Clinical Signs of Temporomandibular Disorders and Various Pain Conditions Among Children 6 to 8 Years of Age: The PANIC Study

Anu Vierola, DDS
Early stage researcher
University of Eastern Finland

Anna Liisa Suominen, DDS, PhD
Professor
University of Turku, Finland, and
National Institute for Health and Welfare

Tiina Ikävalko, DDS
Early stage researcher
University of Eastern Finland and
Kuopio University Hospital, Finland

Niina Lintu, MSc
Early stage researcher

Virpi Lindi, PhD
Postdoctoral researcher

University of Eastern Finland

Hanna-Maaria Lakka, MD, PhD
Docent and Senior researcher
University of Eastern Finland

Jari Kellokoski, DDS, PhD
Professor
University of Eastern Finland and
Kuopio University Hospital, Finland

Matti Närhi, DDS, PhD
Professor
University of Eastern Finland

Timo A. Lakka, MD, PhD
Professor
University of Eastern Finland and
Kuopio Research Institute of Exercise Medicine

Correspondence to:
Dr Anu Vierola
Institute of Biomedicine /Physiology
University of Eastern Finland
PO Box 1627
Kuopio 70211
Finland
Email: anu.vierola@pp.inet.fi

The last two coauthors (Matti Närhi and Timo Lakka) share the last authorship.

Aims: *To examine the prevalence and significance of clinically determined signs of temporomandibular disorders (TMD) and pain in different parts of the body as well as the frequency, intensity, and other features of pain in children.* ***Methods:*** *The subjects were a population-based sample of children 6 to 8 years of age. Complete data on clinical signs of TMD were available for 483 children. Data on pain during the past 3 months, assessed by a questionnaire administered by parents, were available for 424 children. Differences between the prevalence of at least one sign of TMD and the location or frequency of pain were evaluated using the chi-square test, as well as the associations between the prevalence, frequency, and location of pain and gender, the use of medication, and visits to a physician. The relationship of various pain conditions with the risk of having clinical signs of TMD was analyzed using logistic regression.* ***Results:*** *Of the 483 children, 171 (35%) had at least one clinical sign of TMD. Of the 424 children, 226 (53%) had experienced pain during the past 3 months. Pain was most prevalent in the lower limbs (35%) and head (32%). Of the 226 children with pain, 119 (53%) had experienced frequent pain (≥ once a week). No gender differences were found. The risk of having at least one clinical sign of TMD was 3.0 (95% confidence intervals [CI]: 1.1–8.5,* $P < .05$*) times higher in children with back pain, 2.7 (95% CI: 1.2–6.0,* $P < .05$*) times higher in children with neck-shoulder pain, and 1.6 (95% CI: 1.1–2.5,* $P < .05$*) times higher in children with headache compared to children without these pain symptoms. The risk of having at least one clinical sign of TMD was 12.2 (95% CI: 1.4–101.8,* $P < .01$*) times higher among children with palpation tenderness in trapezius muscles than among those without it.* ***Conclusion:*** *Clinical signs of TMD and pain symptoms are common in children. The relationship of back pain, neck-shoulder muscle palpation tenderness, and headache with clinical signs of TMD suggests that more attention should be paid to stomatognathic function in children with such pain problems.* J OROFAC PAIN 2012;26:17–25

Key words: children, headache, pain, temporomandibular disorders, widespread pain

It has been suggested that various pain conditions are common in young children. However, current evidence on this topic is scarce and highly inconsistent. The wide variation in the results of previous studies may be due to differences in examination methodologies and the definition of pain.[1–3] The prevalence of pain symptoms during the past 3 months in children varies between 22% and 83% across these studies.[1–3]

