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**Associations between Daytime Sleepiness, Psychological Symptoms, Headache, and
Abdominal Pain in School Children -**

Keywords: abdominal pain, adolescents, daytime sleepiness, headache, psychological symptoms, school health service, school nursing

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Abstract

Daytime sleepiness and different symptoms are common problems affecting health- and well-being of school children. This population-based cohort study included 568 children who were followed from ages 10 to 15 years. Daytime sleepiness, headache, abdominal pain, and psychological symptoms (depression, irritability or bad temper, nervousness, anxiety and dejection) were assessed by self-administered questionnaires. The prevalence of frequent daytime sleepiness was 13% at the ages of 10 and 12 years and increased significantly up to 24% at the age of 15 ($p < 0.0001$). Daytime sleepiness as well as psychological symptoms were positively associated with headache and abdominal pain from ages 10 to 15 years. Headache in girls at the ages of 10 predicted the occurrence of headache at the age of 15. School nurses and other professionals need to understand the importance of a holistic evaluation of sleep and different symptoms in children. There is also a need of interventions targeting several co-occurring symptoms.

Keywords

abdominal pain, adolescents, daytime sleepiness, headache, psychological symptoms, school health service, school nursing

Background

In school children, different kinds of psychosomatic symptoms such as headache, abdominal pain and depression are common. Older children and girls suffer from pain symptoms more often than younger children and boys (Kinnunen, Laukkanen & Kylmä, 2010). Headache and abdominal pain are the most commonly reported pain symptoms among school-aged children (Roth-Isigkeit, Thyen, Stöven, Schwarzenberge & Schmucker, 2005) and the most commonly co-occurring pain symptoms are abdominal pain and headache (Stanford, Chambers, Biesanz & Chen, 2008; Haraldstad, Sørum, Eide, Natvig & Helseth, 2011). Prevalence rates of the symptoms vary widely depending on the study population, classification of the symptom, and determination of frequency. During adolescence, the prevalence of headache varies from 10–48%, abdominal pain 3–39%. Of the psychological symptoms, depression is one of the most common health problem in adolescents. Estimations also vary according to the studies, between different countries, and across socioeconomic backgrounds (Ravens-Sieberer, Erhart, Gosch & Wille, 2008). Depression is associated with impaired school and work performance and difficulties in social relationships (Hammen 2009).

In addition to different types of symptoms, school children often report inadequate sleep, such as short sleeping times and experiencing daytime sleepiness (Singh & Kenney, 2013; Owens, 2014). Sleep is essential to health and good quality of life (Pavia, Gaspar & Matos, 2015; Gustafsson et al., 2016) and lack of sleep and daytime sleepiness are risk factors for mood and behavioral problems (Yen, King & Tang, 2010), compromised well-being (Brand et al., 2010), overweight (Hart, Cairns & Jelalian, 2011) and poor school performance (Dewald, Meijer, Oort, Kerkhof & Bogels, 2010; Schmidt & Van der Linden, 2015). The association between short sleep duration and daytime sleepiness has been found in several studies among children and

adolescents (Moore, et al., 2011; Langberg, Dvorsky, Marshall & Evans, 2013). Shorter sleep time has been found to be associated with both daytime sleepiness and depressive symptoms, anxiety and withdrawal (Fredriksen, Rhodes, Reddy & Way, 2004; O'Brien & Mindell, 2005; Coulomb, Reid, Boyle & Racine, 2010). Symptoms and inadequate sleep duration often co-occur (Kröner-Herwig, Heinrich & Vath, 2010) and similar physiological background factors have been linked with both headache and inadequate sleep (Brun Sundblad, Saartok & Engström, 2007).

Cross sectional evidence supports an association between headache, abdominal pain, depression and sleep. There is however lack of longitudinal, cohort research. In this research, we study the change in prevalence and associations between daytime sleepiness, headache, abdominal pain and psychological symptoms (depression, irritability or bad temper, nervousness, anxiety and dejection) as children of a certain age cohort grow from age 10 to 15.

