka on toteutettu vuonna 2012 kaikilla Tampereen yläasteilla kahdeksasluokkalaisille. Kyselyyn vastasi yhteensä 1493 kahdeksasluokkalaista.

Tulosten perusteella kävellen tai pyörällä kouluun kulkevilla oppilailla riski niska-hartiakipujen viikoittaiselle esiintymiselle oli pienempi kuin bussilla, autolla, mopolla tai mopoautolla kouluun kulkevilla. Lisäksi vähintään kuusi tuntia ohjattua liikuntaa viikoittain harrastavilla riski niska-hartiakivuille oli pienempi kuin vähemmän harrastavilla. Tulokset osoittavat, että koulumatkaliikuntaan erityisesti kävellen tai pyöräillen tulisi kannustaa. Pienilläkin toimenpiteillä voidaan arjessa vähentää tuki- ja liikuntaelinkipuja.

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INTRODUCTION

Neck-shoulder pain and low back pain are significant and common symptoms in adolescents (1,2). In Finland, the number of adolescents suffering from neck-shoulder pain and low back pain has increased since the 1980s (1). In the study accomplished in 1990s by Vikat et al (2000) 15 % of 12-18-year-old adolescents had neck-shoulder pain and 8 % low back pain once a week or more frequently (3). In 2000s the prevalence of weekly neck-shoulder pain has almost doubled and the amount of low back pain even more (2,4,5). It has been shown that the incidence of low back pain and neck-shoulder pain increases with age (2,3,6,7). These symptoms occurring already in adolescence increase the risk of having these same problems in the adulthood (1,8).

Physical inactivity may be one risk factor for musculoskeletal pain in adolescence (2,5,6,9,10). According to Finnish national guidelines children and adolescents aged 7-18 years should be physically active at least one hour per day (11). These guidelines are parallel to the WHO recommendations in which it is stated that children should have at least one hour of moderate to vigorous physical activity daily (12). In secondary school less than one fifth of students met these criteria in national "Finnish Schools on the Move" -program where daily vigorous physical activity was measured with accelerometers (13). Active commuting to and from school is an important part of leisure time activity. Children who actively commute to school (including bicycling and walking) have higher physical activity levels and are more likely to meet physical activity recommendations (14). On the average two thirds of adolescents actively commute to school (15,16). Physical activity including active commuting decreases with age (13,15,17,18).

Also different kind of evidence occur for the association of physical activity with musculoskeletal pain. According to Auvinen et al (2008) inactive lifestyle with less than half an hour of brisk physical activity per week was not related with low back pain (19). They also found that physically very active adolescents (aged 15-16 years) having more than 6 hours of brisk exercise per week reported more low back pain than moderately active adolescents (2-3 hours of brisk activity per week) (19). Also, the current knowledge of the relation of active school commuting with musculoskeletal pain is inadequate. More information about the influence of physical activity for adolescents is needed.

A major increase in the use of information and communication technology has led to more sedentary lifestyle (5,20). According to recommendations continuous sitting periods over two hours should be avoided among school-aged children and screen time with entertainment media should not to exceed two hours per day (11). Hakala et al (2006) discovered that computer use over 2-3 hours per day and Internet use over 14 hours per week is a threshold for weekly neck-shoulder pain (2). For low back pain a threshold was television viewing or computer use over 5 hours per day (2). On average adolescents use computers 2 hours a day (21). Using

mobile phones were not associated with neck-shoulder pain or low back pain (2). Based on the previous studies low back pain is associated with prolonged stationary sitting position and neck-shoulder pain with increased amount of screen-based activities (2,6,9). Auvinen et al (2007) found that prolonged time spent with sitting was associated with neck and occipital pain (22). However, in a review made by Brink et al (2013) there were no obvious relationship between sitting and upper quadrant musculoskeletal pain in children and adolescents (23). The knowledge of the relationships of musculoskeletal pain and screen time are also inconsistent and more information is thus needed.

To summarize, more information about the relationships of physical activity and screen time with musculoskeletal pain in adolescence is needed. Therefore, the aim of this study is to examine the association of self-reported physical activity and screen time with neck-shoulder pain and low back pain in 13 to 15-year-old eighth graders. The hypothesis is that low levels of physical activity and large amounts of screen time increase the risk of neck-shoulder pain and low back pain.

MATERIALS AND METHODS

The data is based on a survey conducted for eighth graders (13 to 15 years old) in 2012. The survey was a part of KIDS OUT! –intervention, which was planned and implemented by the UKK institute for the Health Promotion Research in Tampere Finland (24). The purpose of the intervention was to encourage adolescents to increase their daily leisure time physical activity and decrease their sedentary behavior especially in relation to screen time. The survey was carried out in all 14 city-owned secondary schools in the city of Tampere located in the South-West Finland. Participating schools were given detailed information before the intervention. An informed consent was required from the participating students and their parents were informed about the study before and during the intervention. Replying to the questionnaire was voluntary for students. The study plan was approved in the Ethics Committee of the Tampere Region, University of Tampere, Human Sciences (running number 6/2012).

