ORIGINAL ARTICLE

Diagnostic criteria for temporomandibular disorders in children and adolescents: An international Delphi study-Part 2-Development of Axis II

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Abstract

Background: Unlike the psychosocial assessment established for adults in the Diagnostic Criteria for Temporomandibular Disorders (DC/TMD), a standardised psychosocial assessment for children and adolescents with TMD complaints has not yet been established.

Objectives: To develop a new standardised instrument set to assess the psychosocial functioning in children and adolescents by adapting the psychosocial status and pain-related disability (Axis II) of the adult DC/TMD and by including new instruments.

Methods: A modified Delphi method was used to survey 23 international TMD experts and four international experts in pain-related psychological factors for consensus regarding assessment tools for psychosocial functioning and pain-related disability in children and adolescents. The TMD experts reviewed 29 Axis II statements at round 1, 13 at round 2 and 2 at round 3. Agreement was set at 80% for first-round consensus level and 70% for each of the second and third rounds. The psychological experts completed a complementary Delphi survey to reach a consensus on tools to use to assess more complex psychological domains in children and adolescents. For the psychological experts, the first round included 10 open-ended questions on preferred screening tools for depression, anxiety, catastrophising, sleep problems and stress in children (ages 6–9 years old) and adolescents (ages 10–19 years old) as well as on other domains suggested for investigation. In the second round, the psychological experts received a 9-item questionnaire to prioritise the suggested instruments from most to least recommended.

Results: The TMD experts, after three Delphi rounds, reached consensus on the changes of DC/TMD to create a form to evaluate Axis II in children and adolescents with TMD complaints. The psychological experts added tools to assess depression and anxiety, sleep disorders, catastrophising, stress and resilience.

Conclusion: Through international expert consensus, this study adapted Axis II of the adult DC/TMD to assess psychosocial functioning and pain-related disability in children and adolescents. The adapted Axis II protocols will be validated in the target populations.

1 | BACKGROUND

Temporomandibular disorders (TMDs) include pain and/or impaired function and are often associated with psychological factors.[1] The biopsychosocial model has been used to describe the complex nature of TMD along with its etiology.[2] This model describes a dynamic relationship between physiological, psychological and social factors and thus underlines the importance of the patient's functional status.[3] Hence, the aetiology of TMD is considered as multifactorial, and psychosocial factors can play a significant role in the onset and in persistence of TMD.[4,5] For example, psychological symptoms, such as stress and anxiety, can induce parafunctional behaviours, which, in turn, can contribute to the development of TMD symptoms.[6,7]In addition, long-term TMD symptoms contribute

to developing psychological symptoms.[8] Many studies have found a higher prevalence of psychological and social disorders in TMD patients, when compared to general populations.[9,10] In addition, psychological factors can influence patient's response to treatment, including an impact on the disorder's prognosis.[11,12] Hence, psychosocial assessment of patients with a TMD is a mandatory step for the clinicians to fully appraise the global impact of the disorder and contribute to better clinical decision making.[3]

The Research Diagnostic Criteria for Temporomandibular Disorders (RDC/TMD), published in 1992, introduced a standardised evaluation protocol for TMD patients with a dual-axis diagnostic system based on the biopsychosocial model and included both a physical diagnoses (Axis I) and a biobehavioural assessment of pain-related disabilities (Axis II).[13]

Thereafter, the Diagnostic Criteria for TMD (DC/TMD) introduced new tools to assess psychosocial factors, providing short screening and comprehensive versions.[14]

The incidence of self-reported TMD pain increases in adolescents with age.[15,16] The prevalence of signs and symptoms in cross-sectional studies also is positively associated with age in children and adolescents.[17-19] Similarly, psychological and psychosocial factors affect children's and adolescents' well-being,[20,21] and a strong association between pain and psychological comorbidities has been found in these populations.[20,22] At present, insufficient standardisation of tools and the limited data available have made it difficult to estimate to what extent children and adolescents are affected by TMD, what impact these disorders have on the emotional and psychosocial domains, and what impact the psychosocial factors have on TMDs. Indeed, most of the studies have used either -unvalidated assessment instruments or instruments validated only in adults.[23]

To overcome this lack of a standardised set of instruments for better research, a Delphi study was planned to identify the most relevant psychosocial domains in TMD and to find the best instruments to screen these domains in children and adolescents. Requirements for the ideal instruments included reliable and valid for the age range as well as brief and easy to use. Preferably, the instruments would be already available in multiple languages. The Delphi method is often used to achieve consensus among experts, and it is especially recognised as valid and suitable for addressing highly complex problems, such as the development of a new diagnostic protocol, and as being flexible and adaptable to different research contexts and data collection.[24]

In a previous Delphi study that adapted the DC/TMD Axis I for physical diagnosis, two different protocols were developed: one for children up to the age of 10 (from here forward, age 6–9); and one for adolescents, from age 10–19 years, according to the definition of adolescent defined according to the World Health Organization as age 10 years and older.[25,26] Similarly, the aim of this international Delphi study was to reach consensus regarding the adaptation of the adult DC/TMD Axis II and the inclusion of new instruments to create two new standardised set of instruments, one for children and one for adolescents, for the assessment of psychosocial functioning and pain-related disability related to TMDs. The final aim of this new set of instruments is to help clinicians in diagnosis and treatment of children and adolescents with TMDs and to help researchers to use standardised instruments during a research protocol. This set of instruments should be validated in the future research studies.

