

# Economic inequalities and temporomandibular disorders: A systematic review with meta-analysis

Giuseppe Minervini<sup>1,2</sup>  | Rocco Franco<sup>3</sup>  | Maria Maddalena Marrapodi<sup>4</sup>  |  
Luca Fiorillo<sup>5</sup>  | Gabriele Cervino<sup>5</sup>  | Marco Ciccù<sup>6</sup> 

<sup>1</sup>Multidisciplinary Department of Medical-Surgical and Odontostomatological Specialties, University of Campania "Luigi Vanvitelli", Naples, Italy

<sup>2</sup>Faculty of Dentistry, Alexandria University, Alexandria, Egypt

<sup>3</sup>Department of Biomedicine and Prevention, University of Rome "Tor Vergata", Rome, Italy

<sup>4</sup>Department of Woman, Child and General and Specialist Surgery, University of Campania "Luigi Vanvitelli", Naples, Italy

<sup>5</sup>School of Dentistry Department of Biomedical and Dental Sciences and Morphofunctional Imaging, University of Messina, Messina, Italy

<sup>6</sup>Department of Biomedical and Surgical and Biomedical Sciences, Catania University, Catania, Italy

## Correspondence

Maria Maddalena Marrapodi, Department of Woman, Child and General and Specialist Surgery, University of Campania "Luigi Vanvitelli", Naples, Italy.

Email: [mariamaddalena.marrapodi@studenti.unicampania.it](mailto:mariamaddalena.marrapodi@studenti.unicampania.it)

## Abstract

**Introduction:** Temporomandibular disorders (TMDs) are a common and debilitating condition that affects millions of people globally. Despite extensive research on TMDs, the exact causes of these conditions remain unclear. However, various factors, including genetics, injury and stress, have been implicated in their development. In addition to these traditional risk factors, the literature suggests that socioeconomic status (SES) may also play a role in the development and progression of TMDs. By synthesizing the available evidence, this review will provide a comprehensive understanding of the role of SES in TMDs and will inform the development of targeted interventions to reduce the burden of these disorders among individuals with lower SES.

**Methods:** We conducted this systematic review followed the recommendations of the Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) 2020. PubMed, Scopus and Lilacs were searched using the terms: ((socio-economic status OR economic status) AND (temporomandibular disorders OR temporomandibular joint)) from the inception until February 10, 2023. We applied the following questions: (P) Participants consisted of human subjects. (E) The Exposure consisted of low economic status. (C) The Comparison: subjects reporting low economic status were compared to subjects reporting medium-high economic status. (O) The Outcome consisted of TMDs diagnosis. Review Manager version 5.2.8 (Cochrane Collaboration; 2014) software was applied to perform the pooled analysis.

**Results:** The included subjects in this review were 14 607. Among them, 631 reported a low economic income, 1880 a medium-high economic income, 4617 were blue-collar workers and 7478 were white-collar workers or entrepreneurs. Among those reporting a low economic income or belonging to the blue-collar workers 12.93% (679/5248) presented sign/symptoms of TMD or a diagnosis of TMD whereas 10.6% (997/9358) of those with a high economic income/white-collar worker.

**Conclusion:** We observed a slightly higher prevalence of TMD among individuals with a low economic income. Further research is needed to better understand this

relationship and to develop effective interventions to reduce the burden of TMD among individuals with low income.

#### KEYWORDS

economic inequalities, poverty, socioeconomic status, temporomandibular disorders, TMD

## 1 | INTRODUCTION

Temporomandibular disorders (TMDs) are a common and debilitating condition that affects millions of people globally<sup>1-6</sup> of every age and gender.<sup>7</sup> TMDs encompass a wide range of conditions that affect the temporomandibular joint (TMJ) and the muscles that control jaw movement.<sup>8-11</sup> These disorders can cause a wide range of symptoms, including pain, joint noises, limited jaw movement and difficulty chewing.<sup>12-14</sup> Despite extensive research on TMDs, the exact causes of these conditions remain unclear. However, various factors, including genetics, injury and stress, have been implicated in their development.<sup>14-17</sup>

In addition to these traditional risk factors, the literature suggests that socioeconomic status (SES) may also play a role in the development and progression of TMDs.<sup>18-23</sup> SES is a complex construct that encompasses several dimensions, including income, education and occupational status. Previous research has suggested that individuals with lower SES are more likely to experience a wider range of chronic health conditions,<sup>24</sup> including musculoskeletal disorders, compared to those with higher SES.<sup>25-29</sup>

Given the potential role of SES in the development and progression of TMDs, it is important to conduct a systematic review of the existing evidence. This review will aim to examine the relationship between SES and TMDs, including studies that have explored the impact of SES on the prevalence, incidence and severity of TMDs. By synthesizing the available evidence, this review will provide a comprehensive understanding of the role of SES in TMDs and will inform the development of targeted interventions to reduce the burden of these disorders among individuals with lower SES.

