

Incidence and Temporal Patterns of Temporomandibular Disorder Pain Among Swedish Adolescents

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Aims: To estimate the incidence of temporomandibular disorder (TMD) pain among Swedish adolescents by age and gender and to describe the temporal patterns of TMD pain. **Methods:** This 3-year longitudinal study was carried out at all Public Dental Service clinics in a Swedish county from 2000 to 2003. All individuals aged 12 to 19 years in the county who visited the clinics for annual examinations were eligible for the study. **Results:** Overall, the incidence of TMD pain among all adolescents was 2.9% annually among 2,255 participating adolescents. Incidence among girls was significantly higher than in boys, 4.5% versus 1.3%, respectively. Incidence increased with age in girls and boys, although less so in boys (3.0% to 6.9% versus 1.7% to 2.6%). These adolescents were re-examined annually for 3 years, and a fluctuating pattern of TMD pain was common. Overall, 11.4% of all subjects reported TMD pain on at least 1 occasion; 88.6% of the cohort remained pain-free. Of those reporting TMD pain, 4.7% could be defined as intermittent cases, 3.1% were single-incident cases, 0.9% were recurrent cases, and 0.9% had continuing pain for 1 or 2 years. **Conclusion:** The incidence of self-reported TMD pain among Swedish adolescents aged 12 to 19 years increased with age, particularly among girls. The pattern of pain in most adolescents fluctuated over time. Less than 1% of the cohort had continued pain over each year, and the majority of these subjects were girls. J OROFAC PAIN 2007;21:127-132

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Temporomandibular disorder (TMD) pain is a relatively common musculoskeletal pain condition that afflicts about 15% of women and 8% of men.¹ The prevalence of TMD pain in childhood, however, is only about 2% to 5% in both boys and girls.² Adolescence has been scrutinized as a time not only of large psychosocial and cultural changes but also of possible increases in pain conditions. Cross-sectional studies have found increases in headache, back pain, and stomach pain from ages 11 to 17.³ Changes in TMD pain, however, were less clear in these and other cross-sectional studies.

Longitudinal studies are investigations in which the same individuals are seen on at least 2 occasions. These studies can be useful to understand fluctuations in patterns of pain, that is, to what extent pain conditions remit, recur, or progress. Cohort studies, a specific type of longitudinal study, are valuable because they provide information on new occurrences of disease via incidence

rates; if sufficient queries are made over time, a picture of the temporal pattern of pain may also emerge. To calculate incidence, it is necessary to follow a group of individuals free of the disease over a specific time period. Data on incidence may clarify not only how many persons develop the disorder, but also at what age.² The incidence rate is a direct estimate of the probability, or risk, of developing a disease during a specific time period. A systematic review pointed out that few published cohort studies report the incidence of TMD pain or give enough data to calculate incidence.² Two cohort studies in adolescents were identified that reported the incidence of TMD pain to vary from 1.6% to 3.9% per year.^{4,5} Kitai et al⁴ studied girls aged 12 to 16 years and found incidence rates for TMD pain elicited during jaw function of 2.7% for girls 12 to 13 years old, 3.9% for girls 13 to 15 years old, and 2.4% for girls 15 to 16 years old. Heikinheimo et al⁵ studied adolescents aged 12 to 15 years and found an incidence rate of 1.8% concerning pain on maximal opening. Few authors have investigated temporal patterns of pain. In a 2-year longitudinal study of adolescents, Wänman and Agerberg⁶ found that the incidence rate of TMD symptoms was 8% each year, while remission of symptoms occurred in 7% and 5% of the 18- and 19-year-olds, respectively. This indicated that TMD symptoms underwent considerable fluctuation longitudinally. However, the sample was small ($n = 285$); thus, these values are imprecise. To summarize, neither the actual incidence rate of TMD pain, especially ambient pain, nor temporal patterns over time are well characterized in adolescence. The working hypotheses for the present study were that the incidence of TMD pain in adolescents would increase with age and that girls would have higher rates than boys. The aims of this study were to estimate the incidence of TMD pain among Swedish adolescents by age and gender and to describe the temporal patterns of TMD pain.

