

Functional disorders of the masticatory system

II. Symptoms in relation to impaired mobility of the mandible as judged from investigation by questionnaire

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Agerberg, G. & Carlsson, G. E. Functional disorders of the masticatory system. II. Symptoms in relation to impaired mobility of the mandible as judged from investigation by questionnaire. *Acta Odont. Scand.* 31, 335—347, 1973.

This study is a continued analysis of answers obtained from 1106 (91 %) of 1215 randomly selected persons. Indices were devised on the basis of answers to elucidate the occurrence of different functional disorders of the masticatory system and of some general and oral conditions. All these indices invariably showed higher values for women than for men. The differences were, however, numerically small. A single symptom of dysfunction was found in 57 %, combinations of 2 or more in 30 %. Every second subject was aware of some kind of orofacial parafunction, every third of general joint and muscle symptoms. Impaired mandibular mobility was most common in elderly persons; functional pain in the youngest age group. Impaired mobility was negatively correlated with the number of residual teeth. Functional pain was associated with orofacial parafunctions.

Of the possible aetiological factors analysed in the present investigation general state of health and general muscle and joint symptoms were most closely correlated with impaired mandibular mobility, while orofacial parafunctions and temporomandibular joint sounds were most closely correlated with functional pain.

The findings suggest that symptoms of functional disorders of the masticatory system are common and that they are of heterogeneous aetiological background.

Key-words: Temporomandibular joint syndrome; epidemiology; bruxism; mastication

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Recent years have witnessed a notable and sustained surge of interest in the frequency of functional disorders of the masticatory system. Several projects have been started in various quarters to eliminate the lack of epidemiologic data. Preliminary results of some investigations in progress have been published (*Hansson & Öberg, 1971; Helkimo et al., 1972*). An unexpectedly high frequency of clinically diagnosed

symptoms of functional disorder has been found in the populations studied, and the age and sex distribution of the symptoms have been much more even than that found in investigations of patients with functional disorders examined at special clinics.

In an investigation by questionnaire designed to elucidate symptoms and signs of functional disorders of the masticatory

Received for publication, July 16, 1973.

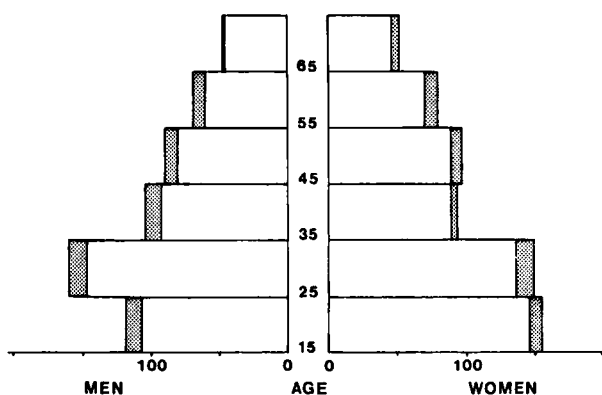


Fig. 1. Sex distribution of the sample divided in six age groups. The dotted areas denote the number of persons who did not answer the questionnaires.

system in a representative selection of a Swedish urban population, *Agerberg & Carlsson* (1972) found that relatively many of those persons who cooperated reported pain and symptoms of functional disorders and were aware of orofacial parafunctions. Thus, 39 % reported temporomandibular joint sounds, such as clicking and crepitation on movement of the mandible; 12 % reported pain when opening the mouth wide; and 7 % decreased maximal opening of the mouth. 10 % were aware of parafunctions, such as grinding of the teeth and 20 % of clenching of teeth. The age and sex distribution of the symptoms reported was much more even than in previously published patient series.

In the present part of the investigation indices were devised on the basis of the data obtained from the questionnaires for further analyses.

MATERIAL AND METHODS

The investigation was carried out on 15–74 year old residents of the city of Umeå. 1215 persons were randomly selected and invited to take part in an investigation by questionnaire of functional disorders of the masticatory system. The questionnaires were filled in and returned

by 1106 or 91 % (Fig. 1). Of those who answered 52 % were women, 48 % men. The design and performance of the investigation has been described previously. (*Agerberg & Carlsson*, 1972). To permit further analysis, in the present investigation certain indices were devised by combining different questions. On the basis of the answers to the questions index values were calculated in an attempt to describe the occurrence and grade of, among other things, impaired mobility of the mandible, functional pain, symptoms of functional disorders of the masticatory system, and orofacial parafunctions.

