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ORIGINAL ARTICLE

Oral parafunctions, piercing and signs and symptoms of temporomandibular disorders in high school students

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ABSTRACT

Objective The use of chewing-gum and piercing has become common among adolescents and might result in increased oral muscle activity and overloading. **Aim** To investigate the frequency of oral piercing and parafunctions in relation to symptoms of temporomandibular disorders (TMD) among adolescents. **Materials and methods** One hundred and twenty-four third level high school students, living either in a city or in a small town, enrolled in either science or media programmes, were included. The students completed a questionnaire regarding different parafunctions and symptoms of TMD. A clinical examination of the temporomandibular system and estimation of the tooth wear was performed in 116 students. **Results** Chewing-gum was used by 86% of the students (25% with a daily use) and 14% had an oral piercing. The science students used more chewing gum than the media students ($p = 0.008$), while the media students had more piercings ($p < 0.001$). Symptoms once a week or more were reported with 39% for headache, 18% for clicking, 7% for facial pain and 6% for difficulty to open wide. Girls reported more headaches ($p = 0.007$) and more severe symptoms ($p = 0.003$), had more medical consultations and used more analgesics (both $p < 0.05$) and had more clinical signs ($p = 0.01$) than boys. Girls had more oral piercings and used more chewing gum than boys (both $p < 0.05$). The media students had more sick leave ($p < 0.01$) than the science students. Chewing-gum use was associated with headache ($p < 0.01$), with difficulty to open wide ($p < 0.05$) and with tenderness of the temporomandibular joints and muscles (both $p < 0.05$). Oral piercing was associated with headache and muscle tenderness (both $p < 0.05$) and daily nail biting with headache ($p < 0.05$) and tooth wear ($p = 0.004$). **Conclusions** There is an association between use of chewing gum, nail biting, oral piercing, and symptoms of TMD.

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Introduction

Temporomandibular disorders (TMD) are a common cause of chronic orofacial pain. Self-reported facial pain among adolescents was found in 2–6%.[1] Headache and fatigue of the masticatory muscles was reported in 6–14%.[2] Facial pain, although usually mild regarding frequency and severity, was commonly experienced, even in childhood, but increased in both prevalence and intensity up to young adulthood. At the ages of 17–25 years, 10% of the responders reported symptoms frequently and another 33% reported occasional symptoms.[2] In adolescents of 12–19 years of age, 4.2% reported temporomandibular pain. However, the prevalence increased with age and with significantly higher prevalence for girls, and was 7.9% at the age of 19.[3] Clinical signs of TMD are infrequent in childhood, but increase after puberty.[4] In a study of adolescents, 7% were diagnosed with TMD-pain, with girls having significantly more symptoms.[5]

The aetiology and background of TMD is complex. Environmental and genetic factors, stress, personality, physical circumstances, and occlusal factors have been recognized.[6] In schoolchildren, headache and other somatic complaints were significantly associated with TMD symptoms [7] and association between psychosomatic symptoms and TMD pain has been found.[8]

Repeated microtrauma, such as caused by bruxism, has been found to correlate with TMD symptoms [2] and prolonged, light clenching can induce signs and symptoms of TMD in healthy subjects.[9] Bruxism and parafunctional habits, such as clenching and unilateral chewing, are considered possible causes of TMD [10,11] and an association between TMD symptoms and parafunctional habits has been noticed among adolescents.[12] Prolonged unilateral chewing of chewing-gum in healthy young women caused increased scores of pain and fatigue, but the scores decreased rapidly when the chewing habit ceased.[13] Pain and fatigue induced by exercise has been related to ischaemia and accumulation of metabolites and decreased pain thresholds.[14] Chewing hard gum gave marked vascular changes [15] and could induce fatigue and facial pain.

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Little is known about the influence of nail biting, use of chewing-gum and oral piercing on the function of the temporomandibular system and its association with facial pain and dysfunction. In a study of 323 girls 15–16 years of age, those who used chewing-gum more than 4 h a day had significantly more facial pain and clicking of the temporomandibular joint (TMJ).[16] Side-effects of oral piercing, such as infections, allergic reactions and gingival or dental trauma, have been reported, with the lower lip being the most common region for oral piercing [17,18] To our knowledge, there is no study of the possible contribution to the development of TMD from oral piercing.