## 2 | MATERIALS AND METHODS

### 2.1 | Eligibility criteria

To guide the selection of relevant studies and to define the study population, exposure, comparator and outcomes of interest (PECO),<sup>30</sup> we applied the following questions:

- (P) Participants consisted of human subjects.
- (E) The Exposure consisted of low economic stats.
- (C) The Comparison: subjects reporting low economic status were compared to subjects reporting medium-high economic status.
- (O) The Outcome consisted of TMDs diagnosis.

TABLE 1 Search strategy.

#### PubMed

Search: (((socioeconomic AND status) OR (economic status) AND (temporomandibular AND disorders OR temporomandibular joint)))  
 (((("socioeconomic factors"[MeSH Terms] OR ("socioeconomic"[All Fields] AND "factors"[All Fields]) OR "socioeconomic factors"[All Fields] OR "socioeconomics"[All Fields] OR "socioeconomic"[All Fields] OR "socioeconomical"[All Fields] OR "socioeconomically"[All Fields]) AND "status"[All Fields]) OR ("economic status"[MeSH Terms] OR ("economic"[All Fields] AND "status"[All Fields]) OR "economic status"[All Fields])) AND (("temporomandibular"[All Fields] AND ("disease"[MeSH Terms] OR "disease"[All Fields] OR "disorder"[All Fields] OR "disorders"[All Fields] OR "disorder s"[All Fields] OR "disordes"[All Fields])) OR ("temporomandibular joint"[MeSH Terms] OR ("temporomandibular"[All Fields] AND "joint"[All Fields]) OR "temporomandibular joint"[All Fields]))

#### Lilacs

temporomandibular disorders [Palavras] and socioeconomic status [Palavras] or economic status [Palavras]

#### Scopus

TITLE-ABS-KEY (((socioeconomic AND status) OR (economic status)) AND (temporomandibular AND disorders OR temporomandibular joint))

Exclusion criteria: (1) diagnosis of rheumatic diseases or chronic inflammatory disorders (e.g. rheumatoid arthritis, juvenile, idiopathic arthritis, psoriatic arthritis); (2) diagnosis of fibromyalgia; (3) congenital abnormality or neoplastic conditions in the TMJ region; (4) studies including subjects undergoing arthrocentesis or intra-articular infiltrations; (5) studies including local pressure pain assessment; (6) studies including women in menopause in the control group; (7) cross-over study design; (8) language different from English; (9) full-text unavailability (i.e. posters and conference abstracts); (10) studies involving animals; (11) review (topical or systematic) article; (12) case reports/series; and (13) studies evaluating TMDs prevalence in subjects not pregnant.

### 2.2 | Search strategy

We conducted this systematic review followed the recommendations of the Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) 2020. PubMed, Scopus and Lilacs were searched using the terms: ((socio-economic status OR economic status) AND (temporomandibular disorders OR temporomandibular joint) from the inception until February 10, 2023 (Table 1). A manual search

for articles reported by published systematic and topical reviews on similar topics. The protocol of this systematic review has been registered on the International Prospective Register of Systematic Reviews (PROSPERO) with the number CRD42022353539.

## 2.3 | Data extraction

A data extraction form was used to record on a Microsoft Excel sheet the relevant information from each study, including study characteristics (e.g. design, sample size, setting and population), intervention details, outcomes and results. The data extraction process was conducted by two independent reviewers to ensure reliability and minimize potential sources of bias. Any discrepancies were resolved through consensus or consultation with a third reviewer. The extracted data served as the basis for further analysis and synthesis of the results.

Particularly, data extracted consisted in: (1) First author; (2) Year of publication; (3) Nationality; (4) Number of study participants; (5) Gender of study participants; (6) Number of blue-collar versus white-collar workers; (7) Number of subjects reporting low economic income versus medium/high economic income; (8) Diagnostic criteria/tools used for the diagnosis of TMD; (9) Prevalence of TMJ/myofascial pain in blue-collar workers/low-income reporting subjects; (10) Prevalence of TMJ/myofascial pain in white-collar workers/entrepreneurs/high-income reporting subjects.

## 2.4 | Quality assessment

The risk of bias was managed by using a standardized and systematic approach to assess the quality of the included studies. The assessment was conducted by two independent reviewers (GM and RF) using the Version 2 of the Cochrane risk-of-bias tool for randomized trials (RoB 2) to ensure reliability and minimize potential sources of bias. Any discrepancies were resolved through consensus or consultation with a third reviewer (MC). The results of the risk of bias assessment were used to inform the interpretation of the results and to make a judgement on the overall quality of the evidence. This provided a comprehensive evaluation of the strengths and limitations of the included studies, allowing for a more informed and accurate synthesis of the results in the systematic review.

## 2.5 | Statistical analysis

Review Manager version 5.2.8 (Cochrane Collaboration; 2014) software was applied to perform the pooled analysis. The risk ratio (RR) between the subjects reporting low economic status and those reporting medium-high economic status was used. To assess Heterogeneity among studies we applied the Higgins Index ( $I^2$ ) and the chi-square test. Heterogeneity was classified in: low (<30%), medium (30%–60%) and high (>60%).

