Research diagnostic criteria for temporomandibular disorders: a systematic review of axis I epidemiologic findings

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Objectives. The aim of this study was to summarize and systematically review the literature on the prevalence of different research diagnostic criteria for temporomandibular disorders (RDC/TMD) version 1.0 axis I diagnoses in patient and in the general populations.
Study design. For each of the relevant papers, the following data/information were recorded for meta-analysis and discussion: sample size and demographic features (mean age, female-to-male ratio); prevalence of the assigned diagnoses; prevalence of the diagnoses assigned to the left and right joints, if available; prevalence of the diagnoses assigned to the 2 genders, if available; prevalence of the different combinations of multiple diagnoses, if available; and prevalence of TMD (only for community studies).
Results. Twenty-one (n = 21) papers were included in the review (15 dealing with TMD patient populations and 6 with community samples). The studies on TMD patients accounted for a total of 3,463 subjects (mean age 30.2-39.4 years, female-to-male ratio 3.3), with overall prevalences of 45.3% for group I muscle disorder diagnoses, 41.1% for group II disc displacements, and 30.1% for group III joint disorders. Studies on general populations accounted for a total of 2,491 subjects, with an overall 9.7% prevalence for group I, 11.4% for group IIa, and 2.6% for group IIIa diagnoses.
Conclusions. Prevalence reports were highly variable across studies. Myofascial pain with or without mouth opening limitation was the commonest diagnosis in TMD patient populations, and disc displacement with reduction was the commonest diagnosis in community samples. **(Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2011;xx:xxx)**

Temporomandibular disorders (TMD) are a heterogeneous group of pathologies affecting the temporomandibular joint (TMJ), the jaw muscles, or both.[1] They are characterized by a classically described triad of clinical signs: muscle and/or TMJ pain; TMJ sounds; and restriction, deviation, or deflection of the mouth opening path.[2] TMD are considered to be the most common orofacial pain conditions of nondental origin, but the frequent concurrent presence of other symptoms, such as earache, headache, neuralgia, and tooth pain, which may be related to the TMD or be present as ancillary findings to be assessed in the differential diagnosis process, makes the assessment of TMD prevalence a complex issue.[3]

The actual TMD prevalence at the population level is a matter of debate, owing to the lack of homogeneity in the diagnostic criteria adopted in different investigations. There is evidence that the prevalence of TMD signs and symptoms may be high in the general population.[4] Early investigations suggested that 1%-75% of general population subjects showed at least 1 objective TMD sign, and that 5%-33% reported subjective symptoms.[5,6] TMD symptoms have always been considered to have a broad prevalence peak between 20 and 40 years of age, with a lower prevalence in younger and older people.[7] For specific TMD conditions, distinct peaks were recently identified in patient populations: one around the age of 30 years for subjects with disc displacements and another over the age of 50 years for inflammatory-degenerative joint disorders.[8]

Differences in the clinical protocols used to establish TMD diagnoses may be responsible for the high variability of results between studies reported by past reviews, but the introduction of the Research Diagnostic Criteria for TMD (RDC/TMD) in 1992 was expected to increase the level of consistency between studies thanks

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to the use of standardized diagnostic criteria.[9] The RDC/TMD provide criteria for a dual-axis diagnosis, i.e., the patient receives a physical diagnosis (axis I) along with a psychosocial assessment (axis II). Data-gathering with the use of RDC/TMD has been suggested to be a fundamental step to enable comparing findings from different studies for epidemiologic purposes and to obtain suggestions for the implementation of RDC/TMD usefulness in the clinical setting.[10] Even though the need for an update of the RDC/TMD has already been proposed,[11] a systematic assessment of findings from epidemiologic studies adopting the RDC/TMD version 1.0 since the time of their introduction was never performed.

In view of these considerations, the present manuscript aims to summarize and systematically review the peer-reviewed literature on the prevalence of different RDC/TMD axis I diagnoses in TMD patients and in the general populations.

MATERIALS AND METHODS

Search strategy

On March 7, 2010, a systematic search in the National Library of Medicine's Pubmed Database was performed to identify all peer-reviewed papers in the English-language literature using the RDC/TMD to assess the prevalence of axis I diagnoses.

