SYSTEMATIC REVIEW

A Systematic Review on the Prevalence of Musculoskeletal Disorders Among Dental Practitioners

Nur Aisyah Mohd Amir[1], Nurun Nadihah Norazam[2], Norfaezah Ahmad[3], Norhidayah Ahmad[4]

[1] Kulliyyah of Dentistry, International Islamic University Malaysia, 25200, Kuantan, Pahang, Malaysia
[2] Department of Health Sciences, Kulliyyah of Nursing, International Islamic University Malaysia, 25200 Kuantan, Pahang, Malaysia
[3] Department of Prosthodontics, Kulliyyah of Dentistry, International Islamic University Malaysia, 25200 Kuantan, Pahang, Malaysia
[4] Department of Biomedical Science, Kulliyyah of Allied Health Sciences, International Islamic University Malaysia, 25200 Kuantan, Pahang, Malaysia

ABSTRACT

Introduction: Musculoskeletal disorders (MSDs) are one of the most common occupational health concerns worldwide. Numerous studies have reported a higher prevalence of MSDs affecting the upper and lower extremities among dental practitioners. These are frequently attributed to poor ergonomic postures, prolonged static position, gender predilection and increased working hours and workload. **Materials and methods:** This systematic review was based on the Preferred Reporting Items for Systematic Reviews and Meta-analysis 2020 (PRISMA) guidelines. The articles were retrieved from four search engines: PubMed, Scopus, Science Direct and Google Scholar. **Results:** 19 studies that fulfilled the eligibility criteria were included. A high prevalence of MSDs (55%-96%) was found among dental practitioners worldwide. The most common affected body parts included the neck (26%-96%), shoulder (20%-90%), upper back (21%-82%) and lower back (21%-80%). Risk factors associated with MSDs included awkward working posture, younger age with less experience, female predilection, increased working hours and high workload. **Conclusion:** Overall, this review highlights the significant burden that MSDs impose on dental practitioners. However, larger studies with higher response rates are warranted to generate more accurate and conclusive results. More importantly, dental education should emphasise the knowledge and application of ergonomics among dental students to promote the necessary awareness and practice in reducing the prevalence of MSDs.
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Corresponding Author:
Norfaezah Ahmad, Master
Email: drfaezah@iium.edu.my
Tel : +60192697997

INTRODUCTION

Work-related musculoskeletal disorders (WMSDs) are the most significant health concern worldwide. Dental practitioners are not spared of the same occupational hazard. Based on the Global Burden of Disease 2019, approximately 1.71 billion people worldwide suffer from a musculoskeletal disorder that can manifest as low back pain, neck pain, fractures, tissue injuries, osteoarthritis, amputation, or rheumatoid arthritis (1). Musculoskeletal disorders (MSDs) encompass a range of illnesses and problems affecting distinct musculoskeletal system structures such as blood vessels, nerves, tendons, muscles, joints, and ligaments, as well as the supporting elements such as intervertebral discs (2,3,4). Several factors, including ageing, unstable working positions, prolonged static positions and psychosocial factors, are linked with a higher frequency and intensity of these injuries (5,6). Furthermore, according to the National Institute for Occupational Safety and Health (NIOSH), frequent heavy lifting, daily exposure to whole-body vibration, routine overhead work, frequent work that involves chronic flexion of the neck and repetitive forceful tasks may predispose to MSDs. An earlier study established a link between work conditions and MSDs of the neck, shoulder, elbow, hand, wrist and back (7). Later, MSDs are also found to be associated with the risk of developing non-communicable diseases (NCDs) such as cardiovascular diseases (CVDs) (8).

Similar to other professions, dental practitioners are also exposed to various WMSDs. In their daily work, they must deal with the oral cavity, a narrow and limited access region. Thus, they need to maintain a great concentration in a specific posture that may be unnatural

for a lengthy period during the dental procedure. Such prolonged repetitive posture can cause excess pressure and strain on muscles and joints, notably in the neck, shoulders, back and waist, subsequently leading to reduced work efficiency and premature functional limitations (9). In the literature, dental practitioners have been associated with a higher prevalence of MSDs in distinct parts of the body than other professions 9). Globally, the prevalence of MSDs-related complaints ranged from 65% to 96% in the wrist, neck, shoulder and lower back (10,11). Common risk factors of MSDs that have been identified include working position, age, gender, working hours, workload, BMI and stress (12). In view of the scarce and inconclusive information, this systematic review would be a valuable addition to the literature, particularly considering the physical demands of dental work and the potential impact on the practitioners' health and well-being. In addition, the systematic review included all dental practitioners in the world with no geographical limitation; this provided a comprehensive understanding and valuable insight into the most reliable assessment method. Thus, we aimed to systematically review the published evidence of the prevalence of MSDs among dental practitioners worldwide to identify the most affected body regions and the associated risk factors.