## 3 | RESULTS

### 3.1 | Study characteristics

Three studies were included in the systematic review and meta-analysis, all of which were cross-sectional studies. The studies had sample sizes ranging from 100 to more than 10000 participants, with a majority of female participants. The included studies have been published between 2006 and 2021. All studies had a cross-sectional design and assessed the prevalence of TMD symptoms and sign in subjects based on economic income or type of occupation. Study selection was performed as illustrated in the PRISMA 2020 flowchart in [Figure 1](#). Nine articles were excluded before the screening: three review articles, two articles were studies on animal and 4 were not in English (Spanish or Portuguese). The remaining 144 articles were selected for the title and abstract screening to evaluate whether they meet the PECO criteria. Eighteen records were duplicates and, therefore, were excluded. One hundred and twenty-six article were assessed for eligibility. Among these, eight were not retrieved, 115 were excluded as the population, the outcome and/or predictors were not of interest. All these three studies reported the prevalence of TMD sign and symptoms comparing it based on the economic status of the subjects. The data extracted from each study, as reported in the paragraph 'data extraction' are reported in [Table 2](#).

### 3.2 | Main findings

The included subjects in this review were 14 607. Among them, 631 reported a low economic income, 1880 a medium-high economic income, 4617 were blue-collar workers and 7478 were white-collar workers or entrepreneurs. Among those reporting a low economic income or belonging to the blue-collar workers 12.93% (679/5248) presented sign/symptoms of TMD or TMD diagnosis whereas 10.6% (997/9358) of those with a high economic income/white-collar worker. Characteristics of the study populations are presented in [Table 2](#).

In the study by Magalhaes and colleagues 100 hundred subjects between 15 and 70 years were enrolled. 57% were over 30 and 83% were women. None of the participant belonged to Class A, 72% belonged to class B/C (moderate economic income) and 28% reported a low economic income (Class D/E). The authors applied the DC/TMD criteria for the diagnosis of TMD. Fourteen on 100 subjects were diagnosed with myofascial pain and 18% with joint problem. A lower economic class was associated with the presence of myofascial pain and joint problems.<sup>21</sup> When gender, age, economic class and marital status were incorporated into a multivariable model together with myofascial pain, the economic class was the only independent variable associated with a diagnosis of myofascial pain, as participants from Classes D/E had a 4.35-fold greater chance of exhibiting myofascial pain.

In the study by de Sousa et al.,<sup>31</sup> poverty income ratio (PIR) was used to measure economic income, which was calculated by

