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ORIGINAL ARTICLE

Prevalence of clinical signs and pain symptoms of temporomandibular disorders and associated factors in adult Finns

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ABSTRACT

Objective: To assess the prevalence of clinical signs and pain symptoms of temporomandibular disorders (TMD) and associated factors in the Finnish adult population, as well as the association between self-reported TMD pain symptoms and clinical signs.

Material and methods: The sample consisted of 1577 Finnish adults who participated in the Health 2011 Survey (BRIF8901). Signs of TMD were assessed using clinical examination, and TMD pain symptoms were inquired using validated questions.

Results: Of the study subjects, 35% showed at least one sign of TMD, 8% reported weekly facial pain and 6% weekly pain when biting or jaw opening. According to logistic regression, female gender, poor general health and low level of education increased the risk for most TMD signs and TMD pain symptoms. Muscle or TMJ pain on palpation associated significantly with self-reported weekly facial pain or pain when biting or jaw opening.

Conclusion: Over a third of the population showed clinical signs of TMD and less than one-tenth reported TMD pain symptoms. An assessment of a patient's general health needs to be a part of TMD diagnosis and treatment. The Finnish versions of the validated questions are applicable for screening of TMD pain.

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Introduction

Temporomandibular disorders (TMD) are a group of dysfunctions and pain related to the masticatory muscles, temporomandibular joints (TMJs) and the adjacent structures. Limitations in jaw movement, pain on palpation in muscles and TMJs as well as clicking and crepitation of the TMJ are common signs of TMD, and they are assessed based on a clinical examination. Typical symptoms of TMD include self-perceived complaints such as pain in the facial area or pain during biting or jaw opening or TMJ noises [1].

TMD are relatively common within the population. Because of the different criteria for TMD used, the prevalence of TMD varies between studies. In the study by Nilsson et al. [2], two questions on TMD pain have shown to be valid for screening pain-related TMD among adolescents. The diagnostic accuracy of these pain-related questions has also been evaluated on adults with TMD by Lövgren et al., showing positive responses in most patients with TMD-related pain [3]. The prevalence of clinical signs of TMD in the adult population is commonly more frequent than TMD related symptoms [1,4–6]. Sociodemographic characteristics, especially gender and age, have been indicated to associate with TMD. TMD signs and symptoms are suggested to be more common in women than men. [4,5,7–9]. TMD symptoms have shown to be most prevalent in 20- to 40-year-olds, whereas TMD signs seem to increase with increasing age [5,9–13]. Some sociodemographic factors and their relationship with TMD are inconclusive, for example, level of education and marital status [5–11,14–16].

The onset and persistence of TMD has been studied in a large population-based study, the Orofacial Pain Prospective Evaluation and Risk Assessment (OPPERA) Study [17], which showed that the incidence for TMD was nearly 4% per year. Psychosocial factors [17,18], poor health [17] and self-reported oral parafunctions [17,19,20] are reported to increase the risk for TMD. There have been three previous comprehensive studies conducted on TMD in the adult Finnish population. The first one by Swanljung et al. [21], conducted over 40 years ago, did not include subjects over the age of 61 and also did not include assessment of muscle pain. According to their study, 41% of subjects had at least one clinically assessed sign of TMD and 58% reported at least one symptom of TMD [21]. The second study, by Rutkiewicz et al. [5], based on the Health 2000 Survey, showed that 38% of Finnish adults had at least one clinically assessed sign of TMD, but symptoms were not comparably assessed [5]. In the third study by Jussila et al. [15] on 46-year-old subjects born in Northern Finland, 34% had clinical signs of TMD and 19% responded positively to a self-

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reported question for TMD related pain [15]. Their study used the validated questions by Nilsson et al. [2] and showed positive associations of self-reported TMD pain with myalgia and arthralgia. However, additional comprehensive studies are needed to study their applicability in the adult population.

The aim of this study was, based on the Health 2011 Survey, to assess the prevalence of clinical signs and pain symptoms of TMD and their association with sociodemographic factors including age, gender, level of education, number of teeth, marital and general health status in the Finnish adult population. In addition, the association between self-reported TMD pain symptoms, using the validated questions, and clinical signs were studied.

