

A 20-year longitudinal study of subjective symptoms of temporomandibular disorders from childhood to adulthood

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Egermark I, Carlsson GE, Magnusson T. A 20-year longitudinal study of subjective symptoms of temporomandibular disorders from childhood to adulthood. *Acta Odontol Scand* 2001;59:40–48. Oslo. ISSN 0001-6357.

The aims were to study the development over 20 years of reported temporomandibular disorders (TMD) symptoms in an epidemiologic sample and to analyze possible correlations between these symptoms and some other variables. Four hundred and two randomly selected 7-, 11-, and 15-year-old subjects were originally examined by means of a questionnaire with regard to symptoms of TMD. The investigation was repeated after 4–5, 10, and 20 years, using the same method. After 20 years, when the original group had reached the age of 27 to 35 years, 378 individuals (94%) could be traced, and they were sent a questionnaire. Three hundred and twenty subjects (80% of the original sample, 85% of the traced subjects) completed and returned the questionnaire. There was a substantial fluctuation of reported symptoms over the 20-year period. Progression to severe pain and dysfunction of the masticatory system was rare. On the other hand, recovery from frequent symptoms to no symptoms was also rare. At the last examination 13% reported one or more frequent TMD symptom. The prevalence of bruxism increased with time, but other oral parafunctions decreased. Women reported TMD symptoms and headache more often than men. Correlations between the studied variables were mainly weak. The highest correlations found ($r_s = 0.4–0.5$) were those between reported tooth clenching and tooth grinding and jaw fatigue. It can be concluded that in this epidemiologic sample, followed over 20 years from childhood to adulthood, a substantial fluctuation of TMD symptoms was found. Severe symptoms were rare, but 1 of 8 subjects reported frequent TMD symptoms at the last exam. □ *Bruxism; epidemiology; headache; orofacial pain; temporomandibular joint*

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Epidemiologic studies have shown that signs and symptoms of temporomandibular disorders (TMD) can be found in all age groups. The prevalence is low in small children but increases with age in adolescence up to young adulthood. Most signs and symptoms in children are characterized as mild, and more severe dysfunction is rare (1, 2). These results, originally reported from cross-sectional studies of different age groups, have been corroborated by later studies (3–5). Longitudinal studies have found that TMD signs and symptoms often fluctuate (6–17). Longitudinal studies have been considered to provide a possibility to solve some of the many still remaining controversial issues with regard to TMD, such as age distribution of TMD patients, sex differences, etiology, and treatment need (6, 18, 19). What longitudinal studies can do is to describe the development with increasing age of signs and symptoms of TMD and possibly related factors. Closer analyses may explain why some individuals experience a gradual impairment of their symptoms and become TMD patients, whereas the great majority, even though some mild fluctuating symptoms may appear, do not require treatment. It is possible that one reason for the relative lack of more conclusive results from longitudinal studies is that the observation periods have not been long enough.

Therefore, the aims of this study were to investigate the development of and to analyze possible associations

between reported symptoms of TMD and some related factors in children over a period of 20 years—that is, from childhood to adulthood. The hypotheses were 1) that reported TMD symptoms fluctuate with time, and 2) that these symptoms are closely associated with oral parafunctions.

Materials and methods

Subjects

Originally, 402 randomly selected 7-, 11-, and 15-year-old subjects were examined by means of a questionnaire on TMD symptoms, headaches, and oral parafunctions and clinically with regard to signs of TMD and occlusal factors. The results were published in a doctoral thesis by one of the present authors (20). The investigation was repeated after 4–5 and 10 years, using the same methods, and the results have been published earlier (6–9). Twenty years after the first examination an attempt was made to find the addresses of the original participants, who at that time had reached the ages of 27, 31, and 35 years, respectively. Three hundred and seventy-eight individuals (94%) of the original group could be traced. The loss of 24 subjects comprised 3 deceased, 5 who had moved out of the country, and 16 whose addresses could not be traced in