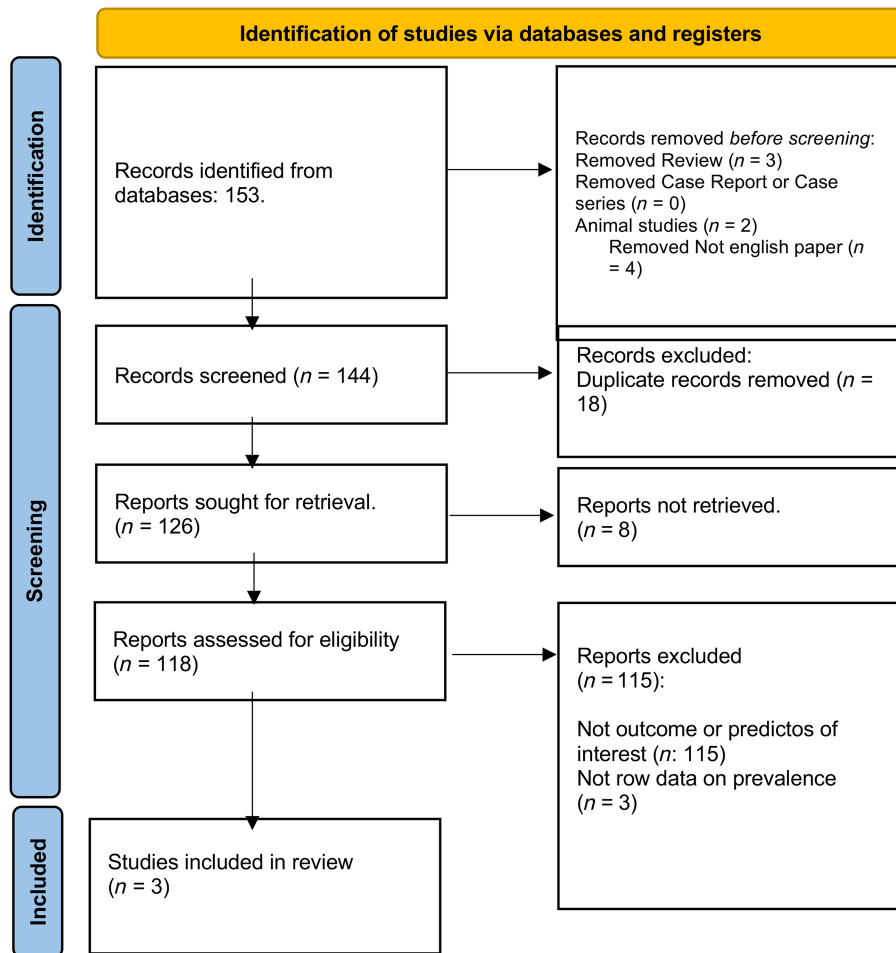


FIGURE 1 Prisma flowchart.<sup>43</sup>

dividing the household income and number of household members by R\$140.00. This value is considered the level of poverty based on World Bank and Brazilian federal government data from 2006. Out of the 1440 participants, 60% had a household per capita income of up to 0.5 minimum wage, 24% had an income between 0.51 and 1.0, 10.3% had an income between 1.01 and 2.0, and 5.2% had an income of more than 2.0 minimum wages. The FAI score, which ranged from 0 to 90 points with a median of 20 and interquartile range of 10–30, was also recorded (data not shown). Over half (51.4%) of the participants reported mild, moderate, or severe TMD, with the most commonly reported symptoms being malocclusion (50.3%), stress (47.5%) and frequent headaches (40.6%). In unadjusted analysis, TMD was found to be more common among adolescents in social classes D-E and C and those with a lower PIR. These relationships held after adjustment. TMD was also more frequently reported among female adolescents, in line with the literature.

In the sample, 12.1% reported some TMD pain, while 11.1% reported difficulty opening their mouth wide.<sup>32</sup> The combination of TMD pain and/or difficulty opening the mouth wide was present in 19.2% of the participants. Women and those who reported poor

general health, dissatisfaction with dental care and their teeth, dental fear, bruxism, intraoral problems (such as overbite or overjet, burning mouth, ulcers or blisters), and those with removable dentures had a significantly higher risk of both TMD pain and dysfunction symptoms. The risk of TMD pain was higher among 50-year-olds, those living in rural areas, blue-collar workers, daily smokers and those reporting dry mouth, changes in taste and changes in the position of their teeth. However, there was no significant difference in the risk of dysfunction symptoms in these groups. A higher risk of difficulty opening the mouth wide was found in those who reported some dental problems (such as tilted or crowded teeth, overbite or overjet), while a lower risk was demonstrated in those who used alcohol and had shift work. The results suggest that those who were aware of a habit of bruxing had approximately four times greater probability of reporting TMD pain and twice the probability of reporting difficulty opening their mouth wide compared to those without bruxism. The risk for women compared to men to have TMD pain and dysfunction symptoms was 1.9 and 1.6, respectively. Those with impaired general health had a higher risk of reporting both TMD pain and dysfunction symptoms (OR 1.8 and 1.4, respectively).

TABLE 2 Data extracted from the studies included in the meta-analysis.

Author	year	Nationality	Number of study participants	Blue collars vs. White collars/Entrepreneurs	Low income vs. High income	Gender N, % of male subjects	Diagnostic criteria	Myofascial/TMJ pain prevalence in subjects with low-income or blue-collar workers	TMD pain prevalence in subjects with high-income or white-collars worker/entrepreneurs
Johansson et al.	2006	Sweden	12095	4617 vs. 7478	—	5727/12905 (44.4%)	Questionnaire designed by the authors to explore TMJ pain	616/4617 (13.3%)	884/7478 (11.8%)
Magalães et al.	2014	Brazil	100	—	28 vs. 72	17/100 (17%)	RDC/TMD Axis I	8/28 (28.6%)	6/72 (8.3%)
De Sousa et al.	2021	Brazil	2412	—	603 vs. 1808	1120 (46.4%)	Fonseca questionnaire	55/603 (9.2%)	107/1808 (5.9%)

Abbreviations: RDC/TMD, Research diagnostic criteria/Temporomandibular disorders; TMJ, Temporomandibular Joint disorders.

### 3.3 | Meta-analysis

The meta-analysis was performed by random model effect due to the high heterogeneity ( $I^2=73%$ ) among the included studies. We considered as outcome the TMD prevalence.

The overall effect, reported in the forest plot (Figure 2), showed that there was a slightly higher prevalence of TMD symptoms in subjects with a low economic income (RR 1.17; 95% CI: 1.07–1.28), suggesting that a low economic income might be a risk factor for TMDs.

### 3.4 | Quality assessment and risk of bias

The risk of bias of the included studies was reported in Figure 3. Risk of bias to the randomization process and the allocation concealment was not applicable as all the studies presented a cross-sectional study design and no randomization process. Two studies excluded a performance; all the studies ensured a high risk of performance bias (blinding of personnel) and 2 of the included studies ensure a low attrition bias.

## 4 | DISCUSSION

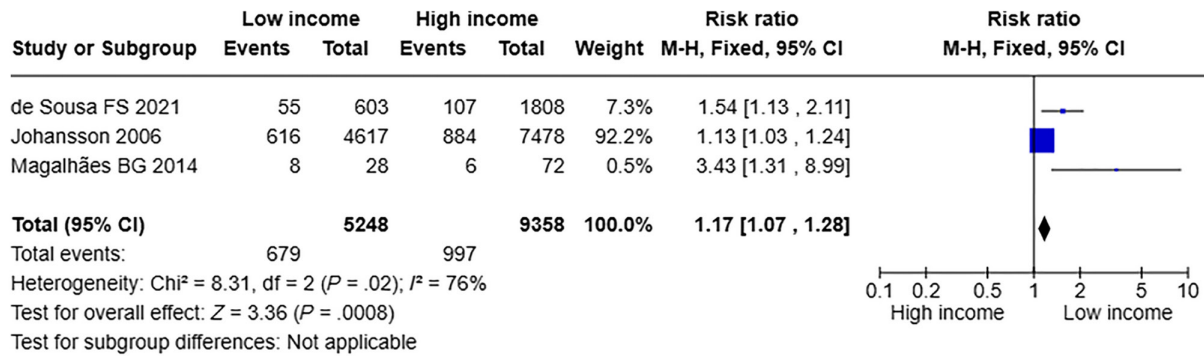
Previous studies have consistently shown a strong correlation between economic condition and health outcomes, including morbidity and mortality rates.

