Protocol

Ergonomics in oral health professions: a mapping review protocol

Shiba Roby[1]*, Zac Morse[2]

[1]Graduate Research School, [2]School of Clinical Sciences, Auckland University of Technology, Auckland, New Zealand

*Correspondence:
Dr. Shiba Roby,
E-mail: shiba.roby@gmail.com

ABSTRACT

Background: Ergonomics is a multidisciplinary science that studies how humans and other system elements interact and a profession that uses theory, concepts, data, and methodologies to improve human well-being and overall system performance. Oral health professionals need good working ergonomics to preserve their work competence, efficiency, and high clinical level of treatment throughout their careers. For various working practices, clinical procedures, and patient types, they must adjust and ensure proper working postures, adequate illumination, and easy access to essential apparatus and materials. Although some systematic studies and original research have been conducted about different aspects of "ergonomics in oral health professions," no mapping review has been shown. The authors believe a broad overview of existing literature is required to map existing research, determine research gaps, and guide future research. **Methods:** The protocol for this mapping review has been designed by the Preferred Reporting Items for Systematic reviews and Meta-Analysis extension for scoping studies (PRISMA-SCR) and the Joanna Briggs Institute (JBI) guidelines. A comprehensive search strategy developed with an experienced liaison librarian for health will be used to search four databases and eight sources of unpublished literature. JBI's proposed search approach will be used. A PRISMA-SCR flowchart will be used to track the number of recognised, screened, and excluded sources. A data extraction table will be used to collate critical information, supplemented with a narrative explanation, and presented in a tabular style. **Conclusions:** This mapping review will identify research gaps in this field and guide further studies.

Keywords: Dental ergonomics, Dentist, Musculoskeletal disorders, Oral health therapists, Scoping review, Systematic review

INTRODUCTION

The oral health profession is exceedingly demanding and arduous because of the degree of hand dexterity and endurance required to perform procedures in a tight, confined, complicated, and restricted workspace, such as the oral cavity. Ergonomics is the study of how people, machines, and work environments interact to improve productivity and worker safety, health, and well-being. It also analyses oral health practitioners' abilities and limitations to guarantee that duties, equipment, information, and the environment are all suitable.[1-5] The scope of ergonomics in dentistry is broad, including everything from dental team chemistry to lighting, noise, and odour conditions and the equipment and software used. The treatment environment must be adaptable with the patient chair, dental unit, operating light, dynamic and hand instrumentation cabinetry, and peripheral equipment. For different working practices, clinical procedures, and patient types, good working ergonomics must adapt and ensure comfortable working postures, adequate lighting, and easy access to required instrumentation and materials so that work capability, efficiency, and a high clinical level of treatment can be maintained throughout the working life of oral health professionals.[1-3] Good ergonomics lead to increased productivity, reduced sicknesses and injuries, and improved employee health and well-being.[6-8] Musculoskeletal disorders (MSDs) are highly prevalent

among oral health professionals. The systematic review by Lietz et al found a pooled yearly prevalence of 78% of MSDs, with the neck (58.5%), lower back (56.4%), shoulder (41.1%), and upper back (43.1%) being the most commonly affected locations.[9] Dentists, orthodontists, dental hygienists, dental nurses, dental therapists, and dental students were among the oral health professionals who made up the study sample.[10-13] Work-related MSDs among oral health professionals have been linked to the inability to work, job quality, job satisfaction, work-related accidents, and premature retirement. Moreover, MSDs can cause high health care expenditures for medical treatments, making health and economic burdens considerable.[14-17]

Clinical investigations such as neuromuscular examinations, nerve conduction tests, electromyographic studies, postural analysis using various methods, sensory vibration tests, baropodometric analysis, or radiographs have been used to identify the musculoskeletal risk factors.[18-20] Posture evaluation scales, photometry, motion capture technology, pressure sensors, precision stadiometers, inclinometers, electro goniometers, angle transducers, force plates, and dynamometers have all been used to measure changes in posture. An electromyogram or strain gauge force transducers can quantify changes in muscle load. In addition, neurological testing or nerve conduction measurements have been used to evaluate changes in nerve function.[18,21-23]

According to the International ergonomics association (IEA 2014), physical ergonomics, cognitive ergonomics, and organisational ergonomics make distinctions between three distinct types of ergonomics.