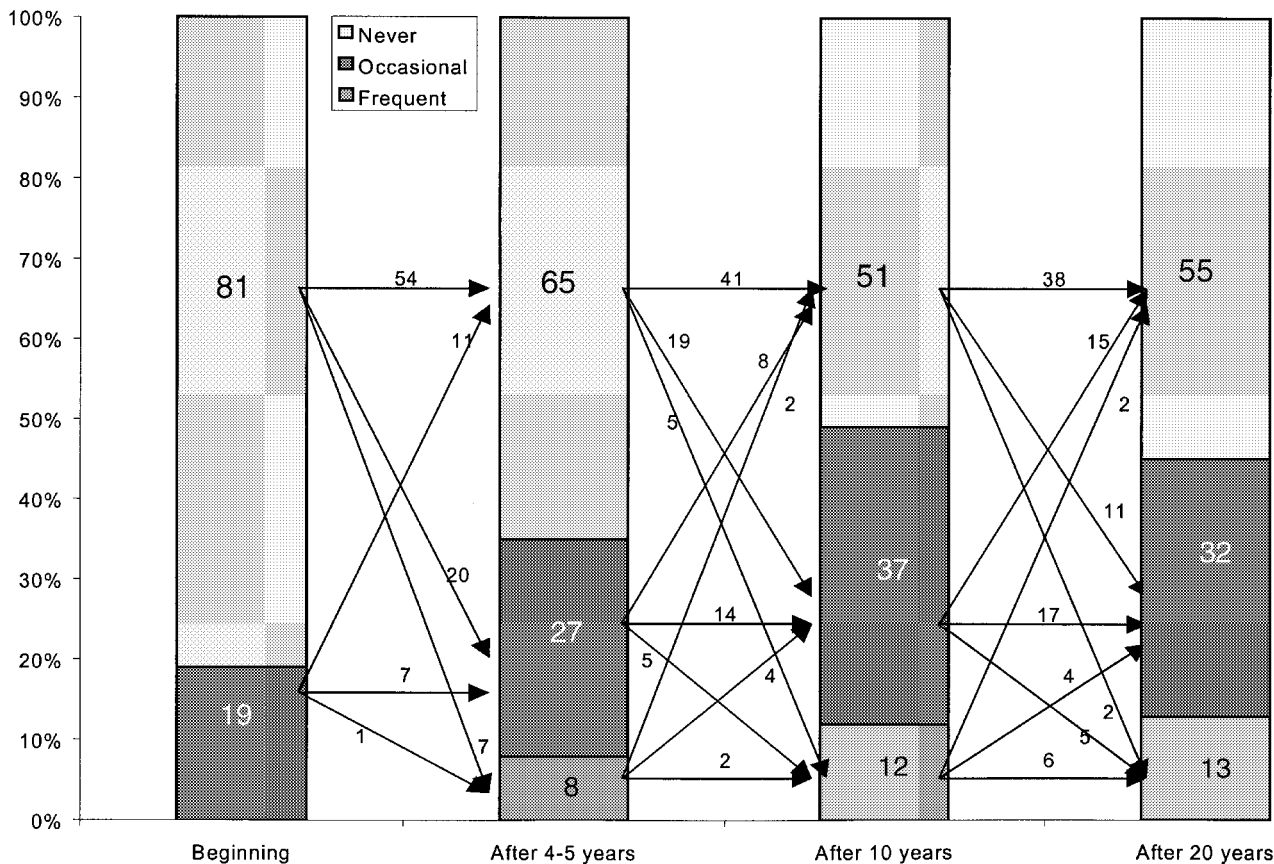


Fig. 1. Variation (in %) in reported temporomandibular disorder symptoms (including temporomandibular joint sounds) in 150 subjects, examined by questionnaire on 4 occasions during a 20-year period.

official Swedish registers (personal registration numbers were not available at the original examination). The traced subjects were all sent a questionnaire (the oldest group also received an invitation to participate in a clinical examination, reported in a separate paper (10)). Three hundred and twenty subjects (80% of the original sample, 85% of the traced subjects), 167 women and 153 men, completed and returned the questionnaire, whereas no response was received from 58 individuals in spite of 2 letters of reminder. The response rate varied somewhat between the three age groups: 74%, 80%, and 84% for the 27-, 31-, and 35-year old subjects, respectively, calculated for the original samples.

Methods

The questionnaire included questions about the presence of symptoms from the masticatory system, including headaches, whether the subject often felt stress or was worried or depressed, and about oral parafunctions, previous trauma to the face, experience of TMD treatment during the observation period, and present/current demand for TMD treatment.

