

BMJ Open Effectiveness of workplace exercise interventions in the treatment of musculoskeletal disorders in office workers: a protocol of a systematic review

Carlos Tersa-Miralles ¹, Roland Pastells-Peiró ^{1,2},
 Francesc Rubí-Carnacea ^{1,2,3}, Filip Bellon ^{1,2}, Esther Rubinat Arnaldo ^{1,2,3,4}

To cite: Tersa-Miralles C, Pastells-Peiró R, Rubí-Carnacea F, *et al.* Effectiveness of workplace exercise interventions in the treatment of musculoskeletal disorders in office workers: a protocol of a systematic review. *BMJ Open* 2020;**10**:e038854. doi:10.1136/bmjopen-2020-038854

► Prepublication history and additional material for this paper are available online. To view these files, please visit the journal online (<http://dx.doi.org/10.1136/bmjopen-2020-038854>).

Received 17 April 2020

Revised 11 November 2020

Accepted 23 November 2020



© Author(s) (or their employer(s)) 2020. Re-use permitted under CC BY-NC. No commercial re-use. See rights and permissions. Published by BMJ.

¹Department of Nursing and Physiotherapy, University of Lleida, Lleida, Spain

²Grup de Recerca de Cures en Salut, IRBLleida, Lleida Institute for Biomedical Research Dr. Pifarré Foundation, Lleida, Spain

³Grupo de Estudios Sociedad, Salud, Educación y Cultura, University of Lleida, Lleida, Spain

⁴Center for Biomedical Research on Diabetes and Associated Metabolic Diseases, Instituto de Salud Carlos III, Barcelona, Spain

Correspondence to

Dra Esther Rubinat Arnaldo; esther.rubinat@udl.cat

ABSTRACT

Introduction Physical inactivity due to changes in our society towards more sedentary behaviours is leading to health problems. Increasing physical activity might be a good strategy to improve physical strength and reduce the prevalence of illnesses associated with prolonged sitting. Office workers exhibit a sedentary lifestyle with short rest periods or even without pauses during the workday. It is important to perform workplace interventions to treat musculoskeletal disorders caused by prolonged sitting and lack of movement adopted on the office setting. This article describes a protocol for a systematic review to evaluate the effectiveness of exercise interventions on office workers in their work environment.

Methods and analysis A literature search will be performed in the PubMed, CINAHL Plus, Cochrane Library, Scopus, ISI WoS and PeDRO databases for randomised controlled trials and studies published from 1 January 2010 to 31 July 2020 in English or Spanish. The participants will be office workers who spend most of their work time in a sitting position. The interventions performed will include any type of exercise intervention in the workplace. The outcome measures will vary in accordance with the aim of the intervention observed. The results of the review and the outcomes from the studies reviewed will be summarised with a narrative synthesis. The review protocol was developed according to the Preferred Reporting Items for Systematic Review and Meta-Analysis Protocols guidelines.

Ethics and dissemination Ethical approval is not required. The review outcomes and the additional data obtained will be disseminated through publications and in scientific conferences.

PROSPERO registration number CRD42020177462.

INTRODUCTION

As a result of technological advances being introduced in people's daily lives, our society has changed greatly by adopting an increasingly sedentary lifestyle, leading to prolonged sitting for an entire day.^{1 2} In addition, this trend is even more impactful when considering the prolonged lifespan of people. The sedentary behaviour in conjunction with the physical inactivity of the population is closely related

Strengths and limitations of this study

- This systematic review protocol follows the Preferred Reporting Items for Systematic Review and Meta-Analysis Protocols guidelines.
- The search strategy was developed in collaboration with an expert documentalist and will include the following databases: PubMed, CINAHL Plus, Cochrane, Scopus, ISI WoS and PeDRO.
- The researcher will conduct a blinded peer review to ensure rigorous and consistent sets of inclusion and exclusion criteria.
- This is an innovative review, as it focuses only on exercise interventions in employees' own workplaces, providing specific data on the most effective active pauses (volume, intensity, time).
- The review may be limited by the heterogeneity of study methodologies and outcome measures due to the diverse types of exercise interventions introduced to office workers.

to the increased prevalence of illnesses due to being both risk factors of health.^{3 4} The average daily time spent by the adult population in a seated position is 346 min per day.⁵ More than 30% of adults worldwide suffer from physical inactivity with higher proportions approximately 43% in American and eastern Mediterranean countries.⁶

Half of the population, who are of working age, are employed in jobs that do not require any physical activity, such as those in administration or business fields; thus, it is important to spend some time exercising daily to prevent all the pathologies caused by poor postures, prolonged sitting and a lack of movement in the workday.⁷ In an office setting, workers who mainly interact with the computer are predisposed to musculoskeletal disorders due to repetitive movements, static postures and lack of physical activity.⁸ Also, employees working overtime and making work-related decisions have a higher prevalence of suffering from



musculoskeletal complaints in the neck, shoulder and back region than office workers with fixed schedules and jobs established by their bosses.⁹ Further, workers who perform demanding tasks with little flexibility in their schedules and with short pauses or even a lack of breaks, more commonly develop musculoskeletal low back pain than those who have longer breaks in their workday, such as a lunch break.¹⁰ Prolonged sitting periods also increase muscle stiffness of the trunk and neck of office workers. As such, an office workplace is an unfavourable environment in terms of the high sedentary behaviour.¹¹