Firstly, physical ergonomics for dental professionals include: operator factors (e.g., correct work posture, appropriate use of patient and dentist chairs, or correct method of instrumentation and tool handling); office design factors (e.g., workstation layout or set-up of space for positioning of operators, patients, machines, delivery systems, and their interrelationships); and dental factors (e.g., correct method of instrumentation and tool handling, with the ergonomically designed operator and patient chairs, instruments, and visual aids).

Secondly, cognitive ergonomics refers to interventions that improve interactions between humans and other system characteristics (such as mental health).

Thirdly, organisational ergonomics improves an organisation's structure, policies, and operations (e.g., organisation of workflow or appointment scheduling).[18]

Organisations and government entities that provide dental care are constantly confronted with new and different needs. Treatment and workplace strategies must adapt to satisfy these objectives. As a result of these changes, staffing plans must be adjusted to ensure that the number of oral health professionals is ideal in response to local demands. Applying a salutogenic approach to a workplace in human services, such as dentistry, where there are demands for restructuring, is a means to maintain and improve employee health, particularly mental health. In terms of dental care, oral health professionals who work in a healthy environment are a more excellent resource for their patients.[9,11,18]

High psychosocial expectations, along with the minimal ability for employees to affect their work and a lack of support in the workplace, can contribute to stress and a fast pace of work. All employees reported increasing difficulties disconnecting from work and increased presenteeism for psychosocial reasons. The most apparent work element in dentistry remains severe physical load, independent of the type of dental organisation structure, and unsatisfactory work positions for all employees. Employees at medium-sized companies report much higher psychosocial demands and more sleep disorders due to their jobs than employees at medium-sized clinics, large clinics, and small clinics.[7,18]

Dental care is a physically and mentally demanding vocation; thus, oral health workers must be free of serious MSDs. The most frequently analysed aetiological factor of musculoskeletal diseases and pain was awkward working posture through cramped, twisted, and prolonged sitting or standing positions.[18,24] Studies have demonstrated that discomfort while working in a certain body position probably caused musculoskeletal pain among oral health professionals.[25] Zarra et al in their study, demonstrated that oral health professionals who worked with awkward postures during clinical practice ran 4.6 times more risk of MSDS.[26] By addressing suboptimal work postures, clinical ergonomic training and education have been shown to reduce the development of MSDs.[27-29] A few comprehensive literature reviews have focused on ergonomic methods to avoid MSDs among oral health practitioners.[18,30,31] The influence of these ergonomic changes on MSDs among dental care practitioners was observed to vary depending on gender, practice type, and hours worked.[32] The work schedule rotation was found to help prevent MSDs and reduce stress caused by repetitive work.[33] Saddle chairs were found to generate a straightening of the pelvis and simultaneous support of the natural lumbar lordosis. In contrast, normal chairs, used as reference models, caused a reduction in lumbar lordosis, and an increased load on the spine and support muscles.[34,35] Hand instruments designed with ergonomics help reduce muscle power, unnatural postures, and fatigue.[36,37] Because a range of magnification loupes were tested across the trials, positive findings on the use of loupes to reduce neck discomfort and improve posture limit interpretation of a general recommendation for the overall usage of loupes.[38-42] Most studies that focused on physical activity interventions concluded that implementing regular physical activity reduced the frequency of musculoskeletal pain. Most of the articles focused on physical activity, including various types of physical therapy, and stretching, concluding that physical

activity had a positively impacted reduction in musculoskeletal pain and symptoms.[43-46]