Measures

Background

The questionnaire included 41 questions, mainly multiple choices. Ten of these questions were related to the themes of this study and were used for this analysis. Variables included questions on gender, weight and height. BMI was calculated by dividing the weight (kg) by the square of height (m). It was then categorized into three groups: underweight (BMI<18), normal weight (BMI 18-25) and overweight (BMI>25) (5).

Musculoskeletal pain

Musculoskeletal pain, which was examined in this study, included neck-shoulder pain and low back pain. These symptoms were assessed by asking them separately with the same formula: “How often have had neck-shoulder pain/low back pain during the last month?”. Respondents were given four response alternatives for both symptoms: “seldom or not at all”, “once a month”, “once a week” and “almost every day”.

Physical activity

Leisure time physical activity was assessed with two questions. *Weekly frequency of physical activity* was asked by a question “On how many days a week do you do at least one hour of moderate to vigorous physical activity?”. Eighth answer options were given from 0 to 7 days a week. The other question on leisure time physical activity was related to supervised exercise during leisure time. *Engagement in weekly regular*

supervised exercise was first surveyed by asking “yes” or “no”. If the answer was “yes”, respondent was referred to answer on how many days a week and how many hours a week they were engaged in regular supervised exercise.

Two variables dealt with active commuting to school. *The primary transportation mode* to school was examined with a question “What is the primary transportation mode to school that you use currently?” Six response alternatives were provided and respondents were given instruction to choose only one alternative: “by walking”, “by bicycling”, “by car”, “with moped or microcar” and “other” (including space for a definition). For the option “other” three different answers appeared: “by bicycling or by walking”, “by bicycling or by walking combined with motorized vehicle” and “by bus and by car”. *The weekly frequency of active commuting* (walking or bicycling) to school at least one direction was also asked. In this question six answer options were given from 0 to 5 days a week.

Screen time

In this study, *screen time* was defined as time spent in watching television and using computer or game consoles. Screen time was assessed by asking “On how many days a week your screen time exceeds two hours a day?”, which is the recommended threshold for adolescents (11). Eight response alternatives were given from 0 to 7 days. *Parents’ interference with screen time* was surveyed by asking “Does your parents interfere with your screen time?”. For this question there were three answer options: “Yes, my parents set limitations”, “Yes, my parents hope that I reduce screen time” and “No, my parents do not interfere”.

Statistical analysis

The study data was analyzed with IBM SPSS statistics 24 software. The associations of physical activity and screen time with neck-shoulder pain and low back pain were evaluated with crosstabulations and risk ratios. To simplify the analysis, response alternatives were grouped into fewer categories.

The original four response alternatives related to the frequency of neck-shoulder pain and low back pain were combined into two categories: “weekly or more often” and “less often than weekly”. With this grouping, the results are more comparable to previous studies, because weekly symptoms are commonly examined in different studies. Weekly frequency of moderate to vigorous physical activity was re-grouped into four categories: 0-1, 2-3, 4-5 and 6-7 days a week. The weekly frequency of supervised exercise was divided into categories of 0, 1-3 and ≥4 days and the weekly duration into 0, 1-5, ≥6 hours.

Grouping was also made for the variables representing commuting to school. The nine alternatives of primary transportation mode to school were combined into three categories: “Active commuting” (walking, bicycling and walking or bicycling), “bus” and “other modes of transportation including a motorized

vehicle" (car, moped or microcar, bus and car, motorized vehicles combined with walking or bicycling, other). The weekly number of days with active commuting to school were combined into categories of 0-1, 2-3 and 4-5 days. In screen time, new variable representing the weekly number of days exceeding the two-hour screen time recommendation included categories 0-1, 2-4 and 5-7 days. No changes were made to the categorization of parental interference with screen time.

First, crosstabulations were formed to explore the statistical associations of physical activity and screen time with neck-shoulder pain and low back pain. The statistical significance was tested with chi-square test with the significance level of $P < 0.05$. After exploring the crosstabulations, risk ratios and their confidence intervals for neck-shoulder pain and low back pain weekly or more often and less often than weekly were calculated. Risk ratio (RR) represents the probability of a certain event to occur in one group compared to the reference group. In this study it describes the probability of neck-shoulder pain or low back pain to occur "weekly or more often" and "less often than weekly". If the risk ratio is 1, it means that there is no difference in the risk between these groups. Risk ratio over 1 means that the risk for the pain is higher than in the reference group and risk ratio under 1 means that the risk is lower. Risk ratios for neck-shoulder and low back pain "weekly or more often" and "less often than weekly" were calculated with command "risk" from the statistics menu one by one for every physical activity and screen time category compared to the reference group. Reference categories in relation to weekly frequency of moderate to vigorous physical activity and of screen time exceeding two hours were based on the recommendations (11,12). In transportation mode and the frequency of active commuting the reference categories were chosen based on the hypothesis that active commuting reduces the risk for musculoskeletal pain. For the parents' interference with screen time the reference category was "Yes, my parents set limitations".