Having a daily schedule with different types of activities, such as exercise interventions in the workplace, might help reduce the time workers spend sitting and increase the amount of low-intensity physical activity that employees perform on a daily basis.¹² For example, breaks with exercises are good options for workplace interventions, which can not only prevent cardiovascular and metabolic illnesses, but also play an important role in the treatment of musculoskeletal dysfunction of the back.¹³

There are a wide variety of types of workplace exercise interventions, such as short breaks throughout the day, and even performing exercise sessions at the start or the end of the workday. The common interventions in the office setting are stretching or strength exercise routines involving the whole body¹⁴ or focusing on a specific region such as neck/shoulder,¹⁵ trunk or the lower limbs.¹⁶

Waongenngarm *et al*¹⁷'s systematic review found positive effects of active breaks with postural change for pain and discomfort of low back pain, without affecting the productivity of office workers. This study conducted on physical exercise in office workers states that the trials reviewed include a wide variety of interventions regarding the duration of the active break, the type of exercise performed or the length of the physical programme at the workplace.

According to Sihawong *et al*¹⁸'s systematic review, strength and aerobic exercises can reduce the intensity, disability and duration of neck and shoulder pain caused by poor postures and can be easily performed in work environments because they do not require equipment and can be performed with individuals' own body weight. Other studies^{19–21} examining workplace exercise interventions among symptomatic office workers with musculoskeletal disorders demonstrated a decrease in pain perception.

The aforementioned systematic reviews, which focused on the treatment of musculoskeletal pain in office workers, have been published in recent years evaluating different types of exercise interventions,¹⁵ or evaluating various kinds of breaks at work.¹⁴ However, no reviews have focused exclusively on workplace exercise interventions, which are becoming a trend that multinational corporations are implementing with their workers.

The practical implications of this review are aiming to identify standards/patterns in the workplace in order to carry out tailored interventions that are as effective as possible, for the subsequent conduction of a randomised controlled trial and to improve the evidence on physical exercise interventions at work in office workers.

Objectives

The aim of this study is to present a protocol paper for a systematic review to evaluate the effectiveness of exercise interventions on office workers in their work environment on the treatment of musculoskeletal disorders.

METHODS

This review protocol follows the recommendations of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses for Protocols (PRISMA-P) reporting guidelines²² and the findings will be reported in accordance with the PRISMA guidelines.²³ This systematic review is registered on the Prospective Register of Systematic reviews.

Criteria for study inclusion

Study characteristics

Randomised controlled studies that have at least one group involved in any kind of intervention with physical exercise in the workplace during the working day.

Randomised controlled studies that have at least one group involved in an intervention with physical exercise in the workplace during the workday and performing a low to moderate physical exercise programme will be included. All studies with ergonomic interventions will be excluded except of posture corrections or patterns taking place during the workday. The search for publications will be restricted considering the temporary interval from 1 January 2010 until 31 July 2020. Studies published in English and Spanish will be considered for inclusion, excluding publications written in other languages. Other sources of research information will be excluded such as books, theses, conferences proceedings, reports or scientific posters.

Participants

Participants should be office workers who spend most of their work time in a sitting position; have musculoskeletal disorders in all regions of the body or some specific region, such as low back or neck/shoulder; and be capable of performing a low to moderate intensity physical exercise intervention without the need to change clothes or use a sports facility. Studies including participants with other pathologies as neurological deficits, cancer, fractures or an inflammatory process will be excluded.

Interventions

The included interventions may be any type of exercise programme in the office environment including, essentially, a change from a seated position in front of the computer position to another with a higher physical activity level and performance of any kind of physical exercise, such as stretching, mobility or strength training with or without workout equipment.

Outcomes

Outcomes will be musculoskeletal disorders measured by different types of validated scales and questionnaires for assessing pain, dysfunction or other related aspects for the office workers. Examples of validation measures include

