

**Factors Associated With Temporomandibular Disorders in Children and Adolescents: A Systematic Review**

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**Type of Publication:** Review Article

**Conflicts of Interest:** Nil

**Abstract**

**Background:** The aim of this systematic review was to assess the Temporomandibular disorders in children and adolescents and various factors associated with it.

**Objectives:** The aim of this systematic review is to recognize the disorders of TMJ, masticatory muscles and associated structures in children and intends to assist the practitioner in the recognition and diagnosis of TMD (temporomandibular disorders) and to identify possible treatment options.

**Data Sources:** Electronic database using search engines Pubmed, Ebsco Host, Cochrane review (from 01/01/2007 to 31/12/2018 were searched)

**Selection Criteria:** Abstracts that appeared to fulfill the inclusion criteria of TMD in children were included. The full text original articles were then retrieved. Their references were also hand searched.

**Data Extraction:** Data were extracted from the original articles which described the TMJ disorders in children and all the studies that met the inclusion criteria. We selected

only studies in which the investigators' primary objective was to evaluate the TMJ disorders and factors associated with it according to the international Research Diagnostic Criteria for Temporomandibular Disorders (RDC/TMD) in children and adolescents and in which dentist was evaluating the TMD.

**Data Synthesis:** A total of 1863 publications were identified from pub med search engine and 11 from Ebsco Host. A total of 504 articles from Pubmed and 8 from Ebsco Host were identified after applying filter of last 10 years. Then 423 articles were passed which included the human studies and full texts. A total of 395 articles were included after customising the filter from 1/1/2007 to 31/12/2018. After screening the articles with the full papers, 350 articles were short listed. On advance searching age filter child birth to 18 years was applied giving a data of 332 articles. All the articles were hand searched and we selected 21 articles and one systematic review.

## Introduction

American Dental Association in 1983 adopted Temporomandibular disorder (TMD) as “functional disturbances of the masticatory system” including masticatory muscle disorders, degenerative and inflammatory TMJ disorders and TMJ disk displacements under the umbrella of TMD.<sup>1</sup>

The clinical signs are TMJ sounds, limitation of mandibular movement, and TMJ and muscle tenderness while the symptoms are difficulty in mouth opening, jaw pain, myofascial pain and dysfunction, arthritic disorders, internal derangement and muscle hyperactivity disorders.<sup>2</sup>

Parafunctional habits such as bruxism, lip/cheek biting, thumb sucking, , tooth grinding, jaw clenching, finger biting, trauma, genetics, bodily pain complaints, female gender or anatomic problems, psychosocial factors may be considered the risk factors of TMD and effect quality of life.<sup>2,3</sup> The Prevalence of TMD ranges between 6% to 68% and it increases particularly in girls between 12-15 years as the age advances.<sup>4,5</sup>

To gain a better insight of TMD in children and adolescents a timely diagnosis, focused examination and the knowledge about the factors associated is important to prevent and minimise pain and discomfort.<sup>6,7</sup>

The aim of this review is to see the association of various factors associated with temporomandibular disorders in children and adolescents.

## Methodology

### Design and Search Strategy

This systematic review followed the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) checklist. The search strategy of this systematic review is fabricated to address the TMJ disorders in children and to address the question:

“Do children and adolescents have TMJ disorders? and “Does it affect their quality of life?”

## Review methods

Titles and abstracts of all studies published between January 2007 to December 2018 using Pubmed , Ebsco Host ,Google scholar were searched using MeSH terms (Medical Subject Headings). Handsearching of the references derived from the key articles was done to ensure that no studies were missed.

The search strategy included appropriate changes in keywords. MESH terms, and other free terms related to TMD , risk factors, etiology , causes, children and adolescents with Boolean operators (OR, AND) to combine searches. The terms used were TMD children, TMD adolescent, TMD factors, TMJ disorders, TMD risk factors.

The articles appearing in one or more database search were considered only once. All the articles were selected and reviewed by three review author and any disagreement regarding the selection process was resolved by discussion. The abstracts with incomplete information were fully retrieved and a decision was made regarding their inclusion.

## Eligibility Criteria

### Inclusion Criteria

Articles published between January 2007 to December 2018 were reviewed.

- Studies in which the authors had investigated the prevalence of clinical signs of TMJ disorders in children and adolescents (aged 0-18 years).
- Studies that evaluated TMJ signs according to the Research Diagnostic Criteria for Temporomandibular Disorders (RDC/TMD) established by the International RDC/TMD Consortium Network of the International Association for Dental Research and the Orofacial Pain Special Interest Group or by using similar criteria even if they had not referenced the criteria as being RDC/TMD were included.

