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SYSTEMATIC REVIEW

Benefits of physical exercise on pain and functioning in workers with work-related musculoskeletal disorders: a systematic review

Benefícios do exercício físico na dor e na capacidade funcional em trabalhadores com distúrbios osteomusculares relacionados ao trabalho: uma revisão sistemática

Beneficios del ejercicio físico sobre el dolor y la capacidad funcional en trabajadores con trastornos osteomusculares relacionados con el trabajo: una revisión sistemática

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ABSTRACT | This systematic review describes the benefits of physical exercise on pain and functioning in workers with work-related musculoskeletal disorders. Bibliographic search was conducted on the Cochrane Library, Biblioteca Virtual em Saúde (BVS), Latin American and Caribbean Health Sciences Literature (LILACS) database, and Physiotherapy Evidence Database (PEDro). Eligibility criteria consisted of randomized clinical trials, published between 2015 and 2020 in English, involving workers with work-related musculoskeletal disorders experiencing pain and functioning limitations at work, and exploring exercise-based interventions. Of the 852 studies identified, ten were selected for analysis. Results indicated that stretching and postural exercises reduced musculoskeletal pain in the shoulders, upper limbs, neck, and lower back, while increasing functioning. In conclusion, physical exercise reduces musculoskeletal pain and enhances functioning of workers with work-related musculoskeletal disorders.

Keywords | Cumulative Trauma Disorders; Physical Exercise; Workers Health; Pain; Physical Functional Performance.

RESUMO | O objetivo deste estudo é descrever os benefícios do exercício físico na dor e a capacidade funcional de trabalhadores com distúrbios osteomusculares relacionados ao trabalho. Trata-se de uma revisão sistemática que foi realizada nas seguintes bases eletrônicas de dados: *Cochrane Library*, Biblioteca Virtual em Saúde, *Latin American and Caribbean Health Sciences Literature* e *Physiotherapy Evidence Database*. Foram adotados como critérios de elegibilidade: ensaios clínicos randomizados publicados entre 2015 e 2020 na língua inglesa com trabalhadores com distúrbios osteomusculares relacionados ao trabalho com dor e restrição funcional no trabalho e intervenções baseadas em exercícios físicos. Foram identificados 852 estudos, dos quais 10 foram incluídos para análise. Os achados indicaram que o alongamento e o exercício postural reduziram as dores musculoesqueléticas nos ombros, membros superiores, pescoço e região lombar, também melhorando a capacidade funcional. Conclui-se que o exercício físico reduz as dores musculoesqueléticas e aumenta a capacidade funcional de trabalhadores com distúrbios osteomusculares relacionados ao trabalho.

Descritores | Transtornos Traumáticos Cumulativos; Exercício Físico; Saúde do Trabalhador; Dor; Desempenho Físico Funcional.

RESUMEN | Este estudio tiene el objetivo de describir los beneficios del ejercicio físico sobre el dolor y la capacidad funcional de trabajadores con trastornos osteomusculares relacionados con el trabajo. Se trata de una revisión

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sistemática, realizada en las bases de datos electrónicas: *Cochrane Library*, Biblioteca Virtual en Salud (BVS), *Latin American and Caribbean Health Sciences Literature* (LILACS) y *Physiotherapy Evidence Database* (PEDro). Se adoptaron como criterios de elegibilidad: ensayos clínicos aleatorizados publicados entre 2015 y 2020 en inglés, con trabajadores con trastornos osteomusculares relacionados con el trabajo con dolor y restricción funcional en el trabajo, además de abordar intervenciones que se basan en ejercicios físicos. Se identificaron 852 estudios, de los cuales 10 se incluyeron para el análisis. Los hallazgos indicaron que el estiramiento y el ejercicio postural redujeron los dolores musculoesqueléticos en los hombros, los miembros superiores, el cuello y la región lumbar, mientras mejoraron la capacidad funcional. Se concluye que el ejercicio físico reduce los dolores musculoesqueléticos y aumenta la capacidad funcional de trabajadores con trastornos osteomusculares relacionados con el trabajo.

Palabras clave | Trastornos de Traumas Acumulados; Ejercicio Físico; Salud del Trabajador; Dolor; Rendimiento Físico Funcional.