Materials and Methods

Participants

Östergötland County is in southeastern Sweden and has 416,000 inhabitants; 81.6% of the residents are of Swedish ancestry, and almost all are Caucasian. The other 18.4% of the residents are immigrants. Sixty percent of these immigrants are from Europe, 29% are from Asia and the Middle East, and 11% are from other regions.⁷

The socioeconomic status of the residents is relatively uniform, as it is in most Swedish counties, and the middle class is predominant. The current study sample was drawn from this population and generally reflects this distribution. A total of 26,084 individuals from this country who were born between 1984 and 1988 were considered eligible for the study. Approximately 11% of these adolescents (2,870 subjects) chose private dentists in the community during this time period and were not eligible for the study. The remaining adolescents in this county were examined at Public Dental Service (PDS) clinics at varying intervals depending upon their history of dental caries, oral hygiene levels, and orofacial growth and development. Only those patients who attended the clinics at least once every 12 months for 4 years met the inclusion criteria. Since most youth did not visit the dental clinics every year for 4 years, the number of ineligible subjects grew with each year until it reached 90%, leaving only 2,255 subjects who had had annual examinations 4 years in a row. The remaining 20,959 individuals were examined at longer intervals and therefore ineligible for the study. This epidemiologic study was carried out at all 33 PDS clinics from 2000 through 2003 during the annual dental examinations of the population living in the catchment areas of the clinics. The study was approved by the ethics committee at the Faculty of Health Sciences of Linköping University.

Inclusion Criteria

All individuals aged 12 to 19 years in Östergötland County who were examined every year from 2000 through 2003 participated in the study. Those individuals who reported TMD pain at baseline were excluded from the cohort for the calculation of incidence but were retained for the description of temporal patterns.

Design

Approximately 145 dentists and 50 to 60 dental hygienists were involved in the assessment procedures of the longitudinal study in 33 separate clinics. Each clinician was carefully instructed through written and audiovisual materials as to the study rationale and protocol, and training reviews of their performance were conducted.

The subjects were asked 2 questions at their annual visits: (1) Do you have pain in your temples, face, jaw joints, or jaws once a week or more? and (2) Do you have pain once a week or more when you open your mouth wide or chew?

Table 1 Temporal Patterns and Groups for TMD Pain

2000	2001	2002	2003	Group
No	No	No	No	No pain
Yes	No	No	No	Intermittent/remitted pain
No	No	Yes	No	Intermittent/remitted pain
No	Yes	No	No	Intermittent/remitted pain
Yes	Yes	No	No	Continuing/remitted pain
Yes	Yes	Yes	No	Continuing/remitted pain
No	Yes	Yes	No	Continuing/remitted pain
No	No	No	Yes	Incident pain
Yes	No	Yes	No	Recurrent pain
Yes	No	No	Yes	Recurrent pain
Yes	Yes	No	Yes	Recurrent pain
No	Yes	No	Yes	Recurrent pain
No	No	Yes	Yes	Continuing pain for 1 year
No	Yes	Yes	Yes	Continuing pain for 2 years
Yes	Yes	Yes	Yes	Continuing pain for 3 years

Subjects reporting TMD pain for the first time in this study were counted as incident cases in the analyses. Not all cases of TMD ("Yes") were incident cases, since the subject may have reported TMD pain in the prior time period (eg, as in the case of continuing pain reported in 2002 and 2003).

Examiners pointed to the various anatomic regions as they asked the questions to aid in understanding. If the patient answered yes to 1 or both of the questions, TMD pain was registered as present. If the patient answered no to both questions, TMD pain was registered as absent. A reliability and validity study of a subset of 5 clinics was conducted near the beginning of this study period, and high reliability and validity were found for these procedures compared to a clinical examination based on the Research Diagnostic Criteria for TMD (RDC/TMD) as the reference standard.⁸

Categorization of Longitudinal Pain Patterns

Multiple combinations of TMD pain over time are possible. All possible patterns over the 3 years were categorized as follows (Table 1):

- Intermittent/remitted pain: Pain that occurs and then remits.
- Continuing/remitted pain: Pain that occurs at least twice in a row and then remits.
- Incident pain: Pain that occurs once on examination in a patient whose preceding examinations were without pain.
- Recurrent pain: Pain that occurs at 1 examination, then remits, and then occurs again.
- Continuing pain: Pain present at 2 or more annual examinations without any pain-free examinations.

