Review Article

Prevalence of Tortuous Temporomandibular Joint Disorders: A Systematic Review and Meta-analysis

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Abstract

Background: Temporomandibular disorder (TMD) is a cumulative terminology that demonstrates musculoskeletal and neuromuscular disorders. It is of extreme relevance that the number of subjects with TMD-related pain has noticeably increased over the recent years. This could be attributed to the increased stress in lifestyles and use of electronic devices (smartphones/laptops/tablets), altering the posture across the boundaries of age, gender, and geography. Thus, this systematic review and meta-analysis was conducted to derive the prevalence of TMD disorders across the aforementioned boundaries.

Methods: The method used in this study to quantify the prevalence of TMD across the countries and populations was in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guidelines. MEDLINE, Scopus, Web of Science, and Google Scholar were systematically searched until July 30, 2024.

Results: The quality of the prevalence studies was assessed using Critical Appraisal Skills Programme (CASP) Tools. The bias within the study data was evaluated using RevMan software, and the prevalence was calculated as 25.8%. Finally, the forest plot was employed to determine the weightages and risk ratios of the studies.

Conclusion: Based on the findings, there has been a slow and steady increase in the prevalence of TMD, and thus sustainable measures are imminent for controlling this disorder.

Keywords: Temporomandibular disorder, Temporomandibular joint, Prevalence, Evidence-based dentistry, Systematic review, Meta-analysis

Background

The temporomandibular joint (TMJ) is a synovial joint present on both sides of the craniomandibular complex. The connecting anatomical configurations are key in jaw movement, enabling everyday tasks of chewing, swallowing, and speaking. The manner of its function ensures non-damage of the anatomy from the stresses generated from each of the aforesaid functions (1). Temporomandibular disorder (TMD) is a cumulative terminology representing musculoskeletal and neuromuscular disorders, symptomized by pain and/or dysfunction in the masticatory muscles, TMJ, and associated structures. Additional related comorbidities are inclusive of headaches, fibromyalgia, tinnitus, chronic fatigue syndrome, depression, and sleep disturbances (2). The diagnosis and management of this disorder become challenging with its myriad associated symptoms. This is compounded by the varied classifications, followed by Research Diagnostic Criteria (RDC/TMD) and diagnostic criteria (DC/TMD), which are currently being used among diagnosticians (3,4). It is highly noticeable that the

number of subjects being reported with TMD-related pain has considerably increased over the years. This could be associated with the increased stress in lifestyles and use of electronic devices (laptops/smartphones/tablets) that has altered the posture across gender, age, and geography boundaries (5). The existing literature predominantly reports the prevalence of TMD among adults alone. Researchers indicate that the knowledge of the prevalence of the disorder would aid as a first step answer to the aforementioned obstacles. It would enable patient literacy of the important preventive methods against disorder development as well as maintenance against symptom worsening. With these research questions as a crux, the following systematic review and meta-analysis was performed to derive the prevalence of TMD disorders across the world.

Materials and Methods

Protocol

This systematic review followed the Preferred Reporting Items for Systematic Reviews and Meta-Analysis checklist

(PRISMA) (6). The protocol was elaborated in accordance with PRISMA-P (7). All the methods of data collection/analysis and the inclusion/exclusion criteria were prespecified and documented in the review protocol.

Eligibility Criteria
Inclusion Criteria
- Studies reporting the prevalence of TMD in the general population
- No restrictions pertaining to the age or gender of the participants in the study
- Language of referenced articles with no restrictions
- All diagnoses of TMD, irrespective of the presence and absence of pain

Exclusion Criteria
- Narrative reviews, systematic reviews, meta-analyses, case reports or series patients, animal or biomechanical studies, and post-conference abstracts
- Duplicate studies
- Studies with patients reporting secondary oral and systemic conditions such as prosthesis, orthodontic treatment, and partial or completely edentulous subjects
- Studies with restrictions in subject selection, such as fibromyalgia, systemic joint hypermobility, arthritis, tinnitus, post-traumatic stress disorder, trigeminal neuralgia, burning mouth syndrome, atypical facial pain, migraine, atypical odontalgia, cervical pain, neuropathic pain, and dentoskeletal deformities or fractures and congenital/developmental disorders or syndromes associated with TMD
- Data from reviews, letters, books, conference abstracts, expert opinions, technique articles, posters, guidelines, and pilot studies