MATERIALS AND METHODS

Review question formulation

PEO formulation was applied to create the research question in this systematic review. In this study, P refers to the populations of dental practitioners of MSDs, E refers to the exposure to MSDs as a dental practitioner and O is the outcome that indicates the prevalence of MSDs.

Search strategy

A comprehensive search was conducted across four online databases, i.e. PubMed, Scopus, Google Scholar and Science Direct. Only studies published after the year 2000 were considered. Manual searches using the snowball technique were also conducted to identify other relevant papers from the reference lists of the retrieved articles. The search string was formed using the BOOLEAN operators (AND, OR, NOT) to combine search terms including "prevalence", "frequency", "musculoskeletal disorder*", "back pain", "occupational hazard", "dentist*", "dental practitioner*" and "dental professional*".

Inclusion and exclusion criteria

Only studies published in the English Language and available as full texts were included in this systematic review. In addition, the included studies must contain investigations on the prevalence and risk factors of MSDs in the interest group, i.e. dental practitioners. In-vitro study, letters to the editor, conference proceedings, and general statements were excluded. All papers that met the inclusion criteria were recorded in a table that consisted of the title, abstract and the availability status of the full article to facilitate the subsequent process of article screening and data extraction.

Study design

The Preferred Reported Items for Systematic Reviews and Meta-Analysis 2020 (PRISMA) guideline was used in this systematic review. The selection of published articles was made in three phases: identification, screening and inclusion of the eligible studies, as shown in Figure 1. All the steps in the systematic review, from the search of studies, selection and qualitative evaluation to data extraction, were performed independently by two researchers. A third individual researcher was consulted in case of disagreement to obtain the final consensus.

Analysis of data

Data obtained during the analysis were tabulated in a table consisting of the reference number, country, response rate, study design, sample size, gender, research instrument, as well as the prevalence of MSDs and risk factors (Table I). In addition, the information obtained from the methodology, result, and discussion sections were extracted and evaluated. All data were then defined, combined, and compared as part of the analysis process.

Quality assessment

All articles included in the review were evaluated with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) checklist (13). This checklist evaluates six main aspects of the quality of the included papers on a score of 1 to 3. Based on this evaluation, all articles were then categorised as low quality (0-6), moderate quality (7-12), or high quality (13-18).

RESULTS

Figure 1 summarises the identification and screening process based on PRISMA 2020 reporting guidelines. A total of 1631 articles were retrieved from four selected online databases: PubMed, Scopus, Science Direct and Google Scholar. After screening the titles and abstracts, 1597 studies were excluded. Following that, another four articles were excluded due to the inability to retrieve records. Then, another 11 papers were rejected due to the unavailability of full texts or because the studies were reviews or did not include the prevalence of MSDs. Thus, only 19 studies were included in the final systematic review.

The characteristics of the reviewed studies are presented in Table I. Most of the studies used the Nordic Musculoskeletal Questionnaire (NMQ) to assess the prevalence of MSDs. However, a few studies adopted a self-reporting questionnaire (SRQ) to evaluate the MSDs issue.

Table I: Characteristics of the studies assessed.

No.	Reference	Region/ Country	Percentage of response rate	Study design	Sample size	Male	Female	Questionnaire	MSD prevalence	Prevalence by body parts	Risk factors	Score by STROBE
1	Bayon-Baanders and Garet, 2022	Spain	42%	Cross-sectional	43	22	21	Validated self-administeredquestionnaire	86%	- Shoulder (70) - Neck (65%) - Lower back (56%) - Upper back (40%)	- Excessive cervical twists and flexions - Bend of the back - BMI	13 (High)
2	Rickert et al., 2021	North Rhine-Westphalia, Germany	38%	Cross-sectional	229	229		Modified Nordic Musculoskeletal Questionnaire (NMQ)	93%	- Neck pain (65%) - Shoulder (58%) - Upper back (49%)	-Female - Increased physical load - A large number of comorbidities - Orthodontist	10 (moderate)
3	Alogaibi et al., 2018	Jeddah, SaudiArabia	100%	Cross-sectional	105	19	86	Self-reporting questionnaire (SRQ)	73%	- Neck (73% - Lower back (72%) - Shoulders (71%)	-Number of patients - Working duration - Work posture (sitting/standing) - Physical activity	9 (moderate)
4	Pejčić et al., 2017	Serbia	71%	Cross-sectional	356	121	235	Self-reporting questionnaire (SRQ)	83%	- Neck (50%) - Lumbar spine (46%)	-Advanced age - Female dentists - Presence of chronic diseases - Long working hours and high frequency of treatedpatients	8 (moderate)
5	Taib et al., 2017	Malaysia	96%	Cross-sectional	82	27	55	Nordic questionnaire	92%	- Neck (93%) - Upper back (71%) - Lower back (60%) - Wrists /hands (52%)	-Age - Gender - BMI - Physical factors - Psychosocial factors	9 (moderate)
6	Gangwar, 2016	Lucknow, India	100%	Cross-sectional	120	60	60	Modified Nordic Musculoskeletal Questionnaire (NMQ)	83%	- Lower back (80%)	-Age - Long working hours - No leisure - Restricted posture	11 (moderate)
7	Hodacova et al., 2015	Czech Republic	73%	cross-sectional	576	161	414	Nordic Questionnaire	66%	- Neck (43%) - Low back pain (63%) - Headaches (18%) - Shoulder (40%) - Upper back (21%)	-Age - Gender - Length of practice - A history of serious MSDs - The occurrence of MSDs in blood relatives	11 (moderate)
8	Sakzewski and Naser-ud-Din, 2015	Australia	52%	Cross-sectional	466	466		Modified Nordic Musculoskeletal Questionnaire (NMQ)	89%	- Neck and shoulders (both 66%) - Lower back (60%)	- Increased work stress - Physical factors - Ergonomic education	9 (moderate)