INTRODUCTION

Work-related musculoskeletal disorders are a great and complex public health issue and one of the most common in occupational health[1]. Its cause is multifactorial but can be related to the lack of breaks and body recovery during the workday[2]. Additionally, the constant excessive use of the musculoskeletal system[3] generates peculiar symptoms which are characterized by an advanced stage in most indivudals[4], usually affecting the upper limbs followed by the lower back and lower limbs, with presence of pain, heaviness, fatigue and functional incapacity[5].

In Europe, musculoskeletal disorders account for 53% of all registered occupational diseases, and of these about 50% lead to an work absence of more than 3 days[3]. In the United States, these disorders represent 29% of all illnesses and work-related accidents resulting in absenteeism, whereas in Brazil, the 2019 Ministry of Health survey found that 67,599 cases of repetitive strain injuries and work-related musculoskeletal disorders were reported between 2007 and 2016, going from 3,212 cases in 2007 to 9,122 case in 2016, totalling an increase in absenteeism of 184%[4].

In this regard, studies addressing work-based physical exercise programmes, also called labour gymnastics or labour kinesiotherapy, found direct and indirect benefits for workers[6]. Scientists argue that physical exercise at work is associated with reduced musculoskeletal pain, functional limitations[7], stress and mental fatigue[8]. However, bibliographic search conducted on the International Prospective Register of Systematic Reviews (PROSPERO) in November 2019 identified no study synthesizing evidence to describe the benefits of physical exercise on pain and functioning in workers. Hence, the present study sought to describe the benefits of physical exercise on pain and functioning in workers with work-related musculoskeletal disorders.

METHODOLOGY

Protocol and registration

This systematic literature review was registered in the International Prospective Register of Systematic Reviews (CRD42021259129), conducted and reported according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines[9].

Research question

The study's research question was formulated using the PICO strategy, as follows:

- P: Workers with work-related musculoskeletal disorders
- I: Physical exercise
- C: Different forms of physical exercise
- O: Pain and functioning

It can thus be summarized as: "What are the benefits of different forms of physical exercise on pain and functioning in workers with work-related musculoskeletal disorders?"

Search strategy

The research began in November 2019, and the search strategy was applied in May 2020. Each search was conducted based on the association of Health Sciences Descriptors (DeCS) using the Boolean operator AND and OR. Descriptors and their combinations were adjusted for each electronic database, as follows:

- Cochrane Library: (Pain at work) OR (functional capacity at work) OR (DORT, pain) OR (DORT, functional capacity) AND (labour gymnastics) OR (physical exercise).
- Biblioteca Virtual em Saúde (BVS): Pain at work OR functional capacity at work OR DORT at work AND physical exercise at work.
- Latin American and Caribbean Health Sciences Literature (LILACS): Pain at work AND physical exercise at work.
- Physiotherapy Evidence Database (PEDro): Exercises* *work; Pain* Worker* Musculoskeletal Pain AND Worker; Worker* exercis* capacity*

Eligibility criteria

Eligibility criteria consisted of scientific articles (randomized clinical trials) published between 2015 and 2020 in English that investigated a variety of physical exercise interventions and their influence on pain and functioning, and performed at least one comparison between the intervention and control group, using PE in different combinations. Interventions such as ergonomic counselling were also considered. As for sample composition, workers aged over 18, encompassing both sexes, from different occupations with work-related musculoskeletal disorders were included.

Studies that provided only published abstracts, books, course completion papers, reviews, not randomized clinical trials, studies differing in terms of the most relevant prognostic indicators of functioning limitation, studies that did not describe the intergroup statistical comparison results of at least one key outcome, and studies that did not include physical exercise in the assessed variables and samples that presented workers with other types of comorbidities were excluded.

Screening protocol

Study selection included title, abstract and full text reading with application of eligibility criteria at all phases. Duplicates were excluded except for two articles in which the authors investigated the same population, used the same inclusion criteria and intervention, but changed the outcomes: one study assessed pain and the other functioning. The entire article selection process was conducted by only one researcher. Search results were imported into a spreadsheet in Microsoft Excel 2016 and organized in a table.