Material and methods

Data collection

A comprehensive study on health and well-being of Finnish adults, Health 2011 Survey (BRIF8901), was conducted in 2011 and 2012. The Health 2011 Survey was a follow-up study of the Health 2000 Survey [5]. All study subjects who took part in the Health 2000 Survey, were at least 18 years of age, and were alive and living in Finland ($n = 8135$) were invited to take part in the Health 2011 Survey. Also, a new random sample of those aged 18–28 years in 2011 ($n = 1994$) were included. In total, the sample included 10,129 subjects. Health examinations were performed in five areas, but oral health examinations were performed in only two areas, due to limited resources; those living in Southern (Helsinki and Uusimaa Hospital Districts) and Northern (Kainuu, Keski-Pohjanmaa, Pohjois-Pohjanmaa, Lappi, Länsi-Pohja, Pohjois-Savo, and Vaasa Hospital Districts) Finland ($n = 3469$), were invited to take part in the oral health examinations and 45% of them participated. The study sample ($n = 1577$) included adults, 18 years of age or older, who participated in the oral health examination and interview. A two-stage stratified cluster sampling design was used to represent the Finnish adult population aged 18 years and over [22–23].

A standardized clinical oral examination was performed by four dentist-nurse teams, in which the well-trained dentists performed oral examinations including assessment of TMD signs; recording of maximum interincisal distance, auscultation of TMJ noises, and palpation of the TMJs and two masticatory muscles (temporalis anterior and masseter superficialis). TMJ tenderness on palpation was assessed by applying a force of approximately 0.5 kg over the immovable condyle, and masticatory muscle tenderness was assessed with a force of about 1 kg. Attempts were made to standardize the palpation force by exerting the forces on a measuring scale between the examinations. TMJ and masticatory muscle pain on palpation was recorded if the subjects reported pain when asked or showed a protective reflex. Except for the maximum interincisal distance, all findings were recorded separately for both sides [22–23].

Data on number of teeth and denture status were obtained through clinical oral examination. To obtain the number of teeth, all teeth were counted including third molars, deciduous teeth and tooth remnants that were visible in the mouth during the examination. Information on status of removable dentures was recorded separately for both jaws and were divided into three groups: edentulous or full denture; dentate with prosthesis; or dentate, no prosthesis.

After the clinical examination, TMD pain symptoms were inquired of by using the following two questions by Nilsson et al. that have shown to be valid in assessing TMD pain [2]:

1. Do you have pain in your temples, face, temporomandibular joint, or jaws once a week or more?
2. (with answering options No/Yes) (Question 1)
3. Do you have pain when you open your mouth wide or chew once a week or more?
4. (with answering options No/Yes) (Question 2)

Sociodemographic information including gender, age, education and marital status as well as general health status was obtained by an interview in connection with the clinical health examination. The level of education was divided into three groups: basic, middle and higher. Marital status was divided into two groups: married/cohabiting and single. Self-perceived general health was divided into two groups: good/fairly good and average/fairly poor/poor.

Statistical analysis

To obtain representative results for the target population, the data analyses were performed using SAS Callable SUDAAN software (Release 11.0) to take into account the two-stage cluster sampling design and weights. The sampling weights were based on age, gender, education, physical activity, use of alcohol, use of vegetables, size of household and body mass index [24].

Chi-square tests were used to evaluate the statistical significance of associations of TMD signs with age groups stratified by gender, of TMD signs with pain symptoms, and of both TMD signs and pain symptoms with gender, age group, level of education, number of teeth, denture status, self-perceived health and marital status. Logistic regressions were used to evaluate the associations of TMD signs and pain symptoms with age, gender, level of education, number of teeth, self-perceived health and marital status.