Construction of indices

Impaired mobility of the mandible. The mobility of the mandible was regarded as impaired if affirmative answers had been given to one or more of the following 3 questions. 1. Do you find it difficult to open your mouth wide?, 2. Do you find it difficult to take a large bite?, 3. Do you find it difficult to move your lower jaw to the side or forwards? The index values varied between 0 and 2. (0 = negative answer, 1 = 1, and 2 = 2–3 affirmative answers).

Functional pain. Pain in association with various functional movements of the

lower jaw was graded according to the number of positive answers to the following 4 questions.

1. If you find it difficult to open your mouth wide, is it because it is painful? Does it hurt anywhere when you 2. open your mouth wide?, 3. chew?, 4. bite your teeth hard together?

The index values varied between 0 and 2. (0 = negative answer, 1 = 1 and 2 = 2—4 affirmative answers.)

Dysfunction. An index for symptoms of disorders of the masticatory system was constructed on the basis of the answers to 13 questions, partly on the basis of the affirmative answers to those 7 questions in the indices for impaired mobility and functional pain, and of the following 3 questions: 8. Is your lower jaw ever caught or locked during certain movements?, 9. Do you hear any joint sounds when you move your lower jaw?, 10. Have you ever before had any of the above mentioned symptoms?, and partly a negative answer to 11. When you open your mouth wide can you place the ends of the left index finger, long finger and ring finger between your front teeth?, and 12. Can you chew all sorts of food, and, finally, the answer »poor» to question 13. What is your chewing ability? (alternatives: good, fairly good, poor).

An index of dysfunction with values between 0 and 3 was obtained by the following combination of answers: 0 = no score, 1 = 1, 2 = 2—3 and 3 = 4—13 points.

Parafunction. An index value of orofacial parafunctions was obtained by counting the number of affirmative answers to the following 7 questions: Are you in the habit of 1. grinding your teeth?, 2. pressing your teeth together?, or biting your 3. tongue?, 4. cheeks?, 5. lips?, 6. nails?, or 7. anything else? The index values

varied between 0 and 3 (0 = negative answer, 1 = 1, 2 = 2 and 3 = 3—7 affirmative answers).

Residual teeth. An index with values from 1 to 6 for the number of residual teeth was based on the following data: 1 = all teeth preserved, 2 = more than 20, 3 = 16—20, 4 = 8—15, 5 = 1—7, 6 = no residual teeth.

Face and head pain. An index with values from 0 to 1 was based on questions concerning the occurrence of facial pain and the frequency of headache. 0 = no facial pain and seldom headache (at most once or twice a month), 1 = facial pain and frequent headache.

General joint and muscle symptoms. An index with values from 0 to 2 was constructed on the basis of answers to questions regarding morning stiffness, existing or previous pain and swelling of any of the joints (other than TMJ). 0 = no symptoms now or previously, 1 = only previously, 2 = symptoms now.

General symptoms. On the basis of answers to questions concerning the general state of health, the occurrence of general joint and muscle symptoms, face pain and headache, the number of points allotted were added up. The sum could vary between 0 and 8. An index for general symptoms was constructed as follows: 0 = no symptoms, *i.e.* 0 points, 1 = 1 point, 2 = 2—3 and 3 = 4—8 points.

Statistical methods. In addition to frequency calculations, Chi-square and t-test for demonstrating differences between sex and age groups, contingency coefficients, product-moment correlation and stepwise multiple regression analysis were performed for demonstrating correlations between the new index values and some of the original variables (Siegel, 1956; Bailey, 1959; Snedecor & Cochran,

Table I. Percentage distribution of index values for impaired mobility, functional pain, dysfunction, parafunction, face and head pain, general joint and muscle symptoms and general symptoms. *p* denotes the level of significance according to Chi-square-test of difference between men and women

	Index value	Women	Men	Total	<i>p</i>
<i>Impaired mobility</i>	0	87	92	89	*
	1	7	4	5	
	2	7	4	5	
<i>Functional pain</i>	0	85	87	86	N.S.
	1	11	10	11	
	2	4	3	3	
<i>Dysfunction</i>	0	39	46	43	***
	1	24	28	26	
	2	26	21	24	
	3	10	5	8	
<i>Parafunction</i>	0	47	52	50	N.S.
	1	35	33	34	
	2	12	11	12	
	3	5	4	5	
<i>Face and head pain</i>	0	64	76	70	**
	1	36	24	30	
<i>General joint and muscle symptoms</i>	0	63	68	66	*
	1	6	5	6	
	2	31	26	29	
<i>General symptoms</i>	0	46	57	52	**
	1	13	10	11	
	2	12	10	11	
	3	29	23	26	

1968). The following symbols for levels of significance are used: N.S. $0.05 < p$, not significant; $*0.01 < p < 0.05$, almost significant; $**0.001 < p < 0.01$, significant, $***p < 0.001$, highly significant, where *p* is the probability of falsely rejecting the null hypothesis.