- Systematic reviews, cohort studies, randomized controlled trials and longitudinal studies were included.
- Articles published in English language were included.

**Exclusion Criteria**

- Animal studies.
- Incomplete Reviews, letters, conference abstracts, and expert opinions.
- Studies in which members of the sample had craniofacial anomalies, genetic syndromes, or neuromuscular diseases.
- Studies with participants who were undergoing any active orthodontic treatment or participants whose conditions indicated a need for orthognathic surgery.
- Studies whose authors investigated only muscular symptoms.
- Studies in which the operating dentist did not conduct the interview, the examination, or both.
- The articles in which there was no significant correlation between the associated factor and TMD as mentioned in the title.

**Data Extraction:** Data were extracted from the original articles

**Studies Selected Based On Inclusion Criteria**

**Study selection**

**Results**

Executing the search strategy generated articles. Following the reviewer’s assessments of the abstracts, a Summary of descriptive characteristics of included articles.

Author/ Country	Country/Place	SampleSize	Age Group	Sample	Methodology	Etiological Factors
I.Bertoli FM, Anto niuk SA (2007) <sup>8</sup>	Hospital de Clínicas de Curitiba, Paraná	50	4-18	Neuropediatric ambulatory	Questionnaire	Higher frequency of TMD with headaches More in tense people than calm.

total of 1863 articles were identified from pub med search engine and 11 from ebsco host. A total of 504 articles from pubmed and 8 from ebsco host were identified after applying filter of last 10 years. Then 423 articles were passed which included the human studies and full texts. After obtaining the full papers, data extraction further papers were excluded leaving a total of 21 papers and one systematic review that met all of the study’s inclusion criteria

Executing the search strategy generated articles. Following reviewes assessments of abstracts a total of 1303 articles were identified from pubmed after searching TMJ disorders in children and adolescents in the search box. Applying the filter of studies on humans resulted in search of 1297 articles. A total of 395 articles were included after customising the filter from 1/1/2007 to 31/12/2018. After screening the articles with the full papers, 350 articles were short listed. On advance searching age filter child birth to 18 years was applied giving a data of 332 articles. All the articles were hand searched and we selected 21 articles and one systematic review.

**Study characteristics:** 21 original research and 1 systematic review were selected based on the inclusion criteria. The studies in various countries like Croatia, Parana, Southern Portugal, Brazil, Sweden, Tokya Japan, America ,Jeddah, Turkey, Israel, Korea, Indonesia were selected.

2. Pizolato R. A. , Silva De Freitas  Fernande s F, Beatriz Duarte Gaviã M. (2009 ) <sup>9</sup>	Sao Paulo,Brazil	152 children	8 to 12 years.	Public schools	Axis I of the Research Diagnostic Criteria for TMD (RDC/TMD) and the symptoms, using a questionnaire.	TMD was not associated with abnormal deglutition.  Orofacial myofunctional alterations could be considered influencing factors on TMD.
3.Stejpan Spalj Martina slaj (2010) <sup>10</sup>	Zagrib ,Croatia	1597	11-19	16 schools	Dental aesthetic index  Aesthetic component of index of orthodontic treatment need  Questionnaire	Parafunctional habits, ectopic eruption, were related to severe TMD Signs  Headaches presented positive relationship with severe rotation, reverse overjet, spacing and lateral openbite  Females are affected more
4. Pizolato RA, Fern andes FS, Gavi ão MB (2011) <sup>11</sup>	Sao Paulo,Brazil	244 children (183 girls and 61 boys) aged	5–12 years		Questionnaire	One habit  Stressful life events with increase in the performance of multiple oral parafunctions in children
5.Racque l Aparecid a Pizolata Maria Beatriz Duarte Gaviao(2 013) <sup>12</sup>	Piracicaba ,SP,Brazil	152 children(78 boys 74 girls)	8 to 12 years	2 public schools	Hospital Anxiety and Depression scale	Children with open lips were six times more susceptible to TMD than those with adequate lip closure  18 fold more higher anxiety level in children with TMD.
6.Beatri Minghelli et al (2014) <sup>4</sup>	Southern Portugal	3260	5-19 years	Public schools of 16 countries	Fonseca Anamnestic Questionnaire	<ul style="list-style-type: none"> <li>• Aggravated by tension, nervousness, and emotional stress</li> <li>• More in females</li> </ul>