RESULTS

Study population

From the total of 1638 eighth-graders in Tampere 1493 (91.1 %) responded to the questionnaire. Of them, 1476 (98.9 %) reported gender: 705 (47.8 %) were girls and 771 (52.2 %) boys. Descriptive characteristics of the study population are presented in table 1.

Neck-shoulder pain and low back pain

Neck-shoulder pain was more common symptom than low back pain in the study population. Nearly seven percent (6.8 %) of adolescents reported suffering from neck-shoulder pain almost every day, 15.6 % once a week, 28.1 % once a month and 49.5 % seldom or not at all. Altogether 22.4 % of adolescents suffered from neck-shoulder pain weekly or more often (table 1). For low back pain the reported prevalence of symptoms weekly or more often was 15.8 %. According to results 6.0 % of eighth graders suffered from low back pain almost every day, 9.8 % once a week, 22.6 % once a month and 61.7 % seldom or not at all. Boys suffered from neck-shoulder pain and low back pain more than girls. Almost one third (28.9 %) of boys had neck-shoulder pain weekly or more often when the same number for girls was 15.3 %. For low back pain weekly or more often the frequencies were 17.6 % for boys and 13.8 % for girls.

Associations with neck-shoulder pain and low back pain

Weekly leisure time physical activity

Only 7.1 % of adolescents met the national guidelines of daily physical activity (1 hour/day). Most commonly (34.2 %) eighth-graders had moderate to vigorous physical activity at least one hour on 2-3 days per week (table 1). Physical activity at least one hour had 15.7 % on 0-1 days, 30.5 % on 4-5 days and 19.6 % on 6-7 days per week. The frequency of weekly leisure time physical activity was not statistically significantly associated with the prevalence of neck-shoulder pain (P=0.30) or low-back pain (P=0.23).

Nearly one third (63.2 %) of the adolescents participated in regular supervised exercise at least once a week and the average weekly duration of supervised exercise was four hours (table 1). No statistical difference was found in the frequency of neck-shoulder pain or low back pain between the groups of eighth-graders with or without engagement in weekly regular supervised exercise (neck-shoulder pain P=0.79, low back pain P=0.24). Neither were there any associations between the weekly frequency of supervised exercise and neck-shoulder pain (P=0.30) and low back pain (P=0.50).

However, the weekly duration of supervised exercise was associated with the lower frequency of neck-shoulder pain (P=0.040): Compared to the reference group, which had six hours or more of weekly supervised exercise, the risk ratio for neck shoulder pain was 1.42 (95 % CI 1.07-1.88) in the group with 1 to 5 hours of weekly supervised exercise and 1.29 (0.98-1.70) in the group with no weekly supervised exercise (table 2). The frequencies of weekly neck-shoulder pain in these groups were 17.7 %, 25.2 % and 23.0 % respectively. Weekly frequency or duration of supervised exercise was not associated with low back pain (days/week P=0.50, hours/week P=0.48). All risk ratios for neck-shoulder pain and low back pain are presented in tables 2 and 3.

Most common (34.9 %) transportation mode to school was by bus. By bicycle commuted 30.4 % of eighth-graders and by walking 22.9 %. Altogether 56.5 % of eight-graders commuted mainly actively to school (by bicycle or by walking) (table 1). 2.5 % commuted to school by car and 0.5 % with moped or microcar. 35.1 % didn't commute to school actively in any day. Girls commuted to school actively more than boys (girls 60.8 %, boys 52.4 %).

Active commuting to school was statistically significantly associated with neck-shoulder pain. Adolescents commuting mainly actively had lower frequencies of neck-shoulder pain weekly or more often compared to adolescents commuting to school mainly by motorized vehicles including bus, car, moped or microcar (P=0.004). In comparison with active commuters the greatest risk for neck-shoulder pain weekly or more often was in the group of eighth graders commuting to school mainly by car, moped or microcar (RR 1.62, 95 % CI 1.19-2.22) (table 2). For eighth graders commuting mainly by bus the risk ratio was 1.31 (95 % CI 1.05-1.63). The frequency of neck-shoulder pain weekly or more often was 19.3 % among active commuters, 25.2 % among bus riders and 31.3 % among car, moped and microcar users.