Data extraction and synthesis

Data extraction was conducted independently by two researchers using a standardized extraction form. Disagreements were resolved by a third researcher. The data extracted were as follows:

- Participants: Age, sex and history of diseases. Number of randomized patients per treatment group. Number of losses to follow-up per treatment group. Clinical parameters of interest for the clinical situation.
- Methods: Follow-up time by treatment group. Adequate randomization, secret allocation, blinding scheme (investigators, participants, outcome evaluators), intention-to-treat analysis, follow-up losses and early interruption for benefits.
- Interventions and outcomes: Description of the experimental and control intervention. Therapeutic scheme in the study groups. Definition of each outcome investigated. Unit of measure (if applicable).
- Results: For each outcome: collection of categorical and/or numerical variables. Subgroups to be analysed: number of events over the total number of patients in each group.

Methodological quality and risk of bias

Methodological quality was analysed using the PEDro quality scale which contains 11 criteria for validity and interpretation of clinical trial results. As the first criterion is an addition to eligibility, it was excluded from the score calculation, therefore the score ranges from 0-10. One point is assigned for the presence of evidence quality indicators and zero for the absence of these indicators. Maximum score represents an adequate study design and greater possibility of data reproducibility.

Risk of bias was assessed by a third independent researcher using the Cochrane Handbook for Systematic Reviews of Intervention. It included the domains: randomization process, intended interventions (effect of assignment to intervention), missing outcome data, outcome measurement, selection of reported results and general outcome. Studies were classified as low

risk of bias, some concerns and high risk of bias, represented in the study results in color[10].

