

Meta-analysis of Treatment Need for Temporomandibular Disorders in Adult Nonpatients

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Aims: To determine the prevalence of treatment need for temporomandibular disorders in adult populations by meta-analysis of nonpatient studies and to investigate factors influencing temporomandibular disorder treatment-need estimates. **Methods:** Population-based and nonpatient studies of adult subjects with temporomandibular disorders published in the English language prior to July 2006 were systematically reviewed. Electronic databases (MEDLINE, CINAHL, and Science Citation Index Expanded) were searched ($n = 641$). To combine data, fixed- and random-effects meta-regression models were used. Subgroup analyses were performed to assess factors influencing treatment need estimates. **Results:** Of 676 articles identified, 17 (9,454 subjects) met the study criteria. The prevalence of treatment need for TMD in adults (95% confidence interval) was estimated to be 15.6% (10.0, 23.6) for the fixed effect model and 16.2% (11.2, 21.1) for the random-effects model. Criteria of estimating treatment need and place of study strongly influenced summary estimates of treatment need ($P < .001$). Need estimates derived from clinical TMD signs were higher than estimates based on subject-reported symptoms ($P = .010$). Estimates for younger subjects (19 to 45 years) were higher than for older subjects (46+ years; $P = .013$). **Conclusion:** The treatment need for TMD in the general adult population is substantial and varies according to definition, criteria, and age. Findings of this meta-analysis can be used for planning and allocating health-care resources. J OROFAC PAIN 2008; 22:97–107

Key words: epidemiology, temporomandibular disorders, temporomandibular joint dysfunction, treatment need

One of the greatest challenges facing health-care systems internationally is meeting the health needs of their populations with the available resources.¹ Several types of health needs exist. “Normative need” is a state defined as in need for some diagnostic or therapeutic action by a health professional. “Expressed need or demand” is felt need converted into action by persons seeking assistance, either by use of services or by a request for information.¹ According to Sheiham et al,² true treatment need may lie somewhere between the objective (ie, assessed by a dentist) and subjective (ie, assessed by the patient) treatment needs.

Temporomandibular disorders (TMD) are a group of related disorders with considerable prevalence and costs. They represent a major cause of nondental pain in the orofacial region and are considered a subclass of musculoskeletal disorders.^{3–5} Hence, it is important to estimate the need for and allocate health-care resources for TMD treatment.

Signs and symptoms of TMD are common in nonpatient adult populations.^{6,7} The range of the prevalence of TMD in a survey of epidemiologic studies was 16% to 59% for clinical signs and 33% to 86% for reported symptoms.⁸ In a meta-analysis, TMD in the population also varied widely; clinical signs were found to have a prevalence of 0% to 93%, while 6% to 93% of those surveyed reported symptoms.⁹ These high prevalences are due to inclusion of mild signs and symptoms.¹⁰ However, only 10% of the adult population reportedly suffers from TMD pain, the most striking TMD symptom.¹¹ It is well known that not all individuals reporting pain seek treatment.¹² However, treatment may be necessary to prevent the development of TMD. Therefore, prevalence figures cannot be directly assumed to be estimations of TMD treatment need.¹³

Normative TMD treatment need can be defined by professionals based upon assessment against an agreed set of criteria. A review identified estimates ranging from 1.5% to 30% for TMD treatment need.¹⁰ That report was based on a narrative review of the literature up to 1994. Because professional opinion about treatment need in general, and more specifically about TMD, depends on collective knowledge that changes over time, treatment need estimates may have changed since 1994. In addition, systematic literature reviews are superior to narrative reviews, as they summarize the evidence in a comprehensive manner rather than being based on only a selection of the published literature. They are used to help formulate policy, efficiently use available resources, establish generalizability, increase power and precision, and limit bias of the results.¹⁴

The aims of the study were to determine the prevalence of treatment need for TMD in nonpatient adult populations by a meta-analysis of the published nonpatient studies and to investigate factors influencing TMD treatment need.