The search strategy consisted of 4 steps: 1) a word terms search within Pubmed; 2) a search within Pubmed to articles related to the selected ones; 3) a search within the reference lists of the selected articles; and 4) a manual search within some selected English-language peer-reviewed journals in the dentistry, TMD, and orofacial pain fields (*Journal of Dental Research*; *Journal of Orofacial Pain; Journal of Dentistry*; *Journal of Oral Rehabilitation*; *International Journal of Oral and Maxillofacial Surgery*; *Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontics*; *Journal of Oral and Maxillofacial Surgery*; *Journal of the American Dental Association*; *Acta Odontologica Scandinavica*; *Journal of Craniomandibular Practice*; and *Minerva Stomatologica*) and within 3 journals' publishers' website search engines (Elsevier, Wiley-Blackwell, and Springer). The search strategy provided that 2 authors performed the first 2 steps, and independently assessed the eligibility of papers for inclusion in the review. The other authors contributed to the expansion of the search strategy in the third and fourth steps, and each of them also contributed a manual search in their own university library catalogs. Data extraction from the selected studies was performed by the same 2 authors, and the strategies adopted for data management (e.g., data extraction, tables formatting, data pooling, and statistical procedures) were carefully checked by the other authors to minimize bias during data extraction and review. In any case of disagreement, decision was reached by consensus of the majority of authors.

The first step of the literature search used the combined word terms "research diagnostic criteria" and "temporomandibular disorders" to identify the potential papers to be included in the review. Limits were set for language (English) and for publication date (later than Dec. 31, 1992). Such a search strategy provided a list of 236 citations, the abstracts of which were read to select articles to be retrieved in full text. The inclusion of papers in the review was based on the type of study, i.e., studies adopting the RDC/TMD to assess the prevalence of TMD diagnoses in consecutive series of either TMD patients or community populations of adults. After reading the abstracts, 44 papers were thus retrieved and read in full text.

Then, searches within Pubmed to articles related to each of the included papers and within the reference lists of the included paper were performed. Five more papers were thereby identified. No additional potentially interesting papers were identified by searching within the selected journals' and publishers' databases. Thus, a total of 49 articles were read in full text, 21 of which were found to be relevant to the present systematic assessment's aim. The reasons for the exclusion of the remaining papers[12-42] are listed in Table I.

Data recorded from the selected studies

For each of the included studies, the following data/information were recorded for meta-analysis and discussion: size and demographic features of the sample (mean age, female-to-male ratio); prevalence of the assigned diagnoses; prevalence of the diagnoses assigned to the left and right joints, if available; prevalence of the diagnoses assigned to the 2 genders, if available; prevalence of the different combinations of multiple diagnoses, if available; and prevalence of TMD (only for community studies).

Definition of RDC/TMD axis I diagnoses

In accordance with RDC/TMD version 1.0,[9] patients may receive ≥ 1 of the following group diagnoses: muscle disorders (group I); disc displacement (group II); and arthralgia, osteoarthritis, or osteoarthrosis (group III); the diagnostic criteria of which are given in Table II.

Meta-analysis of data

The strategy to present data were not consistent among the selected studies. Group diagnoses were reported in 14/15 studies on TMD patient populations for group I, in 5/15 for group II, and in 4/15 for group III.

