Review Article

RBAFS Revista Brasileira de Atividade Física & Saúde
SOCIEDADE BRASILEIRA DE ATIVIDADE FÍSICA & SAÚDE

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Characteristics of effective physical exercise interventions conducted in the workplace: a scoping review

Características das intervenções efetivas de exercício físico conduzidas no ambiente de trabalho: uma revisão de escopo

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DOI

10.12820/rbafs.29e0355

ABSTRACT

The workplace can be considered an environment with potential for developing programs that promote health. Despite positive evidence in the literature on physical exercise interventions in these locations, it becomes relevant to understand the characteristics (type, intensity, duration) of the interventions that positively impact workers' health. Therefore, this study aims to contribute to tracking down scientific evidence of physical exercise interventions performed in the workplace. This is a scoping review with six databases: PubMed, Lilacs, SciELO, PsycInfo, Web of Science, and Scopus. Using the search strategy: ((Workers OR Worker) AND (Physical Activities OR "Physical Exercise") AND (Workplace OR Workplaces OR "Work Location") NOT (leisure-time physical activity). 4,181 articles were found, and 53 articles were selected. Data analysis was performed by calculating frequency and percentage, focusing mainly on the characteristics of physical exercises. All procedures were performed using R software version 4.2.1. Strength training (71.8%) was the most used physical exercise, followed by aerobic training (15.1%), combined (11.2%), and others (1.9%). 56% of the interventions used a progressive approach to intensity, while the volume varied from 10 to 60 minutes. The study demonstrated that strength training with progressive intensity and short duration is the most commonly used interventions. The workplace, with limited time and space, proved to be an excellent moment to include physical exercise in people's routines.

Keywords: Exercise; Occupational groups; Workplace.

RESUMO

O local de trabalho pode ser considerado um ambiente com potencialidade para o desenvolvimento de programas que promovam saúde. Apesar das evidências positivas na literatura acerca das intervenções de exercício físico nesse local, torna-se relevante compreender quais são as características (tipo, intensidade, duração) das intervenções que possuem impacto positivo na saúde dos trabalhadores. Dessa forma, este estudo visa contribuir no rastreamento de evidências científicas de intervenções no âmbito do exercício físico realizados no ambiente laboral. Trata-se de uma revisão de escopo, com seis bases de dados: PubMed, Lilacs, SciELO, PsycInfo, Web of Science e Scopus. Utilizando a estratégia de busca: ((Workers OR Worker) AND (Physical Activities OR "Physical Exercise") AND (Workplace OR Workplaces OR "Work Location") NOT (leisure-time physical activity). Dos 4.181 artigos encontrados, foram selecionados 53 artigos. A análise dos dados foi realizada através do cálculo da frequência e percentual, tendo como foco principal as características dos exercícios físicos. Todos os procedimentos foram feitos no Software R versão 4.2.1. O treinamento de força (71,8%) foi o exercício físico mais utilizado, seguido pelo treinamento aeróbico (15,1%), combinado (11,2%) e outros (1,9%). 56% das intervenções utilizaram uma abordagem progressiva acerca da intensidade, enquanto o volume variou de 10 a 60 minutos. O estudo demonstrou que o treinamento de força com intensidade progressiva e curta duração são os mais utilizados nas intervenções. O local de trabalho com tempo e espaço reduzido se mostrou um excelente momento para incluir o exercício físico nas rotinas das pessoas.

Palavras-chave: *Exercício; Grupos ocupacionais; Ambiente de trabalho.*

Introduction

Work tasks that demand long periods in a sitting or reclining position with low energy expenditure are increasingly common[1]. These work characteristics can bring deleterious health consequences[1,2]. Evidence in the literature indicates that sedentary behavior, activities that do not exceed resting levels, is associated with an increased risk of chronic diseases[4], obesity[5,6], and mental distress[7]. Furthermore, repetitive tasks and prolonged time in a single posture can lead to muscu-

loskeletal pain, physical discomfort, and low work capacity[8]. Scientific evidence has shown that a plausible alternative to improving these consequences would be the regular practice of physical exercise[9,10].

The workplace can be suitable for executing health promotion programs in order to reduce risk factors such as obesity, diabetes, and cardiovascular diseases in the workforce[11,12], among other harmful health outcomes[13]. According to the Center For Disease Control And Prevention, more physically active workers are more productive, require fewer medical leaves, and have lower health costs[14-16]. In addition, studies have observed a positive relationship between physical fitness and job performance[17-19]. Which reinforces the importance of promoting physical exercise in the workplace, achieving positive health impacts for workers[20-22].

Various systematic reviews and meta-analyses evaluated interventions that promoted physical exercise in the workplace[23-26]. One example is a systematic review conducted by Gobbo et al.[23] which found that physical exercise programs conducted in the workplace were effective in reducing low back pain symptoms, improving muscle strength, flexibility, and quality of life. Another similar study observed that physical exercise conducted in the workplace could improve cardiorespiratory fitness, endurance, and muscle power[25]. They are also demonstrated in literature that shows the positive role of physical activity carried out in the workplace concerning mental health outcomes[26,27].

A scoping review by Boyette et al.[28] sought to identify and evaluate studies describing physical exercise programs for preventing upper limb injuries, focusing on industrial workers. Regarding the type of physical exercise, training and stretching were the most frequent. The intervention period ranged from 4 weeks to 1 year the research did not identify standardization in physical exercise programs. Therefore, it is essential to investigate programs in various work environments in order to map the types of interventions and characteristics[28-30]. Despite previous reviews having relevant findings, no reviews focused on interventions that effectively generated positive effects on different outcomes were found in the literature. Moreover, many approaches included interventions outside the scope of physical exercise.

