Counseling to change the lifestyle of sedentary workers on musculoskeletal pain: systematic review

Aconselhamento para mudança do estilo de vida de trabalhadores sedentários sobre a dor musculoesquelética: revisão sistemática

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ABSTRACT

BACKGROUND AND OBJECTIVES: Musculoskeletal pain (MSP) in sedentary workers is a cause of absenteeism, high health costs and is relate to their lifestyle and work. Systematic reviews of interventions on the condition of MSP in this population are based on work equipment and do not present consensus on the type of intervention and its effectiveness. Therefore, the objective was to analyze the evidence of intervention studies that included education strategies to change the lifestyle of sedentary workers on the reduction of MSP.

CONTENTS: This systematic review follows the recommendations of PRISMA 2020. Searches were conducted until April 2021 in the PubMed, BIREME and Scielo databases, in order to identify randomized or non-randomized clinical trials published between January 1999 and April 2021. Indexed search descriptors were used and eligibility criteria were defined according to the PICOS strategy. The risk of bias was assessed using the PEDro scale. Eight randomized clinical trials published between 2004 and 2020, conducted in Europe, Asia, the United States and Australia involving 1,871 people (35 to 52 years old) were included. Interventions ranged from two weeks to 12 months. Five studies showed a higher number of women. In addition to lifestyle counseling, three studies addressed work characteristics (time in sitting posture, body posture) and three others investigated issues related to pain (symptoms, neck/shoulder anatomy and self-management). Six interventions were effective to reduce the intensity and frequency of MSP in the cervical and lumbar regions of the spine, shoulders and thoracic spine, which used counseling to increase the practice of physical activity, stress control, healthy eating, decreased alcohol consumption and smoking. Six studies presented medium/low bias risk in the following items: occult allocation, baseline comparability, blinding (individuals, therapists and evaluators), adequate follow-up and intention to treat analysis; and two studies presented medium/high risk in the same items, except in baseline comparability.

CONCLUSION: Workplace interventions that include education strategies and counseling for lifestyle changes are effective for reducing the intensity and frequency of MSP in sedentary workers.

PROSPERO registration: CRD42022342636.

Keywords: Counseling, Exercise, Lifestyle, Musculoskeletal pain, Occupational health, Sedentary behavior.

RESUMO

JUSTIFICATIVA E OBJETIVOS: A dor musculoesquelética (DME) em trabalhadores sedentários é causa de absenteísmo, custos elevados em saúde e está relacionada ao seu estilo de vida e de trabalho. Revisões sistemáticas de intervenções sobre a condição de DME nesta população baseiam-se nos equipamentos de trabalho e não apresentam consenso quanto ao tipo de intervenção e sua efetividade. Portanto, o objetivo foi analisar as evidências dos estudos de intervenção que incluíram estratégias de educação para mudança do estilo de vida de trabalhadores sedentários para a redução da DME.

CONTEÚDO: Esta revisão sistemática segue as recomendações do PRISMA 2020. Foram realizadas buscas até abril de 2021 nas bases de dados Pubmed, BIREME e Scielo, visando identificar estudos clínicos randomizados ou não randomizados publicados entre janeiro de 1999 e abril de 2021. Foram utilizados descritores de busca indexados e definidos critérios de elegibilidade segundo a estratégia PICOS. O risco de viés foi avaliado por meio da escala PEDro. Foram incluídos oito estudos clínicos randomizados publicados entre 2004 e 2020, realizados na Europa, Ásia, Estados Unidos e Austrália, que envolveram 1.871 pessoas (35 a 52 anos). As intervenções variaram de duas semanas a 12 meses. Cinco estudos apresentaram maior número de mulheres. Além dos aconselhamentos para estilo de vida, três estudos abordaram características do trabalho (tempo na postura sentada, postura corporal) e outros três investigaram questões relacionadas à dor

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HIGHLIGHTS

- Lifestyle education can reduce musculoskeletal pain in workers.
- Physical activity and stress control contribute to reducing pain intensity.
- The workplace is a potent environment for decreasing musculoskeletal pain.

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(sintomas, anatomia pescoço/ombro e autogerenciamento). Seis intervenções foram efetivas para a redução da intensidade e da frequência de DME nas regiões cervical e lombar da coluna, nos ombros e coluna torácica, as quais utilizaram aconselhamentos para aumento da prática de atividade física, controle do estresse, alimentação saudável, diminuição do consumo de álcool e do tabagismo. Seis estudos apresentaram risco de viés médio/baixo nos itens alocação oculta, comparabilidade da linha de base, cegamento (indivíduos, terapeutas e avaliadores), acompanhamento adequado e análise de intenção de tratar; e dois estudos apresentaram risco médio/alto nos mesmos itens, exceto na comparabilidade da linha de base.
CONCLUSÃO: Intervenções realizadas no local de trabalho e que incluam estratégias de educação e aconselhamentos para mudanças no estilo de vida podem ser efetivas para redução da intensidade e da frequência de DME em trabalhadores sedentários. Registro PROSPERO: CRD42022342636.
Descritores: Aconselhamento, Comportamento sedentário, Dor musculoesquelética, Estilo de vida, Exercício físico, Saúde do trabalhador.

INTRODUCTION

Musculoskeletal problems comprise more than 150 disorders that affect the locomotor system, being characterized by pain and mobility limitations, and may reduce the ability to work[1]. A systematic analysis of data from the 2019 Global Burden of Disease Study showed that approximately 1.71 billion people worldwide had problems associated with musculoskeletal pain (MSP)[2], which had a 58% increase over the past two decades, with women having a higher incidence than men, and the conditions of low back pain, neck pain, rheumatoid arthritis, osteoarthritis, and gout were the five with the highest occurrence[3]. The prevalence of MSP In Brazil ranged from 16% to 82%[4], which is a public health problem. According to Brazilian Social Security data, musculoskeletal problems such as back pain, hand, wrist, knee and leg injuries are the most prevalent causes of work disability[5], and sedentary workers (administrative or office services) were the ones who presented the highest number of days of absence from work due to these problems[6]. This situation leads to loss of productivity and high costs to public health[7].

