Craniomandibular disorders in adult populations of West Bothnia, Sweden

Göran Agerberg and Axel Bergenholtz
Department of Stomatognathic Physiology and Department of Periodontology, Odontological Faculty, University of Umeå, Umeå, Sweden

Agerberg G, Bergenholtz A. Craniomandibular disorders in adult populations of West Bothnia, Sweden. Acta Odontol Scand 1989;47:129–140. Oslo. ISSN 0001-6357.

A randomly selected sample of 1992 adults (995 men and 997 women) representing four equally sized age groups of 25-, 35-, 50-, and 65-years-old inhabitants of West Bothnia were studied for prevalence of symptoms and clinical signs of mandibular dysfunction. Of the sample 79% completed a questionnaire and a clinical examination. The chewing inability increased with age. Recurrent headaches (once a week or more often) were reported to occur in 11% to 15% of the four age groups, and the duration of headaches was generally more than 2 years. Tooth-clenching, which was the most frequent oral parafunction, was reported significantly more often in women, whereas attrition was more severe in men. The commonest clinical finding was temporomandibular joint clicking, which varied between 13% and 35% in the different age groups. Crepitation was observed more often in women and increased with age. The jaw muscles were more frequently tender to palpation in women and the elderly. The mean maximal mouth opening capacity varied between 55 mm and 44 mm, decreasing with age, and was for the whole sample significantly higher among men. Since signs and symptoms of craniomandibular disorders were common findings in all age groups, routine dental examination should always include functional evaluation of the stomatognathic system.
□ *Bruxism; epidemiology; functional disturbances; temporomandibular joint syndrome*

Göran Agerberg, Department of Stomatognathic Physiology, Faculty of Odontology, University of Umeå, S-901 87 Umeå, Sweden

The frequency and distribution of symptoms and clinical signs of mandibular dysfunction/craniomandibular disorders have been presented in several epidemiologic studies of adult samples since the beginning of the 1970s (1–6).

Varying but often high prevalences of craniomandibular disorders have been reported, but no striking sex differences have been found. In an extensive review by Helkimo (7) subjective symptoms of dysfunction were reported by 12–57% of the different samples, whereas clinical signs of dysfunction were found in 28–88% of the examined subjects. The median values for the presented frequencies were 25% and 73%, respectively. In a recent survey by Carlsson (8) of the worldwide distribution of mandibular dysfunction in epidemiologic studies, the prevalence figures given are similar to those in the previous studies, whereas the median values were 32% for subjective symptoms and 61% for clinical signs of dysfunction.

During the past decade interest has mainly been focused on the younger (9–13) and the older (3, 14) parts of the Swedish population. Subjective reports (2, 5) and clinical findings have only been presented for middle-aged persons working in a shipyard (5). Besides Helkimo's study of Skolt and Inari Lapps (15) the only randomly selected sample available concerning middle-aged individuals is the one by Swanljung & Rantanen (16) consisting of 18- to 64-year-old Finns, 58% of whom reported subjective symptoms of mandibular dysfunction. Temporomandibular joint (TMJ) sounds were the most frequently experienced symptom (38%), followed by fatigue in the jaws (19%) and difficulties in opening the mouth (13%). Clinical examination showed symptoms in 41%. No differences between the sexes were found. However, clinical symptoms were more fre-

quent among those more than 35 years old than in the younger age groups. The most frequent clinical finding was TMJ sounds (23%), whereas deviations (18%) and impaired maximal opening (< 40 mm) (6%) were less common.

Thus, there has been an extensive lack of knowledge about mandibular dysfunction in the middle-aged portion of the Swedish population. To increase the knowledge about the frequency and distribution of mandibular dysfunction in different age groups, the aim of the present study was to investigate the prevalence of signs and symptoms of mandibular dysfunction among 25-, 35-, 50-, and 65-year-old inhabitants in the county of West Bothnia, Sweden.

Materials and methods

The studied population originates from a random sample of 1992 adults (995 men and 997 women) in the county of Västerbotten, Sweden, born in 1956, 1946, 1931, and 1916. These age groups consisted of 497 25-year-old, 488 35-year-old, 493 50-year-old, and 514 65-year-old persons. They represented 15.8% of the total number of inhabitants in the county. The random sampling was performed in December 1981 in accordance with the principle to select each 1/nth individual within each sex and age group in each of the 13 municipalities in the county of Västerbotten, where n is dependent on the number of inhabitants in each municipality. The total population in the county of Västerbotten at the time of selection was 244,789 inhabitants (17).

A few weeks before the start of the study in March 1982, 19 registration teams, each consisting of a dentist and a chair-side dental assistant from the local public dental care clinic, were invited to Umeå for 2 days of information, training, and calibration. The teams were then given the necessary materials, questionnaire forms, interview forms, random tests, and so forth. The study was terminated in November 1982, when all registrations and questionnaires were collected and a new calibration was done.