2 | MATERIALS AND METHODS

The modified Delphi method was used to reach consensus among TMD experts on how to adapt to children and adolescents, the Axis II assessment for adults. Development of the adaptation of the DC/TMD started at a workshop promoted by the International Network for Orofacial Pain and Related Disorders Methodology (INfORM)

at the General Session of the International Association of Dental Research (IADR) in London in 2018. The organising committee was designated in an INfORM workshop during the IADR in Seoul in 2016. The members of the committee initiated the development of new set of instruments to evaluate TMD in children and adolescents given their clinical and research expertise in this age group. Before London 2018, the organising committee performed a literature review aimed to find references to be sent to all participants to the workshop and then to all participants to the Delphi. The literature review aimed to search instruments that evaluate psychological constructs in children and adolescents. Fourteen TMD experts, (PA, JD, ECE, SK, FK, MK, TL, AM, IMN, CCP, RO, CR, MJR, SS) and the Delphi facilitator (RR) attending the workshop, created a list of key issues about the applicability of DC/TMD to children and adolescents. Thereafter, the facilitator (RR), who did not participate in the online Delphi survey, developed a questionnaire with 29 statements based on the key issues relating to the Axis II assessment raised by the experts during the London workshop. The statements were about pain intensity/physical function, pain location, jaw function limitation, depression/anxiety/physical symptoms, parafunction and other domains not included in the DC/TMD for adults. Twenty-three experts worldwide (Table 1) were invited by email to participate in the process. It includes the 14 experts who had participated in the London workshop (excluding the facilitator RR), and 9 other experts (AA-K, PCRC, JPG, CH, FL, OK, PS, CV, KW) who were identified as having different competencies, such as oral surgery, orthodontics, orofacial pain, paediatric dentistry, physiotherapy and epidemiology. All 23 invited experts agreed to participate. A TMD expert was defined as a person with at least 5 years of experience in the clinical management of TMD patients, experience in using the DC/TMD and having research interest in TMD as demonstrated by their publications in international peer-reviewed journals. The experts were asked to respond to each statement on a five-point Likert scale ranging from 'Strongly disagree' to 'Strongly agree'; further, they could comment on each statement. Consensus to retain or reject a statement was reached when the percentage of experts answering, 'Agree or Strongly agree' or the percentage of experts answering 'Disagree or Strongly disagree' was equal to or higher than the selected threshold for each round. The threshold level for consensus was set at 80% (18 out of 23 experts) for the first round and at 70% (16 out of 23 experts) for the subsequent rounds. The survey was created on Survey Monkey® (SVMK, San Mateo, CA, USA), an online survey development cloud-based software. With the invitation to participate in the survey, each expert received a letter of instructions, a list of references and corresponding full-text papers.

The Delphi Technique is shown in Figure 1. After Round 1, the facilitator and the organising committee (ECE, IMN, AM) analysed the results. Based on the experts' comments, the statements were either rephrased or removed and/or new statements were added when necessary, resulting in a total of 13 statements for Round 2. A similar process of analysing the experts' replies and comments was conducted at the end of the second round, resulting in 2 statements for Round 3.

TABLE 1 List of experts included in the Delphi study with area of expertise and affiliations