Therefore, this study is justified by the need to find systematized evidence regarding the type, frequency, intensity, and duration of physical exercise in the workplace. Relating them to various health outcomes and work environments, as a detailed description of how physical exercises programs can identify a minimum standard of parameters that can serve as a basis for promoting physical exercise in the workplace. Therefore, this study aims to contribute to tracking effective scientific evidence in the field of physical exercise, focusing on interventions applied in the workplace and their respective health benefits for workers health.

Methods

Research Strategies

This is a review of academic literature indexed in international databases in line with the scoping review methodology. Evidence synthesis involves aggregating available information using well-defined resources[32]. The technique aims to map, synthesize, and disseminate the state of the art in a thematic area through a rigorous and transparent method, providing a descriptive view of the reviewed studies[33]. The study was based on the guidelines recommended by the Joanna Briggs Institute[34] and the specific methodological framework[35]. The extension for scoping reviews was used through the Transparent Reporting of Systematic Reviews and Meta-Analyses (PRISMA-ScR) guidelines[34].

The review was developed based on the following steps: 1. Elaboration of the research question and definition of search descriptors; 2. Literature search in international databases; 3. Reading the titles and abstracts of the articles for selection according to the inclusion and exclusion criteria; 4. Full-text reading of the selected studies and data mapping; 5. Summarizing and critically analyzing the results; and 6. Presentation of the main results.

Information was collected from six databases - PubMed, Lilacs, SciELO, PsycInfo, Web of Science, and Scopus. The following combinations of expressions were used: “Workers” AND “Physical Exercise” AND “Workplace” NOT “leisure-time physical activity”. The final search strategy was as follows: (Workers OR Worker) AND (Physical Activities OR “Physical Exercise”) AND (Workplace OR Workplaces OR “Work Location”) NOT (leisure-time physical activity). The adopted search strategy can be observed in detail in Table 1.

Selection of Studies

The primary selection of articles derived from the digital search process was uploaded into the Endnote online reference management software, first selecting the titles and abstracts. Two reviewers (LF and LG) independently examined and extracted the studies, and any

Table 1 – Example of a Research Strategy

Description	Search Terms
Language	(English[lang]) AND "Workers" AND "Physical Exercise" AND "Workplace" NOT "leisure-time physical activity"
Population	Workers OR Worker
Intervention	(Workplace OR Workplaces OR "Work Location")
Age Range	Over 18 years old
Date	No time cut
Publication Type	Experimental Studies
Publication Type	NOT (leisure physical activity)
Physical Exercise	(Physical Activities OR "Physical Exercise")
Final Strategy	((Workers OR Worker) AND (Physical Activities OR "Physical Exercise") AND (Workplace OR Workplaces OR "Work Location") NOT (leisure physical activity))

lack of consensus was discussed with a third reviewer (AJO). The articles that met the research criteria were downloaded for full-text reading.

Inclusion/Exclusion Criteria

The studies for the research questions and the eligibility criteria are described in Table 2. In general, the studies were eligible if they applied physical exercise interventions in the workplace, according to the following inclusion criteria: (a) experimental; (b) with workers over the age of 18 years old; and (c) with interventions that had the following outcomes benefits for workers health. However, the following were excluded: (a) studies of protocol or without a specific study design; and (b) studies that did not minimally detail how the intervention was conducted.

Table 2 – Eligibility Criteria for the Review

	Research Questions	
	What is the volume and intensity of the physical exercises that were applied? What types of physical exercises are applied in interventions? Investigate the benefits of interventions for worker health? Identify the outcomes used in the studies?	
	Inclusion	Exclusion
Participant	Workers over 18 years old.	Under 18s
Context	Studies experimental; Studieswith interventions that presented benefits for worker health in the outcomes.	Protocol studies or without specific study design; Studies that did not provide minimal detail on how the intervention was carried out.

Data Extraction

From each selected study, the following information was extracted: author, year, country where the study was conducted, sample, average age of participants, study design, physical exercise intervention, control group intervention, basic characteristics of the intervention (duration, frequency, intensity, and supervision status), follow-up loss, measurement scales, and outcomes.

Data Analysis

The information from the studies was summarized and described with the number of observations and the respective percentage values. Figures were created using the Ggplot2 package of R software version 4.2.1 to relate different characteristics of the selected studies. According to the data analysis, two of these studies presented two interventions with distinct application times. Therefore, they were considered two distinct studies, totaling 55 analyzed interventions.

Results

The research resulted in 1,190 studies in PubMed, 51 in BVS - LILACS, 282 in PsycInfo, 1,480 in Scopus, and 1,178 in Web of Science, totaling 4,181 results found. 807 studies were removed due to duplication. Of the remaining 3,374 articles, titles and abstracts were read; by the end of this phase, 3,154 were excluded. Consequently, 220 articles were selected for full reading. After excluding 167 articles, 53 studies were selected. The screening process can be observed in Figure 1.

This scoping review selected 53 studies published between 1999 and 2022. The sample size of the studies ranged from 20 to 1,113 individuals, while the average age was between 26.5 and 56.5 years. Regarding the geographical distribution of the studies, the highest prevalence was conducted in Europe (n = 38; 69.8%), followed by South America (n = 5; 9.4%), Asia (n = 5; 9.4%), and North America (n = 3; 5.7%). Other continents together represented 5.7% of the selected studies.