Aim

1. To identify the prevalence of each of the following: daytime sleepiness, headaches, abdominal pain, and the psychological symptoms (depression, irritability or bad temper, nervousness, anxiety and dejection) over time in school children at 10, 12 and 15 years of age.
2. To identify the association between daytime sleepiness and headaches, abdominal pain, and the psychological symptoms (depression, irritability or bad temper, nervousness, anxiety and dejection) in school children followed from 10 to 15 years.
3. To determine the modifying effects of sex and age on the associations between daytime sleepiness, headache, abdominal pain and psychological symptoms (depression, irritability or bad temper, nervousness, anxiety and dejection).

Methods

This prospective follow-up survey study complies with national legislation (Medical research act 488/1999) and general guidelines for research ethics (TENK 2004). The study protocol has been approved by the Ethics Committee of the Hospital District of Southwest Finland (VSSHP 2004). All participating children provided their assent and the parents provided their informed consent for the child to participate in the study.

Sample/ participants

The study population consisted of the total cohort (n=1351) of schoolchildren starting 4th grade (age 9-10) in 2004 at Finnish primary schools (n=31) in an urban city of 175,000 inhabitants. The schools located around the city and respondents represent a very wide range of different socioeconomic backgrounds. The baseline research was performed in 2004 and the follow-ups in 2006 and 2010. The participants across the study years are presented in the flow chart (Picture 1).

Picture 1. The participants across the study.



The rate of attrition (from baseline to 2nd follow-up) for girls was 36% and for boys 39%. In the drop-out analysis we used data from the age of 10 to compare those who did not complete the questionnaire at age 15 years with those who completed the questionnaire. For both those completing and drop out at age 15 years, there were no statistically significant differences in the amount of sleep, frequency of daytime sleepiness, headache, and abdominal pain when aged 10 years.

Instruments

The Health Behavior of School Aged Children (HBSC) questionnaire was used to assess self-reported daytime sleepiness and symptoms (www.hbsc.org). Both electronic and paper form questionnaires were used because some schools were lacking computers. Paper and electronic form questionnaires were identical in content and as identical as possible in outer appearance. The questionnaires were piloted for validity and reliability prior to the data collection. No changes to the questionnaire were made at nor after the pilot stage.

Daytime sleepiness was assessed by the question: how often have you felt tired in the daytime during the last week. The response alternatives were “daily, several times/week, twice/week, once/week and not at all”. The symptom questionnaire included questions about headache and abdominal pain and specific questions about psychological symptoms including depression, irritability or bad temper, nervousness, anxiety and dejection. The following questions were used to assess self-reported pain and psychological symptoms: “How often during the preceding six months have you had headache/abdominal pain/ depression/ irritability or bad temper/ nervousness/ anxiety/ dejection?”. Symptoms were rated on a five-point frequency scale (seldom or never, once a month, once a week, more than once a week, almost daily). In the

analysis, symptom frequencies of more than once a week and almost daily were combined and renamed as “frequent.”

Data collection

The teachers from each school informed children and their parents about the study. All children provided their assent and the parents provided their informed consent for the child to participate in the study. The students responded anonymously to a standardized questionnaire during one lesson (45 minutes) at school. Teachers followed a standard set of instructions to carry out the classroom data collection. The questionnaires were completed in a paper or electronic form, depending on the availability of computers at the schools. Most of the children completed the electronic form of the questionnaire

Data analysis

Descriptive statistics are shown with counts and percentages. Headache was handled with 4-ordinal categories in the analyses (response options “almost daily” and “at least once a week” were combined and reported as “frequent”). For abdominal pain the same modelling approach explaining above was used.