The weekly frequency of active commuting to school was also statistically associated with neck-shoulder pain (P=0.034). Active commuting to school only on 0-1 days a week increased the risk of having neck-shoulder pain weekly or more often compared to commuting actively on 4-5 days a week (RR 1.32, 95 % CI 1.07-1.62) (table 2). Instead, active commuting on 2-3 days a week did not increase the risk for weekly neck-shoulder pain (RR 0.99, 95 % CI 0.57-1.71). The primary transportation mode or the weekly frequency of active commuting had no statistical associations with the frequency of low-back pain (P=0.11).

Screen time

One fifth (20.7 %) of the adolescents exceeded the recommendation of two hours of screen time on two days a week. Fourteen percent (14.3 %) of the adolescents exceeded the recommendation every day and 7.6 % reported never exceeding it. The weekly frequency of exceeding two hours of screen time was not statistically significantly associated with either neck-shoulder pain (P=0.55) or low-back pain (P=0.09).

Exceeding the daily recommendation on 2 to 4 days a week increased the risk of having low back pain (RR 1.46, 95 % CI 1.02-2.09) (table 3). However, the increased risk disappeared if the recommendation was exceeded on 5 to 7 days a week (RR 1.24, 95 % CI 0.84-1.85). Parents' interference with screen time was not associated with neck-shoulder pain or low back pain (for neck-shoulder pain P=0.30, for low back pain P=0.50).

Table 1. Descriptive characteristics of the study population by gender

		Girls	Boys	Total
		N=705 (47.8 %)	N= 771 (52.2 %)	N=1493* (100 %)
BMI	<18	126 (22.7)	150 (26.0)	276 (24.4)
	18-25	400 (72.1)	404 (70.1)	804 (53.9)
	>25	29 (5.2)	22 (3.8)	51 (3.4)
Frequency of neck-shoulder pain	Weekly or more often	93 (15.3)	190 (28.9)	283 (22.4)
	Less often than weekly	515 (84.7)	468 (71.1)	983 (77.6)
Frequency of low back pain	Weekly or more often	84 (13.8)	116 (17.6)	200 (15.8)
	Less often than weekly	525 (86.2)	543 (82.4)	1068 (84.2)
Weekly frequency of moderate to vigorous physical activity at least one hour a day (days/week)	0-1	97 (15.3)	109 (16.2)	206 (15.7)
	2-3	190 (30.0)	257 (38.1)	447 (34.2)
	4-5	197 (31.1)	202 (30.0)	399 (30.5)
	6-7	150 (23.7)	106 (15.7)	256 (19.6)
Engagement in weekly regular supervised exercise	Yes	369 (59.0)	450 (67.2)	819 (63.2)
	No	256 (41.0)	220 (32.8)	476 (36.8)
Weekly frequency of supervised exercise (days/week)	0	256 (42.0)	222 (33.4)	478 (37.5)
	1-3	150 (24.6)	268 (40.3)	418 (32.8)
	≥4	203 (33.3)	175 (26.3)	378 (29.7)
Weekly duration of supervised exercise (hours/week)	0	255 (42.4)	223 (34.2)	478 (38.1)
	1-5	136 (22.6)	252 (38.7)	388 (30.9)
	≥6	211 (35.0)	177 (27.1)	388 (30.9)
Primary transportation mode to school	Walking or bicycling	387 (60.8)	355 (52.4)	742 (56.5)
	Bus	198 (31.1)	260 (38.4)	458 (34.9)
	Car, moped or microcar	52 (8.2)	62 (9.2)	114 (8.7)
Weekly frequency of active commuting to school (days/week)	0-1	214 (33.6)	287 (42.5)	501 (38.2)
	2-3	25 (3.9)	31 (4.6)	56 (4.3)
	4-5	397 (62.4)	358 (53.0)	755 (57.5)
Frequency of exceeding 2 hours screen time (days/week)	0-1	89 (14.1)	199 (29.7)	288 (22.2)
	2-4	308 (48.9)	321 (47.9)	629 (48.4)
	5-7	233 (37.0)	150 (22.4)	383 (29.5)
Parents' interference with screen time	Set limitations	142 (22.7)	175 (26.3)	317 (24.6)
	Hope for reduce in screen time	253 (40.5)	206 (30.9)	459 (35.6)
	No interference	230 (36.8)	284 (42.6)	514 (39.8)

* 17 adolescents did not report the gender

Table 2. Risk ratios for neck-shoulder pain and 95 % confidence intervals.
Statistically significant results (P <0.05) are bolded