RESULTS

The distribution of the various index values for men and women is given in

Table I and Fig. 2. The values found for the indices were always higher for women than for men. Impaired mobility of the mandible, was reported by 11 % of those who answered, 14 % of the women and 8 % of the men, which gave an almost significant difference between the sexes. Pain on movements of the lower jaw, functional pain, was noted in 14 %, roughly equally often in both sexes. Symptoms of dysfunction of the masticatory system were noted in 57 %. The index values were higher for the women than for the men ($p < 0.001$). 50 % of those who answered were aware of some form of parafunction. For the indices for face and head pain, general joint and muscle pain and general symptoms, the values were significantly or almost significantly higher for women than for men.

The frequency of impaired mobility was roughly the same, 9–10 %, in the age groups between 15 and 54 years, but for the oldest age groups it increased to 16–17 % (Fig. 3). The frequency of functional pain was highest in the youngest age group, but did not differ notably between the others (Fig. 3). The relation between impaired mobility and functional pain in the whole material is shown in Table II. 81 % had none of these symptoms, 5 % had both, and 14 % reported one of the symptoms without having the

Table II. Relation between index values for impaired mobility and functional pain. Numbers of persons with different index values

	Functional pain				
	0	1	2	Total	
Impaired mobility	0	891	86	10	987
	1	39	12	9	60
	2	23	18	18	59
Total	953	116	37	1106	

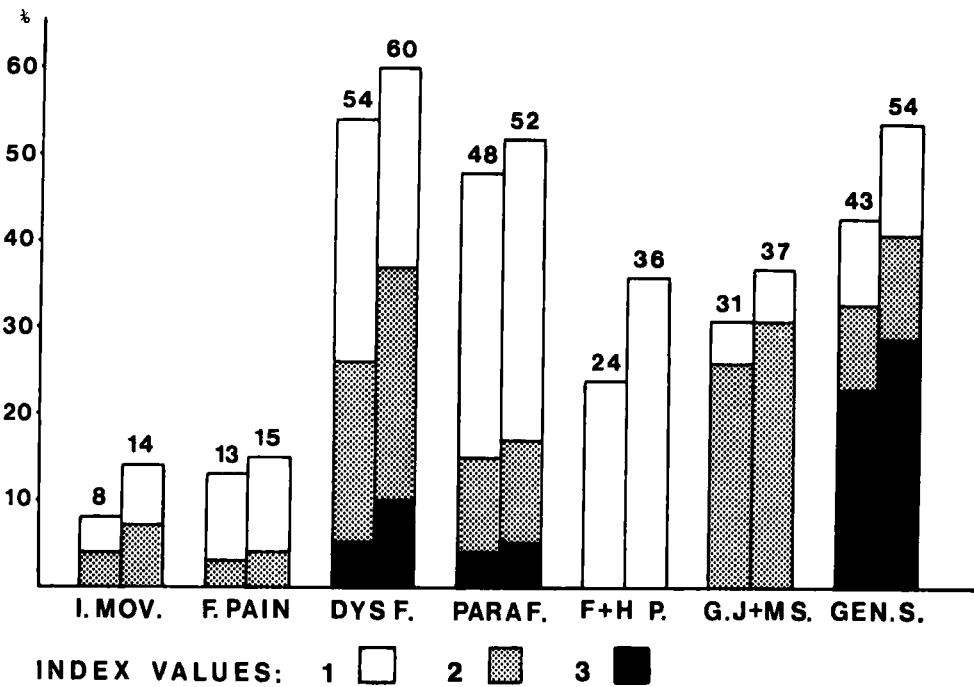


Fig. 2. Percentage distribution of men (left column of each pair) and women (right column of each pair) according to the different index values for impaired mobility of the mandible (I. MOV), functional pain (F. PAIN), dysfunction of the masticatory system (DYSF), parafunction (PARAF), face and head pain (F+HP.), general joint and muscle symptoms (G.J+MS.) and general symptoms (GEN.S) (see Material and methods).