RESULTS

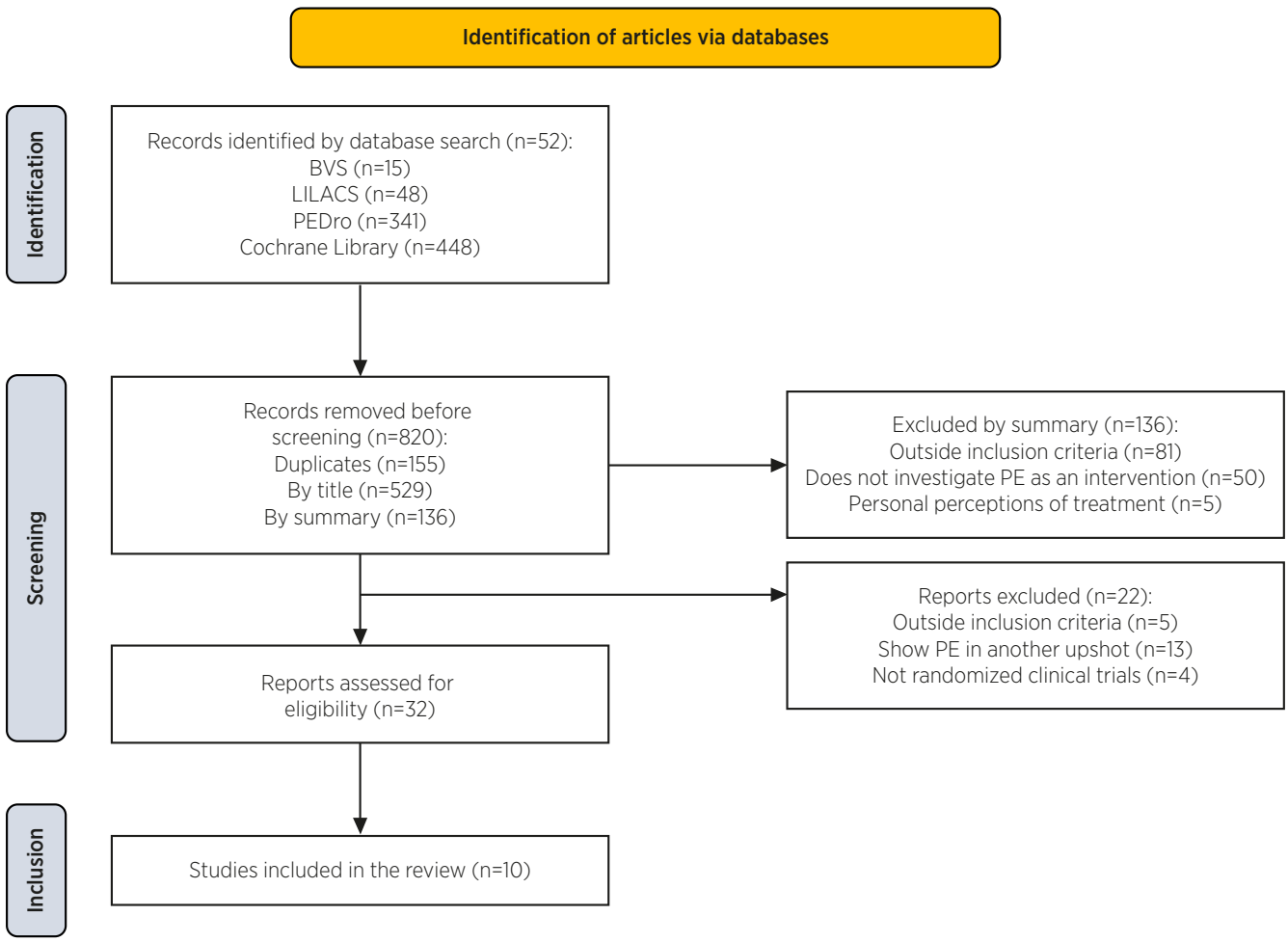
Description of the studies

Bibliographic search identified 852 articles from which 155 duplicates were excluded, resulting in 697 studies. After reviewing titles and abstracts, another 665 articles were removed, leaving 32 articles for detailed examination. Following full review and assessment using the PEDro scale and other relevant eligibility criteria, 22 studies were excluded for failing to meet the inclusion criteria. Finally, ten articles were deemed suitable for the subsequent analysis (Figure 1).

Sample size ranged from 35 to 219 participants, with a minimum age of 18 years and a maximum age of 67 years (Table 1). Eight articles included workers with mild to moderate pain in the neck and upper limbs followed by lower back pain[11,13,15-20], highlighting that pain during the workday leads to limitations in performing tasks.

Intervention time ranged from 4 to 24 weeks (6 months), frequency from two to five times a week, and duration from 10 to 60 minutes each session[11-18]. Most studies compare types of PE programme such as resistance training versus stretching and posture[13-15,19,20], workplace exercises versus exercises performed at home[11,12], and conventional exercises versus ergonomic counselling[16,18,19]. All sought to investigated which PE modalities reduce pain and disability at work. Some studies included a control group which received only ergonomic guidelines or no intervention.

Figure 1. Flowchart of the selection process of articles included in the review according to PRISMA 2020.



BVS: Biblioteca Virtual em Saúde; LILACS: Latin American and Caribbean Literature in Health Sciences; PEDro: Physiotherapy Evidence Database; PE: Physical Exercise.