Questionnaire and interview forms

A questionnaire was sent to each randomly selected participant in the sample. The questions in the questionnaire concerned an estimation of the chewing ability in accordance with a 10-graded scale, discomfort in chewing, and disability in chewing all sorts of food.

When the patients came to the dental clinic for their check-up, each was interviewed by the chair-side dental assistant. The questions in the interview concerned the occurrence of headaches and migraine, the duration and location of these symptoms and other pain symptoms from the oral and neck area, and awareness of various oral parafunctions such as grinding or clenching of teeth and biting habits. The questions were constructed to be answered yes or no, and the participants were allowed to discuss the questions with the chair-side dental assistant. After completing the interviews the participants were examined clinically.

Clinical examination

The clinical examinations were performed in accordance with the routine methods used at the Department of Stomatognathic Physiology in Umeå, previously described by Carlsson & Helkimo (18) and Wänman & Agerberg (12). The following variables were recorded:

1. TMJ tenderness. The joints were simultaneously palpated bilaterally, both laterally and posteriorly, on active opening and closing movements of the mandible. Tenderness was recorded as an objective pain reaction from the patient—for example, if pain gave rise to a palpebral reflex of the eye or a protective reflex from the patient.

2. Muscle tenderness was also recorded as an objective pain reaction from the patient as in point 1. The following muscles were palpated bilaterally: the anterior portion and the insertion of the temporal muscle, the superficial portion of the masseter muscle, and the lateral pterygoid muscle.

3. TMJ sounds such as clicking and/or crepitation were recorded if the sound could be confirmed by palpation and/or heard during vertical movements of the mandible.

4. Maximal mandibular mobility. Maximal opening capacity of the mandible (interincisal distance = vertical overbite not included) was recorded as the vertical distance between the incisal edges of the left maxillary and mandibular central incisors in accordance with Agerberg (19). Pain reaction during this movement was also recorded.

5. Degree of attrition was estimated in each of the six sextants of the dental arches where the most serious attrition in the sextant gave the highest score. The following grading of attrition was used: no attrition = 0; attrition visible in enamel = 1; attrition visible in dentin = 2; and extensive attrition = 3.

Statistical methods

The data were processed in a computer (Control Data 3200) at Umeå University Computer Centre (UMDAC) by means of a Standard Program (SPSS). The statistical calculation of differences between sexes and age groups was made by the chi-square test: NS (not significant) $p > 0.05$; $^{*}0.05 \geq p > 0.01$; $^{**}0.01 \geq p > 0.001$; and $^{***}p \leq 0.001$.

Results

Random samples

Of the randomly selected sample of 1992, 1578 persons completed the recordings, which represent 79.2% of the total sample.

Table 1. Number of women and men (n = 1578) in the four age groups and percentage distribution of those *unable* to chew all sorts of food and *dissatisfied* with their chewing ability

Age group, years	Sex	n	Unable	Dissatisfied
65	F	191	17.0	13.7
	M	203	20.4	16.3
50	F	198	8.3	10.1
	M	191	9.7	12.6
35	F	203	3.5	6.9
	M	196	1.5	6.6
25	F	199	1.0	0.5
	M	197	1.6	1.5

When the material dropouts (dead, 8; people with severe disease or handicap, 41; institutionalized, 23; mentally disabled, 10; people who had left the county, 50; and people with too long travelling time, 57) were excluded, the registration frequency was 89%. Six individuals were excluded from the study owing to improper forms, leaving 219 refusers (11%).

Questionnaire

The inability to chew all kinds of food increased for both sexes with age ($p < 0.001$) except between 50 and 65 years of age (Table 1). The percentage of persons dissatisfied with their chewing ability increased significantly with age for the whole sample ($p < 0.05$ and $p < 0.001$) except between the 25- and the 35-year-olds. This tendency was also obvious from the results of the 10-graded scale estimating the chewing ability (Fig. 1). Among the 25-year-old participants 64% had selected the best alternative 'very good chewing ability' for how they could chew their food, whereas only 23.5% of the 65-year-old age groups did so.

Interview

The occurrence of headaches and/or migraine showed a uniform pattern within and between the different age groups, and no significant differences were found (Table 2). Recurrent headaches (once a week or more often) were reported by 11% to 15% in the four age groups. Women in all age groups significantly more often had headaches. This difference was significant for 35-year-olds ($p < 0.01$) and 65-year-olds ($p < 0.001$) and also for the whole sample ($p < 0.001$).