Calculation of Incidence

The incidence of TMD pain was defined as a new case of TMD pain in a person who had not complained of the condition during the prior study period, divided by all persons who were at risk for developing a new case of TMD pain.⁹ Once a person met the criteria for TMD pain, he or she was subsequently deemed no longer at risk for developing TMD pain during the rest of the study. The questions used to classify subjects concerning TMD pain were designed to be simple and easy to understand, with a high accuracy for detecting current, recent TMD pain. Subjects were not asked to attempt to recall more distant events, such as TMD pain over the past year; such recall is likely to be less accurate among adolescents. In essence, this study sampled approximately 1 month of TMD pain experience of every 12 months for 48 months (4 years). This sampling strategy is 1 approach to dealing with commonly recurring events such as TMD pain, which subjects may forget if the period between recall examinations is longer than a few months.

Statistical Analysis

Descriptive statistics and 95% confidence intervals (CIs) were calculated for the proportion of subjects with TMD pain. Logistic regression analysis, performed using generalized estimating equations (GEE), was used to estimate the incidence rates simultaneously by age and gender, compute 95% CIs, and perform tests for gender and age differences.¹⁰ The GEE method was used to account for the fact that there were multiple observations per

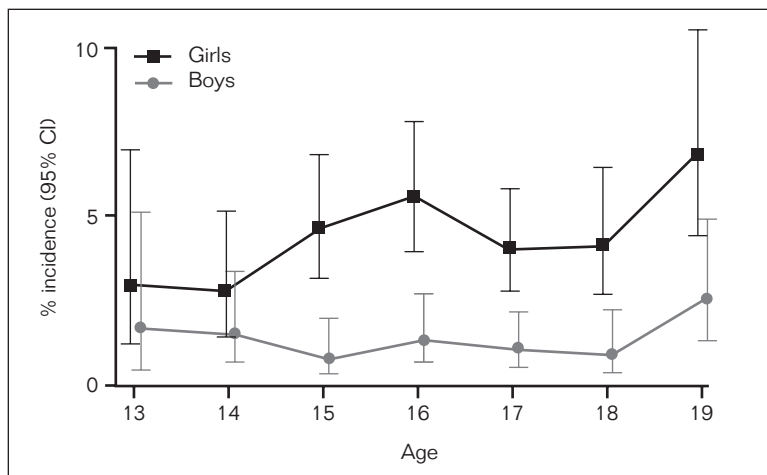


Fig 1 Incidence of TMD pain by age and gender with 95% CI from 2001 to 2003. Girls showed a higher incidence of TMD pain for each age group, although the differences were only statistically significant from ages 15 to 19.

subject due to the longitudinal nature of the study design. A generalized score test was used to test for gender and age differences, and Holm's multiple comparison was used to maintain a .05 error rate for the multiple tests for a gender difference by age.¹¹ The data were analyzed with the statistical program SPSS (version 12.0).

Results

From 2001 through 2003, the overall annual incidence of TMD pain was 2.9% (95% CI, 2.5% to 3.3%) among 2,255 participating adolescents aged 13 to 19 years. The overall annual incidence was 4.5% (95% CI, 3.9% to 5.3%) for girls and 1.3% (95% CI, 1.0% to 1.8%) for boys. A test for overall gender difference (controlled for age) showed that these values were significantly different ($P < .001$).