7.Lara Jansiski Motta(2015) <sup>13</sup>	Brazil	48	6-9 years	Pediatric clinic of school of dentistry	Pertes and Gross Palpation  Method	Association between bruxism and joint sounds in children  72.25% exhibited clicking /popping sound  27.5% exhibited crepitation
8.G.Fernandes(2015) <sup>7</sup>	Brazil	7172	12-14 years	24 schools	Brazilian – Portuguese  RDC/ TMD questionnaire	Sleep bruxism, awake bruxism, other parafunctional habits, bodily pain associated with TMD
9. Karibe H, Shimazu K, Okamoto A, Kawakami T, Kato Y, Warita-Naoi S.(2015) <sup>14</sup>	Tokyo japan	1,415 subjects	11–15 years old	6 schools	State Trait Anxiety Inventory for Children-Trait (STAIC-T) scale  RDC/ TMD questionnaire	The prevalence rates for headache and neck pain were significantly higher in the TMD group than in the control group.  Diurnal clenching had a strong association with TMD
10. Ah-Hyeon Kim, Hyun-Dae Lim, So-Youn An, Je-Woo Lee, Ji-Young Ra (2016) <sup>15</sup>	Korea	18,112 Subjects	10, 12, and 15 Year-Old Children	2010 National Oral Health Surveys	3 Questionnaires	Prevalence during mouth opening was 13.0%,  TMJ pain – 3.1%  TMJ limitation- 4.3%  Higher in females  Older the subjects higher The Prevalence Of TMJ sounds, TMJ pain, and limitation of mouth opening
11.Marita R.Inglehart et al (2016) <sup>6</sup>	America	8302	4-12 years	35 schools	Michigan oral health related quality of life scale-child version (MOHRQoL-C)	More in Females than Males  More in African American than European American  TMD is seen significantly associated with poorer OHRQoL
12.Aman Al Khotani ,Aron N Akbari	Jeddah	456	10-18	10 boys  10 girls school	Research diagnostic criteria for TMD (RDC/TMD)	Myofacial pain is the most common casue of TMD followed by disc displacement with reduction, arthralgia.

(2016) <sup>16</sup>						
13. Marina de Faria da Silva (2016) <sup>17</sup>	Sau Paulo Brazil	248	12 years	Public schools	Child perceptions Questionnaire	TMD symptoms associated with pain and teeth clenching having negative impact on quality of life
14. Ulku Sermet Elbay, Husniye D Kocasara c, (2017) <sup>2</sup>	Turkey	385	8-18 years	3 schools	Questionnaire	TMD is seen more in child-protection institutions (CLCPI) than with children living with their parents (CLWP)
15. Bilgiç F, Gelgör İE (2017) <sup>5</sup>	Kirikkale, Turkey	923	7-12 years	Randomly from 3 schools	Clinical Dysfunction Index (Modified Helkimo Dysfunction Index)	Malocclusion =40% TMD is high in class III malocclusion, bimaxillary protrusion, decreased and increased overjet and crossbite cases
16. Cortese S, Mondillo A, Galarza R, Biondi A (2017) <sup>18</sup>		243	10 to 15 years			Significant association was observed between muscular TMD and alterations in spinal curves, head posture, and lower limbs: The most frequent types were hyperlordosis  Alterations in head posture, vertebral curves and lower limbs could be considered risk factors for muscular TMD.  The most frequent postural alterations were lumbar hyperlordosis, forward head posture and genu valgus.
17. Fernanda Mara de Paiva Bertoli (2018) <sup>19</sup>	Curitiba PR, Brazil	934 adolescents	10 to 14 years	Public and private schools	State-Trait Anxiety Inventory (STAI -T)  AAOP questionnaire,	Prevalence of at least one type of malocclusion was found in 52.3%.  Anxiety was found in high level (12.2%), moderate (70.4%) and low (17.5%).  Presence of high anxiety was significantly associated with the prevalence of TMD symptoms ( $P < 0.001$ ), as well as the prevalence of myofascial pain ( $P < 0.001$ ) and prevalence of disc displacement with reduction ( $P < 0.001$ ).  Adolescents Class II had higher prevalence of myofascial pain (Class II ( $P < 0.015$ )) than adolescents Class I. Adolescents Class III presented higher prevalence of myofascial