Table I. Excluded papers after full-text reading and main reason for exclusion

Study's first author and year	*Reason for exclusion*
Lim (2010)[12]	No specification of RDC/TMD diagnostic groups
Schiffman (2010)[13]	Selective recruitment of patients
Gharaibeh (2009)[14]	Patient population limited to subjects with gastroesophageal reflux disease
Pereira (2009)[15]	Investigation on adolescents
Gurbuz (2009)[16]	No specification of RDC/TMD diagnostic groups
Cunali et al. (2009)[17]	Patient population limited to subjects with obstructive sleep apnea
Naeije (2009)[18]	No specification of RDC/TMD diagnostic groups
Weingarten (2009)[19]	No specification of RDC/TMD diagnostic groups
Hasanain et al. (2009)[20]	No specification of RDC/TMD diagnostic groups
Wiese (2008)[21]	Nonconsecutive sample
Khoo (2008)[22]	Language validation study without epidemiologic purposes
Reissmann (2008)[23]	No specification of RDC/TMD diagnostic groups
Ballegaard et al. (2008)[24]	Small and nonrepresentative sample
Storm (2007)[25]	No specification of RDC/TMD diagnostic groups
Glaros, Urban and Locke (2007)[26]	Incomplete RDC/TMD assessment
John (2006)[27]	Language validation study without epidemiologic purposes
Casanova-Rosado[28]	Study sample consisted of adolescents and young adults
Lobbezoo (2005)[29]	Language validation study without epidemiologic purposes
John (2005)[30]	No specification of RDC/TMD diagnostic groups
Plesh et al. (2005)[31]	Selective recruitment of population based patients
Rantala (2004)[32]	Follow-up study on a sample described in[33]
Yap (2004)[34]	Only RDC/TMD axis II data
Yap (2004)[35]	Only RDC/TMD axis II data
Rammelsberg et al. (2003)[36]	Follow-up study on a sample described elsewhere[37]
Huang (2002)[38]	Duplication data[37]
List (2001)[39]	Investigation on adolescents
Phillips (2001)[40]	No specification of RDC/TMD diagnostic groups
Epker (2000)[41]	No specification of RDC/TMD diagnostic groups
Epker (1999)[42]	No specification of RDC/TMD diagnostic groups

Subgroup diagnoses were reported in 10/15 studies for group I, and in 5/5 studies for groups II and III. The percentage of affected joints for each of the group II and III diagnostic subgroups was described in 6/15

Table II. RDC/TMD criteria for axis I diagnoses[9]

Group I: muscle disorders

Ia. Myofascial pain:

- Report of pain or ache in the jaw, temples, face, preauricular area, or inside the ear at rest or during function;
- Pain reported by the subject in response to palpation of ≥3 of the following muscle sites (right side and left side count as a separate sites for each muscle): posterior temporalis, middle temporalis, anterior temporalis, origin of masseter, insertion of masseter, posterior mandibular region, submandibular region, lateral pterygoid area, and tendon of the temporalis;
- At least one of the painful sites must be on the same side as the complaint of pain.

Ib. Myofascial pain with limited opening:

- Myofascial pain as defined in Ia;
- Pain-free unassisted mandibular opening <40 mm;
- Maximum assisted opening (passive stretch) ≤5 mm greater than pain-free unassisted opening.

Group II: disc displacements

IIa. Disc displacement with reduction:

- Reciprocal clicking in TMJ (click on both vertical opening and closing that occurs at point ≥5 mm greater interincisal distance on opening than closing and is eliminated on protrusive opening), reproducible on 2 out of 3 consecutive trials; or
- Clicking in TMJ on both vertical range of motion (either opening or closing), reproducible on 2 out of 3 consecutive trials, and click during lateral excursion or protrusion, reproducible on 2 out of 3 consecutive trials.

IIb. Disc displacement without reduction with limited opening:

- History of significant limitation in opening;
- Maximum unassisted opening ≤35 mm;
- Passive stretch increases opening by ≤4 mm over maximum unassisted opening;
- Contralateral excursion <7 mm and/or uncorrected deviation to ipsilateral side on opening;
- Absence of joint sound or presence of joint sounds not meeting criteria for disc displacement with reduction.

IIc. Disc displacement without reduction, without limited opening:

- History of significant limitation of mandibular opening;
- Maximum unassisted opening >35 mm;
- Passive stretch increases opening by ≥5 mm over maximum unassisted opening;
- Contralateral excursion ≥7 mm;
- Presence of joint sounds not meeting criteria for disc displacement with reduction;
- In those studies allowing images, imaging conducted by either arthrography or magnetic resonance reveals disc displacement without reduction.