To check for existing and ongoing scoping and systematic reviews on ergonomics in oral health professions, searches were conducted in the Cochrane database of systematic reviews, Open science framework database, PROSPERO, JBI systematic review register, JBI evidence synthesis journal, Dentistry, and Oral sciences source, CINAHL, MEDLINE, and Scopus databases. A few systematic reviews have been published on various topics, such as the prevalence of musculoskeletal diseases among oral health practitioners and ergonomic strategies for musculoskeletal disorder prevention. However, we could not find a mapping review that included and mapped all the major areas of ergonomics in oral health professions in one study. The authors consider that a broad review of existing literature is required to identify gaps in existing research and provide direction for future studies in this field. A mapping review was chosen as the most acceptable methodology because it aims to categorise, classify, characterise patterns, trends, or themes in evidence production, particularly in numerous publications.[47-49]

This mapping review will provide an overview of the available research evidence by aggregating and interpreting the literature, including identifying research gaps in ergonomics in oral health professions. The study embarks on a mapping review of research on ergonomics in oral health professions to determine the existing degree of research used to identify research gaps and inform future research. This mapping review will cover primary and secondary studies, guidelines, and publications about ergonomics in oral health professions. The review will cover studies authored in English and published until January 2022. There will be no geographical or setting restrictions.

The literature will be mapped under these domains and subdomains.

1. Risk factors 2. Health assessment methods e.g., Physical, Muscle activity (EMG), Psychosocial 3. Musculoskeletal health e.g., Epidemiology of musculoskeletal conditions like upper and lower back pain, neck pain, Temporomandibular Joint Disorders (TMD), Carpal tunnel syndrome, etc 4. Ergonomic interventions e.g., Mechanical exposure interventions (Tool design, Seating & workstation design, Magnification loupes), Production systems & organisational culture interventions (Work organisation, Productivity, Efficiency), Modifier interventions (Yoga and meditation, Exercises, Complementary and alternative medicine) 5. Education e.g., Training, Awareness, Student populations 6. Policies, standards & best practices e.g., International policies and procedures.

Review question

The aim is to answer a broad, overarching question: 'what is known from existing literature about ergonomics in oral health professions?'

METHODS

Eligibility criteria

The Population, Concept, Context (PCC) framework, which JBI recommends, was used to determine the eligibility criteria for this mapping review.[50]

Participants

Oral health professions include dentists, dental hygienists, oral health and dental therapists, and dental assistants.

Concept

This review will consider any substantive concepts in publications on ergonomics in oral health professions.

Context

Studies from any geographical location and setting will be eligible for inclusion to provide a broad overview of the existing literature.

Types of sources

Primary and secondary studies, guidelines, and reports will be included, both published and unpublished. Letters, narratives, opinion papers, commentaries, and historical reviews will not be included. Only English-language information will be considered because translation resources are unavailable for this mapping evaluation. However, where abstracts in English are accessible, the authors wish to highlight potentially relevant work in other languages.

Search strategy

This mapping review will use a multi-step search method provided by the Joanna Briggs Institute.[50]

An initial, limited search of the Dentistry and Oral Sciences Source, CINAHL, MEDLINE, and Scopus databases was conducted, followed by a text word and index term analysis of pertinent publications. This aided in creating a comprehensive search strategy.

A complete search strategy will be devised and later adapted for each of the databases we aim to search with the assistance of an expert health sciences librarian. Dentistry and Oral Sciences Source, CINAHL, MEDLINE, and Scopus are the databases to be searched. There will be no restrictions on geographic area or setting, date of publication, and both published and unpublished work will be explored.

In each database, searches will be conducted in two stages. The initiative will focus on research completed by the end of 2021. Then, later, a follow-up search will be conducted to discover all sources published in 2022. This will maintain uniformity across databases and provide 'fixed' numbers of detected sources in a PRISMA-SCR flowchart.[51] Other search filters will not be used. A complete search strategy for MEDLINE can be found in Table 1.

Table 1: Search strategy for Medline.