Different school programmes mean different challenges which might influence the degree of pressure and strain for the students. Living in a rural area might give more natural physical activity, and a lower prevalence of TMD pain has previously been found.[3]

The aims of the study were to investigate, among Swedish late adolescents:

The frequencies of oral piercing and parafunctions, and their association to signs and symptoms of TMD; and

The frequency and type of TMD signs and symptoms and to compare students in two different high school programmes and in rural and urban areas.

The hypothesis was that there is no significant difference between adolescents of different programmes, areas or oral habits and signs and symptoms of TMD.

Materials and methods

Selection of students

The study comprises 124 students (71 girls, 53 boys), at the third year high school level, in the county of Värmland, Sweden, receiving free statutory dental care. To compare an urban and rural population, the city of Karlstad, with 80 000 inhabitants, and the communities of Sunne and Torsby, with 28 000 inhabitants scattered within a wider area, were chosen. Students from the science or media programmes were considered for inclusion. In Karlstad the students of one of the schools were invited, and at Sunne/Torsby of the only high school available.

A total of 134 students were invited and 92% accepted participation in the study; the distribution of the students according to programmes and areas is shown in Table 1. The average age was 18.1 years (range = 17–21). Eight students (6%) chose only to answer the questionnaire and underwent no clinical examination. Ten students declined participating, three girls and seven boys. The study was approved by the ethical committee in Uppsala (2007/186).

Table 1. Distribution of the 124 students included in the study.

Programme	Place	Number	Girls/Boys
Science	Karlstad	38	19/19
Media	Karlstad	28	24/4
Science	Sunne/Torsby	38	20/18
Media	Sunne/Torsby	20	8/12

Questionnaire and clinical examination

The classes were contacted 1 week before the examination during a personal visit by one of the authors, and informed about the purpose and performance of the study. The students received written information and the parents of the few students under age 18 also received written information. Just before the examination the students answered a standardized questionnaire regarding any symptoms of orofacial pain and/or dysfunction.

The standardized questionnaire comprised:

(1) Symptoms of TMD and frequency (never, 1–2 times/month, 1–2 times/week, 3–4 times/week, daily); tiredness of the jaws, any joint sound, headache and its common location, pain in face and jaws, difficulties when open wide, locking of the jaws.
(2) Symptoms of hypersensitive or tender teeth with frequency (never, 1–2 times/month, 1–2 times/week, 3–4 times/week, daily).
(3) If the symptoms reported under (1) and (2) resulted in
    (a) sleep disturbances, disturbances of the studies, difficulties to eat, medical consultation,
    (b) sick leave during the past 6 months (frequency and approximate length in days/absence) and
    (c) analgesic consumption (never, 1–2 times/month, 1–2 times/week, 3–4 times/week, daily).
(4) Intensity of reported symptoms
    (a) five-point scale (0 = no or minimal, 1 = slight, 2 = moderate, 3 = fairly severe, 4 = severe) and
    (b) VAS (0 mm (no pain)–100 mm (worst pain imaginable).[19]
(5) Reported parafunctions and frequency (never, 1–2 times/month, 1–2 times/week, 3–4 times/week, daily); clenching or bruxing during sleep, clenching when awake, pressing the tongue towards the front teeth or palate, biting or sucking the cheek, lips or tongue, biting the nails, use of chewing gum and if daily use of chewing gum, for how many hours.
(6) Any oral piercing, location and for how long.
(7) General health on a 5-point scale (0 = very good, 1 = good, 2 = fairly good, 3 = bad, 4 = very bad).