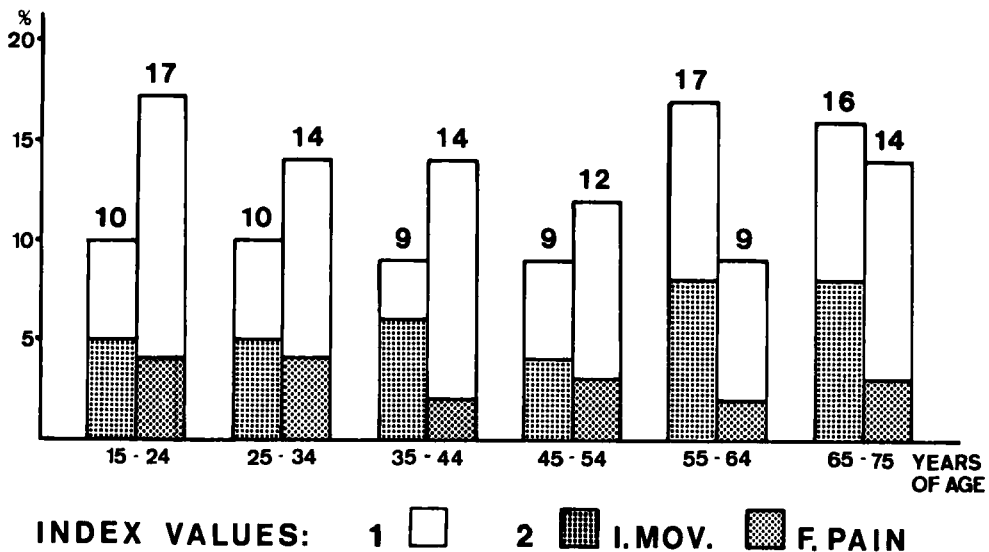


Fig. 3. Age distribution of indices for impaired mobility of the mandible, (left column of each pair) and functional pain on movements of the mandible (right column of each pair). Unfilled column = 1 affirmative answer; dotted columns = 2 or more affirmative answers (see Material and methods).

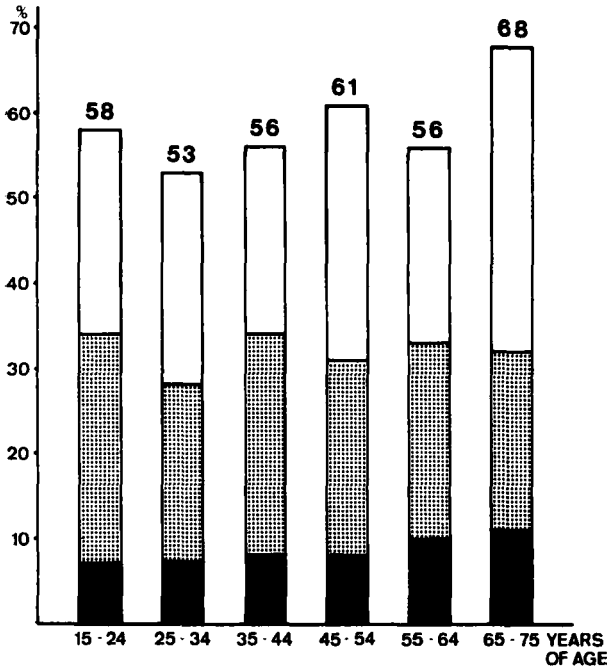


Fig. 4. Age distribution of index values for dysfunction of the masticatory system. Unfilled column = 1 symptom; dotted column = 2-3 symptoms; filled column 4 or more symptoms.

other. The correlation between these two indices was moderate but highly significant (correlation coefficient $r = 0.43^{***}$, contingency coefficient $C = 0.41^{***}$).

82 persons (7%) reported that they could not open the mouth wide enough to put three fingers of the left hand between the incisal edges of the front teeth. The