Table 1. Characterization of reviewed studies

Author/Country	Sample and randomization	Intervention	Outcomes	Results
Caputo et al.[11] (Spain)	35 UEV workers (both sexes) with physically disabled and functional disability, from 38 to 45 years old, were randomly allocated by a computer-generated list.	The ERPO group performed specific cervical and scapulothoracic exercises, whereas the ECAP group undertook stretching of the neck-shoulder muscles and postural re-education.	Musculoskeletal pain and functioning.	Pain intensity was 55.5% and 83% lower in the ERPO and ECAP groups, respectively, with a statistically insignificant difference between groups (p=0.619). Ability related to CNP, and work improved in both groups (p=0.001 in ERPO and p=0.002 in ECAP), but without a statistically significant difference (p=0.430).
Jakobsen et al.[12] (Denmark)	200 female health professionals aged 18 to 67 years were randomly allocated at the cluster level.	GTR performed strength training, whereas the GCS performed PE at leisure focused on stretching and free exercises.	Functional capacity.	Pain decreased in GTR compared with GCS (p<0.0003). As a result, participants reported increased job satisfaction and desire to exercise.
Jakobsen et al.[13] (Denmark)	200 female health professionals aged 18 to 67 years were randomly allocated at the cluster level.	GTR performed strength training, whereas GCS performed PE at leisure focused on stretching and free exercises.	Musculoskeletal pain and functioning.	Physical effort was more reduced in the GTR group than in the GCS (p<0.01), improving functioning. The need for body recovery at the end of work tended towards greater reduction with workplace exercise compared with exercise at home (p≤0.05).
Mulla et al.[14] (Canada)	43 desk workers of both sexes were randomly allocated by a number generator.	IG performed leg strengthening plus postural exercises. CG was asked to refrain from changing their physical activity levels.	Musculoskeletal pain and functioning.	IG showed greater improvement in physical function and capacity compared with CG, with greater improvement in LEFS (p≤0.016).
Rasotto et al.[15] (Italy)	60 precision craft workers aged 30 to 60 years were randomly allocated using 10 blocks and a number generator (opaque envelopes).	IG performed warm-up exercises, shoulder mobilization and upper limb muscle strengthening and stretching. CG had no intervention.	Musculoskeletal pain and functioning.	IG showed a greater reduction in shoulder pain (p≤0.039) when compared with CG. Reduction in upper limb and neck pain and disability with concomitant increase in grip strength were also observed.
Shariat et al.[16] (Malaysia)	142 office workers of both sexes aged 20 to 50 years were randomly assigned using the permuted block method (opaque envelopes).	IG performed McKenzie, William and stretching exercises. GME received changes in the workplace. GEME received the ergonomics modification and performed the exercises. CG was left without intervention.	Musculoskeletal pain.	There were significant differences in pain scores for the neck, shoulders and lower back in all groups. However, significant improvement in the final phase of the protocol was observed only in IG (p≤0.05).
Sundstrup et al.[17] (Denmark)	66 slaughterhouse workers of both sexes aged 43 to 48 years were randomly allocated.	IG performed exercises designed to target the muscles of the shoulder, arms and hands. CG received ergonomic training focused on job-specific hands-on training.	Musculoskeletal pain.	Time to fatigue, FM, hand/wrist pain and functioning significantly improved after strength training in IG compared with CG (p≤ 0.01).
Taulaniemi et al.[18] (Finland)	219 health professionals of both sexes aged 30 to 55 years were randomly allocated using the sequentially numbered sealed envelope method.	EG (EF + counselling) performed exercises in three progressive stages, focusing on the control of neutral spine posture + stretching + strengthening. Non-exercisers received only counselling.	Musculoskeletal pain and functioning.	Pain reduction was higher in the EG, reaching 35.7% after PE (p≤0.047). Functional capacity in heavy nursing tasks also improved (p≤0.007).
Tsang et al.[19] (China)	101 patients of both sexes aged 20 to 54 years, diagnosed with work-related neck and shoulder pain, were randomly allocated using the computer.	CG performed general stretching exercises. IG received individualized training in motor control, counselling, and ergonomic modifications in the workplace.	Musculoskeletal pain and functioning.	Both groups showed an improvement in pain intensity (neck and shoulder pain in the IG and CG [p≤0.0278 and p≤0.0232, respectively]). Functional capacity also increased (p≤0.05) in both groups.

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Author/Country	Sample and randomization	Intervention	Outcomes	Results
Tunwattanapong et al.[20] (Thailand)	96 office workers of both sexes were randomly allocated using computer number generator and opaque envelopes.	IG was instructed to perform neck and shoulder stretching exercises. CG received only ergonomic guidelines.	Musculoskeletal pain and functioning.	Improvement was greater in IG than in CG in pain scores (p≤0.001). Functional capacity improved among patients who exercised three times/week than among those who exercised less frequently (p≤0.005).

