REVIEW ARTICLE

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Preventive factors against work-related musculoskeletal disorders: narrative review

Fatores de prevenção de distúrbios osteomusculares relacionados ao trabalho: revisão narrativa

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ABSTRACT | Musculoskeletal disorders (MSDs) are major causes of morbidity among workers. They comprise several signs and symptoms, as e.g. pain, paresthesia, fatigue and limited range of motion, which can be related to work tasks. Workplace-related factors include physical, psychological, social and biomechanical hazards. The main kinetic factors associated with MSDs include repetitive movements, exerting excessive force, awkward postures, compression and mechanical vibration. Accurate knowledge of epidemiological aspects, evaluation of ergonomic hazards and musculoskeletal symptoms, and workplace exercise may help reduce the occurrence of MSDs. The aim of the present review is to analyze the applicability of preventive strategies against MSDs among workers. We performed a narrative review based on a survey of databases PubMed and BIREME and included studies published in English, Spanish or Portuguese. We found that workplace exercise is beneficial for both employers and workers. Risk analysis of MSDs is essential for early identification of occupational hazards and to prevent health consequences and costs associated with absenteeism.

Keywords | work; disease prevention; exercise; musculoskeletal diseases; occupational health.

RESUMO | Os distúrbios osteomusculares (DOM) representam as principais causas de morbidade nos trabalhadores. Estes distúrbios podem ser entendidos como um conjunto de sinais e sintomas relacionados ao trabalho, tais como dor, parestesia, fadiga e limitação da amplitude de movimento. Estas disfunções são devidas a fatores biomecânicos, sociais, psicológicos e físicos no ambiente de trabalho. Os principais fatores cinéticos funcionais associados a essas lesões são: movimentos repetitivos, força excessiva, postura inadequada, compressão e vibração mecânica das articulações. Nesse contexto, o conhecimento das características epidemiológicas, das ferramentas para avaliação do risco ergonômico e da sintomatologia osteomuscular e a realização de ginástica laboral podem contribuir para reduzir a ocorrência dos DOM. Assim, a proposta da presente revisão é demonstrar a aplicabilidade de estratégias para a prevenção dos DOM nos trabalhadores. A revisão narrativa foi realizada a partir de um levantamento nas bases de dados PubMed e BIREME. Foram incluídos estudos publicados em inglês, espanhol ou português. A prática de exercício promove benefícios tanto para as organizações quanto para os trabalhadores. As ferramentas para análise de risco de DOM são importantes para a identificação precoce dos riscos no trabalho e assim evitar consequências negativas para a saúde e os custos gerados pelo afastamento dos trabalhadores.

Palavras-chave | trabalho; prevenção; exercício; doenças musculoesqueléticas; saúde do trabalhador.

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MUSCULOSKELETAL DISORDERS

Musculoskeletal disorders (MSDs) are characterized by lesions in muscles, tendons, joints, ligaments, bone, nerves and the blood circulation system[1] likely to cause functional imbalances. As per definition, MSDs include degenerative and inflammatory conditions which may affect a wide range of structures and result in acute or chronic pain, decreased mobility and impaired social participation. These disorders may further reduce the quality of life of workers[2] and damage their physical and mental health.

Musculoskeletal pain may occur in any period of life—childhood, adolescence, adulthood or old age[3,4]—and persist long term. The main risk factors in childhood and adolescence are obesity, psychological problems, sitting too much, exhausting exercise and smoking. In adulthood, a sedentary lifestyle, overweight/obesity, psychological distress and long history of pain. All these factors contribute to the chronic pain associated with MSDs[3].

Together with the increase of the life expectancy in developing countries, the incidence of sedentary lifestyles has grown, and consequently also that of MSDs[5]. These conditions may be triggered or aggravated when associated with comorbidities among individuals of advanced age and with bone fragility[5,6]. In the general population, a growing relationship has been noticed between work and development, exacerbation or worsening of work-related musculoskeletal disorders (WMSDs).

