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Oral habits and their association with signs and symptoms of temporomandibular disorders in adolescent girls

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SUMMARY **A group of 248 randomly selected high school girls, aged 15–16 years, completed a questionnaire and were examined clinically with regard to various oral habits and signs and symptoms of temporomandibular disorders (TMD). Common habits reported in the literature, such as gum chewing, nail biting, biting foreign objects, clenching and bruxism, eating seeds and crushing ice, as well as two less reported habits, 'jaw play' and continuous arm leaning, were evaluated. The most outstanding finding was the high prevalence and intensity of gum chewing among our study group: 92% of the girls chewed daily and 48% chewed gum for more than 3 h a day (intensive gum chewing). Statistically significant associations were found between intensive gum chewing and muscle sensitivity ($P < 0{\cdot}001$) and joint noises ($P < 0{\cdot}05$), and between crushing ice and muscle sensitivity to palpation ($P < 0{\cdot}005$). A positive association was found between 'jaw play' and joint disturbances: reported joint noises ($P < 0{\cdot}01$), catching of the joint ($P < 0{\cdot}01$) and joint tension ($P < 0{\cdot}001$). A positive association was also found between arm leaning and reported joint noises ($P < 0{\cdot}05$), catching ($P < 0{\cdot}05$), and joint tension ($P < 0{\cdot}005$). There was no association between the presence of bruxism and muscle sensitivity to palpation or joint disturbances. The potential harmful effects of intensive gum chewing, 'jaw play', continuous arm leaning and ice crushing are presented in this study. In light of these findings, the professional community should address these habits with proper data gathering, examination and consultation.**

Introduction

Oral habits that can be detrimental to oral health include a number of behaviours, such as bruxism, cheek and tongue biting, thumb sucking, unusual postural habits, occupational-related activities, biting hard objects, nail biting, gum chewing, etc. (Okeson, 1993). Such parafunctional behaviours are common and usually do not harm the stomatognathic apparatus (Rugh & Ohrbach, 1988). However, when the activity exceeds the individual's physiological tolerance, the system begins to alter and breakdown may occur. The initial breakdown is seen in the tissue with the lowest structural tolerance (Okeson, 1993). In other words, the effects of diurnal or nocturnal parafunctional activities can cause damage to dentition, musculature, or joints (Rugh & Ohrbach, 1988).

Numerous investigators have proposed that oral parafunctional habits are a possible cause of temporomandibular disorders (TMD), and report their prevalence and association with signs and symptoms of dysfunction. Studies conducted on adults have shown a positive correlation between parafunction and muscle and temporomandibular joint (TMJ) tenderness (Molin *et al.*, 1976; Ingervall, Mohlin & Thilander, 1980). When 749 children and adolescents were evaluated, 74% reported at least one oral habit, showing a strong correlation between parafunction and tenderness in masticatory muscles (Nilner, 1981; Nilner & Lassing, 1981). In another study conducted on 402 children, bruxism was reported in 20–25% with a positive correlation between bruxism and clinical signs of dysfunction (Egermark-Eriksson, Carlsson & Inger-

vall, 1981). The number of parafunctions found in 166 children, aged 10–16 years, correlated positively with the Dysfunction Index (DI) of Helkimo (1974) (Kononen *et al*., 1987). In a population of 10–18 year-old schoolchildren, there was a positive correlation between joint sounds and occlusal wear (Gazit *et al*., 1984). In a population of 173 individuals, aged 7–27 years, no relationship was found between finger sucking, nail biting or gnashing and the presence of dysfunction; the most frequently recorded oral habit was nail biting (52%) (Meng *et al*., 1987). In a population of female nursing students, the most outstanding parafunction habits were gum chewing (87%), prolonged nail biting (48%), biting foreign objects (72%), clenching teeth when awake (59%) and grinding teeth while awake (22%), performed at least once a week or more. A positive, although weak, association was also found between mandibular dysfunction and parafunctional habits (Schiffman, Fricton & Haley, 1992).

Several parafunctions are quite common among teenagers in Israel, including gum chewing, nail biting, biting foreign objects, leaning on the arm, eating seeds, crushing ice and icepops, and teeth clenching or grinding. An additional habit which was observed clinically was 'jaw play' (unintentional small mandibular movements without tooth contact).

The purpose of the study was twofold: to investigate the prevalence and inter-relationship of several parafunctional activities, and to evaluate their association and contribution to the presence of various signs and symptoms of TMD.