Search no.	Search strategy
1	"Oral health profession*" OR "dentist*" OR "dental hygienist*" OR "dental therapist*"OR "oral therapist*" OR "dental assistant*" OR "oral health therapist*"
2	"Ergonomic*" OR "posture" OR "postural" OR "system performance" OR "microergonomic*" OR "human engineering" OR "work design" OR "human factor*" OR "safety" OR "macroergonomic*" OR innovativeness OR efficiency
3	1 AND 2

The Cochrane library, Cochrane oral health's trials register, Google, Google Scholar, ISRCTN registry, Open grey, ProQuest dissertations and Theses global, and the WHO clinical trials registry Platform will also be searched for unpublished material. The first 100 items on Google, and the first 100 articles on Google Scholar, will be screened for eligible studies, as it is unlikely that any useful information will be found beyond this number of items. In addition, organisational websites will be searched for policies. Finally, we will also conduct a 'cited reference search' and a 'related documents search' for the most relevant articles in Scopus to source additional studies.

Source of evidence selection

Duplicates will be removed from all identified sources before being exported and uploaded into EndNote version X9.[52] RAYYAN, a web-based systematic review tool that extracts data from selected studies.[53] Pilot testing will be carried out at this point. First, each reviewer will screen 50 titles and abstracts individually using the inclusion criteria and discuss any inconsistencies. Once a 75 per cent agreement has been reached, source selection will begin.

Two reviewers will independently screen identified sources in two steps. One reviewer will scan the titles and abstracts of the retrieved sources in stage one to identify possibly relevant documents. The second reviewer will independently check the first reviewer's decisions by evaluating included and omitted citations. In stage two, one reviewer will retrieve full texts of possibly relevant sources and assess them in detail against the eligibility criteria. Any differences among the reviewers will be handled through dialogue at any level of the selection process. If any difference in opinion still cannot be resolved, then a third reviewer will adjudicate. A PRISMA-SCR flowchart will be used to track the number of recognised, screened, and excluded sources. A narrative account of the selection process will be included. The reasons for sources not being included at each stage of the selection process and a table describing the relevance of the included sources to the review topic may be reported.

Data extraction

Using a data extraction table produced by the reviewers, data will be extracted from all sources included in the mapping review. The data extraction table from three references will be pilot tested by the two reviewers. The findings will be discussed, and changes will be made to the table if necessary. The data extraction table can be found in Table 2.

Table 2: Data extraction table.

	Source characteristics
1	Citation details (author/s, date, title, journal, volume, issue, pages, DOI)
2	Type of the source of evidence (peer-reviewed journal, conference papers)
3	Location of a study (or the location of the primary author if the study location was not stated)
4	Type of the study (RCT, cohort, and review)
5	Population and sample size (if applicable)
6	Aims and objectives
7	Prevalence (if applicable)
8	Risk factors and assessment (if applicable)
9	Type and duration of the intervention (if applicable)
10	Was there a follow-up (if applicable)
11	Key findings
12	Suggestions for future research
13	Conclusions of the original author(s)

If the reviewers determine that additional data is valuable and should be collected, the data extraction table can be refined further during the extraction process. The authors will not analyse the risk of bias because the goal is to present a broad overview of existing literature, regardless of the risk of bias or methodological quality.

Any modifications to the data extraction table will be recorded and can be reported in the mapping review as appropriate. One reviewer will extract data, while the other will double-check the accuracy of the information. Any differences amongst the reviewers will be handled by dialogue at any step of the data extraction process.

Data analysis and presentation

The outcomes of the included sources will be drawn out descriptively. Furthermore, an overview of principles,

types of evidence, research techniques, and study populations will be offered. An evidence gap map can also visually depict studies and discuss the concepts. A mind map may be used to demonstrate the number of research that has been conducted on various themes and subtopics. A narrative description will accompany all tables and graphics. The study's findings will map existing literature about ergonomics in oral health professions and guide future research.

Collating, summarising, and reporting the result

A descriptive analysis will be carried out following data extraction to map the finding. A method flow chart will be produced according to the PRISMA-SCR guideline. Results will be summarised and presented in a tabulated form configured in such a way as to address the objectives of the review. Data will be accompanied by an exploratory narrative focusing on the role of ergonomics in the oral health profession. Finally, the reviewers will discuss the implications of the findings on further research, practice, and policy.

