Two-year longitudinal study of symptoms of mandibular dysfunction in adolescents

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Symptoms of mandibular dysfunction were followed up longitudinally from the age of 17 to 19 years in 285 adolescents. Totally, 27 subjects dropped out, leaving 258 for the longitudinal intraindividual comparisons. Reports of TMJ sounds increased significantly with age from 14% to 23% for girls, and at 19 years of age they significantly more often reported such sounds than boys. Girls also more frequently reported recurrent headaches (18%) than boys (1–6%). The prevalence of symptoms of mandibular dysfunction was about 20% each year, but there was no general increase of frequency and severity of symptoms during the observation period in spite of an incidence of 8%; new symptoms thus appeared as frequently as old symptoms disappeared. The prevalence of dysfunction was, according to the anamnestic index (Ai), significantly higher for 18- and 19-year-old girls. Girls also significantly more often reported more symptoms than boys, according to an accumulated index (AAi). Most symptoms were of mild character and fluctuated longitudinally. The need and demand for treatment may therefore be considered small. A routine stomatognathic screening is justified to identify those in need of treatment and those who should be observed more closely. □ *Bruxism; epidemiology; functional disturbances; temporomandibular joint syndrome*

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Symptoms of mandibular dysfunction and frequent headaches are common findings in young populations (1–5), but they are mostly of mild character. The most frequently reported symptoms have been temporomandibular joint (TMJ) sounds, feelings of fatigue or tiredness in the jaws, and headaches. The prevalence of symptoms of mandibular dysfunction in children and adolescents ranges from 16% to 41% in Swedish samples (2–5). It has been suggested that these, often mild, symptoms in childhood will develop into more severe symptoms as the child matures (6), and symptoms of mandibular dysfunction are more frequently found in adult samples (7–8). However, in consideration of the mild symptoms in children it has also been proposed that the need and demand for treatment may be considered small in younger populations (9).

Most studies so far have been cross-sectional, and at present there are only a few longitudinal studies of the development of mandibular dysfunction available (9, 10) indicating an increase of subjective symptoms during childhood and adolescence.

The aim of this study was to follow up a sample of 285 previously studied adolescents for 2 more subsequent years with regard to their function of the stomatognathic system, parafunctional pattern, symptoms of mandibular dysfunction, and recurrent headaches.

Materials and methods

The study was carried out in the town of Skellefteå, in northern Sweden, from 1981 until 1983. The subjects comprised 285 adolescents born in 1964 who were 17 years old at the start of the study. They constituted a sample of all individuals in this age group receiving dental care at one of two public dental clinics in the town. The sample comprised 146 boys (51.2%) and 139 girls (48.8%), who were followed up for 2 years (Table 1).

Table 1. Numerical (*n*) and percentage distribution of adolescents born in 1964 on the three subsequent annual recordings at 17, 18, and 19 years of age

	17 years		18 years		19 years	
	n	%	*n*	%	*n*	%
Boys	146	51.2	142	51.6	138	52.3
Girls	139	48.8	133	48.4	126	47.7
Total	285		275		264	

When the adolescents came to the dental clinic for their annual routine dental check-up, each subject received a questionnaire and information about the study. The questions were on all three occasions so constructed that they could be answered with a yes or a no. The questions concerned the general state of health; illness or diseases such as allergic reactions, sleep disturbances, joint diseases, or stomach complaints; symptoms of mandibular dysfunction (see below); localization of symptoms; general effects of the symptoms; use of drugs; and parafunctional habits such as bruxism and cheek-, lip-, tongue-, and nail-biting. Data on headache were collected on 5-graded scales for both frequency and intensity. Recurrent headaches were defined as headaches appearing once a week or more often. Time, onset, and the total duration of headaches were also asked for. Details have been presented elsewhere (5).

After completing the questionnaire, the subjects were examined clinically in accordance with routine methods used in the Department of Stomatognathic Physiology, University of Umeå (11). The examiner was not aware of the answers to the questionnaire before the clinical examination.

Symptoms of mandibular dysfunction were noted if affirmative answers were given with regard to TMJ sounds, feeling of tiredness/fatigue in the jaws, difficulties in opening the mouth wide, difficulties in chewing, locking, or luxation of the TMJ, pain on jaw movements, or presence of facial and/or jaw pain.