MSP outcomes in workers are related to their lifestyle[8], including low level of physical activity (PA), inadequate eating habits, high body mass, difficult stress control, sedentary behavior and social factors such as the work activity performed[8-11]. Regarding sedentary workers, the literature shows that besides long periods of sitting and inadequate body postures, other factors such as PA, obesity and psychosocial factors (stress, low social support and mental health problems) are related to the onset of MSP[9,12,13].

The European Agency for Safety and Health at Work (EU-OSHA)[9] conducted a scoping review study with the working population of 28 countries in the European Community that showed 30% of workers spending between 25% and 75% of their working time in a sitting posture, which is a risk factor for the onset of pain, especially in the neck, shoulders, upper limbs, lumbar, and upper back regions[9,12,13].

In this context, the workplace is presented as an appropriate environment for interventions to benefit the worker's health[14], which is recognized by the World Health Organization[15] and by the EU-OSHA[9,16] as a suitable place to promote PA, healthy eating and to reduce MSP, especially in sedentary or office workers[9,15,16]. Regarding pain, the strategies to reduce it must consider the risk and protection factors against it, such as changes in lifestyle (PA, eating habits, reduction of alcohol and tobacco consumption, and stress control), and address issues related to work and workers, such as sitting time and postural control in the sitting position[9,16].

These strategies should be presented in the form of counseling, lectures, courses, group talks[16], offering healthy foods in the workplace cafeterias, making available living spaces for PA practice, providing gym equipment in the office space[15], offering exercise programs, and education about psychosocial risk factors for MSP related to individual life, the work environment, as well as stress control[9,17,18].

However, a systematic review study of reviews showed that a large proportion of interventions for lifestyle changes carried out in the workplace used strategies based on individuals or on adjustments to the environment. Furthermore, few review studies evaluated broad intervention strategies aimed at total worker health, which was also observed in studies that evaluated MSP as an outcome, especially in sedentary workers[19].

Other review studies that evaluated interventions on MSP in the workplace in this population did not present consensus on the intervention models and their effectiveness[20,21]. Therefore, the objective was to analyze the evidence of intervention studies that included education strategies for lifestyle changes in sedentary workers in order to obtain a reduction in MSP.

CONTENTS

This systematic review followed the Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) 2020 statement: an updated guideline for reporting systematic reviews[22] (checklist - Appendix 1). It was registered in the International prospective register of systematic reviews (PROSPERO) database, number CRD42022342636[23], and was based on the following guiding question: what are the characteristics of intervention studies that used, among other strategies, lifestyle change counseling for sedentary workers to prevent musculoskeletal pain?

Search strategy

Searches were performed in English in the electronic database Medline/Pubmed (04/14/2021), in English and Portuguese in the Latin American and Caribbean Center on Health Sciences Information/BIREME (04/14/2021) and in the Scientific Eletronic Library Online/SciELO (04/15/2021). A time limit between January 1, 1999, until the search dates in April 2021 was applied. For the searches, descriptors indexed in Medical Subject Headings (MeSH) and Health Sciences Descriptors (DeCS) were

used, with the following combinations: 1) *motor activity OR physical activity OR exercise AND occupational health AND pain*; 2) *motor activity OR physical activity OR exercise AND occupational health AND musculoskeletal pain*; 3) *motor activity OR physical activity OR exercise AND occupational health AND musculoskeletal pain AND counseling*; 4) *motor activity OR physical activity OR exercise AND occupational health AND musculoskeletal pain AND universities*; 5) *motor activity OR physical activity OR exercise AND occupational health AND musculoskeletal pain AND healthy diet*; 6) *motor activity OR physical activity OR exercise AND occupational health AND musculoskeletal pain AND body composition*; 7) *motor activity OR physical activity OR exercise AND occupational health AND pain AND healthy diet*; 8) *motor activity OR physical activity OR exercise AND occupational health AND pain AND body composition.*

Eligibility criteria

Inclusion and exclusion criteria were defined according to the PICOS strategy[22,24] (Population, Intervention, Comparator, Outcome and Study design). Participants were to be sedentary workers (performing their activities in the sitting position, such as office or administrative services) at work, 18 years of age or older, recruited from the workplace, without a medical diagnosis for any type of disease or problem related to MSP, and who were not under treatment during the study period.

The interventions should be on site or during working hours and contain counseling (regardless of the medium used) for lifestyle changes (PA, eating habits, stress control, sedentary behavior). In addition to the intervention group, the studies should have one or more comparison groups (control or other intervention) and have as primary or secondary endpoint the reduction of the MSP evaluated in at least two periods. Intervention studies (randomized or non randomized clinical trials)[25], published in English or Portuguese, were eligible.

Cross-sectional studies, cohorts, reviews, case-controls, guidelines, instrument/questionnaire validation studies, studies with patients in treatment, research protocols, interviews, books, theses, dissertations, monographs, letters to the editor, and theoretical essays were excluded. Also were excluded intervention studies not conducted with sedentary workers, studies in which the intervention or part of the intervention was conducted outside the workplace or outside working hours, studies with multi-component interventions that did not present components for lifestyle behavior change, (e.g. only application of PA or physical exercise or only changes in the work environment), studies that did not evaluate MSP, repeated studies (same sample and same intervention), and studies written in languages other than English or Portuguese.

Selection process, data extraction and risk of bias

The process of study selection, data extraction, and risk of bias assessment was carried out independently by two reviewers (JSJ and SVL), and doubts were resolved by consensus and, when necessary, with the help of a third reviewer (MCS). The records identified in the electronic databases were exported to the EndNote X4 reference manager. After exclusion of duplicates, titles, abstracts, and full texts of eligible articles were read. Manual searches on reference lists of the selected studies were performed and the same selection process was applied.

Data were extracted and registered in a form created by the authors, which contained the variables of interest: author, year of publication, country of realization, type of study, objective, sample size, population, age, gender, characteristics of the intervention (number of groups, strategy, period, and number of evaluations), and results on the MSP (quantification and body regions). The data were synthesized and presented in the form of text; flow chart for the selection of the studies; a table for the description of the interventions; main results (proportions and p-value for the degree of significance of difference between groups); and a table for the risk of bias.