Subjects and methods

A group of 248 girls, aged 15–16 years, randomly selected from a junior high school in central Israel, participated in this study. Prior to the clinical examination, they all completed a questionnaire. One experienced examiner determined beforehand that all the questions were correctly understood and answered. A second experienced examiner performed the clinical examinations and was purposely unaware of the results of the questionnaire.

Information regarding the following symptoms of TMD and oral habits was obtained from the questionnaire:

Symptoms

(1) Joint noises: feeling of joint noises (clicking, popping or grading) during jaw movement.
(2) Joint catching: presence of joint catching (a sudden momentary sticking of the jaw that prevents full opening but is self-releasing).
(3) Joint lock: limitation in opening and feeling that the jaw is caught without the ability to release.
(4) Joint pain: pain in the joint area.
(5) Joint tension: feeling of increased tension within the joint, forcing a tension-releasing movement.
(6) Joint disturbance in the family: presence of these types of joint symptoms in the family.

Oral habits

(1) Gum chewing: average time of chewing per day (in h).
(2) Nail biting: at present.
(3) Biting foreign objects (e.g. pencils): daily frequency.
(4) Eating of seeds: daily frequency.
(5) Crushing of ice and icepops: daily frequency.
(6) Continuous leaning on the arm: leaning of the head on the palm of the hand or arm, daily frequency.
(7) Day-time bruxing, clenching or grinding awareness.
(8) Night-time bruxing, clenching or grinding knowledge.
(9) 'Jaw play': habit of performing small non-functional mandibular movements without tooth contact.

Respondents were also requested to specify the reasons for their gum chewing habit on a scale of 1–6 (Table 1).

Table 1. Reasons for gum chewing

Reason	Mean score
Prevents bad mouth odour	4·79 (1·56)
Gives pleasure	4·57 (1·53)
Serves as a distraction	3·88 (1·78)
Helps to relax	3·64 (3·37)
Prevents caries	2·80 (3.19)
Helps concentration	2·74 (1·76)
Helps with the diet	2·52 (3·57)
Socially accepted	1·05 (0·47)

Mean score (on a scale from 1–6) and s.d. (in parentheses).

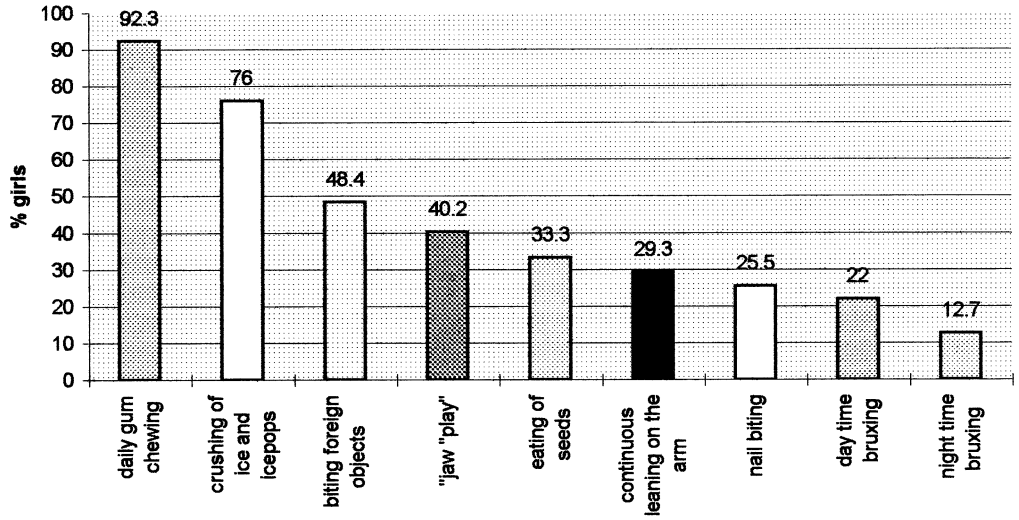

Fig. 1. Distribution and prevalence of the oral habits.