Materials and Methods

Search Strategy

The present review follows guidelines of Meta-analyses Of Observational Studies in Epidemiology (MOOSE).¹⁵

A comprehensive search of several databases was performed by combining the key words “temporomandibular disorders,” “temporomandibular-joint-disorders,” “craniomandibular-disorders,” “temporomandibular-joint-dysfunction-syndrome,”

“TMD,” “CMD,” “craniomandibular dysfunction,” “temporomandibular dysfunction,” “oromandibular-dysfunction,” “facial pain,” “myofascial pain-syndromes,” “facial arthromyalgia,” and “need.”

The following databases were searched: MEDLINE (PubMed) was searched through the National Library of Medicine from 1966 to June 2006; the Cumulative Index of Nursing and Allied Health Literature (CINAHL) was searched from 1982 to June 2006; and Science Citation Index Expanded was searched through Web of Science from 1945 to June 2006. To compare the searched electronic databases, the common time interval from 1982 to June 2006 was considered.

References from review papers, meta-analyses, identified studies, and relevant books and doctoral theses available at Martin-Luther-University Halle-Wittenberg dental library were assessed to identify additional articles. In addition, the *Journal of Oral Rehabilitation* and *Journal of Orofacial Pain* were manually searched for about 10 years (1996 to June 2006) to enhance the sensitivity of the search.

Study Selection

Studies were selected for inclusion based on the following criteria:

- Full reports, published in English up to June 30, 2006. Letters, editorials, PhD theses and abstracts were excluded.
- Original research in the form of observational cohort, prevalence, and case-control studies. Clinical trials of treatment, case reports, case series, and experimental laboratory studies were excluded.
- Outcomes reported as the actual number of subjects needing TMD treatment or as a percentage of the number of subjects assessed.
- General and nonpatient adult population studies. Studies covering both adults and adolescents 10 years and older were also considered, but studies covering only adolescents (< 19 years) were excluded.
- Definitions were based on self-reported TMD symptoms and/or clinical TMD signs. Studies presenting data on other pain syndromes were excluded.

Each publication was initially assessed for relevance by using data presented in the abstract of the article. When the abstract was not available or failed to provide sufficient information, a reprint of the full paper was obtained. All abstracts were independently evaluated by 2 assessors. Each

reviewer assessed and categorized abstracts of articles as “included” or “not included” according to the aforementioned criteria. Their inter-rater reliability was estimated using the kappa statistic ($\kappa = 0.81$). In case of disagreement, the assessors discussed and decided by consensus whether to include the study. Complete articles were obtained for those in the included category. The selection process was repeated until all articles were finally categorized as included or not included.

Data Extraction

Data were extracted concerning title, author, year of publication, number of subjects participating, participation rate, population age range, percentage of participating women, sample information about population, country of study, method of investigation (postal questionnaire, telephone interview, clinical examination), criteria and definition of treatment need for TMD (clinical or patient-based), type of sampling (random or non-random), and treatment-need estimate (as a percentage). The same 2 reviewers independently extracted data from each article. Their inter-rater reliability was estimated using the kappa statistic ($\kappa = 0.94$). Extracted data were compared, and disagreement was resolved by consensus.

Assessment of Study Quality

To gain insight into the validity of the study results,¹⁵ the quality of each study was assessed using checklists designed by Downs and Black¹⁶ and Crombie.¹⁷ The data extraction form and the quality assessment form are available on request from the corresponding author.

All variables were assumed to be of equal importance to the validity of the original research and were weighted equally. Each was assigned a score of 1 if deemed adequate and 0 if deemed inadequate. An index of study quality was obtained by summing the scores of the criteria. The maximum score attainable was 19. Quality scores were grouped into low (< 12 points), medium (12 or 13 points), and high (14 or 15 points) quality groups. Treatment-need estimates were computed for each group. The meta-analytic estimates were not adjusted for the quality score.

Data Management and Analysis

To combine data, a fixed-effects model (FEM) and a random-effects model (REM) were used. Results are presented as a forest plot displaying each

study's TMD treatment need prevalence with its 95% confidence interval estimate and the FEM and REM meta-analytic estimate, including their 95% confidence intervals. A forest plot is a graphical display of results from individual studies that allows a visual comparison of trial results and examination of degree of heterogeneity among studies. As there is no generally accepted method for the meta-analytic summary of prevalences,^{18,19} beta-binomial regression models for combining estimates from individual studies²⁰ were applied. To investigate heterogeneity between studies, the variance of this beta-distribution was examined. As there were several studies yielding more than 1 estimate of the prevalence, robust sandwich standard errors (which are used to estimate the actual standard error of an estimate) were applied to calculate 95% confidence intervals (CIs) for the mean prevalence to account for the dependence of the observations. The influence of the different study characteristics (sampling type and size, residential area, place of study, etc) was submitted to random-effects meta-regression; that is, the respective factor was included as a covariate in the beta-binomial regression model.

