THIEME OPEN ACCESS

# Prevalence of Musculoskeletal Disorders among Dental Professionals: An Umbrella Review

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## Abstract

Performing repetitive tasks on patients' mouths increases the risk of strain-related injuries for dental professionals, ultimately leading to musculoskeletal disorders (MSDs). This umbrella review aims to assess the scope of the MSD problem and identify the most often impacted body parts among dental professionals. A comprehensive search of the literature was performed from inception to March 30, 2024, in PubMed-MEDLINE, Embase, Scopus, and Web of Science databases. This review evaluated systematic reviews (SRs) and meta-analyses (MAs) of the observational studies that reported the prevalence of MSDs or any form of MSD among dental professionals such as dentists, dental hygienists, or dentistry students. The extracted data were complemented with narrative synthesis. A total of eight SRs and MAs were included in this umbrella review. Five of the eight studies were conducted globally, one in the context of Western countries and two in an Iranian context. Four of the eight studies focused on MSDs in dental practitioners, with prevalence rates ranging from 0.5 to 93%. Four body areas, that is, the neck, the lower and upper back, the shoulders and wrists, and hands were widely exposed to MSDs, with significant prevalence reported across studies. In conclusion, MSDs are common among dental professionals. Consequently, there is a pressing need to implement infrastructural and behavioral ergonomic solutions in the dental profession. However, a major concern arises from the critically low quality of available studies on MSD prevalence in dental professionals. Therefore, more rigorous research adhering to the basic quality criteria is required.

**Keywords**
► musculoskeletal diseases
► dentists
► ergonomics

## Introduction

Musculoskeletal diseases (MSDs) are the leading cause of years lived with disability (YLDs) and the global demand for rehabilitation.[1] Globally, there were 322.75 million incident cases, 117.54 thousand fatalities, and 150.08 million disability-adjusted life years (DALYs) due to MSDs in 2019.[2] MSDs are a group of inflammatory and degenerative ailments that affect the muscles, tendons, ligaments, joints, and nerves. Common symptoms include pain, stiffness, swelling, and restricted mobility.[3] MSDs frequently cause psychological issues, as well as pain and poor psychological effects, resulting in a downward spiral.[4] Furthermore, MSD doubles the incidence of various systemic chronic diseases in affected persons compared to those without MSD.[5] Occupational risk is the most significant risk factor for MSDs, resulting in 15.31 million DALYs.[2] Previous research indicates that intense physical labor, an incorrect work posture, repeated motions, and psychological variables such as inadequate support, high stress at work, and a high mental burden all raise the risk of MSDs.[6,7] Health care personnel are particularly vulnerable to developing MSDs, with global studies highlighting the incidence and impact of these disorders in this workforce segment.[8]

Dental professionals are among the health care workers who are at a higher risk of MSDs due to the precision required in patient treatment.[9] The oral cavity is a fairly compact area that is difficult to access and navigate when delivering dental care. As a result, dentists have to endure atypical body postures for extended periods, putting a strain on the musculoskeletal system.[10] Research has demonstrated that performing repetitive tasks on patients' mouths, such as drilling, scaling, and using hand tools, increases the risk of strain-related injuries for health care professionals.[11] These repetitive actions often lead to MSDs affecting the hands, wrists, shoulders, back, and neck. This type of work ergonomics in dentistry, in combination with factors such as high workload, stress, and lack of rest, increases the risk of these diseases even further.[12] Previous studies have consistently reported the neck, back, and shoulders as the most common sites of MSD among dental professionals.[13–15] The incidence of MSDs imposes significant costs on organizations, including employee absenteeism, decreased productivity, and increased health care, disability, and compensatory expenditures.[16]

Creating successful prevention and management plans requires an understanding of the occurrence and effects of MSDs in the dental field. By identifying the affected body regions, health care providers and policymakers can design ergonomic interventions, training programs, and policies to cater to the unique needs of dental professionals. Several systematic reviews (SRs) have been published on this subject.[13,17,18] Nevertheless, the prevalence of MSDs in these studies is broad and diverse, necessitating synthesizing the available data from multiple SRs. As a result, this complete synthesis is critical for understanding the scope of the problem and identifying the most often impacted body parts among dental professionals. These insights can help stakeholders design effective risk-mitigation strategies or tailored interventions and promote a healthier, more sustainable workforce.