Some of the symptoms reported formed the basis of the anamnestic dysfunction index (Ai) of Helkimo (12) and an accumulated anamnestic index (AAi) of Agerberg (13). The former index was based on the severity of reported symptoms and the latter on the number of seven symptoms reported in Table 4 and recurrent headaches.

The AAi index was assigned as follows:
AAi_0: individuals who reported none of the symptoms;
AAi_1: individuals who reported any of the symptoms;
AAi_2: individuals who reported two or three of the symptoms; and
AAi_3: those with four or more of the symptoms.

At the 2nd examination 10 subjects (4 boys and 6 girls) did not participate, and at the 3rd examination 21 subjects dropped out (8 boys and 13 girls). Totally, 258 subjects were studied all 3 subsequent years. The reason for not participating was that they had moved from the district.

The symptoms of the dropouts were analyzed, and since they did not differ from those of the total sample in any remarkable way, all those examined at any of the three occasions were included. However, for the intraindividual longitudinal comparisons only those 258 who participated in all three examinations were included.

Some individuals who both needed and demanded stomatognathic treatment were given this. At the age of 17 years 13 subjects were treated for their signs and symptoms of mandibular dysfunction. Another 6 subjects were treated, and 7 of the earlier subjects were re-treated at the age of 18, giving a total of 19 subjects (14 girls and 5 boys) who were treated during these 2 years. They all received information and recommendations for doing jaw exercises; 9 subjects received bite splints, and in 11 selective grinding was performed.

Statistical methods

The data were processed in a computer (Control Data 3200) at Umeå University Computer Center (UMDAC), using standard programs (SPSS and SPSSX). The statistical calculation of differences between variables was made by the chi-square test. For analysis of the longitudinal development

the non-parametric Friedman test of paired observations was used (14). The following symbols are used for different levels of significance in the tables: NS (not significant) $p > 0.05$; * $0.05 \geq p > 0.01$; ** $0.01 \geq p > 0.001$; and *** $0.001 > p$.

Results

The distribution of the sample on the three occasions is presented in Table 1, and their occupations are presented in Table 2. Whereas only about 5% of the 17-year-olds were unemployed, this figure had increased to almost 16% when they were 19 years of age.

At all occasions 5% reported the general state of health to be less good, but none ever judged it to be poor. Of the specific diseases, stomach complaints and allergy were more frequently reported by 19-year-old girls than boys ($p < 0.05$).

A statistically significant preponderance of headache among females was found ($p < 0.001$) on all three occasions (Table 3). The prevalence of recurrent headache was about 9–12% each year. During the whole 3-year period a total of 18% had reported weekly headache, and 3% (nine subjects) had noted it on all of the occasions. Only 1 of 258 adolescents reported daily headache. Fifty-four per cent of the adolescents consequently reported no headache at any of the examinations. Reports of frequency of headache fluctuated longitudinally. The incidence of recurrent headaches was about 5% each year and corresponded to the percentage of adolescents who improved. No significant difference in frequency of headache appeared longitudinally.

Table 2. Percentage distribution of answer to question on occupation at 17, 18, and 19 years of age

Occupation	17 years	18 years	19 years
Studying	91.5	72.7	51.1
Employed	3.9	16.4	33.3
Unemployed	4.6	10.9	15.5

Table 3. Percentage distribution of occurrence of recurrent headache at 17, 18, and 19 years of age. Level of statistically significant sex difference is indicated

	17 years, $n = 285$	18 years, $n = 275$	19 years, $n = 264$
Total	11.6	11.7	9.1
Boys	5.5	5.6	1.4
Girls	17.9	18.0	17.5
Level of significance	***	***	***

Of the specific symptoms of mandibular dysfunction TMJ sounds increased significantly with age from 14% to 23% for girls ($p < 0.05$). In the 19-year-olds a significant sex difference with higher frequencies in girls was found ($p < 0.05$) for clicking sounds in the TMJ and for pain in the face or jaws (Table 4). For other symptoms of mandibular dysfunction the prevalence was quite similar during the examination period and mostly of low frequency.