Table 1 Search terms and PubMed search strategy

Search terms	PubMed search strategy
	("Office Work" [tiab] OR "Office Worker"[tiab] OR "Office Workers"[tiab] OR "Desk Worker"[tiab] OR "Desk Workers"[tiab] OR "Computer Work"[tiab] OR "Computer Workers"[tiab] OR "Nonmanual Workers"[tiab] OR "Administrative Personnel"[MeSH] OR "Administrative Personnel"[tiab] OR "sedentary workers"[tiab] OR "sedentary personnel"[tiab] OR "sedentary employees"[tiab] OR "Work Performance"[MeSH] OR "Work Performance"[tiab] OR "Work Performances"[MeSH] OR "Work Performances"[tiab] OR "Job Performance"[MeSH] OR "Job Performance"[tiab] OR "Job Performances"[MeSH] OR "Job Performances"[tiab] OR "Occupational Diseases"[Mesh] OR "Occupational Disease"[tiab] OR "Occupational Illness"[tiab] OR "Administrative Personnel"[MeSH] OR "Administrative Personnel"[tiab] OR "White Collar Worker" [tiab] OR "Administrative Worker"[tiab] OR "Corporate Workers"[tiab] OR "Video Display terminal workers"[tiab] OR "Video Display Visual operators"[tiab] OR "Clerical wokers"[tiab])
Musculoskeletal disorders	("Musculoskeletal Illness"[MeSH] OR "Musculoskeletal Illness"[tiab] OR "Musculoskeletal Pain"[MeSH] OR "Musculoskeletal Pain"[tiab] OR "Musculoskeletal Pain"[MeSH] OR "Musculoskeletal Pain"[tiab] OR "Musculoskeletal Disease"[MeSH] OR "Musculoskeletal Disease"[tiab] OR "Musculoskeletal Diseases"[MeSH] OR "Musculoskeletal Diseases"[tiab] OR "Musculoskeletal Disorder"[tiab] OR "Musculoskeletal Disorders"[tiab] OR "Musculoskeletal Disfunction"[tiab] OR "Musculoskeletal Disfunctions"[tiab] OR "Low back pain"[MeSH] OR "Low back pain"[tiab] OR "Low back pains"[tiab] OR "Lumbago"[tiab] OR "Lower Back Pain"[tiab] OR "Lower Back pains"[tiab] OR "Low Back Ache"[tiab] OR "Low Back Aches"[tiab] OR "Low Backache"[tiab] OR "Low Backaches"[tiab] OR "Postural Low back pain"[tiab] OR "Posterior Compartment Low back pain"[tiab] OR "Recurrent Low back pain"[tiab] OR "Mechanical Low back pain"[tiab] OR "Neck pain"[MeSH] OR "Neck pain"[tiab] OR "Neck pains"[tiab] OR "Neck Ache"[tiab] OR "NeckAches"[tiab] OR "Cervicalgia"[tiab] OR "Cervicalgias"[tiab] OR "Cervicodynia"[tiab] OR "Cervicodynias"[tiab] OR "Cervical Pain"[tiab] OR "Cervical Pains"[tiab] OR "Posterior Cervical Pain"[tiab] OR "Posterior Cervical Pains"[tiab] OR "Posterior Neck Pain"[tiab] OR "Posterior Neck Pains"[tiab] OR "Anterior Cervical Pain"[tiab] OR "Anterior Cervical Pains"[tiab] OR "Posterior Neck Pain"[tiab] OR "Posterior Neck Pains"[tiab] OR "Shoulder pain"[MeSH] OR "Shoulder pain"[tiab] OR "Shoulder pains"[tiab])
Exercise interventions	("Exercise movement Therapy"[MeSH] OR "Exercise movement Therapy"[tiab] OR "Exercise Therapy"[MeSH] OR "Exercise Therapy"[tiab] OR "Circuit Based Exercise"[MeSH] OR "Circuit Based Exercise"[tiab] OR "Stretching Exercise"[MeSH] OR "Stretching Exercise"[tiab] OR Yoga[MeSH] OR Yoga[tiab] OR "Pilates Training"[tiab] OR "Active Rest"[tiab] OR "Active Rests"[tiab] OR "Active Pause"[tiab] OR "Active Pauses"[tiab] OR "Active Break"[tiab] OR "Active Breaks"[tiab] OR "Exercise Therapy"[MeSH] OR "Exercise Therapy"[tiab] OR "Exercise Therapies"[tiab] OR "Remedial Exercise"[tiab] OR "Remedial Exercises"[tiab] OR "Rehabilitation Exercise"[tiab] OR "Rehabilitation Exercises"[tiab] OR "Incidental Physical activity"[tiab] OR "Standing breaks"[tiab] OR "Stretching breaks"[tiab] OR "Mobility exercise"[tiab] OR "Workplace exercise intervention"[tiab])

MeSH, medical subject headings.

Scale²⁴ or more specific scales, such as the Neck Disability Index for neck pain²⁵ or the Oswestry or Roland-Morris Scale²⁶ for the measurement of dysfunction caused by low back pain.

Information sources

For the literature search, the PubMed, CINAHL Plus, Cochrane, Scopus, ISI WoS and PeDRO databases will be searched by using Medical Subject Headings terms and keywords related to office workers, musculoskeletal pain, exercise interventions and adherence. The search strategy in the PubMed database through the MEDLINE nomenclature and thesauruses is available in [table 1](#).

The search will be adapted and performed in the other databases mentioned above with the aforementioned terminology and search strategy.

Data management and collection

Once the search has been performed, the results will be imported to EndNote V.X9²⁷ for duplicates to be removed, and the remaining articles will be subsequently transferred to Covidence²⁸ software for screening and data extraction.

Two independent reviewers will screen the titles and abstracts of the articles according to the eligibility criteria to determine the eligibility of the articles. Subsequently, the full texts of the included studies will be reviewed by the same reviewers. If a disagreement between reviewers in any stage of the screening occurs regarding the inclusion of studies, it will be resolved by discussion, and if needed, a third reviewer will determine whether the article will be included.

