Occurrence of Clinical Signs of Temporomandibular Disorders in Adult Finns

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Aims: *To study the age- and gender-related prevalence of signs of temporomandibular disorders (TMD) in the Finnish adult population.* ***Methods:*** *A clinical health examination was performed as a part of a Health 2000 Health Examination Survey in 2000 and 2001. A nationally representative sample included 8,028 Finns at least 30 years of age, of whom 79% participated also in an oral health investigation, including examination of the stomatognathic system in order to assess the presence of certain TMD signs: maximum interincisal distance < 40 mm, pain in temporomandibular joints or masticatory muscles, and sounds in temporomandibular joints (crepitation, clicking).* ***Results:*** *Thirty-eight percent of the subjects had at least 1 sign of TMD. All the signs studied were more common in women than men. Overall, signs of TMD were also associated with age; the older the subject, the higher the prevalence of the TMD signs. However, when stratified by gender, the association with age was not as clear, and gender differences were observed in the prevalence of the single TMD signs at different ages.* ***Conclusion:*** *Signs of TMD may be more common among the elderly than is usually reported.* J OROFAC PAIN 2006;20:208–217

Key words: age, gender, prevalence, temporomandibular disorders

Temporomandibular disorders (TMD) belong to the category of musculoskeletal disorders. TMD is a collective term that comprises several clinical problems related to the temporomandibular joints, the masticatory muscles, and associated structures and tissues. Orofacial disorders of neurological, vascular, or neoplastic origin or inflammation are not considered temporomandibular disorders.[1]

Epidemiologic studies have reported that signs and symptoms of TMD, such as pain and tenderness in the temporomandibular joint and masticatory muscles, sounds in the joints, and limitation of mandibular movements are common in general populations.[2–4] The same studies have revealed differences in TMD prevalence between genders and age groups, with somewhat inconsistent results. For instance, although a higher prevalence of symptoms in women than in men[3,5–11] has not been reported in all studies,[12–14] more clinical TMD signs have been registered among women than men.[3,7] Subjective symptoms are more common among young adults and middle-aged individuals than among children or elderly individuals,[5,14–17] while clinical signs seem to be more prevalent in the elderly.[6,12,16]

The results of previous studies have shown a higher prevalence of signs and symptoms of TMD in edentulous denture wearers than in dentate individuals.[6,18] Edentulousness and wearing of complete dentures are more common at an older age. In Finland, as in all developed countries, the proportion of the population that is edentulous is decreasing.[19] The available information about the prevalence of TMD is partly contradictory; furthermore, previous surveys did not record data from old-age cohorts and/or data were recorded at a time in which edentulousness was far more common than today. The only comprehensive epidemiologic study on TMD among adult Finns was carried out 30 years ago.[16] In that study, TMD were investigated without performing muscle palpation, and in a sample that included only 18- to 64-year-old inhabitants. Thus, a comprehensive study was considered necessary.

The aim of the present study was therefore to study the age and gender distribution of signs of TMD in a large sample of Finnish adults that included elderly individuals.

Materials and Methods

Selection of Subjects

The data for the present study were obtained from a comprehensive Health 2000 Health Examination Survey performed in 2000 and 2001. The 2-stage stratified cluster sampling design was planned by Statistics Finland. The sampling frame comprised adults at least 30 years of age who lived in mainland Finland. This frame was regionally stratified according to the 5 university hospital regions, each containing roughly 1 million inhabitants. From each region 16 health-care districts were sampled as clusters. Thus the 80 health center districts were the primary sampling units. The ultimate sampling units were subjects who were selected by systematic sampling from the health center districts. This sampling method was chosen because it allows for more efficient estimation methods than random sampling. Persons aged 80 years or more were oversampled by doubling the sampling fraction.[20]

The total sample comprised 8,028 persons, of whom 6,335 took part in the clinical oral health examination—3,466 women and 2,869 men. In this study the subjects were not asked about previous subjective experiences concerning disorders of the masticatory system and symptoms in the temporomandibular joint region. Additional information about the Health 2000 Health Examination Survey is available at http://www.ktl.fi/health2000.