Regarding the training applied in the interventions, the intensity was predominantly classified as progressive in 31 interventions (56.4%), followed by 13 interventions classified as moderate (23.6%), 7 (12.7%) as low, and 4 (7.3%) as high. Concerning the duration (in days) of the interventions per session, 44 of them (80%) were conducted between 10 and 60 minutes, 4 (7.2%) between 60 and 120 minutes, and 7 (12.7%) over 120 minutes (Figure 2).

In terms of research methodologies, 34 studies employed randomized clinical trials (RCTs), representing 64.1% of the total. This was followed by 11 studies

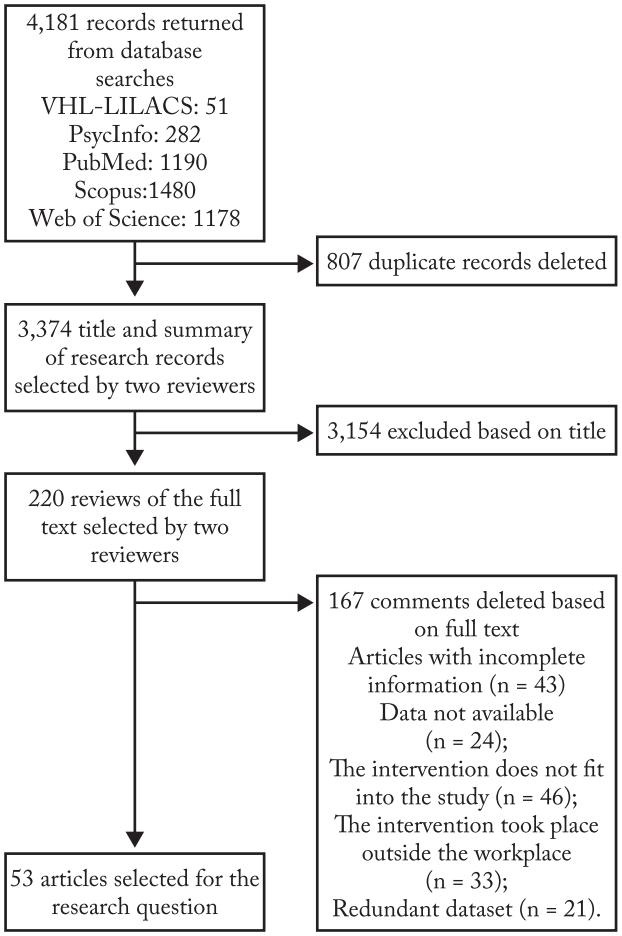


Figure 1 – Flowchart PRISMA-ScR

utilizing community-based randomized clinical trials (CRCT - 20.7%), and 8 studies (15.1%) employed other methodological strategies (Figure 3). Strength training (71.8%) was the most commonly used physical exercise, followed by aerobic (15.1%), combined training (11.2%), and sports activities (1.9%).

The study summarized the positive effects promoted by the interventions on the participants. Most of the studies showed more than one positive result in the outcomes described: a large part of the interventions were relevant for reducing musculoskeletal pain (n = 26), improving mental health (n = 6), improving work capacity (n = 6), improving social aspects (n = 6), and other health-related aspects (n = 9), increasing physical activity (n = 17), and aerobic fitness (n = 5) (Table 3).

Discussion

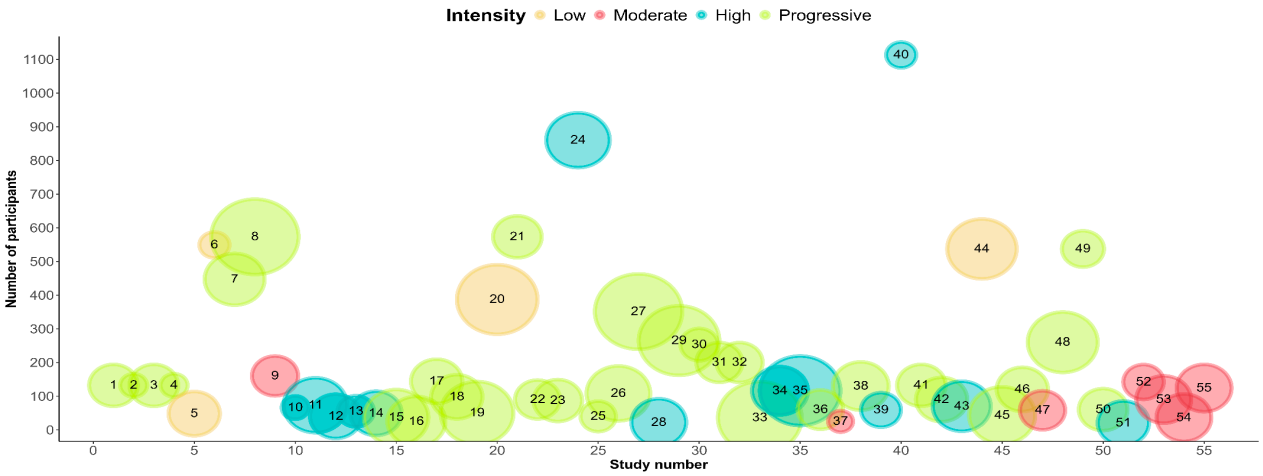
The purpose of this study was to investigate physical exercise interventions performed in the workplace to obtain comprehensive information on the volume, intensity, and types of exercises, as well as the study designs and outcomes used. The scoping review found robust evidence between 1999 and 2022 from 55 interventions. The study observed different positive effects promoted by physical exercise, highlighting the reduction of musculoskeletal pain, improvement in work capacity, and mental health.