Information Sources and Search
A detailed and rigorous systematic review search was conducted primarily in PubMed, followed by Scopus and Web of Science (Figure 1), by two researchers (Y.A. and K.C.L.), with the opinion of the third author (A.G.) used in the event of any disagreement. An additional literature search was performed in Google Scholar, and a manual search was conducted in the institute's central library in the event of non-accessibility of a complete literature text. The MeSH terminologies searched in this regard included "Temporomandibular joint disorders AND prevalence", "Temporomandibular joint disorders AND epidemiology", and "Temporomandibular joint disorders AND population" from January 1, 2019 to July 30, 2024. The Cohen kappa statistic between the reviewers was 0.97, indicating substantial agreement.

Risk of Bias in Individual Studies
Two of the authors (K.C.L. and A.G.) used the Critical Appraisal Skills Programme (CASP) Tools for the quality assessment of the selected studies. The CASP had 11
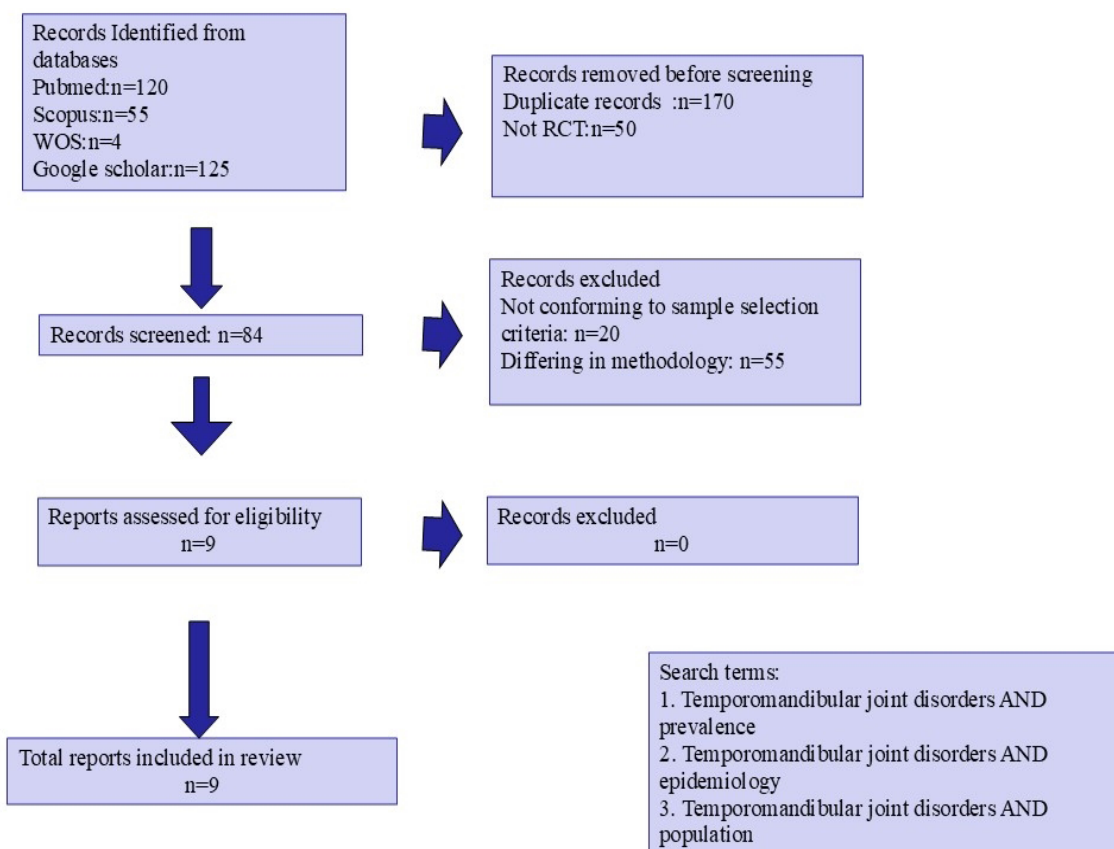