The objective of the study is to assess the prevalence of MSD problems among dental professionals and identify the most often impacted body parts.

This overview of SRs addresses the research question, "What is the prevalence of MSDs among dental professionals?" focusing on the following:

- P—Population: dental professionals such as dentists, dental surgeons, dental auxiliaries, dental assistants, and dental students.
- E—Exposure: work conditions.
- C—Comparison: none.
- O—Outcomes: prevalence of MSD.
- S—Settings: global.

## Methods

The current study summarizes and synthesizes the findings from published SRs and/or meta-analyses (MAs) to determine the prevalence of MSDs among dental professionals.

### Review Registration

This overview of SRs was conducted in accordance with the Preferred Reporting Items for Overviews of Reviews (PRIOR) guidelines.[19] An a priori protocol for this study was registered with the International Prospective Register of Systematic Reviews (PROSPERO; registration number: CRD42024532231).

### Data Sources and Search Strategy

From database inception to March 30, 2024, the following online databases have been sought to retrieve SRs irrespective of MAs: Scopus, PubMed-MEDLINE, Embase, and Web of Science. We also pulled the first 100 articles from the Google Scholar search engine to ensure that relevant studies were included. Two independent reviewers searched the repositories using Medical Subject Headings (MeSH) terms and text words, without language restrictions. Boolean operators were used for combining the following search terms (Musculoskeletal disorder and dental professionals and Systematic review). A detailed search strategy is given in ►**Table 1**, which was tailored for each database where necessary. A filter of SRs and MAs was incorporated during each search.

### Inclusion and Exclusion Criteria

#### Inclusion

This review evaluated SRs and MAs of the observational studies that reported the prevalence of MSDs or any form of MSD among dental professionals such as dentists, dental hygienists, or dentistry students. Studies conducted worldwide were included.

#### Exclusion

Studies that did not use an SR technique or did not critically evaluate included studies, narrative reviews, qualitative SRs, or primary investigations were eliminated. SRs published in languages other than English were also excluded.

**Table 1** Search strategy

| Keywords | MeSH terms | Key terms |
|---|---|---|
| Musculoskeletal disorders | "Musculoskeletal Diseases" [Mesh] OR "Occupational Health" [Mesh] | Musculoskeletal Disease* OR Orthopedic Disorder* OR musculoskeletal disorder OR Low back pain OR Neck pain OR upper extremit* OR lower extrem* OR occupational disorder OR occupational disease |
| Dental professionals | "Dentists" [Mesh] OR Dentistry" [Mesh] | Dentist OR dental professionals OR dental students OR dental hygienist OR oral health therapist OR dental assistants OR auxiliary dent* OR orthodontist OR periodontist OR endodontist OR prosthodontist OR oral surgeon |
|  | "Systematic Review" [Publication Type] | Literature review OR narrative review |

## Study Selection

The search results were uploaded to Rayyan, an online SR aid tool. Then, potentially relevant articles were chosen utilizing a multistep process that comprised deduplication, title and abstract reading, and full-text reading. The two reviewers separately examined the titles and abstracts of all the studies discovered via the electronic search. The full texts were then retrieved and examined for additional inclusion/exclusion.

Studies that did not match the inclusion criteria were omitted. Any issues were settled through discussion among the reviewers. The included articles were additionally carefully searched to identify further potentially relevant SRs with or without MAs.

## Data Extraction and Management

Data extraction was performed on studies that were determined to be eligible following full-text reading. Two reviewers extracted data separately and considered the following information for each article: (1) author and year of publication, (2) review time frame, (3) study setting, (4) the number of studies retrieved and included, (5) study design of studies included in the SR or MA, (6) sample characteristics, (7) MSD prevalence as the primary outcome, (8) MSD prevalence by body part, (9) MA performance, and (10) outcome. In the case of inadequate or missing information, contact was made with the authors.