To investigate potential publication bias, which has been shown to be a substantial potential problem in observational studies,²¹ a funnel plot²² was constructed. The presence of publication bias was judged by the *P* value for the regression line in the funnel plot.

To determine robustness of the results, sensitivity analyses were performed. First, studies were grouped according to their quality (high, medium, or low), and mean prevalences from the REM model were recalculated for each group. Second, a “leave-one-out” experiment was performed where each study was removed in turn, and the analysis was repeated to check the undue influence of a particular study.

The analyses were performed using the statistical software package SAS version 9.1.3. FEM and REM were estimated by the GLIMMIX (generalized linear models with mixed effects) procedure.

Results

Searching of electronic databases and hand-searching identified a total of 676 studies (Table 1). Of those, 47 articles were initially selected for inclusion, and the full text of these articles was evaluated. After exclusion of duplicate studies and those that did not fulfill the inclusion criteria, 17 studies (among them were 6 articles identified in the references of initially selected studies and from previ-

Table 1 Results of Electronic and Hand Search for Reports of Nonpatient Studies of TMD Treatment Need

	No. of abstracts identified	No. of abstracts selected	Unique articles identified*			
			All years		1982 through June 2006 only	
			n	%	n	%
MEDLINE (PubMed)	406	19	11	65	11	85
Science Citation Index Expanded	175	14	3	18	3	23
CINAHL	60	3	1	6	1	8
Hand-searching	35	11	6	35	2	15
Overall results of electronic and hand-searching	676	47	21		17	
Total no. of unique articles after exclusion of duplicates			17		13	

*Percentages do not add up to 100%, as the same reference could be found in several databases.

ously published reviews) were selected for inclusion in the meta-analysis. Hand-searching of *Journal of Orofacial Pain* and *Journal of Oral Rehabilitation* did not provide additional studies.

For the interval from 1982 through June 2006, MEDLINE had the highest sensitivity (85%), followed by Science Citation Index Expanded (23%), where the sensitivity was defined as the proportion of the total number of known studies identified by the search.²³

Description of Study Characteristics

A wide variation across studies regarding study settings, method and criteria used for need assessment, and definition of TMD treatment need was observed (Table 2).

The earliest year of publication was 1971 and the latest 2002. Five (29%) studies were published more than 20 years ago. Most of the studies (n = 11) were conducted in Europe, including 8 in Sweden (47%). The median study sample size was 468. The total number of subjects in this meta-analysis was 9,454. Participants' age varied from 10 to 90 years. When participants' age in a study was given as an interval, the sum of the lowest and the highest value of the age interval was divided by 2 to allow a comparison across studies. Thus calculated, participants' age varied from 19 to 78 years. Studies were then divided into 2 groups: 19 to 45 years of age, and 46 and older. The younger group contained 82% of the studies (n = 14) when the studies were categorized this way. The older group (46 to 78 years) contained the 3 remaining studies. The percentage of participants who were female ranged from 8%²⁹ to 100%.^{26,27} The median was 51%, which is close to the percentage of women in the general population in most industrialized countries. The studies were mostly performed in urban areas (83%), but 3 studies (18%)

included subjects from both urban and rural areas.^{28,30,31} Only a third of the studies (n = 6) were random samples, and response rates varied from 62% to 100% (median 86%). Twelve studies (70%) used clinical examination for their treatment need assessment, 3 studies (18%) used only self-report data, and 2 studies (12%) used both clinical examination and self-report data. Criteria and definitions for estimating treatment need varied widely:

Magnumsson et al^{24,32,36} based their estimation for TMD treatment need on the examiners' clinical experience, taking into account both clinical signs and subjective symptoms. Kutila et al³³ estimated treatment need according to a new classification system:

- Active treatment need: Moderate or severe signs and subjective symptoms of TMD that prompted the subject to seek help or designated him or her as needing care independently of other possible oral health problems, ie, TMD alone required treatment.
- Passive treatment need: Patient needed stomatognathic treatment in association with other dental care.