Clinical examination

The clinical examination included the following:
(1) Measurement of the interincisal distance in active (voluntary) maximal mouth opening (AMO) and in passive (assisted) maximal opening (PMO) by applying finger pressure to extend the opening to its maximal capacity.
(2) Presence of joint clicking/crepitation in opening, closing, or in lateral movement felt by palpation over the TMJ area.
(3) Joint sensitivity: sensitivity to palpation of the lateral aspect of the joint of approximately 3 lb (present or absent).
(4) Presence of wear facets on canines (grade 1—enamel only; grade 2—enamel and dentin; grade 3—abrasion of the cusp).
(5) Presence of marked inner cheek imprint (linea alba).
(6) Presence of indentations on lateral sides of the tongue.
(7) Muscle sensitivity to palpation: tenderness on manual palpation of approximately 4 lb on the superficial and deep masseter, anterior portion of the temporalis and its tendon (mild, moderate, or severe).

Statistical analysis

The BMDP statistical software (Dixon, 1990) was used to analyse the data.

The Pearson chi-square test was used to establish the association between variables. Logistic regression analysis was used to identify the most important habit (independent variables) affecting each of the signs and symptoms of TMD (dependent variables). The odds ratio, with 95% confidence intervals, was computed from these regression results.

Results

The distribution of oral habits and their prevalence is summarized in Fig. 1. The most frequent habit was gum chewing (92·3% chewed daily), followed by crushing ice and icepops (76%). The mean gum chewing time was 3·1 h/day (s.d. 2·7), with a range of 0–12 h. More than 3 h/day gum chewing was reported by almost half of the group examined (48%) and defined as intensive gum chewing. The distribution by hours of gum chewing is illustrated in Fig. 2.

Table 1 shows eight different reasons for gum chewing. The highest score (on a scale of 1–6) was given to the prevention of mouth odour (4·79, s.d. 1·56), followed by pleasure (4·57, s.d. 1·53) and distraction (3·88, s.d. 1·78).

The prevalence of reported symptoms is shown in Fig. 3. Joint noises have the highest prevalence (43·5%), followed by joint pain (29·4%) and joint catching (20·6%). Only four girls (1·6%) reported joint locking.

Clinical examination

The following signs were registered:
(1) AMO: 35–70 mm, with a mean of 51·6 mm (s.d. 6·2).
(2) PMO: 37–71 mm, with a mean of 53·7 mm (s.d. 6·1). Only 1·2% of the girls opened less than 40 mm, while 19·2% opened more than 60·0 mm.
(3) Joint clicking during movement of the mandible was found in 92 girls (37·7%).
(4) Joint crepitation was found in three girls (1·2%).
(5) Joint sensitivity to palpation was found in 86 girls (35·1%).
(6) Muscle sensitivity to palpation: at least one site of moderate sensitivity upon palpation in the masticatory muscles was found in 58 girls (23·4%). Moderate sensitivity in more than two muscle sites was found in 31 girls (7%).
(7) Dental wear of the cuspids: enamel only, 94 girls (38·4%); enamel and dentin combined, 45 girls (18·4%).

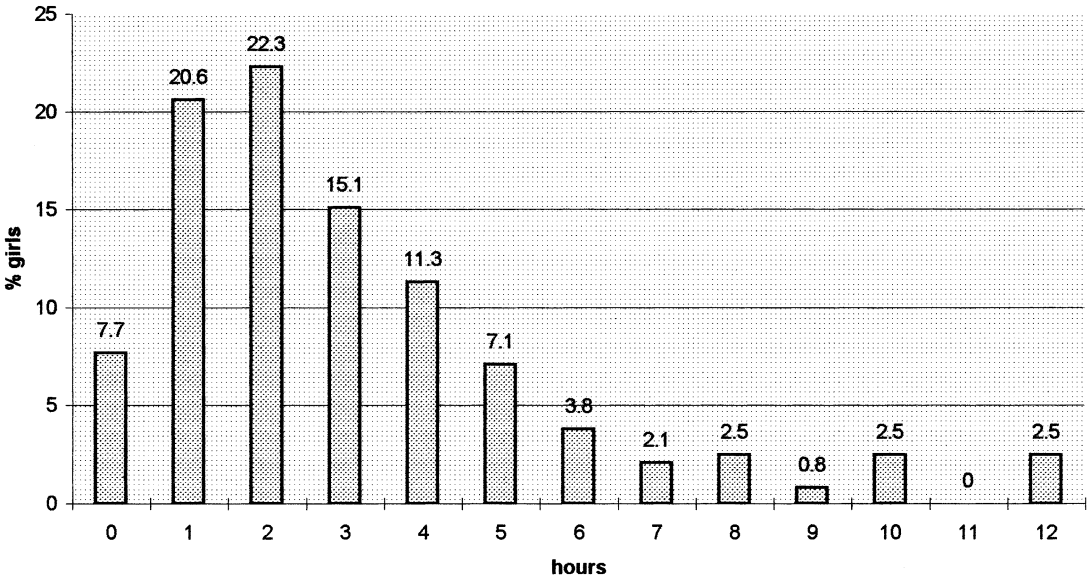

Fig. 2. Duration of gum chewing.

