Recurrent Neck Pain and Headaches in Preadolescents Associated with Mechanical Dysfunction of the Cervical Spine: A Cross-Sectional Observational Study With 131 Students

Sue A. Weber Hellstenius, DC, MSc

Abstract

Objective: To identify if there were differences in the cervical biomechanics in preadolescents who had recurrent neck pain and/or headaches and those who did not.

Methods: A controlled comparison study with a convenience sample of 131 students (10-13 years old) was performed. A questionnaire placed students in the no pain group or in the neck pain/headache group. A physical examination was performed by a doctor of chiropractic to establish head posture, active cervical rotation, passive cervical joint functioning, and muscle impairment. The unpaired t test and the χ^2 test were used to test for differences between the 2 groups, and data were analyzed using SPSS 15 (SPSS Inc, Chicago, Ill).

Results: Forty percent of the children (n = 52) reported neck pain and/or recurrent headache. Neck pain and/or headache were not associated with forward head posture, impaired functioning in cervical paraspinal muscles, and joint dysfunction in the upper and middle cervical spine in these subjects. However, joint dysfunction in the lower cervical spine was significantly associated with neck pain and/or headache in these preadolescents. Most of the students had nonsymptomatic biomechanical dysfunction of the upper cervical spine. There was a wide variation between parental report and the child's self-report of trauma history and neck pain and/or headache prevalence.

Conclusion: In this study, the physical examination findings between preadolescents with neck pain and/or headaches and those who were symptom free differed significantly in one of the parameters measured. Cervical joint dysfunction was a significant finding among those preadolescents complaining of neck pain and/or headache as compared to those who did not. (J Manipulative Physiol Ther 2009;32:625-634)

Key Indexing Terms: *Neck Pain; Headache; Child; Cervical Vertebrae; Chiropractic*

Recurrent neck pain and headaches are among the most commonly occurring pain syndromes in childhood.[1-4] This is a concern because there has been an increase in prevalence of both neck pain and/or headaches in childhood and because these pain syndromes more often become chronic in adolescence as well as in adulthood.[4-7] Neck pain and/or headaches are a significant cause of morbidity in children both in terms of personal suffering and the negative impact on participation in daily activities.[8-10] There are also significant economic consequences resulting from lost productivity as parents are home from work with sick children as well as the long term impact when a percentage of these children will not be fully productive as adults.[6,7]

There are several difficulties encountered when interpreting the literature in regards to neck pain and/or headaches in young children. There are very few studies investigating neck pain in preadolescents. One author suggests that neck pain fluctuates through preadolescence but that some children have persistent neck pain.[11] Headaches evolve and change in their presentation, duration and symptomatology through childhood transitioning into the types of headaches that we recognize in adults.[12,13] Headaches in preadolescents are more diffuse than those in adults and can be difficult to interpret or distinguish. Both neck pain and headache have an even sex distribution in preadolescence, but in adolescence, there is a significant rise in the prevalence of neck pain and headaches and a sex shift with female preponderance.[2-4,14]

Clinician in Private Practice, Stockholm, Sweden.
Postgraduate Lecturer in Chiropractic Paediatrics.
This study was completed for the Masters dissertation in Chiropractic Paediatrics at Anglo-European College of Chiropractic/Bournemouth University in England August 2008.
Submit requests for reprints to: Sue A. Weber Hellstenius, DC, MSc, Wirsensv. 11, 186 50 Vallentuna, Sweden
(e-mail: *dr.sue@telia.com*).
Paper submitted April 29, 2009; in revised form June 26, 2009; accepted July 27, 2009.
0161-4754/$36.00

doi:10.1016/j.jmpt.2009.08.025

Studies investigating headaches in children classify recurrent headaches as either migraine or tension-type headaches according to the criteria proposed by the International Headache Society.[15] These criteria are based on adult headache symptomatology. It is not until adolescence that headaches take on adult-like characteristics. In younger children, headache symptoms are not specific to headache type.[15] Not surprisingly, headaches are commonly misdiagnosed in these children and statistics regarding prevalence rates of specific headaches are unreliable.[14,16] Furthermore, studies in children have not been uniform in their methods of headache classification nor in their inclusion criterion making comparison of prevalence rates difficult.[17,18] This is reflected in the wide range of prevalence rates quoted in studies: they are from as low as 6% to as high as 80%.[16,19-28]

Almost all of the information obtained from studies of neck pain and/or headache in children comes from questionnaires, but the validity of assessing pain retrospectively in children has been disputed.[29-31] Age appropriate daily pain diaries have been found to be most accurate in assessing the duration, intensity and frequency of pain in children.[29-32]

Most of the studies of children with recurring neck pain and/or headaches focus on the association with adverse psychological factors. The literature suggests that children with psychological problems have an increased prevalence of somatic pain including neck pain and headaches.[33-35] Laurell et al[3] investigated the relationship between psychosocial factors and headache in school children and, in contrast to other previous studies, concluded that anxiety and depression were not significantly associated with headaches in younger school children.[1,36-41]

Among preadolescents with neck pain, a relationship between the frequency of neck pain and the frequency of headache has been documented.[4] Faulty sitting posture in school, particularly prolonged neck flexion and static postures, were associated with neck pain and headaches in this age group.[42,43] Preadolescents diagnosed with migraine headache had associated pericranial, neck, and shoulder muscle tenderness, while those classified as having tension-type headache did not.[44]

In adults, mechanical dysfunction of the cervical spine can be the primary cause of recurrent neck pain and/or headaches and has been termed cervicogenic headache.[45-47] The findings in adults with cervicogenic headache include faulty head posture, cervical joint dysfunction (CJD), trigger points (TPs) in associated cervical paraspinal muscles, and reduction in cervical range of motion.[45,48-53] Forward head posture is a deviation from normal which strains the upper cervical spine and can be a cause of neck pain and headache.[54-56] Trigger points or focal points of increased tension in a muscle, when present in the cervical spine, can also lead to neck pain and/or headaches.[57-64] Studies indicate that the upper cervical spine is the primary area of dysfunction in adults with cervicogenic headache.[46,50,51,65-72]