The prevalence of symptoms of mandibular dysfunction estimated with the anamnestic dysfunction index (Ai) showed a statistically significant difference between sexes for 18-year-olds ($p < 0.01$) and for 19-year-olds ($p < 0.001$) (Fig. 1). There was no significant difference for the Ai index longitudinally, but for girls it tended to increase ($p = 0.055$).

When the two anamnestic indices Ai (Fig. 1) and AAi (Fig. 2) are compared, it can be seen that 18- and 19-year-old girls not only reported more severe symptoms (Ai) than boys but also more often reported a combination of several symptoms (AAi), and these differences were significant for all three examinations ($p < 0.01$ for 17- and 18-year-olds and $p < 0.001$ for 19-year-olds).

Each year about one-fifth of the adolescents reported symptoms of mandibular dysfunction according to the Ai index. When the subjects' cumulative reports of symptoms were estimated—that is, those who at least once during the 3 years reported any symptom of mandibular dysfunction—the prevalence of the period was increased to 33% (Table 5). The variations within the studied period of each symptom and the Ai index are shown in Fig. 3. About half of the variations depended on one occasional report of the specific symptoms.

Table 4. Percentage distribution of affirmative answers to questions on symptoms of mandibular dysfunction at 17, 18, and 19 years of age. Statistically significant sex difference is indicated (*). Statistically significant differences (d) are denoted: + = increase, $p < 0.05$; − = decrease, $p < 0.05$

	17 years, $n = 285$	18 years, $n = 275$	19 years, $n = 264$	d
1. TMJ sounds				
Boys	11.6 NS	10.6 NS	10.1 *	
Girls	14.4	16.5	23.0	+
Total	13.0	13.5	16.3	
2. Tiredness of the jaws				
Boys	3.4 *	2.8 *	3.6 NS	
Girls	9.4	10.5	10.3	
Total	6.3	6.5	6.8	
3. Pain in the face or the jaws				
Boys	2.7 NS	1.4 NS	0.0 *	
Girls	2.2	3.8	4.8	
Total	2.5	2.5	2.3	
4. Locking or luxation of the TM joint				
Boys	1.4 NS	0.0 *	0.0 NS	
Girls	3.6	4.5	3.2	
Total	2.5	2.2	1.5	
5. Difficulty in opening wide or in taking a large bite				
Boys	1.4 NS	0.7 NS	0.7 NS	
Girls	2.2	1.5	4.8	
Total	1.8	1.1	2.7	
6. Pain when moving the lower jaw				
Boys	0.7 NS	0.7 NS	0.0 NS	
Girls	2.2	3.8	2.4	
Total	1.4	2.2	1.1	
7. Difficulties in chewing				
Boys	0.7 NS	0.7 NS	0.7 NS	
Girls	1.4	0.0	2.4	
Total	1.1	0.4	1.5	
8. None of these symptoms				
Boys	83.6 NS	85.9 *	89.1 ***	
Girls	75.5	75.2	66.7	−
Total	79.6	80.7	78.4	

The longitudinal pattern of changes of the adolescents within the anamnestic index (Ai) for the 3 years is shown in Fig. 4. Almost 9% reported symptoms each year, of whom about 5% were stable within the same level of the index, whereas 2% improved, 1% worsened, and 1% fluctuated. The incidence of symptoms of mandibular dysfunction was 8% each year, and remission of symptoms was found in 7% and 5% of the 18- and 19-year-olds, respectively, showing that symptoms of mandibular dysfunction fluctuated longitudinally.

The subjects generally located their symptoms to the same sites and extent during the 3 years, but for the temples, forehead, and neck/shoulder regions an increase was noted for girls, who at 19 years of age significantly more often ($p < 0.01$) related symptoms to these areas than boys. For girls symptoms