						pain ( $P = 0.004$ ) than adolescents Class I.
18. Bertoli FMP, Br uzamolín CD, Pizzato E, Losso EM, Brancher JA(2018) <sup>20</sup>	Brazil	934 adolescents	(10-14-years-old)	public and private schools	Questionnaire by the American Academy of Orofacial Pain.	There was a significant association between sex and TMD symptoms; Prevalence of myofascial pain of TMD was significantly higher in girls
19. Carolina Marpaung Maurits K.A. van Selms  Frank Lobbezo (2018) <sup>21</sup>	Greater Jakarta, Indonesia	1800	7 to 12 years (parental report) and adolescents aged 13-18 years (self-report).	National elementary schools and high schools located in rural and city areas	Dutch questionnaire  Originally made by Van Selms et al	Psychological factors and the presence of bodily pain were strongly associated with pain-related TMDs in both children and adolescents, Oral habits (in children),  Sleep and awake bruxism (in adolescents)  Socioeconomic status of parents was not associated with pain-related TMD.
20. Amal Alkhotani(2018) <sup>22</sup>	Jeddah	386	10 and 18 years	Two schools with boys and Two schools with girls	Child Behavior Checklist scale	Higher frequency of anxiety, depression and somatic complaints in their children than the parents of children in the non-TMD group .  Only one significant association regarding the externalizing problems was found for the aggressive behavior in the TMD-pain group.
21. Carolina Marpaung, Frank Lobbezo, and Maurits K. A. van Selms(2018) <sup>3</sup>		4,235	12 and 18 years			Prevalence of pain-related TMDs was 21.6% (26.1% for girls and 17.6% for boys) and that of TMJ sounds was 15.5% (19.3% for girls and 11.7% for boys).  Strongest predictors of TMD pain: female gender, increasing age, sleep bruxism, biting on lips and/or cheeks, stress, and feeling sad.  Regarding self-reported TMJ sounds revealed that female gender, increasing age, awake bruxism, and biting on lips and/or cheeks were the strongest predictors.

**Systematic Review**

Da Silva CG, Pachêco-Pereira C, Porporatti AL, Savi MG, Peres MA, Flores-Mir C, Canto Gde L. (2016) <sup>23</sup>	RDC/TMD	11 articles that described studies in which 17051 participants were enrolled	Prevalence of TMJ sounds was 14% The most prevalent was clicking followed by jaw locking
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**Articles excluded and the reasons for the exclusion**

Author, Year	Reason For Exclusion
Barbosa TS, Gavião MB (2008) <sup>24</sup>	10
Nilsson IM, Drangsholt M, List T(2009) <sup>25</sup>	5,9
Paulsson L, Ekberg E, Nilner M, Bondemark L.(2009) <sup>26</sup>	11
Moyaho-Bernal A, Lara-Muñoz Mdel C(2010) <sup>27</sup>	8
Tecco S, Festa F (2010) <sup>28</sup>	3
Carra MC, Huynh N, Morton P, Rompré PH, Papadakis A, Remise C, Lavigne GJ(2011) <sup>29</sup>	3
Barbosa TS, Castelo PM, Leme MS, Gavião MB.(2011) <sup>30</sup>	9
A.Anastassaki Kohler(2012) <sup>31</sup>	5,10
Vierola A, Suominen AL, Ikavalko T, Lintu N, Lindhi V, Lakka HM, KellokoskiJ, Narhi M, Lakka TA(2012) <sup>32</sup>	9
Gary D. Slade, Anne E. Sanders (2013) <sup>33</sup>	5
Branco LP, Santis TO, Alfaya TA, Godoy CH, Fragoso YD, Bussadori SK.(2013) <sup>34</sup>	9
Assaf AT, Kahl-Nieke B, Feddersen J, Habermann CR (2013) <sup>35</sup>	13
Leme M, Barbosa T, Castelo P, Gavião MB(2013) <sup>36</sup>	9
Franco-Micheloni AL, Fernandes G, Gonçalves DA, Camparis CM(2014) <sup>37</sup>	9
Marangoni de Godoy CH Biasotto-Gonzalez DA Alfaya TA Fernandes KP, Mesquita-Ferrari RA Bussadori SK.(2014) <sup>38</sup>	9
Keller H,Muller LM (2015) <sup>39</sup>	13
Litko M, Szkutnik J, Berger M (2016) <sup>40</sup>	5
Lauren M. Horton ,Rita Marie John, EdD, Hiroyuki Karibe PhD,Patricia Rudd PT,(2015) <sup>41</sup>	10
Yasuda E, Honda K, Hasegawa Y, Matsumura E, Fujiwara M, Hasegawa M, Kishimoto H(2016) <sup>42</sup>	13
Gökalp H(2016) <sup>43</sup>	3
Hongxing L, Astrøm AN(2016) <sup>44</sup>	5
Kobayashi FY, Gavião MBD, Marquezim MCS, Fonseca FLA(2017) <sup>45</sup>	9
Kranya-Victoria Díaz-Serrano (2017) <sup>46</sup>	13
Essam Ahmed Al-Moraissi(2017) <sup>47</sup>	3
Simona Tecco (2017) <sup>48</sup>	3
Saeid Nokar (2018) <sup>49</sup>	5
S Obamiyi, S Malik, Z Wang(2018) <sup>50</sup>	3,5