		Risk ratio (95 % CI)	
		Less often than weekly	**Weekly or more often**
BMI	18-25	1	1
	<18	1.05 (0.98-1.13)	0.84 (0.64-1.10)
	>25	1.05 (0.92-1.21)	0.83 (0.47-1.46)
Weekly frequency of moderate to vigorous physical activity at least one hour a day (days/week)	6-7	1	1
	4-5	1.00 (0.93-1.09)	0.99 (0.72-1.36)
	2-3	0.95 (0.87-1.03)	1.22 (0.90-1.64)
	0-1	0.95 (0.85-1.05)	1.22 (0.86-1.72)
Engagement in weekly regular supervised exercise	Yes	1	1
	No	0.99 (0.93-1.06)	1.03 (0.83-1.27)
Weekly frequency of supervised exercise (days/week)	≥4	1	1
	1-3	0.95 (0.88-1.02)	1.23 (0.94-1.61)
	0	0.96 (0.89-1.03)	1.18 (0.90-1.54)
Weekly duration of supervised exercise (hours/week)	≥6	1	1
	1-5	**0.91 (0.84-0.98)**	**1.42 (1.07-1.88)**
	0	0.94 (0.88-1.00)	1.29 (0.98-1.70)
Primary transportation mode to school	Walking or bicycling	1	1
	Bus	**0.93 (0.87-0.99)**	**1.31 (1.05-1.63)**
	Car, moped or microcar	**0.85 (0.75-0.97)**	**1.62 (1.19-2.22)**
Weekly frequency of active commuting to school (days/week)	4-5	1	1
	2-3	1.00 (0.88-1.15)	0.99 (0.57-1.71)
	0-1	**0.92 (0.86-0.98)**	**1.32 (1.07-1.62)**
Frequency of exceeding 2 hours screen time (days/week)	0-1	1	1
	2-4	0.98 (0.91-1.06)	1.07 (0.82-1.39)
	5-7	1.02 (0.94-1.11)	0.93 (0.69-1.26)
Parents' interference with screen time	Set limitations	1	1
	Hope for reduce in screen time	0.94 (0.88-1.01)	1.26 (0.94-1.68)
	No interference	0.94 (0.87-1.01)	1.28 (0.97-1.70)

Table 3. Risk ratios for low back pain and 95 % confidence intervals.
Statistically significant results (P <0.05) are bolded

		Risk ratio (95 % CI)	
		Less often than weekly	**Weekly or more often**
BMI	18-25	1	1
	<18	1.03 (0.97-1.09)	0.86 (0.61-1.21)
	>25	**0.87 (0.73-1.03)**	**1.68 (1.05-2.69)**
Weekly frequency of moderate to vigorous physical activity at least one hour a day (days/week)	6-7	1	1
	4-5	1.07 (0.99-1.15)	0.74 (0.52-1.05)
	2-3	1.06 (0.98-1.14)	0.76 (0.54-1.06)
	0-1	1.08 (0.99-1.17)	0.68 (0.44-1.05)
Engagement in weekly regular supervised exercise	Yes	1	1
	No	1.03 (0.98-1.08)	0.85 (0.65-1.12)
Weekly frequency of supervised exercise (days/week)	≥4	1	1
	1-3	1.02 (0.96-1.09)	0.89 (0.65-1.23)
	0	1.036 (0.98-1.10)	0.828 (0.61-1.13)
Weekly duration of supervised exercise (hours/week)	≥6	1	1
	1-5	1.01 (0.95-1.08)	0.95 (0.70-1.31)
	0	1.04 (0.98-1.10)	0.83 (0.61-1.13)
Primary transportation mode to school	Walking or bicycling	1	1
	Bus	1.01 (0.97-1.07)	0.93 (0.70-1.23)
	Car, moped or microcar	0.92 (0.83-1.02)	1.45 (0.98-2.12)
Weekly frequency of active commuting to school (days/week)	4-5	1	1
	2-3	0.97 (0.85-1.10)	1.19 (0.66-2.13)
	0-1	0.99 (0.94-1.04)	1.06 (0.82-1.39)
Frequency of exceeding 2 hours screen time (days/week)	0-1	1	1
	2-4	**0.94 (0.88-0.99)**	**1.46 (1.02-2.09)**
	5-7	0.97 (0.91-1.03)	1.24 (0.84-1.85)
Parents' interference with screen time	Set limitations	1	1
	Hope for reduce in screen time	0.97 (0.91-1.02)	1.23 (0.86-1.76)
	No interference	0.96 (0.90-1.01)	1.29 (0.91-1.83)

DISCUSSION

Key findings

The key finding of the study was the association of active commuting with the frequency of neck-shoulder pain. The risk of having neck-shoulder pain weekly or more often was the smallest when the primary transportation mode to school was walking or bicycling. Furthermore, the risk for neck shoulder pain was the greatest if the primary transportation mode was a car, moped or microcar. The weekly frequency of active commuting only on 0-1 days a week increased the risk for weekly neck-shoulder pain compared to eighth-graders actively commuting on 4-5 days a week. For eighth graders that actively commuted to school on 2-3 days a week the risk was approximately the same as for those actively commuting almost every day. These results show that active commuting is an important factor in the prevention of neck-shoulder pain in adolescents.