Clinical Assessment

Five experienced and calibrated examiners (dentists) performed a standardized clinical examination as part of the oral health study and assessed the signs of TMD and the grade of malocclusion. Experienced specialists trained the examiners in order to increase the reproducibility of the clinical examination. The examiners were videotaped while they performed the clinical examination, and the videotapes were carefully reviewed by the trainers and the examiners together in order to minimize any differences in the clinical examination technique. The 5 examiners were also assessed using a reference examinee. The agreement degrees for the different signs were 95% for maximum interincisal distance, 84% for clicking, 91% for crepitation, 92% for pain in joints, and 95% for pain in muscles.[21] The kappa values (95% confidence intervals [CI]) for the assessment of the different signs were 0.56 (0.34 to 0.77) for maximum interincisal distance, 0.44 (0.35 to 0.52) for clicking, 0.21 (0.13 to 0.29) for crepitation, 0.26 (0.19 to 0.34) for pain in joints, and 0.47 (0.41 to 0.53) for pain in muscles.[21]

The standardized clinical examination of the masticatory system included recording of maximum mouth opening, auscultation of temporomandibular joint noises, and palpation of the joint and 2 masticatory muscles (temporalis anterior and masseter superficialis). Maximum mouth opening was measured with a ruler and reported as maximum interincisal distance without overbite; it was considered limited when less than 40 mm. Joint noises, clicking, and crepitation were recorded bilaterally over the temporomandibular joint region with gentle digital palpation when the subject opened and closed the mouth. Temporomandibular joint tenderness to palpation was assessed by applying a force of 5 N over the immovable condyle, and muscle tenderness was assessed with a force of 10 N. Attempts were made to standardize the palpation force by exerting the forces on a measuring scale between the examinations. Joint and muscle pain on palpation was recorded if the subjects reported pain when asked or showed a protective or palpebral reflex. Except for the maximum interincisal distance, all the findings were recorded separately for both sides, although they were combined in the results and recorded as either present or absent. For the statistical analyses, 5 dichotomous outcome variables were formed: maximum interincisal distance < 40 mm, clicking, crepitation, pain in joints, and pain in muscles.

Table 1 Number (n) and Prevalence (%) with 95% CI of Clinical Signs of TMD in Adult Finns in 2000 and 2001

Sign of TMD	n	% (95% CI)	Participants
Maximal interincisal distance < 40 mm	594	9 (8–10)	6,254
Clicking	983	15 (14–17)	6,310
Crepitation	511	8 (7–9)	6,310
Pain in joints	249	4 (3–5)	6,312
Pain in muscles	918	14 (13–15)	6,309
At least 1 of the 5 TMD signs	2,442	38 (36–40)	6,278
At least 1 of 4 selected TMD signs*	2,096	32 (31–34)	6,309
More than 1 of the 5 TMD signs	647	10 (9–11)	6,248
More than 1 of 4 selected TMD signs*	484	7 (6–8)	6,307

* maximum interincisal distance < 40 excluded.

Statistical Analyses

Because of the complex sampling design (stratified 2-stage cluster with oversampling of people aged 80 years or more) and to compensate for nonresponse effects on demographic distributions, weights were used in statistical analyses. The calibrated weights provide correct population distributions with respect to gender, age, and region. For analyses, age was categorized as follows: 30 to 40 years, 41 to 50 years, 51 to 60 years, 61 to 70 years, 71 to 80 years, and more than 80 years. Chi-square tests were performed to study associations between gender, age group, and the 5 dichotomous outcome variables. Separate logistic regression analyses were fitted for each outcome variable to adjust the shown prevalence estimates by gender and age group. Results are presented in terms of odd ratios (ORs) with 95% CIs. First-order interaction terms, including age group and gender, were included in every model. Data analyses were performed with SAS software using SUDAAN.[22]

Results

The most common TMD symptom was clicking, followed by muscle pain, maximum interincisal distance < 40 mm, crepitation, and joint pain. More than one third of the subjects (38%) had at least 1 TMD sign, and 10% had more than 1 (Table 1).

All the recorded clinical TMD signs were more often present in women than in men ($P < .001$) (Figs 1 to 5 and Table 2). The differences between genders with respect to the prevalences of all signs recorded were statistically significant (Table 2). Maximum interincisal distance without overbite of < 40 mm was observed twice as often in women as in men ($P < .001$). Joint sounds were more typical for women than for men ($P < .001$), and more than twice as many women as men showed signs of pain in joints or muscles ($P < .001$) (Table 2).