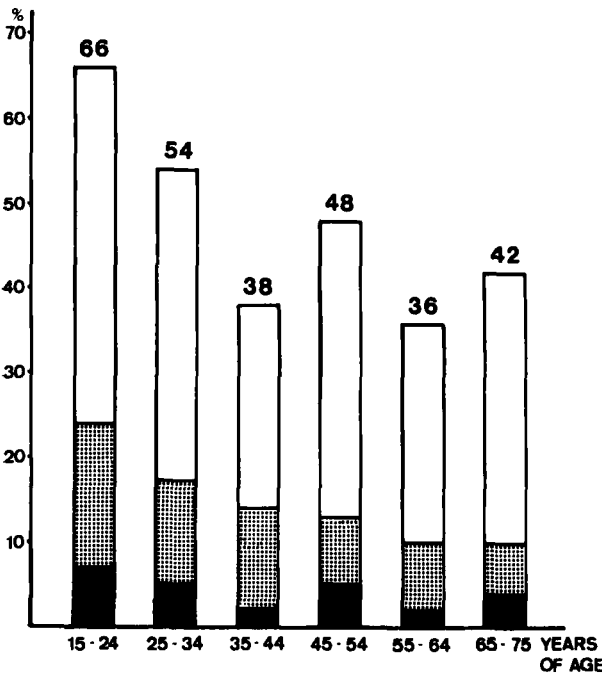


Fig. 5. Age distribution of index values for orofacial parafunctions. Unfilled column = aware of 1 parafunction; dotted column = aware of 2 parafunctions; filled column = aware of 3 or more parafunctions.

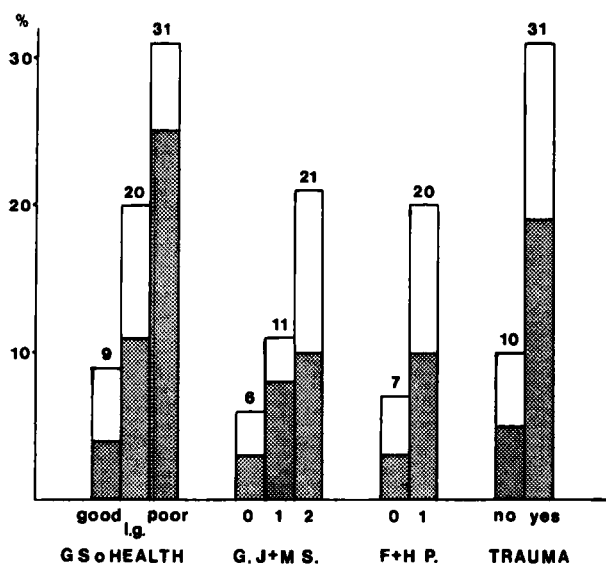


Fig. 6. Impaired mandibular mobility in relation to 4 other variables. The columns represent the percentage distribution of the index values for impaired mobility in groups divided according to the other variables: unfilled column = 1 affirmative answer, dotted column = 2—3 affirmative answers to 3 questions concerning impairment of mandibular movements. From left: general state of health (GS o HEALTH; 1.g. = less good); general joint and muscle symptoms (G.J+M S.; 0 = none; 1 = previous; 2 = existing symptoms); face and head pain (F+H P.; 0 = no face pain and seldom headache; 1 = face pain and frequent headache); trauma against head in case history (TRAUMA).

loss of this ability was highly significantly correlated with impaired mobility ($r = 0.37$) and functional pain ($r = 0.27$).

The age distribution of dysfunction and parafunction is given in Figs. 4 and 5. The frequency of dysfunctions was highest in the oldest age group, but the differences between the age groups were not significant. Parafunctions were most common in younger individuals; the differences between the youngest age group and each of the others were significant.

Impaired mobility of the mandible was reported significantly more often ($p < 0.001$) by individuals in a poor general state of health, and those with general joint and muscle symptoms, with face and head pain or with a trauma against the head in their history, which had initially caused symptoms on movement of the mandible than by those who had lower index values for these variables (Fig. 6).

Individuals with impaired mandibular movements reported joint sounds as clicking and crepitation, poor chewing ability, parafunctions, unilateral chewing and a difference in the number of residual

teeth between the right and left side more often than individuals without impaired movements (Table III). The difference was highly significant for joint sounds and

Table III. Percentage distribution of index values (0—2) for impaired mandibular mobility in groups divided according to 5 other variables. *p* denotes the level of significance according to Chi-square test of difference between the groups

Impaired mobility	0	1	2	<i>p</i>
TM joint sounds				
no	93	4	3	***
yes	84	8	9	
Parafunction				
no	91	5	4	N.S.
yes	87	6	7	
Chewing ability				
good	92	4	4	***
fairly good	85	9	6	
poor	46	14	40	
Chewing side				
both	91	4	5	*
one	85	8	7	
Same number of residual teeth on both sides				
yes	93	4	3	N.S.
no	88	6	6	