The frequency of adverse health outcomes in occupationally active populations has increased regardless of the type of labor activity[7,8]. These situation may influence the occurrence of WMSDs, as well as psychosocial problems, organizational behaviors, sociodemographic factors[9] and underlying pathologies. WMSDs are one of the main problems in occupational health, resulting in high costs[7,8], decreased productivity and poorer health-related quality of life[10,11]. While reducing workplace risk factors is difficult, ergonomic interventions and workplace exercise are essential to prevent injuries.

Indeed, ergonomic interventions and workplace exercise improve the quality of the work environment, help prevent or control musculoskeletal symptoms and provide the flexibility and adaptability needed to accomplish tasks[7,12,13]. This type of interventions may reduce the frequency of absenteeism, medical leave, exposure to risk factors and future injuries. In addition, workplace exercise programs may substantially improve the employees' perspective of their own work and quality of life and afford them a greater sense of wellbeing[14], since regular physical activity can help prevent or reduce risk of several diseases[5].

Prevention is favorable for workers, employers and society in general[12]. Within this context, identifying, correcting and avoiding work-related disorders is crucial, because the workplace affords conditions for adequate support and attention to occupational health[15].

In the present review we discuss epidemiological and etiological aspects, the pathogenesis and clinical manifestations of WMSDs. We further address clinical evaluation, ergonomic interventions, workplace exercise and the applicability of primary prevention resources. Interventions likely to optimize and improve the quality of work environments enhance the functional quality of services and the health of employees, resulting in improved productivity and performance in daily life and at work.

EPIDEMIOLOGICAL ASPECTS

Musculoskeletal pain have gained worldwide attention inasmuch are seeking to understand and measure their burden to society[15]. The socioeconomic impact of WMSDs is significant in both developed and developing countries[9], and identifying the main factors associated with their incidence and prevalence may help shape the primary prevention interventions.

Sociodemographic variables, such as ethnicity, sex, age and economic status, are directly related to the onset of WMSDs[16]. A high prevalence of these disorders has been identified among whites[17]. Women exhibit higher incidence and prevalence of MSDs[16,18] than men in association with anthropometric differences. Older workers, as a function of their longer length in the job, are more susceptible to these conditions as a result of cumulative exposure[19]. These disorders are

more frequent in countries with lower gross domestic product (GDP)[16].

Low levels of education and of professional qualification are other factors to be taken into account[20]. Occupation directly influences WMSDs. For example, manual labor, traditional occupations, such as agriculture and fishing, or and jobs with high physical demands include repetitive and physically intensive tasks [9,20]. Also conditions such as long working hours and pre-existing diseases, cultural factors and lack or scarcity of laws to support healthy and appropriate working conditions are aspects which should be considered[21-23]. In inadequate environments, workers are more susceptible to lesion[24]. Discomfort and pain; joint and soft injuries are Musculoskeletal complaints frequent in primary care[25], that can lead the work withdrawal.

Chronic pain is more common among populations in developing than in developed countries. A meta-analysis found high frequency of WMSDs, unspecified chronic pain, lower back pain and chronic headache in low-income countries in Latin America, Africa and Asia. However, on comparison with the general population only the prevalence of low back and musculoskeletal pain was higher[26].

Low back pain is the main complaint associated with work-related health problems[22,27]. This type of chronic pain causes financial losses, increases medical costs and impairs the personal life of workers[21,22]. Among workers, low back pain has been associated with heavy workloads, smoking, previous history of pain, and cultural and psychosocial factors, including poor mental health and multiple physical disorders[28-31]. Also neck and upper limb complaints are frequent among workers[17,18]. Cervicalgia occurs more often among females and workers who perform repetitive activities[18]. Work-related psychosocial and organizational factors were found to be associated with variables such as insecurity, work-life imbalance, hostile environment, non-standard work organization, multiple jobs and long working hours, all of which are potential risk factors for neck pain[32]. Neck pain is associated with higher-level occupations, working at the computer more than 6 hours/day, psychological fatigue and limited neck movement[33].