Comparisons have been made with the symptoms

reported 20 years ago and with the findings at the 4- to 5- and 10-year follow-ups, respectively. One hundred and fifty-nine subjects returned the questionnaire on all four occasions (a few questions were not always answered by all participants, which explains the differences in numbers in Figs. 1 to 4). All statistical comparisons between the four different examinations relate only to subjects participating in all examinations. Consequently, the prevalence figures presented for the previous examinations can differ slightly from those presented earlier. The discrepancies between Tables 1 and 2 and the figures in the present paper can be explained by the fact that the tables present data for all participants at each examination, whereas the figures include only those who participated in all four exams. A comparison of sex and the original results of those who participated at all examinations and those who were lost to one or more of them did not show any significant differences

Statistical methods

Sign tests and Wilcoxon's matched-pairs signed-rank test were used for analysis of differences between the four examinations, and Pitman's nonparametric permutation

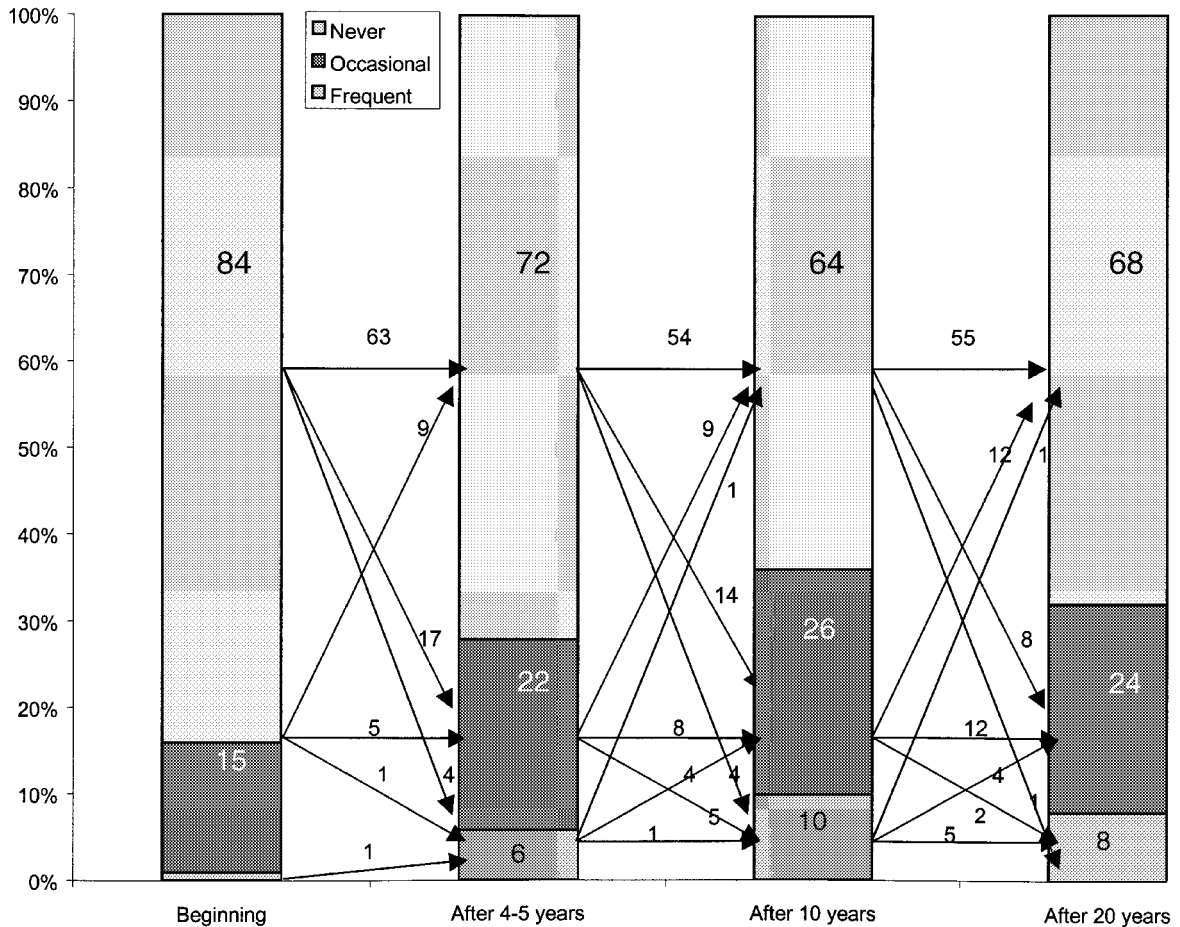


Fig. 2. Variation (in percentage) in reported temporomandibular joint sounds in 153 subjects, examined by questionnaire on 4 occasions during a 20-year period.

test was used to test for sex differences (21). Correlations between variables were calculated by means of Spearman's (r_s) rank correlation test (22). The following levels of significance have been used: $P > 0.05$ = not significant (NS); $*0.01 < P \leq 0.05$; $**0.001 < P \leq 0.01$; $***P \leq 0.001$.