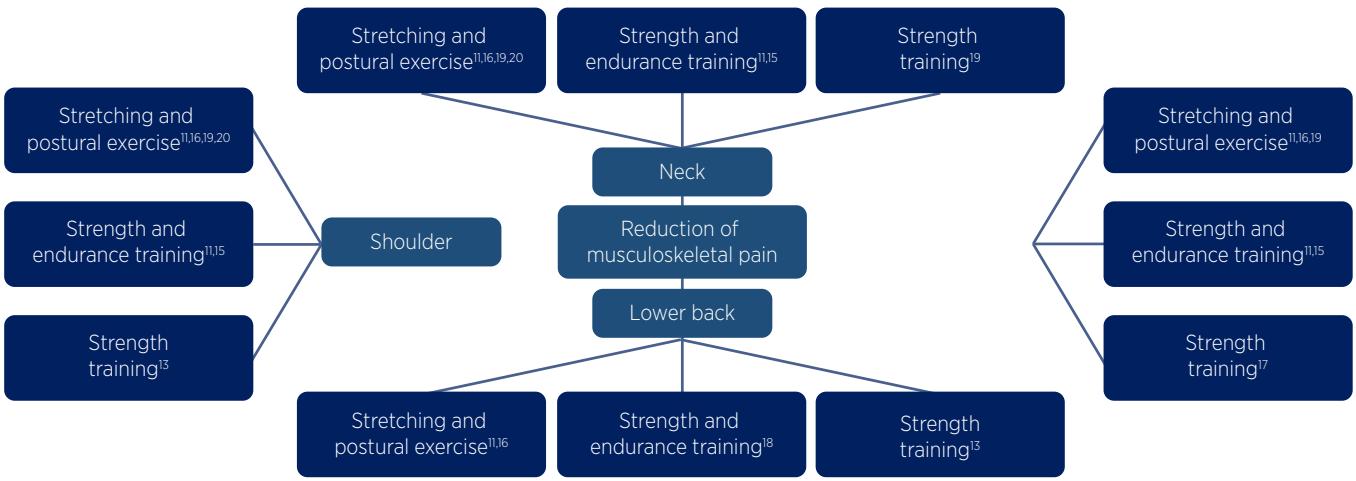
UEV: video display unit; CNP: chronic neck pain; ERPO: neck-shoulder resistance exercise; ECAP: conventional stretching and posture exercise; GTR: working group; GCS: home group; PE: physical exercise; EG: experimental group; CG: control group; LEFS: Lower extremity functional scale; IG: intervention group; MMSS: upper limbs; ADM: range of motion; GE: exercise group; GME: ergonomic modification group; GEME: combined exercise and ergonomic modification group; FM: muscle strength; MS: ergomotor; GT: treatment group.

Chronic pain, chronic joint inflammation, osteoarthritis, low back pain/neck pain and pain with radiation to the upper limbs were the most frequent musculoskeletal disorders in the study populations. Regarding job roles, the samples are quite heterogeneous including office workers, health professionals, slaughterhouse workers and computer workers as participants.

Benefits of physical exercise on musculoskeletal pain and functioning

Nine studies assessed musculoskeletal pain (Table 1), and most reported its occurrence in the neck, shoulders, upper limbs, and lower back. Figure 2 summarizes the benefits of physical exercise regarding this outcome.

Figure 2. Favorable effects of physical exercise on musculoskeletal pain.



Seven studies evaluated functioning. Most findings related to incapacity arising from pain during work, physical effort required and difficulty in performing daily living activities due to poor workplace conditions. However, we observed important heterogeneity in functioning reporting. Different instruments were used to collect and analyse data on functioning limitations, including the Borg rating of perceived exertion (RPE), which is used to classify physical effort at work into seven levels[12]; the Need for Recovery Scale (NFRS), which assesses the body recovery at five points by the end of a workday[13]; the Neck Disability Index (NDI), which provides information about neck or cervical-related disability and how neck pain has affected the ability to perform daily activities[11,19]; the Lower Extremity Functional Scale (LEFS), which measures an individual's functioning to perform daily activities focusing on the lower limbs[14]; the Northwick Park Neck Pain Questionnaire (NPNPQ), which assesses neck function, pain and consequent impairments[20]; the Shoulder and Hand Questionnaire (DASH), which describes arm, shoulder and hand disorders and disabilities[15,19]; and the Neck Pain and Disability Scale (NPDS)[15] (Figure 3). Nonetheless, the reviewed studies revealed benefits on functioning regarding perceived physical effort, reduced fatigue, and increased endurance.

Methodological quality and risk of bias assessment

All ten reviewed articles had their methodological quality assessed based on the PEDro scale (Table 2A). Importantly, eligibility criteria (criteria), which relates to external validity, was excluded from the cumulative scoring process, resulting in a score range from 0 to 10. Only three studies[14,17,20] had a score 8, and seven studies achieved a score of 7[11-13,15,16,18,19]. As for risk of bias, according to the Cochrane Handbook for Systematic Reviews of Intervention six studies were rated with some concerns[11-13,15,16,19] and four presented low risk of bia[14,17,18,20] (Table 2B).

Figure 3. Favorable effects of physical exercise on functioning.

