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Associations between craniomandibular disorders, sociodemographic factors and self-perceived general and oral health in an adult population

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Abstract

Objective. The aim of this study was to analyze the relationships between pain in the craniomandibular region and jaw dysfunction, respectively, to sociodemographic factors and self-perceived general and oral health in a middle-aged and elderly population in Västerbotten County, Sweden. ***Materials and methods.*** Six hundred individuals, 35-, 50-, 65- and 75 years old, from inland and 600 individuals from coastal areas were randomly selected in 2002. Of these, 987 individuals completed a questionnaire and 779 participated in a clinical examination. Thirty-five- and 50-year-olds together constituted a middle-aged group and the rest an elderly group. ***Results.*** Among the middle-aged, craniomandibular pain was associated with impaired general health status, signs of temporomandibular disorder (TMD) pain were associated with female gender and living alone, jaw dysfunction symptoms were associated with university degree and chewing with caution; and signs of TMD dysfunction were associated with female gender and living in the more densely populated coastal region. Among the elderly, craniomandibular pain was more common among those living in the inland region, craniomandibular pain and signs of TMD pain were associated with impaired general health status, jaw dysfunction symptoms were associated with higher education level and self-perceived impaired general health and oral health; and signs of TMD dysfunction were associated with female gender and living in the coastal region. Dental status was not associated with craniomandibular pain. ***Conclusions.*** Socioeconomic factors and impaired general state of health were related to signs and symptoms indicative of CMD. These factors may influence demand for treatment among the affected.

Key Words: *temporomandibular disorders, elderly, epidemiology, headaches, jaw dysfunction, socioeconomics*

Introduction

Craniomandibular disorders (CMD) is an umbrella term used to embrace pain and dysfunction in the jaw–face–head region [1]. Terminology has varied over time and the most commonly used term the last decades to capture musculoskeletal disorders in the jaw, face and temple region has been temporomandibular disorders (TMD). In the presented paper we have chosen to add frequently reported headaches in the analyses and, thus, chosen the term craniomandibular disorder as a heading. The etiology of CMD/TMD is considered multi-factorial, including local factors such as trauma and biomechanical loading of the temporomandibular joint and muscles of mastication, together with more general contributing aspects such as biological, psychological and social factors [2–4] summarized in a biopsychosocial model [5]. Biological issues such as age and gender seem to influence the prevalence of TMD and headaches significantly [6,7]. The explanations behind these fairly clearly observed age and gender differences remain to be identified [6]. Regarding associations between TMD and socioeconomic factors (i.e. family structure, occupation, education and financial resources), the results are not conclusive [8,9]. Impaired general state of health has in several population-based studies emerged as an important factor associated with presence of TMD [8–12]. TMD symptoms can be associated with a variety of systematic diseases, such as inflammatory [13] and hypermobility disorders [14], and can manifest as local pain conditions or as a part of general pain conditions [10,15,16]. TMD has also been associated with mood disturbances and sleep disorders [11,13], thus resembling other pain conditions and having a

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significant effect on the individual's quality-of-life [17–19].

Those affected by TMD are not homogeneous with regard to main symptom, diagnosis, co-morbidities and related disability. Therefore, differences in perceived oral health are to be expected among TMD sub-groups [18]. One major TMD cohort consists of those with predominantly pain disorders (i.e. myofascial pain, arthralgia and associated headaches) and another those with predominantly symptoms of dysfunction (i.e. TMJ sounds, TMJ locking and impaired jaw function). Based on the NIH consensus conference and several recent studies, TMD should be viewed from these two main aspects: the pain domain and the dysfunction domain [5]. Few studies have analyzed possible contributing factors to TMD from this perspective [12,20].

In Västerbotten, Sweden, surveys of oral health based on 35-, 50- and 65-year-old people done in 1990 and in 2002 with 75-year-olds added in, showed associations between dental status and some sociodemographic background factors [21]. An analysis of the influence of gender and age on headaches, pain and dysfunction indicative of TMD of the sample examined in 2002 revealed an obvious age-related pattern of symptoms, with the highest prevalence of both pain and dysfunctions in the 35- and 50-year-old samples compared to the 65- and 75-year-old samples [7]. These significant differences in distribution of symptoms indicative of TMD between middle-aged and elderly people may indicate that differences in the relative importance of socioeconomic and psychosocial factors on TMD also exist.

The aims of this study were to analyze the relationships between the domains signs and symptoms of pain in the jaw-face-head region (in the following referred to as craniomandibular region) and jaw dysfunction, respectively, to sociodemographic factors and self-perceived general and oral health in a middle-aged and an elderly population. The hypothesis was that sociodemographic factors and general and oral health are associated with signs and symptoms of pain in the craniomandibular region and/or jaw dysfunction in middle-aged and older adults.