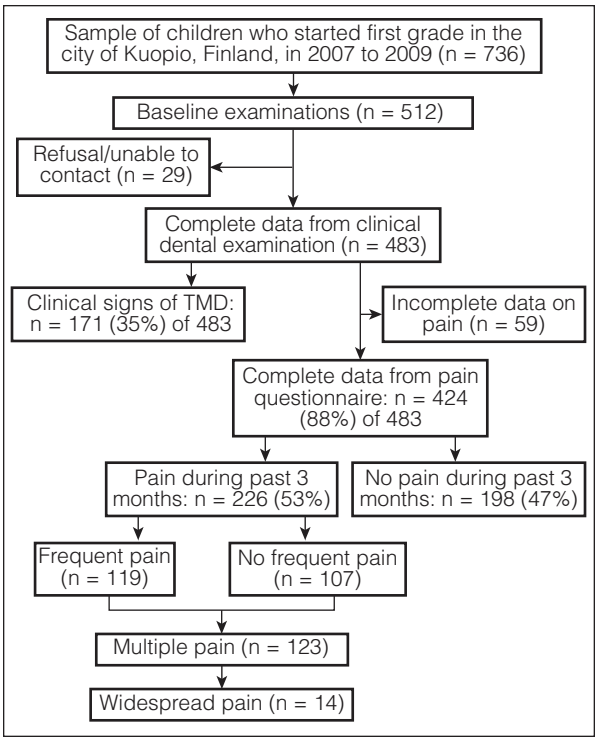

Fig 1 Selection of subjects for the study and prevalences of the signs of TMD and pain.

Temporomandibular disorders (TMD) is a collective term that embraces a number of clinical problems that involve the temporomandibular joint, the masticatory muscles, and the associated structures.[4] Symptoms of TMD, such as jaw and facial pain, as well as signs of TMD, such as joint sounds, impaired movement of the mandible, and limited mouth opening, are common among children.[4,5] However, the prevalence of TMD among children varies widely in the literature.[4] A reason for the wide variation in the reported prevalence of TMD may be that the signs and symptoms of TMD are usually mild or moderate[6] or that the findings are based on different examination methods. In addition, the signs and symptoms of TMD seem to fluctuate, but in a study covering two decades, their overall prevalence did not change significantly.[7]

Patients with TMD often have other pain complaints.[8] In children 10 to 18 years of age, the risk of TMD pain was 60% higher among those who also had other pain complaints than among those without them.[9] Similarly, children with TMD were more prone to palpation tenderness in other parts of the body and frequent headache attacks than those without TMD.[10] The difference in the prevalence of the signs and symptoms of TMD between genders seems to be small in childhood,[11] but from adolescence onwards girls are more likely to report chronic pain and TMD-related pain than boys.[12,13]

Various pain conditions, especially chronic pain, multiple pain, and widespread pain (WSP), can be a burden for a child and family.[12,14,15] Headache is one of the most prevalent pain symptoms in children.[16,17] In a German population-based study, headache was associated with other health problems, including other pain conditions.[18] In another study, headache and abdominal pain were the most prevalent combinations of pain symptoms.[12] The results of a 13-year follow-up study suggested that chronic musculoskeletal pain may appear at the ages of 8 to 14 years or even earlier.[19] In a Finnish study, 32% of all children 10 to 12 years of age had musculoskeletal pain at least once a week and at least in one location of the body, and 7.5% of all children fulfilled the criteria of WSP.[20] Various pain conditions often reduce the quality of life,[21,22] and any strategy to prevent pain may considerably improve children's and adolescents' overall health. Restrictions in daily activities because of pain have been poorly investigated.

The purpose of the present study was to examine the prevalence and significance of clinically determined signs of TMD and pain in different parts of the body as well as the frequency, intensity, and other features of pain in children.