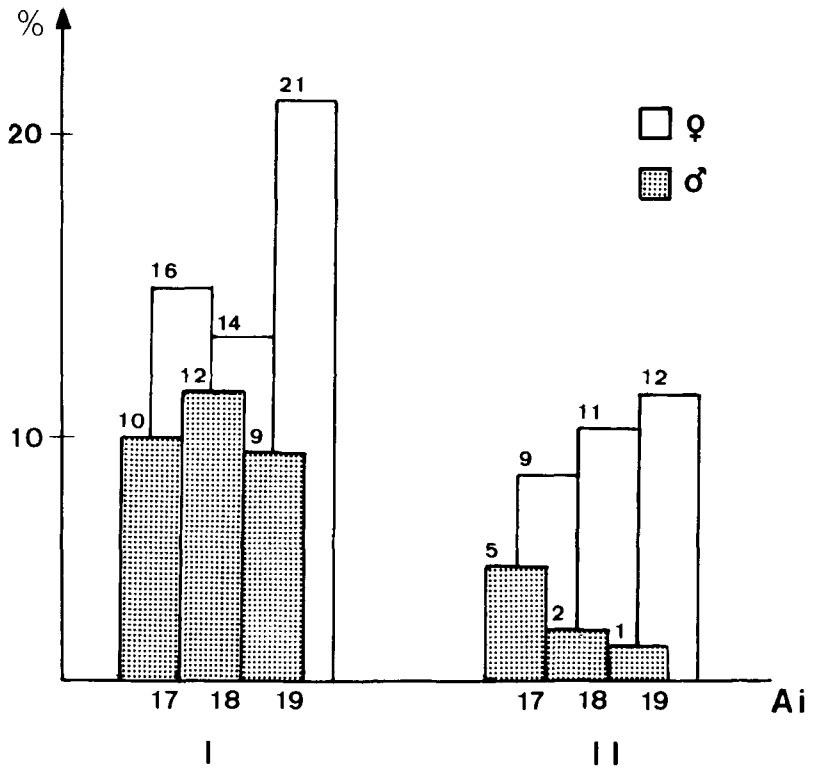

Fig. 1. Percentage distribution of anamnestic dysfunction index (Ai) for boys and girls at 17, 18, and 19 years of age.

related to the temples and neck/shoulder areas increased significantly ($p < 0.01$) for both locations, from 5% and 3%, respectively, to 13% at the last examination.

Concerning the general effects and the severity of the symptoms during this period between 4% and 7% of the girls reported that their studies or work was affected. Between 2% and 3% felt that they had to take analgesics regularly.

Table 5. Percentage distribution of the cumulative prevalence of symptoms of mandibular dysfunction (Ai) during 3 years in 258 adolescents from the age of 17 to 19 years. The p value denotes the level of significant difference between sexes

	Ai			
	0	I	II	p
Total	67	21	12	
Boys	77	19	4	***
Girls	57	23	20	

Unilateral chewing was reported by about one-quarter of the subjects each year, but only 8% consequently reported a unilateral chewing habit at all the occasions.

There was an increased awareness of occlusal parafunctions such as tooth-clenching and tooth-grinding up to 19 years of age, but the increase was statistically significant only for tooth-clenching ($p < 0.001$). The orofacial parafunctions (lip-, cheek-, or tongue-biting) had decreased significantly ($p < 0.01$), as had the reports of nail-biting ($p < 0.05$) (Table 6). The total number of oral parafunctions was reduced from 68% to 59% ($p < 0.01$). No uniform sex-related parafunctional pattern was found during the whole period, but on all occasions girls significantly more often than boys reported parafunction when they were under stress.

The frequency of trauma to the jaws stayed constant and was significantly more often reported by boys ($p < 0.001$) than girls during the whole period.