Results

Reported symptoms

The reported prevalences of symptoms in the 3 age groups of 27-, 31-, and 35-year-old individuals were quite similar, and no statistically significant difference between the groups could be established ($P > 0.05$). Therefore, the results have been pooled for all subjects examined at the 20-year follow-up. Both at the original and the 4- to 5- and the 10-year-follow-up examinations there were some differences between the three age groups, as reported previously (1, 6–9), but to simplify comparisons, the prevalences recorded at the previous examinations have been averaged for all examined subjects (Tables 1 and 2).

Almost half of the subjects at the 20-year follow-up (46%) reported one or more of the symptoms TMJ clicking, jaw fatigue, and difficulty in mouth opening, at least occasionally (Table 1). The prevalence of these three symptoms was significantly greater than at the first examination ($P < 0.01$), whereas the changes from the 10-year examination up to the 20-year one were nonsignificant ($P > 0.05$). Pain or fatigue in the jaws or face during chewing (for example, gum) did not change significantly during the observation period.

At the last examination 10% reported that they occasionally experienced a locking of the mandible; none said this occurred frequently. The corresponding figure at the 10-year follow up was 7%, and 1% (one individual) reported frequent locking on that occasion.

There was a substantial fluctuation of the symptoms during the observation period (Figs. 1, 2). With regard to TMJ clicking, almost half of the respondents (45%) never reported this symptom, whereas 5% reported clicking on all four occasions over 20 years. Variation in TMJ sounds was thus relevant for only half of the sample. A similar situation was found for TMD symptoms excluding TMJ