DISCUSSION

To our knowledge, this is the first mapping review investigating ergonomics in oral health professions. There are systematic reviews on the prevalence of musculoskeletal disorders and ergonomic interventions to prevent them. However, the ergonomic framework proposed as applied to oral health, with the various domains and subdomains, has not been reviewed. In this search, the gap from the previous reviews will be filled. This protocol was written on the recommendations provided by PRISMA.[51]

The results could allow clinicians to make evidence-based decisions and inform further research into this topic. This study will systemically identify literature from a broad range of databases and map evidence in the field of ergonomics in oral health professionals. The review will take a rigorous approach adhering to the PRISMA-ScR and Joanna Briggs Institute guidelines. Multiple reviewers will independently conduct screening and data extraction to provide greater reliability.

A limitation is that only sources in English will be reviewed.

CONCLUSION

The mapping review will map relevant information about ergonomics in oral health professions. This protocol offers clarity, strength, and transparency in the preparation process to avoid problems occurring during the undertaking of this review.

ACKNOWLEDGEMENTS

REFERENCES

1. Das SK. Integrating ergonomic tools in physical therapy for musculoskeletal risk assessment and rehabilitation - A review. Int J Eng Scientific Res. 2014;(2)10:136-54.
2. Gupta A, Bhat M, Mohammed T, Bansal N, Gupta G. Ergonomics in dentistry. Int J Clin Pediatric Dentistry. 2014;7(1):30-4.
3. Leggat PA, Smith DR. Musculoskeletal disorders self-reported by dentists in Queensland, Australia. Aust Dent J. 2006;51(4):324-7.
4. Alexopoulos EC, Stathi IC, Charizani F. Prevalence of musculoskeletal disorders in dentists. BMC Musculoskeletal Disord. 2004;(5):16.
5. Valachi B, Valachi K. Mechanisms are leading to musculoskeletal disorders in dentistry. J Am Dent Assoc. 2003;134(10):1344-50.
6. Droeze EH, Jonsson H. Evaluation of ergonomic interventions to reduce musculoskeletal disorders of dentists in the Netherlands. Work. 2005;25(3):211-20.
7. Rolander B, Bellner AL. Experience of musculoskeletal disorders, the intensity of pain, and general conditions in work: the case of employees in non-private dental clinics in a county in southern Sweden. Work. 2001;17(1):65-73.
8. Åkesson I, Johnsson B, Rylander L, Moritz, S Skerfving Musculoskeletal disorders among female dental personnel - clinical examination and a 5-year follow-up study of symptoms. Int Arch Occup Environ Health. 1999;72(6):395-403.
9. Lietz J, Kozak A, Nienhaus A. Prevalence and occupational risk factors of musculoskeletal diseases and pain among dental professionals in Western countries: A systematic literature review and meta-analysis. PLoS One. 2018;13(12):e0208628.
10. Garcia PP, Gottardello AC, Wajngarten D, Presoto CD, Campos JADB. Ergonomics in dentistry: experiences of the practice by dental students. Eur J Dent Educ. 2017;21(3):175-9.
11. Ng A, Hayes M, Polster A. Musculoskeletal disorders and working posture among dental and oral health students. Healthcare. 2016;4(1):13.
12. Barry RM, Spolarich AE, Weber M, Denise Krause, William D Woodall, Jessica H Bailey Impact of operator positioning on musculoskeletal disorders and work habits among Mississippi dental hygienists. J Dent Hyg. 2017;91(6):6-14.
13. Gandavadi A, Ramsay JR, Burke FJ. Assessment of dental student posture in two seating conditions using RULA methodology - a pilot study. Br Dent J. 2007;203(10):601-5.

14. Shirzaei M, Mirzaei R, Khaje-Alizade A, Mohammadi M. Evaluation of ergonomic factors and postures that cause muscle pains in dentistry students' bodies. J Clin Exp Dent. 2015;7(3):e414-8.

15. Morse T, Bruneau H, Michalak-Turcotte C, Sanders M, Warren N, Dussetschleger J, et al. Musculoskeletal disorders of the neck and shoulder in dental hygienists and dental hygiene students. J Dent Hyg. 2007;81(1):10.