Two dentists performed the clinical examination.[20] Before the study, they trained together, comparing and calibrating their examination, analysing any diversity of the examination result. The clinical examination included palpation of the TMJ and masticatory muscles for tenderness, measuring the range of active and passive mandibular movement, registration of joint sounds and pain sites on mandibular movements and incoordination of the opening path. Overbite and over jet were measured and the type of jaw relation was noted. Changes in the oral mucosa from parafunctions were noted and the degree of attrition (0–3) [21] and erosion (0–1 and/or cuppings), were evaluated of the upper incisors and the mandibular 6-year-molars. The severity and degree of the clinical symptoms noticed were estimated by the use of the clinical dysfunction index of Helkimo [22] with 4 grades of severity (0–III). Clinical diagnoses were made according to the American Academy of Orofacial Pain.[23]

Table 2. Prevalence of some oral parafunctional habits reported by 124 high school students and frequencies of the habits once a week or more often.

Parafunctions	*n*	Total (g/b) %	1–2 times/week all (g/b) %	3–4 times/week all (g/b) %	Daily all (g/b) %
Clenching daytime	57	46 (48/36)	15 (21/8)	6 (6/6)	11 (11/11)
Clenching at night	46	37 (43/27)	8 (12/4)	4 (4/4)	8 (12/2)
Tongue press	47	38 (38/35)	4 (6/—)	7 (9/4)	12 (8/17)
Lip press	74	60 (62/54)	12 (14/9)	11 (11/9)	16 (16/17)
Biting the nails	60	48 (50/43)	10 (17/—)	9 (10/8)	12 (13/10)
Chewing gum use	107	86 (91/79)	26 (25/26)	15 (13/19)	25 (35/9)

g/b: girls/boys; percentage proportion in parentheses within the gender.

Table 3. Prevalence of some reported symptoms of the temporomandibular system by 124 high school students and frequencies of symptoms once a week or more often (percentage proportion and within the gender).

			1–2 times/week (%)		3–4 times/week (%)		Daily (%)	
	n	Total %	girls	boys	girls	boys	girls	boys
Tiredness	43	35	6	6	4	2	6	—
TMJ sound	46	37	13	4	7	—	6	4
Facial pain	25	20	7	2	3	—	—	—
Opening difficulties	16	13	3	2	1	2	1	2
Locking	17	14	4	—	1	—	—	—
Headache	98	79	27	21	20	2	4	2
Sensitive teeth	63	51	10	6	1	2	1	2

Statistical analysis

The Chi-square test was used for comparison of the distribution of variables within the different groups of students and comparing differences. For analysing associations between variables the Mann-Whitney U-test and the Spearman correlation test were used and in some analysis the Fisher's exact test. Multiple regression analyses were performed with adjustment for gender, school programme and area. Statistical significance was considered at the 5% level of probability, odds ratio (OR) and 95% confidence intervals (CI) are presented. A power analysis was made using Power Analysis for ANOVA Designs regarding expected differences of the maximum mouth opening capacity. The statistical analyses were performed in co-operation with statisticians at the Centre of Clinical Research, County Council of Värmland.

Results

Reported oral parafunctions and piercing

Oral piercing was found in 14% (17% of females, 9% of males). The ornaments were located in the tongue in 40%, the rest in the lips or in combination with the lips. The media students had more piercings compared to the science students ($p < 0.001$) and piercing was more common in rural areas ($p < 0.01$). The students in science classes had generally few oral piercing ornaments.

A use of chewing-gum was reported by 86% of the students, 25% reported daily use and 11% chewed 4 h or more daily. Girls used chewing gum more frequently than boys, 91% and 79%, respectively, and for daily use 35% and 9% ($p < 0.01$). With gender as a confounding factor there was significantly more gum-chewing among science compared to media students ($p = 0.008$).

Nail biting was reported by 48% of the students, daily biting by 12% and girls more often than boys ($p < 0.01$). Frequencies for some reported parafunctions are shown in Table 2.

Reported symptoms and subjective evaluation

Headache was reported by 79%; in 39% once a week or more (Table 3). Females reported significant more headache than males (OR = 0.384, 95% CI = 0.191–0.768, $p = 0.007$). When compensating for the gender a greater risk regarding headache was noticed for science compared to media students (OR = 2.458, 95% CI = 1.225–4.932, $p = 0.011$). Facial pain was reported by 7% once a week or more, locking by 4%, difficulties in opening wide by 6% and TMJ clicking by 18%. Sensitive teeth were frequently reported.