Group III: arthralgia, osteoarthritis, osteoarthrosis

IIIa. Arthralgia:

- Pain in one or both joint sites (lateral pole and/or posterior attachment) during palpation;
- One or more of the following self-reports of pain: pain in the region of the joint, pain in the joint during maximum unassisted opening, pain in the joint during assisted opening, and pain in the joint during lateral excursion;
- For a diagnoses of simple arthralgia, coarse crepitus must be absent.

IIIb. Osteoarthritis of the TMJ:

- Arthralgia as defined in IIIa;
- Either coarse crepitus in the joint or radiologic signs of arthrosis.

IIIc. Osteoarthrosis of the TMJ:

- Absence of all signs of arthralgia;
- Either coarse crepitus in the joint or radiologic signs of arthrosis.

studies, one of which reported only subgroup IIa and IIIa diagnoses. In the general population studies, 5/6 papers reported the prevalence of subgroup Ia diagnoses, 3/6 papers reported IIa diagnoses, and 2/6 reported the prevalence of all possible diagnostic subgroups. Data from studies adopting the same strategy to report findings (i.e., prevalence of either group diagnoses, subgroup diagnoses, or percentage of affected joints) were pooled together to provide a meta-analysis of findings and to assess the overall prevalence of axis I diagnoses. Thus, the total number of subjects to which the overall prevalence data are referred was different from the total sample and was specified for each single diagnosis.

RESULTS

Fifteen of the included papers were based on patient populations,[7,8,43-55] and 6 dealt with data gathered from community samples.[33,56-60] The studies on patients referred to populations of Italians,[8,49,51,53] Israeli,[43,44,50] Chinese,[46,52,54] USA Americans,[37,55] Germans,[47,48] Swedes,[37] and Brazilians,[45] and the studies on general populations were performed on Swedes,[56,58] Germans,[57,60] Finns,[33] and USA Americans.[37]

The 15 studies on TMD patients accounted for a total of 3,463 subjects (1,836 women, 553 men, 1,074 unspecified gender, female-to-male ratio 3.3), with a mean age ranging between 30.2[55] and 39.4[46] years. The prevalence of the different axis I diagnoses was quite variable among studies, with a range of 9.2%[46]-50.6%[45] for group Ia diagnoses, 1.9%[49]-48.3%[46] for group Ib, 20%[50]-44.2%[47] for group IIa, 0[45]-12.8%[44] for group IIb, 0[50]-8.1%[44] for group IIc, 13%[48]-58%[50] for group IIIa, 2%[48]-55.6%[50] for group IIIb, and 0%[46]-11.3%[50] for group IIIc (Table III).

Meta-analysis of the data showed that the overall prevalence was 45.3% (1,400 patients out of 3,091 for whom data were available) for group I diagnoses, 41.1% (414/1,006) for group II, and 30.1% (233/740) for group III. The most prevalent subgroup diagnoses were Ia (34% of 2,351 patients with available data), IIa (41.5% of 824), and IIIa (34.2% of 824; Table IV). Some studies reported the prevalence of group II and III diagnoses per joint and per side (Table V).

The 6 studies on general populations accounted for a total of 2,491 subjects (1,815 women, 676 men, mean age range 23.4[56]-46[33] years). The study design was quite variable among studies, and only 2 papers reported prevalence data for all specific axis I diagnoses.[56,33] Prevalence ranges were 6%[58]-13.3%[33] for axis I diagnoses, 8.9[56]-15.8[33] for group II, and up to 8.9%[56] for group III (Table VI). Meta-analysis of the data showed an overall 9.7% prevalence (155/1,598 patients from 5 studies) for group Ia, 11.4% (136/1,190, 3 studies) for group IIa, and 2.6% (8/297, 2 studies) for group IIIa diagnoses.

DISCUSSION

Since the time of their introduction, the RDC/TMD have been used to classify TMD patients according to their physical diagnosis (axis I) and pain-related disability and psychologic status (axis II).[9] The RDC/TMD provide researchers and clinicians with a standardized system that can be used for examining, diagnosing, and classifying the most common subtypes of TMD. One of the primary aims of this classification system was to implement diagnostic standardization and to enable cross-population comparison between different investigations to increase knowledge on TMD epidemiology and to avoid confusion generated by the use of multiple terms to indicate the same disorders. The International RDC/TMD Consortium[61] supported the translation of the diagnostic criteria into more than 20 languages, some of which appeared in peer-reviewed journals,[21,26,28] thus allowing the widespread use of the RDC/TMD to conduct clinical research.