The reported duration of headaches/migraine for the 537 individuals who gave affirmative answers to this question showed a uniform pattern in all age groups, with a duration of more than 2 years in 77–86% of the individuals in all four age groups. Headaches or migraine appearing at any time during the day were most common. No significant differences were found between the sexes. However, headaches in the morn-

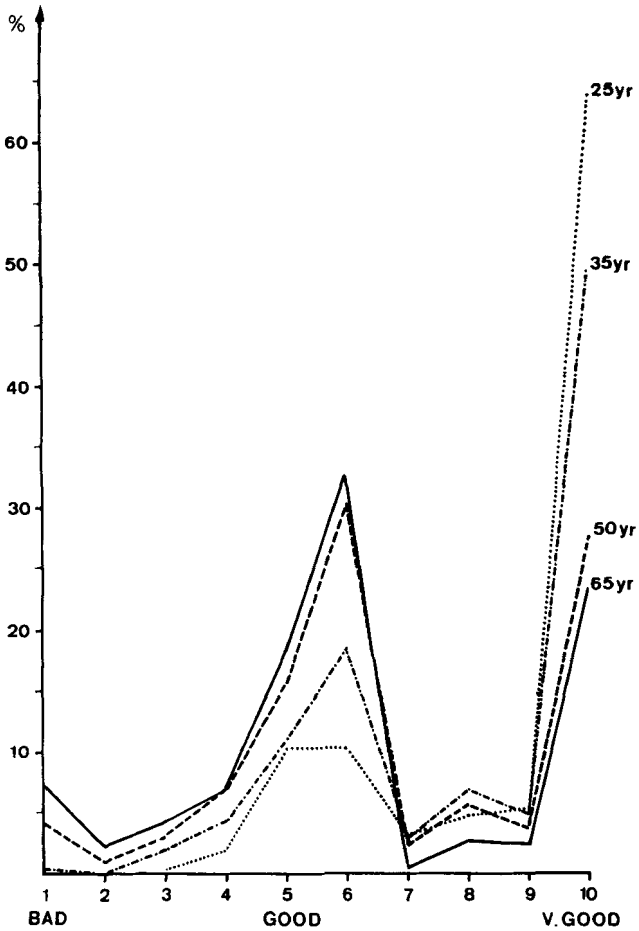

Fig. 1. Percentage distribution of estimated ability to chew the food in accordance with a 10-grade scale (bad = 1; good = 5; very good = 10) in the four age groups.

ing were commoner in the older age groups (Table 3), and this increase with age was significant, whereas headaches at night decreased with age.

The main sites of the symptoms of headaches in the different age groups were the forehead (12–23%), for which significant sex differences were found in the two youngest

Table 2. Percentage distribution of frequency of headaches among women and men in the four age groups (n = 1578)

Age group, years	Sex	Hardly every	Once or twice a month	Once a week	Several times a week	Daily
65	F	65.9	14.2	9.7	6.3	4.0
	M	82.1	7.9	3.7	3.2	3.2
50	F	62.4	21.0	6.5	6.5	3.8
	M	72.6	16.8	6.7	1.7	2.2
35	F	58.0	28.0	6.7	4.1	3.1
	M	81.4	10.4	5.5	2.2	0.5
25	F	69.9	16.7	11.3	1.6	0.5
	M	77.0	14.2	5.5	2.7	0.5

Table 3. Percentage distribution of time of appearance of headache or migraine in the four age groups (n = number of individuals)

Age group, years	n	In the morning	At night	Any time during day	Week-ends
65	125	44.8	12.0	42.4	0.8
50	140	29.3	12.1	57.1	1.4
35	144	18.1	18.1	62.5	1.4
25	128	12.5	28.9	56.3	2.3

age groups, the temples (7–24%), with a higher frequency in 35- and 50-year-old women, and the top of the head (7–14%) (Table 4). In women and in the total sample there was a significant increase with age between the two youngest age groups ($p < 0.01$).

Other often-recurring pain symptoms were in all age groups most frequently localized to the neck or shoulder area, followed by the throat (Table 5). At all locations and in all age groups women dominated. The most prominent sex differences were found in the 35-year-old age group. The number of individuals with these symptoms increased with increasing age. This was statistically significant when comparing the youngest and oldest age groups for both men and women.

Tooth-clenching was a commonly reported oral parafunction, of which women in the whole sample were significantly more

Table 4. Percentage distribution of affirmative answers to different locations of the symptoms in the four age groups (n = number of individuals). The asterisks denote the level of significant differences between sexes

Location	Sex	n	Age group, years 65	50	35	25
In or near the ear	F	58	7.9	3.5	3.4	4.5*
	M		5.4	2.6	1.5	0.5
Cheek	F	21	1.6	1.0	3.4**	2.5
	M		1.0	0.0	0.0	1.0
Temple	F	203	15.7	16.7*	24.1***	12.6
	M		9.4	9.4	7.7	7.1
Forehead	F	266	17.3	20.2	20.7*	23.1**
	M		13.8	15.2	11.7	12.7
Top of the head	F	161	13.6*	11.1	11.3	7.5*
	M		6.9	8.4	9.2	13.7

* $0.05 \geq p > 0.01$; ** $0.01 \geq p > 0.01$; *** $p \leq 0.001$.

Table 5. Percentage distribution of number of affirmative answers to different locations of pain in women and men in the four age groups. The asterisks denote the level of significant differences between sexes

Age group	Sex	Neck and shoulder	Throat	Teeth or gums	Tongue
65	F	53.9	29.8	13.6	3.1*
	M	51.2	22.2	8.9	0.5
50	F	52.5*	26.3*	11.6	3.5
	M	40.8	16.2	7.3	1.6
35	F	43.3***	13.3	15.8**	2.5*
	M	26.0	7.7	7.1	0
25	F	29.1*	8.0	6.5	1.0
	M	19.3	5.6	8.1	0.5

* $0.05 \geq p > 0.01$; ** $0.01 \geq p > 0.01$; *** $p \leq 0.01$.