According to the evaluation of pain and discomfort with the verbal scale, 62% of the students reported some degree of pain/dysfunction of the temporomandibular system; 38% mild, 17% moderate and 7% fairly severe symptoms. The females graded their symptoms as more severe than the boys did (OR = 0.317, 95% CI = −1.918–−0.378, $p = 0.003$). Reported sleep disturbance was association with the verbal scale ($p < 0.001$). On evaluating the symptoms on the VAS scale, girls scored a mean value of 17 (range = 0–68) and boys 10 (range = 0–55) ($p = 0.04$). Reported clenching daytime was associated with a higher rating in the verbal scale ($p = 0.011$) and with the clinical dysfunction index ($p = 0.005$). Reported clenching during sleep was also associated with the dysfunction index ($p = 0.001$)

Pain and dysfunction resulted in any sick leave for 20% of the students and a use of analgesics by over 50%; 15% of the girls and 6% of the boys used analgesics once a week or more. The media students had more frequent and longer sick leave due to signs and symptoms of TMD and/or headache ($p < 0.01$) and they used more analgesics ($p < 0.05$) than the

science students. Thirteen per cent of the girls had consulted a physician due to their symptoms, while only 2% of the boys had done so ($p < 0.05$). Five students classified their general health as less good, four of these reported headache, but their clinical dysfunction did not diverge from the average. The eight students only answering the questionnaire reported more symptoms compared to those who both answered the questionnaire and were clinically examined.

Clinical findings

Muscle tenderness on palpation was noticed in 54% of the students, 29% with three or more tender muscles. Females had significant more tenderness to muscle palpation than males (OR = 0.376, 95% CI = −1.698–0.238, $p = 0.009$) and science students more than media students after compensating for gender ($p = 0.045$). TMJ clicking and diagnosed as disc displacement with reduction was noticed in 24%, of which 1/4 was bilaterally. Deviation on opening was noticed in 22% and TMJ tenderness to palpation in 12%. The differences in opening capacity between the girls (mean = 47 mm) and boys (mean = 52 mm) were significant ($p < 0.001$). Five girls and one boy opened less than 40 mm. Pain on opening was noticed in 22%, mostly judged as with muscle origin. When opening pain of joint origin, none was bilateral.

According to the Helkimo clinical dysfunction index, 23% of the students were classified with index II and III (moderate and severe signs); 31% of the girls and 12% of the boys (OR = 0.322, 95% CI = −1.885–−0.380, $p = 0.003$). Comparing the different programmes, index II–III were noticed in 16% of the science students as opposed to 33% for the media students ($p = 0.012$). Among those with daily use of chewing-gum, the proportion of TMJ clicking and TMJ tenderness on palpation was about twice that of those with less frequent gum chewing.

Any dental wear was noticed in 61% of the students, but only in 8% with degree 2–3 (including the dentin). Dental wear was more frequently found in the media students ($p < 0.05$). A vertical overbite of 5 mm or more was noticed in 14 students (12%) and was associated with the Helkimo dysfunction index ($p = 0.007$).

Associations between oral piercing, use of chewing-gum, nail-biting and symptoms of TMD

Oral piercing was associated with headache ($p = 0.020$) and with muscle tenderness on palpation ($p = 0.039$). The Helkimo clinical dysfunction index (estimating the degree and severity of the symptoms) was associated with piercing ($p = 0.05$). In the group with tongue piercing, 57% had a dysfunction index of II–III.

Chewing-gum use was associated with headache, for daily chewing ($p = 0.004$), with reported difficulties to open wide ($p = 0.046$), with TMJ tenderness to palpation ($p = 0.050$) and with muscle tenderness to palpation ($p = 0.028$). Among females there was also a significant association between chewing-gum use and TMJ clicking ($p = 0.036$), as well as with reported locking ($p = 0.035$).

Daily nail biting was associated with headache ($p = 0.016$) and there was an association between nail biting and dental wear ($p = 0.004$).