Figure 1. PRISMA Flowchart Illustrating the Search Strategy. *Note.* PRISMA: Preferred Reporting Items for Systematic Reviews and Meta-Analysis Checklist

points per study, according to four quality domains, namely, basic study design, methodology validation, the completeness and quality of results, and finally the helpfulness of the results in the local scenario. In the currently reported study, all articles were ascribed to the CASP checklist. The data were further tabulated, inclusive of the main assessment criterion, in Tables 1 and 2, respectively. Further, the risk assessment within the study was performed using RevMan software.

Results

In the selected studies (N = 8), the total number of subjects amounted to 5992, including 754 males and 2691 females, and 2547 of them were of unspecified gender. The ages of the participants ranged from 10 years to 40 years. In addition, DC/TMD (1 study), RDC/TMD (n = 2), American Academy of Orofacial Pain (n = 1), TMD pain screener (n = 1), Fonseca's Anamnestic Index (n = 3), Oral Health Impact Profile for RMD (n = 1), and Helkimo Index modified by Maglione (n = 1) were used for diagnosis. The study reports ranged from 7 varied countries, with the sample size varying from 70 to 3,263. A summary of the descriptions of the studies is listed in Tables 1 and 2.

For article selection, articles using RDC/TMD, DC/TMD, Fonseca's Questionnaire, Oral Health Impact Profile for RMD, and American Academy of Orofacial Pain were included in the study as the authors convened that under the expert supervision, the criteria for diagnosis would not

impact the study quality in terms of diagnosis. Conversely, they indicated that the exclusion would hamper the accurate approximation of the prevalence of the disorder. All the selected studies reported a higher observation of the disorder in the female gender. However, not all the studies ascertained a numerical value in results, thus hampering numerical calculation in this meta-analysis. The mean age of presentation ranged from 10 years to 31.5 years. Considering that the studies also reported the group prevalence, it was impossible to assess the sub-group diagnosis of which type of TMD was prevalent. The heterogeneity among the studies in the meta-analyses was high ($I^2 = 99\%$), owing to differences in the characteristics of the sample, and thus a random effect was taken into consideration. Based on the tabulated data, the prevalence of TMD in this meta-analysis at a 95% confidence interval was 25.8%. The effect estimate was 0.28.

The forest plot (Figure 3) was calculated to determine the risk ratio and weightages of the study. The study by Wu et al had the maximum weightage at 26.4%. It was concluded that the number of subjects suffering from TMD was statistically significant.

Discussion

This systematic review was conducted to estimate the prevalence of TMD across the globe, populations, and age groups. The prevalence rates reported in the selected studies were acquired from educational institutions

Table 1. Summary of Selected Articles

Study	Place	Year	Sample/ Male: Female	Mean Age (y)	Diagnostic Criteria
Filho et al (8)	Brazil	2020	2624 F = 1,647 M = 977	21.5	American Academy of Orofacial Pain
Yap and Natu (9)	Singapore	2020	400 M = 191 F = 209	19.26 ± 1.89	RDC/TMD
Natu et al (10)	Singapore	2018	181 M = 37 F = 207	19	1. Fonseca's Anamnestic Index 2. Oral Health Impact Profile for Temporomandibular Disorders
Paz-Cortés et al (11)	Spain	2024	70 M = 38 F = 32	21.5	1. DC/TMD criteria 2. Fonseca Anamnestic Index 3. Helkimo Index modified by Maglione
Wu et al (12)	China	2021	754 M = 354 F = 400	21.5	DC/TMD
Romani et al (13)	Italy	2018	106 M = 47 F = 59	10.4	Fonseca's Questionnaire
Sanders et al (14)	USA	2013	3263	31.5	RDC/TMD criteria
Jomhawi et al (15)	Jordan	2021	396 M = 200 F = 196	16	RDC/TMD
de Melo Júnior et al (16)	Brazil	2019	1342 M = 421 F = 921	12	RDC/TMD

Note. DC/TMD: Diagnostic Criteria for Temporomandibular Disorders; RDC/TMD: Research Diagnostic Criteria for Temporomandibular Disorders.