Materials and Methods

Study Design and Population

The study population consisted of children who participated in the baseline examinations of The Physical Activity and Nutrition in Children (PANIC) Study, which is an ongoing 2-year controlled exercise and diet intervention study in a population sample of children 6 to 8 years of age at the beginning of the study. Altogether, 736 children who started the first grade in primary schools of a geographically and socioeconomically homogenous area in the city of Kuopio, Finland, in autumn 2007 through 2009, were invited to participate in the study (Fig 1). Of the invited children, 512 (70%) participated in the baseline examinations between October 2007 and November 2009. Complete data on clinical signs of TMD were available in 483 children (94% of the children who participated), of whom 234 (48.5%) were girls and 249 (51.5%) were boys. Their mean (± standard deviation) age at the time of study visits was 7.9 ± 0.4 years. Complete data on pain gathered by questionnaires were available in 424 children (82% of the children who participated). Both children and their parents were asked for written and

oral consent to participate in the study. The study was approved by the Research Ethics Committee of Hospital District of Northern Savo in 2006.

Assessment of Clinical Signs of TMD

All clinical examinations were carried out by one dentist who was trained before the beginning of the study by a TMD specialist. During the examinations, at the beginning of each examination day, a digital scale was used to ensure that approximately the same pressure was applied during the palpation of the muscle sites (1 kg) and the joints (0.5 kg) in each clinical examination.[23,24] The recorded findings included mouth opening limitation, deviation in mouth opening movement, palpation tenderness in masticatory muscles and temporomandibular joints, pain in mandible movements, and joint sounds as follows:

1. Mouth opening limitation: The child was asked to place the mandible in a comfortable position and first to open the mouth as far as possible (unassisted opening without pain) without feeling any pain and then to open the mouth as wide as possible, even if he/she felt pain (maximum unassisted opening). The opening was recorded with a millimeter ruler at the incisal edge of the maxillary central incisor that was the most vertically oriented and measured vertically to the labioincisal edge of the opposing mandibular incisor in maximum unassisted opening. Vertical incisal overlap was added to the actual value of mouth opening limitation. A mouth opening < 35 mm was considered to represent an opening limitation.
2. Deviation in mouth opening movement: The subject was asked to position the mandible in a comfortable position and to open the mouth as wide as possible three times. Opening pattern was assessed and scored as straight, lateral deviation to right or left, or corrected deviation ("S" deviation).
3. Palpation tenderness in masticatory muscles: The muscles were palpated using the fingertips with 1 kg of pressure for extraoral muscles. Intraoral muscle palpation was not done because of technical difficulties related to the subjects' young age. The muscles were palpated while the clinician's opposite hand was used to brace the head to provide stability. The child's mandible was in a resting position, without the teeth touching, and the muscles were in a passive state. Palpation tenderness in muscles was evaluated with the Faces Pain Scale–Revised (FPS–R), which is a commonly used metric measure of pediatric pain, and was graded from 0 to 10 as no pain (0), mild pain (1–3), moderate pain (4–7), and severe pain (8–10) (www.painsourcebook.ca). The posterior, middle, and anterior temporal muscle as well as origin, body, and insertion of masseter muscle were bilaterally palpated with a pressure of 1 kg. The posterior mandibular region (posterior digastric muscle) and submandibular region (anterior digastric muscle) were bimanually and bilaterally palpated.
4. Palpation tenderness in temporomandibular joints: The joints were laterally palpated using the fingertips with 0.5 kg of pressure. The child was asked to open slighty until the lateral pole of the condyle translated forward. The joints were also palpated from the posterior side by placing the fingertips into the child's external meatus and asking the child to slighty open and close the mouth. Palpation tenderness in joints was evaluated with the Faces Pain Scale.
5. Pain in mandibular movements: The child was asked if he/she felt pain on maximum unassisted mandibular opening or on excursive movements (right/left lateral excursion and protrusion) and recorded whether or not he/she felt pain and location (right/left side in the joint).
6. Temporomandibular joint sounds: The child was asked to open and close three times. Temporomandibular joint sounds were registered on palpation for vertical range of motion as well as by auscultation with a stethoscope on opening or closing and were classified as clicking or crepitation. Temporomandibular joint sounds on palpation for lateral excursions and protrusion were registered on palpation by fingertips, but not scored. Three of these six examinations (deviation in mouth opening, palpation tenderness in temporomandibular joints, pain in mandibular movements) were based on the Research Diagnostic Criteria for TMD (RDC/TMD, Axis I).[23] Three examinations differed slighty from RDC/TMD as follows: due to the subjects' young age, a maximum unassisted mouth opening of < 35 mm was considered to represent an opening limitation[25] instead of < 40 mm as defined in the RDC/TMD. Intraoral palpation of the lateral pterygoid muscle and tendon of the temporalis muscle were not done because of technical difficulties related to the subjects' young age. The presence of joint sounds were examined by auscultation with a stethoscope instead of by fingers as defined in the RDC/TMD. For analyses, each of the six findings were recorded as either present or absent by grouping the clinical signs of TMD as *(1)* "at least one of the six signs," *(2)* "at least one sign excluding deviation," *(3)* "painful TMD signs," or *(4)* "nonpainful TMD signs."