CONTINUE

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Table I: Characteristics of the studies assessed. (CONT.)

No.	Reference	Region/ Country	Percentage of response rate	Study design	Sample size	Male	Female	Questionnaire	MSD prevalence	Prevalence by body parts	Risk factors	Score by STROBE
9	Aljanakh et al., 2015	Hail Region ofSaudi Arabia	85%	cross-sectional	68	43	25	Nordic Questionnaire	78%	- Lower back (73.5%) - Neck (66%) - Shoulders (43.3%)	Age, gender, work duration, musculoskeletal symptoms that affectedtheir daily activities	11 (moderate)
10	Lin et al., 2012	Taiwan	-	Cross-sectional	197	146	51	Modified Nordic Musculoskeletal Questionnaire (NMQ)	75%	- Shoulder (75%) - Neck (72%) - Lower back (67%) - Hip (15%) - Knee (15%) - Ankle (15%)	-Female - Days of work - No more than 1 dental assistance - Body height >178cm - Patient load >20pts/day	6 (low)
11	Muralidharan, Fareed and Shanthi, 2013	Andra Pradesh, India	96%	Cross-sectional	73	50	23	Modified Nordic Musculoskeletal Questionnaire (NMQ)	78%	- Neck (52%) - Low back (41%) - Shoulder (29%) - Wrist (26%) - Elbow (8%)	- Attending >40 patients a day	12 (moderate)
12	Leggat and Smith, 2006	Queensland, Australia	73%	Cross-sectional	285	209	76	MSD Questionnaire	87%	- Neck (58%) - Lower back (54%) - Shoulder (53%) - Upper back (34%) - Wrist (34%)	- Females - Younger and less experienced dentists	11 (moderate)
13	Phedy and Gatam, 2016	Indonesia	65%	Cross-sectional	241	35	206	Nordic Musculoskeletal Questionnaire (NMQ)	64%	- Neck (26%) - Upper back (22%) - Lower back (21%)	-Prolong sitting -Exercise -Stress	13 (high)
14	Ísper Garbin et al., 2017	Brazil	-	Cross-sectional	204	75	129	Interview, Nordic Questionnaire, job-related pain questionnaire, Pain disability questionnaire	81%	- Neck (55%) - Shoulder (52%) - Upper back (51%) - Elbow (16%) - Wrist (46%)	- Bending or twisting the back in an awkward way - Static position for an extended period.	13 (high)
15	Feng et al., 2014	China	90%	Cross-sectional	272	151	121	Modified Nordic Musculoskeletal Questionnaire (NMQ)	88%	- Neck (84%) - Shoulder (74%) - Wrist/hand (44%) - Elbow (30%)	- Long working hours - Regular exercise - Inability to select the appropriate size of dental instrument - High job demand	13 (high)

CONTINUE

Table I: Characteristics of the studies assessed. (CONT.)

No.	Reference	Region/ Country	Percentage of response rate	Study design	Sample size	Male	Female	Questionnaire	MSD prevalence	Prevalence by body parts	Risk factors	Score by STROBE
16	Khan, 2017	Karachi, Pakistan	100%	Cross-sectional	50	24	26	Modified Nordic Musculoskeletal Questionnaire (NMQ)	86%	- Neck (96%) - Shoulder (90%) - Upper extremities (82%) - Lower extremities	Not reported	13 (high)
17	Ratzon et al., 2000	Israel	-	Cross-sectional	60	60	0	SNQ	55%	- Lower back (55%) - Neck (39%)	Long static position (sitting) * Compared to an alternate position	10 (moderate)
18	Kierklo et al., 2011	Poland	-	Cross-sectional	220	26	194	MSD questionnaire	92%	- Neck (47%) - Lower back (35%) - Fingers (29%) - Hip (23%) - Shoulder (20%)	-Years of practice- increase with the number of Years - Standing work position - Non-use of a rest break. - Prolong constrained work position with neck and	9 (moderate)
19	Ohlendorf et al., 2020	German	18%	Cross-sectional	450	163	287	Modified Nordic Musculoskeletal Questionnaire (NMQ)	96%	- Neck (78%) - Shoulders (66%) - Lower back (59%) - Elbow (11%) - Wrist (30%)	- Females are affected more than males. -Age - Professional experience	12 (moderate)