Results

TMJ clicking was found to be the most common clinical sign of TMD, followed by maximal interincisal distance <40 mm, TMJ crepitation, muscle pain on palpation and lastly TMJ pain on palpation (Table 1). More than a third (34.6%) of the study subjects had at least one sign of TMD. Of the TMD pain symptoms, the subjects experienced weekly facial pain (Question 1) more often than weekly pain when biting or jaw opening (Question 2) (8.0% and 5.8%, respectively).

The prevalence of every measured clinical sign of TMD was at least 60.2% more common in women than in men (Table 2). Among women, limited maximal interincisal

distance, TMJ clicking and muscle pain on palpation showed the highest prevalence in the oldest age groups. Among men, TMJ crepitation and muscle pain on palpation were highest in the oldest age groups.

In the bivariate analyses, female gender had a statistically significant association with all the measured TMD signs but not with TMD pain symptoms (Table 3). Low level of education associated significantly with limited mouth opening and TMJ crepitation. Low number of teeth associated significantly with limited mouth opening, TMJ clicking and crepitation. Denture status associated with limited mouth opening and TMJ crepitation: those who were edentulous or had a full denture more often had limited mouth opening and TMJ crepitation than dentate individuals. Poor self-perceived health associated significantly with limited mouth opening and muscle pain on palpation, as well as with both of the TMD pain symptoms (Question 1 and Question 2). Single subjects had significantly more limited mouth opening as compared to married or cohabiting subjects.

Of those who had muscle pain on palpation in clinical examination, 47.5% reported also having weekly facial pain (Question 1) and 18.4% reported weekly pain when biting or

Table 1. Weighted prevalence (%) of clinical signs and self-reported pain symptoms of temporomandibular disorders (TMD) in Finnish adults ($n = 1577$) in the Health 2011 Survey.

Sign of TMD	*n* (%)
Maximal Interincisal distance <40 mm	223 (11.5)
TMJ† clicking	261 (15.4)
TMJ† crepitation	188 (9.8)
TMJ† pain	55 (2.7)
Pain in muscles	75 (4.3)
At least 1 of the 5 TMD signs	631 (34.6)
At least 1 of 4 selected TMD signs‡	489 (27.2)
More than 1 of the 5 TMD signs	142 (7.6)
More than 1 of 4 selected TMD signs‡	80 (4.4)
TMD pain symptom	*n* (%)
Question 1	116 (8.0)
Question 2	73 (5.8)

Question 1: Do you have pain in your temples, face, temporomandibular joint, or jaws once a week or more? Question 2: Do you have pain when you open your mouth wide or chew once a week or more?
†Temporomandibular joint (TMJ).
‡Maximal interincisal distance <40 mm excluded.

Table 2. Weighted prevalence (%) of clinical signs of temporomandibular disorders (TMD) by gender and age group in Finnish adults ($n = 1577$), based on the Health 2011 Survey.