Lower socioeconomic status is associated with a higher risk of chronic diseases such as diabetes, cardiovascular disease and mental health disorders.

The underlying mechanisms linking economic condition and health are complex and multifactorial. Factors such as limited access to healthcare, poor nutrition, exposure to environmental toxins and chronic stress may all contribute to the observed disparities.

In recent years, there has been growing interest in the relationship between economic income and TMDs.<sup>18,32,33</sup> Economic income, as a component of socioeconomic status (SES), has been linked to a wide range of health outcomes, including chronic pain conditions.<sup>34,35</sup> Individuals with lower economic income may face various social and environmental stressors, including poverty, unemployment and inadequate access to health care, that can increase their risk for developing TMDs.<sup>29,32,36–38</sup>

Given the potential role of economic income in TMDs, it was important to conduct a systematic review of the existing evidence. This review aimed to examine the relationship between economic income and TMDs, including studies that have explored the impact of economic income on the prevalence, incidence and severity of TMDs. By synthesizing the available evidence, this review aimed to provide a comprehensive understanding of the role of economic income in TMDs and will inform the development of targeted interventions to reduce the burden of these disorders among individuals with lower economic income.



### Risk of bias legend

- (A) Random sequence generation (selection bias)
- (B) Allocation concealment (selection bias)
- (C) Blinding of participants and personnel (performance bias)
- (D) Incomplete outcome data (attrition bias)
- (E) Selective reporting (reporting bias)
- (F) Other bias

FIGURE 2 Forest plot of the meta-analysis.

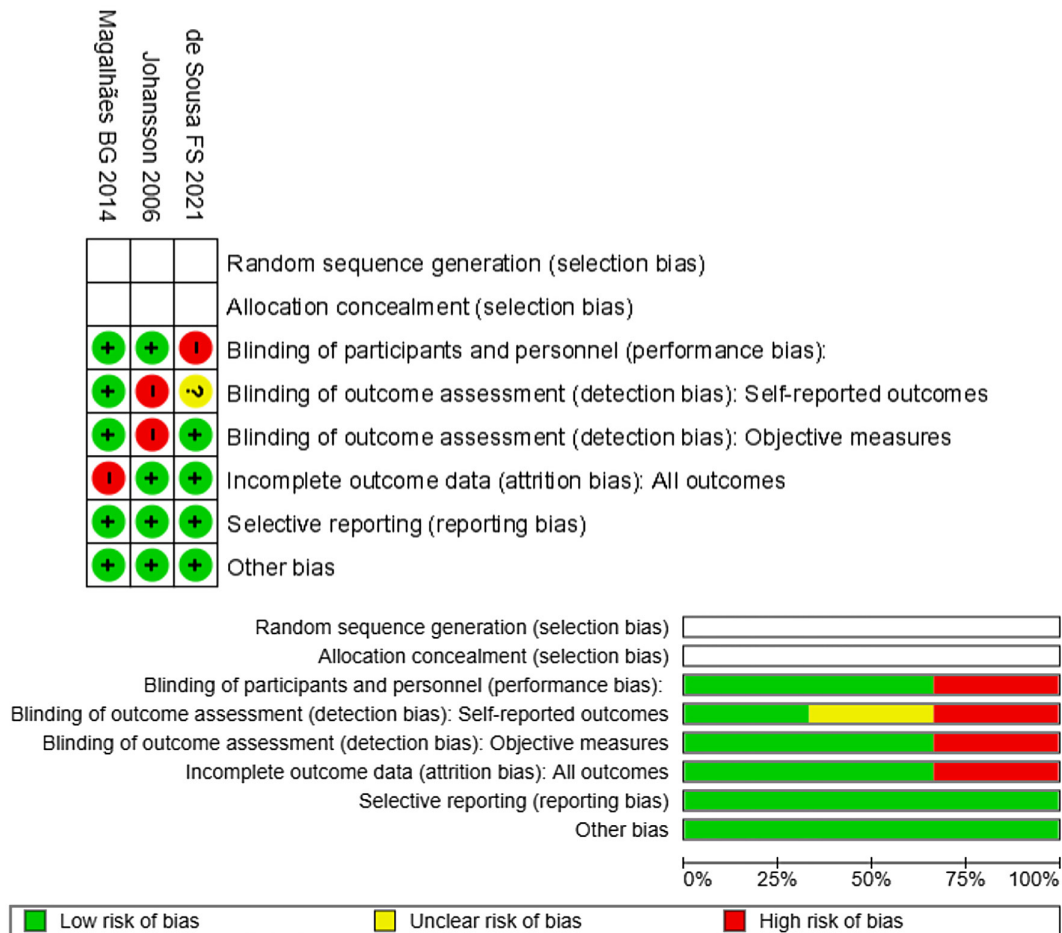


FIGURE 3 Risk of bias domains.