16. Morse TF, Michalak-Turcotte C, Atwood-Sanders M, Nicholas Warren, Donald R Peterson, Heather Bruneau, et al. A pilot study of hand and arm musculoskeletal disorders in dental hygiene students. J Dent Hyg. 2003;77(3):173-9.

17. Gandavadi A, Ramsay JRE, Burke FJT. Assessment of dental student posture in two seating conditions using RULA methodology – a pilot study. Br Dent J. 2007;203(10):601-5.

18. Mulimani P, Hoe VC, Hayes MJ, Idiculla JJ, Abas AB, Karanth L. Ergonomic interventions for preventing musculoskeletal disorders in dental care practitioners. Cochrane Database Syst Rev. 2018;10:CD011261.

19. Sanderson TR, Kearney RC, Kissell D, Salisbury J. Evaluating student self-assessment through video-recorded patient simulations. J Dent Hyg. 2016;90(4):257-62.

20. Branson BG, Williams KB, Bray KK, Holt LA, Keselyak NT, Mitchell TV, et al. Validity, and reliability of a dental operator posture assessment instrument. J Dent Hyg. 2002;76(4):255-61.

21. Sutherland CA, Albert WJ, Wrigley AT, Callaghan JP. The effect of camera viewing angle on posture assessment repeatability and cumulative spinal loading. Ergonomics. 2007;50:877-89.

22. Watson AW, Mac Donncha C. A reliable technique for the assessment of posture: assessment criteria for aspects of posture. J Sports Med Phys Fitness. 2000;40:260-70.

23. Ohlendorf D, Erbe C, Hauck I, Nowak J, Hermanns I, Ditchen D, et al. Kinematic analysis of work-related musculoskeletal loading of trunk among dentists in Germany. BMC Musculoskeletal Disorders. 2016;17(1):427.

24. Andrews N, Vigoren G. Ergonomics: muscle fatigue, posture, magnification, and illumination. Compendium Continuing Educ Dent (Jamesburg, NJ:1995). 2002;23(3):261-70.

25. Sanders MJ, Turcotte CA. Ergonomic strategies for dental professionals. Work. 1997;8(1):55-72.

26. Zarra T, Lambrianidis T. Musculoskeletal disorders amongst Greek endodontists: a national questionnaire survey. Int Endod J. 2014;47(8):791.

27. Peros K, Vodanovic M, Mestrovic S, Rosin-Grget K, Valic M. Physical fitness course in the dental curriculum and prevention of low back pain. J Dent Educ. 2011;75(6):761-7.

28. Garbin AJ, Garbin CA, Diniz DG, Yarid SD. Dental students' knowledge of ergonomic postural

requirements and their application during clinical care. Eur J Dent Educ. 2011;15(1):31- 5.

29. AliakbariR, Vahedian-Shahroodi M, Abusalehi A, Jafari A, Tehrani H. A digital-based education to improve occupational health and ergonomic conditions of dentists: An application of theory of planned behaviour. Int J Health Prom Educ. 2020;58(5):268-81.

30. De Sio S, Traversini V, Rinaldo F, Colasanti V, Buomprisco G, Perri R, Mormone F, La Torre G, Guerra F. Ergonomic risk and preventive measures of musculoskeletal disorders in the dentistry environment: an umbrella review. Peer J. 2018;6:e4154.

31. Lietz J, Ulusoy N, Nienhaus A. Prevention of Musculoskeletal Diseases and Pain among Dental Professionals through Ergonomic Interventions: A Systematic Literature Review. Int J Environ Res Public Health. 2020;17(10):3482.

32. Ylippa V, Arnetz BB, Preber H. Predictors of good general health, well-being, and musculoskeletal disorders in Swedish dental hygienists. Acta Odontologica Scandinavica. 1999;57(5):277-82.

33. Yamalik N. Musculoskeletal disorders (MSDs) and dental practice. Part 2. Risk factors for dentistry, magnitude of the problem, prevention, and dental ergonomics. Int Dent J. 2007;57(1):45-54.