Signs of TMD were also associated with age, with older age groups showing higher prevalences. However, when the sample was stratified by gender, differences between women and men were noticed. Among the men, there were no large differences between the prevalence of clicking and pain in the joints between the different age groups. However, muscle pain was more common in older men. In women, as for men, the occurrence of joint clicking was about the same in all age groups. However, joint crepitation as well as joint and muscle pain were more prevalent in the older age groups (Table 2, Figs 1 to 5).

In adjusted analyses the associations between the signs of TMD, age, and gender were statistically significant, with 1 exception (clicking). The risk of signs of TMD, except for clicking, increased in the older age groups (Table 3, Fig 6). Significant interactions between gender and age group were found for maximum interincisal distance < 40 mm ($P < .05$), crepitation ($P < .05$), and pain in joints ($P < .01$). This is shown in Table 2, where prevalences of each outcome are stratified by gender.

Table 2 Prevalence of Clinical Signs of TMD by Gender and Age Group

	Women				Men				*P**
	n	%	Total	*P*†	n	%	Total	*P*†	
Maximum intercisal distance < 40 mm	414	12	3,433	< .001	180	6	2,821	< .001	< .001
30–40 y	42	5	813		15	2	731		
41–50 y	73	9	818		29	4	721		
51–60 y	71	10	683		41	6	649		
61–70 y	88	17	512		38	9	410		
71–80 y	74	20	371		35	17	215		
> 80 y	66	28	236		22	24	95		
Clicking	613	18	3,449	< .001	370	13	2,861	.736	< .001
30–40 y	128	16	814		89	12	731		
41–50 y	179	22	819		87	12	725		
51–60 y	101	15	686		93	14	662		
61–70 y	91	18	514		57	14	417		
71–80 y	67	18	378		29	13	226		
> 80 y	47	20	238		15	15	100		
Crepitation	358	10	3,449	< .001	153	5	2,861	< .001	< .001
30–40 y	42	5	814		20	3	731		
41–50 y	68	8	819		45	6	725		
51–60 y	87	13	686		49	7	662		
61–70 y	66	13	514		19	5	417		
71–80 y	59	16	378		12	5	226		
> 80 y	36	15	238		8	8	100		
Pain in joints	182	5	3,451	.002	67	2	2,861	< .001	< .001
30–40 y	26	3	814		19	3	731		
41–50 y	38	5	819		18	2	725		
51–60 y	29	4	686		18	3	662		
61–70 y	34	7	514		8	2	417		
71–80 y	31	8	379		4	2	226		
> 80 y	24	10	239		0	0	100		
Pain in muscles	693	19	3,449	< .001	225	8	2,860	< .001	< .001
30–40 y	99	12	814		34	5	730		
41–50 y	123	15	819		38	5	725		
51–60 y	125	18	686		44	7	662		
61–70 y	120	23	514		52	13	417		
71–80 y	128	34	379		31	13	226		
> 80 y	98	40	237		26	26	100		

P values based on chi-square tests for associations between TMD and *gender (df = 1 in all cases) and †age (df = 5 in all cases).

Discussion

The present findings indicate that there are more clinically verified signs of TMD in older age groups than among younger subjects. However, the association between TMD signs and age is not straightforward, as interactions between age and gender were detected. Some factors besides problems related to aging probably play a role as well. One of these could be the lack of teeth,[6,16,23] which, in Finland, is still more common among elderly women than men. Indeed, a higher prevalence of symptoms and signs of TMD in edentulous denture wearers than in dentate individuals has been reported previously.[6,18] This could be 1 reason why the present results are not in line with a previous study that suggested that TMD diminish at an older age.[24] In addition, the higher prevalence of masticatory muscle pain on palpation in older age groups may well reflect a general increase of muscle tenderness with age. Indeed, several reports have demonstrated higher prevalences for many types of pain and muscular tenderness for older age groups than for younger ones (for a recent review, see Leveille[25]). These results suggest that the decrease in mortality that has resulted from improved health care may have led to an increase in the prevalence of chronic musculoskeletal conditions in the elderly population. Therefore, the increase of TMD signs among elderly cannot be

Table 3 Crude and Adjusted OR (CI 95%) of Maximum Interincisal Distance < 40 mm, Clicking, Crepitation, Pain in Joints, and Pain in Muscles in Relation to Gender and Age Group