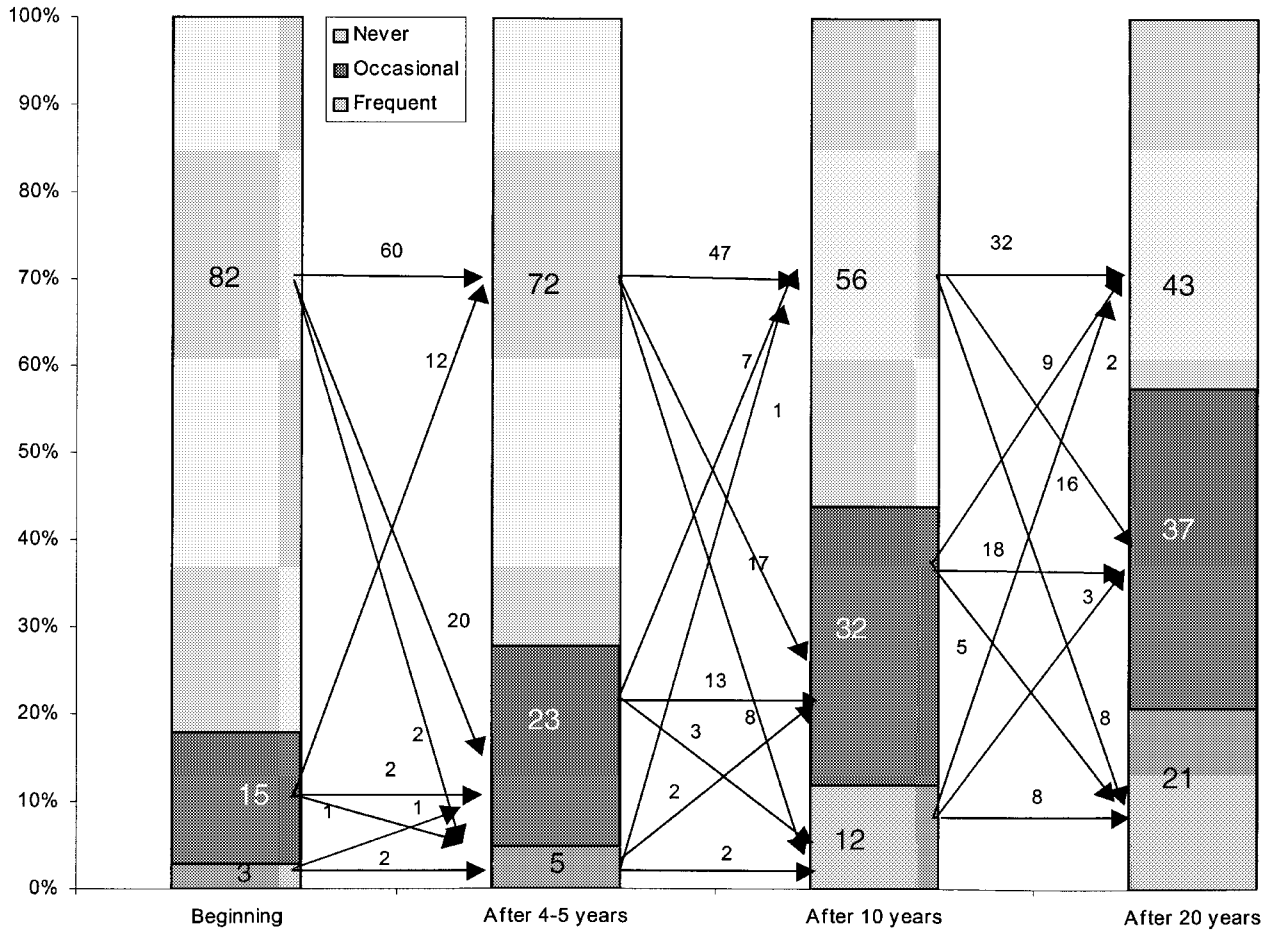


Fig. 3. Variation (in percentage) in reported bruxism (tooth clenching and/or grinding) in 155 subjects, examined by questionnaire on 4 occasions during a 20-year period.

sounds: 55% never reported such symptoms, 22% only at one, and none at all examinations.

Progression to severe pain and dysfunction of the masticatory system was rare. On the other hand, recovery from frequent symptoms to no symptoms was also rare (Fig. 1).

Oral parafunctions

Both frequent daily tooth clenching and frequent nocturnal tooth grinding were at the last examination reported by 16% of the participants (Table 2), which was much more than at the first one ($P < 0.001$) and slightly more than 10 years ago ($P < 0.05$). The presence of either grinding or clenching increased both in comparison with the original ($P < 0.001$) and with the examination 10 years ago ($P < 0.01$; this was due to an increase in the youngest age group from 17 to 27 years, whereas the changes in the older ones were nonsignificant). More than half of the participants at the 20-year-follow-up (55%) were aware of occlusal parafunction.

The prevalence of nail biting and other biting habits

decreased with increasing age, but 14% of the 27- to 35-year-old subject reported that they frequently performed such habits (Table 2). One or more of the mentioned occlusal and other oral parafunctions were reported by about 70% of the subjects. Almost one third said they performed these habits frequently.

The reports of bruxism (tooth clenching and/or grinding) showed great variation, even though the general trend was an increased prevalence over time (Fig. 3).

Headache

Headache has had about the same prevalence in all subjects over the 20-year follow-up period except for a lower frequency in the 7-year old children at the first exam. A small group (15%) said they never had a headache, and 12% reported frequent headaches, both at the last and the 10-year examinations. Of those with headache, 7% judged their headaches as severe, 9% often took analgesics because of their headaches, and 14% had consulted a physician for their headaches. To the question as to when they had a headache, 9% said it was present