34. De Bruyne MAA, Van Renterghem B, Baird A, Palmans T, Danneels L, Dolphens M. Influence of different stool types on muscle activity and lumbar posture among dentists during a simulated dental screening task. Appl Ergon. 2016;56:220-6.

35. Dable RA, Wasnik PB, Yeshwante BJ, Musani SI, Patil AK, Nagmode SN.Postural assessment of students evaluating the need of ergonomic seat and magnification in dentistry. J Indian Prosthodontic Soc. 2014;14(1):51-8.

36. Simmer-Beck M, Branson BG, Mitchell TV, Holt L. Comparison of tactile discrimination associated with varying weights of explorers. J Dent Educ. 2007;71(5):687-93.

37. Simmer-Beck M, Bray KK, Branson B, Glaros A, Weeks J. Comparison of muscle activity associated with structural divergences in dental hygiene mirrors. J Dent Hyg. 2006;80(1):8.

38. Hayes M, Taylor J, Smith D. Introducing loupes to clinical practice: dental hygienists' experiences and opinions. Int J Dent Hyg. 2015;13(1):1-5.

39. Hayes MJ, Osmotherly PG, Taylor JA, D R Smith, A Ho The effect of wearing loupes on upper extremity musculoskeletal disorders among dental hygienists. Int J Dent Hyg. 2014;12(3):174-9.

40. Hayes MJ, Osmotherly PG, Taylor JA, Derek R Smith, Alan HO. The effect of loupes on neck pain and disability among dental hygienists. Work. 2016;53(4):755-62.

41. Jennifer R, Thomas FD. Dental hygienists' opinions about loupes in education. J Dent Hyg. 2007;81(4):82.

42. Maillet JP, Millar AM, Burke JM, Maillet MA, Maillet WA, Neish NR. Effect of magnification loupes on dental hygiene student posture. J Dent Educ. 2008;72(1):33-44.

43. Dehghan N, Aghilinejad M, Nassiri-Kashani MH, Amiri Z, Talebi A. The effect of a multifaceted ergonomic intervention program on reducing musculoskeletal disorders in dentists. Med J Islam Repub Iran. 2016;30:472.

44. Koneru S, Tanikonda R. Role of yoga and physical activity in work-related musculoskeletal disorders among dentists. J Int Soc Prev Comm Dentistry. 2015;5(3):199-204.

45. Valachi B. Practice dentistry pain-free: evidence-based ergonomic strategies to prevent pain and extend your career. Posturedontics Press, Portland, Oregon. 2008;204.

46. Verhagen AP, Karels C, Bierma-Zeinstra SM, Feleus A, Dahaghin S, Burdorf A, Koes BW. Exercise proves effective in a systematic review of work-related complaints of the arm, neck, or shoulder. J Clin Epidemiol. 2007;60(2):110-7.

47. Booth A. Evident Guidance for Reviewing the Evidence: a compendium of methodological literature and websites. The University of Sheffield. 2016.

48. McAlister FA, Clark HD, van Walraven C, Straus SE, Lawson FM, Moher D, Mulrow CD. The medical review article revisited: has the science improved? Ann Intern Med. 1999;131(12):947-51.

49. Sutton A, Clowes M, Preston L, Booth A. Meeting the review family: exploring review types and associated information retrieval requirements. Health Info Libr J. 2019;36(3):202-22.

50. Aromataris E, Munn Z. JBI Manual for Evidence Synthesis: JBI. 2020. Available at: https://jbi-global-wiki.refined.site/space/MANUAL. Accessed on 12 July 2022.

51. Tricco AC, Lillie E, Zarin W, O'Brien KK, Colquhoun H, Peters MD. PRISMA extension for scoping reviews (PRISMA-ScR): checklist and explanation. Ann Intern Med. 2018;169(7):467-73.

52. The EndNote Team. EndNote. EndNote X9 ed. Philadelphia, PA: Clarivate. 2013.

53. Ouzzani M, Hammady H, Fedorowicz Z, Elmagarmid A. Rayyan — a web and mobile app for systematic reviews. Syst Rev. 2016;5.