Conti et al³⁴ based their estimation on severity classification according to the number and frequency of positive responses to a questionnaire (moderate and severe TMD symptoms). Wanman and Wigren²⁸ used the clinical experience of 6 trained dentists. Bibb et al³⁵ based their estimation on the consensus of 2 examiners at the completion of examinations of individuals with symptoms of notable intensity or disability and Shiao and Chang²⁵ on more than 1 of these clinical signs of dysfunction: pain at the temporomandibular joints or muscles, joint noises, and limitation of jaw-opening ability. Agerberg and Inkapool³⁷ based their estimate on subjective symptoms

Table 2 Studies with TMD Treatment-Need Estimates in Nonpatient Adolescents and Adults and Their Study Characteristics

	Year	Country	No. of subjects	Prop. of women	Age (y)	Gender	Area	Sampling type	Response rate	Method	Criteria to determine treatment need	Treatment need prevalence % [95% CI]	Quality scores
Magnusson ³²	2002	Sweden	114	0.43	35	Both	Urban	Selective	0.81	Clinical	Authors' estimate	11.4 [5.6, 17.2]	14
Kuttila ³³	1998	Finland	506	0.51	25 to 65	Both	Urban	Random	0.87	Clinical	Active treatment need	09.1 [6.6, 11.6]	15
											Active and passive treatment need	57.5 [53.2, 61.6]	
Conti ³⁴	1996	Brazil	310	0.52	18 to 21	Both	Urban	Selective	1	Question	Moderate and severe TMD symptoms	06.5 [3.7, 9.2]	12
Wanman ²⁸	1995	Sweden	160	NR	35	NR	Both*	Random	0.95	Clinical	Authors' estimate	26.3 [19.4, 33.1]	12
			90		50							14.4 [7.2, 21.7]	
			108		65							06.5 [1.8, 11.1]	
Bibb ³⁵	1995	USA	429	0.58	65 to 90	Both	Urban	Selective	0.69	Clinical	Moderate and severe TMD symptoms	00.9 [0.0, 1.8]	13
Magnusson ²⁴	1994	Sweden	84	0.45	25	Both	Urban	Selective	0.62	Clinical	Authors' estimate	25.0 [15.7, 34.3]	13
Shiau ²⁵	1992	Taiwan	2033	0.43	17 to 32	Both	Urban	Selective	1	Clinical	Clinical signs of dysfunction	05.3 [4.3, 6.3]	14
Magnusson ³⁶	1991	Sweden	119	0.46	20	Both	Urban	Selective	0.88	Clinical	Authors' estimate	26.9 [18.9, 34.9]	13
Agerberg ³⁷	1990	Sweden	637	0.50	18 to 65	Both	Urban	Random	0.82	Question	Authors' estimate	14.0 [11.3, 16.7]	12
										Clinical	(subjective symptoms) Authors' estimate (objective signs)	19.0 [15.9, 22.0]	
Schiffman ²⁷	1990	USA	250	1.00	22, 23, 25	Women	Urban	Selective	0.86	Question	Subjects with SSI values equal to or greater than patients' SSI means	06.0 [3.1, 8.9]	12
Locker ³⁸	1988	Canada	677	0.56	≥18	Both	Urban	Random	0.68	Question	Reported all 3 symptoms 2 or more symptoms Problems with eating, talking, or swallowing Moderate to severe pain or other symptoms caused a great deal of bother	03.5 [2.2, 4.9] 04.0 [2.5, 5.5] 05.5 [3.8, 7.2] 09.7 [7.5, 12.0]	15
Tervonen ³¹	1988	Finland	1275	0.54	25, 35, 50, 65	Both	Both*	Random	0.80	Clinical	Moderate or severe signs of TMD	26.9 [24.5, 29.3]	14
Wanman ³⁹	1986	Sweden	264	0.48	19	Both	Urban	Selective	0.93	Clinical	Symptoms in all 3 examinations	09.1 [5.6, 12.6]	9
Solberg ⁴⁰	1979	USA	739	0.50	19 to 65	Both	Urban	Selective	0.82	Clinical	Authors' estimate	05.0 [3.4, 6.6]	12
Hansson ²⁹	1975	Sweden	1069	0.08	10 to 79	Both	Urban	Selective	0.96	Clinical	Authors' minimum estimate Authors' maximum estimate	25.0 [22.4, 27.6] 30.0 [27.3, 32.8]	9
Helkimo ³⁰	1974	Finland	321	0.51	15 to 65	Both	Both*	Random	0.81	Clinical	Helkimo's dysfunction index Dilll	22.1 [17.6, 26.7]	13
										Question	Helkimo's anamnestic index Aill	25.9 [21.1, 30.6]	
Posselt ²⁶	1971	Sweden	269	1.00	19 to 22	Women	Urban	Selective	1	Clinical	Author's estimate	20.8 [16.0, 25.7]	9