In the statistical models, headache was handled as the dependent variable, and the association with daytime sleepiness, psychological symptoms, and gender was examined. While the same children were examined at ages 10, 12 and 15, ordinal logistic regression for repeated measures was used to take into account the correlations between the measurements (SAS[®] GLIMMIX Procedure). Further, interactions between daytime sleepiness and age, gender, and year, as well as psychological symptoms and year were included in the model; we were also interested in whether the association of these factors changed during the study period. If a statistically

significant effect was found, further contrasts were programmed to find out where the significant differences lay. For example, if the age effect was significant, it was examined whether the effect was found between 10–12 years of age, 10–15 years of age and/or 12–15 years of age.

Further, we examined whether symptoms at age 10 predict headache or abdominal pain at age 15 and whether the prediction differed between boys and girls. First, univariate analyses were performed with a chi-square test for all children and separately for boys and girls. Associations between headache at the age of 15 and headache, psychological symptoms, and daytime sleepiness (at the age of 10 years) were studied. Secondly, we modelled headache at 15 years while including all the explanatory variables in the same ordinal logistic regression model (SAS® GLIMMIX Procedure). This model was performed for boys and girls separately and also in a model where gender was one factor in the model. In the combined model, all interactions with gender were included.

P-values of less than 0.05 (two-tailed) were considered statistically significant. The software used for statistical analysis was SAS ® System (version 9.3 and 9.4 for Windows).

Results

The aims of the study were to 1. identify the prevalence of daytime sleepiness, headaches, abdominal pain, and the psychological symptoms (depression, irritability or bad temper, nervousness, anxiety and dejection) over time, 2. identify the association between daytime sleepiness and headaches, abdominal pain, and the psychological symptoms (depression, irritability or bad temper, nervousness, anxiety and dejection) and 3. determine the modifying effects of sex and age on the associations between daytime sleepiness, headache, abdominal

pain and psychological symptoms (depression, irritability or bad temper, nervousness, anxiety and dejection).

The prevalences of daytime sleepiness are presented in Table 1. The prevalence of frequent daytime sleepiness (daily or several times a week) was 13% at both ages 10 and 12 years and increased significantly up to 24% at the age of 15 years ($p < 0.0001$). The increase in prevalence between ages 12 and 15 was greater among girls (13% to 31%) than among boys (14% to 12%) ($p < 0.0001$).

The prevalences for headache are presented in Table 2. The occurrence of headache increased statistically significantly between the ages 10 and 15 years (Test statistics F_{df} with degrees of freedom (df); $F_4=4.1$, $p=0.017$). At the age of 15 years, 35% of girls and 19% of boys suffered from weekly or more frequent headache.

Table 2 also presents the prevalence of abdominal pain. The prevalence rates for weekly or more frequent abdominal pain slightly dropped from 14% at 10 years to 11% at 12 years. The prevalence of abdominal pain ($F_2=1.0$, $p=0.38$) did not change significantly between ages 10 and 15. However, girls suffered more abdominal pain than boys (10 yrs 16% vs 11%; 12 yrs 15% vs 8%; 15 yrs 13% vs 10%) ($F_1=52.0$, $p < 0.0001$).

Overall a greater proportion of girls compared to boys suffered from at least weekly headache ($F_2=33.5$, $p < 0.0001$). Furthermore, changes in abdominal pain and headache over time did not differ significantly between boys and girls (gender*time interaction $F_2=0.1$, $p=0.90$ headache and $F_2=2.4$, $p=0.95$ abdominal pain).

We also wanted to study associations between daytime sleepiness and headache as well as abdominal pain. Overall, the prevalence of daytime sleepiness in all ages was significantly

associated with frequency of headache ($F_4 = 17.4$, $p < 0.0001$) and abdominal pain ($F_4 = 9.2$, $p < 0.0001$). The more children experienced daytime sleepiness, the more they also experienced headache and abdominal pain. We did not detect any changes in the association between headache and daytime sleepiness during adolescence ($F_8 = 1.2$, $p = 0.29$) or abdominal pain and daytime sleepiness ($F_8 = 1.0$, $p = 0.44$).