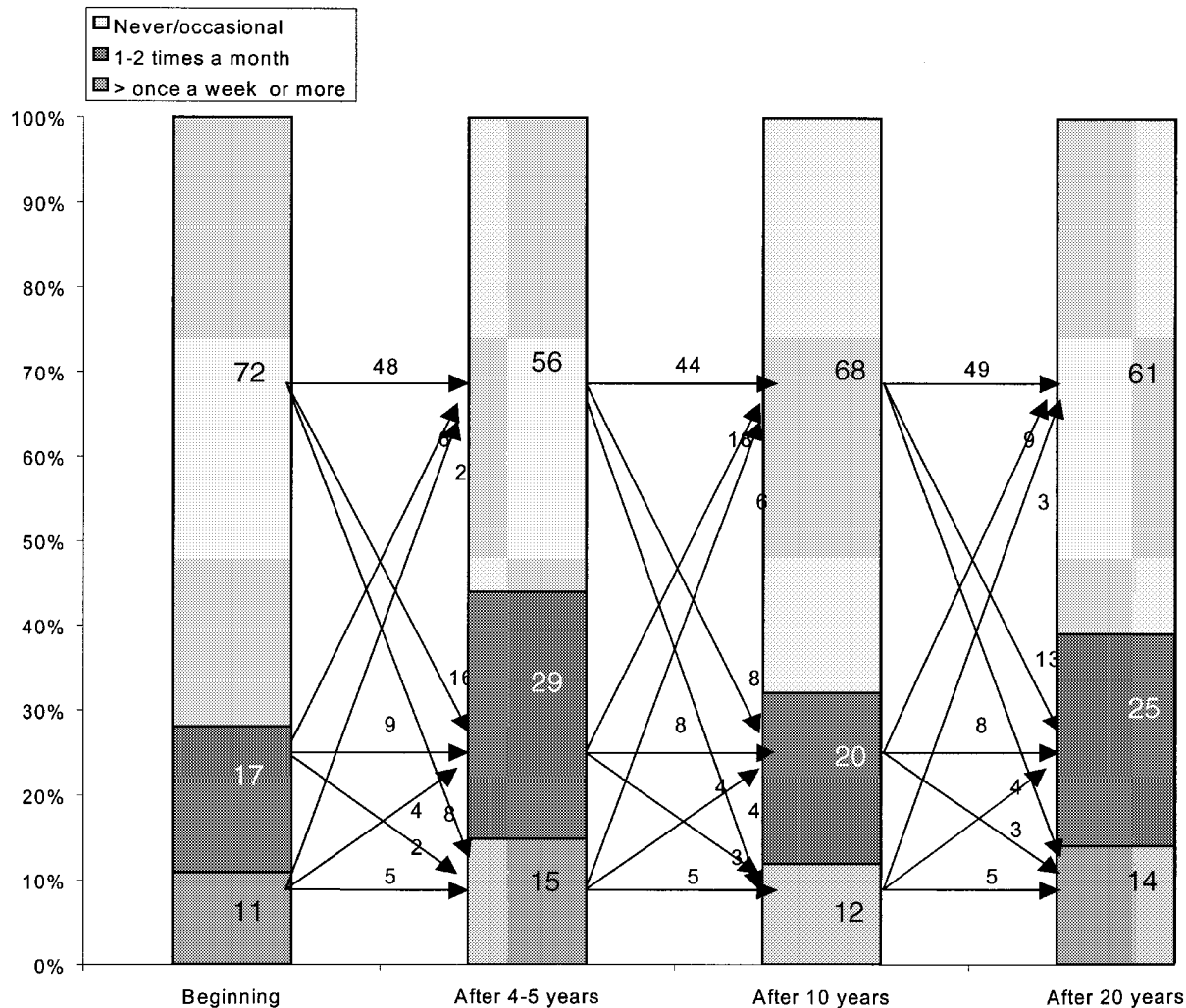


Fig. 4. Variation (in percentage) in reported headache in 159 subjects, examined by questionnaire on 4 occasions during a 20-year period.

already in the morning, in 41% it developed during the day, and 49% thought it varied. The most common locations were the forehead (19%) and the temporal region (16%), but 41% said it varied or appeared in many parts of the head. Of the respondents, almost two thirds (64%) believed in an association with stress.

A fluctuation of headache frequency was evident (Fig. 4), and only one subject reported frequent headache in all four questionnaires (this individual said at the last examination that she had several serious diseases).

Background factors

More than one third (37%) reported that they had experienced a forceful blow on the chin or to the face, and 11% said they had some disease. To the question of how they evaluated their general health, 82% thought it was good, 14% had minor complaints, and 4% had a severe

disease. The questions on the mental situation also indicated some disturbances: 6% said they were often depressed, 17% often worried/anxious, 26% often irritated, and 37% often stressed.

Sex differences

Several symptoms were reported more frequently by women than by men: jaw fatigue ($P < 0.001$), difficulties in mouth opening ($P < 0.05$), pain during chewing ($P < 0.05$), subjective TMD symptoms taken together ($P < 0.01$), tooth clenching and bruxism (clenching and/or grinding of teeth, both $P < 0.05$), locking of the mandible ($P < 0.05$). Women also had headache more frequently and took medication for headache and sought medical care for headache more often than men did (all, $P < 0.001$). The only variable that was significantly more frequently

Table 1. Prevalence (in percentage) of reported symptoms of temporomandibular disorder in originally 402 subjects examined on 4 occasions during a 20-year period

Reported symptoms	Age at examination			
	7–15 years, <i>n</i> = 402	11–20 years, <i>n</i> = 240	17–25 years, <i>n</i> = 293	27–35 years, <i>n</i> = 320
1. Temporomandibular joint sounds				
Frequent	0	5	8	8
Occasional	13	18	24	24
2. Jaw fatigue				
Frequent	0	0	2	4
Occasional	5	4	14	17
3. Difficulties in mouth opening				
Frequent	0	1	2	4
Occasional	6	6	7	11
4. Pain or fatigue in the jaws or face during chewing of, for example, chewing gum				
Frequent	6	7	12	11
Occasional	47	50	51	45
5. One or more symptoms 1–3				
Frequent	0	6	11	13
Occasional	19	24	33	33
6. One or both of symptoms 2, 3				
Frequent	0	2	2	6
Occasional	6	12	17	23

reported by the men was facial trauma (50% of the men, 26% of the women; $P < 0.001$).