The reliability and validity of the diagnostic techniques included in the RDC/TMD protocol have recently been critically appraised[10,13,18,43,62-64] to create a solid basis for an updated version of the diagnostic criteria to be used in both research and clinical settings.[11,65] The present systematic assessment of the literature was performed to summarize data gathered over the years for epidemiologic purposes using RDC/TMD version 1.0.

From a methodologic viewpoint, it should be noted that inclusion in the present review was based on the type of the study, and that inclusion was enlarged to studies assessing the prevalence of RDC/TMD axis I diagnoses in series of consecutive patients attending TMD clinics. Such an approach may not be the most suitable to perform reviews at the highest level, as suggested by some guidelines for the assessment of methodologic quality of systematic reviews,[66] but it accomplished the intention to gather as many data as possible on the argument. Inclusion was limited to English-language literature included in PubMed, which is the most comprehensive medical database, and then expanded as described in Materials and Methods. However, this strategy did not exclude the possibility that some publications in other languages and/or publications included only in other databases were unjustly excluded and should be considered in future reviews. Publication bias, i.e., the likelihood that negative findings on the outcome of a particular treatment may be published less frequently than positive ones, did not represent a problem given the nature of the issue under review, which is supposedly free from conflicts of

Table III. Systematic review of epidemiologic studies adopting the RDC/TMD axis I in TMD patient populations

Study's first author and year	Sample	Single diagnosis								Multiple diagnosis			
		Group I		Group II			Group III						
		Ia	Ib	IIa	IIb	IIc	IIIa	IIIb	IIIc	I + II	I + III	II + III	I + II + III
Manfredini (2010)[8]	n = 199; m.a. 37.7 ± 17.1; M:F 1:5	42.2%	7.5%							—	—	—	—
Winocur (2010)[43]	n = 372												
Winocur (2009)[44]	n = 298; F = 78%	47%	18%	36.2%	12.8%	8.1%	14.1%	6.4%	2.9%	—	—	—	—
Barros (2009)[45]	n = 83; m.a. 36.5 ± 13.5; M:F 1:4.9	50.6%	26.5%		0					—	—	—	—
Lee (2008)[46]	n = 87; F = 77 (m.a. 39.3 ± 12.7); M = 10 (m.a. 39.4 ± 14.3)	9.2%	48.3%							—	—	—	—
John (2007)[47]	n = 416; m.a. 37.4 ± 16.2; F 79%	27.4%	21.4%	44.2%	6.3%	4.8%	33.2%	3.6%	3.4%	—	—	—	—
Reissmann (2007)[48]	n = 293	19.4%	11.3%	43.3%	5.8%	2.4%	13%	2%	2.7%	—	—	—	—
Manfredini (2006)[49]	n = 377; m.a. 38.8 ± 15.7; M = 101; F = 276	36.9%	1.9%							4.2%	12.2%	16.5%	13.3%
Reiter (2006)[50]		IA 50%; IJ 46.1%	IA 32%; IJ 23.1%	IA 20%; IJ 32.3%	IA 2%; IJ 1.5%	0	IA 58% IJ 53.8%	IA 12%; IJ 53.8%	IA 8%; IJ 13.8%	—	—	—	—
Manfredini, 2004[51]	n = 285; m.a. 40 ± 12.5; F:M 3.1:1	50.2%		38.6%; R. 22.8%, L. 19.3%, RL 3.5%			50.2%; R. 27.4%, L. 30.2%, RL 7.4%			5.6%	14.7%	9.5%	11.9%
Yap (2003)[52]	n = 191; F = 138 (m.a. 34.8); M = 53 (m.a 30.6)	19.6%	9.4%			0		0	0	—	—	—	—
		11.5%	21.7%							—	—	—	—
Manfredini (2003)[53]	n = 212; m.a. 34.7; M = 68; F = 144	13.6%			26.9%			9.4%		7.5%	14.1%	14.1%	14.1%
Yap (2002)[54]	n = 117; m.a. 33.3 ± 10.3	26.5%			29.9%			12.8%		6%	13.7%	4.3%	6.8%
Rudy (2001)[55]	n = 126; m.a. 30.2 ± 7.9; M = 29; F = 97	75.4%			31.1%			35.7%		—	—	—	—
List (1996)[37]	n = 82 Swedish (S); n = 210 USA (A)	S 50% A 46%	S 26% A 30%		0%-4%			0%-6%		—	—	—	—