Table 2. Summary of Data of Selected Articles

Study	Diagnosis	Other Assessed Factors	Sampling	Prevalence	Outcomes
Filho et al (8)	TMD	1. Oral Health Impact Profile (OHIP-14)	Random	557 (21%) M:F = NA	1. TMD prevalence: 557 (72%) 2. Impact on quality of life (with TMD): 133 (17.38%)
Yap and Natu (9)	TMD	1. Patient Health Questionnaire-15 (PHQ-15) 2. Depression, Anxiety, and Stress Scales-21 3. TMD pain screener	Random	34 (9%) M:F = 11:23	1. TMD prevalence: 8.5% (34) 2. M = 11, F = 23 3. PHQ-15 mean: 11.5 4. Depression scores mean: 14.94 5. Anxiety scores mean: 14.82 6. Stress scores mean: 17.06
Natu et al (10)	TMD	1. Depression Anxiety Stress Scales-21 2. Pittsburgh Sleep Quality Index	Random	102 (41.8) M:F = NA	1. Total TMD prevalence: 41.8% 2. Mild TMD: 32.4% (79) 3. Moderate TMD: 9.4% 4. F > M = 83.3% 5. An increase in the OHIP score as per TMD severity 6. An increase in depression and anxiety scores as per TMD severity
Paz-Cortés et al (11)	TMD	1. Perceived Stress Scale (PSS-14) 2. Salivary cortisol 3. Criteria for Classification of Occlusion. 4. State-Trait Anxiety Inventory	Random	38 (54.28%)	1. No significant association with gender, occlusion, and TMD observed 2. Positive correlation with stress and anxiety
Wu et al (12)	TMD	1. Patient Health Questionnaire-9 (PHQ-9) 2. Generalized Anxiety Disorder Scale-7 3. Pittsburgh Sleep Quality Index	Random	239 (31.7%)	1. TMD prevalence: 31.7% 2. Mild depression: 52.3% 3. Moderate depression: 15.5% 4. Severe depression: 2.1% 5. Depression: 69.9% 6. Anxiety: 69.5% 7. Sleep disorder: 51.5%
Romani et al (13)	TMD signs	Revised Children's Manifest Anxiety Scale	Random	91 (86.39%) F = 74 (82%) M = 32%	1. TMD prevalence: 86.79% 2. F = 39%, M = 23% 3. Positive association between TMD and anxiety
Sanders et al (14)	TMD signs	1. OPPERA Comprehensive Pain and Symptom Questionnaire 2. Health status 3. Pittsburgh Sleep Quality Index 4. Anthropometric Status 5. Cigarette Smoking 6. Short Form 12 Health Survey V2 (SF-12v2)	Random	260 (8%)	Positive association of an increase in TMD incidence in association-assessed factors of chronic back pain, altered sleep, smoking, and health disorders
Jomhawi et al (15)	TMD	Nil	Random	TMD prevalence = 29% 15 years = 20 (40%) 16 years = 49 (28.2%) 17 years = 46 (27.4%)	1. TMD prevalence: 29% 2. M > F = disability, depression, and unspecific physical symptoms 3. Low disability-low-intensity pain: 64.9% 4. Severe depression: 69.6% 5. TMD without pain: 53% 6. TMD with pain: 57.4%
de Melo Júnior et al (16)	TMD	Brazilian Economic Classification Criteria	Random	TMD = 446 (33.2%)	1. TMD prevalence: 446 (33.2%) 2. Peak age: 12 years 3. TMD with headache: 162.16 (36.4%) 4. Low disability: 24.6% 5. High disability: 3.2% 6. Females: 68% 7. Low socio-economic level: 60%

Note. TMD: Temporomandibular Disorders; OPPERA: Orofacial Pain: Prospective Evaluation and Risk Assessment.

and healthcare centers of private and public domains in different geographic locations. These contribute to a more probable accurate assessment, unlike pain clinics or TMD specialization clinics, which would overreport the prevalence in a population, thus ascertaining the case group in a general population would be challenging.