	Women			Men			
	n **(%)**	Total	p^G	***n*** (%)	Total	p^G	p^A
Maximum interincisal distance <40mm	155 (14.8)	875	<.001	68 (8.0)	702	.005	<.001
≤30	5 (2.9)	62		2 (4.3)	43		
31–40y	15 (11.8)	119		3 (3.3)	98		
41–50y	28 (14.5)	206		7 (4.5)	153		
51–60y	35 (17.8)	192		19 (13.7)	160		
61–70y	37 (19.6)	178		17 (9.6)	157		
71–80y	25 (31.6)	90		17 (22.1)	73		
>80y	10 (38.2)	28		3 (16.9)	18		
TMJ† clicking	168 (18.9)	875	.215	93 (11.8)	702	.334	.474
≤30	12 (14.6)	62		5 (8.9)	43		
31–40y	30 (29.8)	119		14 (12.9)	98		
41–50y	31 (14.7)	206		16 (11.1)	153		
51–60y	37 (18.2)	192		24 (13.7)	160		
61–70y	33 (18.9)	178		28 (16.6)	157		
71–80y	20 (23.0)	90		5 (6.5)	73		
>80y	5 (20.6)	28		1 (7.2)	18		
TMJ† crepitation	126 (12.0)	875	.027	62 (7.4)	702	.038	<.001
≤30	5 (3.8)	62		3 (2.2)	43		
31–40y	15 (14.7)	119		5 (4.1)	98		
41–50y	24 (11.8)	206		12 (8.1)	153		
51–60y	28 (13.8)	192		14 (11.2)	160		
61–70y	34 (19.3)	178		16 (12.8)	157		
71–80y	16 (15.3)	90		9 (11.4)	73		
>80y	4 (14.2)	28		3 (13.5)	18		
TMJ† pain	39 (3.5)	875	<.001	16 (1.7)	702	.955	.020
≤30	1 (0.4)	62		1 (1.0)	43		
31–40y	7 (5.2)	119		3 (2.3)	98		
41–50y	14 (6.8)	206		3 (1.8)	153		
51–60y	8 (4.1)	192		3 (1.7)	160		
61–70y	4 (2.2)	178		3 (1.7)	157		
71–80y	5 (4.9)	90		2 (2.6)	73		
>80y	0 (0)	28		1 (4.7)	18		
Pain in muscles	58 (6.5)	875	.473	17 (1.9)	702	.125	.355
≤30	4 (2.9)	62		1 (1.0)	43		
31–40y	9 (7.1)	119		3 (2.9)	98		
41–50y	15 (7.7)	206		1 (0.7)	153		
51–60y	9 (4.9)	192		4 (2.1)	160		
61–70y	11 (6.0)	178		1 (0.6)	157		
71–80y	9 (17.6)	90		5 (6.5)	73		
>80y	1 (5.0)	28		2 (9.7)	18		

p-values are based on chi-square tests for associations between TMD and gender (p^G) and for TMD and age (p^A).
†Temporomandibular joint (TMJ).

Table 3. Weighted prevalence (%) of clinical signs and pain symptoms of temporomandibular disorders (TMD) by sociodemographic background, number of teeth, denture status, and self-perceived health in Finnish adults ($n = 1577$), based on the Health 2011 Survey.

	TMD signs					TMD pain symptoms	
	Mouth opening < 40 mm *n* (%)	TMJ clicking *n* (%)	TMJ crepitation *n* (%)	TMJ pain *n* (%)	Pain in muscles *n* (%)	Question 1 *n* (%)	Question 2 *n* (%)
Gender							
Male	68 (8.0)	93 (11.8)	62 (7.4)	16 (1.7)	17 (1.9)	33 (6.6)	30 (5.9)
Female	155 (14.8)	168 (18.9)	126 (12.0)	39 (3.5)	58 (6.5)	83 (9.3)	43 (5.8)
p	.001	.008	.008	.032	<.001	.187	.975
Age group							
≤30	7 (3.6)	17 (11.7)	8 (3.0)	2 (0.7)	5 (2.0)	9 (7.4)	8 (7.2)
31–40	18 (7.2)	44 (20.6)	20 (8.9)	10 (3.6)	12 (4.8)	18 (10.3)	9 (8.5)
41–50	35 (10.0)	47 (13.1)	36 (10.1)	17 (4.6)	16 (4.6)	28 (8.1)	20 (6.1)
51–60	54 (15.8)	61 (16.0)	42 (12.5)	11 (2.9)	13 (3.5)	21 (5.4)	15 (4.1)
61–70	54 (14.5)	61 (17.8)	50 (15.9)	7 (2.0)	12 (3.2)	18 (4.9)	12 (3.3)
71–80	42 (27.6)	25 (16.0)	25 (13.7)	7 (4.0)	14 (12.9)	20 (17.0)	6 (3.4)
>80	13 (30.8)	6 (16.0)	7 (13.9)	1 (1.6)	3 (6.6)	2 (4.8)	3 (8.5)
p	<.001	.474	<.001	.020	.355	.152	.504
Level of education							
Basic	72 (20.5)	52 (12.6)	35 (9.9)	11 (2.7)	28 (8.8)	29 (14.5)	20 (10.4)
Middle	53 (8.3)	83 (16.9)	53 (7.1)	16 (2.1)	22 (3.3)	36 (6.8)	22 (6.0)
Higher	95 (9.9)	123 (15.4)	98 (11.9)	28 (3.2)	25 (3.1)	51 (6.1)	29 (3.3)
p	.006	.452	.042	.347	.082	.143	.093
Number of teeth							
0	28 (30.3)	26 (23.7)	6 (5.7)	3 (2.3)	7 (6.3)	8 (7.1)	5 (5.2)
1-19	49 (21.2)	27 (11.8)	37 (18.9)	7 (3.0)	13 (5.9)	15 (7.8)	8 (3.6)
≥20	146 (9.1)	208 (15.3)	145 (9.0)	45 (2.6)	55 (4.0)	93 (8.1)	60 (6.1)
p	<.001	.015	.008	.931	.295	.932	.449
Denture status							
Edentulous or full denture	28 (30.3)	26 (23.7)	6 (5.7)	3 (2.3)	7 (6.3)	8 (7.1)	5 (5.2)
Dentate with prosthesis	42 (19.9)	30 (14.7)	32 (18.7)	7 (3.5)	12 (6.0)	10 (6.0)	6 (3.0)
Dentate, no prosthesis	153 (9.4)	205 (14.9)	150 (9.1)	45 (2.6)	56 (4.0)	98 (8.2)	62 (6.2)
p	.001	.088	.014	.860	.298	.633	.275
Self-perceived health							
Average/ fairly poor/ poor	68 (23.6)	52 (16.4)	36 (10.4)	18 (5.5)	31 (12.1)	48 (20.1)	30 (12.1)
Good/ fairly good	150 (11.1)	198 (16.7)	148 (12.1)	37 (2.9)	41 (3.1)	63 (5.4)	37 (3.4)
p	.001	.909	.393	.106	.004	<.001	.003
Marital status							
Single	73 (18.4)	67 (16.0)	59 (14.2)	15 (3.6)	19 (4.6)	31 (8.4)	26 (7.3)
Married/ cohabiting	145 (12.0)	183 (16.9)	125 (10.9)	40 (3.3)	53 (5.1)	80 (8.5)	41 (4.5)
p	.015	.706	.154	.789	.714	.949	.108