Data management and risk of bias assessment

Data from the included studies will be extracted following the recommendations of the Cochrane Handbook for Systematic Reviews of Interventions,²⁹ using an adapted data extraction form: the form will follow the steps from the template of the Cochrane good practice data extraction,³⁰ taking into account the relevant aspects of the workplace exercise interventions. The data extraction form is shown in online supplemental file 1.

The quality of the studies included in the review will be assessed independently by two reviewers using the Rob2



tool provided in the Cochrane Reviews to assess the risk of bias,³¹ and a third reviewer will resolve any disagreements in the risk of bias assessment between the two principal reviewers for a final decision.

This tool assesses different aspects of the trials, mainly regarding the design of the methodology and outcome measures. Based on the reviewer's responses to the questions presented for the different domains and a scoring algorithm, each study will be determined to have 'low risk', 'some concerns' or 'high risk' of bias.

Data synthesis

A narrative synthesis will be conducted in stages, as recommended by the Economic and Social Research Council guidance on the conduct of Narrative Synthesis,³² according to the aims of each intervention due to discrepancies in the workplace exercise interventions and the different outcomes included in the studies.

A preliminary synthesis will be performed, presented in a common rubric through tabulation to develop an initial description of the results of included studies. The trials will be grouped by the region of the body that was evaluated. The tables will summarise the results of the interventions with the comparator groups and the outcome measures used in the trials such as scales or questionnaires, also the adherence of the interventions will be described with a numerical percentage of the participants that were lost to follow-up.

Next the relationship between characteristics of individual studies and their reported findings will be explored with a subgroup analysis of the studies included according to each body region categorised from the preliminary synthesis. The assessment of the robustness of the synthesis will be carried with the Rob2 tool.

If the studies included in the review have sufficiently similar characteristics, based on the information in the data extraction form (eg, the use of the same outcome measures such as scales or questionnaires to evaluate pain or dysfunction), a meta-analysis will be performed.

Patient and public involvement

Data will be extracted from previously published studies. No patients, public institutions or private enterprises of any kind will be involved in this protocol. Additionally, no personal data have been used in the development of this protocol.

Ethics and dissemination

For the protocol and the posterior systematic review, ethical approval is not required. The aim of this review is to summarise the results of the outcomes from the studies that meet the inclusion criteria.

The review outcomes and the additional data will be disseminated through publications and scientific conferences.

DISCUSSION

In the 21st century, one of the main reasons that health conditions in society have worsened is due to the increase of physical inactivity. Also, a sedentary lifestyle in the workplace is strongly related to the constant use of electronic devices and technological machinery replacing physical human work. One of the largest groups of people that are affected by this change in society is office workers, as they spend a large number of hours in a seated position. It is necessary to evaluate the evidence found in the trials involving workplace exercise interventions to reduce and treat musculoskeletal pain due to the high prevalence that office workers suffer in their workday.

It is important to analyse the adherence to the exercise interventions as the aim of these exercise programmes is to be performed in the office setting, and the musculoskeletal dysfunction or other work-related stressors might decrease the compliance to realise the physical exercises at the workplace. This can be a potential bias due to the lack of information in the data collection at the end of the intervention due to the loss to follow-up.^{33–35}

To the best of our knowledge, this systematic review will be the first published review on the effects of physical exercise in workers' own workplace and during their own working hours, excluding interventions for which the main aim is to perform an ergonomic modification or to set up a 'sit-stand' desk. Both of these types of interventions might increase the physical activity of the workers, but the latter interventions do not involve an exercise programme.

The results of this review will help identify the most effective workplace exercise interventions considering training variables such as the volume, intensity, type of programme and time spent on the exercise per session, allowing to design randomised controlled trial with the best current evidence of workplace intervention in the reduction and treatment of musculoskeletal pain.

Also, this review aims to evaluate the actual evidence on exercise interventions for office workers related to musculoskeletal disorders in their work environment. It is important to improve the workplace health promotion and well-being of the office workers due to the lack of physical activity and the sedentary behaviour due to the requirements of their particular type of job.

Acknowledgements The authors want to acknowledge the Research Group of Health Care (GRECS)—IRB Lleida and the University of Lleida.

Contributors The systematic review protocol was developed and conceived by CTM. RP-P was involved in the review of the manuscript contributing in the methodological aspects and the search strategy. ERA, FRC and FB have been involved in the supervision and quality assurance of the protocol.

Funding The authors have not declared a specific grant for this research from any funding agency in the public, commercial or not-for-profit sectors.

Competing interests None declared.

Patient consent for publication Not required.

Provenance and peer review Not commissioned; externally peer reviewed.

Supplemental material This content has been supplied by the author(s). It has not been vetted by BMJ Publishing Group Limited (BMJ) and may not have been peer-reviewed. Any opinions or recommendations discussed are solely those

of the author(s) and are not endorsed by BMJ. BMJ disclaims all liability and responsibility arising from any reliance placed on the content. Where the content includes any translated material, BMJ does not warrant the accuracy and reliability of the translations (including but not limited to local regulations, clinical guidelines, terminology, drug names and drug dosages), and is not responsible for any error and/or omissions arising from translation and adaptation or otherwise.