These factors are not only a cause of neck pain and/or headache, but they can initiate or exacerbate both migraine headaches and tension-type headaches.[57-59,63,64,66-68] Cervicogenic headaches commonly become chronic. This is thought to be the result of the production of proinflammatory cytokinins which contribute to neuronal sensitization resulting in chronic pain syndromes.[63,73,74]

Because the cervical spine influences all three headache types, its importance should not be underestimated.[58,60,75] The contribution of dysfunctional mechanics of the cervical spine to neck pain and headaches has been investigated to some extent in adults but, thus far, has not been studied in preadolescents. The intention of this study was to investigate whether preadolescents presenting with recurrent neck pain and/or headaches had different physical findings than preadolescents who are symptom free, particularly in regards to faulty head posture, reduced cervical rotation, focal areas of tension in cervical paraspinal muscles, and CJD.

Methods

This was a cross-sectional observational study investigating whether preadolescents with neck pain and/or headache differed from preadolescents who did not have neck pain or headache in physical examination findings including head posture, active cervical rotation, palpation of cervical paraspinal muscles, and cervical joint functioning. Subjects were selected from a convenience sample of students at a municipal school in a middle-class suburb outside of Stockholm, Sweden. Information was gathered from students in a questionnaire (Appendix A) which was completed in school; an informed consent form with additional questions for parents (the parents were asked separately if their child had neck pain and/or headaches and also if their child had experienced trauma to the head or neck); and a physical examination by a blinded, experienced chiropractor of students.

The inclusion criteria were students who: were in the fourth, fifth, and sixth grades; agreed to participate; had written consent from a parent or guardian; had completed the questionnaire; and had the ability to communicate verbally. Exclusion criteria were students who: were undergoing treatment for a systemic or infectious disease; at any time expressed unwillingness to participate; and/or did not have parental consent.

The questionnaire and was completed by 131 students (100%). It was adapted from questionnaires found in the literature investigating characteristics of headaches and neck pain.[36-39] It was pilot-tested on a group of 10-year olds (n = 10) to ensure that the youngest students had no problem understanding the questions and the alternatives provided. The questions concerned the duration and frequency of pain, associated symptoms, medication use, and initiating or exacerbating factors. For average pain intensity and pain at

its worst, an 11-point Likert scale was used. Children were asked to rate pain from 0 to 11 where 0 was no pain and 11 was intolerable pain. Impairment was measured by assessing how pain affected their ability to participate in activities of daily living.

Categorization

The neck pain/headache group was defined as those students who answered "I have neck pain" or "I have headaches" when asked on the questionnaire if they experienced neck pain or headaches. The no pain group consisted of students who answered "I never have neck pain or headaches", or "I only have neck pain or headaches when I am sick" when answering the same question. The examiners were blinded to which group the students were in as they had no access to the questionnaires prior to the physical examination and communicated with students only in the form of asking for their participation and giving instructions.

Physical Examination

The examination was conducted in school by a doctor of chiropractic with 20 years of clinical experience working with children and adults; instructions were given for all parts of the examination and results recorded by an experienced Swedish chiropractor. One hundred ten students filled the inclusion criteria and were given instructions in how to stand and sit so measurements were as uniform as possible. A plumb line test for postural alignment was used to assess forward head posture.[55] The base point was fixed anterior to the lateral malleolus and forward head posture was recorded when the external auditory meatus (EAM) was anterior to the plumb line. Students were then instructed to sit upright with their buttocks positioned at the back of a school chair and their arms relaxed at their sides. The midpoint of the body laterally was used for a fixed point and the position of the EAM was evaluated in relation to the plumb line. Forward head posture was noted when the EAM was anterior to the plumb line.

While still sitting, a cervical collar goniometer (Reedco Research, Geneva, NY) was used to measure active cervical range of motion, specifically rotation to the right and left. While sitting erect, students were instructed to rotate their head to each side as far as they comfortably could without moving their shoulders. The examiner stood behind them with fingers resting on their shoulders to feel if and when shoulder movement was engaged. Rotation was measured in degrees to the right and to the left before shoulder activity was engaged.

Students were then asked to lie supine on the treatment table and relax with their hands clasped on their stomach. The examiner palpated the cervical spine translating each cervical segment in order to identify areas of segmental dysfunction. These were noted in the upper, the mid, and the lower cervical spine on the right and on the left sides when present as CJD.

The cervical musculature was palpated for focal areas of muscle tension in taut bands in the upper, mid, and lower cervical spine. These were noted when present on the right and/or left in the upper, mid and/or lower cervical spine as TPs on the examination sheet. Because the examiner was blinded, no information could be obtained from students about the presence of pain on palpation or radiation of pain to a distant site.

Statistical Analysis

Data were analyzed using descriptive statistics. To test for differences in continuous variables (cervical range of motion), the unpaired t test was used. To test for differences in categorical variables (forward head posture, CJD, and focal points of increased tension in cervical muscles) between the two groups, the χ^2 test was used. Statistical analysis was conducted at a 95% confidence interval. $P \leq .05$ was considered statistically significant. The data were analyzed using the SPSS version 15 (SPSS Inc, Chicago, Ill).

Ethical Consideration

The procedures were performed with the approval of the Anglo-European Chiropractic College Research Ethics Sub-Committee for postgraduate research in accordance with the Declaration of Helsinki. Ethics approval was required in Sweden and was granted by the Stockholm Regional Medical Ethics Committee (2007/1027-31/2).