To assess the risk of bias of the studies included in the review, the Physiotherapy Evidence Database (PEDro) scale[26] was used. The first criterion of the scale is not computed, so trials can be scored from zero to 10 points, and the higher the score, the lower the risk of bias. The PEDro scale was translated into Brazilian Portuguese and tested against the English version, demonstrating adequate reproducibility and similarity[26]. Furthermore, this scale shows moderate agreement with the risk of bias assessment tool used by the Cochrane Library[49]. Although the scale is efficient and easy to apply, it does not allow inferences about the degree of evidence.

RESULTS

The searches identified 3.670 titles. After exclusion of duplicates, 2.026 studies were screened, of which 28 eligible full texts were read. In manual searches, 291 titles were identified and seven eligible full texts were read. According to the eligibility criteria, 27 full texts were excluded and eight studies were selected (Figure 1).

The selected studies were published in the period from 2004 to 2020. All were characterized as randomized clinical trials[27-34], with two or more groups, and had MSP as the primary endpoint. The body regions evaluated were cervical[27,29-32], shoulders[27,29,30,32], upper limbs[27,28], thoracic[30,32] and lumbar[30,33,34] spine. They involved a total of 1.871 subjects, aged 35 to 52 years, who worked in offices in different places: public administration[27-29], universities[31,33,34], public telecommunications services[30] and airline companies[32].

In five studies, was observed a higher frequency of women in the samples: 64%[29], 76% in the intervention group and 78% in the control group[31], 56%[32], 78%[33] and 69%[34]. Among these, four trials showed pain intensity reduction effects in the cervical[29,31], shoulder and thoracic spine[32], and lumbar[33] regions.

There were patients with different degrees of MSP in six selected studies[27-32], including no pain at all, who were analyzed together in both intervention and control groups. That is, in both group types in these six studies, there were subjects with MSP (symptomatic) and subjects without MSP (asymptomatic). In two studies[33,34], the subjects were symptomatic and asymptomatic, respectively (Table 1). In the first group, the

inclusion criterion was to have chronic pain (≥ 3 months) and in the second was to have no pain in the past 12 months. The interventions lasted from 2 weeks[32] to 12 months[29] and used intervention strategies containing lifestyle counseling (PA[27-34], diet[28,33,] stress[28,30,33], alcohol consumption[28,33] and smoking[28,33]); physical exercise[29,32,34] and electronic media with information on stress control, health promotion[30] and how to increase the number of daily steps[31]. In addition to these components, three studies used advice related to work characteristics (sitting time[33,34], sedentary behavior[33], body posture during work[27]) and three addressed issues related to MSP (symptoms[28], anatomy of the neck and shoulder[32] and self-management of pain[33]).

All of the eight studies selected contained advice for the practice of PA[27-34] or application of physical exercises[29,32,34]. Six showed statistically significant effects on the intensity and frequency of MSP[27,29-33], of which five showed a reduction in the workers' pain in the cervical[27,29,30], shoulder[27,30,32], thoracic[32] and lumbar spine[30,33] regions. One study showed a lower frequency of cervical pain[31]. Table 1 presents the characteristics of the selected studies, as well as the detailed description of the intervention and its main results on MSP.

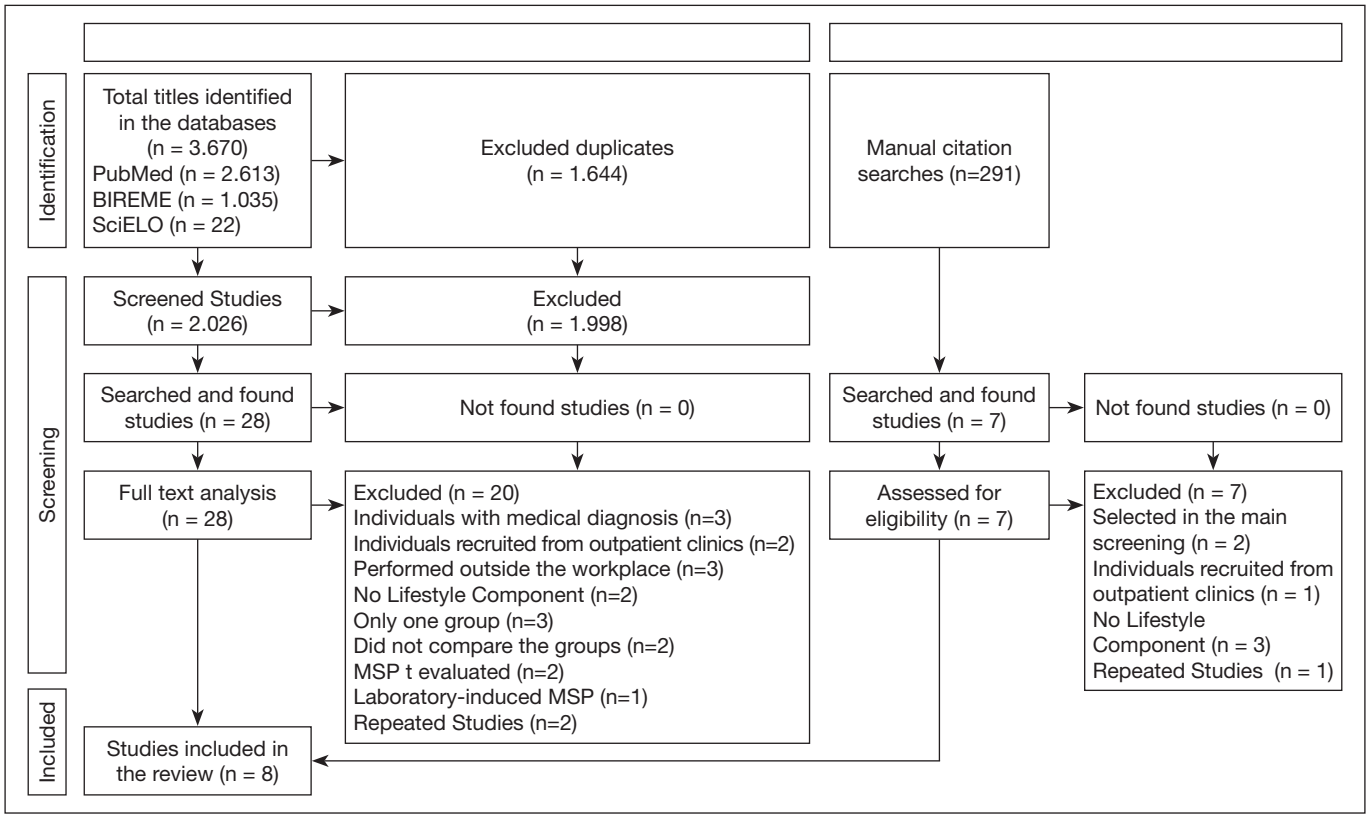

Figure 1. PRISMA[22] Flowchart of study selection.