Demand for treatment

Thirty-nine participants (9%; that is, 17% of the women, 7% of the men; $P < 0.01$) reported that they had had such pain-dysfunction problems that they had sought treatment for TMD during the 20-year follow-up period. The most common treatment received was an interocclusal appliance, often in combination with jaw exercises

and/or occlusal adjustment. A positive outcome of the treatment was reported by 83% of those who had been treated; 15% said it had had no effect, and 2% considered it led to impairment. At the last examination 4% (all men) said that they had such problems related to the masticatory system that they now wished to be treated.

Correlations (at the 20-year examination)

The reported TMD symptoms and headache were significantly correlated to each other and to tooth

Table 2. Prevalence (in percentage) of reported orofacial parafunctions in originally 402 subjects examined on 4 occasions during a 20-year period

Reported parafunction	Age at examination			
	7–15 years, <i>n</i> = 402	11–20 years, <i>n</i> = 240	17–25 years, <i>n</i> = 293	27–35 years, <i>n</i> = 320
1. Tooth clenching				
Frequent	2	3	9	16
Occasional	6	17	29	32
2. Nocturnal tooth grinding				
Frequent	2	4	9	16
Occasional	9	10	17	22
3. 1 and/or 2				
Frequent	2	5	14	21
Occasional	10	22	34	34
4. Nail, lip, cheek, tongue biting or biting on foreign objects				
Frequent	23	23	18	14
Occasional	44	39	34	28
5. 3 and/or 4				
Frequent	22	26	29	31
Occasional	44	47	46	40

Table 3. Significant Spearman rank correlation coefficients between various reported symptoms in 320 subjects aged 27, 31, and 35 years (at the 20-year follow-up)

Variable	1	2	3	4	5	6
1. TMJ clicking	–					
2. Jaw fatigue	0.20***	–				
3. Difficulty in mouth opening	0.34***	0.22***	–			
4. Tooth clenching	0.23***	0.42***	0.20**	–		
5. Tooth grinding	0.27***	0.53***	0.20**	0.47***	–	
6. Headache	0.11*	0.25***	0.17**	0.21***	–	–
7. Often stressed	–	0.19**	0.16**	0.20**	–	0.23***
8. Often worried	–	0.19**	0.22***	0.18**	0.15*	0.19**
9. Often depressed	–	0.12*	–	0.12*	0.15*	0.14*
10. Often irritated	–	0.13*	0.29***	0.17**	–	0.23***

* $0.01 < P \leq 0.05$; ** $0.001 < P \leq 0.01$; *** $P \leq 0.001$.

clenching and grinding (the only exception: headache was not significantly correlated to nocturnal tooth grinding). Headache was also significantly correlated to the psychological variables included, all of which were also associated with jaw fatigue and difficulty in mouth opening. However, most of the correlations were weak (Table 3). The strongest correlations found ($r_s > 0.4$) were between jaw fatigue and tooth grinding and clenching. Reported disease was correlated to difficulty on opening the mouth and the psychological variables except 'often depressed' (all $r_s \approx 0.2$).

Discussion

In descriptive epidemiologic investigations it is essential that the examined sample is representative of the target population. The original 402 subjects of this study comprised all but 2 pupils from randomly selected school classes of 7-, 11-, and 15-year old schoolchildren in a small town in southwestern Sweden. Although not a strict epidemiologic sample, the participants were considered to constitute a reasonably good cross-section of healthy Swedish schoolchildren in the respective age groups at the time of the original investigation (1, 20). In this 20-year questionnaire follow-up, 80% of the original sample participated. The participation rate was 85% when the explainable loss (dead, emigrated, untraceable) was deducted. Even though any loss of participants in a longitudinal study implies a risk of selection bias (23), the participation rate in our study should be acceptable, especially with regard to the long observation period. It is probably one of the highest response rates reported for long-term epidemiologic studies of TMD symptoms. Practically all questions in the questionnaires have been identical at all examinations, which also should strengthen the reliability of the results.

The finding that almost half of the participants were aware of occasional TMD symptoms was in line with previous epidemiologic results (24). However, only very few reported such symptoms on all occasions (5% TMJ sounds and none the other TMD symptoms). This study

corroborates the considerable fluctuation of TMD symptoms found in several longitudinal studies (11–17).