Table 6. Percentage distribution of awareness of different parafunctions in women and men in the four age groups. The asterisks denote the level of significant differences between sexes

Age group, years	Sex	Tooth-clenching	Tooth-grinding	Tongue pressure	Cheek-biting	Tongue-biting	Nail-biting
65	F	24.6	3.1	14.1	2.1	2.6	1.6
	M	18.7	6.4	11.8	2.5	1.5	2.5
50	F	28.3	7.1	15.2	5.6	2.0	6.6
	M	19.4	8.4	9.4	5.2	2.6	6.8
35	F	28.1**	11.3	9.4	13.3**	1.0	19.2
	M	16.8	15.3	8.2	5.6	1.5	13.3
25	F	26.1	15.6	11.1	20.6*	1.0	28.6
	M	19.3	17.3	8.1	12.2	3.6	32.0

* $0.05 \geq p > 0.01$; ** $0.01 \geq p > 0.01$.

aware than men ($p < 0.001$). However, within each separate age group except the 35-year-olds no significant sex difference and no age differences were found. For all other parafunctions no sex differences were found except for cheek-biting in 35-year-olds. Tooth-grinding and cheek- and nail-biting were often reported in the 25- and 35-year age groups, whereas tongue parafunctions showed a more equal distribution over the four age groups (Table 6). When the youngest and the oldest age groups were compared, there was a significant decrease with age for tooth-grinding and cheek- and nail-biting.

Clinical examination

Calibration. To check the concordance between the 19 recorders, a statistical analysis of the calibration data with regard to the clinical scoring before starting (March 1982) and after finishing the study (November 1982) was performed. The percentage concordance between registrators with regard to attrition before and after the study was equal (75%); with regard to palpation tenderness of the muscles and the TMJs it was 96% before and 92% after the study; and with regard to TMJ sounds (clicking and crepitation) it was 75% before and 84% after finishing the study.

Table 7. Percentage distribution of degree of attrition (enamel = 1; dentin = 2; extensive = 3) in dentate women and men in the four age groups (n = number of individuals)

Age group, years	Sex	n	1	2	3
65	F	82	34.1	64.6	1.2
	M	112	17.9	69.6	12.5
50	F	168	31.5	67.3	1.2
	M	164	16.5	79.9	3.7
35	F	198	46.5	53.0	0.5
	M	195	33.8	63.6	2.6
25	F	199	61.3	38.7	0.0
	M	197	45.7	53.8	0.5

Dentition. The number of residual teeth decreased significantly ($p < 0.001$) with increasing age. None in the 25-year age group was edentulous, 1.5% of the 35-year-olds, 14.7% of the 50-year-olds, and 51% of the 65-year-old individuals were edentulous. In the total sample 16.7% were edentulous. Edentulousness was commoner among women than among men and commoner in the population of the mountain districts than in the town of Umeå. On an average, the 25-year-olds had 26.9 teeth, the 35-year-olds 24.3 teeth, the 50-year-olds 18.3 teeth, and the 65-year-old persons 12.8 teeth per dentate individual.

Attrition. In the whole sample and in the four age groups, attrition was more severe in men than in women ($p < 0.001$) (Table 7). A significant increase with age was also found for both men and women.

TMJ. The clinical examination showed TMJ sounds in 25% of the total sample (31% in women and 19% in men), with a variation between 13% and 35% of the subjects in the

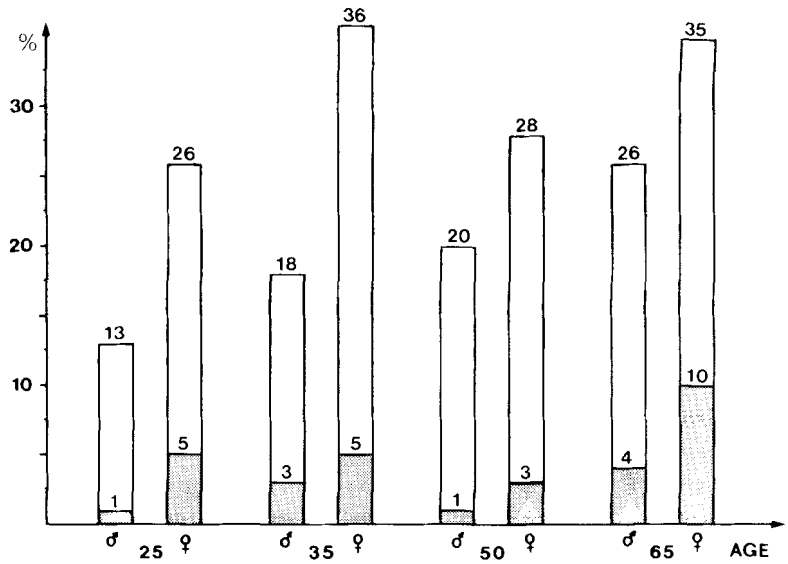

Fig. 2. Percentage distribution of TMJ sounds—clicking (unfilled columns) and crepitation (stippled parts)—in men and women in the four age groups.