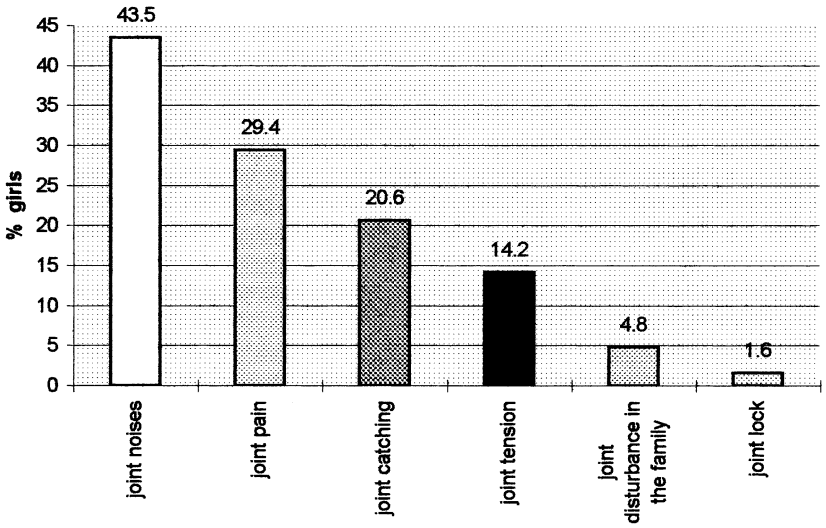

Fig. 3. The frequency of reported symptoms.

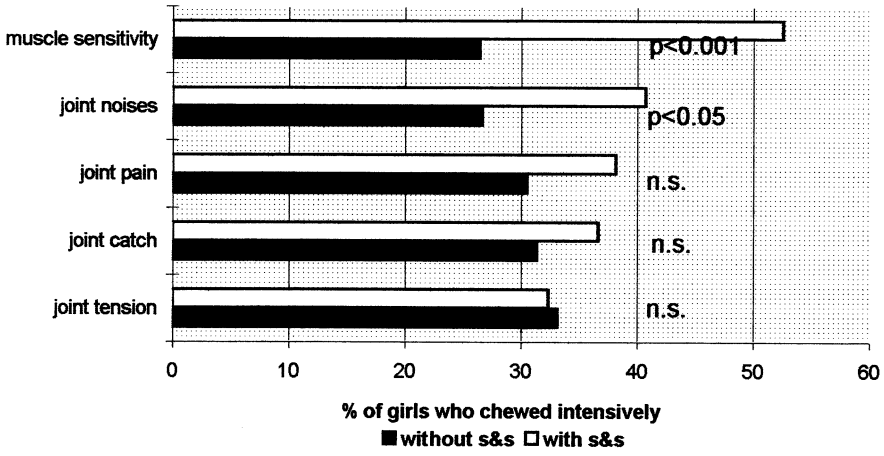

Fig. 4. Intensive gum chewing and signs and symptoms of TMD.