Table 1. Description of the studies selected in this review (n = 8)

Authors/Country	Goal	Characteristics of the Intervention	Results
Bernaards et al.[27] Netherlands	To evaluate the effectiveness of a single intervention targeting work style and a combined intervention targeting work style and physical activity in the recovery of neck and upper limb symptoms in computer workers.	n = 466, symptomatic and asymptomatic individuals; six months of intervention and a further six months of follow-up, with three measures (baseline, six months and 12 months). The participants received six monthly interactive meetings lasting 30-90 minutes on body posture during computer use in the sitting position (feet position, spine alignment and support, elbow and wrist angulation, cervical spine tilt, and distance between the eyes and the computer screen) and on moderate to vigorous intensity physical activity in the commuting, occupational, household, and leisure domains (walking, cycling, gardening, housework, and sports), which did not include physical exercise. They were randomized into: Work style group (n = 152): body posture meetings; Work style and physical activity group (n = 156): meetings about body posture and physical activity; Usual care group (n = 158): do not receive any intervention.	Reduction in neck and shoulder pain intensity (Visual Analog Scale 0-10 points) at 12 months in the work style group compared to the usual care group. No significant differences were observed between the work style and physical activity group and the usual care group.

Continue...

Table 1. Description of the studies selected in this review (n = 8) – continuation

Authors/Country	Goal	Characteristics of the Intervention	Results
Proper et al.[28] Netherlands	Assess the impact of workplace physical activity counseling using cost-benefit and cost-effectiveness analyses.	n=299, symptomatic and asymptomatic individuals; nine months of intervention with seven measurements. All participants received written general lifestyle information (physical activity, nutrition, alcohol, smoking, work stress, and musculoskeletal symptoms). They were randomized into: Intervention group (n = 131): written material and seven monthly consultations of 20 minutes each, with individualized counseling directed by the results of the first two consultations, with the objective of promoting physical activity and healthy eating habits; Control Group (n = 168): received only the written material.	Reduction in the frequency of upper extremity pain (Nordic Questionnaire, adapted) in the Intervention Group (17.9%) compared to the Control Group (6.2%), but without statistical differences.
Andersen et al.[29] Denmark	To investigate the effect of three different workplace interventions on long-term compliance, muscle strength gains, and neck/shoulder pain in office workers.	n=549, symptomatic and asymptomatic subjects; 12-month intervention with three measures (baseline, mid-term, and post-intervention). They were randomized into: Specific resistance exercises group (n=180): for neck (lateral flexion in sitting position with a fixed elastic band) and shoulder (lateral and front raise: 3 sets of 15 repetitions with dumbbells) and performed three times a week (twice with instructor present), twenty minutes per session; Physical activity group (n=187): received counseling on physical activity at work and during leisure time. In addition to instructor visits, which varied from one to four times a month, to perform running and walking activities. They also received pedometers, an eight-minute compact disc with instructions for aerobic and strength exercises (except for the neck and shoulder), an exercise step/platform placed in strategic places (next to the copy machine), and indications for increasing daily physical activity at commuting and leisure; Control group (n=182): received counseling on physical activity, diet, ergonomics, stress, and work organization.	Reduction in mid-term neck pain intensity (VAS 0-9 points) in the specific resistance exercise and physical activity groups compared to the reference group, but no differences between the exercise and physical activity groups; Individuals in the control group, without pain at baseline, triggered greater shoulder pain intensity compared to subjects without pain at baseline in the intervention groups.
Schell et al.[30] Sweden	To evaluate the influence of a web-based stress management and health promotion program on intensity and occurrence of neck/shoulder and back pain and on the association of perceived pain with stress in a prospective, controlled study.	n=232, symptomatic and asymptomatic individuals; six months of intervention and a further 6 months of follow-up with three measures (baseline, 6 months and 12 months). Group I (n=55): received access to a web-based device, on which they performed real-time monitoring of current health perception and stress status through a diary and also access to information about stress and health promotion, which could be printed and used for reading and practice elsewhere. The device also contained a program of classic stress management exercises, with relaxation and sleep improvement, cognitive reframing, time management, emotional control and self-awareness, strengthening self-esteem, life reflection, and dissociation, as well as the possibility of chatting with other participants; Group II (n = 71): access to the device for daily monitoring, with information about stress and health promotion with the possibility of printing the material; Control group (n = 106): did not receive any intervention.	Reductions in pain intensity (VAS 0-10 points) in the lumbar region for group I at 6 months and in the lumbar region, neck and shoulder for group II at 12 months in comparison to the Control Group. In the intragroup analyses, a reduction in total pain intensity was observed for group II at 12 months, measured by summing the points of the four 0-10 point pain scales (cervical, shoulder, thoracic, and lumbar spine) on a 0-40 point VAS adapted by the authors of the study.
Sitthipornvorakul et al.[31] Thailand	To evaluate the effectiveness of increasing daily walking steps on the 6-month incidence of neck pain in office workers.	n=91, symptomatic and asymptomatic individuals; six-month intervention with six measurements (one per month). Intervention Group (n=50): received an app on their smartphone with daily step goals to be achieved during the six-month intervention. Participants were instructed to carry the smartphone with the app in their pocket from getting up in the morning until going back to bed at night. The daily step goals were calculated based on a cohort study of increased daily steps and incidence of neck pain in office workers, a calculation that estimated the number of daily steps that could prevent neck pain. Participants wrote down daily on the app the number of daily steps and the sensation/intensity of neck pain, measured by a 0-100 point Visual Analog Scale, and received incentives for each daily goal achieved. Control Group (n = 41): did not receive any intervention.	In the six-month period, subjects in the Intervention Group reported less frequent neck pain (22%) compared to the Control Group (34%). However, no differences were observed regarding pain intensity (VAS 0-10 points).