	Name Surname	Area of expertise	Affiliations
TMD experts			
1.	Al-Khotani Amal	TMD/Orofacial Pain in children and adolescents; Paediatric Dentistry; Paediatric Psychology, Epidemiology	Ministry of Health (Saudi Arabia)
2.	Alstergren Per*	TMD/Orofacial Pain; Rheumatological disease; TMJ physiology	Malmö University (Sweden)
3.	Durham Justin*	TMD/Orofacial Pain; TMD pathophysiology; TMD treatment	Newcastle University (United Kingdom)
4.	Ekberg EwaCarin*	TMD/Orofacial Pain; TMD pathophysiology; TMD treatment	Malmö University (Sweden)
5.	Goulet Jean-Paul	TMD/Orofacial Pain; TMD treatment; Oral disease	Laval University (Canada)
6.	Hirsch Christian	Epidemiology; TMD/Orofacial Pain in children and adolescents; TMD treatment	University of Leipzig (Germany)
7.	Kalaykova Stanimira I*	TMD/Orofacial pain; Dental Sleep Disorders; Oral physiology	Radboud University Medical Centre (The Netherlands)
8.	Kapos Flavia P*	TMD/Orofacial Pain; Epidemiology; TMD diagnosis	University of Washington (United States of America)
9.	Komiyama Osamu	TMD/Orofacial Pain; TMD pathophysiology; TMD treatment	Nihon University (Japan)
10.	Koutris Michail*	TMD/Orofacial pain; Dental Sleep Disorders; TMD pathophysiology	ACTA (The Netherlands)
11.	List Thomas*	TMD/Orofacial Pain; Oral physiology; TMD treatment	Malmö University (Sweden)
12.	Lobbezoo Frank	TMD/Orofacial Pain; Oral Movement Disorders; Dental Sleep Disorders	ACTA (The Netherlands)
13.	Michelotti Ambrosina*	TMD/Orofacial Pain; TMD treatment; Orthodontics	University of Naples Federico II (Italy)
14.	Nilsson Ing-Marie*	Epidemiology; TMD/Orofacial Pain in children and adolescents; TMD treatment	Malmö University (Sweden)
15.	Ohrbach Richard*	TMD/Orofacial Pain; Psychology; Epidemiology	University of Buffalo (United States of America)
16.	Peck Christopher C.*	TMD/Orofacial Pain; TMD treatment; Neuroscience	University of Sydney (Australia)
17.	Restrepo Claudia*	TMD/Orofacial Pain in children and adolescents; Paediatric Dentistry; Dental Sleep Disorders	Universidad CES (Colombia)
18.	Rodrigues Conti Paulo Cesar	TMD/Orofacial Pain; TMD diagnosis; TMD treatment	Universidade de São Paulo (Brazil)
19.	Rodrigues Maria Joao*	TMD/Orofacial Pain; Dental Sleep Disorders; TMD treatment	University of Coimbra (Portugal)
20.	Sharma Sonia*	TMD/Orofacial Pain; Epidemiology; TMD diagnosis	Malmö University (Sweden) University of Buffalo (United States of America)
21.	Svensson Peter	TMD/Orofacial pain; Neuroscience; Oral physiology	Aarhus University (Denmark)
22.	Visscher Corine M.	TMD/Orofacial pain; Physiotherapy; Dental Sleep Disorders	ACTA (The Netherlands)
23.	Wahlund Kerstin	Epidemiology; TMD/Orofacial Pain in children and adolescents; TMD treatment	Malmö University (Sweden)
Psychological experts			
24.	Bryant Caroline	Psychology in patients with chronic disease	North Tyneside GH (United Kingdom)

TABLE 1 (Continued)

	Name Surname	Area of expertise	Affiliations
25.	King Christopher D.	Pain in children and adolescents; NIH/NIDCR K99/R00 in TMD	Cincinnati Children's Hospital (United States of America)
26.	Penlington Chris	Pain Management Psychological treatment for Long Term Conditions	Newcastle University (United Kingdom)
27.	Palermo Tonya M.	Paediatric chronic and recurrent pain, sleep disorders in children Psychological treatment of paediatric chronic pain	University of Washington (United States of America)