Of the 8 studies, 5 evaluated the depression and anxiety scores (Table 2) using validated scales. Unanimously, a significant positive association was found irrespective of age and geographical location. It was noted that there was a significant rise in the stress scores of children and adolescents (10,11,13,15), which is in line with the reporting by Dickson et al, evaluating anxiety disorder in children (17). The mechanism is such that the inflammatory factors produced in pain cross the blood-brain barrier and alter the neurotransmitter metabolism and neuroendocrine function, thereby causing depression (18).

Among the selected studies, 4 assessed the health status of the patient through validated patient-filled questionnaires using the Quality of Life (QoL) Questionnaire (8,9,12,14).

QoL is a multidimensional feature classifying the positivity with which a young individual rates his/her life circumstances and state. It crosses the boundaries of psychological symptoms to a comprehensive sense of well-being and life satisfaction inclusive of physical, psychological, and social functioning. In this study, a positive correlation was noted wherein a dip in scores of QoL was associated with TMD, which conforms to the findings of Pigozzi et al (19). One of the studies (16) evaluated the association of lower socio-economic status with the prevalence of TMD and reported a proportional alteration, which matches the results of a meta-analysis performed by Minervini et al (20).

In this meta-analysis, the obtained prevalence was 25.8%. However, this rate was 23% in a previous meta-analysis by Valesan et al (21). The previous study reported
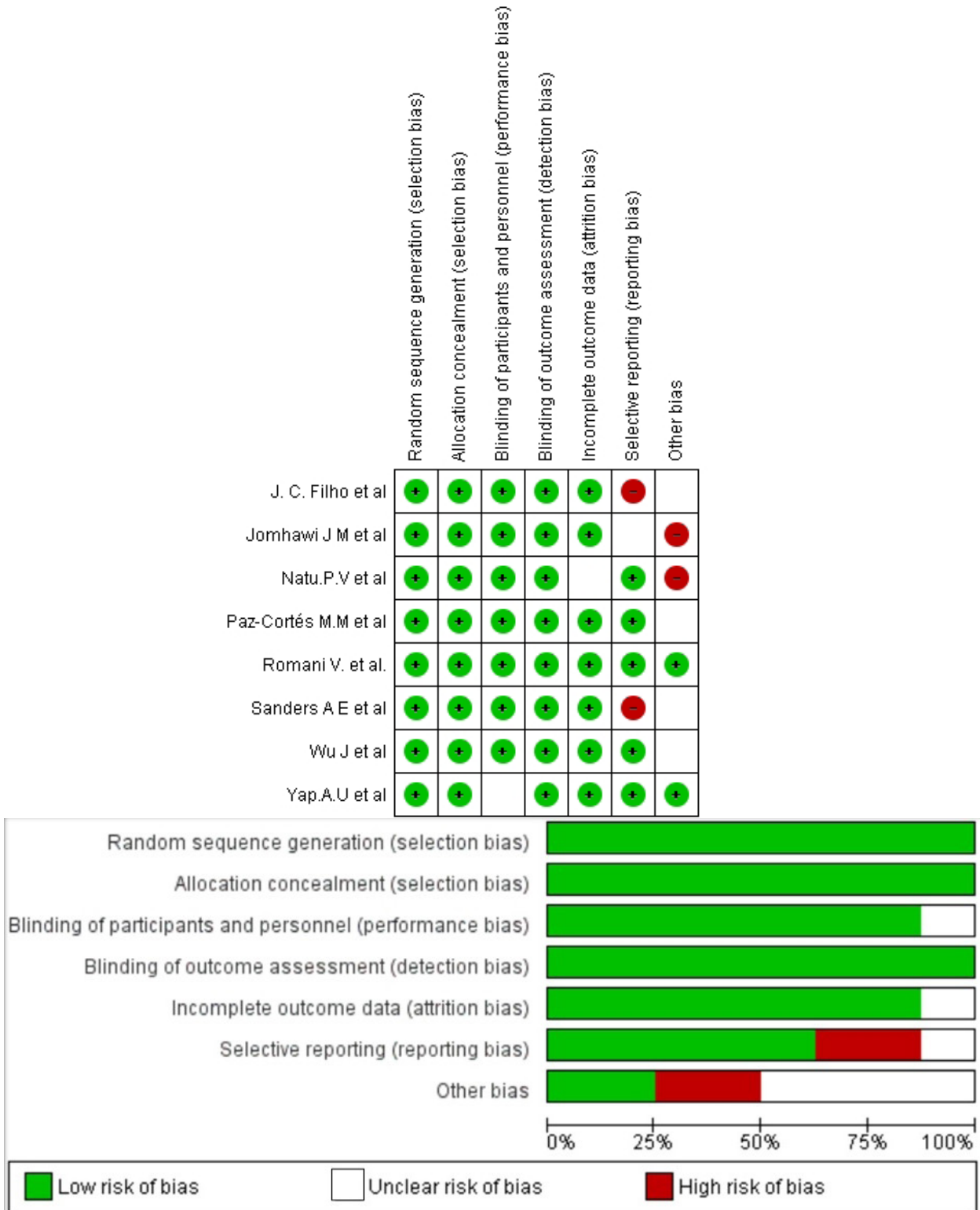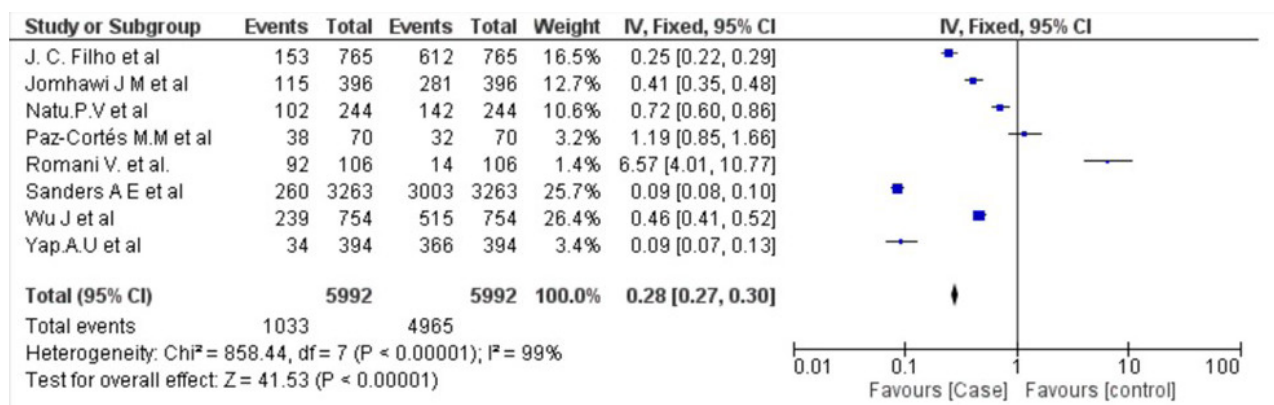

Figure 2. Risk of Bias Assessment of Selected Articles

Study or Subgroup	Events	Total	Events	Total	Weight	IV, Fixed, 95% CI	IV, Fixed, 95% CI
J. C. Filho et al	153	765	612	765	16.5%	0.25 [0.22, 0.29]	
Jomhawi J M et al	115	396	281	396	12.7%	0.41 [0.35, 0.48]	
Natu.P.V et al	102	244	142	244	10.6%	0.72 [0.60, 0.86]	
Paz-Cortés M.M et al	38	70	32	70	3.2%	1.19 [0.85, 1.66]	
Romani V. et al.	92	106	14	106	1.4%	6.57 [4.01, 10.77]	
Sanders A E et al	260	3263	3003	3263	25.7%	0.09 [0.08, 0.10]	
Wu J et al	239	754	515	754	26.4%	0.46 [0.41, 0.52]	
Yap.A.U et al	34	394	366	394	3.4%	0.09 [0.07, 0.13]	
Total (95% CI)		5992		5992	100.0%	0.28 [0.27, 0.30]	
Total events	1033		4965				