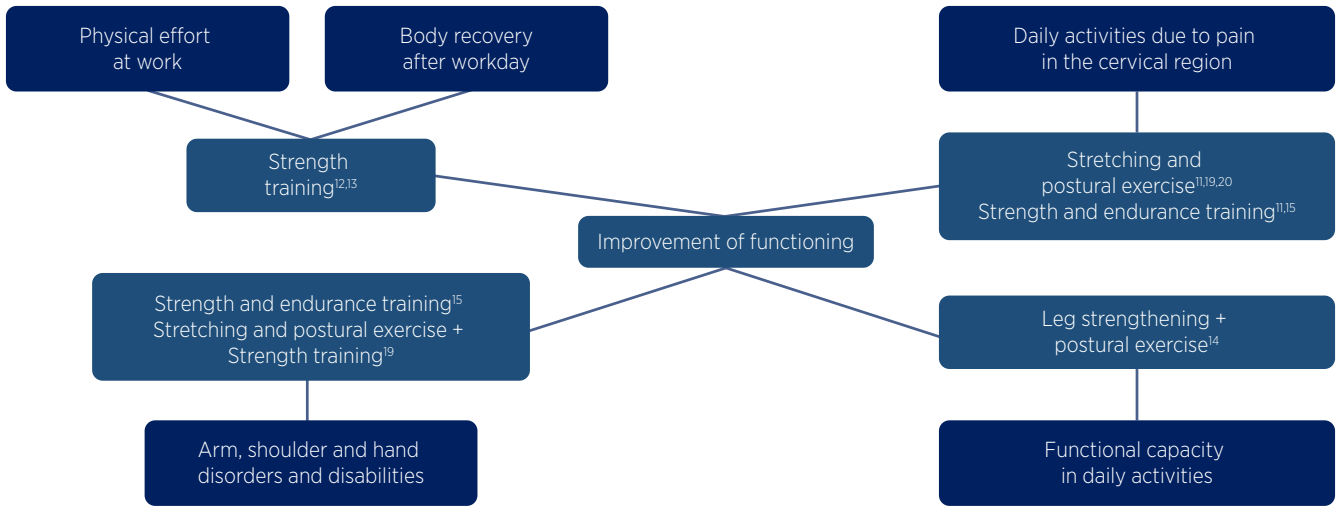


Table 2. Quality of studies on the PEDro scale and risk of bias

Criteria Assessment	Caputo et al.[11] (Spain)	Jakobsen et al.[12] (Denmark)	Jakobsen et al.[13] (Denmark)	Mulla et al.[14] (Canada)	Rasotto et al.[15] (Italy)	Shariat et al.[16] (Malaysia)	Sundstrup et al.[17] (Denmark)	Taulaniemi et al.[18] (Finland)	Tsang et al.[19] (China)	Tunwattanapong et al.[20] (Thailand)
A) PEDro scale										
Eligibility criteria	+	+	+	+	+	+	+	+	+	+
Random allocation	+	+	+	+	+	+	+	+	+	+
Secret allocation	+	-	-	+	+	+	+	+	+	+
Similar groups	+	+	+	+	+	+	+	+	+	+
Blinding of participants	-	-	-	-	-	-	-	-	-	-
Blinding of therapists	-	-	-	-	-	-	-	-	-	-
Blinding of evaluators	-	+	+	+	-	-	+	+	-	+
Sample loss <15%	+	+	+	+	+	+	+	-	+	+
Intent-to-treat analysis	+	+	+	+	+	+	+	+	+	+
Intergroup comparison description	+	+	+	+	+	+	+	+	+	+
Precision and variability measurements	+	+	+	+	+	+	+	+	+	+
Total	7	7	7	8	7	7	8	7	7	8