## Quality Assessment

The methodological quality and potential for bias of the included SR and/or MA were assessed using the latest Assessment of Multiple Systematic Reviews 2 (AMSTAR 2)[20] version for systematic reviews and meta-analyses (SRMAs). The tool includes eight critical and eight noncritical criteria, with responses of yes, no, or partial yes. The overall quality of the articles was defined as "critically low" if there was more than one critical weakness, "low" if there was only one critical error, "moderate" if there was more than one noncritical weakness, and "high" if there was one or no noncritical weakness. Two reviewers completed the quality assessment, and it was thereafter compared. Any disagreements over the decision were resolved by discussion between the two reviewers.

## Data Synthesis and Summary

The extracted data was complemented with narrative synthesis to answer the questions of this umbrella review.

## Results

The electronic search initially resulted in 1,755 citations from all the databases. A total of 114 studies were duplicated and a further 1,616 studies were excluded after title–abstract screening. The remaining 25 full-text articles were selected. From those, a total of eight SRs and MAs[13,14,17,18,21–24] were included in this umbrella review. The reasons for exclusion were not reporting prevalence ($n = 5$), not including population of interest ($n = 4$), full text not accessible ($n = 1$), and not an SR or MA ($n = 7$). The list of excluded studies is presented in ►**Supplementary Table S1** (available in the online version only). ►**Fig. 1** shows the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flowchart and the study selection process.
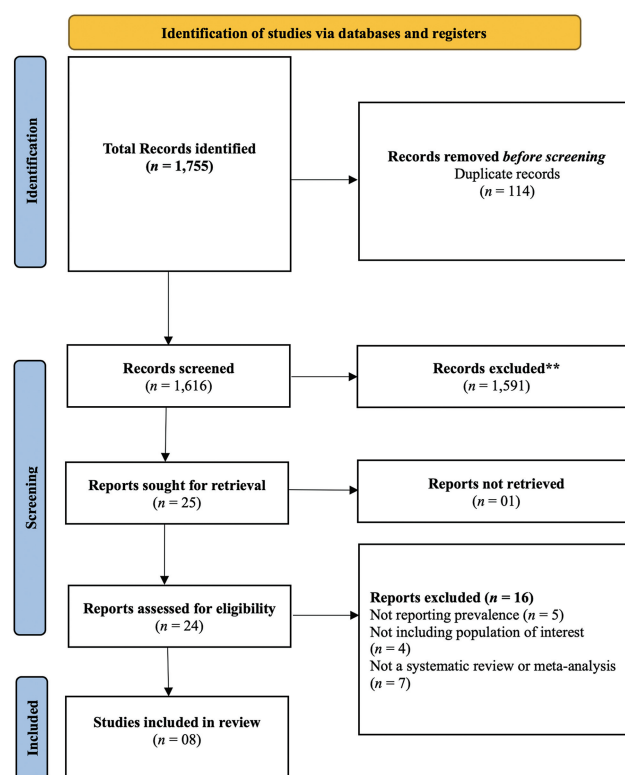


**Fig. 1** Selection process for included studies.

### Study Characteristics

The salient features of the included studies are compiled in ►Table 2. We considered eight studies, consisting of 237 primary articles. The included SRs and/or MAs were published between 2017[14] and 2023.[21–23] Only three studies reported a priori protocol registration.[17,21,22] The number of electronic databases searched in the included articles ranged between 2 and 17, with PubMed-MEDLINE, Embase, Scopus, and CINAHL being the most common.

All investigations used language filters, with two using English and Persian, one using English and Portuguese, and the other five using English filters. The study population comprised dental surgeons, dental assistants, orthodontists, dental hygienists, dental nurses, dental therapists, and dentistry students. Five of the eight studies were conducted globally, one in the context of Western countries,[13] and two in an Iranian context.[14,18] Two of the eight MAs focused on carpal tunnel syndrome,[21,23] while the other six focused on MSDs according to body parts.