The symptoms of the 19 subjects treated

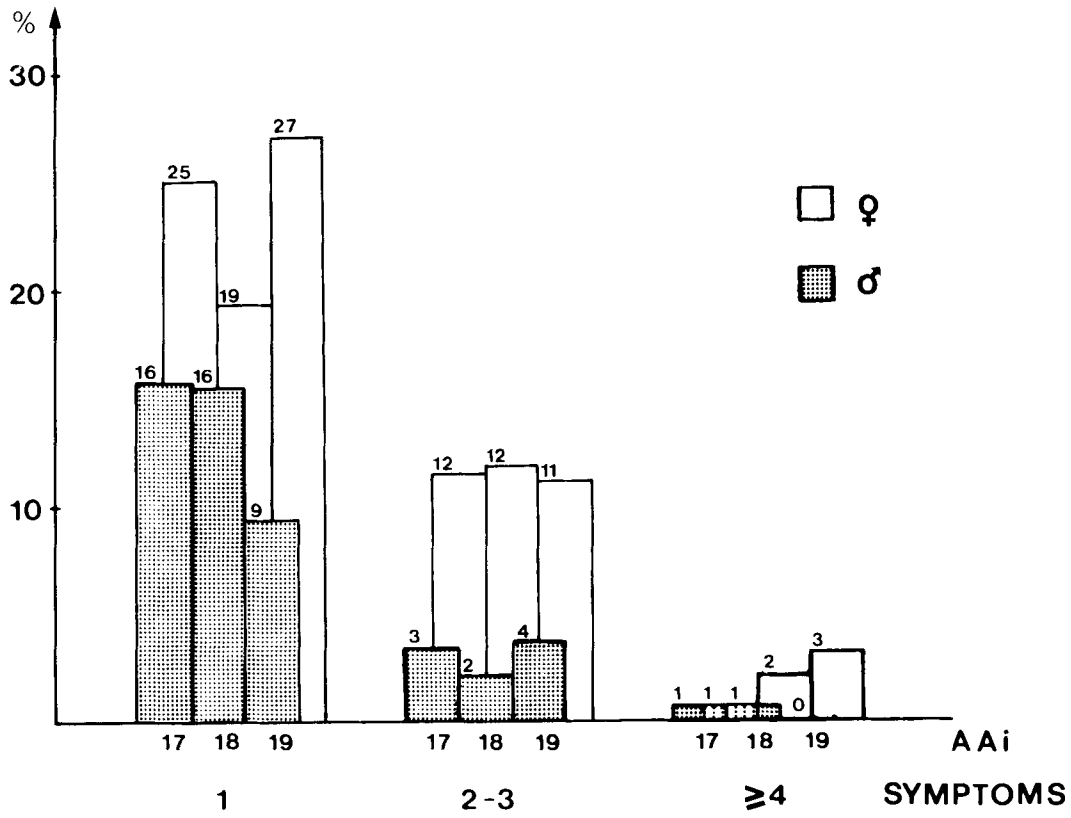

Fig. 2. Percentage distribution of accumulative anamnestic index of symptoms of dysfunction (AAi) for boys and girls at 17, 18, and 19 years of age.

Table 6. Percentage distribution of affirmative answers to questions on occlusal and orofacial parafunctions. Statistically significant differences between years (d) are denoted: + = increase, $p < 0.05$; − = decrease, $p < 0.05$

	17 years, $n = 285$	18 years, $n = 275$	19 years, $n = 264$	d
1. Nail-biting	42.6	37.5	33.3	−
2. Biting of the cheek, lips, or tongue	37.9	29.5	27.3	−
3. Tooth-clenching	10.9	16.7	18.2	+
4. Tooth-grinding	7.7	10.5	11.7	
5. 3 and/or 4	14.0	21.1	24.6	+
6. One parafunction	28.4	21.5	32.6	
2–3 parafunctions	30.9	27.6	25.0	−
4–6 parafunctions	8.8	9.1	1.5	
7. Do you do any of these more frequently when stressed?	24.8	22.9	23.9	