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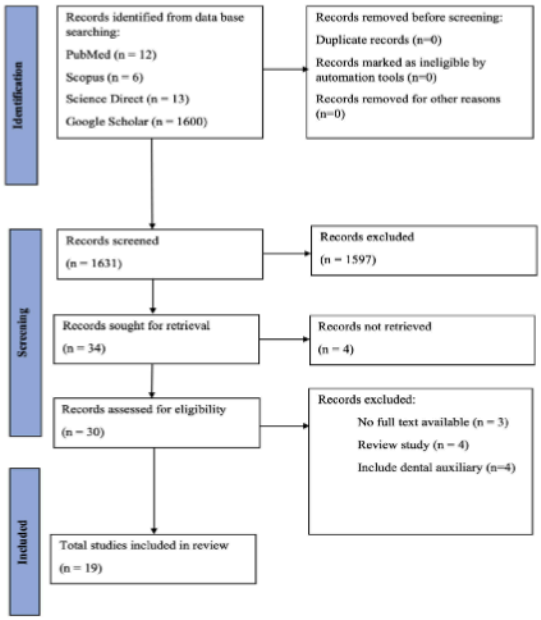


Figure 1: PRISMA flow Diagram

This systematic review involved 19 cross-sectional studies from 13 countries (Figure 2). It included one study each from Malaysia, Spain, Pakistan, Indonesia, Poland, Israel, and Brazil, as well as two studies each from Germany, Saudi Arabia, India, Europe, Australia and China. The prevalence of MSDs and their associated risk factors among 4,037 dental practitioners worldwide were analysed.

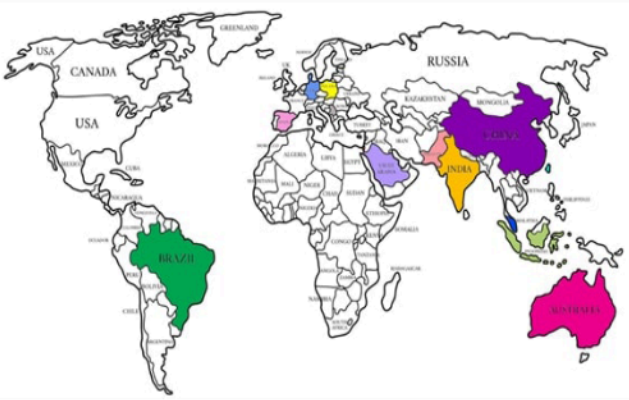


Figure 2: Countries with studies included in this systematic review are shaded in colours

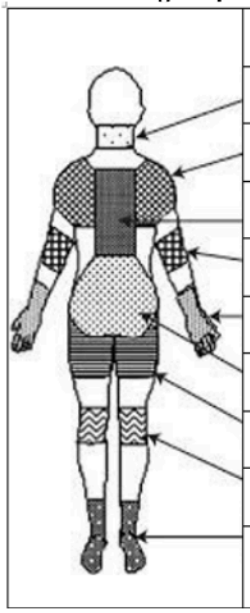
The prevalence of musculoskeletal disorders (MSDs)

All studies included in this systematic review indicated a high prevalence of MSDs among dental practitioners. The prevalence ranged from 55% to 96%, as shown in Table I. Two studies in Germany recorded the highest prevalence of MSDs at 93% and 96%, respectively (14,11). Similarly, dental practitioners in Malaysia and Poland also recorded a high prevalence of MSDs (92%) (15,5). In addition, eight studies reported that more than 80% of the dental practitioners in the countries suffered from MSD, including Spain (86%), Serbia (83%), Australia (89% & 87%), China (88%), Pakistan (86%), India (83%), and Brazil (81%) (16,17,18,19,20,21,10,22). Apart from that, 73% of dental practitioners in Jeddah and 66% of dental practitioners in the Republic of Czech Europe also reported MSDs. Studies from Taiwan (78%), India (78%), and Indonesia (64%) reported similar prevalence rates for MSDs among local dental practitioners. Lastly, the lowest prevalence of MSDs was reported among dental practitioners in Israel (55%).