A significant association between neck-shoulder pain and weekly duration of supervised exercise was also found. The smallest risk for having neck-shoulder pain weekly or more often was in the group of eighth graders that had regular supervised exercise 6 hours or more per week. For eighth graders having 1-5 hours of supervised exercise weekly the risk for neck-shoulder pain was greater than for those having supervised exercise 6 hours or more. Based on this study supervised exercise can be considered as a protective factor for neck-shoulder pain when the weekly duration is at least 6 hours a week.

Neck-shoulder pain and low back pain

According to these results it seems that the frequency of neck-shoulder pain and low back pain has not increased anymore in recent years. In the previous studies the prevalence of neck-shoulder pain in adolescents has been approximately 15 % in 1990s and 25 % in 2003 (2,3). In this study material collected in 2012 the frequency of neck-shoulder pain weekly or more often was 22.4 %, which is close to the prevalence observed in 2003. Boys reported suffering from neck-shoulder pain weekly or more often almost two times more than girls. In 1990s only 8 % of adolescents had low back pain at least once a week (3). In 2005-2006 the frequency was 17.6 % for boys and 19.1 % for girls in Finland (5). In this study the frequency of low-back pain weekly or more often was 15.8 %.

Leisure time physical activity and supervised exercise

According to the Finnish national guidelines and the WHO recommendations children and adolescents aged 7-18 years should be moderately to vigorously physically active at least one hour every day. According to

the findings of this study only 7.1 % of eighth graders met these criteria based on the questionnaire. The proportion is much lower than in the previous studies. 17 % of students in secondary school met these criteria when the physical activity was measured with accelerometers (data collected in 2010-2012) (13). One explanation for this result can be the discrepancy in different surveys. Physical activity level can be assessed with different kind of questions and methods and for this reason results may not be comparable with each other.

When the association of neck-shoulder pain and the duration of supervised exercise was examined, the smallest risk for having neck-shoulder pain weekly or more often was in the group of eighth graders that had regular supervised exercise 6 hours or more per week. However, the risk for neck-shoulder pain was not the highest in the group of eighth graders not having any supervised exercise weekly. Instead, the risk was the highest if the weekly duration of supervised exercise was 1-5 hours a week. It seems that supervised exercise is a protective factor for neck-shoulder pain only when the weekly duration is at least 6 hours a week. No similar association was found for weekly frequency of supervised exercise and thus the duration of exercise can be considered as more important factor in the prevention of neck-shoulder pain. These results differ from the previous studies, where sports participation in adolescence has been associated with higher occurrence of musculoskeletal pain (25).

The amount of physical activity or supervised exercise was not associated with the frequency of low back pain. For physical activity this result is parallel to the previous studies (3,6,19). However, although it seems that inactivity does not increase the risk for low back pain in adolescence, it is possible that inactivity leads to a sedentary lifestyle in the adulthood. Inactivity is a predisposing factor for low back pain in adults (10). Inactivity occurring already in adolescence might expose to low back pain or other musculoskeletal pain in the adulthood (7).

Active commuting

In this study, 56.5 % of adolescents actively commuted to school. This is at the same level than in the previous studies where the data was collected in 1998-1999 and 2005-2006 (15,16). It seems that the amount of active commuting has not decreased in the past two decades. This result is comparable when we focus on adolescents living in the cities, but for adolescents living in the countryside this percentage value might have been different due to ever longer distances to school.

The risk of having neck-shoulder pain weekly or more often was the highest when the primary transportation mode to school was by car, moped or microcar. One explanation for this result could be that using these transportation modes requires the lowest level of physical activity. Commuting to school by bus also increased the risk for neck-shoulder pain compared to active commuting. By bus there is usually some

walking distance from home or school to the bus stop and thus higher level of physical activity is needed compared to commuting with own motorized vehicles. Active commuting over two days a week decreased the risk for weekly neck-shoulder pain. Based on this result active commuting at least in two days a week is recommended for the prevention on neck-shoulder pain. For girls the frequency of active commuting was higher than for boys and a higher proportion of girls reported walking or bicycling as a primary transportation mode. This might be one of the factors accounting for the greater frequency of neck-shoulder pain among boys.

These results indicate that active commuting is an important factor in the prevention of neck-shoulder pain in adolescents. One explanation for this can be the regularity and continuity of school commuting. Adolescents usually commute to school constantly in five days a week. Active commuting increases the total amount of physical activity and adolescents actively commuting to school are more likely to meet the physical activity recommendations (14). The previous knowledge of the association of active school commuting with musculoskeletal pain is inadequate. Thus, in the future we should pay more attention to the active commuting in the prevention of musculoskeletal pain and consider it as an essential part of adolescents' daily physical activity.