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Table 1. Description of the studies selected in this review (n = 8) – continuation

Authors/Country	Goal	Characteristics of the Intervention	Results
Tsauo et al.[32] China	Develop a workplace exercise program to relieve neck and shoulder symptoms and compare the effectiveness of 3 types of execution models.	n=178, symptomatic and asymptomatic individuals; two-week intervention and 3-month follow-up with three measures (baseline, two weeks and three months). Participants received a two-hour lecture on anatomy of the neck and shoulder region, practical demonstration of stretching exercises (flexion, extension, lateral flexion, and rotation, 10 repetitions for each with a 5-second interval), printed material describing the exercises to take home and two weeks of exercises at the workplace with advice to keep exercising on their own for another three months. They were randomized into: Self-exercise group (n=56): performed exercises alone during the breaks, with a physical therapist available to answer any questions; Supervised exercise group I (n = 69): held daily 15-20 minute sessions with demonstration; Supervised exercise group II (n = 14): performed twice daily, before and after work, 15-20 minute sessions, with supervision in one of the sessions; Control group (n = 39): received only the lecture and printed material.	The supervised exercise II group had a lower frequency (Nordic Questionnaire: last seven days) of pain in the shoulder and thoracic spine region at three months compared to the other groups.
Barone Gibbs et al.[33] United States	To evaluate the feasibility and effects of a multi-component intervention on pain in desk workers with chronic low back pain.	n=27, symptomatic individuals; six-month intervention with six monthly measurements Intervention Group (n = 13): received behavioral counseling, initially through a 75-90 minute lecture, which included education about the health risks of sedentary behavior and pain self-management. The counseling included improved nutrition, reduction of alcohol, smoking, stress, and gradual reduction of time in sitting posture, inserting moments of standing or short walks in the workplace, and later activities such as walking or biking on the commute and involvements in sports activities in leisure. In addition to a desk attachment that made it possible to work standing up and a device to use on the wrist that emitted an alert signal every 30 minutes without moving. With the signal, the subjects were advised to walk for 2 to 3 minutes; The lecture was followed by monthly 10-15 minute phone contacts; Control Group (n = 14): did not receive any intervention;	Reduction in low back pain intensity (Oswestry Disability Index - ODI) in the Intervention Group compared to the Control Group, but no differences in the 0-10 point VAS; Reduction in pain frequency (p=0.04) in the Intervention Group (54%) compared to the Control Group (14%).
Johnston et al.[34] Australia	Compare the feasibility and impact of stand-stand workstations plus advice, with or without exercise, on low back pain and sitting time in office workers at risk for low back pain.	n=29, asymptomatic individuals; four weeks of intervention with two measures (pre and post-intervention); All participants received a customized workstation with adjustable height and angulations that made it possible to work both standing and sitting, in addition to verbal and written advice to start with short periods of standing (10 min) and to spend no more than 30 minutes sitting. Participants were advised to gradually accumulate at least two to four hours standing per day during working hours and to gradually increase the level of general physical activity (leisure and commuting), such as using stairs instead of elevator, cycling to work, and engaging in sports activities; They were randomized into: Workstation Group (n=13): received the workstation and the counseling; Workstation + Exercises Group (n=16): received the workstation, the counseling, and a standardized progressive resistance exercise program (arm and leg extensions with knees and hand supported on the floor, bridge; wall squats and hip abduction on the floor in lateral lying position). Taught by a physical therapist in 20-minute sessions with two sets of 20 repetitions, three times a week during the work shift. Each participant received a yoga mat to perform the exercises comfortably at work.	Both groups showed a reduction in maximum low back pain intensity (VAS 0-10 points) post-intervention. However, there was no statistically significant difference between the groups.

Regarding the risk of bias, according to the PEDro scale, the scores of the selected studies ranged from four points, in two studies,[28,32] to eight points, in two others,[33,34], with the others reaching five[30,31] or six points[27,29]. Of the eight selected studies, six showed medium/low risk of bias (≥ five points)[27,29-31,33,34]. On the other hand, half of the studies[27,28,31,32] did not achieve adequate follow-up of participants and three studies did not use intention-to-treat analysis[28,30,32]. Table 2 presents the detailed score for each of the criteria.

Table 2. Bias risk analysis of the studies included in the review (n=8)

Criteria/Studies	Bernaards et al.[27]	Proper et al.[28]	Andersen et al.[29]	Schell et al.[30]	Sitthipornvorakul et al.[31]	Tsauo et al.[32]	Barone Gibbs et al.[33]	Johnston et al.[34]
Eligibility*	+	+	+	+	+	–	+	+
Random allocation	+	+	+	+	+	+	+	+
Hidden allocation	–	–	–	–	–	–	+	+
Baseline comparability	+	+	–	+	+	+	+	+
Blind individuals	–	–	–	–	–	–	–	–
Blind therapists	–	–	–	–	–	–	–	–
Blind assessors	+	–	+	–	–	–	+	+
Proper follow-up	–	–	+	+	–	–	+	+
Intention-to-treat analysis	+	–	+	–	+	–	+	+
Comparisons between groups	+	+	+	+	+	+	+	+
Point estimates and variability	+	+	+	+	+	+	+	+
Total	6	4	6	5	5	4	8	8

*First criterion is not scored; +: yes; -: no.

DISCUSSION

In addition to advice on lifestyle changes, the selected studies applied educational strategies on work characteristics and on MSP, as suggested by the literature on workplace interventions for sedentary workers[9,15,16]. This shows that all the selected studies have a workplace education aspect, which, according to EU-OSHA[16], can present very satisfactory results in the prevention of MSP.

Five of the eight included studies showed a higher frequency of women in the samples[29,31-34]. These results may indicate that women are more related to the MSP outcome than men, either because they have more symptoms of musculoskeletal problems, or because they are more often employed in administrative and sedentary jobs. In the same way, EU-OSHA reports show that women are more affected by musculoskeletal problems than men[10], and among the risk factors for MSP are gender and time spent sitting at work[9]. The agency stated that although men are more likely to report MSP-related problems, especially back pain, women have a higher prevalence of neck, shoulder and upper limb problems[9,10].