Materials and methods

The study population was 35-, 50-, 65- and 75-year-olds living in the County of Västerbotten, Sweden. The total population in these age groups was 11 324 individuals in 2002. In each age group, 300 individuals were randomly selected from the population, half from the inland and half from the coastal regions (in total, 1200 individuals were thus included). The study included a questionnaire and a clinical examination; 987 individuals completed a questionnaire and 779 participated in a clinical examination. Details have been reported in a previous paper [7]. In the cross-sectional analysis, information was used both from clinical examinations regarding signs indicative of TMD and from responses to a questionnaire regarding headaches, symptoms indicative of TMD, sociodemographic factors and general and oral state of health.

A questionnaire, together with a pre-paid return envelope, was sent to the randomly selected individuals. It included a total of 65 items. The questions regarding symptoms in the jaw–face and head region concerned occurrence during the past 3-month period and for each question participants were asked to state the frequency on a 5-graded scale (never; a few times; once a week, several times per week; daily). The following six symptoms indicative of CMD were included: temporomandibular joint clicking or other sounds, feelings of tiredness/stiffness in the jaw region, pain in the jaw or face region, jaw locking, impaired maximal jaw opening capacity and headaches. The perceived general state of health and oral health was, respectively, stated on a single item question with a 5-graded scale (very good; fairly good; neither good nor bad; fairly bad; very bad). The answers were categorized into good (very good, fairly good), moderate (neither good nor bad) and poor (fairly bad, very bad). The returned questionnaires were read optically. Reported symptom frequency was dichotomized into those occurring with a frequency of once a week or more and those occurring less frequently. A pain domain (pain in the jaw–face–head region) was constituted to include symptoms reported to occur at a frequency of once a week or more (pain in the jaw-face region, headaches and/or feelings of tiredness in the jaws) and was used as a dependent variable in the regression analysis (Table I). A dysfunction domain (jaw dysfunction) was constituted to include symptoms reported to occur at a frequency of once a week or more (TMJ sounds, jaw locking and/or impaired jaw opening) and was used as a dependent variable in the regression analysis (Table I).

Clinical examinations were performed from September 2002 to February 2003 by four examination teams. The examinations included dental status, function of the temporomandibular joint (TMJ) and signs of muscle pain to palpation. Presence of dull clicking, sharp clicking or crepitation sounds was registered during jaw opening and closing movements; TMJ pain to palpation was assessed by palpation over the TMJ. Only palpation that elicited a clear palpebral reflex in the eye or a protection reflex was registered as a sign of TMJ pain. TMJ pain during jaw movements was registered. Maximal mandibular opening capacity was measured with the aid of a ruler as the distance in millimeters between the edges of the upper and lower incisors during voluntary maximal opening and with the vertical overbite added in. Jaw muscle pain to palpation was assessed based on

Table I. Description of dependent and independent variables. The reference used for independent variables in the regression analysis is specified first. In each row the number of included individuals is presented in Middle-aged (35 + 50 years old) and Elderly (65 + 75 years old) groups, respectively.

	Definition	Middle-aged number	Elderly number
Dependent variables			
Frequent pain in the craniomandibular region	Reported jaw/face pain or jaw tiredness or headache; ≥ once a week	No = 367	No = 426
		Yes = 119	Yes = 63
Frequent jaw dysfunction	Reported TMJ locking or TMJ sounds or difficulty to open the jaw wide; ≥ once a week	No = 418	No = 449
		Yes = 70	Yes = 37
TMD pain signs	Registered jaw muscle pain to palpation or TMJ pain to palpation or pain on jaw movements	No = 210	No = 211
		Yes = 187	Yes = 159
TMD dysfunction signs	Registered TMJ sounds or jaw opening less than 40 mm	No = 311	No = 254
		Yes = 86	Yes = 116
Independent variables			
Gender	Man (M)	255	249
	Woman (W)	236	247
Region	Inland (I)	255	257
	Coast (C)	236	239
Education	Elementary (ES)	81	356
	High school (HS)	265	88
	University (U)	140	43
Living condition	With other (WO)	415	342
	Alone (A)	69	145
Employment status	Working (Wk)	403	12
	Not working (Nwk)	82	481
Income	Level of income per month in Swedish Crowns (SEK) (2002)*	≥15 000 = 343	≥15 000 = 109
		<15 000 = 126	<15 000 = 365
Financial resources (Resources)	Able to obtain 14 000 SEK within a week	Yes = 260	Yes = 358
		No = 210	No = 113
Self-perceived general state of health during the last year (General health)	Good (Good)	368	352
	Moderate (Mod)	70	84
	Poor (Poor)	51	49
History of general arthritis	No	461	434
	Yes	20	37
Regular use of prescribed medicine	No	336	173
	Yes	155	323
Currently smoking	No	417	436
	Yes	73	49
Currently using snuff	No	359	424
	Yes	121	36
Self-perceived oral health the last year	Good (Good)	338	366
	Moderate (Mod)	102	91
	Poor (Poor)	49	30
Oral hygiene	Brushing teeth ≥ daily	475	464
Tooth brush	Brushing teeth < daily	10	20
Oral hygiene	≥ weekly	179	278
Proximal cleaning	< weekly	305	168
Regular dental health care	<2 years between examinations	387	333
	>2 years between examinations	97	117