### Findings on the Prevalence of MSDs

The detailed findings on the prevalence of MSDs are presented in ►Table 3. Four of the eight studies focused on MSDs in dental practitioners, with prevalence rates ranging from 0.5 to 93%. Notably, Lietz et al[13] identified a frequency of 58% in dental practitioners in Western countries, and Chenna et al[17] documented a rate of 78.4% globally. Zakerjafari and YektaKooshali[18] observed a relatively low prevalence of 17.6%, whereas Shams-Hosseini et al[14] reported the incidence among Iranian dental practitioners ranges between 0.5 and 70%. Some studies did not provide specific rates of MSD prevalence.[21–24]

Based on body regions, neck pain was the most commonly reported MSD concern among dental practitioners. Neck pain prevalence among dental professionals varies greatly, with Lietz et al[13] showing 58.5% (95% confidence interval [CI] = 46.0–71.0) in Western countries and Shams-Hosseini et al[14] and Zakerjafari and YektaKooshali[18] both reporting 51% in Iran. Thorat et al[24] claimed a global frequency of 48.602%, whereas Almeida et al[22] found a considerably lower prevalence of 13.9%. Three studies did not describe the prevalence of neck pain.[17,21,23]

Lower back pain was the second most commonly reported condition among dental professionals, with worldwide incidence ranging from 37.3% (95% CI: 31.5–43.5)[18] to 60.8% (95% CI: 39.072–80.488%).[24] According to Lietz et al,[13] 56.4% of dentistry professionals in Western countries suffer from lower back pain (95% CI: 46.1–66.8%). Studies conducted among Iranian dental professionals reveal lower prevalence rates, with Shams-Hosseini et al[14] reporting 42% and Zakerjafari and YektaKooshali[18] showing 37.3% (95% CI: 31.5–43.5). Three studies[21–23] did not provide specific rates for lower back pain.

Four studies examined the prevalence of wrist and hand discomfort among dental employees. According to Lietz et al,[13] the frequency in Western countries is 35.9%. The global prevalence ranges from 8.80%[22] to 26.848%.[24] Zakerjafari and YektaKooshali[18] discovered an Iran-specific

prevalence of 33.7% (95% CI: 28.2–39.6). Carpal tunnel syndrome was reported in two global MAs, with prevalence ranging from 9.87% (95% CI: 6.84–14.03%)[23] to 15% (95% CI: 0–86%).[17]

Five studies concerning shoulder pain among dental personnel demonstrate that the prevalence varies by region. In Western countries, Lietz et al[13] found a prevalence of 43.1% (95% CI: 30.7–55.5%). In Iran, Shams-Hosseini et al[14] observed a lower incidence of 18%, while Zakerjafari and YektaKooshali[18] reported a slightly higher shoulder pain prevalence of 33.2% (95% CI: 24.1–43.8%). The global shoulder pain prevalence was found to be between 12.20%[22] and 36.75%[24] among dental professionals.

Only three studies analyzed elbow pain among dental workers. Western countries[13] found a 17.2% prevalence rate (CI: 12.5–21.9%), whereas Iran[18] reported a somewhat lower frequency of 12.9% (95% CI: 7.7–20.6%). Almeida et al[22] found a significantly lower frequency of 3.30% worldwide. Similarly, knee discomfort among dental professionals varies by geographical region, with a prevalence of 23.6% (95% CI: 16.3–30.8%) in Western countries,[13] 17.6% (95% CI: 11.7–25.5%) in Iran,[18] and a global prevalence of 8%.[22]

Hip and thigh pain among dental workers was reported among 21.2% of dental professionals in Western countries,[13] while a lower percentage of 11.9% was found in Iran.[18] Almeida et al[22] reported a global prevalence of 4.20%. Ankle and foot pain was found among 12.8% of dental professionals in Western countries.[13] A similar rate of 12.9% was noted in Iran,[18] while Almeida et al reported a global rate of 5.90%. Leg discomfort among dental professionals has been reported at 13.5% (95% CI: 1.7–25.3%) in Western countries[13] and 10.5% (95% CI: 7–15.4%) in Iran.[18] However, the remaining global research did not report any prevalence of leg discomfort.