*Both urban and rural areas.

NR = not reported; selected = nonrandom; Question = self-report via questionnaire, SSI = Symptom Severity Index, Dilll = severe signs, and Aill = severe symptoms.

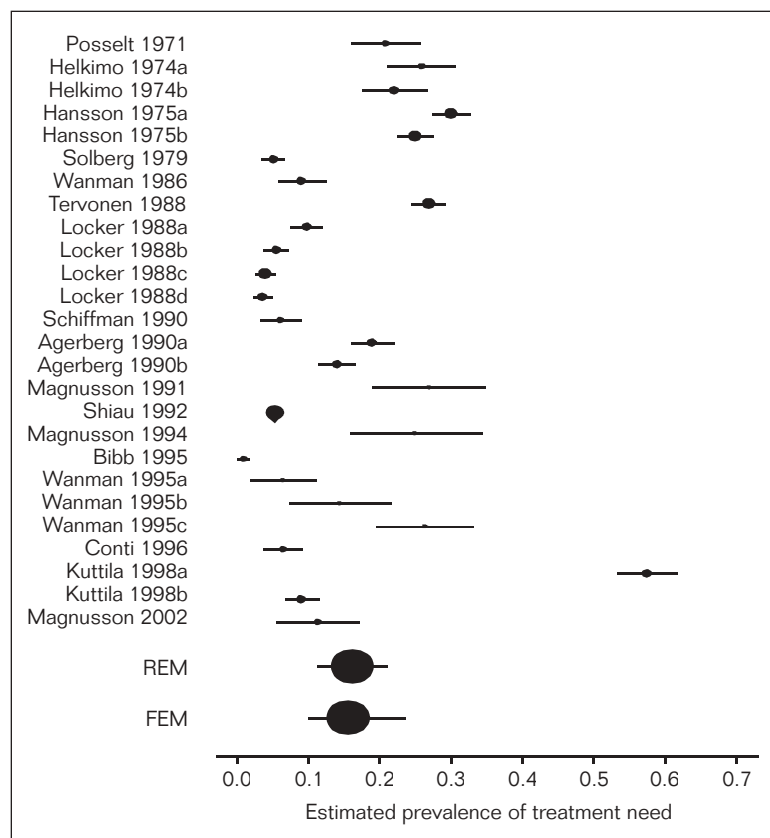


Fig 1 Forest plot of the meta-analysis summarizing individual study estimates and overall estimate of treatment need for TMD. The small letters after some dates indicate the presence of different estimates of treatment need in the same study due to use of different criteria.

and moderate and severe clinical signs. Schiffman et al²⁷ based theirs on subjects who had symptoms and signs that made them candidates for treatment relative to the level of symptoms of patients with the same diagnosis (subjects with Symptom Severity Index values equal to or greater than patients' Symptom Severity Index means). Locker and Slade³⁸ estimated treatment need if the subject reported all 3 symptoms about which he or she was questioned (pain, joint sounds, limitations in mandibular mobility), if he or she reported 2 or 3 of the problems with activities of daily living about which he or she was questioned (eating, talking, swallowing), or if he or she reported moderate to severe pain or other symptoms causing "a great deal of bother."