Open access This is an open access article distributed in accordance with the Creative Commons Attribution Non Commercial (CC BY-NC 4.0) license, which permits others to distribute, remix, adapt, build upon this work non-commercially, and license their derivative works on different terms, provided the original work is properly cited, appropriate credit is given, any changes made indicated, and the use is non-commercial. See: <http://creativecommons.org/licenses/by-nc/4.0/>.

ORCID iDs

Carlos Tersa-Miralles <http://orcid.org/0000-0001-7037-5033>

Roland Pastells-Peiró <http://orcid.org/0000-0002-9561-9038>

Francesc Rubí-Carnacea <http://orcid.org/0000-0002-0162-3950>

Filip Bellon <http://orcid.org/0000-0003-4880-9207>

Esther Rubinat Arnaldo <http://orcid.org/0000-0003-0232-9777>

REFERENCES

- Ng SW, Popkin BM. Time use and physical activity: a shift away from movement across the globe. *Obes Rev* 2012;13:659–80.
- Proper KI, Singh AS, van Mechelen W, et al. Sedentary behaviors and health outcomes among adults: a systematic review of prospective studies. *Am J Prev Med* 2011;40:174–82.
- de Rezende LFM, Rodrigues Lopes M, Rey-López JP, et al. Sedentary behavior and health outcomes: an overview of systematic reviews. *PLoS One* 2014;9:e105620.
- Guthold R, Stevens GA, Riley LM, et al. Worldwide trends in insufficient physical activity from 2001 to 2016: a pooled analysis of 358 population-based surveys with 1.9 million participants. *Lancet Glob Health* 2018;6:e1077–86.
- Bauman A, Ainsworth BE, Sallis JF, et al. The descriptive epidemiology of sitting. A 20-country comparison using the International physical activity questionnaire (IPAQ). *Am J Prev Med* 2011;41:228–35.
- Hallal PC, Andersen LB, Bull FC, et al. Global physical activity levels: surveillance progress, pitfalls, and prospects. *Lancet* 2012;380:247–57.
- Mainenti MRM, Felicio LR, Rodrigues EdeC, et al. Pain, work-related characteristics, and psychosocial factors among computer workers at a university center. *J Phys Ther Sci* 2014;26:567–73.
- Collins RM, Janse Van Rensburg DC, Patricios JS. Common work-related musculoskeletal strains and injuries. *South African Family Practice* 2011;53:240–6.
- Mahmud N, Bahari SF, Zainudin NF. Psychosocial and ergonomics risk factors related to neck, shoulder and back complaints among Malaysia office workers. *Int J Soc Sci Humanit* 2014;4:260–3.
- Kaliniene G, Ustinaviciene R, Skemiene L, et al. Associations between musculoskeletal pain and work-related factors among public service sector computer workers in Kaunas County, Lithuania. *BMC Musculoskelet Disord* 2016;17:420.
- Ryan CG, Dall PM, Granat MH, et al. Sitting patterns at work: objective measurement of adherence to current recommendations. *Ergonomics* 2011;54:531–8.
- Parry S, Straker L, Gilson ND, et al. Participatory workplace interventions can reduce sedentary time for office workers—a randomised controlled trial. *PLoS One* 2013;8:e78957.
- Kett AR, Sichtung F. Sedentary behaviour at work increases muscle stiffness of the back: why roller massage has potential as an active break intervention. *Appl Ergon* 2020;82:102947.
- Andersen LL, Christensen KB, Holtermann A, et al. Effect of physical exercise interventions on musculoskeletal pain in all body regions among office workers: a one-year randomized controlled trial. *Man Ther* 2010;15:100–4.
- Lidegaard M, Jensen RB, Andersen CH, et al. Effect of brief daily resistance training on occupational neck/shoulder muscle activity in office workers with chronic pain: randomized controlled trial. *Biomed Res Int* 2013;2013:1–11.
- Phattharasupharek S, Purepong N, Eksakulka S, et al. Effects of Qigong practice in office workers with chronic non-specific low back pain: a randomized control trial. *J Bodyw Mov Ther* 2019;23:375–81.
- Waongenngarm P, Areerak K, Janwantanakul P. The effects of breaks on low back pain, discomfort, and work productivity in office workers: a systematic review of randomized and non-randomized controlled trials. *Appl Ergon* 2018;68:230–9.
- Sihawong R, Janwantanakul P, Sitthipornvorakul E, et al. Exercise therapy for office workers with nonspecific neck pain: a systematic review. *J Manipulative Physiol Ther* 2011;34:62–71.
- de Freitas-Swerts FCT, Robazzi MLdoCC. The effects of compensatory workplace exercises to reduce work-related stress and musculoskeletal pain. *Rev Lat Am Enfermagem* 2014;22:629–36.
- Macedo AC, Trindade CS, Brito AP, et al. On the effects of a workplace fitness program upon pain perception: a case study encompassing office workers in a Portuguese context. *J Occup Rehabil* 2011;21:228–33.
- Marangoni AH. Effects of intermittent stretching exercises at work on musculoskeletal pain associated with the use of a personal computer and the influence of media on outcomes. *Work* 2010;36:27–37.
- Shamseer L, Moher D, Clarke M, et al. Preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P) 2015: elaboration and explanation. *BMJ* 2015;349:g7647.
- Moher D, Shamseer L, Clarke M, et al. Preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P) 2015 statement. *Syst Rev* 2015;4:1.
- Hawker GA, Mian S, Kendzerska T, et al. Measures of adult pain: visual analog scale for pain (vas pain), numeric rating scale for pain (NRS pain), McGill pain questionnaire (MPQ), short-form McGill pain questionnaire (SF-MPQ), chronic pain grade scale (CpGs), short Form-36 bodily pain scale (SF-36 BPs), and measure of intermittent and constant osteoarthritis pain (ICOAP). *Arthritis Care Res* 2011;63 Suppl 11:S240–52.
- Shin YJ, Kim WH, Kim SG. Correlations among visual analogue scale, neck disability index, shoulder joint range of motion, and muscle strength in young women with forward head posture. *J Exerc Rehabil* 2017;13:413–7.
- Chiarotto A, Maxwell LJ, Terwee CB, et al. Roland-Morris disability questionnaire and Oswestry disability index: which has better measurement properties for measuring physical functioning in nonspecific low back pain? systematic review and meta-analysis. *Phys Ther* 2016;96:1620–37.
- EndNote [program]. X9.2 version. New York: Clarivate Analytics, 2020.
- Covidence. Covidence, 2019. Available: <https://www.covidence.org/home>
- Higgins JPT, Green S, Cochrane C. *Cochrane Handbook for systematic reviews of interventions*. Hoboken: Wiley-Blackwell, 2008.
- Practice CE, Organisation of Care. Cochrane data abstraction form. EPOC resources for review authors, 2013. Available: <https://epoc.cochrane.org/resources/epoc-resources-review-authors> [Accessed 10 June 2020].
- Sterne JAC, Savović J, Page MJ, et al. Rob 2: a revised tool for assessing risk of bias in randomised trials. *BMJ* 2019;366:14898.
- Popay J, Roberts H, Sowden A, et al. Narrative synthesis in systematic reviews: a product from the ESRC methods programme. *ESRC Methods Programme* 2006;2006:93.
- Akl EA, Briel M, You JJ, et al. Potential impact on estimated treatment effects of information lost to follow-up in randomised controlled trials (LOST-IT): systematic review. *BMJ* 2012;344:e2809.
- McLean S, Holden MA, Potia T, et al. Quality and acceptability of measures of exercise adherence in musculoskeletal settings: a systematic review. *Rheumatology* 2017;56:426–38.
- World Health Organization. *Adherence to long-term therapies: evidence for action*. Geneva: World Health Organization, 2003: 198.