	Crude			Adjusted		
	P	OR	95% CI	*P*	OR	95% CI
Maximum intercisal distance < 40 mm						
Gender	< .001			< .001		
Male		1.0			1.0	
Female		2.0	1.7–2.4		1.8	1.5–2.2
Age	< .001			< .001		
30–40 y		1.0			1.0	
41–50 y		1.9	1.4–2.6		1.9	1.3–2.6
51–60 y		2.5	1.8–3.4		2.4	1.8–3.4
61–70 y		4.2	3.1–5.8		4.1	3.0–5.7
71–80 y		6.1	4.5–8.3		5.7	4.2–7.8
> 80 y		9.8	7.0–13.6		8.8	6.3–12.4
Clicking						
Gender	< .001			< .001		
Male		1.0			1.0	
Female		1.4	1.2–1.7		1.4	1.2–1.7
Age	.086			.152		
30–40 y		1.0			1.0	
41–50 y		1.3	1.1–1.5		1.3	1.1–1.5
51–60 y		1.0	0.9–1.3		1.0	0.9–1.3
61–70 y		1.2	1.0–1.4		1.2	0.9–1.4
71–80 y		1.2	0.9–1.6		1.2	0.9–1.5
> 80 y		1.4	1.0–1.9		1.3	1.0–1.8
Crepitation						
Gender	< .001			< .001		
Male		1.0			1.0	
Female		2.1	1.7–2.5		2.0	1.7–2.4
Age	< .001			< .001		
30–40 y		1.0			1.0	
41–50 y		1.9	1.4–2.6		1.9	1.4–2.6
51–60 y		2.8	2.0–3.8		2.8	2.0–3.8
61–70 y		2.4	1.8–3.4		2.4	1.7–3.3
71–80 y		3.3	2.4–4.6		3.1	2.2–4.2
> 80 y		3.6	2.4–5.6		3.2	2.1–4.0
Pain in joints						
Gender	<.001			< .001		
Male		1.0			1.0	
Female		2.2	1.7–2.8		2.1	1.6–2.7
Age	.014			.060		
30–40 y		1.0			1.0	
41–50 y		1.3	0.8–1.9		1.2	0.8–1.9
51–60 y		1.2	0.8–1.9		1.2	0.8–1.9
61–70 y		1.6	1.0–2.5		1.5	1.0–2.4
71–80 y		1.9	1.2–3.1		1.8	1.1–2.8
> 80 y		2.4	1.5–3.8		2.1	1.3–3.3
Pain in muscles						
Gender	< .001			< .001		
Male		1.0			1.0	
Female		3.0	2.5–3.5		2.7	2.3–3.2
Age	< .001			< .001		
30–40 y		1.0			1.0	
41–50 y		1.3	1.0–1.5		1.2	1.0–1.5
51–60 y		1.6	1.2–2.0		1.6	1.2–2.0
61–70 y		2.5	2.0–3.1		2.4	1.9–3.0
71–80 y		3.8	2.9–4.8		3.5	2.7–4.5
> 80 y		6.3	4.7–8.4		3.5	4.1–7.5

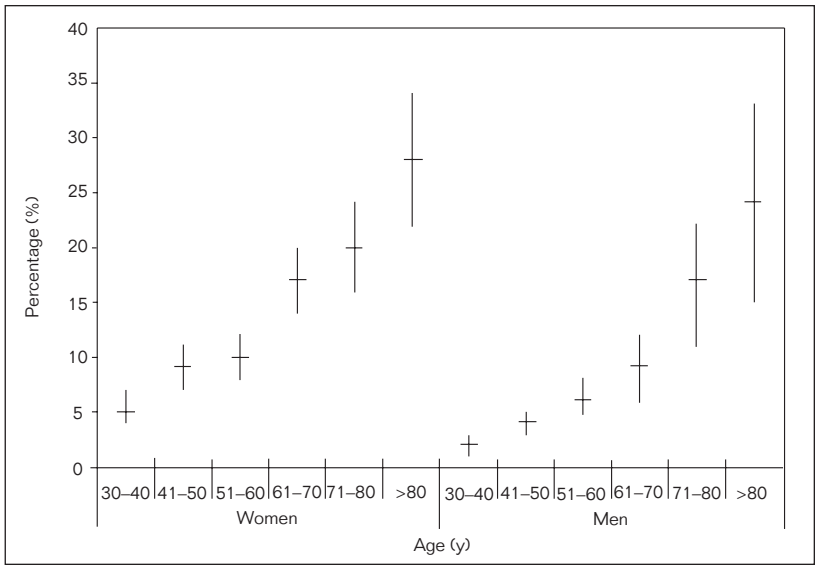

Fig 1 Prevalences (%) with 95% CIs of occurrence of maximal interincisal distance < 40 mm by gender and age group.