different age groups (Fig. 2). TMJ sounds were found significantly more often in women than in men both in the two youngest age groups and in the total sample (Table 8). Clicking was recorded more often ($p < 0.001$) in women (27%) than in men (17%), with a variation of 12-31% between the groups. Unilateral clicking (9–19%) was most frequent in all age and sex groups. The frequency of bilateral clicking varied with sex and age from 3% to 13% (Table 8). Crepitation was also more often ($p < 0.001$) recorded in women (7%) than in men (3%) and increased with age from 3% in the youngest to 7% in the oldest age group (Fig. 2). When these two age groups were compared, a significant increase ($p < 0.001$) was observed for clicking in men and the total sample and for crepitation in both men and women ($p < 0.05$).

Palpation tenderness of the TMJs was a significantly ($p < 0.01$) commoner finding in women (3.5%) than in men (1%). Unilateral tenderness (3.2%) was more frequent than bilateral tenderness (1.2%) (Table 8).

Jaw muscles. Palpation tenderness in the jaw muscles varied between 19% and 36% in the age groups and was most frequently

Table 8. Percentage distribution of TMJ sounds and palpation tenderness in the TMJ in women and men in the four age groups. The asterisks denote the level of significant differences between sexes

Age groups, years	Sex	No sounds	Clicking		Crepitation	Palpation tenderness	
			Unilateral	Bilateral		Unilateral	Bilateral
65	F	66	12	13	10_{*}	2.6	0.5
	M	73	11	11	4^{*}	0	1.0
50	F	72_{*}	15	10	3	2.0	0
	M	81^{*}	11	8	1	0.5	0.5
35	F	65_{***}	19	12_{***}	5	3.4	0.5
	M	82^{***}	11	4	3	1.0	0
25	F	75_{**}	13	8_{*}	5_{*}	2.5	2.0
	M	87^{**}	9	3^{*}	1^{*}	0.5	0

* $0.05 \geq p > 0.01$; ** $0.01 \geq p > 0.01$; *** $p \leq 0.001$.

Table 9. Percentage distribution of palpation tender muscles in women and men in the four age groups

Age groups, years	Sex	No tenderness	Masseter		Temporalis		Lat. pterygoid	
			Unilateral	Bilateral	Unilateral	Bilateral	Unilateral	Bilateral
65	F	63.9	3.1	3.0	10.5	14.7	12.6	17.3
	M	70.0	2.5	2.0	9.9	8.4	8.4	16.3
50	F	66.7	3.5	4.5	8.1	9.1	9.1	20.2
	M	80.6	2.1	2.1	5.2	7.3	6.8	11.0
35	F	71.4	5.4	0.5	8.9	9.9	10.3	12.3
	M	82.1	2.0	1.0	4.6	3.1	9.2	6.6
25	F	73.4	3.5	2.0	8.5	4.0	11.1	13.1
	M	81.2	0.5	0.5	3.6	3.0	8.1	8.1

found in the lateral pterygoid and temporal muscles (Table 9). Bilateral findings were more frequent than unilateral. For the whole sample women showed palpation tenderness in the temporal and lateral pterygoid muscle significantly more often ($p < 0.001$) than men. Findings were commoner in the 65-year-old age group, and a significant increase of tenderness was found with age ($p < 0.01$).

Mandibular mobility. The mean maximal opening (interincisal distance) for the four age groups varied between 44 mm in the oldest and 55 mm for the youngest age group (Fig. 3). In all age groups men opened wider than women, which was statistically significant ($p < 0.001$) both for the whole sample and for the youngest age group. A significantly decreased mobility with age was found both for women and men ($p < 0.001$). The percentage of individuals unable to open 40 mm or more was 2.5, 4.5, 11.3, and 15.8 in the different age groups.

Discussion

The county of Västerbotten is composed of 13 municipalities. The mountain and inland areas are sparsely and the coastal area more densely populated. The population density for the random selected samples varied between 100 and 400 individuals with equal distribution among both sexes and age groups. When the dropouts were analyzed with regard to refusers, these were similar within the age groups and sexes and with