In addition, positive associations between psychological symptoms and headache ($F_1 = 152.4$, $p < 0.0001$) as well as abdominal pain ($F_1 = 131.0$, $p < 0.0001$) were observed; subjects with psychological problems suffered more frequently from headache and abdominal pain. These associations were similar in all age groups ($F_2 = 0.8$, $p = 0.46$ headache and $F_2 = 0.7$, $p = 0.50$ abdominal pain) Table 3.

Univariate analysis showed a significant association between headache at 15 years and daytime sleepiness, headache and psychological symptoms at 10 years. The multivariable ordinal logistic regression analysis showed that associations with headache suffered at 10 years old was statistically significantly different between girls and boys ($p = 0.028$). Girls showed a significant association for headache at 10 years and 15 years ($p < 0.00001$), whereas the association in boys was not statistically significant ($p = 0.49$). In the multivariable model, neither daytime sleepiness nor psychological symptoms significantly predicted headache at 15 years (Figure 1).

The univariate analysis showed a significant association between abdominal pain ($p < 0.0001$), daytime sleepiness ($p < 0.0001$), and psychological symptoms ($p < 0.0001$) at ten years. In the analysis between daytime sleepiness at 10 years, abdominal pain, psychological symptoms and abdominal pain at 15 years only psychological symptoms at the age of 10 indicatively predicted abdominal pain at age 15 ($p = 0.043$).

Discussion

The results of this prospective cohort study showed a predictive association between headache at 10 years of age and headache at 15 years of age. Moreover, daytime sleepiness at the age of 10 was significantly associated with headache and psychological symptoms at the age of 10. However daytime sleepiness or psychological symptoms at the age of 10 did not significantly predict headache at the age of 15. Moreover, daytime sleepiness, headache or psychological symptoms at the age of 10 did not predict abdominal pain at the age of 15. Previous studies show similar results in headache being a symptom that is associated with other symptoms earlier in life (Blaauw et al., 2015).

Our study is consistent with findings from previous studies that show that children who reported frequent daytime sleepiness also reported other symptoms. We found a significant association between daytime sleepiness, headache, abdominal pain, and psychological symptoms in both genders. Daytime sleepiness has been studied in association with several individual symptoms, e.g. with cognitive function and mood, (Coulombe, Reid, Boyle, & Racine, 2009, Millman & Working Group on Sleepiness in Adolesc, 2005, O'Brien & Mindell, 2005, Pavia, Gaspar & Matos, 2015, Yang, Choe, Park & Kang, 2017). While the association between daytime sleepiness and different symptoms is quite well established the mechanisms behind daytime sleepiness are complex and not yet well understood in the general school child population.

School Nursing Implications

For the school health care and school nursing professionals, the results of this study show the importance of a holistic evaluation of sleep and different symptoms. As both daytime sleepiness and co-occurring symptoms are fairly frequent, it is relevant to evaluate these factors in schools

on a regular basis. A clinical examination and assessment of psychological and social issues is relevant and also the need for interventions targeting not merely a single symptom but several co-occurring symptoms.

School health care can play a vital role in preventing, detecting and intervening in these issues. However, all problems cannot be solved in health care since the causes of symptoms may be associated with, for example, family situations, bullying, and stress. In early adolescence, children form a lifestyle that they often follow through with in later life. Hence schools and school health care play a key role in health education (WHO 2011, WHO 2012). Our results indicate that interventions should be implemented separately for girls and boys and already before puberty, so that the negative effect of unhealthy habits can be prevented.

Strengths and limitations of the study

There are several strengths as well as some limitations that need to be considered. One strength is that this is one of the first studies where a group of children and a wide spectre of symptoms have been followed during five years of adolescence. Another strength is the population-based sample from a school cohort that includes children from very heterogenic socioeconomic backgrounds, making the results generalizable.

Limitations that need to be considered relate to using only child self-assessment questionnaires, while no clinical examinations were performed. The number of drop-outs can be considered a limitation, though the dropout analysis showed little effect from attrition on the final results. In the Finnish school system, children often change schools and sometimes also city when they move from grade 6 to 7. This is one reason for high rate of attrition. Also, if the children were sick or

otherwise unable to fill in the questionnaire at the school at a specific time they were not able to attend. Moreover, high attrition rate is quite usual in follow-up studies lasting for five years.