**Studies Were Excluded For the Following Reasons**

1. Reviews, letters, conference abstracts and personal opinions
2. Studies in which sample included patients with craniofacial anomalies, genetic syndromes, or neuromuscular diseases
3. Studies in which sample included orthodontically treated patients or undergoing orthognathic surgeries
4. Animal studies
5. Studies in adults other than children and adolescents above 18 year



6. Studies in which interview, examination or both weren't done by dentist
7. Didn't follow RDC for temporomandibular disorders
8. Studies whose full text is unavailable
9. Nothing relevant regarding the factors associated with TMD in the title
10. Review of literature: a retrospective study covering studies before 2007
11. On premature children
12. Retrospective study
13. Invasive technique base
14. Only abstracts available
15. No study included

### **TMD Prevalence**

It is seen one in 6 children and adolescents have clinical signs of TMD which is alarming.<sup>23</sup> The prevalence of TMD (ages till 18 years) varied between 7.3 and 30.4%.<sup>51</sup> 6-68% of children and adolescents show TMD.<sup>2</sup> Kohler reported the TMD-related symptoms were rare in three and five year olds whereas 5-9% of 10- and 15-year olds reported more severe symptoms.<sup>24,52</sup> Higher prevalence of TMD was found in children with Angle's Class III malocclusion, bimaxillary protrusion, decreased and increased overjet, deep bite or open bite, and posterior crossbite.<sup>5</sup> The prevalence of self-reported TMD symptoms range from 23.6% of children reporting facial pain on chewing tough food to 18.8% of those who reported pain on opening their mouth wide. The prevalence data reported in prior research TMD ranged from only 7% among 12-18 year old children by List et al. to 35% in a study by Vierola with children aged between 6 and 8 years.<sup>6</sup> Girls were more likely to report TMD symptoms than boys and children from African American backgrounds were more likely than children from European American background to report TMD symptoms.<sup>6</sup>

Thilander et al. showed that 25% of the 5-17 year old children in their study had one or more signs of TMD, and Feteih found that 21.3% of their 12-16 year old subjects exhibited at least one sign of TMD.<sup>32,53</sup>

### **Severity**

The most common symptoms of TMD observed in this study included emotional stress (52%), headache (36.8%), habit of clenching or grinding teeth (27.3%), pain in the neck (17.7%), fatigue/muscle pain while chewing (14.3%), and ear pain (14.2%).<sup>4</sup>

Children who grind their teeth, play a wind instrument, finger nail biting were found to complain more often of pain and muscle tenderness when eating. Depression, anxiety, posttraumatic stress disorder, psychologic distress, and sleep dysfunction may influence TMD prognosis and symptoms.<sup>12</sup> Systemic factors may include joint hypermobility, genetic susceptibility, and hormonal fluctuations. Generalized joint laxity or hypermobility (eg. Ehler Danlos syndrome) has been cited but has a weak association with TMD. Both Jedel et al. and Barbossa et al. found that children with TMD symptoms had a lower oral health-related quality of life than children with no TMD symptoms.<sup>6,53</sup>

### **TMD And Musical Instruments**

A possible association between TMD and playing a violin is seen. It is whether playing a musical instrument is directly associated with TMD, or only in combination with other factors.<sup>54,55</sup>

### **TMD and Parafunction**

Bruxism is considered a risk factor for temporomandibular dysfunction (TMD).<sup>21</sup> Studies have found that a child's emotional status may influence the risk of developing signs of TMD. High tension level can lead to the development of a constant dental clamping, which affects the local circulation in muscles, altering the cell membranes that perform ion

exchange leading to an accumulation of lactic and pyruvic acids which results in the stimulation of pain receptors.<sup>4</sup>

Females have high stress level than men throughout life and coping with this stress leads to TMD because of parafunctional habits ,tension, anxiety,headaches and overload of masticatory system. The fluctuating hormones decrease pain threshold and thereby increase the TMD pain prevalence.<sup>4</sup>

### Conclusion

This systematic review concluded TMD is a condition found in the pediatric population, and it is important to take an adequate history and physical examination .Lower prevalence rates of joint sounds are found in 6-7 years in comparison to 8-9 years. Girls have significantly higher prevalence of TMD than boys which increases with age.

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