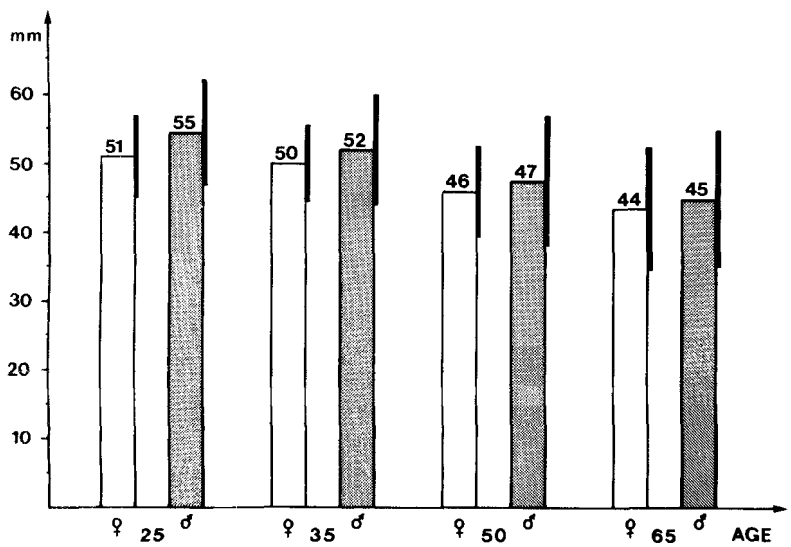

Fig. 3. Mean maximal mouth opening (interincisal distance) for women and men in the four different age groups. The heavy lines denote ± 1 standard deviation.

regard to edentulousness, giving no obvious reasons for systematic faults.

It can therefore be assumed that the constituted random sample is representative for the population of Västerbotten in general (excluding the handicapped and institutionalized), also with regard to the function of the stomatognathic system.

Questionnaire and interview

Self-administered questionnaires have previously been successfully used for estimation of various oral and functional variables such as dysfunction of the masticatory system in epidemiologic studies (2, 11).

The validity of the patients' answers to questionnaires and in interviews varies with the type of question and the type of symptom (20, 21).

The observed ability to chew all sorts of food, which decreased with age, was in accordance with the results of an earlier study using the same question (22), with nationwide surveys (23, 24), and with results for the elderly (25), in which the estimation of chewing ability was found to be closely correlated to the number of residual teeth. This may be the main reason for the results of the 10-scaled estimation of the chewing ability, since there was a decreasing number of teeth with increasing age. The reason for the discontinuity of the obtained results was the guidance of the word 'good' in the scale.

In different studies the diagnostic criteria for headache frequency often differ. However, by defining recurrent headache as once a week or more often, the obtained occurrence of headaches and/or migraine is in agreement with earlier studies (26) and with a report on living conditions in Sweden (23) in which 12% of the population had headache. The higher frequency in women than in men is a common finding in all epidemiologic headache samples; the reason for this is still obscure.

The reported long duration of headache/migraine in all age groups must be seen in relation to the early onset of these symptoms, which often can be related to the teenage period (27, 28).

The variations in time and location among those with headache indicate that these symptoms have a variety of origins, of which mandibular dysfunction has been found to be one (26, 28–30).

The reported differences between sexes in oral parafunction habits must also be taken into consideration, since women more often were aware of tooth-clenching than men. Tooth-clenching has been found to be the parafunction most closely correlated to headache (26, 29), which also appeared more frequently in women.

The predominance of nail- and cheek-biting in the younger age group is in agreement with most epidemiologic studies in which different parafunctions have been reported by the participants (9–11).

Clinical examination

To minimize differences in the clinical examination, calibration between examiners was performed before and after the study. This is important in epidemiologic studies in which differences between examiners can be greater than differences between studied groups (31). It is also difficult to compare various studies because of the lack of generally accepted standards of definitions, methods of investigation, and ways of presenting results. These factors may probably explain more of the existing variations than any real differences between the presented materials in the literature.

Earlier studies of interobserver variability in the assessment of signs of mandibular dysfunction (32, 33) have presented the lowest differences in the measurement of maximal mandibular mobility, which makes this variable the most reliable one for clinical research.

The mean maximal opening capacity of the mouth in the presented study differed both between sexes and between age groups, as has earlier been found in recordings of younger and older age groups (3, 9, 10, 12, 19, 34). The values obtained from the middle-aged part of the population adds valuable information as to mean values and pattern of reduction of vertical mobility with age. The greatest mobility is, obviously, to be found in the 20- to 25-year age group.

Reduced mobility, defined as less than 40 mm, also became commoner with increasing age, as has earlier been indicated (3, 14, 34). In the present study it varied between 2.5% in the youngest and 15.8% in the oldest age group. In other epidemiologic samples reduced mandibular mobility has been reported to be between 4% in students (6) and 13% among 15- to 65-year-old Lapps (4).

Attrition was more severe in men than in women and increased in severity with age. This observation is in agreement with earlier reports (35, 36) and is logical, since tooth wear increases with time because of functional and parafunctional use of the teeth. The sex differences cannot be explained within this study.

The prevalence of the recorded sounds from the TMJ (25%), such as clicking (25%) and crepitations (4%), was in the present study somewhat lower in all age groups than figures earlier reported in the epidemiologic literature (35–65%) (1–5, 7, 8), which may be due to the used recording technique. Whether the prevalence has decreased over the years is impossible to judge, since criteria have varied between different studies. However, the general pattern, with more sounds in women and an increase with age, is strongly underlined by our findings.