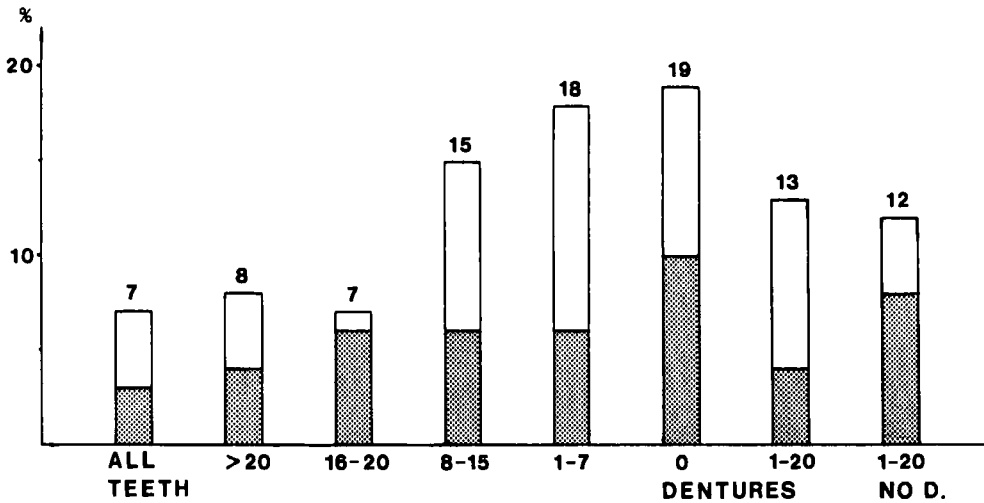


Fig. 7. Percentage distribution of index values for impaired mobility of the mandible in persons grouped according to dental status. The first 6 columns represent the number of teeth. The two last columns represent persons with 1-20 residual teeth with and without dentures (NO D). Un-filled column = 1 affirmative answer; dotted column = 2-3 affirmative answers to 3 questions concerning impaired mobility.

chewing ability, almost significant for unilateral chewing, but was not significant for the other two variables.

Impaired mandibular mobility was correlated with the number of teeth (Fig. 7). Of individuals with more than 16 residual teeth 7-8% reported difficulty in mandibular movements but the frequency increased with decreasing number of residual teeth and was 19% in the edentulous individuals. Complete-denture wearers more often found it difficult to move the mandible than did persons with a partial denture.

Of those who reported dysfunction of the masticatory system, a comparison was made between the side of the symptoms and the side on which they chewed (Table IV). Bilateral symptoms and bilateral chewing were most common. In unilateral chewing the right side was most common. In those who chewed on one side no obvious pattern for the localisation of the symptoms appeared. Nor did a corresponding comparison between the

affected side and the distribution of residual teeth show any particular pattern. On the other hand, it was noted that individuals tended to chew most on that side where they had most residual teeth, but by no means always (Table V). Bilateral chewing was dominant. In unilateral chewing the right side was more often preferred than the left when the distribution of residual teeth was equal on both sides.

Table IV. Relation between affected side and chewing side and distribution of residual teeth between the sides. Figures denote numbers of persons

Affected side		both	left	right
Chewing side				
	both	85	33	41
	left	18	12	6
	right	31	15	25
Distribution of residual teeth				
	even	49	23	26
	more on left side	15	10	11
	more on right side	19	11	10

Table V. *Relation between chewing side and distribution of residual teeth between the sides. Figures denote numbers of persons*

Chewing side		both	left	right
Distribution of residual teeth	even	306	32	65
	more on left	61	40	17
	more on right	65	18	47

Correlations. Table VI gives the coefficients for the correlations between the indices for impaired mobility, functional pain and dysfunction of the masticatory apparatus, as well as for the correlations between each of these indices and some other variables. The correlation analysis largely confirmed earlier results. The association between the 3 indices was positive and relatively close. The correlations between each one of these three indices and other variables were often weak, yet many of them were statistically significant due to the large sample size.

Impaired mobility and functional pain were positively associated with one another and showed similar associations with other variables but certain differences deserve mentioning. Age was positively correlated with impaired movements but negatively with functional pain, which is illustrated in Fig. 3. In contrast with functional pain, impaired mobility was significantly correlated with the dental status (number and distribution of residual teeth, and presence or absence of dentures). The reverse relationship was found for parafunctions. The general state of health showed a stronger correlation with impaired mobility than with functional pain. The dysfunction index often showed higher values for the correlation coefficients than the two indices separately (this was but natural because the dysfunction index included the other two indices).

The association between the index for general symptoms and the index for dysfunction of the masticatory system was highly significant and the correlation coefficient was 0.29 (which is the highest numerical value found for r except for some variables partly interdependent owing to the construction of the indices; Table VI).