### Quality Assessment

The critical appraisal of included studies using the AMSTAR 2 method revealed that five of them had critically low levels of evidence, while the remaining three[13,17,22] had low levels of evidence (►Table 4). The critical areas of flaws were usually because of not providing the list of excluded studies (8/8), nonreporting of funding sources (8/8), and nonreporting of a priori protocol registration (4/8).

## Discussion

MSDs associated with the workplace are becoming more common among health care professionals, particularly dentists. This is a growing worry that has been labeled "a looming catastrophe and the tip of an iceberg."[25] Despite this, no comprehensive umbrella review on MSD among dental professionals has been performed. Our comprehensive analysis finds a high frequency of MSDs among dental practitioners, raising serious concerns about the health of both dentists and the larger community who rely on their services. This emphasizes the need for targeted preventive efforts against MSDs.

The general prevalence showed very high rates of MSDs in dental health professionals with values ranging from 0.5 to

**Table 2** Study characteristics

| Study | Protocol registration | Search duration | Language restriction | Database searched | Total no. of retrieved studies | No. of included studies | Study design included | Overall sample size | Study population | Meta-analysis conducted | Regions |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Shams-Hosseini et al[14] | Not mentioned | 1989–2014 | Yes (English and Persian) | MEDLINE (PubMed), Google Scholar, Scopus, CINAHL, the Iranian search engine, Irandoc (Iranian Research Institute for Information Science and Irandoc.ac.ir) 2014, Iran-medex, Magiran | 137 | 17 | Cross-sectional studies | Not mentioned | Dentists | Yes | Iran |
| Lietz, et al. 2018[13] | Not mentioned | Till December 2017 | Yes (English) | MEDLINE, CINAHL, LIVIVO, Science Direct, PubMed, and Web of Science | 1,325 | 30 | Cross-sectional studies | Not mentioned | Dentists, orthodontists, dental hygienists, dental nurses, dental therapists, and dental students | Yes | Western countries |
| Zakerjafari et al[18] | Not mentioned | Until January 1, 2017 | Yes (English and Persian) | SID, Magiran, Irandoc, IranMedex, and Medlib, and international databases such as MEDLINE, Web of Sciences, Scopus, PubMed, Science Direct, Cochrane, Embase, Springer, Online Library Wiley, Ebsco, CEBM, CINAHL, and Google Scholar search engine | 471 | 23 | Cross-sectional | 2,531 | Dentists | Yes | Iran |
| Chenna et al[17] | INPLASY | Inception to August 5, 2021 | Yes (English) | Scopus, Embase, CINAHL, Web of Science, Dentistry & Oral Sciences Source | 3,090 | 88 | Cross-sectional studies | Not mentioned | Dentists, dental students, hygienists, or dental auxiliaries | Yes | Global |
| Thorat et al[24] | Not mentioned | 2015–2021 | Yes (English) | PubMed, Embase, Elsevier, and Journal on web databases | 624 | 16 | Cross-sectional | Not mentioned | Dentists | Yes | Global |
| Chenna et al[21] | International Platform of Registered Systematic Review and Meta-analysis protocols | Till January 1, 2022 | Yes (English) | PubMed, Embase, Dentistry and Oral Sciences Source, CINAHL, Web of Science, and Scopus | 1,381 | 37 | Cross-sectional studies | 17,152 | Dental auxiliaries and dentists | Yes | Global |
| Kostares et al[23] | Not mentioned | Inception up to December 16, 2022 | Yes (English) | MEDLINE and Scopus | 106 | 10 | Cross-sectional studies | 3,547 | Dental surgeons | Yes | Global |
| Almejda et al[22] | PRSOPERO | Inception to August 2022 | Yes (English or Portuguese) | PubMed, COCHRANE, EBSCO, and Scopus | 3,037 | 16 | Cross-sectional, prospective, or longitudinal design studies | 3,615 | Dental students | Yes | Global |