The effectiveness of workplace exercise interventions in the reduction of musculoskeletal disorders in office workers. A systematic review.

Data Extraction Form adapted from the Cochrane Collaboration

Title of the systematic review: The effectiveness of workplace exercise interventions in the reduction of musculoskeletal disorders in office workers. A systematic review.

Trial Registration no: CRD42020177462.

This form can be used as a guide for developing your own data extraction form. Sections can be expanded and added, and irrelevant sections can be removed. It is difficult to design a single form that meets the needs of all reviews, so it is important to consider carefully the information you need to collect, and design your form accordingly. Information included on this form should be comprehensive, and may be used in the text of your review, 'Characteristics of included studies' table, risk of bias assessment, and statistical analysis.

Notes on using a data extraction form:

- Be consistent in the order and style you use to describe the information for each included study.
- Record any missing information as unclear or not described, to make it clear that the information was not found in the study report(s), not that you forgot to extract it.
- Include any instructions and decision rules on the data collection form, or in an accompanying document. It is important to practice using the form and give training to any other authors using the form.
- You will need to protect the document in order to use the form fields (Tools / Protect document)

Review title or ID
Study ID (<i>surname of first author and year first full report of study was published e.g. Smith 2001</i>)
Report IDs of other reports of this study (<i>e.g. duplicate publications, follow-up studies</i>)
Notes:

1. General Information

1. Date form completed (<i>dd/mm/yyyy</i>)	
2. Name/ID of person extracting data	
3. Report title (<i>title of paper/ abstract/ report that data are extracted from</i>)	
4. Report ID (<i>if there are multiple reports of this study</i>)	
5. Reference details	
6. Report author contact details	

Data extraction form 2013 08 12

7. Publication type <i>(e.g. full report, abstract, letter)</i>	
8. Study funding source <i>(including role of funders)</i>	
Possible conflicts of interest <i>(for study authors)</i>	
9. Notes:	

2. Eligibility

Study Characteristics	Review Inclusion Criteria <i>(Insert inclusion criteria for each characteristic as defined in the Protocol)</i>	Yes/ No / Unclear	Location in text <i>(pg & ¶/fig/table)</i>
10. Type of study	Randomised trial	...	
	Controlled before-after study <ul style="list-style-type: none"> • Contemporaneous data collection • At least 2 intervention and 2 control clusters 	...	
	Interrupted time series OR Repeated measures study <ul style="list-style-type: none"> • At least 3 timepoints before and 3 after the intervention • Clearly defined intervention point 	...	
	Other design (specify):	...	
11. Participants		...	
12. Types of intervention		...	
13. Types of outcome measures		...	
14. Decision:	...		
15. Reason for exclusion			
16. Notes:			