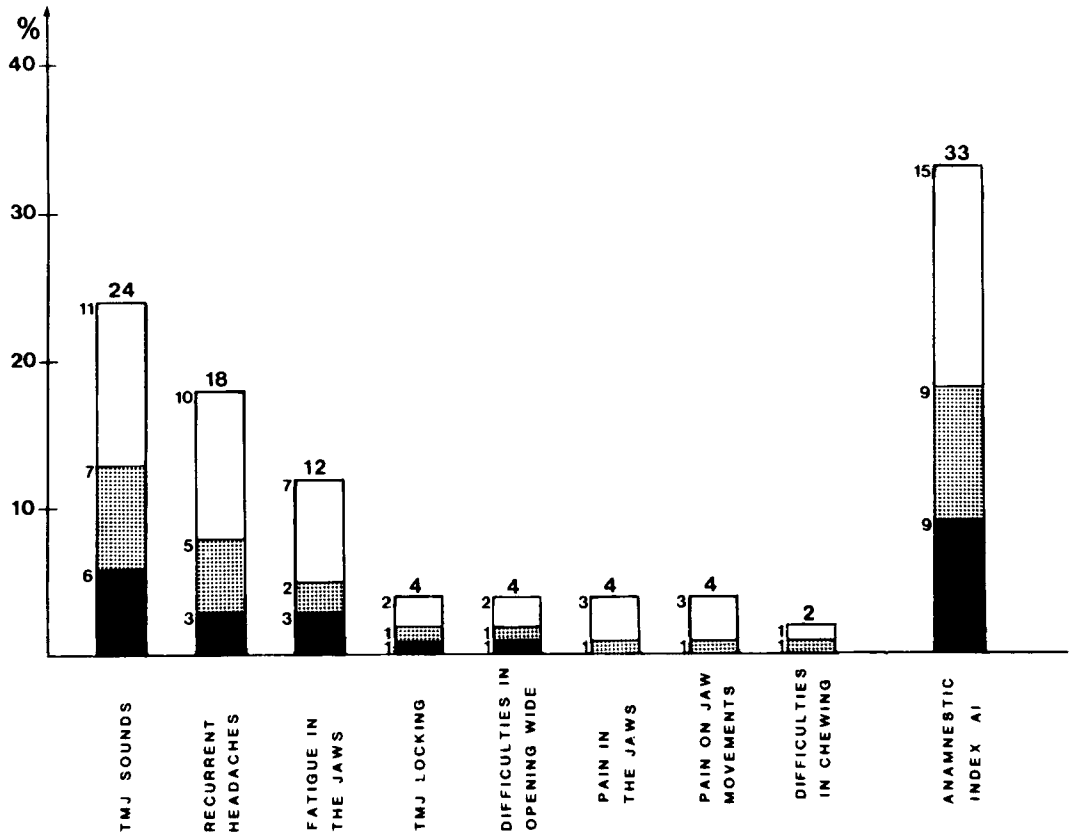

Fig. 3. Percentage distribution of the whole 3-year period prevalence of symptoms of mandibular dysfunction and recurrent headaches in 258 adolescents. The occurrence is given as once = symptoms reported only 1 year (open bars), twice = 2 years (dotted bars), and three times = all subsequent years (filled bars).

at 17 and 18 years of age are presented in Table 7. Most of them still reported symptoms at the age of 19, but 90% (17 subjects) subjectively evaluated that the effect of treatment was positive. Both the subjective severity and frequency and the number of symptoms in accordance with the AAi index were reduced.

Discussion

Skellefteå is a city in which the socioeconomic structure is focused on industry, but in general it is representative of a medium-sized Swedish city. The migration rate is about 3% a year.

The adolescents constituted a well-defined sample selected in accordance with epidemiologic principles. Everyone born in 1964 living in the area and referred to the dental clinic participated, as has been explained in detail previously (5). The drop-outs were few, and since an analysis did not show any differences in symptoms compared with the total sample, they can hardly have had any implications for the results of this longitudinal study. The reason for not participating was that they had left the area because of studies/work abroad or in other Swedish towns. Totally, only four individuals were examined just once, on the first occasion; however, for the longitudinal intraindividual comparisons only those examined all 3 years were included.