Tervonen and Knuuttila³¹ based their estimation on severity of clinical signs of dysfunction (moderate and severe signs of TMD) and Wanman and Agerberg³⁹ on symptoms repeated in 3 examinations. Solberg et al⁴⁰ considered subjects who had symptoms that justified treatment (authors' estimate), while Hansson and Nilner²⁹ used subjects' histories and clinical symptoms of the muscles and joints as well as dentition (authors' estimate). Helkimo³⁰ based his estimate on the presence of severe symptoms according to the anamnestic

index AiII and severe signs according to the clinical dysfunction index DiIII. Posselt²⁶ used the presence of severe symptoms (ie, symptoms of a magnitude that required treatment) as a guide (author's estimate).

Quality Assessment of the Studies

Quality scores varied from 9 points (47% of the maximum score) to 15 points (79.0%; Table 2). Three studies were considered low quality (< 12 points), 9 were considered medium quality (12 to 13 points), and 5 were considered high (14 to 15 points) quality.

Summary Estimate of the Meta-analysis and Subgroups Analyses

The prevalence of treatment need for TMD in adults (95% confidence interval) was estimated to be 15.6% (10.0, 23.6) for the fixed-effects model and 16.2% (11.2, 21.1) for the random-effects model. A third of the studies provided more than 1 treatment-need estimate (Table 2, Fig 1). The forest plot (Fig 1) showed a considerable variation of need estimates, with CIs ranging from 0.9% to 57.5%.

Visual examination of the funnel plot (Fig 2) provided minimal evidence of publication bias. The number of observations on each side of the meta-analytic average was approximately equal, and the spread around the meta-analytic average was about the same on either side. The regression line was nearly parallel to the x-axis ($P = .694$).

Treatment need estimates for TMD were stratified by study characteristics. Results of subgroup analyses are summarized in Table 3. The summary estimate of treatment need varied across categories of study characteristics.

The P values for the factors “Place of studies” and “Criteria of estimating need” were significant ($P < .001$). The factors “Participants’ age interval” ($P = .013$) and “Method of examination” ($P = .010$) also significantly influenced treatment-need estimate.

Heterogeneity between studies was observed (homogeneity test $P = .002$).

Discussion

This meta-analysis systematically evaluated 17 studies that provided prevalence figures of treatment need for TMD in adults. Treatment need for TMD was approximately 16%. The magnitude of TMD treatment need is substantial and underscores the importance of TMD as a condition of importance to public health.

A previous review reported treatment need estimates for TMD ranging from 1.5% to 30%.¹⁰ The report was based on a narrative review of the literature which included 14 studies published through 1994.⁴¹ Although the aforementioned review presented many study details, a summary estimate of treatment need was not computed. In contrast, the present investigation of the available literature was a systematic review. Interestingly, although the approaches differed in these 2 studies, the ranges of treatment-need estimates reported by Carlsson and in the present meta-analysis were similar.

Characteristics Influencing TMD Treatment Need

It could be shown that several study characteristics influenced TMD treatment need. Not surprisingly, the factors “Criteria of estimating need” and “Place of study” were found to be significant.

Due to the early interest in TMD in Scandinavia, the majority of the studies included in this meta-analysis were conducted there (especially in Sweden). Treatment estimates based on European studies were larger than those from non-European

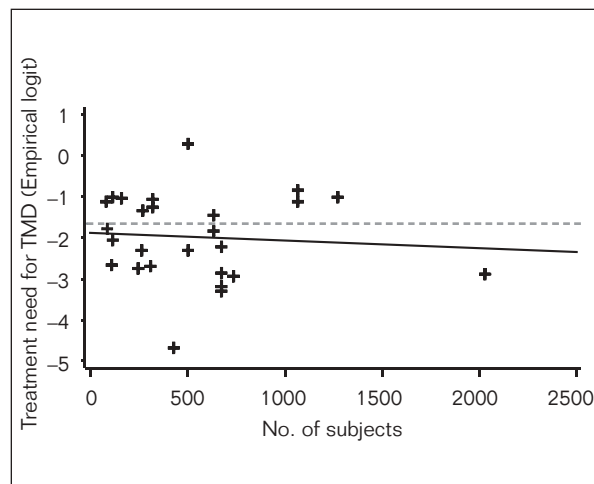


Fig 2 Funnel plot.

investigations. This finding supports the well-known fact that treatment need is a concept that is culture-dependent. Therefore, the potential to generalize the present study results to a wider range of cultures other than those included in this report may be limited.