Results

Subjects

All of the students (n = 131) who were approached to participate in the study agreed to complete the questionnaire. Of these, 40% (n = 52) reported that they experienced neck pain and/or headaches. Among the students, there was an approximately even sex distribution with 66 girls and 65 boys answering questions. In the fourth grade (10-11-year olds), there were as many boys as girls who described having neck pain and/or headaches and this was also true for the students in the fifth grade (11-12-year olds). In the sixth grade (12-13-year olds) where students were periadolescent, there was an increase in the prevalence of neck pain and/or headaches among the boys and the girls as well as a sex shift with female preponderance.

Findings from the Questionnaire

There was a discrepancy between what the children and the parents reported, respectively, 31% (n = 41) of the children reported in the questionnaire that they "often" had neck pain and/or headaches, whereas only 6% (n = 8) of the parents wrote that their child had neck pain and/or headaches

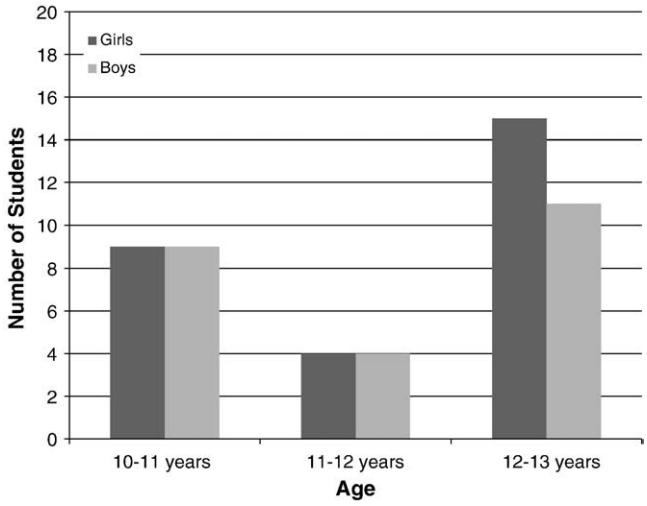

Fig 1. *Prevalence of neck pain and/or headache in Swedish preadolescents.*

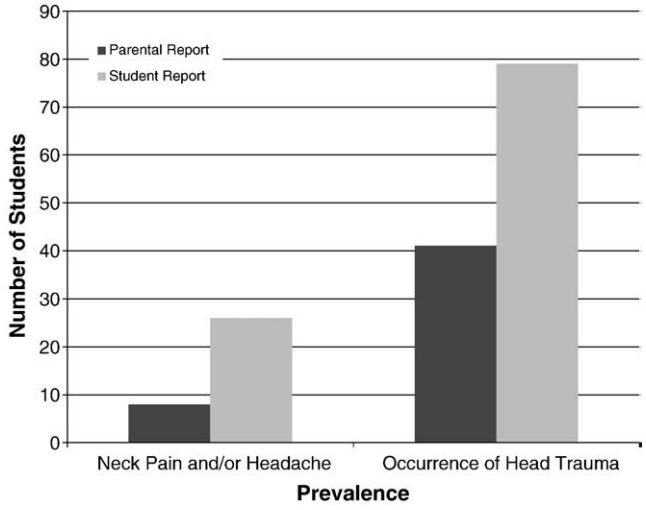

Fig 2. *Parental and preadolescent report of neck pain and/or headache, and trauma.*

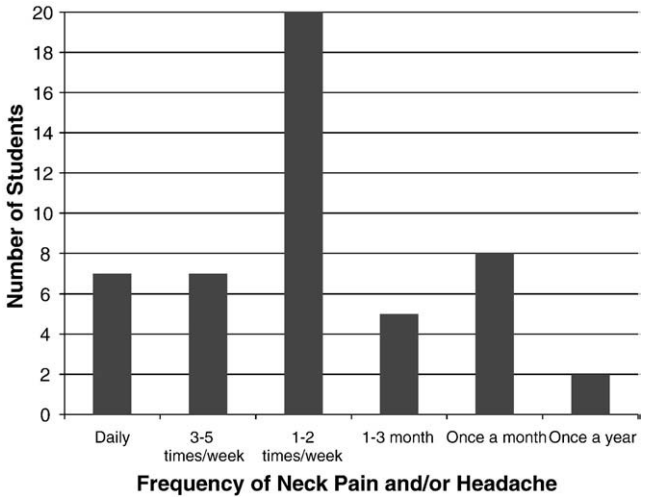

Fig 3. *Frequency of neck pain and/or headache reported by Swedish preadolescents.*

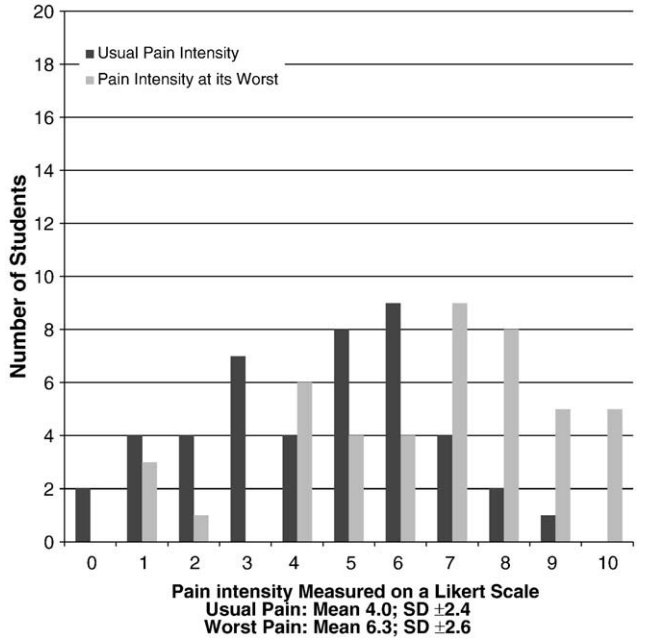

Fig 4. *Pain intensity reported by Swedish preadolescents with neck pain and/or headache.*

"often" (Fig 1). Similarly, 61% (n = 80) of children reported trauma to the head/neck, whereas only 20% (n = 26) of parents reported that their child had experienced trauma to the head and/or neck region (Fig 2). There was no significant relationship found between the occurrence of trauma and the incidence of neck pain and/or headaches in the students examined when analyzed with the χ^2 test ($P = .102$).