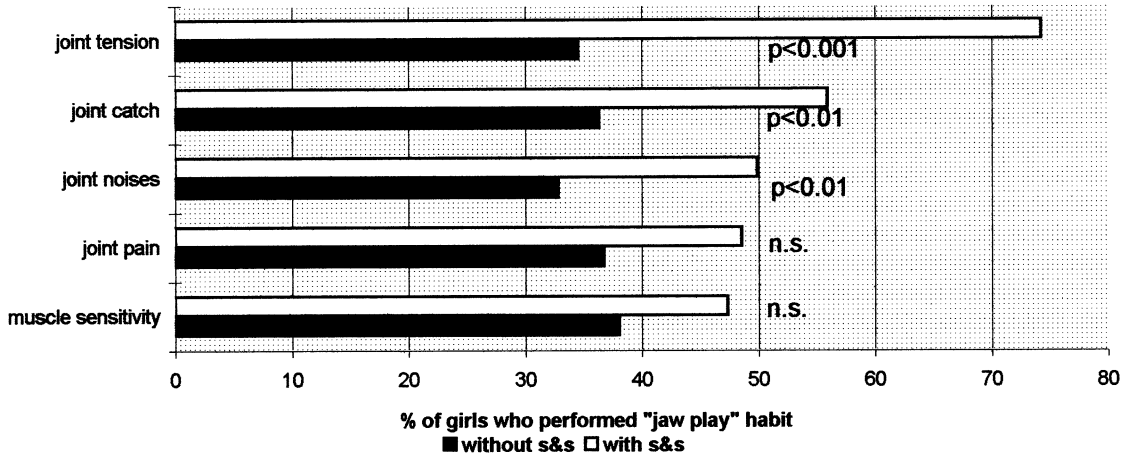

Fig. 5. 'Jaw play' habit and signs and symptoms of TMD.

(8) Marked inner cheek imprint was found in 22 girls (9%).

Statistical analysis

The Pearson chi-square test revealed the following associations:

Among the various reported habits, there were several significant associations: (1) between nail biting and foreign object biting, e.g. pencils ($P < 0{\cdot}01$); (2) between 'jaw play' and leaning on the arm ($P < 0{\cdot}01$); and (3) between day-time and night-time clenching and grinding ($P < 0{\cdot}001$).

Several habits were associated with the presence of signs and symptoms of TMD. Intensive gum chewing was associated with joint noises ($P < 0{\cdot}05$) and muscle sensitivity upon palpation ($P < 0{\cdot}001$) (Fig. 4). 'Jaw play' and arm leaning showed a statistically significant association with joint disturbances: 'jaw play' and joint noises ($P < 0{\cdot}01$), joint catch ($P < 0{\cdot}01$), and joint tension ($P < 0{\cdot}001$) (Fig. 5); arm leaning and joint noises ($P < 0{\cdot}05$), joint catch ($P < 0{\cdot}05$), and joint tension ($P < 0{\cdot}005$) (Fig. 6). In addition, crushing ice and icepops was significantly associated with muscle sensitivity upon palpation ($P < 0{\cdot}005$), and reported night-time bruxism associated with the feeling of joint tension ($P < 0{\cdot}05$).

Analysis of the association between the reported symptoms in the questionnaire and the findings from the clinical examination is seen in Table 2. Significant associations were found between clicks and reported joint noises and joint catch. In addition, an association was found between joint pain and muscle sensitivity. Joint sensitivity was found to be associated with joint noises and joint tension.

The inter-relationships among the reported symptoms related to the TMJ in the questionnaire are shown in Table 3. There was a significant association between joint noises and the symptoms of joint tension, catch and joint pain, and between joint tension and joint catch and pain.

Table 4 summarizes the significant habits for each of the signs and symptoms of TMD revealed by the logistic regression analysis. The habits of 'jaw play', continuous leaning on the arm, intensive gum chewing, and crushing of ice and icepops were associated with an increased prevalence of the signs and symptoms of TMD, as evidenced by positive coefficients. Girls who played with their jaws were about 5 times more prone to feel tension in the joints and 2·3 times more prone to experience joint noises and joint catch when compared with those who did not play with their jaws. Girls who continuously leaned on their arm were

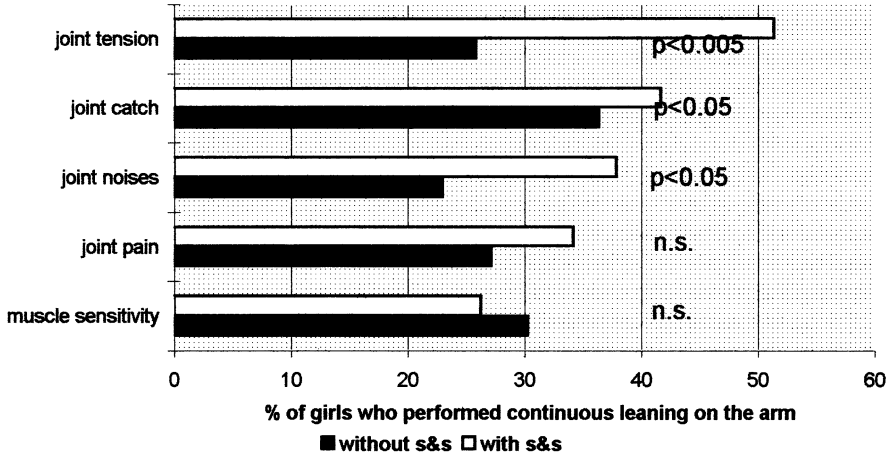

Fig. 6. Leaning on the arm and signs and symptoms of TMD.