Crepitation is a good indication of osteoarthrosis. Earlier epidemiologic and patient studies have noted that individuals with a reduced number of teeth have a somewhat higher risk than others of developing osteoarthrosis of the TMJ (37). This is supported by our finding of an increase of crepitation with age and that old people have fewer teeth. A comparison with reports of TMJ sounds in a sample 15–74 years of age from the city of Umeå (2) 15 years ago is of special interest, since it is located in the surveyed region. Here, a sex difference was also reported, with 44% in women and 34% in men, and clicking was almost three times as frequent as crepitation.

The lateral pterygoid and the temporal muscle are often found to be the commonest sites for tenderness (4, 7). When palpation tenderness in the jaw muscles is analyzed, there is an increasing frequency of these signs with age both in the present study and in earlier reports in the literature (3–5, 7, 8), which may partly be explained by the number of teeth and tooth contacts lost with age. This means that natural teeth should be saved or reconstructions substituted, to avoid parafunctions or unilateral chewing, which may result in non-physiologic loading of the structures of the masticatory system and subsequent TMJ disorders. With regard to the multifactorial etiology of these disorders, the achievement of a stable occlusion is of importance not only for the masticatory system but also for the general health (22, 26). The positive effects of preventive measurement versus caries and periodontitis will in the future result in an increased number of teeth and will probably reduce the importance of the occlusal factors for craniomandibular disorders.

When clinical and subjective symptoms of mandibular dysfunction are compared, more clinical signs of TMJ disorders are often found than reports given of subjective symptoms (1–15, 38), which was also the case in the present material. Only one study (16) has reported higher figures for subjective symptoms than for clinical signs, which may be due to the questions and clinical examination method used.

The frequency of both clinical signs and subjective symptoms of mandibular dysfunction has been shown to increase with age. This may not only be explained by increasing age and osteoarthrosis but can also depend on a shift from natural to artificial teeth or a reduction in the number of residual teeth. The state of the dentition apparently plays a considerable role in the multifactorial etiology of functional disorders (7). An association between a decreasing number of residual teeth and dysfunction has been found (15, 34). The obvious risks for impaired function and signs and symptoms of dysfunction in complete denture wearers have recently been reviewed and pointed out by Agerberg (39).

On the basis of the presented figures of mandibular dysfunction it is difficult to estimate the need and demand for treatment that these figures represent. In view of our findings there is such a need, and it increases

with age. In an earlier study of a sample from one of the cities in the county (2), 7% of the subjects reported that the symptoms were of such a magnitude that they had been seeking advice from physicians or dentists. Almost half of the referrals to the Department of Stomatognathic Physiology in Umeå are from physicians (40). However, since signs and symptoms were frequent findings in all age groups, a routine dental examination should also include a functional evaluation of the stomatognathic system.

The present study indicates the need for further analyses of the sample, including correlation and regression analysis of variables such as number of residual teeth and the different signs and symptoms of mandibular dysfunction.

Acknowledgements.—This study has been supported by the Swedish Medical Council (K-83.24X-66 58-01), by the Västerbottens läns landsting, and by the Swedish Dental Society. We also want to express our gratitude to the recording teams and to Dr. Nils Segerlund for coordinating the study.