The advantages and disadvantages of

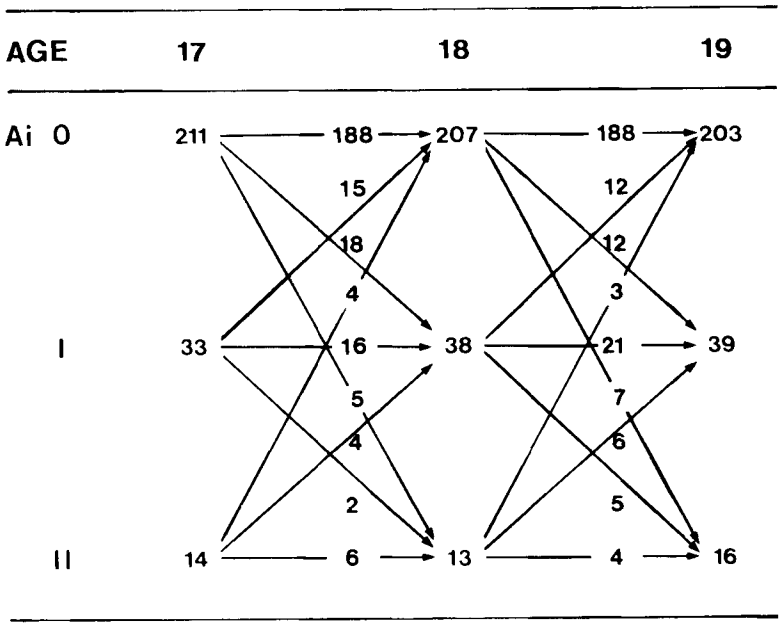

Fig. 4. Distribution of the longitudinal pattern of changes of the subjects according to anamnestic index of dysfunction (Ai) during the subsequent years (n = 258).

using a questionnaire have been discussed previously (5), and it has proved to be a valuable and effective instrument for us in this investigation. We consider it to be an advantage to use a questionnaire in longitudinal studies, since the subjects will be presented with the same wordings, which otherwise can have implications for both the prevalence and incidence figures.

During the studied period a shift from education to employment occurred, but at the age of 19 years half of the adolescents were still studying. According to the cross-sectional findings of frequency of symptoms of mandibular dysfunction, this psychosocial change seems to have had little influence on symptoms on a group basis of the sample.

According to the adolescents' own judgement, few considered themselves unhealthy, which is in agreement with other studies of young samples (7). This group may, however, be of interest, since analysis of other populations has indicated a relationship between symptoms of mandibular dysfunction and poor general state of health (15, 16). Allergy was during the whole period reported more frequently in this sample than in others (17, 18), as previously discussed (5).

At the age of 19, girls more often reported stomach complaints, which at the first examination was found to be related to headache (19), another symptom that predominates in

Table 7. Numerical distribution before (17- and 18-year-olds) and after (19-year-olds) treatment of symptoms of mandibular dysfunction and headache, and anamnestic indices (Ai and AAi) in 19 adolescents subjected to stomatognathic treatment

Symptoms	Before	After
Recurrent headache	11	7
Tiredness of the jaws	11	11
Joint sounds	7	11
Pain when moving the lower jaw	6	1
Pain in face or jaws	5	4
Locking or luxation of the joint	2	0
Difficulty in opening wide	2	3
Difficulty in chewing	1	2
Ai 0	3	4
I	9	9
II	7	6
AAi 0	0	4
1	7	4
2	7	9
3	5	2

females; evidently, both may be effects of a psychosomatic reaction pattern (20).

The prevalence of headaches was quite constant each year in this study and similar to that in other studies (15, 19–22). Headache can have various origins (23). Muscular contraction or tension headache is, however, considered to be the major type of headache (24, 25), and despite the assumption that these adolescents had different forms of headache, a statistically significant relationship was found between headache and symptoms and signs of mandibular dysfunction (19). In the longitudinal perspective, however, fluctuations in reports of frequency of headache was found, and only 3% of the sample reported recurrent headache each year. Recurrent headaches are thus a symptom to be followed up in adolescents.

Reports of TMJ sounds increased for girls, and a statistically significant sex difference was found at the age of 19, which also agrees with findings in younger samples (3, 4) and with the higher frequency of pathological changes seen in female TM joints in autopsy material (26). In a cross-sectional epidemiologic study (7) in the same county, women (44%) significantly more often reported clicking than men (34%). A statistically significant increase of frequent and occasional TMJ sounds has been reported in longitudinal studies of 7–11-, 11–15-, and 15–20-year-olds (9, 10).

The statistically significant increase of the frequency of subjective symptoms reported in two samples in 4- and 5-year longitudinal studies (9, 10) could not be confirmed during this shorter observation period. Our findings agree better with the relatively 'calm' period found between 11 and 15 years of age (9). The prevalence of single symptoms of mandibular dysfunction and of combinations of symptoms, as expressed in the Ai and AAi indices, was for the whole sample quite similar during the examination period and mostly of mild character. Both indices demonstrated a skewed distribution of symptoms between sexes, and they apparently measure different aspects of the symptoms, both of which are important in the estimation of the functional state of the masticatory system and the treatment need. Girls reported severe symptoms (Ai) significantly more often than boys at the second and at the third examination, and they were more polysymptomatic, as can be seen in the AAi index. For boys, however, symptoms of mandibular dysfunction tended to decrease. Whether these sex differences are effects of a greater female awareness of these symptoms for psychological reasons or as a result of the study is impossible to judge. Girls had, however, more clinical findings than boys (27), and at the age of 17 a relationship was found between signs and symptoms for the total sample (28). In most epidemiologic studies, however, it has been concluded that there are no statistically significant differences between sexes with regard to symptoms of mandibular dysfunction (1–5, 7–10, 12).