Neck, shoulder, upper back and lower back

As shown in Table II, the neck (26% - 96%), shoulder (20% - 90%), upper back (21% - 82%) and lower back (21% - 80%) are reported as the body parts most affected by MSDs among dental practitioners. A Pakistani study in 2017 also revealed that 96%, 90%, and 82% of MSDs were in the neck, shoulder, and upper extremities (10). The same findings were reported by a study in year 2014 in China with 84% and 74% of the MSDs affected the neck and shoulder.

Table II: The range of prevalence of MSDs by body regions.



Body Regions	Range of prevalence
Neck	26% - 96%
Shoulder	20% - 90%
Upper back	21% - 82%
Elbow	11% - 30%
Wrist/Hand	18% - 52%
Lower back	21% - 80%
Hip/Thigh	4% - 44%
Knee	7% - 34%
Ankle/feet	5% - 20%

Taib et al. (5) reported that the body regions most affected by MSDs among Malaysian dentists were the neck (93%) and the upper back (71%). The same findings were reported among Taiwanese dentists in 2011, Spain dentists in 2022 and Germany in 2021, whereby the shoulder and neck were the body parts most commonly affected by MSDs. Moreover, an Australian study in 2015 also reported that two-thirds (66%) of dental practitioners suffered from neck and shoulder MSDs. Similarly, in Saudi Arabia, Alogaibi et al. (6) recorded that 73%, 71% and 72% of dental practitioners suffered from MSDs in the neck, shoulder, and lower back, respectively. However, in India, the most common body area affected by MSDs was the lower back (80%), according to a study in year 2016.

Other body regions

Generally, there was a lower percentage of MSDs (Table

II) affecting the elbow (8% - 30%), wrist/hand (18% - 52%), hip/thigh (4% - 44%), knee (7% - 34%), and ankle/feet (5% - 20%). However, studies from certain countries recorded a higher prevalence of MSDs on these body parts. For example, a study in year 2014 reported that 30% of MSDs among dental practitioners in China involved the elbow region. In Malaysia, Taib et al. (5) showed that more than half (52%) of dental practitioners suffered from MSDs on the wrist and hand. In contrast, an Indian study by Muralidharan et al. in (27) reported the elbow as the least affected region, with only 8% of all MSDs. In addition, a Pakistani study (10) revealed a rather high prevalence of MSDs in the hip (44%), knee (34%) and ankle areas (34%) as compared to other studies.

Risk factors for MSDs

Table III summarises the risk factors of MSDs among dental practitioners. The prevalence of MSDs was significantly associated with working positions. Dental practitioners in Spain, Saudi Arabia, Europe, India, Australia, Indonesia, Brazil, Israel and Poland all reported a high prevalence of MSDs due to awkward body positions at work. Such positions can result from poor ergonomic postures, especially those involving excessive torsions and cervical flexions (22), awkward bending or twisting of the back (20,22), prolonged constrictive work position with neck and spine flexion (15), as well as sitting, standing, or remaining in a static position for a long duration (23,15,24,6).

Table III: Risk factors for MSD

Risk factors	References
Work position (9)	Ratzon et al., 2000; Kierklo et al., 2011; Sakzewski and Naser-ud-Din, 2015; Gangwar, 2016; Phedy and Gatam, 2016; Hsper Garbin et al., 2017; Pejčić et al., 2017; Alogaibi et al., 2018b; Bayona-Baanders and Garet, 2022
Age (8)	Feng et al., 2014; Hodacova et al., 2015; Gangwar, 2016; Pejčić et al., 2017; Taib et al., 2017; Ohlendorf et al., 2020
Gender (8)	Leggat and Smith, 2006; Lin et al., 2012; Feng et al., 2014; Hodacova et al., 2015; Pejčić et al., 2017; Taib et al., 2017; Ohlendorf et al., 2020; Rickert et al., 2021
Working hours (5)	Feng et al., 2014; Gangwar, 2016; Pejčić et al., 2017; Taib et al., 2017; Alogaibi et al., 2018
Workload (6)	Lin et al., 2012; Muralidharan, Fareed and Shanthi, 2013; Feng et al., 2014; Pejčić et al., 2017; Taib et al., 2017; Rickert et al., 2021
Experience (4)	Leggat and Smith, 2006; Feng et al., 2014; Hodacovaet al., 2015; Ohlendorf et al., 2020
BMI (2)	Taib et al., 2017; Bayona-Baanders and Garet, 2022
Stress (1)	Phedy and Gatam, 2016
Presence of chronic disease (1)	Pejčić et al. 2017
Body height (1)	Lin et al. 2011

In addition, age and years of practising dentistry were also found to be associated with the prevalence of MSDs. For example, an Australian study showed that dental practitioners who were younger and less experienced complained more often of MSDs compared to their senior counterparts. This could be attributed to the fact that experienced practitioners are more likely to adapt better to their working position and techniques in an ergonomic manner. Similarly, a study among dental practitioners in China also showed that almost 50% of the MSDs were reported among dental practitioners in the 20-30 age group as compared to only 7% among those in the 50-60 age group (17). However, two of the studies from Europe and Taiwan reported the opposite findings whereby a higher prevalence of MSDs was reported by dental practitioners who were older and with longer working experience. Apart from age, gender also showed a strong association with MSDs with a predilection towards female dental practitioners. These findings were consistent in almost all studies in this review (16,25,17,26,21,5,14,11).