A proportion (55%) similar to that for those with TMD symptoms at the last follow-up reported diurnal and/or nocturnal bruxism. It might be tempting to take this as support for the frequently assumed cause–effect relationship between bruxism and TMD (25), especially as the strongest correlation found in our analyses ($r_s = 0.4$ and $r_s = 0.5$) were between jaw fatigue and tooth clenching and tooth grinding, respectively. Other correlations were weak and around 0.2. Associations between oral parafunctions and TMD signs and symptoms have been reported in several studies (3, 4, 8, 26). However, an association does not tell us whether a parafunction is the cause or the consequence of pain/dysfunction. One must be cautious about jumping to any conclusion about TMD etiology on the basis of a questionnaire study or other epidemiologic methods (27). Even when other research is included, it has been suggested that the evidence for an etiologic relationship between bruxism and TMD is weak (28, 29).

Other oral parafunctions had decreased in prevalence from childhood but were surprisingly frequent also at the 20-year examination when the subjects had reached adult age (27 to 35 years). A significant relationship between intensive oral parafunctions and TMD signs and symptoms in adolescent girls has recently been reported (30). In our study such correlations were weak. However, further analyses of the longitudinal aspects of oral parafunctions are in progress.

In this questionnaire study it has naturally not been possible to examine the often-discussed relationship between occlusal interferences and TMD signs and symptoms (31). However, in clinical studies of the same individuals only very weak associations have been found (10, 32).

It is well established that in clinical series of TMD patients, women predominate. The question of this sex difference has often been discussed, but it remains largely unexplained (33, 34). Several more recent epidemiologic studies (4, 5, 14, 35) as well as this one have found significantly more frequent and more severe TMD symptoms in women than in men. In a 10-year longi-

tudinal study men seemed to recover from TMD signs and symptoms to a greater extent than women (14). The sex differences in prevalence and severity and the different courses with longer duration of TMD signs and symptoms in women may help to explain why they are more likely than men to seek care. In our study women had had a greater demand for TMD treatment during the 20-year observation period. However, in the last questionnaire, only men presented a demand for treatment, an unexpected finding that will be further analyzed.

An interesting observation was the favorable outcome of TMD treatment reported by 83% of those who had sought care. Such a treatment result is at least equal to what can be expected by recommended simple methods for management of TMD (19). Most of this treatment was performed by general practitioners, which indicates that management of TMD in most cases can be successfully conducted in general dental practice.

The prevalence of frequent headache (once a week or more) was remarkably consistent during the 20-year period (11% to 15%). Similar to TMD symptoms, headaches showed great individual variation over time (Fig. 4). It was of course not possible to identify a correct headache diagnosis from the answers to the questionnaire, but the results corroborated the findings of several investigations that observed an association between headache and TMD (36–39). Studies using diagnoses established by neurologists have reported that most patients with tension-type headache have signs and symptoms of TMD, and many TMD patients have headaches (37–39). The interpretation has been that these two conditions may have a similar etiology, manifested in, among other things, tenderness of pericranial muscles. The association established in this study between headache and TMD symptoms may be taken as support of previous results, but it should be noted that the correlations were weak.

The importance of psychological factors in the etiology of TMD has been much discussed, but a common current view is that they may predispose certain individuals to TMD and may also perpetuate TMD once such symptoms have become established (25, 28). In this study psychosocial factors such as 'often stressed, often worried, often depressed, often irritated' showed statistically significant correlations with headache and with jaw fatigue and difficulty in mouth opening (Table 3). It should be noticed, however, that the associations were weak ($r_s < 0.3$).

The first of our hypotheses, that TMD symptoms fluctuate with time, was corroborated in this long-term study. The hypothesis of an association between TMD symptoms and oral parafunctions was verified to some extent, but the correlations found were in general weak.

Within the limitations of this longitudinal study, the following conclusions may be drawn. 1) This study has shown a substantial fluctuation of reported TMD symptoms and headache from childhood to adulthood. In general, the symptoms increased during the first half of the follow-up period but remained at a similar prevalence level to the last examination (12%–13% of frequent

symptoms). 2) Occlusal parafunctions tended to increase with time, whereas other oral parafunctions showed a decreasing prevalence with time. Tooth clenching and grinding showed moderate correlation ($r_s = 0.4$ – 0.5) with jaw fatigue, whereas other correlations between possible etiologic factors and TMD symptoms were weak ($r_s \leq 0.2$).

Acknowledgements.—This investigation was supported by grants from the Research Council, County of Halland, Sweden, and the Swedish Dental Society.

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Received for publication 11 September 2000

Accepted 10 November 2000