DO NOT PROCEED IF STUDY EXCLUDED FROM REVIEW

3. Population and setting

	Description <i>Include comparative information for each group (i.e. intervention and controls) if available</i>	Location in text <i>(pg & ¶/fig/table)</i>
17. Population description <i>(from which study participants are drawn)</i>		
18. Setting <i>(including location and social context)</i>		
19. Inclusion criteria		
20. Exclusion criteria		
21. Method/s of recruitment of participants		
22. Notes:		

4. Methods

	Descriptions as stated in report/paper	Location in text <i>(pg & ¶/fig/table)</i>
23. Aim of study		
24. Design <i>(e.g. parallel, crossover, non-RCT)</i>		
25. Unit of allocation <i>(by individuals, cluster/groups or body parts)</i>		
26. Start date		
27. End date		
28. Duration of participation <i>(from recruitment to last follow-up)</i>		
29. Notes:		

5. Risk of Bias assessment

The risk of bias will be assessed using the Version 2 of the Cochrane risk-of-bias tool for randomized trials (RoB 2).

6. Participants

Provide overall data and, if available, comparative data for each intervention or comparison group.

	Description as stated in report/paper	Location in text (pg & ¶/fig/table)
30. Total no. randomised <i>(or total pop. at start of study for NRCTs)</i>		
31. Clusters <i>(if applicable, no., type, no. people per cluster)</i>		
32. Baseline imbalances		
33. Withdrawals and exclusions <i>(if not provided below by outcome)</i>		
34. Age		
35. Sex		
36. Race/Ethnicity		
37. Severity of illness		
38. Co-morbidities		
39. Other treatment received <i>(additional to study intervention)</i>		
40. Other relevant sociodemographics		
41. Subgroups measured		
42. Subgroups reported		
43. Notes:		

7. Intervention groups

Copy and paste table for each intervention and comparison group

Intervention Group 1

	Description as stated in report/paper	Location in text (pg & ¶/fig/table)
44. Group name		
45. No. randomised to group <i>(specify whether no. people or clusters)</i>		
46. Description <i>(include sufficient detail for replication, e.g. content, dose, components; if it is a natural experiment, describe the pre-intervention)</i>		

	Description as stated in report/paper	Location in text (pg & ¶/fig/table)
47. Duration of Exercise intervention period		
48. Length of the session		
49. Weekly sessions		
50. Supervised or Unsupervised		
51. Co-interventions		
52. Economic variables <i>(i.e. intervention cost, changes in other costs as result of intervention)</i>		
53. Equipment <i>(e.g. staff numbers, cold chain, equipment)</i>		
54. Notes:		
	Description as stated in report/paper	Location in text (pg & ¶/fig/table)
55. Group name		
56. No. randomised to group <i>(specify whether no. people or clusters)</i>		
57. Description <i>(include sufficient detail for replication, e.g. content, dose, components; if it is a natural experiment, describe the pre-intervention)</i>		
58. Duration of treatment period		
59. Timing <i>(e.g. frequency, duration of each episode)</i>		
60. Delivery <i>(e.g. mechanism, medium, intensity, fidelity)</i>		
61. Providers <i>(e.g. no., profession, training, ethnicity etc. if relevant)</i>		
62. Co-interventions		
63. Economic variables <i>(i.e. intervention cost, changes in other costs as result of intervention)</i>		

	Description as stated in report/paper	Location in text (pg & ¶/fig/table)
64. Resource requirements to replicate intervention (e.g. staff numbers, cold chain, equipment)		
65. Notes:		

8. Outcomes

Copy and paste table for each outcome.

Outcome 1

	Description as stated in report/paper	Location in text (pg & ¶/fig/table)
66. Outcome name		
67. Time points measured (specify whether from start or end of intervention)		
68. Time points reported		
69. Outcome definition (with diagnostic criteria if relevant and note whether the outcome is desirable or undesirable if this is not obvious)		
70. Person measuring/ reporting		
71. Unit of measurement (if relevant)		
72. Scales: upper and lower limits (indicate whether high or low score is good)		
73. Is outcome/tool validated?	... Yes/No/Unclear	
74. Imputation of missing data (e.g. assumptions made for ITT analysis)		
75. Assumed risk estimate (e.g. baseline or population risk noted in Background)		
76. Notes:		

9. Results

Copy and paste the appropriate table for each outcome, including additional tables for each time point and subgroup as required.