The incidence of TMD pain by age and gender showed that girls had higher values at all ages studied (Fig 1). The figure shows a trend toward increasing incidence with increasing age; this trend was more pronounced for the girls (generalized score test = 2.9; degrees of freedom = 1; $P = .087$) than for boys (generalized score test = 0.3; degrees of freedom = 1; $P = .59$). The separate test for gender differences by age showed highly significant differences between boys and girls among 15- and 16-year-olds ($P < .0001$) and significant differences among 17- ($P = .0007$), 18- ($P = .0019$), and 19-year-olds ($P = .015$). However, there was no significant gender difference among 13- ($P = .43$) or 14-year-olds ($P = .25$). Incidence was the highest at age 19 for both girls (6.9%) and boys (2.6%). The precision of these age and gender estimates of incidence was good; the 95% CI and point estimates when the respective birth cohorts are combined are shown in Fig 1.

The incidence of TMD pain in each of 5 separate birth cohorts (those who were 12, 13, 14, 15, and 16 when the study began in 2000) was analyzed by gender to determine any possible cohort effect. No pattern indicated that a younger or older cohort had a higher or lower incidence of TMD pain. The temporal pattern over 3 years showed fluctuating patterns of TMD pain. Overall, 11.4% of the subjects reported TMD pain on at least 1 occasion. Of these participants, a little more than one third of all cases, or 4.7%, could be defined as intermittent/remitted pain cases, 0.9% as recurrent pain cases, 1.4% as continuing/remitted pain, and 0.5% as continuing pain cases for 1 year (2002 to 2003). One group of individuals (0.4%) had continuing pain for 2 years (2001 to 2003), and another (0.2%) had continuing pain for 3 years (Tables 1 and 2). The ratio of the number of girls to the number of boys in each temporal category of TMD pain were all larger than 1 (Table 2).

Discussion

In this prospective, population-based longitudinal study, the incidence of TMD pain generally increased from age 13 to 19 during adolescence, with girls having higher rates than boys. Incidence was at its highest at age 19 for both girls and boys. Among those subjects with reports of TMD pain, various fluctuating temporal patterns of pain were most common. Four major pain patterns were found; in order of decreasing frequency, they were intermittent/remitted, continuing/remitted, continuing, and recurrent pain. The participating adolescents were individuals who answered questions about TMD pain annually at 4 time points during

Table 2 Temporal Patterns of TMD Pain by Gender

Group	All		Girls		Boys		Gender ratio girls:boys
	Frequency	%	Frequency	%	Frequency	%	
No pain	1,998	88.6	926	83.0	1,072	94.1	0.9
Intermittent/remitted pain	107	4.7	72	6.4	35	3.1	2.1
Continuing/remitted pain	32	1.4	27	2.4	5	0.5	5.4
Incident pain	71	3.1	54	4.8	17	1.5	3.2
Recurrent pain	21	0.9	17	1.5	4	0.4	4.3
Continuing pain for 1 year	12	0.5	6	0.5	6	0.5	
Continuing pain for 2 years	9	0.4	9	0.8	0	0	3.3
Continuing pain for 3 years	5	0.2	5	0.4	0	0	

Data are shown for 2003.

the 3-year period. They represented 8.6% of all adolescents in the age group 12 to 19 years in Östergötland County. The gender and age distribution as well as the prevalence of TMD pain (compared to a previous study¹²) among the adolescents studied are virtually identical to that of the entire population of 12- to 19-year-olds in this county. Those who did not participate in the study either were not examined each year or attended private dental offices. Patients at PDS clinics who have a lower risk for dental caries generally visit the dentist less often than those with a higher risk. However, to the authors' knowledge, no published data indicate that adolescents with a higher prevalence of dental caries have more or less TMD pain. In addition, there is no evidence to suggest that the recall rate was influenced by the report of TMD pain.