Apart from non-modifiable factors such as age and gender, other risk factors of MSDs included longer working hours (6,21,19,5,17), increased workload (25,27,17,21,5,11), high BMI (5,22), increased stress (24), presence of chronic diseases (21), and body height (25).

DISCUSSION

In this systematic review, data obtained from 19 studies presented extensive evidence of MSDs casting a significant burden among dental practitioners worldwide. Most of the studies applied the modified standardised Nordic Questionnaire as the instrument. It has been shown to be reliable tools in measuring the prevalence of MSD as it covers the entire body region and captures multiple time frames in terms of the occurrence of MSDs. Thus, it has been used in most MSDs-related studies worldwide. Even though physical examination may be more accurate in determining the presence of MSDs compared to questionnaires, it is seldom applied due to time and cost constraints.

Based on the analysis, the highest prevalence of MSDs was reported in two studies from Germany, with a rate of 93% and 96%, respectively (11,14). This high prevalence of MSDs could be attributed to the higher ratio of female dental practitioners in Germany, as females were more likely to report frequent pain in all regions of the musculoskeletal system, particularly for the item “pain in the last seven days” (14). Concerning the association between female predilection and MSDs, as reported in multiple studies (25,19,6,14,11), this might be explained by the higher threshold of pain tolerance among males compared to females (6). Furthermore, Rickert et al (11) postulated another possible reason to be greater muscle forces and activations that were

generated in females, especially when working above shoulder level. In contrast, Ratzon et al (23) recorded the lowest prevalence of MSDs among Israeli dental practitioners (55%). However, the results of this study might be inconclusive since the survey was conducted among male dental practitioners only as compared to the studies in other countries that captured both male and female dental practitioners.

In addition, Rickert et al (11) claimed that the prevalence of MSDs was associated with higher workloads and pre-existing comorbidities. The same condition was also detected among dental practitioners in Malaysia and Poland, with a prevalence of 92% (5,15). In addition, Taib et al (5) reported the significant physical, psychosocial, and sociodemographic risk factors associated with 93% of Malaysian dental practitioners with MSDs.

In Poland, Kierklo et al (15) indicated that a majority of the surveyed dental practitioners demonstrated improper working postures and poor knowledge of ergonomics. Another eight studies in Spain, Europe, Australia, China, India, Pakistan and Brazil also reported a relatively high prevalence of MSDs (> 80%). Excessive cervical twists and flexions were significant predictors of MSDs in Spain (22). The same positions were also reported among dental practitioners in Brazil, Australia, and Europe (18,20,21). In addition, an Indian study showed that dental practitioners who attended more than 40 patients per day (27) were more likely to suffer from MSDs. This was concurred by Feng et al (17), who mentioned that the high prevalence of MSDs in China could be attributed to an increased workload.

Additionally, the most reported regions affected by MSDs among dental practitioners were the neck, shoulder, upper back, and lower back (17,19,10,5,14,11,22). These body parts were mainly affected because of incorrect ergonomic postures, such as excessive torsions and cervical flexions during work. In addition, MSDs in the neck and shoulder are also indirectly caused by repetitive movement and flexed neck (22). On a similar note, MSDs among Malaysian dental practitioners were also found to be significantly related to awkward postures during dental procedures include bending or twisting the spine as reported by Taib et al (5).

In comparison, some body regions were less affected by MSDs, namely the elbow, wrist/hand, hip/thigh, knee and ankle/feet. Feng et al. in 2014 reported a relatively strong association between neck, shoulder and hand/wrist pain, in which 87% of dental practitioners in China with neck pain also suffered from shoulder pain while another 51% had experienced wrist/hand symptoms. In the same study, the right side of body regions was also more frequently related to MSDs. However, this could be explained by the predominance of right-handed respondents that led to a higher report of MSDs on the dominant side. Wrist/hand symptoms were more likely to be reported among female dental practitioners (16) as compared to elbow symptoms, which were more common among male practitioners (27). Even though less commonly reported in other countries, a study in Poland showed that 75% of dental surgeons suffered from foot and hip pain (15).