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Criteria Assessment	Caputo et al.[11] (Spain)	Jakobsen et al.[12] (Denmark)	Jakobsen et al.[13] (Denmark)	Mulla et al.[14] (Canada)	Rasotto et al.[15] (Italy)	Shariat et al.[16] (Malaysia)	Sundstrup et al.[17] (Denmark)	Taulaniemi et al.[18] (Finland)	Tsang et al.[19] (China)	Tunwattanapong et al.[20] (Thailand)
B) Risk of bias										
Randomization process	Low risk of bias	Some concerns	Some concerns	Low risk of bias	Low risk of bias	Low risk of bias	Low risk of bias	Low risk of bias	Low risk of bias	Low risk of bias
Intended interventions (effect of assignment to intervention)	High risk of bias	High risk of bias	High risk of bias	High risk of bias	High risk of bias	High risk of bias	High risk of bias	High risk of bias	High risk of bias	High risk of bias
Missing outcome data	Low risk of bias	Low risk of bias	Low risk of bias	Low risk of bias	Low risk of bias	Low risk of bias	Low risk of bias	Low risk of bias	Low risk of bias	Low risk of bias
Outcome measurement	Some concerns	Low risk of bias	Low risk of bias	Low risk of bias	Some concerns	Some concerns	Low risk of bias	Low risk of bias	Some concerns	Low risk of bias
Selection of the reported result	Low risk of bias	Low risk of bias	Low risk of bias	Low risk of bias	Low risk of bias	Low risk of bias	Low risk of bias	Low risk of bias	Low risk of bias	Low risk of bias
Overall	Some concerns	Some concerns	Some concerns	Low risk of bias	Some concerns	Some concerns	Low risk of bias	Low risk of bias	Some concerns	Low risk of bias

DISCUSSION

This literature review sought to summarize the benefits of physical exercise on pain reduction and functioning improvement among workers aged 18 and above, specifically focusing on individuals with work-related musculoskeletal disorders. Among its primary findings, we highlight the positive impact of physical exercise practiced during the workday, with outcomes influenced by factors like intensity, frequency, meticulousness in adherence, and the established exercise protocol. Ergonomic counselling or alternative exercise modalities also contributed substantially to reducing pain and enhancing functioning in workers. Notably, these benefits were observed across various types of work tasks showing the effectiveness of exercise interventions regardless of job roles. A significant novelty of the present study lies in demonstrating these effects by means of randomized clinical trials.

Regarding body regions presenting with pain, the neck, upper limbs and low back spine were the most cited. Work-related neck and shoulder pain are common problems that affect workers' functioning and quality of life. As such, an experimental study sought to compare well-protocol ergomotor interventions with usual conventional physiotherapy in patients with neck and shoulder pain for 12 weeks, concluding that ergomotor interventions were more effective in reducing pain and increasing functioning and occupational health compared with conventional physical therapy care[21]. These findings corroborate our study since well-protocoled exercises and ergonomic counselling help to reduce pain manifestation and improve capacity.

Functioning of workers with work-related musculoskeletal disorders who experience pain can be improved by strength exercises and training which bring benefits such as less perceived physical effort, reduced fatigue and greater capacity for recovery[22]. This significant pain reduction, especially in the spine (cervical, thoracic and low back), could be explained by the segmental stabilization techniques used for the low back spine and the isostretching performed, which focus more on stretching and strengthening the back-supporting muscles. These findings corroborate the studies reviewed which used these exercises to reduce the outcomes studied[7].

However, we lack a commonly accepted exercise program and consistent conclusions about effectiveness on the environment and supervisory requirements[23]. Another systematic review[24] found a variety of physical exercise programs as in the present study. Overall, occupational physical exercise reduces musculoskeletal pain and improves the general physical fitness and functioning of workers[25].

Certain types of physical exercise increase muscle strength consequently reducing fatigue during work which may be a determining factor in preventing the development of musculoskeletal disorders[26]. A physical exercise program targeting workers' functional capacity is effective in reducing the intensity of chronic low back pain[27] and cervical pain[28,29].

Limitations of the Study

Several study limitations merit discussion. Firstly, during data extraction one reviewer noted that most studies employed diverse functioning assessment instruments. Secondly, this variability hindered obtaining complete methodological consistency across the studies regarding this particular outcome. Thirdly, we initially intended to conduct meta-analyses on data that exhibited sufficient homogeneity in statistical measures, reported outcomes, and methodological characteristics. But given significant heterogeneity in outcomes observed across the studies, conducting meta-analyses became unfeasible.

CONCLUSION

Physical exercise reduces musculoskeletal pain and increases the functioning capacity of workers with work-related musculoskeletal disorders who experience neck pain, low back pain, osteoarthritis, and chronic pain in the neck, upper limbs, and low back, by favouring the perceived physical effort and reducing fatigue.

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