Among the studies that collected data on TMD sign or symptoms prevalence and economic income, three compared TMD prevalence between subjects with low with those with moderate-high

income.<sup>21,31,32</sup> All the studies pointed towards a higher prevalence of TMD sign and symptoms among subjects with a lower economic income. However, we observe extreme variability in the results of the



three studies. Each of these also has some limitations. The study by Magalaesh and colleagues applied the DC/TMD but had a very small sample size. They observed a sensible higher prevalence of TMD among subjects reporting low economic income compared to those reporting a high economic income. The study by Johansson et al. had a large sample size but the criteria used to define TMD prevalence were not standardized. Furthermore, they compare prevalence based on occupation and not economic income. Finally, the study by Fonseca and colleagues had a large sample size, but unfortunately did not apply the DC/TMD for the diagnosis.

The relationship between economic income and chronic diseases is complex and multifaceted. Chronic diseases, such as cardiovascular disease, diabetes, as well as oral diseases can have a profound impact on an individual's quality of life. There is a growing body of evidence suggesting that there is a strong association between economic income and the prevalence of chronic diseases.

Studies have shown that individuals living in low-income households are at a higher risk of developing chronic diseases compared to those living in high-income households. This can be attributed to several factors, including poor access to healthcare, limited availability of healthy food options, and exposure to environmental hazards. Additionally, individuals living in low-income households often have higher levels of stress and psychological distress, which have been linked to the development of chronic diseases.<sup>25-28</sup>

On the other hand, higher economic income can provide individuals with greater access to health-promoting resources, such as healthy food options, physical activity opportunities and preventive healthcare services. This, in turn, can lead to improved health outcomes and a lower risk of chronic diseases.<sup>29,36-38</sup>

It is important to note that the relationship between economic income and chronic diseases is not unidirectional and can be influenced by several other factors, including education, race/ethnicity and gender. Addressing the root causes of health disparities, such as poverty and limited access to healthcare, is critical to improving health outcomes and reducing the burden of chronic diseases in populations.

Temporomandibular Disorders (TMD) refer to a group of conditions affecting the temporomandibular joint (TMJ), which is the joint that connects the jawbone to the skull.<sup>8,15,16</sup> TMD can cause a range of symptoms, including pain, clicking or popping sounds when opening the mouth, and limited jaw movement.<sup>10,11</sup>

Several studies have reported a higher prevalence of TMD among individuals with a low economic income. This association is thought to be due to multiple factors, including increased stress levels, poor oral health habits, and a lack of access to dental care and treatment.<sup>18,33</sup>

Stress is a known risk factor for TMD, and individuals living in poverty are more likely to experience chronic stress due to financial and social challenges. The physiological response to stress can lead to muscle tension in the face, neck and jaw, which can exacerbate TMD symptoms.

Poor oral health habits, such as bruxism (teeth grinding), can also contribute to the development of TMD. Bruxism is often associated

with stress, and individuals with low income may have limited access to dental care and treatment, making it more difficult to manage this condition.<sup>39</sup>

In addition, a lack of access to dental care and treatment can also contribute to the higher prevalence of TMD among individuals with low income. Dental treatments, such as splints and orthotics, can be effective in managing TMD symptoms, but these treatments can be costly and may not be covered by insurance. This lack of access to dental care can lead to untreated TMD, which can result in further complications and increased pain.

In this regard, telemedicine has the potential to improve access to healthcare services for individuals with low economic income, particularly in areas where there is a shortage of healthcare providers or where transportation to healthcare facilities is difficult.<sup>40-42</sup> By allowing patients to communicate with healthcare providers remotely, telemedicine can reduce the cost and time burden associated with in-person healthcare visits. This may increase the likelihood that individuals with low income seek and receive timely healthcare services, including for the management of temporomandibular disorders.

## 5 | CONCLUSION

In conclusion, our study has demonstrated a clear association between economic inequalities and temporomandibular disorders (TMD). Our findings suggest that individuals with low economic income are more likely to experience TMD than those with higher income. However, this relationship is likely due to a complex interplay of multiple factors.

Stress is a well-known risk factor for TMD and is more prevalent among individuals with low economic income. This can be due to job insecurity, financial difficulties and social isolation. Additionally, poor oral health habits, such as teeth grinding and clenching, can contribute to TMD and may be more prevalent among individuals with low income who may not have access to regular dental check-ups or preventative care. Furthermore, the lack of access to dental care and treatment can exacerbate TMD symptoms, leading to chronic pain and reduced quality of life.

Our study highlights the need for further research to better understand the complex relationship between economic inequalities and TMD. More specifically, future studies should explore the mechanisms that underlie this relationship and identify effective interventions to reduce the burden of TMD among individuals with low income. This research is crucial to developing targeted policies and programs to address health inequalities and promote oral health equity.