Criteria for need estimation varied. Criteria including pain-related signs and symptoms and non-pain signs and symptoms, such as the Helkimo Index, provided higher estimates than studies that based their estimates on mainly pain-related criteria, such as the Symptom Severity Index. This suggests that the presence of pain in the temporomandibular joint and masticatory muscles is the dominant factor for treatment need, but the severity of the pain condition may also be influential. According to Rugh and Solberg,⁴² it is necessary to separate subclinical and clinical cases to find cases with reasonably severe clinical conditions for treatment. That treatment need may be divided into more than yes-no categories is reflected in a classification system proposed by Kuttilla et al.³³ These authors suggested 3 groups: active, passive, and no treatment need. “Active treatment need for TMD” denotes patients with moderate or severe signs and symptoms of TMD that prompt the individual to seek help or a patient who is estimated by the clinician as needing care independently of other possible oral health problems. “Passive treatment need for TMD” includes those with mild signs of TMD or only minor or fluctuating symptoms. The subjects in this subgroup are assessed as needing no treatment if no other dental care was considered. “No treatment need for TMD” refers to those patients whose TMD problems did not call for treatment in any circumstances.

Table 3 Summary Estimates of Treatment Need Stratified by Study Characteristics

Study characteristic/ category	No. of studies	Estimated treatment need [95% CI]	<i>P</i>
Sampling type			
Random	6	18.8 [10.9; 26.6]	.334
Nonrandom	11	13.9 [7.8; 19.9]	
Age interval			
19 to 45 years	14	19.1 [13.9; 24.2]	.013
46+ years	3	8.8 [2.6; 15.1]	
Publication interval			
2002–1993	6	17.3 [8.7; 25.9]	.167
1992–1982	7	12.2 [6.0; 18.5]	
1981–1971	4	21.2 [14.2; 28.3]	
Sample size			
< 600 (small)	11	17.5 [11.7; 23.4]	.489
≥ 600 (large)	6	14.1 [6.1; 22.0]	
Residential area			
Urban	14	14.9 [8.9; 20.8]	.145
Rural and urban	3	20.9 [15.3; 26.4]	
Response rate			
< 85%	11	13.8 [7.3; 20.3]	.336
≥ 85%	6	18.4 [11.7; 25.0]	
Gender			
Both genders	14	16.5 [10.7; 22.4]	.876
Only women	2	13.4 [3.1; 23.7]	
Not reported	1	15.7	
Method of examination			
Clinical examination	14	19.0 [13.8; 24.2]	.010
Questionnaire	5	09.3 [3.7; 14.9]	
Proportion of women			
< 50%	6	18.5 [11.0; 26.0]	.751
≥ 50%	10	15.1 [8.1; 22.1]	
Not reported	1	15.7	
Place of study			
Europe	11	21.5 [16.9; 26.1]	< .001
Other	6	5.4 [4.6; 6.1]	
Criteria used to estimate need			
Authors' estimate	8	18.3 [14.2; 22.4]	< .001
Kuttilla's definition	1	33.3	
Presence of moderate or severe	3	5.6 [5.3; 5.9]	
TMD symptoms			
Helkimo's Index	1	24.0	
Clinical signs of dysfunction	2	16.1 [1.1; 31.1]	
Symptoms in 3 examinations	1	9.1	
Symptom Severity Index	1	6.0	

The variation in need estimates may be attributable not only to differences in opinions about need but also to differences in the understanding of TMD. This situation is largely due to a lack of well-defined criteria for TMD.²⁴ However, it is obvious that treatment need for TMD should be somehow related to TMD prevalence. Unfortunately, the literature on the prevalence of TMD varies widely. A meta-analysis of 51 prevalence studies presented a wide range of results.⁹

The prevalence figures ranged from 6% to 93% for self-reported symptoms and from 0% to 93% for clinically assessed dysfunction. The mean prevalence for perceived dysfunction was 30% among 15,000 subjects; the average value for clinically assessed dysfunction was 44% among 16,000 subjects. This result is in line with the present authors' finding that need estimates based on clinical criteria were higher than estimates derived from patients' self-report.