m.a., Mean age, years; *M,* male; *F,* female; *R,* right (joint); *L,* left (joint); *IA,* Israeli Arab; *IJ,* Israeli Jewish; *RL,* bilateral (joints).

Table IV. Meta-analysis of findings from TMD patient populations studies: overall prevalence of the different RDC/TMD axis I diagnoses

RDC/TMD diagnosis	*Prevalence*	*No. of studies (patients)*
Group I	45.3%	14 (3,091)
Ia	34%	10 (2,351)
Ib	12.6%	10 (2,351)
Group II	41.1%	5 (1,006)
IIa	41.5%	4 (824)
IIb	5.5%	4 (824)
IIc	6.2%	4 (824)
Group III	30.1%	4 (740)
IIIa	34.2%	4 (824)
IIIb	9.8%	4 (824)
IIIc	5.3%	4 (824)

Table V. Meta-analysis of findings from TMD patient populations studies reporting the RDC/TMD axis I group II-III diagnoses per joint

RDC/TMD diagnosis	*Prevalence*	*No. of studies (joints)*
IIa	31.8%	8 (3,055)
IIb	5.6%	7 (2,471)
IIc	3.6%	7 (2,471)
IIIa	22.6%	8 (3,055)
IIIb	8.2%	7 (3,055)
IIIc	5.5%	7 (3,055)

interests. It should also be borne in mind that redundancy concerns, i.e., duplication studies on the same study populations, cannot be ruled out, owing to the relatively few groups involved in this clinical research field, some of them contributing with multiple papers on populations of different size.[43,44,47-51]

The reviewed literature suggested that treatment-seeking populations of TMD patients are mainly composed of women, with a 3.3 ratio between genders. Such an observation is in line with the gender distribution of other painful musculoskeletal disorders showing a female predominance.[67] The mean age of patients was in the 30-40-years range for all of the reviewed studies, which is in line with reports from early comprehensive reviews.[6,7] Demographic features of the subsamples represented by patients included in the different diagnostic subgroups could not be extrapolated, and the hypothesis that age differences between patients affected by disc displacements and those affected by degenerative joint diseases are significant could not be tested.[8]

Muscle disorders were the most frequent axis I diagnosis in patients populations, with slightly fewer than one-half of the patients (45.3%) fulfilling the criteria for myofascial pain with or without limited mouth opening. An unspecific group II disorders diagnosis

Table VI. Systematic assessment of epidemiologic studies adopting the RDC/TMD axis I in general populations

Study's first author and year	*Sample*	*TMD prevalence*	*Single diagnosis*								
			Group I		*Group II*			*Group III*			
			Ia	*Ib*	*IIa*	*IIb*	*IIc*	*IIIa*	*IIIb*	*IIIc*
Abrahamsson (2009)[56]	n = 56; m.a. 23.4 ± 7.4; M = 23; F = 33	32.1%	7.1%	0	8.9%	0	0	8.9%	0	3.6%
Hirsch (2008)[57]	n = 893; m.a. 40.6 ± 11.7; M = 387; F = 506	14%	Group I + group IIIa: 2.8%; Group IIa: 11.2%							
Marklund (2008)[58]	n = 371; m.a. 23 (range 18-28); M = 142; F = 229	—	6%	—	—	—	—	—	—	—
Janal (2008)[59]	n = 779; F 100%	—	10.5%	—	—	—	—	—	—	—
Schmitter (2007)[60]	n = 151; m.a. 31.0 ± 18.8; F 100%	—	9.9%	—	—	—	—	—	—	—
Rantala (2003)[33]	n = 241; m.a. 46 ± 7; M 52%	27% (M 16%, *F* 38%)	12.9%	0.4%	15.8%; R 9.1%, L 10.8%	0	0	1.2%; R 0.4%, L 0.8%	0.4%; R 0, L 0.4%	2.4%; R 1.2%, L 1.2%