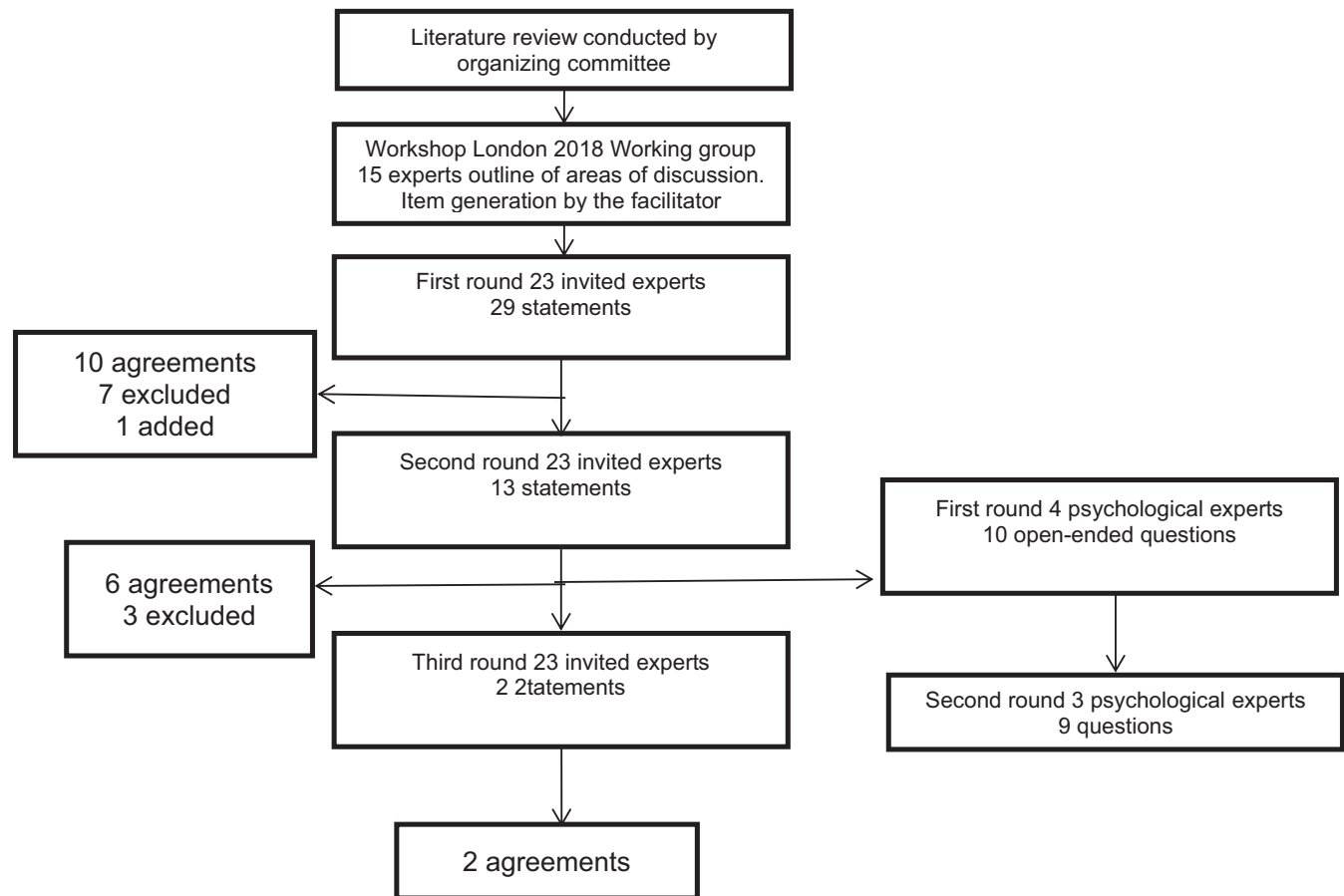*Experts that participated in the workshop in London 2018.

FIGURE 1 Flowchart of Delphi rounds

At the end of each round, the TMD experts received a document with the instructions for the subsequent round and a summary of the previous round.

In addition to the TMD experts survey, in October 2019 the facilitator (RR) conducted a complementary survey involving experts in child and adolescent psychology (Delphi Psych). The psychological experts were involved to compliment the TMD experts in important psychological domains with no agreement or areas identified with limited knowledge regarding instruments in the Delphi survey. The expert in psychological domains was defined as internationally well-recognised researcher and/or clinician, having research interest in psychological aspects related to pain in children and adolescents and/or experience in clinical setting in treating children or adolescents with pain.

Temporomandibular disorders experts were invited to suggest experts in the field of child and adolescent psychology. They provided to the organising committee a list of 4 international experts who were not members of the INfORM group (CB, CK, CP, TP). These experts in psychology were invited to participate in the Delphi Psyc survey by email; they also received instructions asking them to indicate instruments to measure psychological domains in children and adolescents.

Delphi Psych Round 1 included 10 open-ended questions regarding the tools they preferred to measure depression, anxiety, catastrophising, sleep problems and stress in children (ages 6–9) and in adolescents (ages 10–19). These psychological experts were also asked to suggest any other constructs that should be considered in a

standard assessment protocol for the psychosocial domains in young patients with TMD pain.

In Delphi Psyc Round 2, the experts received a survey with nine questions regarding the suggested instruments, a list of references and the corresponding full-text papers, and a table indicating the most important psychometric properties of the instruments, which consisted of Cronbach alpha, instrument structure, validity and sensitivity and specificity if available. In the first six statements of the survey, the psychological experts had to rank the suggested screening tools for depression and anxiety, sleep problems and stress from most to least recommended, based on their opinion of the questionnaires (eg relevance, utility, psychometric properties). Ranking depends by scores that were calculated as the mean of the scores assigned by the experts (sum of scores divided by three). The maximum score was influenced by the number of items, that is, if 5 items were included in the list, the maximum score was 5.

The other three statements were on the assessment of resilience in children and adolescents. The analyses of the replies and of the data were performed blinded, that is, the organising committee (ECE, IMN, AM) did not know the identities of the expert panel members. Only the facilitator (RR) kept the code list to match responses to the experts' identities. At the end of each round, the external experts received a document with the instructions for the subsequent round and a summary of the previous round. Final consensus was achieved in April 2020. The present manuscript was sent to all participating experts, who were invited to be co-authors, and the manuscript was finalised in March 2021.

3 | RESULTS

3.1 | Delphi among TMD experts

The results of the three rounds of the Delphi for TMD experts are shown in Table 2. The response rate was 100% with all the experts responding to all the statements in each of the three rounds regarding Axis II for children and adolescents.