Prolonged static postures (longer than 2 hours) were reported to initiate or exacerbate neck pain and/or headaches by the students reporting symptoms, specifically, prolonged reading (42%, n = 22) and prolonged computer use (44%, n = 23). Twenty-seven percent (n = 14) of the children with symptoms reported that moving their neck could initiate or exacerbate their neck pain and/or headaches. Figure 3 illustrates the frequency of neck pain and/or headache reported by students. Children most commonly reported that they had episodes of pain 1 to 2 times a week (n = 20).

Children rated their average pain intensity on the Likert scale 4.02 with SD 2.38 (Fig 4). Seventy-five percent reported that activities of daily living were not interrupted by pain. Nineteen percent reported neck pain/headaches could affect them so that at times they could only partially participate in activities, 13% could not at times participate in activities, and 15% needed to lie down with severe episodes.

Findings From the Physical Examination

Of the 131 students who agreed to fill in the questionnaire, 110 students (84%) fulfilled the inclusion criteria and were examined.

Forward Head Posture and Neck Pain and/or Headache. There was a fairly even distribution of forward head posture (FHP) in both sitting and standing between the two groups of students, both those with complaints of neck pain and/or headaches and those who were symptom free. Fifty-three percent (n = 58) of all the students examined had FHP while standing and 50% (n = 55) had FHP while sitting. In this study population, there was no difference between the 2 groups of preadolescents when measuring forward head posture while standing (P = .204) or sitting (P = .846). Forward head posture was not significantly associated with neck pain and/or headache when analyzed with χ^2 test.

Cervical Range of Motion. Cervical rotation to the right and to the left did not differ significantly between the students with symptoms and those who were symptom-free when analyzed with the unpaired t test.

Trigger Points or Focal Points of Increased Tension in Taut Bands of Muscle. More than half of all the students (60%, n = 66) examined had these focal points of increased tension in the suboccipital muscles. There were no significant associations found between neck pain and/or headache and the presence of focal points of increased tension in the upper, mid, or lower cervical musculature. The two groups of students did not differ in this parameter when analyzed with χ^2 test.

Cervical Joint Dysfunction. Evaluation of the students revealed that 46% (n = 51) had upper CJD, 33% (n = 36) had mid-CJD and 16% (n = 18) had lower CJD. There was no significant difference between the two groups of students when evaluating the presence of CJD in the upper and middle cervical spine. A significant relationship was found however between the presence of lower CJD on the right among preadolescents with neck pain and/or headaches (on right: P = .050 which is significant; on left: P = .475) as compared to those students who were symptom-free when analyzed with χ^2 test.

The results from the physical examination for all the students (n = 110) are compiled and illustrated in Figure 5.

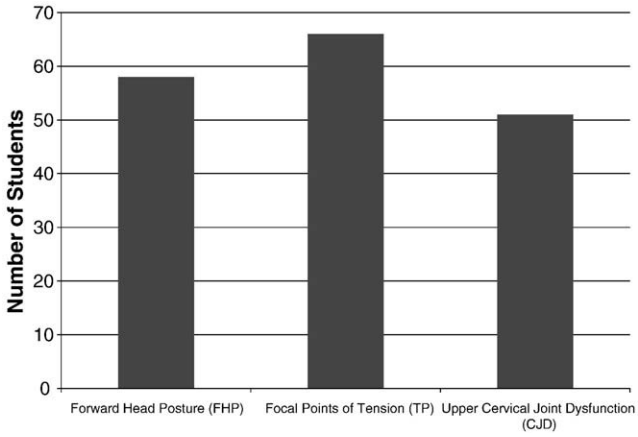

Fig 5. *Prevalence of FHP, focal points of tension in suboccipital muscles (TP), and upper CJD in Swedish preadolescents.*

Discussion

There was a 40% prevalence of neck pain and/or headache reported by the preadolescents in this study. This statistic is difficult to compare with results from other studies because the prevalence of either or both neck pain and/or headaches in preadolescents had not been measured before. There was an even sex distribution among the students who reported having neck pain and/or headache who were between 10 and 12 years of age. This is in agreement with other reported data for this age group.[4,28] Students between 12 and 13 years of age must be considered periadolescent and interestingly, in this group, there was an increase in prevalence of neck pain and/or headaches among both boys and girls, and a clear shift in sex distribution with female preponderance. The increase in prevalence of neck pain and/or headache with a female sex shift in adolescence has been noted previously in the literature.[5,14,19,23,27,28,76,77]

Students in this study reported having a fairly high level of pain and that it affected some students in their ability to participate in daily activities. Twenty percent reported that they have pain 1 to 2 times a week. It is interesting that very few parents reported that their child had neck pain and/or headache. There was a discrepancy between parents' report of their child's neck pain and/or headache occurring "often" (6%) and children (31%) who reported having pain "often." These discrepancies may reflect the weakness of questionnaires in assessing pain in preadolescents and highlight the need gathering data prospectively with daily recording of symptoms as well as through interviews with parents and children. The results otherwise support the findings of Lundqvist et al[29] which indicated that parents not uncommonly underestimate headaches in their children.

There was also discrepancy between parental report and child self-report in regards to the incidence of head trauma. It is feasible that children do not always tell that they have hurt themselves, so interviews with both children and parents would have improved the accuracy of this question. Considering that 60% of the students reported head trauma and more than half of the students had dysfunction in the upper cervical spine, the possible relationship between the two should be investigated more closely.