Heterogeneity: Chi² = 858.44, df = 7 (P < 0.00001); I² = 99%
Test for overall effect: Z = 41.53 (P < 0.00001)

Figure 3. Forest Plot Displaying the Weightage and Risk Ratio of Selected Studies

this value around 5 years earlier. The researchers were in consensus that there was a gradual rise in the prevalence of the disorder. This can be attributed to lifestyle changes, along with anxiety and depression levels in the community.

The greatest limitation of this study was the unanimous absence of imaging studies for the confirmation of TMD (22). Additionally, adequate sample size representation and calculation require multicentric observations, which were reported in only two studies performed by Jomhawi et al and de Melo Júnior et al, respectively (15,16).

Conclusion

Based on the findings, the prevalence of TMD represents a gradual rise. Considering the chronic nature of the disorder and the high cost of treatment, sustainable treatment alternatives and prevention strategies are the need of the time (23). Oral literacy programs for prevention and the need for management at the first sign of the disorder can be introduced at the school level as the manifestation of this disorder starts in the age group. Sustainable medications from natural resources with lower costs and adverse effects are the other challenges that need to be overcome.

Authors' Contribution
Conceptualization: K Yesoda Aniyan, C L Krithika.
Data curation: K Yesoda Aniyan, C L Krithika.
Writing–original draft: K Yesoda Aniyan.
Writing–review & editing: G Anuradha.

References

1. Li DT, Leung YY. Temporomandibular disorders: current concepts and controversies in diagnosis and management. Diagnostics (Basel). 2021;11(3):459. doi: 10.3390/diagnostics11030459.
2. Kapos FP, Exposto FG, Oyarzo JF, Durham J. Temporomandibular disorders: a review of current concepts in aetiology, diagnosis and management. Oral Surg. 2020;13(4):321-34. doi: 10.1111/ors.12473.
3. Schiffman E, Ohrbach R, Truelove E, Look J, Anderson G, Goulet JP, et al. Diagnostic criteria for temporomandibular disorders (DC/TMD) for clinical and research applications: recommendations of the International RDC/TMD Consortium Network* and Orofacial Pain Special Interest Group†. J Oral Facial Pain Headache. 2014;28(1):6-27. doi: 10.11607/jop.1151.
4. Dworkin SF, LeResche L. Research diagnostic criteria for temporomandibular disorders: review, criteria, examinations and specifications, critique. J Craniomandib Disord. 1992;6(4):301-55.
5. Al-Baghdadi M, Durham J, Araujo-Soares V, Robalino S, Errington L, Steele J. TMJ disc displacement without reduction management: a systematic review. J Dent Res. 2014;93(7 Suppl):37S-51S. doi: 10.1177/0022034514528333.
6. Moher D, Liberati A, Tetzlaff J, Altman DG. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. PLoS Med. 2009;6(7):e1000097. doi: 10.1371/journal.pmed.1000097.
7. Shamseer L, Moher D, Clarke M, Ghersi D, Liberati A, Petticrew M, et al. Preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P) 2015: elaboration and explanation. Bmj. 2015;350:g7647. doi: 10.1136/bmj.g7647.
8. Filho JC, Vedovello SA, Venezian GC, Vedovello Filho M, Degan VV. Women's oral health-related quality of life as a risk factor for TMD symptoms. A case-control study. Cranio. 2023;41(2):139-43. doi: 10.1080/08869634.2020.1833159.
9. Yap AU, Natu VP. Inter-relationships between pain-related temporomandibular disorders, somatic and psychological symptoms in Asian youths. J Oral Rehabil. 2020;47(9):1077-83. doi: 10.1111/joor.13033.
10. Natu VP, Yap AU, Su MH, Irfan Ali NM, Ansari A. Temporomandibular disorder symptoms and their association with quality of life, emotional states and sleep quality in South-East Asian youths. J Oral Rehabil. 2018;45(10):756-63. doi: 10.1111/joor.12692.
11. Paz-Cortés MM, Martín-Vacas A, Mendoza PA, Rozalén M, Alvaredo M. Analysis of the effect of exams on perceived stress and temporomandibular joint status in physiotherapy students: a pilot study. Medicina (Kaunas). 2024;60(6):952. doi: 10.3390/medicina60060952.
12. Wu J, Huang Z, Chen Y, Chen Y, Pan Z, Gu Y. Temporomandibular disorders among medical students in China: prevalence, biological and psychological risk factors. BMC Oral Health. 2021;21(1):549. doi: 10.1186/s12903-021-01916-2.
13. Romani V, Di Giorgio R, Castellano M, Barbato E, Galluccio G. Prevalence of craniomandibular disorders in orthodontic pediatric population and possible interactions with anxiety