In Delphi Round 1, there was >80% agreement among the experts for 10 of the 29 statements. Based on the TMD experts' answers, of the remaining 19 statements, seven were dropped, 12 were

rephrased, and one was added. Thus, 13 statements were presented in Delphi Round 2; of these, >70% agreement was reached for six out of 13 statements, five were dropped, and two were rephrased and proposed for Delphi Round 3. Finally, both statements proposed in Round 3 reached >70% agreement.

During the survey, consensus was reached for all domains but one. For pain intensity/physical function, experts agreed to adapt the Graded Chronic Pain Scale (GCPS) 2.0, rephrasing the questions and using a Faces Pain Scale–Revised (FPS-R) rather than a numeric rating scale (NRS) for children only. For the pain location, experts agreed that the figures in the pain drawing must be a child in the child version and an adolescent in the adolescent version. Furthermore, the drawings should include pre-selected areas for both children and adolescents. In the DC/TMD for adults, the recommended instrument to assess jaw limitation is the Jaw Function Limitation Scale with 20 items for a comprehensive evaluation. In this Delphi the experts agreed to assess jaw limitation by means of JFLS-20 for adolescents and JFLS-8 for children. To assess parafunction in children and adolescents, it was decided that a shorter form of the Oral Behaviour Checklist (OBC) should be used for both children and adolescents. Finally, regarding domains not initially included in the DC/TMD for adults, it was decided that catastrophising, sleep disorders and stress would be assessed. The TMD experts agreed to assess catastrophising in children and adolescents using the Pain Catastrophising Scale for Children (PCS-C)[27] and for parent reporting on their own worry/catastrophising about their child's pain using the PCS-Parents (PCS-P).[28] However, the TMD experts did not have recommendation for tools to screen for sleep disorders or for stress. Furthermore, TMD experts did not agree on the screening tools for depression and anxiety in either children or adolescents. These and additional domains were also addressed by the psychological experts.

3.2 | Delphi among psychological experts

The results of the two rounds of the Delphi Psyc are shown in Table 3. Of the four experts invited, all replied to the statements in the first round and three in the second round. In Delphi Psyc Round 1, these experts suggested five questionnaires to assess depression and/or anxiety in children and eight questionnaires for

TABLE 2 Round of agreement achievement

Domain	Round 1 Agreement	Round 2 Agreement	Round 3 Agreement	No agreement Agreement
Pain intensity/Physical function	x			
Pain location			x	
Jaw limitation		x		
Parafunction		x		
Depression and anxiety				x
Other domains		x		

TABLE 3 Suggested instruments and best instruments (in bold text) ranking in the Delphi for psychological experts

Round 1–2

Domain	Children		Adolescents	
	Instrument	Score	Instrument	Score
Depression and anxiety	**1. Revised Child Anxiety and Depression Scale (RCADS-SV)**	**4.33 (Maximum score 5)**	**1. Revised Child Anxiety and Depression Scale (RCADS)**	**6.00 (Maximum score 8)**
	2. Center for Epidemiology Studies-Depression Child (CES-DC)	4.00	2. Generalised anxiety Disorder (GAD-7)	5.67
	3. Patient-Reported Outcomes Measurement Information System (PROMIS)	3.67	3. Patient-Reported Outcomes Measurement Information System (PROMIS)	5.33
	4. Mood and Feelings Questionnaire (MFQ)	2.00	4. Screen for Child Anxiety Related Disorders (SCARED)	5.33
	5. Clinical Outcomes in Routine Evaluation (CORE)	1.00	5. Center for Epidemiology Studies-Depression Child (CES-DC)	5.33
			6. Patient Health Questionnaire- ADOLESCENTS (PHQ-A)	4.67
			7. Mood and Feelings Questionnaire (MFQ)	2.67
			8. Clinical Outcomes in Routine Evaluation (CORE)	1.00
Catastrophising	**Pain Catastrophising Scale for Children (PCS-C)**		**Pain Catastrophising Scale for Children (PCS-C)**	
	Pain Catastrophising Scale for Parents (PCS-P)		**Pain Catastrophising Scale for Parents (PCS-P)3**	
Sleep disorders	**1. Children's Sleep Habits Questionnaire (CSHQ)**	**4.67 (Maximum score 5)**	**1. Adolescent Sleep-Wake Scale (ASWS)**	**6.00 (Maximum score 7)**
	2. Children's Report of Sleep Patterns (CRSP)	3.00	2. Insomnia Severity Index (ISI)	5.67
	3. Patient-Reported Outcomes Measurement Information System (PROMIS)	2.67	3. Patient-Reported Outcomes Measurement Information System (PROMIS) Sleep-Related Disturbance	3.67
	4. Sleep-Related Disturbance Patient-Reported Outcomes Measurement Information System (PROMIS) Sleep-Related Impairment	2.33	4. Children's Report of Sleep Patterns (CRSP)	3.33
	5. BEARS	2.33	5. Patient-Reported Outcomes Measurement Information System (PROMIS) Sleep-Related Impairment	3.33
			6. BEARS	3.00
			7. Adolescent Sleep Hygiene Scale (ASHS)	2.67
Stress	**1. Perceived Stress Scale for Children (PSS-C)**	**2.67 (Maximum score 3)**	**1. Perceived Stress Scale for Children (PSS-C)**	**3.67 (Maximum score 5)**
	2. Strengths and Difficulties Questionnaire (SDQ)	2.33	2. Adolescent Stress Questionnaire -Shortened (ASQ)	3.33
	3. Paediatric Pain Screening Tool (PPST)	1.00	3. Responses to Stress Questionnaire (RSQ)	3.33
			4. Strengths and Difficulties Questionnaire (SDQ)	2.67
			5. Paediatric Pain Screening Tool (PPST)	2
Resilience			**Adolescent Resilience Questionnaire (ARQ)**	