The present study is to our knowledge the first cross-sectional observational study to evaluate whether preadolescents with recurrent neck pain and/or headache differed from peers not complaining of neck pain and/or headache in physical examination findings, specifically,

forward head posture, active cervical rotation, CJD, and the presence of focal areas of tension in the cervical paraspinal muscles.

Forward head posture is associated with neck pain, cervicogenic headache, tension- type headache and migraine headache in adults.[51,54-56,70] In our study, the group of students with neck pain and headaches did not have an associated forward head posture suggesting that in this group of adolescents forward head posture is not yet a significant associated factor. It is of interest that most of the students examined had forward head posture both in standing and sitting. Further studies are needed to investigate if this is a predisposing factor for the increase in neck pain and headache prevalence observed in adolescence.

Reduced cervical rotation has been recorded in adults with cervicogenic headache and thought to be a result of cranio-CJD reducing rotation at the C0-C1 joint.[58,71,72] Unlike adults with cervicogenic headache, the group of preadolescents in this study with neck pain and/or headaches did not have associated upper CJD nor did they have reduced cervical rotation. The group of students with neck pain and/or headache did have a significant associated right lower CJD. This could be an important finding which may help to guide the implementation of treatment strategies for those preadolescents with neck pain and/or headaches who have associated joint dysfunction in the cervical spine.

Unlike adults, the preadolescents in this study with neck pain and/or headaches did not have associated focal areas increased tension in cervical paraspinal muscles. However, when evaluating the physical examination findings from all of students combined, 60% had focal areas of tension in the suboccipital muscles, 53% had forward head posture, and 46% had upper CJD. It is the combination of these factors which has been found in adult patients with dysfunctional mechanics of the cervical spine contributing to neck pain and headache. Our results indicate that there may be a pattern of dysfunctional mechanics in the upper cervical spine in the majority of the preadolescents examined but that not everyone is symptomatic.

Prolonged static postures were found to initiate or exacerbate neck pain and/or headache episodes in the preadolescent students who reported pain and were participating in this study. One quarter reported that neck movements initiated or exacerbated neck pain and/or headache episodes. This is similar to what has been found in adolescents.[5,46,49,70,74,76-80]

A longitudinal prospective study, following a cohort of preadolescents through adolescence and ideally into young adulthood, would provide more information as to whether those individuals with asymptomatic faulty head posture, upper CJD and focal areas of tension in suboccipital muscles are more commonly represented among those who develop neck pain and/or headache and are responsible for the increase in prevalence of neck pain and/or headache in adolescence and adulthood.[81]

Limitations

This was a pragmatic study of students in their own school setting. A pragmatic study is useful for its real world implications, but also has some weaknesses. Despite a high participation rate the study sample was small so only trends may be observed. The study sample, a convenience sample, represents students from one school only which introduces bias. The study sample was intended to be preadolescent. In Sweden, groups of students are commonly categorized by the year they are born. A miscalculation was made when estimating the ages of the students in grade 6.

Although the students were estimated to be 12 years old, they were turning thirteen during the school year and therefore periadolescent. However, this gave us a chance to see the transition into adolescence. Although widely used, the instruments selected to measure forward head posture and cervical rotation have not been validated in previous studies. Forward head posture may be measured more specifically but requires taking pictures of the students, and this could have resulted in a lower participation rate. Social desirability bias may have influenced students' posture and how they answered questions. Another limitation in the study concerns the method of gathering data; questionnaires introduce recall bias and are not as accurate as diaries in studies concerning children with pain.[29-31] As well, the questionnaire, although prepared from widely used surveys, was not validated for use with children.

There are different opinions in the literature as to the validity of using palpation to assess musculoskeletal impairment of the spine, but experience is considered mandatory for reliability of the findings.[58,82-83] At the same time, chiropractors are extensively trained in this and base their work on their ability to assess and treat just these problems. An important parameter of this study was that the examiner was blinded as to whether students had neck pain and/or headaches. Because of this, TPs could not be accurately assessed in relation to the area of pain. In order to define a focal point of increased tension in a taut band of muscle as a TP, one needs to know if it refers pain to a distant site. Because the study design required that the examiner refrain from obtaining historical information from the students, the presence of TPs could not be established, but instead, the examiner evaluated whether the student had nodules in taut bands of muscle.

Conclusion

Forty percent of the preadolescents in this study had recurring neck pain and/or headache which was initiated or exacerbated by prolonged static activities. Among those students with neck pain and/or headache, there was an even sex distribution in those clearly preadolescent and an increase in neck pain and/or headache prevalence as students transitioned into adolescence as well as a sex shift with

female preponderance. There was a discrepancy between parental report and child self-report in regards to the occurrence of head trauma and the prevalence of neck pain and/or headache. One parameter, CJD, was found significantly more often among those preadolescents complaining of neck pain and/or headache as compared to those who were symptom free.

Practical Applications

- Children and parents may report different views of the clinical history
- Prolonged static postures can initiate and/or aggravate neck pain and/or headaches in children
- Dysfunction of the cervical spine may contribute to recurrent neck pain and/or headache in preadolescents

Funding Sources and Potential Conflicts of Interest

No funding sources or conflicts of interest were reported for this study.