Most interventions, influenced by the very nature of the workplace environment, do not allow workers to reach the levels established by the World Health Organization (WHO). It is evident that the promotion of physical exercise in the work context needs to be complemented by additional practices outside this environment. Moreover, interventions that have shown satisfactory results, even with duration and intensity below WHO recommendations for this specific audience, deserve attention[21,23,25].

The distribution of studies on physical exercise interventions at work varies between continents and countries, being more prevalent in Europe. This is due to its conception as linked to social well-being and public policies based on the political strand of social democracy, which generally seeks the well-being of all. This context allowed the discussion of labor issues and the focus on worker health, especially in the academic sphere[15,16].

Another relevant aspect relates to the types of physical exercises used. They identified strength training, aerobic exercise, combined exercise, whose training consists of a technique that mixes aerobic and anaerobic exercises in one single training session, and team sports. Despite the variation in interventions, the highest prevalence was limited to strength training. A plausible explanation for this prominence lies in the fact that this type of physical exercise is easily adaptable in different workplace environments (with little space and varied workstations) since it does not require large structures and does not necessarily demand the use of equipment, as the individual can use their body weight as a form of resistance[16,22,29,30]. Most studies using strength training utilized low- or medium-cost and easily transportable materials such as bands and elastic tubes (TheraBand, FlexBar), Wrist Roller, mats, dumbbells, kettlebells, and the body weight itself. For aerobic exercise, stairs or treadmills were used. It is important to note that some studies used modalities like aerobic dance, yoga (asanas and vinyasa), and badminton, which often require structures and/or materials that are difficult for many workers to access in their respective work environments[39,51,57,59,67,69].

The studies revealed that implementing physical exercises in the workplace, even at low frequency, can



1. Andersen Lars et al, 2011[42]
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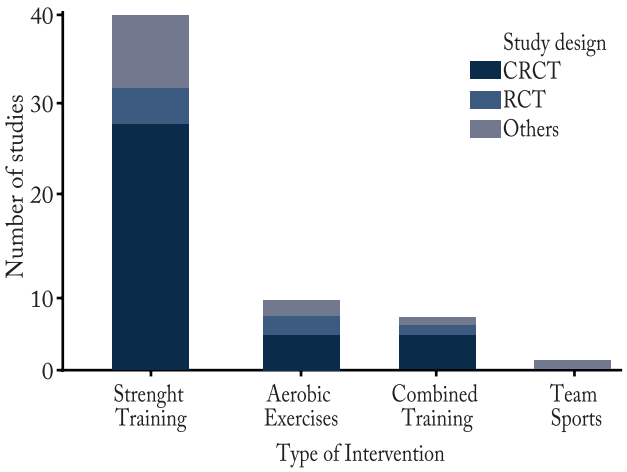
10. Andersen Lars et al., 2017[40]
11. Atlantis Evan et al., 2006[44]
12. Barros Fernanda et al., 2019[45]
13. Bernardelli Giuseppina et al., 2020[46]
14. Brinkley Andrew et al., 2017[47]
15. Cheema Birinder et al., 2013[52]
16. Chopp-Hurley et al., 2017[50]
17. Christensen Jeanette et al., 2013[48]
18. Christensen Jeanette et al., 2011[49]
19. Corbett Duane et al., 2018[51]
20. Dalager Tina et al., 2017[53]
21. Dalager Tina et al., 2015[54]
22. del Pozo-Cruz et al., 2013[55]
23. Delshad Mohammad et al., 2019[56]
24. Eriksen Hege et al., 2002[57]
25. Faude Oliver et al., 2015[58]
26. Fukahori Masaru et al., 1999[59]
27. Gram Bibi et al., 2014[60]
28. Groenesteijn Liesbeth et al., 2016[61]
29. Stenner Hedwig et al., 2020[85]
30. Holzgreve Fabian et al., 2012[62]
31. Jakobsen Markus et al., 2015[63]
32. Jakobsen Markus et al., 2015[64]
33. Karatrantou Konstantina et al., 2020[65]
34. Korshøj Mette et al., 2016[66]
35. Lidegaard Mark et al., 2018[67]
36. Matsugaki Ryutaro et al., 2019[69]
37. Metcalfe Richard et al., 2020[70]
38. Michishita Ryomaet et al., 2017[72]
39. Michishita Ryomaet et al., 2017[68]
40. Moreira Roberta et al., 2021[74]
41. Montero-Marin et al., 2013[73]
42. Bispo Lucas et al., 2020[71]
43. Moreira-Silva et al., 2014[75]
44. Mortensen Peter et al., 2014[76]
45. Mulla Daanish et al., 2018[79]
46. Muñoz-Poblete et al., 2019[77]
47. Muyor José et al., 2012[78]
48. Nurminen Eija et al., 2002[80]
49. Pedersen Mogenset et al., 2013[81]
50. Rasotto Chiara et al., 2015[82]
51. Saracini Chiara et al., 2022[83]
52. Shariat Ardalan et al., 2018[84]
53. Sjögren Tuulikki et al., 2006[86]
54. Sjögren Tuulikki et al., 2006[87]
55. Sjögren Tuulikki et al., 2005[88]

*=Intervetion line

Figure 2 – Intensity and volume of physical exercise



Note: CRCT = community randomized clinical trial; RCT = randomized clinical trial.