Table I. (*Continued*).

	Definition	Middle-aged number	Elderly number
Chewing capacity of hard food	No problem (NP)	441	376
	With caution (WC)	47	118
Dental status	Number of teeth ≥ mean	305	227
	Number of teeth < mean	92	143
Occlusal supporting zones**	Eichner Index	A1 = 325	A1-B = 213
		Other = 72	Other = 157

*Year 2002.
**The Eichner classification is based on occlusal supporting zones in premolar and molar regions on each side. Class A defined as all four support zones. Class B contains three (B1), two (B2) or one (B3) support zone(s) or support in the front area only (B4). In Class C, there are no antagonist contacts between the maxilla and the mandible.

palpation of the following muscle and/or tendon sites: anterior and posterior parts and attachments of the temporal muscles; the body and origin of the masseter muscles; the area of the lateral pterygoid muscle origin; the attachment of the medial pterygoid muscles. Pain criteria were the same as for TMJ pain. The details of clinical examination have been presented in a previous paper [7]. A domain with TMD pain signs was constituted to include jaw muscle pain to palpation, TMJ pain to palpation and pain on jaw movements and was used as a dependent variable in the regression analysis (Table I). A domain with TMD dysfunction signs was constituted to include TMJ sounds and jaw opening of less than 40 mm and was used as a dependent variable in the regression analysis (Table I).

Statistical method

The data analysis was done by STATA statistical software version 10. Analysis was based on 975 individuals who answered the questionnaire and on 767 individuals who participated in the clinical examination. Owing to minor variations in missing data, the number of individuals included in the regression analysis varies. The maximum missing data in the middle age-group was for question regarding their income level (4%). In the elderly group the maximal missing data was for a question regarding frequency of using tooth picks or dental flossing (10%). The definitions of dependent and independent variables used are presented in Table I. The reference group for the related independent variables in the regression analysis is presented first in each column (Table I). Descriptive information is presented as absolute numbers in each group. Logistic regression analysis was used to estimate factors associated with the dependent variables for 35- and 50-year-olds and 65- and 75-year-olds, respectively. After applying univariate analysis for each of the included independent variables, all factors significantly associated with the dependent variable were added into a multivariate model. The results are presented as odds ratio (OR) with 95% confidence interval (95% CI). A p-value less than 0.05 was considered statistically significant.

Results

The majority of the individuals had neither frequent symptoms indicative of CMD nor related signs (Table I). The middle-aged sample reported a higher education level compared to the older one ($p < 0.001$). Almost three quarters of the participants considered their general health as good (75% and 72%, respectively), with no significant difference between age groups. A similar figure was noted for perceived good oral health (69% and 75%, respectively), with significantly ($p < 0.05$) lower prevalence in the middle-aged group. Most of the 65- and 75-year-olds (65%) used medicine on a regular basis and reported a lower income level compared to the younger sample. The majority of 65- and 75-year-olds had a reduced number of antagonist tooth contacts as measured with the Eichner index.

35- and 50-year-old sample

Univariate and multivariate models for symptoms and signs indicative of CMD pain and symptoms and signs indicative of TMD dysfunction are presented in Table II. Significant associations are indicated in italics. In total, 25% (n = 119) of 486 individuals reported craniomandibular pain once a week or more often and 47% (n = 187) of 397 individuals had one or more signs of pain at the clinical examination.

In the univariate analysis with craniomandibular pain as a dependent variable (Table II), female gender, unemployment, low income, lack of financial resources, impaired general state of health, general arthritis, regular use of medicine and perceived moderate oral health status emerged as significantly related factors. In the multivariate model only impaired general state of health remained significant.

Table II. Univariate and multivariate models present pain in the jaw–face–head region (craniomandibular pain), signs indicative of TMD pain, frequent dysfunction symptoms and signs indicative of TMD dysfunction in 35- and 50-year-olds.