Question 1: Do you have pain in your temples, face, temporomandibular joint, or jaws once a week or more? Question 2: Do you have pain when you open your mouth wide or chew once a week or more?.
†Temporomandibular joint (TMJ).

jaw opening (Question 2) (Table 4). Of those with TMJ pain on palpation, 27.0% reported positively to Question 1 and 22.1% reported positively to Question 2. The presence of muscle or TMJ pain on palpation associated significantly with self-reported TMD pain symptoms (Question 1 and Question 2).

According to the logistic regressions (Tables 5 and 6), female gender associated significantly with occurrence of all TMD signs except for TMJ pain on palpation and also associated with weekly facial pain (Question 1). Those with poor self-perceived health had the highest odds to have TMJ pain on palpation, muscle pain on palpation, limited mouth opening or both of the TMD pain symptoms. In addition, basic or middle level of education associated significantly with occurrence of muscle pain on palpation and weekly facial pain (Question 1). Higher age in turn associated with occurrence of TMJ crepitation and lower age with weekly pain when biting or jaw opening (Question 2). Higher number of teeth associated with lower occurrence of limited mouth opening.

Discussion

In this study, approximately one-third of the subjects showed at least one clinical sign of TMD. The prevalence of TMD pain symptoms was less than one-tenth. Female gender, poor general health and low level of education increased the risk for both studied TMD signs as well as studied TMD pain symptoms. Statistically significant associations were noted between TMD signs and pain symptoms, which were inquired using the Finnish versions of the validated questions by Nilsson et al. [2].