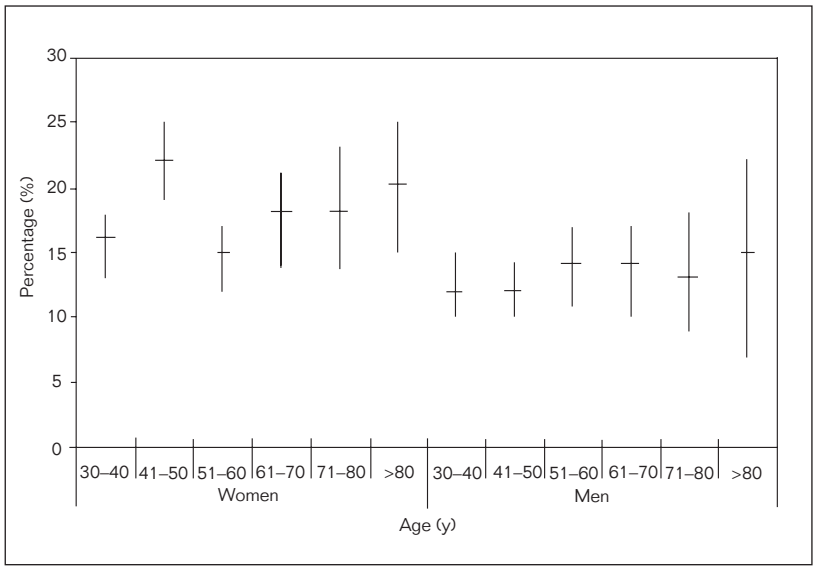

Fig 2 Prevalences (%) with 95% CIs of occurrence of clicking by gender and age group.

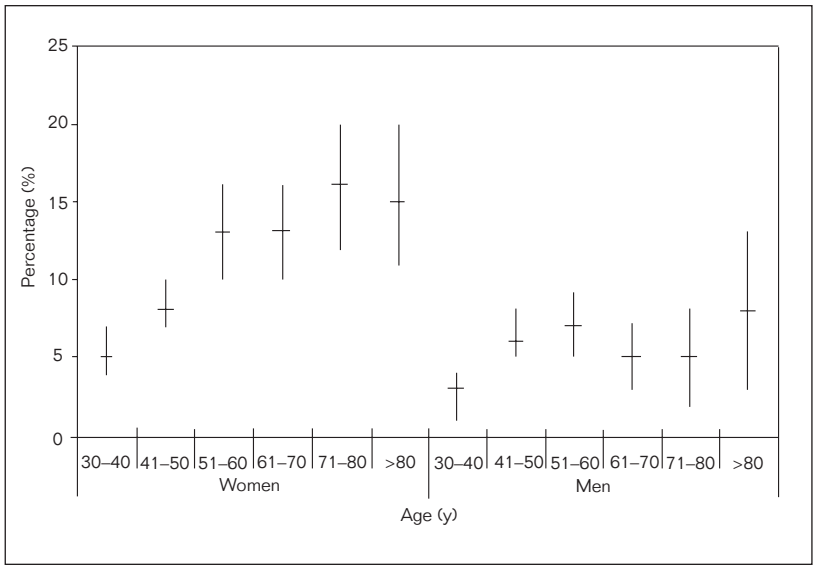

Fig 3 Prevalences (%) with 95% CIs of occurrence of crepitation by gender and age group.