**Table 3** Prevalence reported in included studies

| Study | MSD | CTS | Wrist and hands | Upper back pain | Lower back pain | Neck pain | Shoulder pain | Elbow pain | Knee pain | Hip/thigh pain | Ankle/feet pain | Leg pain |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Shams-Hosseini et al[14] | 0.5–70% | NR | NR | NR | 42% | 51% | 18% | NR | NR | NR | NR | NR |
| Lietz et al[13] | 58.0% (95% CI: 38.8–77.2) | NR | 35.9% (95% CI: 27.8–44) | 41.1% (95% CI: 32.3–49.9) | 56.4% (95% CI: 46.1–66.8) | 58.5% (95% CI: 46.0–71.0) | 43.1% (95% CI: 30.7–55.5) | 17.2% (95% CI: 12.5–21.9) | 23.6% (95% CI: 16.3–30.8) | 21.2 (95% CI: 14.8–27.6) | 12.8 (95% CI: 10.1–15.4) | 13.5 (1.7-25.3) |
| Zakerjafari et al[18] | 17.6% (CI: 95%: 11.7–25.5) | NR | 33.7% (CI 95%: 28.2–39.6) | NR | 37.3% (CI 95%: 31.5–43.5) | 51.9% (CI 95%: 46.7–57.2) | 33.2% (CI 95%: 24.1–43.8) | 12.9% (CI 95%: 7.7–20.6) | 17.6% (CI: 95%:11.7–25.5) | 11.9% (CI 95%: 8.7–16.1) | 12.9% (CI 95%: 3.8–36) | 10.5% (CI 95%: 7–15.4) |
| Thorat et al[24] | NR | NR | 26.848% (95% CI: 15.805–39.591%) | 41.994% (95% CI: 35.468–48.664%) | 60.8% (95% CI: 39.072–80.488%) | 48.602% (95% CI: 29.610–67.806%) | 36.758% (95% CI: 24.000–50.538%) | NR | NR | NR | NR | NR |
| Chenna et al[17] | 78.40% | NR | NR | NR | NR | NR | NR | NR | NR | NR | NR | NR |
| Chenna et al[21] | | 15% (95% CI: 0–86%) | NR | NR | NR | NR | NR | NR | NR | NR | NR | NR |
| Kostares et al[23] | | 9.87% (95% CI: 6.84–14.03%) | NR | NR | NR | NR | NR | NR | NR | NR | NR | NR |
| Almeida et al[22] | NR | NR | 8.80% | 11% | NR | 13.9% | 12.20% | 3.30% | 8% | 4.20% | 5.90% | NR |

Abbreviations: CI, confidence interval; CTS, carpel tunnel syndrome; MSD, musculoskeletal disorder; NR, not reported.

93%. Four body areas, that is, the neck, the lower and upper back, the shoulders and wrists, and hands were widely exposed to MSDs, with significant prevalence reported across studies. Similar findings were noted[15,25–27] among other groups of health care professionals such as physicians, surgeons, nurses, and physical therapists. However, it is noted that back pain is the most prevalent form of MSD among nurses, in contrast to neck pain, which is more common among dental professionals and surgeons.[26,27] This difference is likely due to the unique demands of dental and surgery practice, which involves frequent neck movements to view and treat the affected area of the patients. A recent umbrella review pointed out the reason behind the high prevalence of MSDs among dental professionals and found that 87.5% of studies detected static posture during working hours, followed by repetitive movements, muscle imbalances, and individual characteristics including sedentary lifestyle and obesity. Other variables such as workplace environment risk factors including inadequate and nonergonomic equipment, duration and extent of muscle effort, and vibrating instruments could also put the dentist at risk of MSDs.[28] Besides these factors, working duration, type and duration of procedures, specialization, number of patients/days, and history of MSD could also substantially impact the estimates of MSD.[17]

Another key finding of this review is that the prevalence reported in Western countries and Iran was somewhat closer to the average prevalence reported in the SRMAs that were considered in the global context. This alignment enhances the credibility of the findings from these studies. Only one study reported considerably lower global prevalence of MSD as it was conducted among dental students.[22] This reduced prevalence may be due to the shorter duration of exposure to poor body mechanics in clinical settings that dental students experience compared to practicing dentists and other dental professionals. Future comparative studies could further investigate this aspect.