In summary, our study adds to the growing body of evidence on the impact of economic inequalities on health outcomes and underscores the need for a comprehensive and multidisciplinary approach to address health disparities. By addressing the underlying causes of TMD, including stress, poor oral health habits and a lack of access to dental care and treatment, we can work towards improving the

oral health and overall wellbeing of individuals, regardless of their socioeconomic status.

## AUTHOR CONTRIBUTIONS

Giuseppe Minervini was involved in conceptualization, methodology, software, validation, formal analysis, investigation, data curation, writing—original draft preparation, writing—review and editing and supervision. Rocco Franco was involved in conceptualization, software, validation and formal analysis. Maria Maddalena Marrapodi was involved in writing—original draft preparation and visualization. Luca Fiorillo was involved in investigation and data curation. Gabriele Cervino and Marco Cicciù were involved in writing—review and editing and supervision. All authors have read and agreed to the published version of the manuscript.

## CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest.

## DATA AVAILABILITY STATEMENT

All data described in the study are presented in the manuscript. The datasets analysed are available from the corresponding author on reasonable request.

## ORCID

Giuseppe Minervini  <https://orcid.org/0000-0002-8309-1272>

Rocco Franco  <https://orcid.org/0000-0002-2398-7843>

Maria Maddalena Marrapodi  <https://orcid.org/0000-0002-9494-6942>

Luca Fiorillo  <https://orcid.org/0000-0003-0335-4165>

Gabriele Cervino  <https://orcid.org/0000-0003-4619-4691>

Marco Cicciù  <https://orcid.org/0000-0003-2311-9728>

## REFERENCES

- Michelotti A, Iodice G. The role of orthodontics in temporomandibular disorders. *J Oral Rehabil.* 2010;37(6):411-429.
- Asquini G, Pitance L, Michelotti A, Falla D. Effectiveness of manual therapy applied to craniomandibular structures in temporomandibular disorders: a systematic review. *J Oral Rehabil.* 2022;49(4):442-455.
- Michelotti A, de Wijer A, Steenks M, Farella M. Home-exercise regimes for the management of non-specific temporomandibular disorders. *J Oral Rehabil.* 2005;32(11):779-785.
- Iodice G, Cimino R, Vollaro S, Lobbezoo F, Michelotti A. Prevalence of temporomandibular disorder pain, jaw noises and oral behaviours in an adult Italian population sample. *J Oral Rehabil.* 2019;46(8):691-698.
- Donnarumma V, Ohrbach R, Simeon V, Lobbezoo F, Piscicelli N, Michelotti A. Association between waking-state oral behaviours, according to the oral behaviors checklist, and TMD subgroups. *J Oral Rehabil.* 2021;48(9):996-1003.
- Perrotta S, Bucci R, Simeon V, Martina S, Michelotti A, Valletta R. Prevalence of malocclusion, oral parafunctions and temporomandibular disorder-pain in Italian schoolchildren: an epidemiological study. *J Oral Rehabil.* 2019;46(7):611-616.
- Minervini G, Franco R, Marrapodi MM, Fiorillo L, Cervino G, Cicciù M. Prevalence of temporomandibular disorders in children and adolescents evaluated with Diagnostic Criteria for Temporomandibular disorders (DC/TMD): a systematic review with meta-analysis. *J Oral Rehabil.* 2023;50:522-530.
- Crescente G, Minervini G, Spagnuolo C, Moccia S. Cannabis bioactive compound-based formulations: new perspectives for the management of orofacial pain. *Molecules.* 2022;28(1):106.
- Minervini G, D'amico C, Cicciù M, Fiorillo L. Temporomandibular joint disk displacement: etiology, diagnosis, imaging, and therapeutic approaches. *J Craniofac Surg.* 2022;34:1115-1121.
- Francesco D, di Francesco F, Lanza A, et al. Application of botulinum toxin in temporomandibular disorders: a systematic review of randomized controlled trials (RCTs). *Appl Sci.* 2022;12(23):12409. doi:10.3390/app122312409
- Minervini G, Mariani P, Fiorillo L, Cervino G, Cicciù M, Laino L. Prevalence of temporomandibular disorders in people with multiple sclerosis: a systematic review and meta-analysis. *Cranio.* 2022;1-9. doi:10.1080/08869634.2022.2137129
- Bucci R, Koutris M, Palla S, Sepúlveda Rebaudo GF, Lobbezoo F, Michelotti A. Occlusal tactile acuity in temporomandibular disorder pain patients: a case-control study. *J Oral Rehabil.* 2020;47(8):923-929.
- Peck CC, Goulet JP, Lobbezoo F, et al. Expanding the taxonomy of the diagnostic criteria for temporomandibular disorders. *J Oral Rehabil.* 2014;41(1):2-23.
- Rongo R, Ekberg EC, Nilsson IM, et al. Diagnostic criteria for temporomandibular disorders (DC/TMD) for children and adolescents: an international Delphi study—part 1-development of axis I. *J Oral Rehabil.* 2021;48(7):836-845.
- Rongo R, Ekberg EC, Nilsson IM, et al. Diagnostic criteria for temporomandibular disorders in children and adolescents: an international Delphi study-Part 2-Development of Axis II. *J Oral Rehabil.* 2022;49(5):541-552.
- Schiffman E, Ohrbach R, Truelove E, 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.
- Minervini G, Franco R, Marrapodi MM, et al. The association between COVID-19 related anxiety, stress, depression, temporomandibular disorders, and headaches from childhood to adulthood: a systematic review. *Brain Sci.* 2023;13(3):481.
- de Sousa AP, de Oliveira RC, da Silva RA. Prevalence and risk factors for temporomandibular disorders in Brazilian adolescents: a cross-sectional study. *BMC Oral Health.* 2017;17(1):147.
- Machado MA, Rached-Junior FJ. Temporomandibular disorders in relation to socioeconomic status and oral health-related quality of life: a cross-sectional study. *Cranio.* 2018;36(1):12-18.
- Souza DD, Rached-Junior FJ. Prevalence and risk factors for temporomandibular disorders in a population-based sample: the influence of socioeconomic status. *J Oral Rehabil.* 2015;42(12):932-939.
- Magalhães BG, de Sousa ST, de Mello VV, et al. Risk factors for temporomandibular disorder: binary logistic regression analysis. *Med Oral Patol Oral Cir Bucal.* 2014;19(3):e232-e236.
- Qamar Z, Alghamdi AMS, Haydarah NKB, et al. Impact of temporomandibular disorders on oral health-related quality of life: a systematic review and meta-analysis. *J Oral Rehabil.* 2023. doi:10.1111/joor.13472
- Minervini G, Franco R, Marrapodi MM, Fiorillo L, Cervino G, Cicciù M. Prevalence of temporomandibular disorders (TMD) in pregnancy: a systematic review with metanalysis. *J Oral Rehabil.* 2023;50:627-634.
- Chakraborty T, Jamal RF, Battineni G, Teja KV, Marto CM, Spagnuolo G. A review of prolonged post-COVID-19 symptoms and their implications on dental management. *Int J Environ Res Public Health.* 2021;18(10):5131.
- Adler NE, Ostrove JM. Socioeconomic status and health: what we know and what we don't. *Ann N Y Acad Sci.* 1999;896(1):3-15.