Table 2. Association between symptoms reported in the questionnaire and signs in the clinical examination

	Symptoms			
Signs	Joint noises	Joint catch	Joint pain	Joint tension
Muscle sensitivity	2·06	0·00	6·81**	0·15
Joint click	17·61****	9·03***	0·79	0·81
Joint sensitivity	4·85*	1·56	3·48	8·83***

Statistical significance is indicated by: * $P<0·05$; ** $P<0·01$; *** $P<0·005$; **** $P<0·001$.
Value of chi-square is written for each association.
d.f. in the above association was 1.

Table 3. Association among the symptoms reported in the questionnaire

	Joint tension	Joint pain	Joint catch	Joint noises
Joint noises	16·19****	6·70**	25·46****	—
Joint catch	12·67****	1·02	—	
Joint pain	5·33*	—		
Joint tension	—			

Statistical significance is indicated by: * $P<0·05$; ** $P<0·01$; *** $P<0·005$; **** $P<0·001$.
Value of chi-square is written for each association.
d.f. in the above association was 1.

Table 4. Oral habits and signs and symptoms of TMD

	Habit			
Signs and symptoms	'Jaw play'	Continuous arm leaning	Intensive gum chewing	Crushing of ice and icepops
Joint tension	1·56 (0·42) 4·76 2·08–10·90	0·91 (0·39) 2·48 1·15–5·36		
Joint noises	0·84 (0·29) 2·32 1·32–4·05	0·70 (0·31) 2·01 1·10–3·68	0·76 (0·30) 2·14 1·19–3·85	
Joint catch	0·83 (0·33) 2·30 1·20–4·40			
Muscle sensitivity to palpation			1·08 (0·32) 2·94 1·55–5·56	1·57 (0·55) 4·81 1·62–14·25

The significant habits for each of the TMD signs and symptoms found in the logistic regression analysis are summarized: coefficients in the logistic regression and its s.e. (top line in each cell); estimated odds ratio associated with the habit (middle line); 95% confidence interval for the odds ratio (bottom line). Empty cells indicate habits that did not have a statistically significant effect on the corresponding signs or symptoms. All habits are associated with increased prevalence of signs and symptoms of TMD, as evidenced by positive coefficients. The effect of having two or more habits did not prove to be statistically significant.

about 2·5 times more predisposed to feel tension in the joints and about 2 times more apt to experience joint noises when compared with those who did not have this habit. Girls who chewed gum intensively were about 2 times more prone to experience joint noises and about 3 times more prone to show muscle sensitivity in the examination when compared with those who did not chew gum intensively. Girls who crushed ice and icepops on a daily basis were about 5 times more prone to show muscle sensitivity in the examination when compared with those who did not perform this habit. The effect of having two or more of the such behaviours did not prove to be statistically significant.

Discussion

This study was conducted on a group of high school girls, aged 15–16 years, in order to investigate the prevalence and inter-relationship of several parafunctional habits and to evaluate their contribution to the presence of various signs and symptoms of TMD. Their socioeconomic status was higher than the average Israeli population, which could influence the prevalence of some of the oral habits, such as gum chewing, when compared with other population groups in the future. Some researchers maintain that gender could influence the prevalence of TMD (Solberg, Woo & Houston, 1979; Grosfeld, Jackowska & Czarnecka, 1985; Wanman & Agerberg, 1986). Moreover, it is our observation that certain habits, such as gum chewing and the crushing of ice and icepops, appear to be more common in female adolescents.

In order to assess the direct impact of the various habits on the muscles and joints of the stomatognathic system, we evaluated the signs and symptoms as reported by the girls and examined clinically without the use of a craniomandibular index (Fricton & Schiffman, 1986) or a Helkimo (1974) index. These indices make the direct association more complex because their value is compound and based on multiple variables, thus making comparison with other studies difficult.