and stress. Eur J Paediatr Dent. 2018;19(4):317-23. doi: 10.23804/ejpd.2018.19.04.13.

14. Sanders AE, Slade GD, Bair E, Fillingim RB, Knott C, Dubner R, et al. General health status and incidence of first-onset temporomandibular disorder: the OPPERA prospective cohort study. J Pain. 2013;14(12 Suppl):T51-62. doi: 10.1016/j.jpain.2013.06.001.

15. Jomhawi JM, Elsamarneh AM, Hassan AM. Prevalence of temporomandibular disorder among schoolchildren in Jordan. Int J Clin Pediatr Dent. 2021;14(2):304-10. doi: 10.5005/jp-journals-10005-1939.

16. de Melo Júnior PC, Aroucha J, Arnaud M, de Souza Lima MG, Gomes SG, Ximenes R, et al. Prevalence of TMD and level of chronic pain in a group of Brazilian adolescents. PLoS One. 2019;14(2):e0205874. doi: 10.1371/journal.pone.0205874.

17. Dickson SJ, Oar EL, Kangas M, Johnco CJ, Lavell CH, Seaton AH, et al. A systematic review and meta-analysis of impairment and quality of life in children and adolescents with anxiety disorders. Clin Child Fam Psychol Rev. 2024;27(2):342-56. doi: 10.1007/s10567-024-00484-5.

18. Meda RT, Nuguru SP, Rachakonda S, Sripathi S, Khan MI, Patel N. Chronic pain-induced depression: a review of prevalence and management. Cureus. 2022;14(8):e28416. doi: 10.7759/cureus.28416.

19. Pigozzi LB, Pereira DD, Pattussi MP, Moret-Tatay C, Irigaray TQ, Weber JB, et al. Quality of life in young and middle age adult temporomandibular disorders patients and asymptomatic subjects: a systematic review and meta-analysis. Health Qual Life Outcomes. 2021;19(1):83. doi: 10.1186/s12955-021-01727-7.

20. Minervini G, Franco R, Marrapodi MM, Fiorillo L, Cervino G, Cicciù M. Economic inequalities and temporomandibular disorders: a systematic review with meta-analysis. J Oral Rehabil. 2023;50(8):715-23. doi: 10.1111/joor.13491.

21. Valesan LF, Da-Cas CD, Réus JC, Denardin AC, Garanhani RR, Bonotto D, et al. Prevalence of temporomandibular joint disorders: a systematic review and meta-analysis. Clin Oral Investig. 2021;25(2):441-53. doi: 10.1007/s00784-020-03710-w.

22. Sivakumar A, Ganesan A, Lakshmi KC, Aniyan Y, Kannan S. Evaluation of the articular disc using the magnetic resonance CartiGram in asymptomatic and symptomatic temporomandibular disorders. Indian J Radiol Imaging. 2025;35(1):50-8. doi: 10.1055/s-0044-1788608.

23. Aniyan KY, Patil K, Guledgud MV. Assessment of knowledge, attitude, and practice of oral disease management among doctors practicing the Ayurveda system of medicine: a questionnaire-based study guide to unconventional dentistry. J Indian Acad Oral Med Radiol. 2023;35(2):222-5. doi: 10.4103/jiaomr.jiaomr_291_22.