Figure 3 – Types of physical exercises and study design

trigger a range of beneficial effects. Among these effects, evidence of the positive impact of physical exercise on social and work aspects was found[36–38]. Highlights also include the reduction of musculoskeletal pain, improvements in mental health, and work capacity. These findings suggest that simple strategies, such as introducing strength exercises, can contribute to promoting worker health[43-46,67-79,71-74].

Our approach identified 11 articles that used an exercise routine characterized by body posture and coordinated movements, breathing and meditation called Qigong. The results of this study showed a positive impact on workers with low back pain[23]. In view of this, low back pain has a significant impact on workers in an office environment due to back pain resulting from repetitive efforts, inadequate physical conditioning, postural error, and non-ergonomic position during work activities. In this context, it is essential to analyze the effects of a physical exercise program on reducing low back pain in this group[23].

The practice of physical exercise can be influenced by various aspects, such as time and frequency, since many workers are limited in their ability to perform these exercises due to their routines. The availability of interventions at this location is more accepted at the beginning of the shift or between the worker's break/lunch hour. The spaces for practices in this environment are flexible and can vary from a reserved room, an open space within the company, or the workplace itself, such as stairs for aerobic practice[39], as well as the use of dynamic workstations (Oxidesk)[61] and in university environments with the use of outdoor spaces or gyms/labs[51]. Most interventions were conducted through strength training with a duration of 10 to 60 minutes, a frequen-

Table 3 – Characteristics of the studies selected in the scoping review

Study, year (Country)	Study model	Participants	Intervention / Period / Time per section (min) / Frequency (wk) / Intensity	Supervision	Results
Andersen et al.[39] 2013 / (Denmark)	RCT	n = 160 both genders / office workers / (42 ± 10 years)	Aerobic exercise / 10 weeks / 10 / 5 x per week / Low	No	Improved cardiovascular health / Health risk reduction
Andersen et al.[40] 2017 / (Denmark)	RCT	n = 66 both genders / slaughterhouse workers / (45 ± 10 years)	Strength training / 10 weeks / 3-10 min / 1 X per week / Moderate	Yes	Improved Social Climate / Improved mental health / Reduction of symptoms of musculoskeletal pain
Andersen et al.[41] 2008 / (Denmark)	RCT	n = 549 both genders / office workers / (Women: 44.6 years) and (Men: 45.7 years)	Strength training / 12 months /10 / 1 X per week /High	Yes	Increased strength / Reduction of symptoms of musculoskeletal pain
Andersen et al.[36] 2008 / (Denmark)	RCT	n = 48 women / office workers / (44 ± 8 years)	Strength training / 10 weeks / 20 min / 3 times per week / High		Increased strength / Reduction of symptoms of musculoskeletal pain
Andersen et al.[37] 2012 / (Denmark)	RCT	n = 447 both genders / office workers / (46 ±10 years)	Strength training / 20 weeks / 60 min / 1 x per week / Progressive	Yes	Reduction of neck and shoulder pain
Andersen et al.[38] 2017 / (Denmark)	CRCT	n = 573 both genders / office workers / (45 ± 8 years)	Strength training / 20 weeks / 60 min / 1 x per week / Progressive	Yes	Pain reduction / Secreased use of painkillers
Andersen et al.[42] 2011 / (Denmark)	RCT	n = 132 office workers / (IG 44 ± 11 years) and (IG 42 ± 11 years)	Strength training / 10 weeks / 2-12 min / 5 x per week / Progressive	Yes	Improved Social Climate / Increased physical activity
Andersen et al.[43] 2014 / (Denmark)	RCT	n = 132 office workers / (IG: 44 ± 11 years) and (IG: 43 ± 11 years)	Strength training / 10 weeks / 2-12 min / 5 x per week / Progressive	Yes	Increased physical activity / Reduction of symptoms of musculoskeletal pain
Atlantis et al.[44] 2006 / (Australia)	RCT	n = 73 both genders / casino worker / (IG: 30 ± 7 years) and (CG: 33 ± 8 years)	Combined exercise / 24 weeks / 20 min / 3 times per week / Moderate	Yes	Increased physical fitness / Increased aerobic fitness
Barros et al.[45] 2019 / (Brazil)	OTHERS	n = 40 both genders / office workers / (GBLA: 28 ± 7 years), (GBLA: 28 ± 8 years) and (GBLA: 32 ± 12 years)	Strength training / 24 weeks / 15 min/ 2 times per week / Moderate	Yes	Increased strength / Reduction of symptoms of musculoskeletal pain
Bernardelli et al.[46] 2020 / (Italy)	RCT	n = 55 both genders / health workers, administrative / (51 ± 9 years)	Strength training / 7 weeks / 30 min / 1 x per week / Moderate	Yes	Reduction of symptoms of musculoskeletal pain / Improving health
Brinkley et al.[47] 2017 / (United Kingdom)	OTHERS	n = 49 both genders / office workers / (40 ± 17 years)	Team sport / 12 weeks / 60 min / 12 times per week / Moderate	Yes	Increased aerobic fitness / Improved Social Climate
Christensen et al.[48] 2013 / (Denmark)	CRCT	n = 144 women / healthcare workers / (45 ± 7 years)	Strength training / 12 months / 60 min / 1 x per week / Progressive	Yes	Increased aerobic fitness / Body weight reduction
Christensen et al.[49] 2011 / (Denmark)	RCT	n = 98 women / healthcare workers / (45.5 ± 9 years)	Strength training / 12 months / 10-15 min / 1 X per week / Progressive	Yes	Increased aerobic fitness / Reducing body weight / Reducing health risks
Chopp-Hurley et al.[50] 2017 / (Canada)	RCT	n = 25 both genders / university employees / (52 ± 6 years)	Strength training / 12 wk / 60 min / 3-4 X per week / Progressive	Yes	Improvement in work capacity
Corbett Duane et al.[51] 2018 / (USA)	OTHERS	n = 50 both genders /university workers / (48 ± 10 years)	Aerobic exercise / 12 weeks / 60 min / 3 times per week / Progressive	Yes	Better Anthropometrics / Improving Biomarkers
Cheema et al.[52] 2013 / (Australia)	RCT	n = 37 both genders / office workers / (38 ± 12 years)	Strength training / 10 weeks / 50 min / 3 times per week / Progressive	Yes	Increased physical activity / Reduction of symptoms of musculoskeletal pain / Reduction of anxiety symptoms
Dalager et al.[53] 2017 / (Denmark)	RCT	n = 387 both genders / office workers / (44 ± 10 years)	Strength training / 12 months / 60 / 1 X per week / High intensity	Yes	Reduction of symptoms of musculoskeletal pain
Dalager et al.[54] 2015 / (Denmark)	RCT	n = 573 both genders / office workers / (46.5 ± 10 years)	Strength training / 10 weeks / 60 min / 1 x per week / Progressive	Yes	Reduction of symptoms of musculoskeletal pain