	Craniomandibular pain (symptoms)		TMD pain (signs)		Jaw dysfunction (symptoms)		TMD dysfunction (signs)	
	Univariate OR (CI)	Multivariate OR (CI)	Univariate OR (CI)	Multivariate OR (CI)	Univariate OR (CI)	Multivariate OR (CI)	Univariate OR (CI)	Multivariate OR (CI)
Gender								
Men	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Women	*2.0 (1.3–3.1)*	1.6 (0.9–2.7)	*2.3 (1.6–3.5)*	*2.1 (1.3–3.2)*	*2.0 (1.2–3.4)*	1.5 (0.9–2.7)	*2.0 (1.2–3.2)*	*2.0 (1.2–3.3)*
Region								
Inland	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Coast	0.9 (0.7–1.5)	—	1.3 (0.9–1.9)	—	1.0 (0.6–1.7)	—	*2.0 (1.2–3.3)*	*1.8 (1.1–3.1)*
Education								
Elementary	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
High school	0.8 (0.5–1.5)	—	0.8 (0.4–1.4)	—	1.6 (0.7–3.7)	1.9 (0.8–4.6)	2.0 (0.9–4.8)	2.0 (0.8–4.7)
University	0.8 (0.4–1.5)	—	0.9 (0.5–1.8)	—	*2.7 (1.1–6.5)*	*2.7 (1.1–6.8)*	*2.9 (1.2–7.0)*	2.2 (0.9–5.6)
Living condition								
With other	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Alone	1.2 (0.7–2.1)	—	*2.1 (1.1–3.8)*	*2.1 (1.0–3.9)*	1.0 (0.5–2.1)	—	1.1 (0.6–2.3)	—
Employed								
Yes	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
No	*2.5 (1.5–4.1)*	0.7 (0.3–1.5)	*1.9 (1.1–3.2)*	0.9 (0.4–1.9)	1.4 (0.7–2.6)	—	1.0 (0.5–1.9)	—
Incomelmonth								
≥15 000 SEK	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
<15 000 SEK	*1.8 (1.2–2.8)*	1.5 (0.8–2.7)	*1.8 (1.1–2.9)*	1.3(0.8–2.3)	1.2 (0.7–2.1)	—	1.0 (0.6–1.7)	—
Resources								
Own savings	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
No savings	*2.1 (1.4–3.2)*	1.6 (0.9–2.7)	*1.7 (1.1–2.6)*	1.3 (0.8–2.1)	1.2 (0.7–2.1)	—	0.7 (0.4–1.2)	—
General health								
Good	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Moderate	*3.8 (2.2–6.7)*	*3.1 (1.6–5.8)*	*1.9 (1.1–3.3)*	1.8 (0.9–3.3)	*2.3 (1.2–4.3)*	1.9 (0.9–3.8)	1.1 (0.5–1.9)	—
Bad	*8.2 (4.4–15.3)*	*3.5 (1.4–17.0)*	*2.5 (1.3–4.9)*	2.2 (0.9–4.9)	*2.1 (1.0–4.4)*	1.8 (0.8–3.9)	1.1 (0.5–2.4)	—
General arthritis								
No	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Yes	*3.4 (1.4–8.4)*	1.6 (0.8–4.9)	1.9 (0.7–5.4)	—	1.5 (0.5–4.8)	—	1.7 (0.6–5.1)	—
Use of medicine								
No	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Yes	*2.3 (1.5–3.5)*	1.4 (0.8–2.4)	1.5 (0.9–2.2)	—	1.3 (0.8–2.2)	—	1.3 (0.8–2.1)	—

Table II. (*Continued*).