Many studies highlighted that the high prevalence of MSDs can be significantly associated with multiple risk factors such as working position, age, gender, working hours, workload, and working experience. For instance, most dental practitioners who presented with symptoms of MSDs also complained of issues with awkward working positions (15,18,20,21,5). In addition, the prevalence of MSDs was directly correlated with work burden, especially when they must work non-stop for more than two hours to treat the patients (17). Apart from working position, it also emphasised that improper selection of dental instruments was significantly associated with the development of wrist/hand symptoms (17). Many dental procedures, such as dental scaling and endodontic treatment, require precise wrist/hand movements. Thus, dental practitioners need to maintain an unnatural posture until the end of the treatment. Moreover, Feng et al (17) believed that the need to handle small dental instruments to gain access to specific regions also result in awkward arm and shoulder positions, which inevitably increases the load on the shoulder and causes pain. Thus, they concluded that the tool sizes and inappropriate working postures across different body regions may predispose to an increased risks of MSDs.

Likewise, a study in Spain shows that more than 50% of dental practitioners performed extreme cervical twists or flexions for better visibility (22). A similar study in Germany reported that repetitive motions, vibration and long duration of the procedures led to a higher prevalence of MSDs. Furthermore, prolonged shoulder abduction (>45◦) with the elbow flexed and pronated with isometric and eccentric contraction, as well as fatigued and strained deltoid, supraspinatus, trapezius, and serratus anterior, have been found to predispose to MSDs in the shoulder region (11).

Aside from the working position, age, gender, and working experience were also significantly associated with the prevalence of MSDs in some studies (16,17,5,14). For example, studies in Australia and Saudi Arabia recorded that dental practitioner who were younger and less experienced might position themselves improperly during dental procedures (16,6). Furthermore, younger dental practitioners tend to practise general dentistry or undergo intensive postgraduate training, thus putting them on a higher workload compared to their senior counterparts, who were more specialised in the field (6).

The strengths of the systematic review are that it used PRISMA 2020 reporting guidelines, the latest PRISMA protocol and conducted quality assessments for their

methodological qualities and risk of bias via the STROBE checklist. On the other hand, there are some limitations to this systematic review when it includes a few studies that lack empirical validity due to factors such as small sample sizes and low response rates. A total of 13 out of 19 studies in this review had excellent response rates. However, three studies did not mention the response rate and another three achieved less than 50% of the response rate. Therefore, future studies should perform appropriate sample size calculations and obtain reasonably high response rates to produce valid results. Furthermore, studies with a larger sample size are required to achieve generalisable results and valid conclusions on the prevalence of MSDs among dental practitioners.

CONCLUSION

In summary, this systematic review demonstrates that MSDs cast a significant burden on dental practitioners worldwide. The high prevalence of MSDs reported in the upper extremities, including the neck, shoulder, upper and lower back, is a significant occupational health concern among dental practitioners. Multiple risk factors significantly increased the prevalence of MSDs, particularly awkward working posture, younger age, female predilection, long working hours, and high workload. In the future, studies of larger sample sizes and higher response rates are essential to generate more conclusive results. More importantly, dental schools are strongly encouraged to inculcate ergonomics education among dental students to create awareness that ensures the strict application of ergonomics when they start practising to prevent and reduce MSDs.