In our sample about 9% of the adolescents reported symptoms of mandibular dysfunction on all three occasions, compared with the 20% found each year and with the total prevalence of one-third during the whole period of 3 years. About half of the variation of each symptom within the period is explained by the fact that it was reported just once. The incidence of symptoms of mandibular dysfunction was 8% each year, and, of these, most cases had mild symptoms, of which TMJ sounds dominated. Of the 23 new subjects who at the age of 18 reported symptoms, most (21 subjects) still had symptoms at the age of 19. Symptoms of mandibular dysfunction in adolescents seem primarily not only to be mild but also to fluctuate longitudinally. The need for treatment may therefore be considered small. Whether these adolescents with fluctuating symptoms will be subjected to more severe and constant symptoms in the future is not known. Further longitudinal studies for longer periods are therefore needed and are also planned to be conducted on the presented group.

The most commonly reported general effect of the symptoms of mandibular dysfunction and headache was that schoolwork/work was affected, and this tended to increase longitudinally for girls. Some girls also used analgesics regularly. These effects may have implications for their future life

situation and need and demand for treatment, including both dental and medical disciplines, for which symptoms of mandibular dysfunction evidently are greater among females (13).

At the age of 19 girls significantly more often than boys located their symptoms to the temples, forehead, and neck/shoulder regions; furthermore, symptoms related to these locations increased longitudinally for girls. These findings can be seen in relation to the higher frequency of recurrent headaches among the girls and may be related to muscular disturbances and may be a part of a psychophysiological reaction pattern (29). The increased localizations of symptoms to these regions may be related both to female maturity and other changes of physical and/or psychological factors (30).

The varying answers on unilateral chewing is in accordance with earlier findings (31) and are obviously a result of the fact that these young individuals had complete dentitions, which generally were used bilaterally.

A significant increase of reports of tooth-clenching was noted. This might be due to both a greater awareness as a result of the investigation and an actual increase. The decrease of lip-, cheek-, tongue-, and nail-biting is more likely due to an actual maturity change. These findings corroborate those of a previous 5-year longitudinal study (10). A change in parafunctional pattern with reduced number of parafunctions is also in line with previous findings from older age groups (7).

Girls significantly more often reported awareness of stress-related parafunctions each year; it may therefore be suggested that females can have a different sensitivity and reaction pattern for environmental loadings than males. It has also been suggested that the skew sex distribution among patients with craniomandibular disorders may be a matter of developmental background combined with differences in potential tissue compensation (32).

The symptoms of the adolescents requiring treatment and the sex distribution are in accordance with those of patients seen at the Department of Stomatognathic Physiology (13). Each year 13 subjects were treated, which represents 5% of the total sample; this almost reaches the level of a population's need and demand for treatment (7).

The treatments performed in 19 subjects did not seem to have had any marked influence on the prevalence of symptoms as expressed in the Ai index and may therefore have had a minor influence on the longitudinal study. Headache frequency and pain when moving the lower jaw seem to have improved more than the natural fluctuations found in the total sample; thus the treatments performed may have had a slight influence on some single symptoms in the longitudinal study. The subjective reports of less severe, fewer, and less frequently appearing symptoms are not incorporated in the symptom index (Ai); consequently, 90% subjectively improved after treatment but still reported symptoms.

It is obvious that symptoms of mandibular dysfunction and headache appear early, but for most individuals these symptoms are of mild character and will fluctuate longitudinally. These fluctuations may also be seen in relation to the fact that many symptoms are reported occasionally (2, 10).

The need and demand for treatment may therefore be considered small. However, a screening for symptoms of mandibular dysfunction and headache in the routine dental examination of adolescents is justified to identify those who are in need of treatment and those who should be observed more closely.

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