Continue…

Continuation of **Table 3 –** Characteristics of the studies selected in the scoping review

Study, year (Country)	Study model	Participants	Intervention / Period / Time per section (min) / Frequency (wk) / Intensity	Supervision	Results
del Pozo-Cruz et al.[55] 2013 / (Spain)	RCT	n = 90 both genders / office workers / (IG: 45 ± 7 years) and (CG: 46 ± 9 years)	Strength training / 7 weeks / 11 min / 6 times per week / Progressive	Yes	Reduction of symptoms of musculoskeletal pain
Delshad et al.[56] 2019 / (Iran)	CRCT	n = 87 both genders / office workers / (IG: 37.7 ± 7.4 years) and (CG: 35.9 ± 7.3)	Strength training / 10 weeks / 10-30 min / 2-5 X per week / low to medium	No	Reduction of symptoms of musculoskeletal pain / increased flexibility
Eriksen et al.[57] 2002 / (Norway)	RCT	n = 860 both genders / postal service workers / (39.8 years)	Aerobic exercise / 12 weeks / 60-120 min / 1-2 X per week / Moderate	Yes	Reduction of symptoms of musculoskeletal pain / Increased aerobic fitness
Faude et al.[58] 2015 / (Switzerland)	OTHERS	n = 40 construction workers / (IG: 40.3 ± 8 years) and (CG: 41.8 ± 9 years)	Strength training / 13 weeks / 15 min / 1 x per week / Progressive	Yes	Increased physical activity
Fukahori et al.[59] 1999 / (Japan)	RCT	n = 108 men / office workers / (IG: 49.9 ± 5 years) and (CG: 48 ± 43 years)	Aerobic exercise / 6 months / 20 min / 3 times a week / low to average	Yes	Reduced health risks / Increased physical activity
Gram et al.[60] 2014 / (Denmark)	RCT	n = 351 both genders / office workers / (47 ± 0.7 years)	Strength training / 20 weeks / 60 min / 3 times per week / Progressive	Yes	Reduction of symptoms of musculoskeletal pain
Groenesteijn et al.[61] 2016 / (Netherlands)	OTHERS	n= 22 both genders / office workers / (26.5 ± 6.0 years)	Aerobic exercise / 5 weeks / 30 min / 6 times per week / Moderate	No	Increased physical activity / Reduced health risks
Holzgreve et al.[62] 2020 / (Denmark)	OTHERS	n = 253 both genders / office workers / (43.3 ± 11.2 years)	Strength raining / 12 weeks / 10 min / 2 x per week / low to medium	Yes	Reducing health risks / Increased quality of life / Improved mental health
Jakobsen et al.[63] 2015 / (Denmark)	CRCT	n = 200 women / healthcare workers / (42 ± 11 years)	Strength training / 10 weeks / 10 min / 5 times per week / Progressive	Yes	Increased physical activity
Jakobsen et al.[64] 2015 /(Denmark)	CRCT	n = 200 women / healthcare workers / (42 ± 1 years)	Strength training / 10 weeks / 10-30-45 min / 5 x per week / Progressive	Yes	Increased physical activity / Reduced symptoms of musculoskeletal pain / Decreased use of painkillers
Karatrantou et al.[65] 2020 / (Greece)	RCT	n = 36 both genders / office workers / (43.3 ± 5.9 years)	Combined exercise / 4 months / 30-40 min / 2 x per week / low to medium	No	Increased physical activity / Improved work capacity
Korshøj et al.[66] 2016 / (Denmark)	CRCT	n = 116 both genders / cleaning worker (cleaning) / (45.3 ± 8.5 years)	Aerobic exercise / 4 months / 30 min / 2 times per week / Moderate	Yes	Biomarker improvements
Lidegaard et al.[67] 2018 / (Denmark)	CRCT	n = 116 both genders / cleaning workers / (IG: 44.9 ± 9.2 years) and (CG: 45.7 ± 8.1 years)	Aerobic exercise / 12 months / 30 min / 2 times per week / Moderate	Yes	Improvement in work capacity
Michishita et al.[68] 2017 / (Japan)	RCT	n = 59 both genders / office workers / (40.9 ± 9.2 years)	Combined exercise / 10 weeks / 10 min / 3 times per week / Moderate	Yes	Increased physical activity / Reduction of symptoms of musculoskeletal pain / Increased aerobic fitness
Matsugaki et al.[69] 2019 / (Japan)	RCT	n = 60 both genders / factory worker / (48.02 ± 7.21 years)	Aerobic exercise / 6 months / 20 min / 1 x per week / Progressive	Yes	Increased physical activity / Reduction of symptoms of musculoskeletal pain / Increased aerobic fitness
Metcalfe et al.[70] 2020 / (Central Scotland and South Wales, United Kingdom)	RCT	n = 25 both genders / office workers / (47 ± 9 years)	Strength training / 6 weeks / 8 min and 40 s / 2 times per week / Low	No	Reduction of symptoms of musculoskeletal pain
Bispo et al.[71] 2020 / (Brazil)	RCT	n = 1113 both genders / footwear industry worker / (32,5± 10,2 years)	Strength training / 3 months / 10 min / 1 X per week / Moderate	Yes	Reduction of symptoms of musculoskeletal pain / Improved Social Climate