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REFERENCES

1. Cieza A, et al. Global estimates of the need for rehabilitation based on the Global Burden of Disease study 2019: a systematic analysis for the Global Burden of Disease Study 2019. Lancet, 2020;396(10267):2006–2017. doi:10.1016/S0140-6736(20)32340-0.
2. Yamalik N. Musculoskeletal disorders (MSDs) and dental practice; Part 1. General information-terminology, aetiology, work-relatedness, magnitude of the problem, and prevention. Int Dent J, 2006;56(6):359–366. doi:10.1111/j.1875-595X.2006.tb00342.x.
3. Aminian, O., Banafsheh Alemohammad, Z. and Sadeghniiat-Haghighi, K. Musculoskeletal disorders in female dentists and pharmacists: a cross-sectional study. Acta Med Iran. 2012;50(9):635–40.
4. Aljanakh M, Al-Mohrej OA, Al-Oraini HS, et al. Prevalence of musculoskeletal disorders among dentists in the Ha'il Region of Saudi Arabia. Ann Saudi Med. 2015;35(6):456-461. doi:10.5144/0256-4947.2015.456.
5. Taib, M.F.M. et al. The effects of physical and psychosocial factors and ergonomic conditions on the prevalence of musculoskeletal disorders among dentists in Malaysia. Work. 2017;57(2):297–308. doi:10.3233/WOR-172559.
6. Alogaibi, Y.A. Asiri FY, Alqahtani AM, et al. Prevalence of musculoskeletal disorders (back, neck and shoulders' pain) among dental personnel in Jeddah – Saudi Arabia', J Dent Health Oral Disord Ther. 2018;9(5):399-405. doi:10.15406/jdhodt.2018.09.00416.
7. Bernard BP, et al. Musculoskeletal Disorders and Workplace Factors A Critical Review of Epidemiologic Evidence for Work-Related Musculoskeletal Disorders of the Neck, Upper Extremity, and Low Back. 1997. Available at: http://www.cdc.gov/niosh.
8. Williams A, et al. Musculoskeletal conditions may increase the risk of chronic disease: a systematic review and meta-analysis of cohort studies. BMC Med. 2018;16(1):167. doi:10.1186/s12916-018-1151-2.
9. ZakerJafari HR, YektaKooshali MH. Work-Related Musculoskeletal Disorders in Iranian Dentists: A Systematic Review and Meta-analysis. Saf Health Work. 2018;9(1):1–9. doi:10.1016/j.shaw.2017.06.006.
10. Khan R, FAMSM. Prevalence of Work-Related Musculoskeletal Disorders (MSD) among Dentists. Int J Contemp Med Res. 2017;4(5).
11. Rickert C, et al. Prevalence of Musculoskeletal Diseases of the Upper Extremity Among Dental Professionals in Germany. Risk Manag Healthc Policy. 2021;14:3755–3766. doi:10.2147/RMHP.S316795.
12. Thorat NC, et al. Prevalence of musculoskeletal pain in dentists; A systematic review and meta-analysis. J Head Neck Physicians Surg. 2022;) Epub ahead of print): 53–60. doi:10.4103/jhnps.jhnps_9_22.
13. Vandenbroucke JP, et al. Strengthening the Reporting of Observational Studies in Epidemiology (STROBE): Explanation and elaboration. Epidemiology. 2007;18(6):805-835. doi:10.1097/EDE.0b013e3181577511.
14. Ohlendorf D, et al. Prevalence of Musculoskeletal Disorders among Dentists and Dental Students in Germany. Int J Environ Res Public Health. 2020;17(23):8740. doi:10.3390/ijerph17238740.
15. Kierklo A, et al. Work-related musculoskeletal disorders among dentists - a questionnaire survey. Ann Agric Environ Med. 2011;18(1):79–84.

16. Leggat PA, Smith DR. Musculoskeletal disorders self-reported by dentists in Queensland, Australia. Aust Dent J. 2006;51(4):324–7. doi:10.1111/j.1834-7819.2006.tb00451.x.
17. Feng B, et al. Prevalence of work-related musculoskeletal symptoms of the neck and upper extremity among dentists in China. BMJ Open. 2014;4(12):e006451. doi:10.1136/bmjopen-2014-006451.
18. Sakzewski L, Naser-ud-Din S. Work-related musculoskeletal disorders in Australian dentists and orthodontists: Risk assessment and prevention. Work. 2015;52(3):559–579. doi:10.3233/WOR-152122.
19. Gangwar A. Low Back Pain among Dentists. J Med Sci Cli Res [Preprint]. 2016. doi:10.18535/jmscr/v4i6.61.
20. Hsper Garbin A, et al. Musculoskeletal disorders and perception of working conditions: A survey of Brazilian dentists in Sro Paulo. Int J Occup Med Environ Health [Preprint]. 2017; doi:10.13075/ijomeh.1896.00724.
21. Pejčić N, et al. Assessment of risk factors and preventive measures and their relations to work-related musculoskeletal pain among dentists. Work. 2017; 57(4):573–593. doi:10.3233/WOR-172588.
22. Bayona-Baanders T, Garet T. Work-Related Musculoskeletal Pain of The Neck, Shoulders And Back Among Dentists At The Dental Hospital of The University Of Barcelona: A Cross-Sectional Study. 2022. doi:10.21203/rs.3.rs-1253094/v1.
23. Ratzon NZ, et al. Musculoskeletal symptoms among dentists in relation to work posture. Work (Reading, Mass.). 2000;15(3):153–158.
24. Phedy P, Gatam L. Prevalence and Associated Factors of Musculoskeletal Disorders among Young Dentists in Indonesia. Malays Orthop J. 2016;10(2):1–5. doi:10.5704/MOJ.1607.001.
25. Lin T-H, et al. Prevalence of and risk factors for musculoskeletal complaints among Taiwanese dentists. J Dent Sci. 2012;7(1):65–71. doi:10.1016/j.jds.2012.01.009.
26. Hodacova L, et al. Self-reported risk factors related to the most frequent musculoskeletal complaints among Czech dentists. Ind Health. 2015;53(1):48–55. doi:10.2486/indhealth.2013-0141.
27. Muralidharan D, Fareed N, Shanthi M. Musculoskeletal Disorders among Dental Practitioners: Does It Affect Practice?. Epidemiol Res Int. 2013;2013:716897:1–6. doi:10.1155/2013/716897.