Nonetheless, one of the studies included in the EU-OSHA review[9], which evaluated 12,426 workers from 18 countries, including office workers, identified a significant association between female gender and low back pain disability. In addition, the report showed that 31% of female workers in the European community reported spending more than 75% of their working time sitting, while the frequency of men for sitting time at work was 25%[9].

In the same way, a study[35] showed that the prolactin hormone, produced by women during pregnancy, is released in excess in stressful situations. The authors observed that, in these situations, the increase in this hormone can produce a greater sensation of nonspecific pain, which does not determine, but may contribute to the multifactorial explanation of the fact that women feel more pain than men, resulting in higher frequencies of MSP in females.

Other studies with interventions in the workplace carried out with sedentary workers also presented a higher frequency of women in the samples. In one study[36], 79% of the sample was composed of women and reductions were observed in the time spent sitting and in musculoskeletal problems. In another study[13], 62.5% of the participants were female, and the authors verified a direct association between time spent sitting and chronic low back pain. Another study[37] showed that 61.7% of the sample was composed of women.

Although these results reflect the reality of European female workers, they corroborate the findings of the present systematic review, showing that female office workers in other continents are also more affected by musculoskeletal pain than men, since four of the five studies with the highest number of women were conducted outside the European continent[31-34]. In addition, the findings also showed that both specific exercises for the neck, shoulder, and lower back[29,32,34] and generic PA advice, such as for walking[29,31,33], can be effective to reduce MSP in women.

All of the eight selected studies contained PA-related components, with advice to practice PA[27-34] or practice of physical exercises[29,32,34], of which six studies[27,29-33] showed reduction of the workers' pain. Exposures to the practice or advice to practice ranged from two weeks of exercise, with recommendations to continue the practice for a period of three months[32], to twelve months[29]. In three studies[29,30,32], the exercises were for the cervical areas (flexion, extension and rotation) and shoulders (lateral and frontal elevation) and for relaxation, to be done three times a week (three sets of fifteen repetitions)[29] to every day, once or twice a day (10 repetitions in 15-20 minute sessions)[32]. In another study[30], the advice to practice relaxation exercises was done with an electronic device that was accessible during the entire time of the study. The other three studies[27,31,33] offered recommendations for general PA of moderate to vigorous intensity on commuting, occupational, household and leisure (walking, cycling, gardening, household chores, sports and increasing daily steps).

These findings suggest that there was adherence to PA practice and are in line with what has been reported in the literature on

PA practice and pain reduction[38]. The neurophysiological explanation for the post-PH hypoalgesia occurs due to the production of endogenous opioids and the increase of neurotransmitters, the catecholamines (dopamine and noradrenaline). This neurophysiological mechanism causes an increase in the pain threshold due to the reduction in the excitability of the plasma membrane of the neuron, especially in afferent nerve fibers of type A that have greater sensitivity. Thus, the higher the PA level of the individual, the higher the production of β-endorphins (endogenous opioids), which act in the descending mechanisms in the spinal cord, reducing the perception of pain[38].

Among the six studies that showed significant reductions in workers' MSP, four were effective in reducing pain intensity[27,29,30,33], three of them in the intensity of neck pain[27,29,30], which contained in their interventions components about neck posture, PA, resistance exercises for the neck, and stress management. As already shown, the occurrence of MSP in sedentary workers is influenced by lifestyle factors (PA, body mass index-BMI, stress management) and work factors (sitting time and inadequate body postures)[8-13].

These results are confirmed by a prospective cohort study[11] with 18.562 workers, which showed protection for MSP in any body region, in physically active individuals and risk in overweight and obese. Moreover, physically inactive and obese individuals had a higher risk of chronic pain. Another study[39] showed that, in sedentary workers, neck posture is a determinant for the production of strength and resistance in the cervical region, physical abilities which are related to the appearance of pain in this body area. The authors suggest that if such a work-related factor is identified, it is possible to modify it and, thus, reduce the appearance of work-related neck pain in the target population.

However, other factors are related to the management of MSP in workers, such as stress control inside and outside the workplace. Three studies included in this review offered information on stress management, which showed reductions in the frequency and intensity of pain in the lumbar, cervical, and shoulder regions[28,30,33]. One of these studies[28], which offered information on stress management at work, showed a reduction in the presence of MSP in both the Intervention Group (received printed material and lectures) and the Control Group, which received only printed material with the same information, which demonstrates the relevance of information on stress management for reducing MSP.

On the other hand, the other two studies that used a stress control approach showed significant reductions in pain intensity[30,33]. It's worth noting the study[30], which compared two intervention groups and one Control Group. Unlike the other two studies[28,33], this one[30] delivered interventions focused on stress management with a broad health promotion approach, including relaxation exercises, and found reduced pain intensity for both groups compared to the control. The findings presented by these three studies[28,30,33] show that multiple interventions linking health promotion and lifestyles, including stress management inside and outside the workplace, can be effective in reducing the frequency and intensity of MSP, showing better results when the intervention is focused on stress management[30].

In this sense, a review study[17] showed that educational processes about pain can reduce the intensity of MSP and psychological distress, a factor that is related to stress[40]. A randomized study[18] showed that education about MSP, combined with exercises that contribute to stress control, such as those practiced in yoga, can also decrease MSP in workers, including sedentary workers[18]. This finding corroborates the results of the three studies included in this review that used, as an intervention strategy, information about stress control[28,30,33].

Despite the described results, the relationship between the mentioned factors and the intensity of MSP is still a controversial issue. A systematic review study conducted by the Cochrane group, with interventions at the workplace in sedentary workers, found no relation between increased level of PA during the work shift (standing or walking) and reduced intensity of MSP[20]. This finding contradicts half of the studies selected in this review, because four studies that contained in the interventions components to increase PA and that evaluated the intensity of MSP showed differences between the groups, with significant reductions[27,29,30,33].

The review proposed by the Cochrane group analyzed 10 studies with different designs and different intervention strategies[20]. Four studies that evaluated the intensity of MSP contained intervention strategies focused on changes in the physical work environment, such as providing treadmill desks or standing workstations, and two studies focused on individual strategies, such as providing a PA tracker or a pedometer, which may explain the lack of association between increasing the level of PA and the intensity of MSP. It should be noted that Cochrane reviews employ methods that analyze the selected studies together, checking the strength of the evidence together.