Table 1 Prevalence of Clinical Signs of TMD in 483 Children

Clinical signs of TMD	n	%
At least one sign of TMD	171	35
Mouth opening limitation (< 35 mm)	14	2.9
Deviation in mouth opening movement	80	17
Palpation tenderness in masticatory muscles*	35	7.3
Palpation tenderness in temporomandibular joints†	18	3.7
Pain in mandible movements‡	24	5.0
Temporomandibular joint sounds§	35	7.2

Definition of clinical signs of TMD was partly based on the RDC/TMD.[23]
*In at least one of the following: posterior, middle, anterior temporal muscles, superior, middle, inferior masseter muscle, posterior mandibular region (posterior digastric) and submandibular region (anterior digastric).
†In either lateral or posterior side of temporomandibular joint.
‡In at least one of the following: lateral, protruding, or opening movement of mandible.
§Included click in opening (n = 21, 4.3%), click in closing (n = 19, 3.9%), and crepitation (n = 3, 0.6%)

Assessment of Pain

A pain questionnaire was used that was designed especially for the present study. The questionnaire was administered by parents and included questions obtained from the RDC/TMD questionnaire with questions on clinical issues. If the answer to the first question (Did your child have pain within the past 3 months?) was no, no other questions needed to be answered. The questionnaire was designed to assess pain symptoms in eight different areas of the body (head, neck-shoulder, abdominal, chest, pelvis, back, upper limbs, and lower limbs) during the preceding 3 months. To have more precise information on orofacial pain conditions, questions on the existence of pain in the forehead, temple, cheeks, temporomandibular joints and mandible on the right or left side were asked. Questions on the frequency of pain (never, seldom, once a month, several times a month, more than once a week, daily, or continuously) in specific areas of the body were also included. Pain was defined as frequent if it existed at least once a week. Pain existing in at least two different areas of the body was defined as multiple pain.[12] Children who reported pain in an upper extremity, a lower extremity, and either neck, back, or chest were defined as suffering from WSP.[9] The definition was adopted from the set of screening criteria established by White and coworkers.[26] The intensity of any pain, the highest intensity of pain, and the most typical pain were asked using a numeric scale ranging from 0 (no pain) to 10 (worst possible pain). Moreover, the questionnaire included items on pain in daily activities (at rest, during exercise) and at different times of the day (morning, day time, evening, night, or all day) as well as the fluctuation of pain. Restrictions in daily activities (drinking, eating, talking, sleeping, playing, hobbies, or school attendance) because of pain were also asked with a numeric scale ranging from 0 to 10 and were categorized as no (0), a little (1–3), moderately (4–7), a lot (8–9), and totally (10). Furthermore, the parents were asked about the child's use of pain medication (yes or no) and visits to a physician due to pain (yes or no).