References

1. Sarioglu B, Erhan E, Serdaroglu G, Doering B, Erermis S, Tutuncuoglu S. Tension-type headache in children: a clinical evaluation. Pediatr Int 2003;45:189-99.
2. el-Metwally A, Salminen J, Auvinen A, Kautiainen H, Mikkelsson M. Prognosis of non-specific musculoskeletal pain in preadolescents: a prospective 4-year follow-up study till adolescence. Pain 2004;110:550-9.
3. Laurell K, Larsson B, Eeg-Olofsson O. Headache in schoolchildren: association with other pain, family history and psychosocial factors. Pain 2005;119:150-8.
4. Ståhl M, Mikkelsson M, Kautiainen H, Häkkinen A, Ylinen J, Salminen J. Neck pain in adolescence. A 4-year follow-up of pain-free preadolescents. Pain 2004;110:427-31.
5. Feldman D, Shrier I, Rossignol M, Abenhaim L. Risk factors for the development of neck and upper limb pain in adolescents. Spine 2002;27:523-8.
6. Brattberg G. Do pain problems in young school children persist into early adulthood? A 13 year follow-up. EJP 2004;8:187-99.
7. Alfven G, Olsson G. Långvarig smärta hos barn och ungdomar kan och bör behandlas. Lakartidningen 2008;10:720-2.
8. Hershey A, Powers S, Vockell A, LeCates S, Kabbouche M, Maynard M. PedMIDAS development of a questionnaire to assess disability of migraines in children. Neurology 2001;578: 2034-9.
9. Frare M, Axia G, Battistella A. Quality of life, coping strategies, and family routines in children with headache. Headache 2002;42:953-62.
10. Powers SW, Patton SR, Hommel KA, Hershey AD. Quality of life in paediatric migraine: characterization of age-related effects using PedsQL 4.0. Cephalalgia 2004;24:120-7.
11. Ståhl M, Kautiainen H, el-Metwally A, Häkkinen A, Ylinen J, Salminen J, et al. Non-specific neck pain in school children: prognosis and risk factors for occurrence and persistence. A 4 year follow-up study. Pain 2008;137:316-22.
12. Wöber-Bingöl C, Wöber C, Karwautz A, Auterith A, Serim M, Zebenholzer K, et al. Clinical features of migraine: a cross-sectional study in patients aged three to sixty-nine. Cephalalgia 2004;24:12-7.
13. Virtanen R, Aromaa M, Rautava P, Metsähonkala L, Anttila P, Helenius H, et al. Changing headache from preschool age to puberty. A controlled study. Cephalalgia 2007;27:294-303.
14. Anttila P. Tension-type headache in childhood and adolescence. Neurology 2006;5:268-74.
15. Lipton R, Bigal M, Steiner T, Silberstein S, Olesen J. Classification of primary headaches. Neurology 2004;63: 427-35.
16. Balottin U, Nicoli F, Pitillo G, Ginevra O, Borgatti R, Lanzi G. Migraine and tension-type headache in children under 6 years of age. Eur J Pain 2004;8:307-14.
17. Laurell K, Larsson B, Eeg-Olofsson O. Headache in schoolchildren: agreement between different sources of information. Cephalalgia 2003;23:420-8.
18. Rossi L, Spreafico F, Menegazzo L. Analysis of the International Classification of Headache Disorders for diagnosis of migraine and tension-type headache in children. Dev Med Child Neurology 2008;50:305-10.
19. Abu-Arefeh I, Russell G. Prevalence of headache and migraine in schoolchildren. BMJ 1994;309:765-9.
20. Sillanpää M, Anttila P. Increasing prevalence of headache in 7-year old schoolchildren. Headache 1996;36:466-70.
21. Aromaa M, Rautava P, Helenius H, Sillanpää M. Factors of early life as predictors of headache in children at school entry. Headache 1998;38:23-30.
22. Rhee H. Prevalence and predictors of headaches in US adolescents. Headache 2000;40:528-38.
23. Camarda R, Monastero R, Santangelo G, Raimondo D, Puma D, Pipia C, et al. Migraine headaches in adolescents: a five-year follow-up study. Headache 2002;42:1000-5.
24. Zwart J, Dyb G, Holmen T, Stovner L, Sand T. The prevalence of migraine and tension-type headaches among adolescents in Norway. The Nord-Trøndelag Health Study (Head-HUNT-Youth), a large population-based epidemiological study. Cephalalgia 2004;24:373-9.
25. Laurell K, Larsson B, Eeg-Olofsson O. Prevalence of headache in Swedish schoolchildren with a focus on tension-type headache. Cephalalgia 2004;24:380-8.
26. Gallelli L, Iannacchero R, Peltrone F, Colosismo M, de Sarro G, de Carro E. A questionnaire-based study on prevalence and treatment of headache in young children. J Headache Pain 2005;6:277-80.
27. Karli N, Akis N, Zarifoglu M, Akgöz S, Irgil E, Ayvacioglu U, et al. Headache prevalence in adolescents aged 12 to 17: a student-based epidemiological study in Bursa. Headache 2006; 46:649-55.
28. Kröner-Herwig B, Heinrich M, Morris L. Headache in German children and adolescents: a population-based epidemiological study. Cephalalgia 2007;27:519-27.
29. Lundqvist C, Clench-Aas J, Hofoss D, Bartonova A. Self-reported headache in schoolchildren: parents underestimate their children's headaches. Acta Paediatr 2006;95:940-6.
30. Palerma T, Valenzuela D, Stork P. A randomized trial of electronic versus paper pain diaries in children: impact on compliance, accuracy, and acceptability. Pain 2004;107: 213-9.
31. van de Brink M, Bandell-Hoelstra E, Abu-Saad H. The occurrence of recall bias in pediatric headache: a comparison of questionnaire and diary data. Headache 2004;41:11-20.
32. Metsähonkala L, Sillanpää M, Tuominen J. Headache diary in the diagnosis of childhood migraine. Headache 1997;37: 240-4.