The findings of this study are in accordance with previous studies conducted on the prevalence of TMD signs. Based on the Health 2000 Survey [5], the proportion of those having at least one TMD sign was 38% (as compared to 35% in the present study). The findings of the present study are also in accordance with another recent Finnish population-based study by Jussila et al. [15], showing 34% prevalence of TMD signs in 46-year-old study subjects born in Northern Finland [15]. Using the same validated questions by Nilsson et al. [2], they found that 19% of the subjects reported TMD-related pain, whereas the corresponding proportion was only 6–8% in the present study among this age group (40- to 50-year-olds). The clinical examination in the study by Jussila et al. was performed using a modified protocol of the newer Diagnostic Criteria for Temporomandibular Disorders (DC/TMD) [25] and the TMD diagnoses were obtained

accordingly. In contrast, in the present study TMD diagnoses were not obtained but only separate signs and pain symptoms, which may be regarded as one of the weaknesses of this study.

TMD signs are commonly more frequent than symptoms. This can partly be explained by the high prevalence of TMJ clicking, which does not necessarily relate to TMJ pathology. TMJ clicking has been shown to be common in youngsters and to fluctuate over time [26]. TMJ clicking is in addition to being a clinical sign of TMD and is also a symptom of TMD.

Table 4. Numbers and weighted prevalence (%) of self-reported temporomandibular disorders (TMD) pain symptoms (Question 1 and Question 2) by clinical TMD signs in Finnish adults ($n = 1577$), based on the Health 2011 Survey.

	Question 1		Question 2	
Signs of TMD	*n* (%)	*p*	*n* (%)	*p*
Maximal Interincisal distance <40 mm				
Yes	23 (13.6)	.143	19 (11.0)	.055
No	93 (7.3)		54 (5.2)	
TMJ† clicking				
Yes	32 (11.7)	.132	21 (8.7)	.187
No	84 (7.3)		52 (5.3)	
TMJ† crepitation				
Yes	20 (11.5)	.195	14 (7.8)	.369
No	96 (7.6)		59 (5.6)	
TMJ† pain				
Yes	15 (27.0)	.008	12 (22.1)	.007
No	101 (7.5)		61 (5.4)	
Pain in muscles				
Yes	31 (47.5)	<.001	15 (18.4)	.004
No	85 (6.2)		58 (5.3)	
At least 1 of the 5 TMD signs				
Yes	75 (12.9)	.001	46 (8.5)	.032
No	41 (5.4)		27 (4.5)	
At least 1 of 4 selected TMD signs‡				
Yes	69 (15.0)	<.001	39 (8.5)	.059
No	47 (5.4)		34 (4.9)	
More than 1 of the 5 TMD signs				
Yes	33 (27.9)	.002	23 (15.6)	.003
No	83 (6.4)		50 (5.0)	
More than 1 of 4 selected TMD signs‡				
Yes	23 (28.9)	<.001	17 (19.4)	.007
No	93 (7.0)		56 (5.2)	

Question 1: Do you have pain in your temples, face, temporomandibular joint, or jaws once a week or more? Question 2: Do you have pain when you open your mouth wide or chew once a week or more?
†Temporomandibular joint (TMJ).
‡Maximal interincisal distance <40 mm excluded.

However, information on patient self-reported TMJ clicking was not gathered in the Health 2011 Survey and was not included in this study. It should be noted that TMD diagnosis is based both on TMD symptoms as well as TMD signs according to the DC/TMD criteria [25]. Because these criteria were not published at the time of the data collection, they were not used in the present study. However, in the present study both questionnaire and clinical examination were performed, which is a strength of the study. The clinical examination gives important information regarding the condition of the masticatory structures in addition to the patient report. By comparing clinical signs with pain symptoms reported by the patient, their compatibility can be evaluated, which gives more information than the single signs. Both of the validated questions on TMD pain symptoms (Question 1 and Question 2) associated with pain in muscles and pain in TMJ on palpation. The Finnish versions of the validated questions by Nilsson et al. [2] are thus applicable to be used as one way in screening for TMD pain.