26. Marmot W. Socioeconomic status and health: a causal review. 1999.
27. Rowe K. The contribution of poverty and low socioeconomic status to the burden of chronic disease in the United States. 1997.
28. Pickett KE, Wilkinson RG. Income inequality and health: a causal review. *Soc Sci Med*. 2015;128:316-326.
29. Quiñones L. Socioeconomic status and health in aging populations: a review of the literature. 1999.
30. Morgan RL, Whaley P, Thayer KA, Schünemann HJ. Identifying the PECO: a framework for formulating good questions to explore the association of environmental and other exposures with health outcomes. *Environ Int*. 2018;121(Pt 1):1027-1031.
31. de Sousa FS, Costa EM, Alves CMC, et al. Socioeconomic inequalities and temporomandibular joint disorders in adolescents: contributions from a Maranhão cohort. *Community Dent Health*. 2021;38(3):192-197.
32. Johansson A, Unell L, Carlsson GE, Soderfeldt B, Halling A. Risk factors associated with symptoms of temporomandibular disorders in a population of 50- and 60-year-old subjects. *J Oral Rehabil*. 2006;33(7):473-481.
33. Oliveira LB, Braga LC, Dias RC. Temporomandibular disorders and oral health-related quality of life in relation to socio-economic status in adult Brazilians. *Health Qual Life Outcomes*. 2017;15(1):107.
34. Badnjević A, Pokvić LG, Džemić Z, Bečić F. Risks of emergency use authorizations for medical products during outbreak situations: a COVID-19 case study. *Biomed Eng Online*. 2020;19(1):75.
35. Gurbeta L, Alic B, Dzemic Z, Badnjević A. Testing of infusion pumps in healthcare institutions in Bosnia and Herzegovina. In: IFMBE Proceedings. 2017:390-393.
36. Mielck K. The relationship between income and health: a causal review. 2001.
37. Moore DR. Socioeconomic status and health: The potential role of environmental risk exposure. 2001.
38. Link P. The impact of poverty on chronic disease risk: a review of the literature. 1995.
39. Lobbzoo F, van der Zaag J, Naeije M. Bruxism: its multiple causes and its effects on dental implants – an updated review. *J Oral Rehabil*. 2006;33(4):293-300.
40. Ricciardi D, Casagrande S, Iodice F, et al. Myasthenia gravis and telemedicine: a lesson from COVID-19 pandemic. *Neurol Sci*. 2021;42(12):4889-4892.
41. Spina E, Trojsi F, Tozza S, et al. How to manage with telemedicine people with neuromuscular diseases? *Neurol Sci*. 2021;42(9):3553-3559.
42. Spina E, Tedeschi G, Russo A, et al. Telemedicine application to headache: a critical review. *Neurol Sci*. 2022;43(6):3795-3801.
43. Page MJ, McKenzie JE, Bossuyt PM, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ*. 2021;372:n71. doi:10.1136/bmj.n71

**How to cite this article:** 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;50:715-723. doi:10.1111/joor.13491