Statistical Methods

Statistical analyses were performed using SPSS version 14.0 (IBM) and SAS version 9.1.3 (SAS). Because no statistically significant gender differences were found in any variable of interest, data from girls and boys were combined in the analyses. Differences between the prevalence of at least one sign of TMD and the location or frequency of pain were evaluated using the chi-square test. The chi-square tests were also applied to study the associations between the prevalence, frequency, and location of pain and gender, the use of medication, and visits to a physician. Logistic regression analyses were used to examine the relations of various pain conditions with the risk of having clinical signs of TMD. The results from the logistic regression analyses are presented in terms of odds ratios (ORs), together with 95% confidence intervals (CIs). The associations were adjusted for gender.

Results

Clinical Signs of TMD

Of 483 children with complete data on TMD, 171 (35%) had at least one clinical sign of TMD (Fig 1, Table 1). The most common clinical signs were deviation in mouth opening, sounds in temporomandibular joints, and palpation tenderness in masticatory muscles. There was no statistically significant difference in the number of children with at least one clinical sign of TMD between girls (n = 90, 18.6%) and boys (n = 81, 16.8%).

Any Pain

Of the 424 children with data on pain gathered by questionnaire, 226 (53%) had experienced any pain during the past 3 months (Fig 1, Table 2). The pain

was most common in the lower limbs (35%) and head (32%), but orofacial pain was also common (27%). Of different times of the day, the pain was most common in the evenings. The intensity of pain typically varied between 2 and 6, and the highest intensity varied between 4 and 8.

Frequent Pain

Frequent pain during the past 3 months was reported among 119 children (Fig 1). This constitutes 28% of all the children whose pain was assessed by a questionnaire (n = 424), and 53% of those children with any reported pain (n = 226) (Table 2). Of the 424 children with data on pain gathered with a questionnaire, frequent pain was most common in the lower limbs (n = 91, 21%) and head (n = 71, 17%).

Multiple and WSP

Of the 226 children with any pain, 123 (50%) had experienced multiple pain (Fig 1). Headache and lower limb pain was the most prevalent combination of pain symptoms (data not shown). WSP was found in 14 children.

Palpation Tenderness in Muscles of Neck-Shoulder Area and Clinical Signs of TMD

The risk of having at least one clinical sign of TMD was 12.2 (95% CI: 1.4–101.8, $P < .01$) times higher among children with palpation tenderness in trapezius muscles than among those without it. There was no difference in the risk of clinical signs of TMD among children with palpation tenderness in other muscles of the neck-shoulder area than among those without it.

Various Pain Symptoms and Clinical Signs of TMD

The risk of having at least one clinical sign of TMD was 3.0 (95% CI: 1.1–8.5) times higher among children with back pain, 2.7 (95% CI: 1.2–6.0) times higher among children with neck-shoulder pain, and 1.6 (95% CI: 1.1–2.5) times higher among children with headache compared to those without these pain symptoms ($P < .05$). There was no statistically significant difference in the risk of clinical signs of TMD between children with other pain conditions and those without them. When deviation in mouth opening movement was excluded from the clinical signs of TMD, the previous risk estimates lowered but remained significantly elevated. In addition, the risk of having at least one clinical sign of TMD without deviation was 1.3 times higher among children with lower limb pain, and 1.8 times higher among children with orofacial pain. When clinical TMD signs were divided into painful or nonpainful signs, risks for both were significantly higher among children with headache or lower limb pain. Back pain was associated with painful TMD signs, but not with nonpainful signs (Table 3).