Discussion

A standardized questionnaire was used to gain information on symptoms and parafunctions experienced by the students. Questionnaires have been used in previous studies in the evaluation of reported symptoms of TMD.[24,25] Self-reporting has been suggested as the criterion standard regarding a subjective experience such as pain and questionnaires have shown good reliability both regarding VAS and numerically answered questions.[26] A strong correlation between self-reporting of bruxism and clinically-based diagnoses has been found.[27] Difficulties in remembering pain has to be considered.[28]

Clinical examinations were performed by two dentists, who calibrated together before the study. However, no study of their variability was performed. The inter-examiner variation has been found to be higher than the intra-examiner variation, but still acceptable.[29]

The two regions studied were chosen deliberately to allow the study of possible differences between demographic areas with different psychosocial study environments and, perhaps, physical activity levels. Two high school programmes were chosen to study the possible influence of different study content and direction. The number of dropouts was low and comparable to similar studies.[6] More boys dropped out and those not attending the clinical examination reported more symptoms, which could have somewhat influenced the results. There was a significant association between gender and school programme, which could influence the results, but was adjusted for in the statistical analysis.

Oral piercing was found in 14%, but with an uneven distribution among classes, which could depend on different lifestyles and fashion among students of different school programmes and on a desire to show group belonging. The prevalence is a little bit higher than reported previously.[18] The clinical suspicion of piercing as a source of increased muscle activity resulting in signs and symptoms of TMD was supported by the findings of this study. Over half the group with an oral piercing had a moderate-to-severe clinical dysfunction index. It is possible that oral piercing could introduce new oral parafunctions contributing to the development of TMD, the ornament has to be controlled or interferes with normal function or is something to play with or bite on. There could of course also be co-existing factors resulting in the statistical association between piercing and TMD.

The use of chewing-gum was frequent, but lower than the 62% with daily chewing found among Israeli girls and where a correlation between a chewing gum habit and facial pain was noticed.[16] In our study, muscles and TMJ symptoms, as well as headache and difficulties to open wide and locking were associated with a chewing gum habit. TMJ clicking and arthralgia were higher among those with daily use of chewing gum, which has been noticed previously.[16] The development of symptoms is probably dependant on both the amount and the type of chewing. The sensation of locking of the jaw could

either have a muscular or joint origin. The science student used more chewing gum and had more muscle tenderness, which seems a logical association. There are reports on the benefits of chewing gum to increase concentration of mind.[30]

Students reporting nail biting had more dental wear, which could point to an abrasive effect from nail biting. The amount of dental wear seen in the study is similar to previously observed levels.[21]

More than half the group studied reported symptoms of pain and dysfunction, mostly mild according to the verbal score, but 1/4 reported moderate-to-fairly severe symptoms. Headache was the most frequently reported symptom with 39% once a week or more, which is frequent but in accordance with other studies.[31] It could be discussed if headache is a sign of TMD; however, the association and comorbidity between headache and TMD is clear.[32] Clinical symptoms of degree II–III of the clinical dysfunction index of Helkimo were found in 23%, in spite of the fact that the adolescents of our study all had an annual check-up at the dentist free of charge. It is important that also symptoms of pain and or dysfunction of the temporomandibular system are considered, diagnosed and taken care of. The need for treatment of TMD symptoms among 20-year-olds has been estimated to 27% [33] and another study of adolescents of 12–18 years of age regarding TMD pain to 4.3%.[5]

The differences found between the science and media programmes could be explained by the different study content, demands and expectations. There could also have been personality and sociological differences affecting the choice of programme.

Throughout the study, girls had more symptoms and signs of dysfunction. These facts are supported by other studies.[3,5,34] The girls also had a higher frequency of parafunctions, also found in a previous study.[12] Parafunctions might be one explanation for a higher frequency of TMD symptoms among girls. Other factors could be less resistance to loading, greater susceptibility to muscle strain [35] and sociologically greater pressure and expectations from both themselves and society.

To conclude, pain and dysfunction of the temporomandibular system is common among adolescents. Oral piercing, nail-biting and use of chewing-gum are associated with signs and symptoms indicative of TMD. Girls report more parafunctions and have more symptoms of TMD than boys. There might be differences regarding signs and symptoms of TMD between students in different school programmes.

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Declaration of interest

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper.

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