Continue…

Continuation of **Table 3 –** Characteristics of the studies selected in the scoping review

Study, year (Country)	Study model	Participants	Intervention / Period / Time per section (min) / Frequency (wk) / Intensity	Supervision	Results
Michishita et al.[72] 2017 / (Japan)	RCT	n = 130 both genders / office workers / (45 ± 11.2 years)	Combined exercise / 8 weeks / 10 min and 40 s / 3 times per week / low average	Yes	Increased physical activity / Improved work capacity
Montero-Marin et al.[73] 2013 / (Spain)	RCT	n = 132 men / logistics company workers / (29.8 ± 5.49 years)	Strength training / 3 months / 10 min / 5 X per week / Progressive	Yes	Improved mental health / Reduction of anxiety symptoms
Moreira et al.[74] 2021 / (Brazil)	RCT	n = 90 both genders / nursing assistants / (44.8 years)	Strength training / 12 weeks / 30 min / 2 X per week / Low to medium	Yes	Reduction of symptoms of musculoskeletal pain / Improved mental healt
Moreira-Silva et al.[75] 2014 / (Portugal)	OTHERS	n = 70 both genders / multinational manufacturing company / (38.8 ± 8.6 years)	Combined exercise / 6 months / 15 min / 3 X per week / Moderate	Yes	Reduction of symptoms of musculoskeletal pain
Mortensen et al.[76] 2014 / (Denmark)	RCT	n = 537 both genders / laboratory technicians from public and private companies / (42 ± 10 years)	Strength training / 12 months / 15 min / 3 times per week / High	Yes (partial)	Reduction of symptoms of musculoskeletal pain
Muñoz-Poblete et al.[77] 2019 / (Chile)	RCT	n =120 both genders / manufacturing workers / furniture making / (28.7 ± 5.4 years)	Strength training / 16 weeks / 15 min / 3 times per week / Progressive	Yes	Reduction of symptoms of musculoskeletal pain
Muyor et al.[78] 2012 / (Spain)	RCT	n = 58 women / private fruit and vegetable company / (44,2 ± 8,8 years)	Strength training / 12 weeks / 13 min / 3 times per week / Low	Yes	Increased physical activity
Mulla et al.[79] 2018 / (Canada)	RCT	n = 43 both genders / office workers / (IG: 44.1 ±10.5 years) and (CG: 43.3 ± 10.4 years)	Strength training / 12 weeks / 45 min / 5 X per week / Low to medium	Yes	Increased physical activity
Nurminen et al.[80] 2002 / (Finland)	CRCT	n = 260 women / laundry / (IG: 40.7 ±10.5 years) and (CG: 39.1 ± 10.4 years)	Combined exercise / 8 months / 60 min / 1 X per week / Progressive	Yes	Increased physical activity / Improved work capacity
Pedersen et al.[81] 2013 / (Denmark)	RCT	n = 537 both genders / industrial laboratory technicians / (42 ± 10 years)	Strength training / 12 months / 20 min / 3 x per week / Progressive	Yes	Reduction of symptoms of musculoskeletal pain
Rasotto et al.[82] 2015 / (Italy)	RCT	n = 60 women / manufacturing job specializing in eyewear / (39.1 ± 6.3 years)	Strength training / 6 months / 30 min / 2 x per week / Progressive	Yes	Reduction of symptoms of musculoskeletal pain
Saracini et al.[83] 2022 / (Chile)	OTHERS	n = 20 both genders / healthcare worker / (43.2 ± 7.1 years)	Strength training / 10 weeks / 30 min / 3 times per week / moderate to high	Yes	Increased quality of life / Increased physical activity / Improved mental health
Shariat et al.[84] 2018 / (Malaysia)	RCT	n = 142 both genders / office workers / (35 ± 8,6 years)	Strength training / 6 months / 10-15 min / 1 X per week / Low	No	Reduction of symptoms of musculoskeletal pain
Stenner et al..[85] 2020 / (Germany)	RCT	n = 265 women / healthcare workers / (IG: 53 ± 5 years) and (CG: 52.7 ± 4.8 years)	Strength training / 6 months / 20-60 min / 3 X per week / Low to medium	Yes	Increased respiratory capacity / Improved work capacity
Sjögren et al.[86] 2006 /(Finland)	CRCT	n = 90 both genders / office workers / (45.7 ± 8.5 years)	Strength training / 15 weeks / 20 min / 3X per week / Low	Yes (partial)	Increased physical activity / Reduced health risks / Increased quality of life
Sjögren et al.[87] 2006 / (Finland)	CRCT	n = 36 both genders / office workers / (47.1 ± 8.4 years)	Strength training / 15 weeks / 20 min / 3 times per week / Low	Yes	Reduction of symptoms of musculoskeletal pain
Sjögren et al.[88] 2005 / (Finland)	CRCT	n = 124 both genders / office workers / (46.6 ± 8.4 years)	Strength training / 15 weeks / 20 min / 3 times per week / Low	Yes	Reduction of symptoms of musculoskeletal pain