Table 2 Prevalence of Any Pain and Frequent Pain (≥ Once a Week) in Different Parts of the Body During the Past 3 Months in 424 Children

	Prevalence of any pain in all 424 subjects		Prevalence of frequent pain in 226 children with any pain	
Part of body	n	%	n	%
Any part	226	53	119	53
Head	135	32	71	31
Orofacial	115	27	61	27
Neck-shoulder	27	6.4	16	7.1
Upper limb	26	6.1	17	7.5
Chest	7	1.7	5	2.2
Abdomen	74	17	39	17
Back	17	4.0	15	6.6
Pelvis	7	1.7	5	2.2
Lower limb	150	35	91	40

Impact of Pains on Daily Activities

Of the 226 children with any pain, 129 (57%) had pain both at rest and during exercise, 70 (31%) had it only at rest, and 27 (12%) had it only during exercise. Pain affected sleeping in 151 (67%), playing in 151 (67%), other hobbies in 131 (58%), eating in 88 (39%), school activities in 84 (37%), drinking in 43 (19%), and speaking in 43 (19%) of the children.

Pain Symptoms, Use of Pain Medication, and Visits to a Physician

Of children who had experienced any pain (n = 226), 138 (61%) had used pain medication and 37 (16%) had visited a physician due to pain. Children who had headache ($P < .01$), lower limb pain ($P < .01$), neck-shoulder pain ($P < .01$) and abdominal pain ($P < .01$) were more likely to use pain medication than those with other pains. Children with headache ($P < .01$) and lower limb pain ($P < .01$) had more likely visited a physician because of pain than those with other pains. There were no statistically significant gender differences between pains, use of pain medication, and visits to a physician.

Table 3 ORs (95% CIs) for Risk of Having Clinical Signs of TMD Among Children with Various Pain Conditions Compared to Children Without Them

	At least one clinical sign of TMD* (n = 171)		At least one clinical sign of TMD excluding deviation† (n = 100)		At least one painful TMD sign‡ (n = 61)		At least one non-painful TMD sign§ (n = 84)	
Pain site	OR (95% CI)	*P*	OR (95% CI)	*P*	OR (95% CI)	*P*	OR (95% CI)	*P*
Headache	1.6 (1.1–2.5)	**.02**	1.5 (1.2–1.9)	**.01**	1.4 (1.1–1.8)	**.01**	1.3 (1.0–1.7)	**.04**
Neck-shoulder	2.7 (1.2–6.0)	**.01**	1.6 (1.0–2.4)	**.03**	1.4 (0.9–2.3)	.13	1.3 (0.9–2.1)	.20
Upper limb	2.1 (0.9–4.6)	.08	1.1 (0.7–1.8)	.71	1.1 (0.7–1.9)	.64	1.3 (0.9–2.1)	.19
Chest	0.6 (0.1–3.3)	.59	1.2 (0.5–2.8)	.63	1.7 (0.7–4.0)	.20	–	–
Back	3.0 (1.1–8.5)	**.04**	2.0 (1.2–3.3)	**.01**	2.4 (1.4–4.1)	**.01**	1.3 (0.7–2.2)	.44
Abdomen	0.8 (0.5–1.4)	.55	1.1 (0.8–1.5)	.47	1.1 (0.8–1.6)	.46	0.9 (0.6–1.3)	.56
Pelvis	0.8 (0.1–4.5)	.81	1.4 (0.5–3.2)	.47	–	–	1.5 (0.6–3.5)	.37
Lower limb	1.5 (1.0–2.3)	.06	1.3 (1.0–1.6)	**.04**	1.4 (1.0–1.8)	**.03**	1.1 (0.9–2.5)	**.03**
Orofacial	1.3 (0.9–2.1)	.18	1.8 (1.1–2.9)	**.02**	1.6 (0.9–2.9)	.11	1.4 (0.8–2.4)	.21

Data are from logistic regression analyses adjusted for gender; statistically significant values highlighted in bold.
*Mouth opening limitation, deviation in mouth opening movement, palpation tenderness in masticatory muscles, palpation tenderness in temporomandibular joints, pain in mandible movement, or temporomandibular joint sounds.
†Mouth opening limitation, palpation tenderness in masticatory muscles, palpation tenderness in temporomandibular joints, pain in mandible movement, or temporomandibular joint sounds.
‡Palpation tenderness in masticatory muscles, palpation tenderness in temporomandibular joints, or pain in mandible movement.
§Mouth opening limitation, deviation in mouth opening movement, or temporomandibular joint sounds.