Abbreviations as in Table III.

was assigned to 41.1% of patients, the large majority of which received a diagnosis of disc displacement with reduction (41.5%). Inflammatory-degenerative disorders (group III) were diagnosed in about one-third of patients (30.1%), with arthralgia being the most frequent diagnosis (34.2%).

In the general population studies, the findings of the different papers were not reported according to a same strategy. Only 2 studies reported the prevalence of each subgroup diagnosis, thus limiting the possibility to discuss the findings in the general population in depth.[33,56] Nevertheless, the pattern of diagnosis distribution seems to suggest that inflammatory-degenerative (group III) disorders are uncommon in the general population, and that myofascial pain (6%-12.9%) and disc displacement with reduction (8.9%-15.8%) are the most frequent diagnoses. The general population data had all been gathered on caucasian subjects, and any conclusions on the potential role of the geographic region, age, race, and gender as risk factors cannot be drawn, owing to the paucity of studies.

These findings are open to several interpretations, and some recommendations for the design of future studies can be suggested. First, it should be noted that, although one of the purposes underlying the development of the original RDC/TMD publication[10] was the implementation of cross-cultural data gathering and comparison, the number of papers adopting the RDC/TMD to describe the prevalence of the different TMD-related diagnoses was surprisingly low and, with the exception of a single 1996 paper, they cover the years between 2001 and 2010. A recent paper pointed out that the word search term "temporomandibular disorders" in the Pubmed database yielded more than 12,000 citations, and that it took almost a decade before the number of papers adopting the RDC/TMD grew up to approximately 20 papers per year.[68] Thus, a further increase in the diffusion of the use of the RDC/TMD in peer-reviewed journals may be reasonably considered to be a goal for the future.

Second, the studies included in the present review are partially inconsistent regarding the strategy adopted in data description. In particular, group II and III diagnoses were reported either in terms of the percentage of patients who received the diagnosis, or in terms of the side of the joint(s) affected by the disorder. Such a different approach prevented performing a meta-analysis of data on a large overall sample as in the case of muscle disorders. However, it should be noted that the prevalence of joint disorder diagnoses seems to be quite similar between studies adopting the 2 approaches. In any case, in view of these considerations, it is recommended that future studies pursue homogeneity of data reporting strategies, because knowledge is yet to be improved on many aspects of joint disorders (e.g., relationship between pathologies of the 2 sides, prevalence of bilateral vs. unilateral disorders, etc.). Also, the problem of the difficult clinical discrimination between anterior disc displacement and symptomatic hypermobility as underlying cause for TMJ clicks should be taken into consideration in future studies to avoid overdiagnosing anterior disc displacement.[18,69]

Third, the majority of data came from only a few research groups and refers to investigations performed on populations recruited in only a few countries. It cannot be excluded that, when not specified by the studies' authors, some of the studies' populations may be partially overlapping, thus carrying the risk of some data overrepresentation in the overall sample. Some interesting differences emerged between investigations. The psychosocial pattern of patients with a treatment-seeking behavior in relation to gender, ethnic, social, cultural, and economic factors as well as diversities in the national health care systems have to be regarded as a potential explanatory factor for such country-to-country differences. A recommendation for the future is that more research be performed at a multicenter level to achieve a full international spectrum of TMD epidemiology and to provide a rationale for the different representation of TMD diagnostic subgroups.