In our study group, the outstanding finding was the high prevalence of gum chewing: 92·3% chewed gum daily and 48% chewed gum intensively (more than 3 h/day) (Figs 1 and 2). In a study by Schiffman *et al.* (1992), it was found that in a population of young women, aged 22–25 years, the prevalence of weekly gum chewing was 87%, but only 20·4% chewed gum at least once a day; however, the duration of chewing was not mentioned. Therefore, it is impossible to evaluate the intensity of this habit. In the present study, the intensity of gum chewing as reflected by hours of chewing per day was examined. In our opinion, the intensity of the habit is the most important aspect of its detrimental potential to the stomatognathic system.

The mean duration of gum chewing was 3·1 h a day. Therefore, the value of 3 h was selected as the cut-off point for the assessment of the association between intensive gum chewing and the signs and symptoms of TMD. A statistically significant association and positive coefficients were found between intensive gum chewing and reported joint noises and muscle sensitivity to palpation (Table 4, Fig. 4). No significant associations between gum chewing and reported pain in the joint area or reported catching were found. In the study of Schiffman *et al*. (1992), the comparison of associations is difficult because, when dealing with specific parafunctionnal habits, they divided the general population into subgroups by means of indices. Only a correlation between gum chewing and the level of mandibular dysfunction in the joint disorders population was found. From the results of present study, this habit seemed to be harmful to both joint and muscles when performed intensively. The underlying mechanism of this finding could be the continuous loading on joints and muscles (Okeson, 1996; McNeill, 1998).

It is our observation that many youngsters who attend our TMD consultation clinic perform small mandibular side movements without tooth contact. When questioned if they were aware of this habit, the majority responded positively. They perform this habit in order to play with joint clicks or to release tension felt in the joint. We termed this habit 'jaw play'. The high prevalence of 40% found in this study confirms our previous clinical observation.

A highly significant association between 'jaw play' and joint tension was noted. It is an open question as to whether 'jaw play' is carried out to relieve tension or to prevent it, or whether the continuous 'jaw play' contributes to the sensation of tension in the joint. There is also a possibility that these two manifestations could be independent entities. This subject requires further investigation.

A significant association was also found between 'jaw play' and reported joint noises and self-releasing jaw catching. A possible explanation for the above associations could be a progressive process of disk displacement leading to the sensation of catching and tension in the joint complex which causes the habit of 'jaw play'. A continuous performance of this habit could possibly lead to the exacerbation and acceleration of the process of disk displacement, probably due to the stretching of the capsular ligaments or deformation of the disk morphology.

In the clinical examination, there was no association between 'jaw play' and clicking. The latter finding could be based on the lower prevalence of clicking at the time of examination compared with the reported joint noises in the questionnaire. The reason for this could be the fluctuating nature of the click.

There was no association between 'jaw play' and sensitivity of the masseter and temporalis muscles on palpation. It can be deduced that the 'jaw play' habit mainly constitutes a risk factor for joint disorders only.

To the best of our knowledge, the effect of arm leaning on the signs and symptoms of TMD has never been investigated. Of the girls, 29% reported daily continuous leaning of the head on the arm. Daily continuous arm leaning was found to affect the appearance of joint tension and joint noises (Table 4) that could be related to the loading exerted on the joint during the behaviour. When analysing the relationships between various habits, an association between 'jaw play' and arm leaning was found. It is possible that leaning on the arm produces a distal vector of forces in the joint area that eventually leads to the sensation of tension in the joint in cases of disk displacement. This tension stimulates 'jaw play' in an attempt to release it. Both habits are highly associated with the sensation of tension and are associated with each other. Leaning on the arm could be another risk factor for joint disorder and requires additional attention and further investigation.

The second most frequent habit was the daily crushing of ice and icepops with a prevalence of 76%. Girls who crushed ice and icepops on a daily basis were about 5 times more likely to have muscle sensitivity compared with those who did not perform this habit. It is possible that the frequent crushing of ice and icepops, as well as continuous gum chewing, exert great demand on the muscles, thus leading to sensitivity. This is also a harmful habit that has an effect on the masticatory muscles in addition to gum chewing.

Another group of oral parafunctions consists of nail biting and biting hard objects, e.g. pencils and foreign objects. The prevalence of nail biting for this study was 25·5%, which was slightly higher than the 16% reported by Agerberg & Carlsson (1972) and less than the 48% reported by Schiffman *et al*. (1992), 45% by Nilner (1985), and 44% by Kononen *et al*. (1987). The prevalence of biting foreign objects was 48%, while in other studies values of between 4 and 72% have been

reported (Helkimo, 1974; Nilner, 1985; Schiffman *et al.*, 1992). When the relationship between the different parafunctions was analysed, a positive association was found between nail biting and biting foreign objects, which could be explained by the psychological need to hold things in the mouth. Schiffman *et al.* (1992) found a positive correlation between biting objects and the level of mandibular dysfunction in a joint disorder population, as well as in the muscle disorder group. However, in our study group population, there was no association between biting objects and signs and symptoms of TMD.