	Craniomandibular pain (symptoms)		TMD pain (signs)		Jaw dysfunction (symptoms)		TMD dysfunction (signs)	
	Univariate OR (CI)	Multivariate OR (CI)	Univariate OR (CI)	Multivariate OR (CI)	Univariate OR (CI)	Multivariate OR (CI)	Univariate OR (CI)	Multivariate OR (CI)
Smoking								
No	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Yes	1.3 (0.7–2.2)	—	1.5 (0.8–2.6)	—	1.5 (0.8–2.9)	—	0.7 (0.3–1.5)	—
Using snuff								
No	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Yes	1.1 (0.7–1.8)	—	0.7 (0.5–1.2)	—	0.7 (0.4–1.3)	—	0.9 (0.5–1.6)	—
Oral health								
Good	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Moderate	*1.9 (1.2–3.1)*	1.6 (0.9–2.9)	1.2 (0.8–2.1)	—	1.5 (0.8–2.7)	—	0.9 (0.5–1.6)	—
Bad	1.7 (0.9–3.2)	0.9 (0.4–2.0)	1.3 (0.6–2.5)	—	1.1 (0.5–2.6)	—	1.3 (0.6–2.7)	—
Oral hygiene								
≥ daily brushing	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
< daily brushing	0.8 (0.2–3.7)	—	0.3 (0.1–1.54)	—	0.6 (0.1–5.2)	—	0.4 (0.1–3.6)	—
Proximal cleaning ≥ weekly	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
< weekly	0.9 (0.6–1.4)	—	0.9 (0.6–1.3)	—	1.5 (0.9–2.6)	—	1.4 (0.8–2.4)	—
Dental care								
<2 years	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
>2 years	1.3 (0.8–2.1)	—	1.5 (0.9–2.5)	—	0.9 (0.5–1.8)	—	0.9 (0.5–1.7)	—
Chewing								
No problem	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
With caution	1.9 (0.9–3.5)	–	1.6 (0.8–3.1)	—	*2.3 (1.1–4.7)*	*2.2 (1.0–4.8)*	1.1 (0.5–2.5)	—
Dental status								
teeth ≥27	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
teeth <27	1.4 (0.8–2.3)	—	1.2 (0.6–2.2)	—	0.98 (0.9–1.1)	—	0.92 (0.5–1.6)	—
Occlusal supporting zones								
A1	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Other	1.6 (0.9–2.8)	—	1.1 (0.6–1.8)	—	1.8 (0.9–3.3)	—	1.3 (0.7–2.3)	—

Significant associations are indicated in bold-italic.

In the univariate analysis with signs of TMD pain as a dependent variable (Table II) the following factors were significantly associated: female gender, living alone, unemployment, low income, lack of financial resources and impaired general health status. Of these, female gender and living alone remained significant in the multivariate model.

In total, 14% ($n = 70$) of 488 individuals reported symptoms of jaw dysfunction and 22% ($n = 86$) of 397 individuals had clinical signs of jaw dysfunction. In the univariate analysis of factors related to jaw dysfunction symptoms the following were significant: female gender, university degree, impaired general state of health and reduced ability to chew hard food (Table II). In the multivariate model educational level and chewing impairment remained significant. In the univariate analysis with signs of TMD dysfunction as dependent variables the following factors were

Table III. Univariate and multivariate models present pain in the jaw–face–head region (craniomandibular pain), signs indicative of TMD pain, frequent dysfunction symptoms and signs indicative of TMD dysfunction in 65- and 75-year-olds.

	Craniomandibular pain (symptoms)		TMD pain (signs)		Jaw dysfunction (symptoms)		TMD dysfunction (signs)	
	Univariate OR (CI)	Multivariate OR (CI)	Univariate OR (CI)	Multivariate OR (CI)	Univariate OR (CI)	Multivariate OR (CI)	Univariate OR (CI)	Multivariate OR (CI)
Gender								
Men	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Women	1.2 (0.7–2.1)	—	1.4 (1.0–2.2)	—	1.6 (0.8–3.1)	—	*2.1 (1.4–3.3)*	*2.1 (1.3–3.4)*
Region								
Inland	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Coast	*0.5 (0.3–0.9)*	*0.5 (0.2–0.9)*	*0.6 (0.4–0.9)*	0.6 (0.4–1.0)	0.9 (0.5–1.7)	—	*1.7 (1.1–2.7)*	*2.0 (1.3–3.3)*
Education								
Elementary	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
High school	1.3 (0.7–2.5)	—	1.1 (0.6–1.8)	—	*2.3 (1.1– 4.9)*	*2.9 (1.3–6.6)*	0.6 (0.4–1.2)	—
University	1.2 (0.5–2.9)	—	1.8 (0.9–3.7)	—	2.1 (0.7–5.9)	1.8 (0.6–5.8)	0.5 (0.2–1.2)	—
Living condition								
With other	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Alone	1.0 (0.6–1.9)	—	0.9 (0.6–1.6)	—	1.1 (0.5–2.3)	—	1.5 (0.9–2.5)	—
Employed								
Yes	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
No	—*	—	1.5 (0.4–6.2)	—	0.9 (0.1–7.2)	—	3.8 (0.5–31)	—
Incomelmonth								
≥15 000 SK	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
<15 000 SK	1.6 (0.8–3.2)	—	1.6 (0.7–2.7)	—	0.7 (0.3–1.6)	—	*2.0 (1.1–3.7)*	1.5 (0.8–2.8)
Resources								
Own savings	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
No savings	1.1 (0.6–2.0)	—	0.9 (0.6–1.6)	—	1.3 (0.6–2.8)	—	1.1 (0.7–1.9)	—
General health								
Good	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Moderate	*3.4 (1.7–6.4)*	*3.0 (1.5–6.3)*	1.1 (0.6–1.8)	0.9 (0.5–1.7)	1.9 (0.8–4.6)	1.7 (0.7–4.2)	0.8 (0.4–1.4)	—
Bad	*6.0 (2.9–12.2)*	*4.6 (1.9–11)*	*3.0 (1.5–6.1)*	*3.0 (1.3–7.1)*	*4.3 (1.8–10)*	*3.3 (1.2–8.7)*	0.8 (0.4–1.7)	—
General arthritis								
No	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Yes	*3.7(1.7–7.9)*	1.8(0.7–4.7)	*2.1 (1.0–4.2)*	1.4 (0.6–3.1)	2.5 (0.9–6.9)	—	0.7 (0.3–1.6)	—
Use of medicine								
No	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Yes	*2.5 (1.3–4.9)*	1.9 (0.8–4.0)	1.5 (0.9–2.3)	—	2.1 (0.9–4.6)	—	1.3 (0.8–2.0)	—
Smoking								
No	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref

Table III. (*Continued*).

	Craniomandibular pain (symptoms)		TMD pain (signs)		Jaw dysfunction (symptoms)		TMD dysfunction (signs)	
	Univariate OR (CI)	Multivariate OR (CI)	Univariate OR (CI)	Multivariate OR (CI)	Univariate OR (CI)	Multivariate OR (CI)	Univariate OR (CI)	Multivariate OR (CI)
Yes	0.8 (0.3–2.1)	—	0.8 (0.4–1.8)	—	0.5 (0.1–2.1)	—	0.9 (0.4–2.0)	—
Using Snuff								
No	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Yes	1.8 (0.8–4.4)	—	1.0 (0.5–2.3)	—	0.3 (0.1–2.4)	—	0.9(0.5–1.6)	—
Oral health								
Good	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Moderate	1.5 (0.8–2.9)	1.1 (0.5–2.5)	1.1 (0.6–1.9)	0.8 (0.4–1.6)	0.7 (0.2–2.0)	0.5 (0.2–1.6)	1.1 (0.6–1.9)	—
Bad	*3.5 (1.5–8.3)*	2.1(0.6–6.8)	*2.9 (1.2–7.1)*	1.5 (0.5–4.1)	*7.3 (3.1–18)*	*3.9 (1.2–13)*	1.4 (0.6–3.2)	—
Oral hygiene								
≥ daily brushing	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
< daily brushing	0.4 (0.1–2.8)	–	0.8 (0.3–2.2)	—	1.4 (0.3–6.2)	—	1.1 (0.7–1.8)	—
Proximal cleaning ≥ weekly	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
< weekly	0.9 (0.6–1.7)	—	1.5 (0.9–2.3)	—	0.9 (0.4–1.8)	—	0.9 (0.6–1.6)	—
Chewing								
No problem	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
With caution	*1.8 (1.0–3.2)*	0.8 (0.4–1.9)	*1.7 (1.1–2.8)*	1.4 (0.8–2.5)	*2.4 (1.2–4.7)*	3.3 (0.7–4.5)	0.5 (0.1–1.8)	—
Dental care								
<2 years	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
>2 years	1.4 (0.8–2.6)	—	1.6 (1.0–2.6)	—	0.5 (0.2–1.4)	—	1.3 (0.7–2.1)	—
Dental status								
Teeth ≥14	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Teeth <14	1.3 (0.7–2.2)	—	1.5 (0.7–3.1)	—	1.35 (0.8–2.1)	—	*2.3 (1.5–3.6)*	1.6(0.60–4.3)
Occlusal supporting zone								
A1–B3	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Other	1.4 (0.7–2.5)	—	1.2 (0.8–1.9)	—	1.2 (0.6–2.5)	—	*2.2 (1.4–3.5)*	1.5 (0.6–3.7)

Significant associations are indicated in bold-italics.

significantly associated: female gender, living in the coastal region of Västerbotten and university degree. Of these, female gender and living on the coast remained significant in the multivariate model (Table II).

65- and 75-year-old sample

Univariate and multivariate models for symptoms and signs indicative of CMD regarding pain and dysfunction, respectively, are presented in Table III. In total, 13% (n = 63) of 489 individuals reported craniomandibular pain at least once a week and 43% (n = 159) of the 370 individuals had clinically registered pain signs.

In the univariate analysis with craniomandibular pain as a dependent variable, living in the inland communities of Västerbotten, self-perceived impaired general state of health, general arthritis, regular use of medicine, perceived bad oral health status and decreased chewing ability were all significantly related factors. In the multivariate model living in the inland

region and impaired general state of health remained significant (Table III).

In the univariate analysis with signs indicative of TMD pain as dependent variables the following factors were significantly associated: living in the coastal region, impaired general health status, general arthritis, self-perceived bad oral health and impaired chewing ability. Of these, impaired general health remained significant in the multivariate model (Table III).