Screen time

Weekly frequency of exceeding two hours of screen time was not associated with the frequency of neck-shoulder pain or low back pain. The previous knowledge of the relationships of musculoskeletal pain and screen time has been inconsistent. These results support the findings of Brink et al (2013) where no obvious relationship between sitting and upper quadrant musculoskeletal pain in children and adolescents was found (23). In this study only the weekly frequency of screen time exceeding 2 hours was measured and risk factors for more hours of screen time daily were not examined. It is possible that an association with musculoskeletal pain may have been found if the total weekly duration of screen time would have been taken into consideration.

In this study data screen time included watching tv, computer use and game consoles, which excluded for instance the use of mobile phones. In the recent years the screen-based behavior has been changing due to wider use of mobile phones. On the grounds of practical experience screen time is nowadays not only sitting stationary with computer or tv anymore. Smartphones and tablet computers have become more common than in the last decades and people can use these devices in different postures and even while walking and doing other things at the same time. In the previous study using of mobile phones was not a risk factor for low back pain or neck-shoulder pain compared to the use of computers and tv (2). When we measure the amount of screen time, different forms of screen-based activities should be separated. For this reason, mobile phones were excluded from the analysis because of their discrepancy with other screen-based activities.

The use of information technology has become more and more frequent also at school and the use of different screens even increases in upper secondary school and university. Social media has also a significant impact on the lives of adolescents today. Even though the amount of screen time did not have associations with the frequency of low back pain or neck-shoulder pain in this study, can screen time take a major part of the daily living and this may result to less time for physical activity. This might reduce the total amount of physical activity. As mentioned before, learning early a passive lifestyle consisting of much screen time is likely to continue in adulthood. It is possible that this can lead to many health problems in later life.

Study strengths and limitations

In this study a major strength is the sample size: 1493 eighth-graders responded to questionnaire which is 91.1 % of all 1638 eighth-graders in Tampere Finland. The sample is though representative and informative. The second strength is the versatility of the used variables in physical activity and screen time. The total physical activity, school commuting and regular supervised exercise were evaluated separately. In addition to the weekly frequency of screen time exceeding 2 hours, parents' interference with screen time was examined.

The first limitation for this study is that study material is based on a questionnaire where the frequency of physical activity, screen time and musculoskeletal pain is self-reported. Self-reporting based on adolescents' own evaluation is a subjective measurement and there can be many problems related to it compared to objective measurements (26). Respondents may not remember to report all requested events and questions can be misunderstood (26). Furthermore, repetitive very short periods of physical activity may not be considered as part of the total physical activity (26).

The second limitation is the cross-sectional research frame: The examination of the causality was not possible. Third, physical activity and screen time are not the only factors having possible influence on neck-shoulder pain and low back pain in adolescents. In the literature smoking, parental history of low back pain, tallness, female gender, spinal trauma, disc degeneration, joint mobility, muscle flexibility, academic performance, self-image, bullying, depression and stress are presented as risk factors for neck-shoulder pain or low back pain in adolescents (2,3). Also, the comorbidity is common between neck-shoulder pain and low back pain and these symptoms are likely to appear together (3). These factors were not taken into consideration in this study and it is possible, that they may have affected to the results.

Conclusion

According to results the risk for neck-shoulder pain weekly or more often was lower for eighth graders commuting to school by walking or bicycling compared to eighth graders commuting by bus, car, moped or

microcar. Furthermore, for eighth graders having six hours or more supervised exercise weekly the risk for neck-shoulder pain was lower than for eighth graders having less supervised exercise. Adolescents should thus be encouraged to increase active school commuting and participation in supervised exercise outside school hours to prevent neck-shoulder pain. Prevention in adolescence may be beneficial also later in life: When musculoskeletal symptoms emerge early, they might be more likely to become chronic and greater impediment during the lifetime. The symptoms persisting in adulthood may impair work ability and furthermore lead to prolonged sick leaves and early retirements. However, more information about the association of active commuting and supervised exercise with musculoskeletal pain is still needed.

REFERENCES

(1) Hakala P, Rimpela A, Salminen JJ, Virtanen SM, Rimpela M. Back, neck, and shoulder pain in Finnish adolescents: national cross sectional surveys. BMJ 2002 October 5;325(7367):743.

(2) Hakala P, Rimpela A, Saarni L, Salminen JJ. Frequent computer-related activities increase the risk of neck-shoulder and low back pain in adolescents. Eur J Public Health 2006 October;16(5):536-541.

(3) Vikat A, Rimpela M, Salminen JJ, Rimpela A, Savolainen A, Virtanen SM. Neck or shoulder pain and low back pain in Finnish adolescents. Scand J Public Health 2000 Sep;28(3):164-173.

(4) Kovacs FM, Gestoso M, Gil del Real MT, Lopez J, Mufraggi N, Mendez JI. Risk factors for non-specific low back pain in schoolchildren and their parents: a population based study. Pain 2003 Jun;103(3):259-268.