Stepwise multiple regression analysis. An attempt was made to rank the effect of some selected factors on the variation in the index for impaired movement and for dysfunction (Table VII). The selected variables were introduced in the regression equations in the order of their importance as predictors for the variance of the dependent variable. The index for general symptoms showed the highest multiple correlation coefficients, viz. $R = 0.21$ and 0.32 respectively, in the stepwise regression analyses with both the dependent variables. For impaired mobility the factors that then followed in decreasing order of importance were: number of residual teeth, age and unilateral chewing. For the index for dysfunction the variables

Table VII. *Multiple correlation coefficients, R , and coefficients of determination, R^2 , between indices for impaired mobility, A, and for dysfunction, B, and the tested variables with the highest prediction values for the dependent variable*

Step	Variable	R	$R^2 \times 100$
A.	1 General symptoms	0.21	4
	2 Residual teeth	0.22	5
	3 Age	0.23	5
	4 Unilateral chewing	0.24	6
	5 General state of health	0.24	6
B.	1 General symptoms	0.32	11
	2 Parafunctions	0.35	12
	3 Unilateral chewing	0.36	13
	4 Occurrence of headache	0.37	14
	5 Residual teeth	0.37	14

Table VI. Coefficients of correlation, r , between indices for impaired mobility, functional pain, and dysfunction and some selected variables. For impaired mobility also the contingency coefficient, C , has been calculated for some associations

Variable	Scores	Impaired mobility C	Impaired mobility r	Functional pain r	Dysfunction r
1 Functional pain	0—2	.41***	.43***	—	—
2 Dysfunction	0—3	.56***	.53***	.54***	—
3 Age		—	.07**	.06*	.06*
4 General state of health	1 = good 2 = less good 3 = poor	—	.16***	.05*	.16***
5 Occurrence of head ache	1 = hardly ever ... 4 = daily	—	.12***	.11***	.25***
6 Face and head pain	0—1	.18***	.18***	.16***	.28***
7 General joint and muscle symptoms	0—2	.20***	.19***	.13***	.25***
8 General symptoms	0—3	.22***	.22***	.15***	.29***
9 TM joint sounds	1 = no 2 = yes	.15***	.14***	.20***	.67***
10 Parafunctions	0—7	—	.05	.16***	.14***
11 Residual teeth	1 = all ... 6 = none	.17***	.14***	.01	.12***
12 Same number of residual teeth on both sides	1 = yes 2 = no	.08	.08*	.03	.13***
13 Chewing side	1 = both 2 = one	.09*	.08*	.08**	.14***
14 Chewing ability	1 = good 2 = fairly good 3 = poor	.26**	.21***	.11***	.26***
15 Dentures	1 = no 2 = yes	—	.11***	.00	.10***
16 Trauma against the head	1 = no 2 = yes	—	.14***	.08**	.13***
17 Mouth opening larger than three fingers of the left hand	1 = yes 2 = no	.36***	.37***	.27***	.40***

parafunction index, unilateral chewing and frequency of headache in decreasing order of frequency followed after the index for general symptoms. The factor occupying the highest rank, index for general symptoms, could explain 4 % of the variation of the index for impaired mobility and 11 % of that for dysfunction ($R^2 = 0.04$ and 0.11 , respectively). Inclusion of

a further 4 variables only increased the prediction value (R^2) to 0.06 and 0.14, respectively.

DISCUSSION

The loss of answers was small (9 %) from the randomly selected group that represented the population of the city of

Umeå between the ages of 15 and 74 years (Fig. 1). Those who answered may therefore be regarded as representative of the population studied. Methodologic problems have been discussed in greater detail in part I (*Agerberg & Carlsson, 1972*).

The indices in the present investigation were built on the answers given to the questions. The selection of data for the construction of the indices was based on clinical experience and surveys of patients with functional disorders of the masticatory system. An evaluation of the clinical importance of the different indices cannot be done without a comparative clinical and enquiry study or a clinical examination of a group of individuals involved in the present study. Such a comparative investigation is in progress (*Helkimo et al., 1972*).

Statistical methods are usually recommended to vary with the kind of measurement and the types of scales used. For example data obtained by nominal and ordinal scales should be analyzed by nonparametric methods, while data measured in interval or ratio scales may be analyzed by parametric methods (*Siegel, 1956*). As for correlation analysis the opinions differ, however. Product-moment correlation requires ratio or interval scales according to *Siegel*, but it is also held that it may be used with ordinal scales (*Vejde, 1971*), and even with nominal scales (*Olkinuora, 1972*). Most of our index values and figures under analysis can be classified as nominal or ordinal, but we have nevertheless used product-moment correlation as a complement to other methods for testing association between variables, e.g. the Chi-square test and contingency coefficient. A comparison between contingency coefficients, *C*, recommended for non-parametric sta-

tistics, and product-moment correlation coefficients, *r*, is shown for some associations in Table VI. The numerical values of the two types of coefficients are quite similar as are the levels of significance for the correlations.