Despite these considerations and recommendations, it is plausible that the present systematic review represents another fundamental step for a critical appraisal of the RDC/TMD literature on the way toward their revision and clinical use. A major point of criticism raised against RDC/TMD version 1.0 was the overrepresentation of muscle versus joint palpation sites, which may lead to a parallel overrepresentation of muscle disorder diagnoses.[10] Moreover, despite the original RDC/TMD publication allowing the use of diagnostic deepening via imaging techniques (specifically, computerized tomography and plain tomography), it appears that it was used only in a minority of studies. In line with suggestions from recent RDC/TMD validation project data reports,[13,64,70] studies using a combined clinical and radiologic diagnosis found a higher prevalence of group III (inflammatory-degenerative) disorders compared with diagnoses based on clinical criteria alone. Also, one study reported that in almost 90% of the patients finally diagnosed as suffering from degenerative TMJ disease, the clinical examination did not support the group III diagnosis, because no coarse crepitus was found.[43] Such observations are likely to explain the higher prevalence of muscle versus joint disorders in the majority of the reviewed studies. Otherwise, the widespread use of imaging techniques as the standard of reference for the detection of TMJ disorders, and the introduction of magnetic resonance-based criteria for

the diagnosis of disc displacement, might lead to the opposite problem, i.e., an overdiagnosis of clinically silent disc position "abnormalities," which is a well known problem for all researchers investigating the relationship between clinical findings and MR images,[18,62,71] to the point that the purported criterion standard status of magnetic resonance is a much-debated issue.[72] Also, the issue of social and biologic costs related to the routine use of imaging techniques to diagnose TMD has to be weighed, along with the risk of forcing some investigators to abandon the use of the RDC/TMD owing to the peculiarity of each national health care system regarding availability of resources. It can be suggested that a clinically oriented decision-making process for the adoption of updated criteria is likely to benefit from a critical weighting of the pros and cons related with the risk for overrepresentation of either muscle or joint disorders.

It should be recognized that the efforts made by the International RDC/TMD Consortium over the years have led to increased knowledge about TMD epidemiology and to a much more standardized approach to TMD diagnosis. In the present systematic review, myofascial pain was the commonest diagnosis in the overall sample of >3,000 TMD patients taking part to the included studies. Some differences in the prevalence data between studies were detected, mainly regarding the diagnoses of joint disorders (group II and III), which showed the widest range of prevalence values. Such data are likely to be partly explainable with the low reliability of some RDC/TMD joint disorder diagnoses, as pointed out by recent papers on the RDC/TMD validation.[70] Therefore, it will be interesting to assess changes in the actual prevalence data once the updated version of the diagnostic criteria, based on validated revised diagnostic algorithms incorporating additional diagnostic tests and newly introduced diagnostic groups, is available.[64,73] A reconceptualization of data gathered with the original RDC/TMD version adopted so far is a compelling need to be discussed in future investigations.

The data on general populations are not relevant from a clinical viewpoint, owing to the very low number of studies adopting the RDC/TMD protocol. Available data suggest that disc displacement with reduction is the commonest diagnosis in the general population and that painful disorders, particularly TMJ pain, i.e., arthralgia, are relatively rare. Unfortunately, a direct comparison with data gathered on patient populations could not be performed, owing to the large variability in the gender and age distribution of the community samples. In any case, early suggestions that disc displacement is a relatively common condition with a doubtful pathologic significance may find support from the present systematic review.[74,75] However, it is strongly recommended to increase the number of studies investigating the pathologic significance of TMD signs and symptoms in the general population, to get deeper into, e.g., the issue of treatment-seeking behavior.

CONCLUSIONS

In the present systematic review, a large variability of findings was noticed, particularly regarding the joint disorders (group II and III diagnoses). If RDC/TMD version 1.0 was used, muscle disorders were diagnosed in about one-half of the TMD patients, being the commonest diagnosis. Disc displacements and inflammatory-degenerative disorders were diagnosed in 41.1% and 30.1% of patients, respectively. In community populations, disc displacement with reduction was the commonest diagnosis, confirming the doubtful pathologic significance of that condition, but a comparison with data gathered on patient samples was prevented by the nonhomogeneity of age and gender distribution between clinical and community cases. The prevalence of the above diagnoses and the ratio between muscle and joint disorders is likely to be reappraised with the adoption of updated and revised diagnostic algorithms.

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