For randomised or non-randomised trial - Dichotomous outcome

	Description as stated in report/paper				Location in text (pg & ¶/fig/table)
77. Comparison					
78. Outcome					
79. Subgroup					
80. Time point (specify whether from start or end of intervention)					
81. Results Note whether: ... post-intervention OR ... change from baseline And whether ... Adjusted OR ... Unadjusted	Intervention		Comparison		
	No. events	No. participants	No. events	No. participants	
82. Baseline data	Intervention		Comparison		
	No. events	No. participants	No. events	No. participants	
83. No. missing participants and reasons					
84. No. participants moved from other group and reasons					
85. Any other results reported					
86. Unit of analysis (e.g. by individuals, health professional, practice, hospital, community)					
87. Statistical methods used and appropriateness of these methods (e.g. adjustment for correlation)					
88. Reanalysis required? (if yes, specify why, e.g. correlation adjustment)	...				
89. Reanalysis possible?	...				
90. Reanalysed results					
91. Notes:					

For randomised or non-randomised trial - Continuous outcome

	Description as stated in report/paper	Location in text (pg & ¶/fig/table)
92. Comparison		
93. Outcome		
94. Subgroup		
95. Time point (specify whether from start or end of intervention)		

	Description as stated in report/paper						Location in text (pg & ¶/fig/table)
96. Post-intervention or change from baseline?							
97. Results <i>Note whether: ... post-intervention OR ... change from baseline And whether ... Adjusted OR ... Unadjusted</i>	Intervention			Comparison			
	Mean	SD (or other variance)	No. participants	Mean	SD (or other variance)	No. participants	
98. Baseline data	Intervention			Comparison			
	Mean	SD (or other variance)	No. participants	Mean	SD (or other variance)	No. participants	
99. No. missing participants and reasons							
100. No. participants moved from other group and reasons							
101. Any other results reported							
102. Unit of analysis <i>(e.g. by individuals, health professional, practice, hospital, community)</i>							
103. Statistical methods used and appropriateness of these methods <i>(e.g. adjustment for correlation)</i>							
104. Reanalysis required? <i>(if yes, specify why)</i>	... <i>Yes/No/Unclear</i>						
105. Reanalysis possible?	... <i>Yes/No/Unclear</i>						
106. Reanalysed results							
107. Notes:							

For randomised or non-randomised trial - Other outcome

	Description as stated in report/paper	Location in text (pg & ¶/fig/table)
108. Comparison		
109. Outcome		
110. Subgroup		
111. Time point <i>(specify whether from start or end of intervention)</i>		

	Description as stated in report/paper				Location in text (pg & ¶/fig/table)
112. Type of outcome					
113. Results	Intervention result	SD (or other variance)	Control result	SD (or other variance)	
	Overall results		SE (or other variance)		
114. No. participant	Intervention		Control		
115. No. missing participants and reasons					
116. No. participants moved from other group and reasons					
117. Any other results reported					
118. Unit of analysis (e.g. by individuals, health professional, practice, hospital, community)					
119. Statistical methods used and appropriateness of these methods					
120. Reanalysis required? (if yes, specify why)	...				
121. Reanalysis possible?	...				
122. Reanalysed results					
123. Notes:					

For controlled before-after study

	Description as stated in report/paper				Location in text (pg & ¶/fig/table)
124. Comparison					
125. Outcome					
126. Subgroup					
127. Timepoint (specify whether from start or end of intervention)					
128. Post-intervention or change from baseline?					
129. Results	Intervention result	SD (or other variance)	Control result	SD (or other variance)	
	Overall results		SE (or other variance)		

	Description as stated in report/paper		Location in text (pg & ¶/fig/table)
130. No. participants	Intervention	Control	
131. No. missing participants and reasons			
132. No. participants moved from other group and reasons			
133. Any other results reported			
134. Unit of analysis (individuals, cluster/ groups or body parts)			
135. Statistical methods used and appropriateness of these methods			
136. Reanalysis required? (specify)	... Yes/No/Unclear		
137. Reanalysis possible?	... Yes/No/Unclear		
138. Reanalysed results			
139. Notes:			

For interrupted time series or repeated measures study

	Description as stated in report/paper		Location in text (pg & ¶/fig/table)
140. Comparison			
141. Outcome			
142. Subgroup			
143. Length of timepoints measured (e.g. days, months)			
Total period measured			
144. No. participants measured			
145. No. missing participants and reasons			
146. No. timepoints measured	147. Pre-intervention	148. Post-intervention	
149. Mean value (with variance measure)			
150. Difference in means (post – pre)			
151. Percent relative change			
152. Result reported by authors (with variance measure)			

	Description as stated in report/paper				Location in text (pg & ¶/fig/table)
153. Unit of analysis (individuals or cluster/ groups)					
154. Statistical methods used and appropriateness of these methods					
155. Reanalysis required? (specify)	...				
156. Reanalysis possible?	...				
157. Individual timepoint results					
158. Read from figure?	...				
159. Reanalysed results	Change in level	SE	Change in slope	SE	
160. Notes:					

10. Applicability

161. Have important populations been excluded from the study? (consider disadvantaged populations, and possible differences in the intervention effect)	...			
162. Is the intervention likely to be aimed at disadvantaged groups? (e.g. lower socioeconomic groups)	...			
163. Does the study directly address the review question? (any issues of partial or indirect applicability)	...			
164. Notes:				

11. Other information

	Description as stated in report/paper	Location in text (pg & ¶/fig/table)
165. Key conclusions of study authors		
166. References to other relevant studies		
167. Correspondence required for further study information (what and from whom)		

168. Further study information requested <i>(from whom, what and when)</i>	
169. Correspondence received <i>(from whom, what and when)</i>	
170. Notes:	