Scores were calculated as the mean of the scores assigned by the experts (sum of scores divided by three). The maximum score was influenced by the number of items, that is, if 5 items were included in the list, the maximum score was 5.

adolescents. In Delphi Psyc Round 2, the experts rated the Revised Child Anxiety and Depression Scale-Short Version (RCADS-SV)[29] as the best tool to assess depression and anxiety in both children and adolescents. For sleep disorders, the experts suggested five tools for children and seven tools for adolescents. In Delphi Psyc Round 2, the experts rated the Children's Sleep Habits Questionnaire (CSHQ)[30] as the best tool to evaluate sleep disorders in children and the Adolescent Sleep-Wake Scale (ASWS)[31] as the best for adolescents. Regarding stress, the psychological experts suggested three tools for children and five for adolescents. In Delphi Psyc Round2, the Perceived Stress Scale for Children (PSS-C)[32] was deemed the best to screen for stress in both children and adolescents. As the experts suggested one questionnaire to assess catastrophising in children and adolescents (PCS-C) and one for parents reporting catastrophising about their child's pain (PCS-P) in Delphi Psyc Round 1, consistent with the recommendations of the TMD experts, this domain was not included in Delphi Psyc Round 2. Finally, in Delphi Psyc Round 1, experts suggested investigating resilience only in adolescents, suggesting in Round 2 the Adolescent Resilience Questionnaire (ARQ).[33] TMD experts accepted the instruments suggested by the experts in psychology. All the authors participated to in the correction and approved the manuscript.

4 | DISCUSSION

This Delphi study established a new set of instruments by adapting the existing DC/TMD for adults and including new constructs and questionnaires to assess psychosocial status in children and adolescents with TMD complaints.

This Delphi study was designed to create expert consensus in standardising evaluation measures for Axis II in the assessment of TMD in children and adolescents. The final aim of this new set of instruments is to support clinicians and to provide researchers with standardised instruments to be used in research protocols.

The Delphi group consisted of 23 international experts from several countries who routinely work with the DC/TMD. This was possible thanks to the dissemination of the DC/TMD for adults, which has already been translated into almost 20 languages.[34]

Since psychosocial functioning is evaluated in Axis II, an additional Delphi survey was organised for experts in psychosocial disciplines whose task was to reach an agreement on the recommended questionnaires to measure some domains of Axis II. The psychological experts contributed to broadening and updating knowledge on the questionnaires used to screen and to investigate the psychosocial functioning of children and adolescents with pain. Further, the psychological experts introduced new tools and new domains in Axis II for this population.

At the end of these two Delphi processes, the experts identified a set of instruments enabling the creation of a DC/TMD Axis II for children and adolescents, that will be validated in the future studies.

4.1 | Delphi among TMD experts

The TMD experts agreed to use the GCPS 2.0 to assess pain intensity and related disability domain in both children and adolescents, rephrasing the items. The GCPS is a valid, reliable tool for adults, which was found to be strongly associated to the management of TMD pain.[3,35] It presents eight questions, six of which include a numeric rating scale (NRS) from 0 to 10. Considering that children under the age of 10 may have limited ordinal numerical competence, the experts agreed to substitute the NRS with the Faces Pain Scale-Revised.[36,37] Moreover, the experts agreed to rephrase GCPS 2.0 items for both children and adolescents to take into consideration activities typically performed by these two distinct age groups.

The pain drawing is an important visual aid for patients and clinicians alike: the patient uses it to indicate the location and the spread of his/her pain on the face and neck, inside the mouth and on other sites on the body. In the adult version, the image used is of a stylised adult man without hair[14] with whom a child or young adolescent may not easily identify. Hence, the TMD experts agreed to substitute the images on the pain drawing with images of a child for the child version and of an adolescent for the adolescent version. Still, it could be argued that a 'typical' adolescent face is not easy to portray, given the ongoing changes occurring during this growth period. The experts agreed to include pre-selected areas on the pain drawing to facilitate locating and reporting the painful areas. The advantage of using pre-selected areas is that it could make the tool more reliable and easier to use on electronic devices; increasing the 'standardisation' of this tool, that could be useful in research studies. The disadvantages could be the limited freedom in selecting areas that are painful.