MSDs detrimentally affect the physical, psychological, and social well-being of practitioners, diminishing productivity and quality of life. Muralidharan et al[29] observed over 12 months a decline in work and leisure activities, increased sick leave, and higher rates of medical consultations and hospitalizations among dental professionals. Given the high MSD prevalence, implementing ergonomic improvements in dental workplaces is crucial. Recent SRs[30,31] show a focus on prevention strategies in dental ergonomics, particularly in equipment and tool design. However, there is a lack of emphasis on behavioral and postural strategies to mitigate MSDs.[32,33] Education and training in ergonomics and proper posture during dental procedures could significantly prevent MSDs in this sector.[21] A recent study evaluated a participatory ergonomic intervention's effect on reducing ergonomic risks and MSD symptoms in young dental professionals. The intervention was more effective in alleviating neck and wrist/hand symptoms and slightly improved workability after 12 months compared to the control group.[34] The long-term benefits of such interventions in reducing MSD prevalence warrant further investigation.[10]

**Table 4** Quality assessment of included SRMAs

| AMSTAR 2 checklist domains | Shams-Hosseini et al[14] | Zakerjafari et al[18] | Lietz et al[13] | Chenna et al[17] | Thorat et al[24] | Almeida et al[22] | Chenna et al[21] | Kostares et al[23] |
|---|---|---|---|---|---|---|---|---|
| PICO component in research questions and inclusion criteria | Y | Y | Y | Y | Y | Y | Y | Y |
| Contain an explicit statement that the review methods were established prior to the conduct of the review and justify any significant deviations from the protocol | N | N | Partial Y | Y | N | Y | Y | N |
| Did the review authors explain their selection of the study designs for inclusion in the review? | Y | Y | Y | Y | Y | Y | Y | Y |
| Did the review authors use a comprehensive literature search strategy? | Y | Y | Y | Y | N | Y | Y | Y |
| Did the review authors perform study selection in duplicate? | Y | Y | Y | Y | Y | Y | Y | Y |
| Did the review authors perform data extraction in duplicate? | Partial Y | Y | Y | Y | Y | Y | Y | Y |
| Did the review authors provide a list of excluded studies and justify the exclusions? | N | N | N | N | N | N | N | N |
| Did the review authors describe the included studies in adequate detail? | Y | Y | Y | Y | Y | Y | Y | Y |
| Did the review authors use a satisfactory technique for assessing the risk of bias in individual studies that were included in the review? | Y | Y | Y | Y | Y | Y | Y | Y |
| Did the review authors report on the sources of funding for the studies included in the review? | N | N | N | N | N | N | N | N |
| If meta-analysis was performed, did the review authors use appropriate methods for statistical combination of results? | Y | Y | Y | Y | Y | Y | Y | Y |
| If meta-analysis was performed, did the review authors assess the potential impact of risk of bias in individual studies on the results of the meta-analysis or other evidence synthesis? | Y | Y | Y | Y | N | Y | Y | Y |
| Did the review authors account for risk of bias in individual studies when interpreting/discussing the results of the review? | Y | Y | Y | Y | N | Y | Y | Y |

(*Continued*)

**Table 4** (Continued)

| AMSTAR 2 checklist domains | Shams-Hosseini et al[14] | Zakerjafari et al[18] | Lietz et al[13] | Chenna et al[17] | Thorat et al[24] | Almeida et al[22] | Chenna et al[21] | Kostares et al[23] |
|---|---|---|---|---|---|---|---|---|
| Did the review authors provide a satisfactory explanation for, and discussion of, any heterogeneity observed in the results of the review? | Y | Y | Y | Y | N | Y | Y | Y |
| If they performed quantitative synthesis, did the review authors carry out an adequate investigation of publication bias (small study bias) and discuss its likely impact on the results of the review? | N | Y | N | Y | N | Y | Y | Y |
| Did the review authors report any potential sources of conflict of interest, including any funding they received for conducting the review? | Y | Y | Y | Y | Y | Y | Y | Y |
| Overall assessment | Critically low | Critically low | Low | Low | Critically low | Low | Critically low | Critically low |

Abbreviations: AMSTAR 2, Assessment of Multiple Systematic Reviews 2; N, no; SRMAs, systematic review and meta-analyses; Y, yes.