Conclusion

Daytime sleepiness, headache, abdominal pain and psychological symptoms are associated strongly with each other. Headache is quite a persistent symptom during adolescence, especially in girls, who had overall more symptoms compared with boys. Girls' headache at the age of ten years strongly predicts headache at the age of 15 years. Girls suffer from daytime sleepiness, headache, abdominal pain and psychological symptoms more frequently than boys, both at the age of 10 and 15. At the age of ten, all the studied variables (daytime sleepiness, headache, abdominal pain, and psychological symptoms) were strongly associated with each other. A better understanding of children's and adolescent's daytime sleepiness and symptoms is still needed, and effective gender specific interventions for high-risk children should be developed. The results of this study show the importance of a holistic evaluation of sleep and different symptoms in children and the need for interventions targeting not only a single symptom, but several co-occurring symptoms. According to our study, the risk of having both psychosomatic and psychological symptoms is high.

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Declaration of Conflicting Interests

None of the authors have any conflict of interests to declare.

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Figure 1. The association between daytime sleepiness, headache, and psychological symptoms at the age of 10 and 15 years. Multivariable approach was ordinal logistic regression model.

Table 1

Daytime sleepiness categorized into five categories (daily, several times/week, twice/week, once/week and not at all) at the age of 10, 12 and 15 years in school children (n=568).

Daytime sleepiness	Age10 n(%)	Age 12 n(%)	Age 15 n(%)
Daily			
All	12(1)	20(2)	21(4)
Girls	8(2)	8(2)	14(5)
Boys	4(1)	12(3)	7(3)
Several times/week			
All	105(12)	99(11)	115(20)
Girls	57(12)	51(11)	78(26)
Boys	48(11)	48(11)	37(14)
Twice/week			
All	218(25)	25(28)	168(31)
Girls	119(25)	136(29)	99(33)
Boys	99(23)	115(25)	70(26)
Once/ week			
All	286(32)	327(36)	168(31)
Girls	144(31)	174(37)	76(25)
Boys	142(32)	153(34)	93(35)
Not at all			
All	233(27)	200(22)	79(14)
Girls	117(25)	96(20)	27 (9)
Boys	116(26)	104(23)	52(19)

Table 2

The prevalence of headache and abdominal pain at the age of 10, 12 and 15 years.

	Headache				Headache				Headache			
Psychological symptom	51(89)	77 (69)	132 (52)	133 (32)	42 (78)	50 (57)	118 (41)	83 (20)	34 (74)	62 (58)	61 (35)	39 (18)
Frequent*	6(11)	35 (31)	122 (48)	278 (67)	12 (22)	38 (43)	171 (59)	328 (80)	12 (26)	44 (42)	112 (65)	178 (82)
No frequent	57(7)	112 (13)	254 (31)	411 (49)	54 (6)	88 (11)	289 (34)	411 (49)	46 (8)	106 (20)	173 (32)	217 (40)
Total												
	Abdominal pain				Abdominal pain				Abdominal pain			
Psychological symptom												
Frequent*	37 (90)	55 (77)	121 (58)	179 (35)	26 (76)	43 (69)	95 (44)	129 (25)	19 (83)	27 (68)	91 (47)	59 (21)
No frequent	4 (10)	16 (23)	88 (42)	333 (65)	8 (24)	19 (31)	122 (56)	395 (75)	4 (17)	13 (32)	102 (53)	226 (79)
Total	41 (5)	71(9)	209 (25)	512 (61)	34 (4)	62 (7)	217 (26)	524 (63)	23 (4)	40 (7)	193 (36)	285 (53)

*Psychological symptom is frequent if one of the symptoms (depression, irritability or bad temper, nervousness, anxiety, dejection) was reported at least weekly.