(5) Torsheim T, Eriksson L, Schnohr CW, Hansen F, Bjarnason T, Valimaa R. Screen-based activities and physical complaints among adolescents from the Nordic countries. BMC Public Health 2010 Jun 09;10:324.

(6) Balague F, Troussier B, Salminen JJ. Non-specific low back pain in children and adolescents: risk factors. European Spine Journal 1999;8(6):429-438.

(7) Siivola SM, Levoska S, Latvala K, Hoskio E, Vanharanta H, Keinanen-Kiukaanniemi S. Predictive factors for neck and shoulder pain: a longitudinal study in young adults. Spine 2004 Aug 1;29(15):1662-1669.

(8) Hestbaek L, Leboeuf-Yde C, Kyvik KO, Manniche C. The course of low back pain from adolescence to adulthood: eight-year follow-up of 9600 twins. Spine 2006 Feb 15;31(4):468-472.

(9) Myrtveit SM, Sivertsen B, Skogen JC, Frostholm L, Stormark KM, Hysing M. Adolescent neck and shoulder pain--the association with depression, physical activity, screen-based activities, and use of health care services. Journal of Adolescent Health 2014 Sep;55(3):366-372.

(10) Shiri R, Falah-Hassani K. Does leisure time physical activity protect against low back pain? Systematic review and meta-analysis of 36 prospective cohort studies. Br J Sports Med 2017 Oct;51(19):1410-1418.

(11) Tammelin T, Iljukov S, Parkkari J. Kasvuikäisten liikunta. Duodecim 2015;131(18):1707-1712.

(12) World Health Organisation. Global recommendations on physical activity for health. 2010.

(13) Tammelin T, Aira A, Kulmala J, Kallio J, Kantomaa M, Valtonen M. Suomalaislasten fyysinen aktiivisuus : tavoitteena vähemmän istumista ja enemmän liikuntaa. Suomen lääkärilehti - Finlands läkartidning 2014;69(25-32):1871-1876.

(14) Davison KK, Werder JL, Lawson CT. Children's active commuting to school: current knowledge and future directions. Preventing Chronic Disease 2008 Jul;5(3):A100.

(15) Johansson K, Laflamme L, Hasselberg M. Active commuting to and from school among Swedish children-a national and regional study. Eur J Public Health 2012 April;22(2):209-214.

(16) Chillon P, Ortega FB, Ruiz JR, Veidebaum T, Oja L, Maestu J, et al. Active commuting to school in children and adolescents: an opportunity to increase physical activity and fitness. Scand J Public Health 2010 Dec;38(8):873-879.

(17) Yang X, Telama R, Hirvensalo M, Tammelin T, Viikari JSA, Raitakari OT. Active commuting from youth to adulthood and as a predictor of physical activity in early midlife: the young Finns study. Prev Med 2014 Feb;59:5-11.

(18) Borde R, Smith JJ, Sutherland R, Nathan N, Lubans DR. Methodological considerations and impact of school-based interventions on objectively measured physical activity in adolescents: a systematic review and meta-analysis. Obesity Reviews 2017 Apr;18(4):476-490.

(19) Auvinen J, Tammelin T, Taimela S, Zitting P, Karppinen J. Associations of physical activity and inactivity with low back pain in adolescents. Scand J Med Sci Sports 2008 Apr;18(2):188-194.

(20) Carlson SA, Fulton JE, Lee SM, Foley JT, Heitzler C, Huhman M. Influence of limit-setting and participation in physical activity on youth screen time. Pediatrics 2010 Jul;126(1):e89-96.

(21) Nuutinen T, Roos E, Ray C, Villberg J, Valimaa R, Rasmussen M, et al. Computer use, sleep duration and health symptoms: a cross-sectional study of 15-year olds in three countries. International Journal of Public Health 2014 Aug;59(4):619-628.

(22) Auvinen J, Tammelin T, Taimela S, Zitting P, Karppinen J. Neck and shoulder pains in relation to physical activity and sedentary activities in adolescence. Spine 2007 Apr 20;32(9):1038-1044.

(23) Brink Y, Louw QA. A systematic review of the relationship between sitting and upper quadrant musculoskeletal pain in children and adolescents. Man Ther 2013 Aug;18(4):281-288.

(24) Jussila A-M, Vasankari T, Paronen O, Sievanen H, Tokola K, Vaha-Ypya H, et al. KIDS OUT! Protocol of a brief school-based intervention to promote physical activity and to reduce screen time in a sub-cohort of Finnish eighth graders. BMC Public Health 2015 Jul 10;15:634.

(25) Kujala UM, Taimela S, Viljanen T. Leisure physical activity and various pain symptoms among adolescents. Br J Sports Med 1999 Oct;33(5):325-328.

(26) Aittasalo M, Tammelin T, Fogelholm M. Lasten ja nuorten fyysisen aktiivisuuden arviointi : menetelmät puntarissa. Liikunta ja tiede 2010;47(1):11-19.