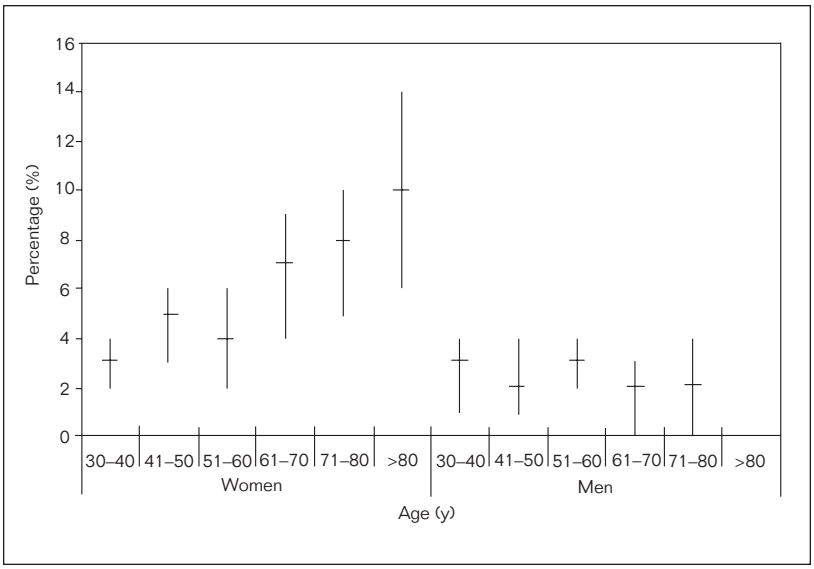

Fig 4 Prevalences (%) with 95% CIs of occurrence of pain in joints by gender and age group.

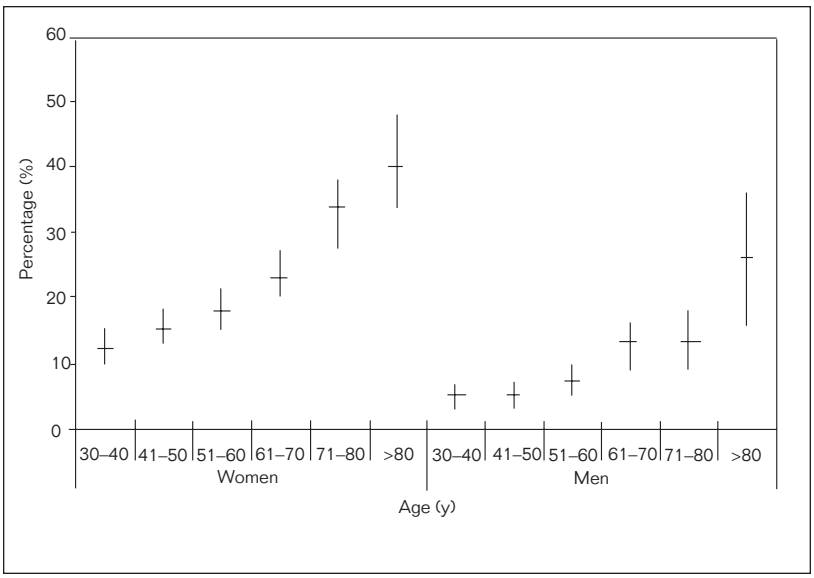

Fig 5 Prevalences (%) with 95% CIs of occurrence of pain in muscles by gender and age group.

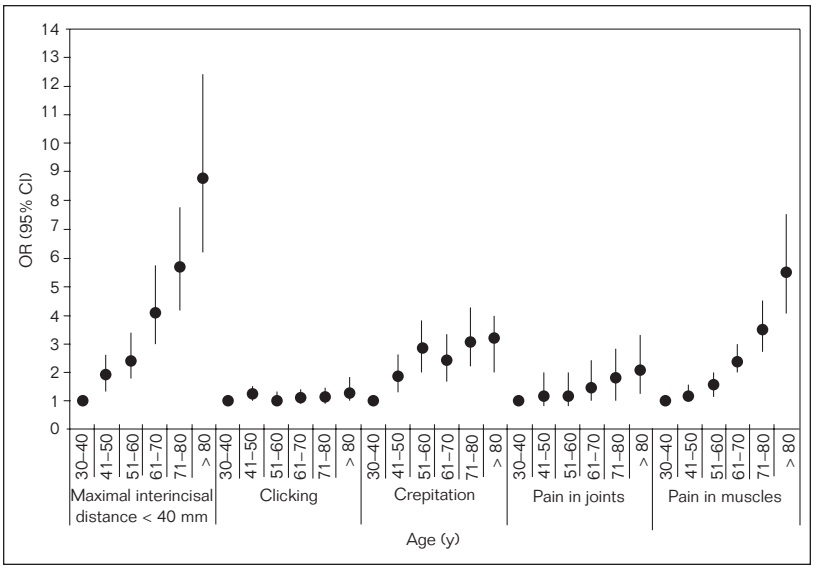

Fig 6 Gender-adjusted ORs for occurrence of TMD by age group (reference group: 30 to 40 years old).

explained simply by changes in the dentition or oral health. Also, the higher incidence of muscle tenderness in aged individuals may be related to a higher number of pain conditions in the elderly. For instance, tenderness of the jaw muscles is associated with other body pains in children,[26] and generalized chronic pain conditions may lead to central sensitization and therefore to a general decrease in pain threshold. A similar association may be present among all age groups, especially in the elderly, but there have been no studies in this area.