Although no TMD diagnoses could be set based on the data, the strong association between self-reported TMD pain with both muscle and TMJ pain on palpation give indication for myalgia and arthralgia diagnoses. Further, the presence of TMJ clicking may indicate disc displacement with reduction, although no information on the reciprocal clicking was gathered. Limited mouth opening, which as a typical sign of disc displacement without reduction, showed an association with self-reported pain when biting or jaw opening, thus indicating that at least some of these signs referred to this diagnosis. On the other hand, limited mouth opening may also be linked with myalgia; a study by Carlsson et al. [27] showed that myalgia was the cause of experienced locking and decreased mouth opening in more than half the patients with decreased mouth opening. The highest percentages of limited mouth opening in the oldest age group may be linked with normal aging processes. This also holds true in the case of degenerative joint disease, of which TMJ crepitation is a typical finding.

In contrast to the previous findings showing that TMD is most common among 20- to 40-year-olds [13], the present

Table 5. Association of sociodemographic factors, number of teeth and self-perceived health with clinically determined TMD signs in Finnish adults ($n = 1511$), based on the Health 2011 Survey. Logistic regression, OR = Odds ratio, 95% Confidence interval (95% CI).

	TMJ† pain			Pain in muscles			Maximal interincisal distance <40 mm			TMJ† clicking			TMJ† crepitation		
	OR	95% CI	*p*	OR	95% CI	*p*	OR	95% CI	*p*	OR	95% CI	*P*	OR	95% CI	*p*
Age (years)	0.98	0.96-1.00	.083	1.00	0.97–1.02	.750	0.97	0.95–1.00	.060	0.99	0.98–1.01	.334	1.02	1.00–1.04	.015
Male gender (ref. women)	0.5	0.2-1.0	.066	0.2	0.1–0.4	<.001	0.5	0.3–0.7	<.001	0.5	0.4–0.8	<.001	0.6	0.4–1.0	.034
Level of education (ref. higher)			.907			.002			.188			.277			.620
middle	0.9	0.5-1.8		1.9	1.0–3.7		0.8	0.6–1.2		1.3	0.9–1.9		0.9	0.5–1.4	
basic	0.8	0.4–1.8		4.0	1.8–8.6		1.3	0.8–2.0		0.9	0.6–1.4		0.8	0.4–1.3	
Married/cohabiting (ref. single)	1.0	0.5–1.9	.971	1.6	0.8–3.3	.171	0.8	0.5–1.3	.372	1.1	0.8–1.5	.442	0.8	0.5–1.2	.329
Number of teeth	1.0	1.00–1.06	.455	1.01	0.97–1.02	.617	0.97	0.95–1.00	.032	0.98	0.96–1.01	.170	1.00	0.98–1.03	.808
Poor/fairly poor/average self-perceived health (ref. good/fairly good)	2.1	1.1–4.3	.036	3.3	1.9–5.9	<.001	1.7	1.1–2.5	.020	0.9	0.6–1.4	.763	0.7	0.4–1.1	.125

†Temporomandibular joint (TMJ).

Table 6. Association of sociodemographic factors, number of teeth and self-perceived health with self-reported TMD pain symptoms (Question 1 and Question 2) in Finnish adults ($n = 1511$), based on the Health 2011 Survey. Logistic regression, OR = Odds ratio, 95% Confidence interval (95% CI).

	Question 1			Question 2		
	OR	95 % CI	*p*	OR	95 % CI	*p*
Age (years)	0.98	0.96–1.01	.138	0.96	0.94–0.99	.004
Male gender (ref. women)	0.5	0.01–0.3	.006	1.1	0.6–1.9	.746
Level of education (ref. higher)			.020			.060
middle	1.9	1.1–3.4		1.4	0.6–3.0	
basic	3.0	1.3–6.9		3.2	1.2–8.3	
Married/cohabiting (ref. single/divorced/widow	1.3	0.7–2.2	.419	0.6	0.4–1.1	.121
Number of teeth	1.03	1.00–1.06	.098	1.02	0.98–1.06	.325
Poor/fairly poor/average self-perceived health (ref. good/fairly good)	4.5	2.7–7.6	<.001	4.4	2.2–8.6	<.001

Question 1: Do you have pain in your temples, face, temporomandibular joint, or jaws once a week or more? Question 2: Do you have pain when you open your mouth wide or chew once a week or more?