To further examine the generalizability of this cohort, the rate of TMD pain in study participants was compared to that of a group of adolescents ($n = 5,998$) who were examined at intervals greater than 12 months. This external group differed slightly from the present cohort in age and gender composition. The incidence rate in this group was 25% less for females, 29% less for males, and 23% less overall; these differences, however, were not significantly different from the main cohort, and the patterns were the same (ie, higher values for girls than boys). Although it is still possible that the present subjects were systematically different in their propensity to develop TMD pain than the general adolescent population in this county, the chance of such a systematic difference is small; these results are probably applicable to the Swedish adolescent population that attended PDS clinics. TMD pain is the most common symptom among those for seeking care for TMD.¹³ Thus, the registration of ongoing self-reported TMD pain, independent of other TMD

symptoms, was considered clinically relevant. In a previous study, self-report of TMD pain was found to have very good reliability and validity with a sensitivity of 0.98 and a specificity of 0.90 when compared to the reference standard of an RDC/TMD examination.⁸ The questions utilized in the present study would identify only TMD pain occurring around the time of the annual examination. However, given the recurrent and intermittent nature of TMD, especially in adolescence, subjects who have longer episodes or have pain more often are more likely to report TMD pain at these yearly examinations.

Factors that influence incidence rates include follow-up intervals and the definition of TMD pain used. Heikinheimo et al⁵ used a 3-year interval and found an incidence of 5.4% for pain on maximal opening. In a 3-year follow-up of adults, Von Korff et al⁶ found a high incidence rate for TMD pain, 6.5%, but the time interval used was "pain in the prior 6 months." Kitai et al⁴ used the question "Do you have pain by active opening or lateral and forward movement of the lower jaw?" Calculations based on the data reported in Kitai et al's 1997 study⁴ of Japanese girls yielded an incidence rate of 2.4% to 3.9%. Conversion of the incidence rates of Von Korff et al and Heikinheimo et al into annualized rates yielded rates of 2.2% and 1.8% per year, respectively. The annual rates observed in the present study, especially those observed among girls aged 16 to 19 years, appear to be higher than values reported in other studies or for adults. In the present study, the incidence of TMD pain was higher in girls than boys. This finding is in agreement with the results of Von Korff et al,¹⁴ who found in a population-based study that women had higher onset rates for TMD pain than men.

Varying pain patterns were seen among the adolescents in the present study. Some individuals had intermittent pain and made only 1 pain report during the 3 years. This group comprised twice as many girls as boys. Recurrent pain was found in 0.9%, and this group comprised 4 times as many girls as boys. Continuing pain for several years that had remitted had a gender ratio of 5.4 girls to 1 boy. A small minority of the individuals had continuing pain without remission for at least 1 year. The majority of them were girls.

The patterns of intermittent, recurrent, and continuing pain observed by Kitai et al in their study of Japanese girls were similar to those observed in the present study. Five of 361 girls reported continuing facial pain for 3 years, and only 1 girl reported such pain for 4 years.⁴ In a comparison between TMD pain and other pain conditions (eg, headache, back, chest, and abdominal pain), the temporal pattern of TMD pain appeared similar to these other pain conditions: All are typically long-standing, intermittent pain problems of mild to moderate intensity.¹

What is the significance of these reports of TMD pain in adolescence? Pain reports in childhood and early adolescence appear to be associated with the report of pain in early adulthood. In a longitudinal study in Sweden, Brattberg¹⁵ followed 335 children aged 8, 11, and 14 years in an attempt to ascertain predictors of pain by determining whether headache and back pain during school years developed into pain problems in adulthood. The children were first studied in 1989. They were followed up first in 1991 and finally in 2002, when they were 21, 24, and 27 years old. The questions used were "Do you usually have headaches?" and "Do you usually have back pain?" Twenty percent of the subjects reported pain at all 3 time points. The number of patients with long-term pain symptoms were 3 times more likely to be women (31%) than men (10%). Predictors of pain in young adulthood were found to be back pain, headaches at least once a week, and reported nervousness from ages 10 to 16 years.¹⁵ Thus, early reports of TMD pain, however transient, may be indicators of a propensity to develop chronic TMD and other pain conditions in adulthood.

In conclusion, adolescent girls reported higher incidence rates for TMD pain at all ages and for all temporal patterns. A natural continuation of this study would be to further explore baseline risk factors and the subsequent development of TMD. A further important step would be to attempt to reliably identify individuals at risk of developing continuing, persistent pain at an early age and to perform intervening treatment in an effort to prevent further chronicity. Ultimately, modification or

removal of etiologic factors for TMD pain in childhood and adolescence could primarily prevent the disorders in adulthood.

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