Differences in samples, criteria, and methods used make it difficult to compare the results of the present study and previous epidemiologic studies on TMDs.[27] In addition, there are discrepancies between symptoms perceived by subjects and symptoms and signs evaluated by a clinician. Indeed, previous epidemiologic studies indicated that subjective TMD symptoms have a lower prevalence than TMD signs.[2,3,7,12,13] In a study by Salonen and coworkers,[12] subjective symptoms decreased with age, while clinical signs increased with age; the latter was also found in this survey. Nevertheless, the prevalence figures of TMD in men and women are in agreement with many previous studies.[3,5–11] The number of women who reported at least 1 sign or symptom of TMD was almost twice as high compared to men. However, in the previous study on adult Finns, no significant differences between genders were found.[16] This difference may be due to differences in the age groups studied and the exclusion from the first study of 1 of the most prevalent signs in women, muscle pain.

In the previous study on the Finnish population, at least 1 symptom of TMD was reported by 58% of subjects, whereas the prevalence figure for at least 1 sign of TMD according to the clinical examination was 41%.[16] This prevalence for any clinical sign corresponds to the present results, but subjective symptoms cannot be compared because subjects were not asked about their previous experiences of discomfort in the temporomandibular region in the present study. The reason was that the oral health examination was part of a much larger health survey, and it was necessary to restrict the number of aspects studied. The present study does not provide prevalence values for TMD but for separate signs of TMD. Thus, the values cannot be directly compared with most TMD prevalence studies, which do not report values for separate signs.

A reliable evaluation of TMD is difficult because of the fluctuation of signs and symptoms of TMD revealed in longitudinal studies.[28,29] The absence of signs of TMD at the time of examination does not necessarily mean that the disorder is absent.[30] For example, subjects suffering from migraine are not classified as migraine-free if they are not experiencing a migraine at the moment of the clinical examination. Furthermore, disc displacement is not necessarily painful.[31–33] Thus, the point estimate can underestimate the prevalence because only those with demonstrable signs at the moment of examination were registered as cases. On the other hand, pain or tenderness to palpation of masticatory muscles is not an entirely objective finding; it is also an expression of a subjective feeling,[34] which can lead to overestimation of clinical signs.

The present study included maximum interincisal distance of < 40 mm in the sum figures for TMD signs, but the sums were also calculated without this outcome variable. This was because measurement of maximum interincisal distance included also subjects with full prostheses. Many of these subjects had an altered vertical dimension because of jaw resorption, and their restricted opening values were therefore probably underestimated. In future analyses, dentate and edentate subjects should be separated.

The present study was part of a carefully conducted comprehensive and nationally representative health survey. Because of the response rates, which were exceptionally high, even in the oldest segment of the population, it was possible to gather information about the signs of TMD in the adult population as a whole. Participation was 89% in the home interview, 85% in the health examination (including home health examination), and 79% in the clinical oral health examination. When taking into account all the subsets of the survey, participation in at least 1 of them was 93%. Of the subjects aged 75 years or more, 79% participated in the clinical examinations. Analysis of the nonattendees in the health examinations is not yet finished, but those who did not attend the interviews were most often men less than 50 years of age (10%) or women greater than 70 years of age (7%).[35] Similar values are most likely to be calculated for participation in the health examinations. Age and gender distributions of attendees in the clinical oral health examination were similar to those of the whole sample.[36] There is also some preliminary information that subjects with functional limitations, lower visual ability, and mental disorders have lowered participation in health examinations. The percentage of the entire sample that refused to participate because of illness or injury was 1%.[35]

In conclusion, the results of this study on the Finnish adult population agree with the findings of the majority of past epidemiologic studies of gender differences in the prevalence of TMD signs. However, the results are not in line with studies reporting lower prevalences of TMD signs. According to the present study, several TMD signs may be quite common among the elderly. Further studies are needed in order to reveal whether this result can be explained by aging, an increase in the frequency of chronic diseases among the elderly, and/or changes in oral health and edentulism.

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