References

1. Hansson T, Öberg T. En klinisk bettfysiologisk undersökning av 67-åringar i Dalby. Tandlakartidn 1971:18;650–5.
2. Agerberg G, Carlsson GE. Functional disorders of the masticatory system. I. Distribution of symptoms according to age and sex as judged from investigation by questionnaire. Acta Odontol Scand 1972;30:597–613.
3. Agerberg G, Österberg T. Maximal mandibular movements and symptoms of mandibular dysfunction in 70-year old men and women. Swed Dent J 1974;67:147–64.
4. Helkimo M. Studies on function and dysfunction of the masticatory system. II. Index for anamnestic and clinical dysfunction and occlusal state. Swed Dent J 1974;67:101–21.
5. Hansson T, Nilner M. A study of the occurrence of symptoms of diseases of the temporomandibular joint, masticatory musculature and related structures. J Oral Rehabil 1975;2:25–34.
6. Solberg WK, Woo MW, Houston JB. Prevalence of mandibular dysfunction in young adults. J Am Dent Assoc 1979;98:25–34.
7. Helkimo M. Epidemiological surveys of dysfunction of the masticatory system. In: Zarb GA, Carlsson GE, eds. Temporomandibular joint. Function and dysfunction. Copenhagen: Munksgaard, 1979, 175–92.
8. Carlsson GE. Epidemiological studies of signs and symptoms of temporomandibular joint-pain-dysfunction. A literature review. Austr Prosthodont Soc Bull 1984;14:7–12.
9. Egermark-Eriksson I. Mandibular dysfunction in children and individuals with dual bite [Thesis]. Gothenburg: University of Gothenburg. Swed Dent J 1982(suppl 10).
10. Nilner M. Epidemiology of functional disturbances and diseases in the stomatognathic system [Thesis]. Lund: University of Lund. Swed Dent J 1983 (suppl 17).
11. Wänman A, Agerberg G. Mandibular dysfunction in adolescents. I. Prevalence of symptoms. Acta Odontol Scand 1986:44;47–54.
12. Wänman A, Agerberg G. Mandibular dysfunction in adolescents. II. Prevalence of signs. Acta Odontol Scand 1986:44;55–62.
13. Wänman A. Craniomandibular disorders in adolescents. A longitudinal study in an urban Swedish population [Thesis]. Swed Dent J 1987(suppl 44).
14. Österberg T, Carlsson GE. Symptoms and signs of mandibular dysfunction in 70-year-old men and women in Gothenburg, Sweden. A population study. Community Dent Oral Epidemiol 1979; 7:315–21.
15. Helkimo M. Studies on function and dysfunction of the masticatory system [Thesis]. Gothenburg: University of Gothenburg, 1974.
16. Swanljung O, Rantanen T. Functional disorders of the masticatory system in Southwest Finland. Community Dent Oral Epidemiol 1979;7:177–82.
17. Siffror om Umeå 1982. Umeå: Kommunkansliets planeringsavd., 1983.
18. Carlsson GE, Helkimo M. Funktionell undersökning av tuggapparaten. In: Holst JJ, et al., eds. Nordisk klinisk odontologi 8–II. Copenhagen: A/S Forlaget for faglitteratur 1972, 7–12.
19. Agerberg G. Maximal mandibular movements in young men and women. Swed Dent J 1974;67:81–100.
20. Heløe LA. Comparison of dental health data obtained from questionnaires, interviews and clinical examination. Scand J Dent Res 1972;80:495–9.
21. Rieder C, Martinoff J, Wilcox S. The prevalence of mandibular dysfunction. I. Sex and age distribution of related signs and symptoms. J Prosthet Dent 1983;1:81–8.
22. Agerberg G, Carlsson GE. Chewing ability in relation to dental and general health. Acta Odontol Scand 1981;39:147–53.
23. Living conditions in Sweden 1978. In: Health and medical care utilization 1975. Official statistics of Sweden. Stockholm: National Central Bureau of Statistics, 1978;Report no. 11.
24. Håkansson J. Dental care habits, attitudes towards dental health and dental status among 20–60 year old individuals in Sweden [Thesis]. University of Lund. Malmö: Dialog, 1978.
25. Palmqvist S. Oral health patterns in a Swedish country population aged 65 and above [Dissertation]. Gothenburg: Faculty of Odontology, University of Gothenburg, 1986.
26. Agerberg G, Carlsson GE. Huvudvärk och bettdysfunktion. Tandlakartidn 1977;7:547–50.

27. Nikiforow R. Headache in random sample of 200 persons: a clinical study of a population in northern Finland. Cephalalgia 1981;1:99–107.
28. Wänman A, Agerberg G. Headache and dysfunction of the masticatory system in adolescents. Cephalalgia 1986;6:247–55.
29. Magnusson T, Carlsson GE. Recurrent headache in relation to temporomandibular joint pain-dysfunction. Acta Odontol Scand 1978;36:333–8.
30. Reik L, Hale MT. The temporomandibular joint pain-dysfunction syndrome: a frequent cause of headache. Headache 1981;21:151–6.
31. Gröndahl HG. Some factors influencing observer performance in radiographic caries diagnosis. Swed Dent J 1979;3:157–72.
32. Carlsson GE, Helkimo M, Agerberg G. Observatörsskillnader vid bettfysiologisk undersökning. Sven Tandlaek Tidskr 1974;66:565–72.
33. Carlsson GE, Egermark-Eriksson I, Magnusson T. Intra- and interobserver variation in functional examination of the masticatory system. Swed Dent J 1980;4:187–94.
34. Agerberg G. On mandibular dysfunction and mobility [Abstract 3]. Umeå University Odontological Dissertations. Umeå, Sweden: Umeå University, 1974.
35. Beyron H. Occlusal changes in adult dentition. J Am Dent Assoc 1954;48:674–86.
36. Österberg T. Odontological studies in 70-year-old people in Göteborg [Dissertation]. Gothenburg: Faculty of Odontology and Medicine, University of Gothenburg, 1981.
37. Carlsson GE, Kopp S, Öberg T. Arthritis and allied diseases of the temporomandibular joint. In: Zarb GA, Carlsson GE, eds. Temporomandibular joint. Function and dysfunction. Copenhagen: Munksgaard, 1979, 269–320.
38. Molin C, Carlsson GE, Friling B, Hedegård B. Frequency of symptoms of mandibular dysfunction in young Swedish men. J Oral Rehabil 1976;3:9–18.
39. Agerberg G. Mandibular function and dysfunction in complete denture wearers—a literature review. J Oral Rehabil 1988;15:237–49.
40. Agerberg G, Helkimo M. Symptomatology of patients referred for mandibular dysfunction: evaluation with the aid of a questionnaire. J Craniomandibular Pract 1987;5:157–63.

Received for publication 22 January 1988