Temporomandibular disorders can provoke alterations and limitations in normal jaw function. The DC/TMD for adults includes two instruments to assess patients' self-reported jaw function limitation: the JFLS-20 and the JFLS-8.[38] The JFLS-20, that is, the complete form of the questionnaire, assesses three different constructs related to jaw function—mastication (items 1–6), vertical jaw mobility (items 7–10) and verbal and non-verbal expression (items 13–20)—and global functional limitation. The JFLS-8, instead, is a short version that assesses global functional limitation using a limited number of items from the three constructs. The TMD experts agreed to assess jaw function limitation using the JFLS-20 in adolescents and the JFLS-8 in children. Both questionnaires will be adapted and assessed for content validity in both age groups. The experts agreed to use the JFLS-8 in children because of its brevity and because the concepts used in the questionnaire, such as kissing, yawning, chewing and talking are easy to understand.[38] In children, the FPS-R will be tested to replace the NRS of the JFLS-8.

The role of parafunction in TMD onset, duration and management is still unclear. The OPPERA study suggested a strong association between self-reports of jaw parafunctions and TMD onset in adults.[39] Perrotta et al.,[18] de Oliveira Reis et al.,[40] and Fernandes et al.[41] found an association between awake and sleep bruxism and TMD pain in children and adolescents as well. The TMD experts

agreed to assess the frequency of oral behaviours in children and adolescents by means of the Oral Behaviours Checklist (OBC),[42] a 21-item self-report that uses a 5-point ordinal scale. However, as the TMD experts considered the OBC too long to be used in children and adolescents, they suggested creating a short version, based on studies conducted by Michelotti et al.,[43] Cioffi et al.[44] and Donnarumma et al.[45] on a 6-item OBC that still must be validated in children and adolescents.

The TMD experts agreed to add other constructs to Axis II screening, such as catastrophising, sleep disorders and stress. Since the publication of the DC/TMD for adults in 2014, several studies indicate that other factors that influence onset, chronification and therapy outcomes of TMD. Pain catastrophising is 'an exaggerated negative "mental set" brought to bear during actual or anticipated painful experience'[46]; it is associated with poor prognosis, possible pain persistence and poor patient treatment compliance in adults with several pain syndromes,[47] including TMD.[48,49] Pain catastrophising has also been investigated in children with chronic pain, with a positive association found between higher catastrophising and increased pain intensity, increased disability, increased anxiety and depression.[50] Sleep quality has been associated with TMD incidence in adults.[39] Similarly, several studies on children and adolescents have reported that sleep has a causal role in the chronification of pain and in the worsening of psychological symptoms.[51,52] Patients have indicated stress as a factor that initiates, exacerbates and perpetuates their pain.[6] Likewise, perceived stress is associated with increased pain intensity in adolescents with musculoskeletal pain.[53] Hence, the experts in our study agreed on the need to search for new tools to screen for these three constructs in children and adolescents. The TMD experts reached an agreement on using the PCS-C and the PCS-P to assess catastrophising. PCS-C is a 13-item questionnaire for subjects between the ages of 8 and 16 years, while the PCS-P is a parent-reported measure to describe the parent's own catastrophic thinking about their child's pain; it is indicated for individuals between the ages of 9 and 16. Understanding parents' catastrophic thinking and behaviour has been important in other paediatric chronic pain conditions where parent and family factors have been found to relate to child's pain, disability and school attendance.[54] To identify assessment tools for sleep disorders, stress, depression, anxiety and physical symptoms, the experts decided to create a parallel Delphi for psychological experts.

4.2 | Delphi among psychological experts

A separate Delphi was created to involve experts in the field of psychology, with better knowledge of measures useful to investigate the psychological aspects related to pain in children and adolescents. In Delphi Psyc Round 1, the experts suggested several instruments, based on their experience and their knowledge. In Delphi Psyc Round 2, all the suggested instruments were ranked, and the questionnaire that had the highest score was included in Axis II. The

psychological experts agreed on using the Revised Child Anxiety and Depression Scale-Short Version (RCADS-SV) to assess depression and anxiety in both children and adolescents. The RCADS-SV, the short version of the RCADS, consists of 25 items—10 for major depressive disorders and 15 for anxiety. This widely used instrument has good psychometric properties and is validated in the population ages 7–18 years.[29,55]

To assess sleep disorders, the psychological experts suggested a questionnaire for children and another one for adolescents. The Children's Sleep Habits Questionnaire (CSHQ) is a 45-item parent questionnaire that screens for both behaviour-based and medically based sleep problems. This questionnaire has an acceptable internal consistency and acceptable reliability and is usually used in the population ages 4–10 years.[30] This widespread tool has been used in more than 600 published studies.