33. Mikkelsson M, Sourander A, Salminen J, Kautiainen H, Piha J. Widespread pain and neck pain in schoolchildren. A prospective one-year follow-up study. Acta Pediatr 1999;88:1119-24.
34. el Metwally A, Salminen J, Auvinen A, Macfarlane G, Mikkelsson M. Risk factors for development of non-specific musculoskeletal pain in preteens and early adolescents: a prospective 1-year follow-up study. BMC Musculoskelet Disord 2007;8:1471-9.
35. Hjern A, Alfven G, Östberg V. School stressors, psychological complaints and psychosomatic pain. Acta Paediatr 2008;97: 112-7.
36. Bruni O, Fabrizi P, Ottavianno S, Cortesi F, Giannotti F, Guidetti V. Prevalence of sleep disorders in childhood and adolescence with headache: a case-control study. Cephalalgia 1997;17:492-8.
37. Özge A, Bugdayci R, Sasmaz T, Kaleagasi H, Kurt Ö, Karakelle A. The sensitivity and specificity of the case definition criteria of headache: a school-based epidemiological study of 5562 children in Mersin. Cephalalgia 2002;22: 791-8.
38. Esposito SB, Gherpelli JL. Chronic daily headaches in children and adolescents: a study of clinical characteristics. Cephalalgia 2004;24:476-82.
39. Galli F, Patron PM, Bruni O, Strambi LF, Guidetti V. Chronic daily headache in childhood and adolescence: clinical aspects and a 4 year follow-up. Cephalalgia 2004;24:850-8.
40. Mazzone L, Vitello B, Incorpora G, Mazzone D. Behavioural and temperamental characteristics of children and adolescents suffering from primary headaches. Cephalalgia 2005;26: 194-201.
41. Powers S, Kruglak D, Hershey A. Headache and psychological functioning in children and adolescents. Headache 2006;46: 1404-15.
42. Murphy S, Buckle P, Stubbs D. Classroom posture and self-reported back and neck pain in schoolchildren. Appl Ergon 2004;35:113-20.
43. Geldhof E, de Clercq D, de Bourdeaudhuij I, Cardon G. Classroom postures of 8-12 year old children. Ergonomics 2007;50:1571-81.
44. Anttila P, Metsähonkala L, Aromaa M, Sournader A, Salminen J, Helenius H, et al. Determinants of tension-type headache in children. Cephalalgia 2002;22:401-8.
45. Sjaastad O, Saunte C, Hovdal H, Breivik H, Grombaek E. "Cervicogenic" headache. An hypothesis. Cephalalgia 1983;3: 249-56.
46. Antonaci F, Fredriksen T, Sjaastad O. Cervicogenic headache: clinical presentation, diagnostic criteria, and differential diagnosis. Curr Pain Headache Rep 2001;5:387-92.
47. Biondi D. Cervicogenic headache: diagnostic evaluation and treatment strategies. Curr Pain Headache Rep 2001;5:361-8.
48. Bogduk N. The anatomical basis for cervicogenic headache. J Manipulative Physiol Ther 1992;15:67-70.
49. Biondi D. Cervicogenic headache: mechanisms, evaluation, and treatment strategies. J Am Osteopath Assoc 2000;100: S7-S14.
50. Grimshaw D. Cervicogenic headache: manual and manipulative therapies. Curr Pain and Headache Rep 2001;5: 369-75.
51. Haas M, Groupp E, Aickin M, Fairweather A, Ganger B, Attwood M, et al. Dose response for chiropractic care of chronic cervicogenic headache and associated neck pain: a randomized pilot study. J Manipulative Physiol Ther 2004;27:547-53.
52. Haldeman S, Dagenais S. Cervicogenic headaches: a critical review. Spine J 2001;1:31-46.
53. Antonaci F, Bono G, Chimento P. Diagnosing cervicogenic headache. J Headache Pain 2006;7:145-8.
54. Watson D, Trott P. Cervical headache: an investigation of natural head posture and upper cervical flexor performance. Cephalalgia 2003;13:272-84.
55. Kendall H, Kendall F, Boynton D. Posture and Pain. Florida: Robert Krieger Publishing Company, Inc; 1952.
56. Fernandez-de-las-Peñas C, Alonso-Blanco C, Cuadrado M, Pareja J. Forward head posture and neck mobility in chronic tension-type headache: a blinded, controlled study. Cephalalgia 2005;26:314-9.
57. Fernandez-de-las-Peñas C, Cuadrado M, Pareja J. Myofascial trigger points, neck mobility and forward head posture in unilateral migraine. Cephalalgia 2006;26:1061-70.
58. Jull G, Amiri M, Bullock-Saxton J, Darnell R, Lander C. Cervical musculoskeletal impairment in frequent intermittent headache. Part 1: subjects with single headaches. Cephalalgia 2007;27:793-802.
59. Amiri M, Jull G, Bullock-Saxton J, Darnell R, Lander C. Cervical musculoskeletal impairment in frequent intermittent headache. Part 2: subjects with concurrent headache types. Cephalalgia 2007;27:891-8.
60. Kidd R, Nelson R. Musculoskeletal dysfunction of the neck in migraine and tension headache. Headache 1993;33:566-9.
61. Fernandez-de-las-Peñas C, Alonso-Blanco C, Miangolarra J. Myofascial trigger points in subjects presenting with mechanical neck pain: a blinded, controlled study. Man Ther 2007;12: 29-33.
62. Jull G, Barrett C, Ho P. Further clinical clarification of the muscle dysfunction in cervical headache. Cephalalgia 1999;19: 179-85.
63. Shevel E, Spierings E. Cervical muscles in the pathogenesis of migraine headache. J Headache Pain 2004;5:12-4.
64. Bartsch T. Migraine and the neck: new insights from basic data. Curr Pain Headache Rep 2005;9:191-6.
65. Vernon H, Steinman I, Hagina C. Cervicogenic dysfunction in muscle contraction headaches and migraine: a descriptive study. J Manipulative Physiol Ther 1992;15:418-42.
66. Boline P, Kassak K, Bronfort G, Nelson C, Anderson A. Spinal manipulation vs amitriptyline for the treatment of chronic tension-type headache: a randomized clinical trial. J Manipulative Physiol Ther 1995;18:148-54.
67. Bove G, Nilsson N. Spinal manipulation in the treatment of episodic tension-type headache. J Am Med Assoc 1998;80: 1576-9.
68. Tuchin P, Pollard H, Bonello R. A randomized controlled trial of chiropractic spinal manipulative therapy for migraine. J Manipulative Physiol Ther 2000;23:91-6.
69. Nilsson N. A randomized controlled trial of the effect of spinal manipulation in the treatment of cervicogenic headache. J Manipulative Physiol Ther 1995;18:435-41.
70. Zito G, Jull G, Story I. Clinical tests of musculoskeletal dysfunction in the diagnosis of cervicogenic headache. Man Ther 2006;11:118-29.
71. Hall T, Robinson K. The flexion-rotation test and active cervical mobility: a comparative measurement study in cervicogenic headache. Man Ther 2004;9:197-202.
72. Sjaastad O, Fredriksen T, Petersen H, Bakketeig L. Features indicative of cervical abnormality. Funct Neurol 2003;18:195-203.
73. Martelletti P. Inflammatory mechanisms in cervicogenic headache: an integrative overview. Curr Pain Headache Rep 2002;6:315-9.
74. Laimi K, Vahlberg T, Salminen J, Metsähonkala L, Mikkelsson M, Anttila P, Aromaa M. Characteristics of neck pain associated with adolescent headache. Cephalalgia 2007;27:1244-54.
75. Leone M, D'Amico D, Grazzi L, Attanasio A, Bussone G. Cervicogenic headache: a critical review of the current diagnostic criteria. Pain 1998;78:1-5.