However, five studies selected in the present review showed reduction in the intensity of MSP, which applied interventions directed to the individuals in an expanded manner, involving, besides PA in the occupational domain, the commuting, leisure and domestic domains[27,29,30,33,34]. This may indicate that approaches involving the four PA domains and suggesting changes in the subjects' lifestyles are effective in reducing pain intensity. According to EU-OSHA[9], the interventions to reduce MSP must consider the multifactorial character of pain, overcome the biomechanical perspective and incorporate intervention strategies that seek to understand and reach the MSP phenomenon in its totality, involving issues related to the subjects' life and work style.

In addition, the literature presents other randomized clinical trials that evaluated office workers and contained in their intervention the component to increase PA, which showed reduction in pain intensity[41,42]. These studies also used broad strategies with approaches involving aspects related to increasing PA, including educational processes about risk and protection factors to prevent MSP, such as prolonged sitting time, knowledge about MSP (definition and symptoms, pain pathogenesis, relation with diseases, and physical and psychological impacts), non-pharmacological treatments (exercises, body posture, nutrition), and sleep and mood management, with moments for

discussions about the topics addressed[41,42], strategies similar to those used by the authors[30,33].

Three studies showed greater effectiveness in reducing pain intensity with six months of intervention and with broad strategies through educational processes and counseling that suggest self-management of health-related behaviors, such as PA practice in leisure and commuting, food control, reduction in alcohol consumption, reduction in the smoking habit and stress self-management, inside and outside the workplace[29,30,33]. This could also be observed in the study[27] that showed, through interactive meetings about body posture and lifestyle, a reduction in the intensity of MSP. However, the reduction was observed after the intervention period, i.e., after six months. This finding suggests that the subjects self-managed the information passed on to them.

Moreover, studies[27,29,33] suggest that interventions with follow-up periods longer than six months may favor the assimilation of information and facilitate the acquisition and self-management of healthy habits. In this sense, the literature shows that self-selected exercise practice can present positive affective responses and greater pleasure during the practice[43], and perhaps the processes of choices and affective and pleasurable responses can explain the results presented.

These results indicate that self-management of information about MSP and related aspects (including PA and other lifestyle factors), as well as freedom of choice, both inside and outside the work environment, are important factors to consider in interventions aimed at reducing pain intensity.

Regarding the practice of physical exercises, three studies contained this component in the intervention, one for the lumbar region[34] and two[29,32] for the cervical and shoulder regions. When the lumbar region is concerned, no difference was found between the evaluated groups[34]. The two studies that analyzed pain in the cervical and shoulder regions used, as an intervention strategy, specific resistance exercises for these areas, showing reduction in pain intensity[29] and frequency[32]. These findings corroborate the results presented in the literature.

A systematic review study analyzing interventions performed at the workplace in office workers concluded that shoulder and neck exercises performed three times a week using light weights or elastic bands for 10 weeks were effective in reducing pain[44]. This result was ratified by the study[29] that used an intervention strategy similar to the one described above (elastic bands and light weights three times a week), observing a reduction in the pain intensity of the cervical region. On the other hand, another study[32] also identified a reduction in the percentage of subjects with shoulder and thoracic spine pain, however, in its intervention, the exercises were performed daily under the supervision of a physical therapist and the subjects who did them did not use any type of material to perform the activities.

In the present review, no Latin American studies were found and only two were conducted in low and middle income countries[31,32]. However, the literature showed that in populations from low and middle-income countries, as well as in high-income countries, lifestyle factors of individuals, such as high BMI or obesity, the smoking habit, low level of PA and poor body posture are related to MSP[9,45]. As measures to prevent MSP in low and middle-income country populations, the literature suggests the implementation of community-based interventions aimed at behavioral changes with the creation and maintenance of healthy habits[45]. However, there is a need to conduct further studies in countries with these characteristics.

An interesting point to note is that the studies included in this review presented intervention strategies that can be applied in other contexts, especially considering the pandemic moment by Covid-19, in which an increase in remote or home-based work was observed[46], a period in which women's reports indicated an increase in work overload due to the overlapping of tasks (work, children, and home). However, they also reported closeness with their children and husbands and more time for PA practice[47]. On the other hand, when working at home during the pandemic, an increase in the presence of MSP, especially low back and neck pain[48], and an increased risk of developing musculoskeletal problems[46], were both observed both, which suggests the need for interventions that can be performed in this context.

Regarding the evaluation of the risk of bias, it should be noted that the included studies used educational processes on MSP, which makes it difficult to blind participants and therapists, suggesting that the evaluation should be analyzed in a relative way.

This review presents limitations and some strengths that deserve to be highlighted. First, a meta-analysis was not conducted, and the degree of certainty of the evidence was not evaluated, which makes it difficult to state the effect of all of them on the outcome. In addition, of the six studies that showed statistically significant effects on MSP[27,29-33], in five[27,29-32] there were asymptomatic and symptomatic subjects, which were analyzed together, which may have affected the direction of the effect of the interventions.

Other factors to report were the searches, conducted in three databases and with a time limit between 1999 and 2021, which may generate a publication bias of the selected studies. In addition, an inclusion criterion of this review was that the studies should be published in English or Portuguese, a criterion that may contribute to the aforementioned bias. Nevertheless, the databases used for the search are among the main ones in Latin America, the Caribbean, and in the international health context, which minimizes the chance that articles referring to this theme were not included in the selection.

As some of the study's strengths, can be highlighted the use of solid methodological review techniques, such as the use of PRISMA[22] guidelines for writing this report and completing its checklist (Appendix 1), the registration of the review in the PROSPERO[23] database, the use of search descriptors indexed in MeSH and DeCS, the definition of eligibility criteria according to the PICOS strategy[22,24], the study selection process and other steps of the review made by two independent reviewers, the use of a tool for assessing the risk of bias in studies[26] and the conclusions based on the quality of evidence. Future intervention studies with the objective of reducing MSP in sedentary workers should focus on the potential for MSP education strategies delivered in the workplace and be aimed at lifestyle changes for these individuals. In addition, researchers should direct greater attention to possible subject losses during the study and, to minimize the effect of such losses, employ intention-to-treat analysis.