In total, 8% (n = 37) of 486 individuals reported symptoms of jaw dysfunction and 27% (n = 116) of 370 individuals had clinical signs of jaw dysfunction. In the univariate analysis of factors related to jaw dysfunction symptoms the following were significant: high school education, impaired general state of health, perceived bad oral health and reduced ability to chew hard food (Table III). In the multivariate model high school education, impaired general state of health and perceived bad oral health remained significant (Table III). In the univariate analysis the following factors were significantly associated with signs of TMD dysfunction: female gender, living on the coast of Västerbotten, low income, dental status and occlusal stability. Of these, female gender and living on the coast remained significant in the multivariate model (Table I).

Discussion

This study indicates that female gender and lower economic status as well as self-perceived impairment of general and oral health status are associated with pain and dysfunction in the jaw, face and head region in middle-aged adults. The most consistent pattern in the total study population was the relationship between CMD and self-perceived impaired general health status, indicating that signs and symptoms of CMD should be regarded as a part of a general health problem.

Gender and age

The study confirms previous observations that women during their fertile period in life have an ~2-fold risk of incurring frequent pain in the jaw–face–head region symptoms as well as signs of TMD pain compared to men before the age of retirement [7,22,23]. In another Swedish study population, women also reported more multiple localizations of pain in neck, shoulder and arm regions compared to men [24]. The observed peak of TMD symptoms during women's fertile period in life and reduction of symptoms in later age may be related to changes in the central processing of nociceptive stimulus and reflecting a period of neuronal hyperexcitability [25]. Hormonal factors [26], different levels of sensitivity and different psychosocial roles with regard to pain expression have also been suggested for this trend [6]. Lately, the focus of interest has been on the role of genetic variation and the search for candidate genes related to development of TMD pain is an ongoing, interesting and challenging project [27]. Middle-aged women also had an ~2-fold risk of having both signs and symptoms of TM dysfunction compared to men, while only signs of TM dysfunction (i.e. TMJ sounds or impaired jaw opening) remained more common among women in the older age groups. In a previous analysis [7], presence of TMJ sounds did not differ significantly between men and women among the elderly, but impaired jaw opening did. It may, thus, be questioned whether a maximal jaw opening capacity not exceeding 40 mm should be regarded as a significant clinical sign of dysfunction in elderly women.

Socioeconomic status

Educational level, employment status, income and financial resources may in part mirror an individual's financial situation. Financial constraints can be a barrier to obtaining regular dental care and, consequently, individuals may refrain from seeking dental care [28]. A significant relationship between tooth mortality and fewer occlusal supporting zones, on one hand, and low education level, unemployment and lack of financial resources, on the other, was found in a previous analysis of this study population [21]. A poorer dentition status among Japanese adults with a lower educational level was recently reported [29], supporting a relationship between socioeconomic conditions and dental status. The relationship between socioeconomic status and TMD is, however, not conclusive. Significant associations of pain in the orofacial region have been found with both higher and lower educational levels [9]. In this study a higher educational level was associated with dysfunction symptoms in both age groups but not with CMD pain. In a large European survey, chronic pain of moderate-to-severe intensity was associated with subjects' impaired social and working lives, including loss of employment, changed responsibilities in their working lives and change of employment status, as a consequence of their pain condition [30]. In the univariate analysis several factors indicating a vulnerable economic position (unemployment, low income and no savings) were associated with both signs and symptoms of pain in the jaw, face and head region among people in the middle-aged population. The same pattern was not found among the elderly and the association ceased in the former group after the multivariate analysis. The results may still indicate that subjects with TMD are in a more vulnerable socioeconomic position, but, owing to the cross-sectional design, no conclusions can be drawn about cause and effect; for that, prospective studies are needed. The

analyses did not reveal any differences in regular (at least, biennial) dental healthcare utilization between individuals with or without signs and symptoms of TMD. In a survey of 50-year-olds a high utilization of dental care was associated with TMJ pain [8]. The authors speculated that the result might be related either to their having sought treatment related to their TMJ pain condition or to tooth fractures inflicted by bruxism. Patients with TMD disorders have been found to utilize more medical care services [31]; it may, thus, not be surprising that many referrals to TMD specialists come from physicians [32].