The frequency of symptoms of functional disorders of the masticatory system, as judged from the present investigation, is high compared with that given in earlier publications (for a survey see part I). It is, however, of the same order as that reported in the recent epidemiologic studies where anamnestic data were compared with clinical findings (*Hansson & Öberg, 1971; Helkimo et al., 1972*).

Of a special interest are the results of the investigation of Skolt Lapps (*Helkimo et al., 1972*), whose age distribution nearly coincided with the present material. Of the Skolt Lapps, about half had had symptoms of functional disorders, and if joint sounds on movement of the mandible (as the only symptom) were excluded, about one third of the population had or had had signs of dysfunction. In the present material about half (57 %) reported one symptom of dysfunction and 30 % two or more. *Öberg et al. (1973)* recently reported preliminary results of a clinical study of 1069 persons working at a shipyard. 30 % had two or more dysfunction symptoms. Four epidemiologic investigations are now available from different areas and different populations in Sweden and Finland, and all show similar frequencies of symptoms of functional disorders of the masticatory system.

The groups of symptoms represented by the indices for impaired mobility and functional pain were relatively strongly associated with one another, but nevertheless showed certain differences in their association with other variables. This suggests that impaired mandibular mobility and functional pain may partly be of

different origin and lends support to the opinion that groups of patients with functional disorders of the masticatory system are heterogeneous (*Greene et al.*, 1969; *Agerberg et al.*, 1970; *Carlsson & Svärdröm*, 1971).

It was noteworthy that the index for dysfunction, which gives the frequency of symptoms of functional disorders of the masticatory system, was more closely correlated with the index for general symptoms and other variables reflecting the general health than with any of the variables representing conditions of the masticatory system, such as dental status and parafunctions, and which are usually regarded as the most important from an aetiological point of view. It might, of course, be objected that the answers are only opinions of laymen and not an expert odontological evaluation of the state of the masticatory system. The results nevertheless support the view advanced by *Berry* (1969) that patients with temporomandibular joint symptoms also have a high frequency of general symptoms (minor diseases) which he interpreted as psychosomatic. A high frequency of general muscle and joint symptoms in patients with temporomandibular joint symptoms has also been reported by *Agerberg et al.* (1970), for example.

In studies on a group of patients with »mandibular pain dysfunction syndrome» *Molin* (1973) found that personality traits and psychologic factors probably played a role for the aetiology and development of the disease. Some of the factors he studied, e.g. psychic anxiety and muscular tension, pain threshold and pain tolerance levels, might help to explain this correlation between dysfunction of the masticatory system and general symptoms of minor diseases reported by *Berry* (1969) and also found in the present results.

The results in the present investigation, however, also suggest that a number of other factors, such as the number and distribution of the residual teeth, side of chewing, earlier trauma and occurrence of parafunctions and stress may be of significance in the causation of symptoms of functional disorders of the masticatory system. The results in the present investigation hardly warrant any conclusions about the aetiological significance of functional factors in the causation of symptoms of functional disorders but the correlations found, though weak, deserve consideration in future clinical studies. Clicking and crepitations of the temporomandibular joint are, for example, symptoms which should be studied more closely — such symptoms are more common in individuals who find it difficult to open the mouth wide and who have pain on movement of the mandible, than in persons without functional disorders. As pointed out by *Greene et al.* (1969) joint sounds are often the first symptom of an insidious functional disorders.

The symptoms of functional disorders of the masticatory system in the population examined can obviously have a very heterogeneous background. It appears that in the population as a whole, no single factor has any dominating significance. It is probable that dysfunction in individual patients differs in regard to aetiology and pathogenesis, even if the symptoms are similar. This must be observed in the examination and treatment of patients with functional disorders of the masticatory system. It is, however, obvious that in a given patient there is often a single factor or a couple of factors combined which are of decisive aetiological importance in the development of functional disorders and which must be attacked to achieve a therapeutic effect.

But the causal factors obviously vary from one patient to another.

Acknowledgement. This work (part I and II) was supported by the Swedish Medical Research Council (Project No K72-24X-2795-02).

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