Discussion

The results of the present study show that clinical signs of TMD and pain symptoms are common among Finnish children 6 to 8 years of age. More than one third of children had at least one clinical sign of TMD. Also, previous studies have shown that clinical signs of TMD are common in children of the same age as in the present study.[27,28] One explanation for the high prevalence of clinical signs of TMD might be that almost all children had a mixed dentition and thus the first stage of eruption of the permanent teeth was ongoing. It has been shown that parafunctional habits, such as bruxism, are common in children, especially at the time of the mixed dentition, and have been associated with TMD.[29] The most common clinical sign of TMD was deviation in mouth opening movement. However, it has to be taken into account that deviation, especially in children, may represent a normal variation, perhaps due to an immature muscle coordination or slight anatomical asymmetry in the joint area rather than a manifestation of TMD.

An important observation of the present study is that children who reported back pain, headache, neck-shoulder pain, or palpation tenderness in trapezius muscles were more likely to have clinical signs of TMD than those without such symptoms. This result remained even when deviation in mouth opening movement was excluded from the clinical signs of TMD. In addition, when clinical signs of TMD were grouped into painful signs or not, headache, back pain, and lower limb pain remained as significant predictors for clinical signs of TMD. However, the relatively small number of children with clinical signs of TMD among children with or without different pain symptoms limits the interpretation of the clinical relevance of the results. The findings are in accordance with the results of earlier studies among adolescents and adults.[8,30] However, the authors could not find any comparable previous studies in children. The present results suggest that the relation between headache, neck-shoulder pain, back pain or palpation tenderness in the trapezius muscles and clinical signs of TMD should be taken into account in clinical practice at a considerably younger age than previously thought.

More than half of the children had experienced pain during the previous 3 months. Of these children, 28% had frequent pain, and the pain was most prevalent in the lower limbs and head. These findings are in accordance with the results of previous studies indicating that recurrent lower limb pain, which is usually related to growth, constitutes the most frequent musculoskeletal pain in children at this age[31,32] and that headache is also recognized as a major pediatric pain problem.[33] Similar findings with a prevalence of frequent pain of 32% were reported in a German study.[2] The present study revealed that pain was most prevalent in the evenings, mainly because of frequent lower limb pain.

Half of the children with pain had more than one location of pain. The most prevalent combination

was headache and lower limb pain. In another study among children 0 to 18 years of age, a similar prevalence of multiple pain was found and the most frequent combination was headache and abdominal pain.[12] In the present study, only 3% of the children fulfilled the criteria of WSP. WSP was defined according to the screening criteria established by White and coworkers,[26] which are commonly used among adults. At the moment, no diagnostic criteria for WSP in children are available.[15] To the authors' knowledge, there are no previous studies on the prevalence of WSP in children of similar age. However, other studies suggest that the prevalence of WSP increases with age. Mikkelsson and coworkers found that the prevalence of WSP increased from 8% at the ages of 10 to 12 years to 15% at the ages of 14 to 16 years.[15] In the present study, neck pain was one of the most common pain complaints. Because only 14 children had WSP, possible associations between neck pain and WSP could not be assessed.

Disturbed sleep because of pain was found in two thirds of the children with any pain. Another important finding was that more than half of the children had restrictions in playing or pursuing other hobbies due to pain. In line with the present findings, Roth-Isigkeit and coworkers found that sleep disturbances were the most prominent pain-related restrictions, in addition to the loss of appetite and absence from school, among children 4 to 9 years of age.[2] In general, the time of the day when pain occurs may be important when evaluating the reasons for pain.