Note: CRCT = community randomized clinical trial; RCT = randomized clinical trial; min = minutes; s = seconds; IG = Intervention group; CG = Control group; GBLA = Groups based on the level of adherence.

cy of 2 to 3 times per week, and progressive load. These results indicate that short-duration exercises can have positive health impacts, especially in work contexts[23].

It is relevant to consider that many studies did not accurately report the locations where physical exercises were conducted. They also did not report if the activities had any impact, even momentarily, on the work environment (moving furniture or using alternative spaces for another purpose, such as a cafeteria). However, it was possible to understand, through the description

of the physical exercises, what would initially be the minimum needs for their realization.

This scoping review has a limitation, particularly related to one of the inclusion criteria. Studies whose interventions did not show health benefits for workers were excluded. Thus, this strategy reinforced the confirmation bias contained in the literature. This is because studies with statistically significant results are more likely to be published. Therefore, possible contributions from studies that did not show positive results were disregarded. On the other hand, this strategy allowed the focus to be on effective physical exercises for worker health.

The results of this study show the importance and benefits of physical exercise in the workplace, highlighting the reduction of musculoskeletal pain, improvement in work capacity, and mental health. It is evident that due to the nature of the intervention, many workers face difficulties performing prolonged exercises, and due to workspace restrictions, strength training was the most common approach as it adapts better to the work environment and can be done in a period of 10 to 60 minutes, 2 to 3 times per week, making it more accessible to workers. Additionally, it was found that even with low frequency, physical exercises can trigger a series of beneficial effects, as already mentioned. Therefore, it is crucial to consider the implementation of physical exercise programs in the workplace to promote the well-being and overall health of workers.

Conclusion

The study demonstrated that progressive intensity strength training and short duration were the most commonly used in the selected interventions. It also demonstrated that a minimum intervention time (10 minutes) can be sufficient to generate health benefits for the worker. However, it is important to consider the specificities of the work environment when choosing a physical exercise in order to include it without posing health risks to people.

Our findings show that the workplace proved to be an excellent alternative to including physical exercise in workers' routines, since positive effects were demonstrated in different outcomes.

Conflict of interest

The authors declare no conflict of interest.

Funding

Carlos Chagas Filho Foundation for Research Support of the State of Rio de Janeiro (FAPERJ).

Author's contributions

Santos LRF: Conceptualization; Software development, implementation and testing; Data validation and experiments; Data analysis; Research; Tool provision; Data curation; Project administration; Data presentation design; Writing of the original manuscript; Writing - review and editing; Approval of the final version of the manuscript. Guimarães LJ: Conceptualization; Methodology; Software development, implementation and testing; Data and experiment validation; Data analysis; Research; Provision of tools; Data curation; Writing - review and editing; Approval of the final version of the manuscript. Soares AMG: Software development, implementation and testing; Data analysis; Data curation; Data presentation design; Original manuscript writing; Writing - review and editing; Approval of the final version of the manuscript. Figueiredo JA: Supervision; Writing of the original manuscript; Writing - review and editing; Approval of the final version of the manuscript. Pimentel JG: Data presentation design; Writing of the original manuscript; Writing - review & editing; Approval of the final version of the manuscript. Oliveira AJ: Conceptualization; Data and experiment validation; Research; Supervision; Project administration; Funding receipt; Writing of the original manuscript; Writing - review and editing; Approval of the final version of the manuscript.

Declaration regarding the use of artificial intelligence tools in the article writing process

The manuscript did not use artificial intelligence tools for its preparation.

Availability of Research Data and Other Materials

After publication, the data will be available upon request from the authors.

Acknowledgements

We would like to thank all the collaborators who participated in the preparation of this article, directly and indirectly.

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Received: 04/17/2024
Approved: 07/24/2024

Associate editor
Paulo Henrique de Araújo Guerra
Universidade Estadual Paulista, Rio Claro, São Paulo, Brasil.

Cite this article as:
Santos LRF, Guimarães LJ, Soares AMG, Figueiredo JA, Pimentel JG, Oliveira AJ. Characteristics of Effective Physical Exercise Interventions Conducted in the Workplace: a Scoping Review. Rev. Bras. Ativ. Fis. Health. 2024;29:e0355. DOI: 10.12820/rbafs.29e0355