The last group of parafunctions includes day and night bruxism. Unlike Glaros & Rao (1977), Glaros (1981), and Schiffman *et al.* (1992) ,who differentiated between tooth grinding and clenching by means of a questionnaire, we agree with Okeson & Phillips (1990) and Okeson *et al.* (1991, 1994) that the person's ability to make this distinction is very doubtful. The prevalence of day-time clenching or grinding awareness was 22%, while at night-time it was 13%. This is within the 7–32% range of others studies (Agerberg & Carlsson, 1972; Molin *et al.*, 1976; Solberg *et al.*, 1979; Egermark-Eriksson *et al.*, 1981; Nilner, 1983a,b; Magnusson, Egermark-Eriksson & Carlsson, 1985, 1986; Kononen *et al.*, 1987). Bruxism is probably underestimated because this habit is subconscious and most people are not aware of its presence and intensity. There was a highly significant association ($P < 0{\cdot}001$) between reported diurnal and nocturnal bruxism. The question is whether or not diurnal and nocturnal bruxism is a separate entity that the person is unable to distinguish, or is the manifestation of the same phenomenon. A correlation between bruxism and tenderness to palpation of the tendon of the temporalis has been previously reported (Nilner, 1983a,b). Surprisingly, the present study did not show an association between the presence of bruxism (cuspid wear, tongue and cheek imprint and awareness of habit performance) and muscle sensitivity to palpation.

In the present study, 108 girls (43·5%) reported joint noises during jaw movement. In the clinical examination, 92 girls (37·7%) exhibited joint clicks. Only three girls had crepitus (1·2%). The occurrence of TMJ clicking noises has been reported to be between 8 and 41% and of crepitation to be between 1 and 24% (Agerberg & Carlsson, 1972; Helkimo, 1974; Heloe & Heloe, 1979; Solberg *et al.*, 1979; Nilner, 1981; Schiffman *et al.*, 1992; Keeling *et al.*, 1994; Fricton & Schiffman, 1995). The results of the present study were slightly higher, possibly because our study population chewed gum intensively, a habit which has a strong association with joint sounds. 'Jaw play' and arm leaning habits could also be contributing factors. Furthermore, a highly significant association was found between reported joint noises, by means of the questionnaire and joint clicks by palpation (Table 2). This fact is very important and could be useful in future epidemiological studies in which it may be possible to screen joint noises using only a questionnaire with good reliability. Moreover, there was a strong association between reported joint noises and catching of the joint ($P < 0{\cdot}001$), reported pain ($P < 0{\cdot}01$) in the joint area, joint tension ($P < 0{\cdot}001$), and tenderness of the joint upon palpation ($P < 0{\cdot}05$) (Tables 2 and 3). In view of these findings, a reported or presented joint noise should be more carefully investigated concerning the presence of other parameters of joint disturbance such as joint pain, tenderness to palpation or joint catching.

The importance of this study is the identification of potential harmful effects of certain habits. Table 4 assesses these effects. The habits of 'jaw play', arm leaning and intensive gum chewing have a potentially harmful effect on the joint, and crushing ice and intensive gum chewing has a similar potential harmful effect on the masticatory muscles examined. Patients should be alerted to the existence of these harmful habits and encouraged to break them. Education is an important approach to prevention and treatment. This is especially difficult because commercial propaganda claims that chewing gum prevents caries and bad breath.

Conclusions

(1) The most common oral habit in adolescent girls was gum chewing, with high intensity and prevalence.
(2) Intensive gum chewing had a potentially harmful effect on the masticatory muscles, as well as on the TMJ, as found by the positive significant association with muscle sensitivity to palpation and joint noises.
(3) 'Jaw play', a habit of performing a small non-functional mandibular movement, was highly prevalent in this population. This habit was positively associated

with joint disturbances (noises, catching and joint tension) and justifies further clinical and epidemiological investigation.
(4) Leaning on the arm was the third habit that specifically showed targeted effects on the TMJ (joint tension and noises).
(5) The crushing of ice and icepops had a detrimental effect on the muscles examined.

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