76. Laimi K, Vahlberg T, Salminen J, Metsähonkala L, Mikkelsson M, Anttila P, et al. Does neck pain determine the outcome of adolescent headache? Cephalalgia 2006;27:244-53.
77. Hakala P, Rimpelä A, Salminen J, Virtanen R, Rimpelä S. Back, neck and shoulder pain in Finnish adolescents: national cross sectional surveys. BMJ 2002;325:743-5.
78. 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;32:1038-44.
79. Niemi S, Levoska S, Kemilä J, Rekola K, Keinänen-Kiukaannieme S. Neck and shoulder symptoms and leisure time activities in high school students. J Orthop Sports Phys Ther 1996;24:25-9.
80. Sjaastad O, Bovim G. Cervicogenic headache: the differentiation from common migraine, an overview. Funct Neurol 1991;6:93-100.
81. Davidoff R. Trigger points and myofascial pain: toward understanding how they affect headaches. Cephalalgia 1998; 18:436-48.
82. Hanten W, Olson S, Ludwig G. Reliability of manual mobility testing of the upper cervical spine in subjects with cervicogenic headache. J Manipulative Physiol Ther 2005;2: 76-82.
83. De Hertogh W, Vaes P, Vijverman V, De Cordt A, Duquet W. The clinical examination of neck pain patients: the validity of a group of tests. Man Ther 2007;12:50-5.

Appendix A. Translated Questionnaire for Swedish Preadolescents Regarding Neck and/or Head Pain

Thank you for answering this brief questionnaire.

A. Have you ever fallen and hurt your head? Think carefully and please check one box.

1. yes
2. no
3. don't know

B. Do you sit facing the teacher and the white board? Please check one box.

1. yes
2. sometimes
3. no

C. Can you read the white board from your seat? Please check one box.

1. yes
2. no
3. don't know

D. Do you have neck pain and/or headaches? Please check any box that is true.

1. I don't have neck pain and/or headache unless I am sick
2. I never have neck pain and/or headaches
3. I have neck pain
4. I have headaches

If you answered that you don't have neck pain or headaches unless you are sick or if you never have headaches you are finished answering questions. Thank you for your help. If you have neck pain or headaches please continue by answering the following questions.

E. How often do you have head or neck pain? Please check one box.

1. Daily
2. 3-5 times a week
3. 1-2 times a week
4. once a month
5. once every 3 months
6. once a year

F. Have you gone for help about your neck or head pain? Please check the appropriate boxes.

1. no
2. general practitioner
3. pediatrician
4. physiotherapist
5. chiropractor
6. massage therapist
7. other_____

G. Do you take medication for your headache? Please check the appropriate box.

1. no, never
2. sometimes
3. often
4. daily

H. Does anyone else in the family have head or neck pain? Please check one box.

1. no
2. yes
3. don't know

I. Do you get neck pain or headache when you do any of the following? Please check the appropriate boxes.

1. sporting activity (strain myself)
2. reading for a long time
3. sit at the computer time for more than 2 hours
4. eat something you are allergic to
5. move your neck or head in a certain way

J. When I have a headache or neck pain: Please check the appropriate boxes.

1. I am able to do everything, it doesn't bother me
2. I am only aware of it if I think about it
3. I feel it all the time but I can do my usual activities
4. It is difficult to concentrate, I can only do easy activities
5. I am able to participate, but only to half my capacity
6. I am unable to participate in activities
7. I must lie down
8. I have missed school
   a. How many days in last 3 months_____

K. Head or neck pain severity on a scale of 0-10 where 10 is the worst pain imaginable. Circle the number which fits for the questions below.

1. How bad is your pain when it is the worst 0 1 2 3 4 5 6 7 8 9 10
2. How much pain do you have on the average 0 1 2 3 4 5 6 7 8 9 10

L. When I get head or neck pain it lasts

1. <2 hours
2. 2-12 hours
3. >2 hours

M. When I have neck pain or headache I also have. Please check the appropriate boxes.

1. phonophobia (I am sensitive to noise)
2. photophobia (I am sensitive to light)
3. restlessness
4. appetite disturbances
5. visual disturbances
6. difficulty falling asleep or falling asleep
7. difficulty moving my neck

N. When I have head pain I feel it…. Please check the appropriate boxes.

1. in my whole head
2. on one side of my head
3. on the top of my head
4. in my forehead
5. in the back of my head
6. on both sides of my head
7. over my eyes
8. in my neck and shoulder(s)
9. in my arm