CONCLUSION

Multi-component interventions carried out in the workplace and that include education strategies and counseling for lifestyle changes are effective in reducing the intensity and frequency of neck, shoulder, upper limb, and low back pain in sedentary workers. The need for more intervention studies with Latin American workers and those from low and middle-income countries is highlighted. Considering the heterogeneity of the studies regarding the ways of measuring the MSP outcome, the generalization about this review findings should be evaluated with caution.

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AUTHORS' CONTRIBUTIONS

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Data Collection, Methodology, Writing - Preparation of the original, Writing - Review and Editing, Supervision
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Appendix 1. PRISMA checklist[22]

Section and Topic	Item #	Checklist item	Page where item is reported
TITLE			
Title	1	Identify the report as a systematic review.	1
ABSTRACT			
Abstract	2	See the PRISMA 2020 for Abstracts checklist.	1
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of existing knowledge.	2-3
Objectives	4	Provide an explicit statement of the objective(s) or question(s) the review addresses.	3-4
METHODS			
Eligibility criteria	5	Specify the inclusion and exclusion criteria for the review and how studies were grouped for the syntheses.	5
Information sources	6	Specify all databases, registers, websites, organisations, reference lists and other sources searched or consulted to identify studies. Specify the date when each source was last searched or consulted.	4
Search strategy	7	Present the full search strategies for all databases, registers and websites, including any filters and limits used.	4
Selection process	8	Specify the methods used to decide whether a study met the inclusion criteria of the review, including how many reviewers screened each record and each report retrieved, whether they worked independently, and if applicable, details of automation tools used in the process.	5-6
Data collection process	9	Specify the methods used to collect data from reports, including how many reviewers collected data from each report, whether they worked independently, any processes for obtaining or confirming data from study investigators, and if applicable, details of automation tools used in the process.	5-6
Data items	10a	List and define all outcomes for which data were sought. Specify whether all results that were compatible with each outcome domain in each study were sought (e.g. for all measures, time points, analyses), and if not, the methods used to decide which results to collect.	6
	10b	List and define all other variables for which data were sought (e.g. participant and intervention characteristics, funding sources). Describe any assumptions made about any missing or unclear information.	6
Study risk of bias assessment	11	Specify the methods used to assess risk of bias in the included studies, including details of the tool(s) used, how many reviewers assessed each study and whether they worked independently, and if applicable, details of automation tools used in the process.	6
Effect measures	12	Specify for each outcome the effect measure(s) (e.g. risk ratio, mean difference) used in the synthesis or presentation of results.	6

Continue...

Appendix 1. PRISMA checklist[22] – continuation

Section and Topic	Item #	Checklist item	Page where item is reported
METHODS			
Synthesis methods	13a	Describe the processes used to decide which studies were eligible for each synthesis (e.g. tabulating the study intervention characteristics and comparing against the planned groups for each synthesis (item #5).	6
	13b	Describe any methods required to prepare the data for presentation or synthesis, such as handling of missing summary statistics, or data conversions.	6
	13c	Describe any methods used to tabulate or visually display results of individual studies and syntheses.	5-6
	13d	Describe any methods used to synthesize results and provide a rationale for the choice(s). If meta-analysis was performed, describe the model(s), method(s) to identify the presence and extent of statistical heterogeneity, and software package(s) used.	5-6
	13e	Describe any methods used to explore possible causes of heterogeneity among study results (e.g. subgroup analysis, meta-regression).	-
	13f	Describe any sensitivity analyses conducted to assess robustness of the synthesized results.	-
Reporting bias assessment	14	Describe any methods used to assess risk of bias due to missing results in a synthesis (arising from reporting biases).	6
Certainty assessment	15	Describe any methods used to assess certainty (or confidence) in the body of evidence for an outcome.	-
RESULTS			
Study selection	16a	Describe the results of the search and selection process, from the number of records identified in the search to the number of studies included in the review, ideally using a flow diagram.	7
	16b	Cite studies that might appear to meet the inclusion criteria, but which were excluded, and explain why they were excluded.	6-7
Study characteristics	17	Cite each included study and present its characteristics.	6-12
Risk of bias in studies	18	Present assessments of risk of bias for each included study.	13
Results of individual studies	19	For all outcomes, present, for each study: (a) summary statistics for each group (where appropriate) and (b) an effect estimate and its precision (e.g. confidence/credible interval), ideally using structured tables or plots.	9-12
Results of syntheses	20a	For each synthesis, briefly summarise the characteristics and risk of bias among contributing studies.	9-13
	20b	Present results of all statistical syntheses conducted. If meta-analysis was done, present for each the summary estimate and its precision (e.g. confidence/credible interval) and measures of statistical heterogeneity. If comparing groups, describe the direction of the effect.	6-13
	20c	Present results of all investigations of possible causes of heterogeneity among study results.	-
	20d	Present results of all sensitivity analyses conducted to assess the robustness of the synthesized results.	-
Reporting biases	21	Present assessments of risk of bias due to missing results (arising from reporting biases) for each synthesis assessed.	-
Certainty of evidence	22	Present assessments of certainty (or confidence) in the body of evidence for each outcome assessed.	-
DISCUSSION			
Discussion	23a	Provide a general interpretation of the results in the context of other evidence.	13-20
	23b	Discuss any limitations of the evidence included in the review.	21
	23c	Discuss any limitations of the review processes used.	21
	23d	Discuss implications of the results for practice, policy, and future research.	20-22
OTHER INFORMATION			
Registration and protocol	24a	Provide registration information for the review, including register name and registration number, or state that the review was not registered.	1,4
	24b	Indicate where the review protocol can be accessed, or state that a protocol was not prepared.	1,4
	24c	Describe and explain any amendments to information provided at registration or in the protocol.	-

Continue...

Appendix 1. PRISMA checklist[22] – continuation

Section and Topic	Item #	Checklist item	Page where item is reported
OTHER INFORMATION			
Support	25	Describe sources of financial or non-financial support for the review, and the role of the funders or sponsors in the review.	23
Competing interests	26	Declare any competing interests of review authors.	23
Availability of data, code and other materials	27	Report which of the following are publicly available and where they can be found: template data collection forms; data extracted from included studies; data used for all analyses; analytic code; any other materials used in the review.	-

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