Residence area

The prevalence of jaw pain was statistically lower in rural compared to urban areas of Canada [22]. Johansson et al. [8] did not find any significant difference in TMJ pain in a large Swedish sample of 50-year-old people, but the prevalence of TMJ sounds was significantly higher in the rural areas. In a study from Iran, the prevalence of facial pain, TMD, disc displacement and degenerative disorders was higher in rural compared to urban areas [33]. In this study, clinical signs of dysfunction were more commonly registered in the more densely populated coastal areas of Västerbotten compared to the more sparsely populated inland communities in both age groups. In the elderly sample, however, the prevalence of craniomandibular pain was, at the same time, significantly lower in the more densely populated regions. The results regarding prevalence of TMD signs and symptoms among people living in rural compared to urban areas are, thus, not conclusive. These inconsistent results are probably related to other differences in living conditions.

Self-rated general and oral health status

Self-perceived health has been used as a valid health indicator for many years [34]. Self-rated impaired general health status was identified as one of the strongest factors associated with CMD in both age groups, confirming results in previous studies [9–11,35]. In the multivariate analysis, impaired general state of health was the only factor that remained to explain the presence of pain in the jaw–face–head region in the 35- and 50-year-olds and one of two factors among the 65- and 75-year-olds. The results also indicate a dose–response-like pattern, with a higher odds ratio with a more severe rating of their general health status. TMD pain has been related to pain conditions in other parts of the body [3,9,10,13,16,36]. In this study, general arthritis also emerged as a co-morbid condition in both age groups in the univariate models, confirming the result of a previous study [3]. In another study [11] the number of painful areas was positively associated with an increased impairment of health status, which may indicate effects from central sensitization. A self-rated impaired oral health status was associated with reported CMD pain, signs of TMD pain and reported dysfunction, especially in the elderly sample. In assessments using oral health-related quality-of-life (OHRQoL), patients with TMD have indicated high levels of related impairment [17–20]. Higher functional and psychosocial impact was observed in those with TMD pain compared to a non-pain condition (disc displacement), which still was higher than in the general population without signs or symptoms of TMD [20]. The study also found that patients with two pain-related diagnoses had significantly higher impaired OHRQoL than patients with a single diagnosis. An interpretation of the results may be that TMD should be considered a part of a general musculoskeletal health problem and handled accordingly. Since pain emerging in the trigeminal sector also may contribute to spread of pain in spinal sectors [37], it may be of both individual and societal concern to regard TMD pain also from this perspective.

Chewing and dental occlusion

One of the first epidemiological studies on mandibular dysfunction in Västerbotten was done in the early 1970s. An analysis of the subjects' reported chewing ability in relation to dental and general health [38] showed that impaired chewing ability was closely related to number of residual teeth, symptoms of mandibular dysfunction and impaired general state of health. From the early 1970s to the early 2000s the dental status among adults in Västerbotten has improved significantly [21], but still approximately one quarter of those in the elderly sample had to be cautious when chewing hard food. In a previous study, based on a Japanese population, chewing ability correlated with presence of TMJ pain, impaired mouth opening capacity and age [39]. The results from the Japanese population as well as from the previous study from Västerbotten, Sweden, are thus supported in this study, since self-reported impairment of chewing capacity was related to both signs and symptoms of CMD/TMD, especially among the elderly. In the cross-sectional analyses, dental status (i.e. number of teeth and occlusal supporting zones) did not show a significant relationship to CMD pain. The relationship to signs of TMD dysfunction among the elderly disappeared after a multivariate analysis.

Strengths and limitations

In this population-based study, participants were selected randomly in four so-called indicator ages to ensure representativeness of the population under study. Based on the presence of signs and symptoms

indicative of TMD, the sample was categorized into groups with pain in the jaw–face–head region or jaw dysfunction. The sample was also dichotomized into a middle-aged (35- and 50-year-old) and an elderly (65- and 75-year-old) group, since the distribution of symptoms was significantly different between ages. Different independent variables were applied to evaluate their relative importance for and impact on the complex nature of TMD. The chosen factors covered different aspects of socioeconomic status, living conditions, general health and oral status. The participation rate was high in the questionnaire part (82%) and fair in the clinical examination part (64%). Although some time has passed since the study was performed, we consider the results relevant and of interest in relation to issues of possible socio-economical determinants of TMD signs and symptoms at different ages. It should be recognized that some included factors are highly time-specific (i.e. levels of financial recourses and income per month) and the results should, thus, be considered with reference to the time period when the data was gathered. Since the study had a cross-sectional design, it cannot identify causal associations. Some factors that might have had some effect on TMD were not included in the analyses, since they were either reported at too low a prevalence (for women, taking oral contraceptives or other hormonal replacement) or not included in the questionnaire (other pain locations, mood disturbances and parafunctional habits).

Conclusion

Socioeconomic factors and impaired general state of health were related to signs and symptoms indicative of CMD. These factors may influence demand for treatment among the affected. Taken together, this observation implies that TMD treatment should be included in the medical healthcare payment systems.

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