### Strength and Limitation of Umbrella Review

Despite the strength of an umbrella review to capture a large amount of evidence in a short duration, it does have some limitations that need to be considered. Umbrella reviews are dependent on the findings and interpretations within SRs, rather than directly on primary research, introducing an inherent limitation regarding the rigor and depth of the synthesized data. Besides, there is a risk of overlap in original studies of SRs. However, to prevent unintended loss of information through the exclusion of important reviews, overlapping reviews within this umbrella review were therefore included and noted about the overall impact on results. For example, Shams-Hosseini et al[14] and Zakerjafari and Yekta-Kooshali[18] have seven MSD studies in common, with both finding a high prevalence of MSDs among Iranian dental professionals. Despite this overlap, we believe it had little impact on the results of our umbrella review. The included SRs revealed that many of the primary studies used self-reported data from participants to report prevalence. As a result, this assessment method frequently raises issues about recall bias in self-reported results. Furthermore, the systematic SRMAs in our umbrella review were limited and varied in terms of study settings and MSD classification. Based on these limitations, there are certain prospects for future studies.

- First, SRMAs from other regions and countries of the world are required to evaluate the true global prevalence of MSD and compare the prevalence across the geographic regions of the world.
- The existing SRMAs on MSDs among dental professionals have a high risk of bias. Consequently, there is an urgent need for more and better research to improve the findings' certainty. These reviews should be designed to meet the basic quality criteria as described in the validated published guidance such as Cochrane handbook or Joanna Briggs Institute guidelines on SRMA.
- Furthermore, the included SRMAs reported moderate to high heterogeneity in their findings, which could be due to use of nonvalidated tools, differences in dental professionals' groups included, and sample size of primary studies. Thus, we also need more primary studies with standardized tools to estimate the prevalence of MSDs among various categories of dental professionals.

### Implications for Clinical Practice

While substantial variation is likely at regional and global levels, it is clear from our findings that MSDs are very common among dental professionals. The summarized data indicate a higher prevalence of neck pain, back pain, and wrist and hand pain among dental professionals. Other MSD disorders such as carpal tunnel syndrome, elbow pain, shoulder pain, and lower extremity pain have not yet been the subject of an SR, but we expect clinical experience to be common in this setting. An SR showed that the use of lighter/wider hand instruments, favorable positioning, and the introduction of microbreaks during lengthy procedures can help reduce upper limb MSD in health care professionals.[35] Furthermore, risk and preventive strategies for MSDs such as using magnification devices, maintaining a low back curve, adjusting dental chairs, avoiding steady postures, positioning patients at the appropriate height, placing feet parallel to the floor, rotating shoulders, avoiding twisting,

using seat cushions, taking regular, occasional breaks, performing stretching exercises during short breaks, and releasing trigger points should be taught to dental professionals during their undergraduate training and services through continuing education programs, so that the onset of MSDs can be prevented through the adoption of an ergonomic approach in their dental practice.[36]

## Conclusion

The prevalence of MSDs in dental health professionals across the included SRs and/or MAs varies, with values ranging from 0.5 to 93%, indicating that MSDs are common among dental professionals. Four body areas, that is, the neck, the lower and upper back, the shoulders and wrists, and the hands are widely exposed to MSDs. Consequently, there is a pressing need for implementing both infrastructural and behavioral ergonomic solutions in the dental profession. However, a major concern arises from the critically low quality of the available primary research and SRMA studies on MSD prevalence in dental professionals. Also, the existing evidence syntheses do not capture the totality of the disease burden of MSDs in dental professionals. Therefore, more rigorous research adhering to the basic quality criteria as described in the validated published guidance of primary studies and SRMAs is required.

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