study showed no significant differences in TMD pain symptoms between age groups. Further, in the present study some clinical signs such as TMJ crepitation and muscle pain on palpation increased with age in men. In women, TMJ crepitation seemed to already increase in the 30-year-olds and stayed at about the same level in the older age groups. It is possible that degenerative changes in the TMJ begin earlier in women compared to men. However, it should be noted that the number of study subjects in some age groups was quite small. In this study, TMD signs were over 60% more common among women than they were with men. The corresponding gender difference was not found in TMD pain symptoms in bivariate analyses (Table 3), but the multivariate analyses (Table 6) showed a statistically significant association between female gender and weekly facial pain (Question 1). The finding of gender differences associating with TMD pain symptoms supports the previous studies [8,12].

According to this study, TMD signs (except for TMJ noises) and pain symptoms associated strongly with poor self-perceived health, which seems to be an independent explanatory factor based on multivariate analyses. This result is supported by the study of Jussila et al. [15]. Poor general health has also been shown to be a risk factor for developing TMD [17,28]. The present study also showed that middle and basic education increased the risk for muscle pain and self-reported weekly facial pain, which also is in accordance with the study by Jussila et al. [15].

In bivariate analyses, the number of teeth associated with TMD signs (i.e. limited mouth opening, TMJ clicking and crepitation) but not with TMD pain symptoms. However, in multivariate analyses, that is, adjusted with other explanatory factors, having fewer teeth associated only with limited mouth opening. This can be partly explained by poor general health as the associations between the number of teeth and TMJ noises disappeared in the multivariate analyses. Those with fewer teeth might suffer from other medical conditions and thus have poorer self-perceived health [29]. The role of loss of occlusal support and TMJ overloading is controversial. In the previous Health 2000 Survey [30], it was found that edentulousness and complete denture wearing associated with pain-related TMD signs, especially among women. This was not noted in the later data collection in 2011, which also may be due to the lower number of edentulous subjects.

Of the masticatory muscles, only the temporalis anterior and masseter superficialis muscles were palpated in this study, separately on each side. Partly due to this, the prevalence of muscle pain on palpation might have remained relatively low, as compared to a protocol which includes also additional masticatory muscles in the examination. The palpation of these two muscles can be easily performed and reproduced. Later, palpation of these two muscles was assessed to be sufficient, based on DC/TMD criteria [25]. The prevalence of muscle pain in this present study was lower than in the study by Progiante et al. [31] conducted on the Brazilian adult population (4% vs. 19%), whereas the prevalence levels of TMJ pain are in accordance with these studies. The reason for the differences in muscle pain is most likely due to that they used the RDC/TMD protocol in which additional sites besides the temporalis and masseter muscles are palpated.

One of the strengths of this study was that a clinical examination was performed for assessment of TMD signs. Moreover, TMD pain symptoms were assessed with validated questions by Nilsson et al. 2006 [2] enabling comparisons with other studies. The representativeness of the results to the population examined (northern and southern Finland) was another strength of this population-based study. This was due to the study design (two-stage cluster sample) and the use of population weights in analyses. In addition, it was previously shown that the data representing the two areas examined in the Health 2011 Survey did not essentially differ from those representing the whole country. A limitation of the study was the low participation rate in the Health 2011 Survey. The background information on the dropouts was however available and was used in defining weights to correct population-level estimates [32]. Also, it should be noted that in the present cross-sectional study the data have been collected during one given time point, and therefore causal inferences cannot be made.

In conclusion, over a third of the population showed clinical signs of TMD and less than one-tenth reported TMD pain symptoms. These levels correspond with other population-based studies, except for masticatory muscle pain, which showed relatively low prevalence levels. Female gender and poor general health were shown to be connected to TMD signs and TMD pain symptoms and thus, an assessment of a patient's general health needs to be a part of TMD diagnosis and treatment. The validated questions used to evaluate

TMD-related pain symptoms correlated with TMD signs, especially with muscle and TMJ related pain, showing the Finnish version of the questions to be applicable for screening of TMD pain.

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Disclosure statement

The authors report no conflict of interest.

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