For adolescents, instead, the psychological experts suggested the Adolescent Sleep-Wake Scale (ASWS) to assess sleep quality in youth ages 12–18 years. The ASWS is a 28-item questionnaire with a 6-point scale ('always', 'frequently-if not always', 'quite often', 'sometimes', 'once in a while', and 'never') for which overall internal consistency has been found to be good for the total scale.[31] Essner et al.[56] developed a short ASWS-10 scale.

To screen for stress, the psychological experts suggested as instrument useful for both children and adolescents, the Perceived Stress Scale - Children (PSS-C),[32] a 14-item instrument that can be used in children ages 5–18 years.

Regarding catastrophising, the psychological experts suggested the same questionnaires in the first round as those suggested by the TMD experts for parents (PCS-P) and for children and adolescents (PCS-C).

Finally, the psychological experts suggested a further domain to be assessed only in adolescents: resilience. Resilience has been defined as positive developmental outcomes in the face of adversity or stress,[33] it is as an emerging area of study in paediatric chronic pain and no studies have evaluated this domain in youth with TMD. The Adolescent Resilience Questionnaire (ARQ) is an 88-item questionnaire with five scales in the self-domain that assess confidence, emotional insight, negative cognition, social skills and empathy/tolerance, and two scales in the family and in the peer domains that assess connectedness and availability. The ARQ also includes two scales in the school domain—supportive environment and connectedness—and one scale in the community domain—connectedness. This instrument can identify those adolescents who are positively engaged with their families, peers, school and environment, who show more resilient behaviour in the face of adversity, as well as those adolescents with more negative or poor engagement who may be more vulnerable in situations of adversity. This instrument is recommended initially in the research setting to determine how it might be associated with onset, duration and management of TMD. There has to date been little if any research into positive attributes that may act as protective factors in this population. In order to be of use clinically, it would be helpful if a shorter questionnaire for resilience could be developed and validated. The psychological experts

included in this survey were all from North America and Europe, and this may represent a limitation.

Developing a unique standardised set of tools to assess the psychosocial functioning and pain-related disability of young patients with TMD in research and clinical settings will be a breakthrough in the orofacial pain field. The association between musculoskeletal pain and psychological factors is well known. Sleep disorders, catastrophising and stress are associated with pain intensity, pain disability and pain persistence; depression and quality of life have been found to be associated with pain developing from acute to persistent.[57] Some studies have evaluated the association between painful TMD and depression or anxiety using the RDC/TMD[20,22,23,58] for the clinical examination but have used different questionnaires for psychological assessment, thereby limiting the possibility of comparisons. Having a standardised protocol to assess Axis I and Axis II would improve the quality of the research as well as clinicians' ability to detect children and adolescents at higher risk of developing long-lasting pain. The need for tools to assess TMD in children has been clear since the publication of at least two previous studies.[59,60] However, both analysed only DC/TMD Axis I, without including any Axis II assessments.

In our Delphi studies, TMD experts developed and adapted instruments to assess Axis I[26] of the DC/TMD in children and adolescents and, with the support of psychological experts, selected instruments for Axis II evaluation. The proposed changes of the DC/TMD will be assessed for validity and reliability. The TMD experts were recruited from different countries including Europe, North and South America, Asia and Oceania while the psychological experts were recruited from North America and Europe. This might represent a limitation, because of sociocultural background. Future research with broader global representation may help to validate, improve and adapt assessment tools to reflect different sociocultural contexts' needs and experiences.

5 | CONCLUSIONS

Agreement reached by the participating experts allowed the creation of a new set of instruments by adapting the previous DC/TMD for adults and including new constructs and questionnaires to assess psychosocial functioning in children and adolescents.

Two future papers will describe the brief and comprehensive forms of the DC/TMD for children and for adolescents, including all the instruments needed to conduct an Axis I and Axis II assessment.

Once the set of recommended instruments to assess domains of the DC/TMD for children and adolescents has been completed, each instrument will be internationally validated in the target populations.

CONFLICT OF INTERESTS

The authors declare that they have no conflict of interest.

AUTHOR CONTRIBUTIONS

RR, ECE, IMN, AM Conception and design of study;RR, ECE, IMN, AM Acquisition of data; RR, ECE, IMN, AM Data analysis and/orinterpretation; AA-K, PA, PCRC, JD, ECE, JPG, CH, SK, FK, CK, OK, MK, TL, FL, AM,IMN, RO, TP, CCP, CP, CR, MJR, RR, SS, PS, CMV, KW Drafting of manuscriptand/or critical revision AA-K, PA, PCRC, JD, ECE, JPG, CH, SK, FK, CK, OK, MK,TL, FL, AM, IMN, RO, TP, CCP, CP, CR, MJR, RR, SS, PS, CMV, KW Approval offinal version of manuscript

PEER REVIEW

The peer review history for this article is available at https://publons.com/publon/10.1111/joor.13301.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author [RR], upon reasonable request.

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