The need for pain medication and the use of health care services vary according to the location and intensity of pain as well as children's age.[2,34] In the present study, 61% of the children with pain symptoms had used pain medications, especially those with lower limb pain, headache, neck-shoulder pain, and abdominal pain, and 16% had visited a physician due to pain. The proportion is similar to the consultation rate of 15% in a Dutch study[35] and slightly higher than the 11% overall consultation rate, regardless of symptoms, in another study from the Netherlands.[36] In accordance with the present results, children with headache and lower limb pain visited a physician more often than those with other pain complaints.[36]

One of the strengths of the present population-based study is the high participation rate. A total of 70% of children who were invited to the study took part in the baseline examinations. A pain questionnaire administered by the parents was used similarly as in other epidemiologic studies of pain in children.[2,37] Complete data on pain were obtained for 82% and clinical signs of TMD for 94% of the children who participated.

The RDC/TMD criteria[23] were used to evaluate the signs of TMD. Although RDC/TMD criteria have not been validated in children, they have been used in other epidemiologic and clinical studies and are the most widely used criteria for TMD among adolescents and adults.[24,38] The clinical signs of TMD were divided into six criteria. Three of these followed the RDC/TMD and three slightly differed from the RDC/TMD. Therefore, several limitations of this study must be taken into account concerning RDC/TMD. First, due to the subjects' young age, the maximum unassisted mouth opening with < 35 mm was considered to represent opening limitation instead of < 40 mm as defined in the RDC/TMD. If < 40 mm had been considered as the opening limitation, the number of children with this sign would have risen enormously. Second, intraoral palpation of the lateral pterygoid muscle and the tendon of the temporalis muscle was not done because of technical difficulties related to the subjects' young age. Third, the presence of joint sounds was examined by auscultation with a stethoscope instead of by fingers as defined in the RDC/TMD; this may overestimate the prevalence of joint sounds. Fourth, the authors decided to use a pressure of 1 kg during the palpation of the extraoral muscle sites and 0.5 kg during the temporomandibular joint palpation. These pressures were chosen according to the recommendation of the RDC/TMD, but also for the reason that the present study is ongoing, and so during the follow-up examinations, when the children become adolescents, the same pressures will be used as in the baseline examinations. The RDC/TMD have good reliability among children and adolescents in the ages of 12 to 18 years.[24] It is possible that the chosen pressures may cause false positive findings during the baseline examinations when the children are 6 to 8 years of age. However, the time between the baseline examination and the first follow-up is short (2 years) and, therefore, the results should not be significantly distorted. Only clinical signs of TMD (Axis I) of the criteria were used and the authors did not register the symptoms of TMD or evaluate the psychosocial factors in accordance to RDC/TMD. Thus, the children could not be classified according to a diagnosis of TMD, which could be considered a study limitation. It would have been interesting to determine the TMD symptoms and psychosocial factors associated with the clinical signs of TMD and to compare them with other pain conditions. Also, since the examinations were carried out once by a single dentist, another study limitation was the inability to estimate inter-rater or intra-rater reliability.

The present findings, especially the relationship of headache and neck-shoulder pain with clinical signs

of TMD, suggest that factors related to these pain conditions in children should receive more attention. Further studies are needed to identify children at risk of developing various pain conditions and to provide more details of the factors that may enhance such development. This could provide a basis to create effective interventions to prevent chronic pain in adolescence and adulthood.

Conclusions

The reported pain complaints and clinical signs of TMD are common among children in Finland. The risk of clinical signs of TMD was significantly higher among children who had headache, neck-shoulder pain, or back pain. However, these associations varied according to the definition of TMD. The relationship between neck-shoulder muscle palpation tenderness and clinical signs of TMD suggests that more attention should be paid to both neck-shoulder pain and clinical signs of TMD in childhood. Because clinical signs of TMD seem to appear already at a young age, routine dental examinations in children should include the evaluation of TMD. This would help in the identification of children who need more careful follow-up of pain conditions and their consequences.

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