The present study found an age influence on treatment need, which is consistent with studies in the general population that younger subjects present higher TMD prevalence than older subjects. Longitudinal findings as well as cross-sectional epidemiologic results indicate that the majority of TMD patients are between 15 and 45 years old.¹⁰ No gender influence was found. Although women represent the majority of patients in clinical treatment centers, the differences between genders in TMD prevalence are much smaller in the general population than in clinical samples. The prevalence of symptoms and signs of TMD was fairly evenly distributed between men and women in earlier studies.^{29,43–45} Later studies reported a higher prevalence among women.^{9,13,46–50}

The findings of no statistical differences for the pertinent variables of interest, eg, gender and sampling size, may be due to low statistical power because of the small number of studies identified in the literature.

It can be concluded that factors influencing TMD treatment-need estimates in this study were similar to factors affecting TMD prevalence, but it is unclear whether TMD treatment need changed over time. The first major influence of changed need over time that comes to mind would be a shift in prevalence over time. It can be hypothesized that the different prevalence estimates available in the literature reflect probably a different conceptualization of TMD and other methodologic influences, eg, the settings where the study was performed, rather than a true change over time. There is a lack of strong evidence that TMD prevalence changed over time. For example, Locker et al, who conducted telephone surveys regarding TMD pain in 1987 and 1992 in the same population^{38,51} found small differences in the TMD prevalence in adults aged 18 to 65 years who reported TMD pain (“pain in the face in front of the ear”) in the last 4 weeks (7.5% in 1987 versus 5.8% in 1992). Kuttilla⁴¹ also reported that the fluctuation of treatment need for TMD was small during a 2-year follow-up of an epidemiologic sample of 515 subjects. The “active treatment need” for TMD varied between 7% and 9%, “passive treatment need” varied from 40% to 46%, and “no treatment need” varied from 46% to 51%. Although in the present study there was a higher summary estimate of treatment need for studies published more than 20 years ago compared with summary estimate of studies published during the last 10 years, the difference was not statistically significant. When the publication year was entered as a continuous variable in the regression analysis (data not shown), *P*

almost reached the level of 5% for statistical significance. In the absence of a TMD prevalence change over time, this change in need estimates may represent a more conservative approach to TMD treatment in the scientific community; at present, some TMD signs and symptoms such as joint noises or particular jaw movement patterns may be less often considered an indication for prevention or treatment than 20 years ago.

Strengths and Limitations of the Study

Because only articles in the English language were included in the present study, a language bias could have been present; however, lack of resources precluded translation from other languages into the English language.

The MEDLINE database showed the highest search sensitivity (65%) compared to other search engines. This finding is in line with previous reports.^{14,23} However, the MEDLINE search was the least specific; the largest proportion of irrelevant articles was retrieved from this database.

Although publication bias has been identified as a potential problem in observational studies,²¹ evidence of this bias was not found in this meta-analysis.

Studies of poor quality may produce different and possibly biased results.^{52,53} Therefore, it was considered important to incorporate a quality appraisal in this review. All items used in the checklist for quality assessment^{16,17} received equal weight. Although flaws may not be of equal importance, and equal weighting may cause studies with few but important flaws (eg, a very low response rate) to be ranked among the best studies,¹⁴ the results of this meta-analysis were considered robust against influences from study quality. Some studies provided more than 1 treatment-need estimate due to the use of different criteria. However, the correlated data analysis model allowed analysis of all need estimates. Results were not dependent on the statistical method chosen for analysis. Both the fixed-effect model and the random-effect model meta-analytic estimates with their 95% CIs provided almost identical results.

Public Health Importance of the Findings

In combination with prevalence figures, treatment demand and need estimates serve to quantify the magnitude of TMD as a public health problem. In particular, treatment need data are essential for qualifying TMD in planning oral health-care programs. For example, curricula of dentists and

other health-care professionals potentially involved in the treatment of TMD patients need this information.⁵⁴ Although the provided need estimate may be useful for the allocation of health-care resources, it should be strongly emphasized that there is a substantial discrepancy between need and demand for TMD treatment.

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