According to a study, independently from the intensity of tasks individual factors associated with WMSDs of the upper limbs among workers were: age (older), race (white), sex (female), previous symptoms and job tasks involving wrist bending or forceful gripping. Wrist bending was found to behave as independent predictor of functional impairment[17]. In another study, the most prevalent WMSDs of the upper limbs among workers in different occupational categories corresponded to nerve compression (radial and ulnar nerve entrapment). However, among shoe industry workers, the highest incidence was found to correspond to rotator cuff syndrome[34]. In regard to the elbow joint (medial or lateral) epicondylitis is the most prevalent disorder and affects mainly women. Job tasks allowing for higher physical mobility and less use of definite parts of the body might reduce the prevalence of elbow and hand pain[18]. Several measures to encourage coworker and supervisor support have been described as protective factors against WMSDs[17].

PATHOPHYSIOLOGY

ETIOLOGY

The etiology of WMSDs is complex, as it involves kinetic, functional, psychosocial and ergonomic aspects of the work environment. Psychosocial conditions involving physical stress and mental health problems with exposure to an overload of fast-paced work may also be related to the etiology of WMSDs[35-37]. Ergonomic factors include awkward postures, continuous and excessive use of force, repetitive movements, working long hours without rest and poor working conditions[35].

Staying in a same position for a long period of time has significant consequences for health, such as increase of musculoskeletal symptoms, discomfort in the workplace and exhaustion during the day[38]. Continuous and excessive use of strength, associated or not with repetitive movements, may cause tissue damage and thus reduce the tolerance to make the same effort again. Imbalance between job demands and workers' skills increases the risk of MSDs[39].

The term workload alludes to a set of variables with impact on workers and which require regulation and constant adaptation to achieve the desired physical, psychological and cognitive outcomes[40]. The physical workload, associated with awkward postures[8], repetitive movements and static postures (sitting or orthostatic)[7] may cause or contribute to WMSDs.

Workers who sit long hours and use computers are predisposed to ergonomic risks and account for most cases of work-related neck and low back pain. Awkward upper limb postures are a risk factor for MSDs among office workers[41]. These WMSDs are directly related to the characteristics of the physical space, such as backrest adequacy, chair height and arm support. Readjusting the work equipment, including monitor, keyboard, mouse, chair and desk, is an important ergonomic intervention to reduce the rates of MSDs and improve the body posture, especially among workers who use computers daily[42].

Keyboard-intensive tasks were found to be associated with less neutral wrist postures, larger wrist velocities and accelerations and larger forearm muscle activities[43]. In turn, mouse-intensive tasks were associated with less neutral shoulder postures and less variability in forearm muscle activity. Combined keyboard and mouse use tasks were associated with higher shoulder muscle activity, larger range of motion and larger velocities and accelerations of the upper arm[43].

Height adjustable desks might help improve workstations and allow workers to perform their tasks either sitting or standing. Therefore, they shorten the time spent sitting and increase the time spent standing. Adjusting these desks is quick and easy[44], while their use contributes to improve cardiometabolic parameters and is well accepted by workers given its easy handling[45].

Workplace adjustments may minimize the impact of work tasks and shorten the workers' exposure to ergonomic hazards associated with WMSDs[46].

PATHOGENESIS AND CLINICAL MANIFESTATIONS

Awkward postures at work may exacerbate pre-existing injuries[24,47] or cause new ones. However, also adequate postures may trigger WMSDs. These disorders occur following the accumulation of microtraumas, which overload the musculoskeletal system, nerves and blood vessels[1]. Here we discuss several aspects of the pathogenesis and clinical manifestations of the body sites most frequently involved in WMSDs, namely the cervical and lumbar spine, and the upper limbs[2].

Injuries in the lower back usually result from an abrupt response to sudden loading[24]. The paravertebral are considered intrinsic back muscles because they are primarily responsible for spine movements. In case of joint injury, the paravertebral muscles surrounding the affected joint contribute to cause pain[48]. Individuals who perform physically intensive activities involving heavy loads require greater activation of the spine flexor and extensor muscles to maintain the body stability[24,49] which causes local hypertonicity. A poor posture may cause disc injury, as is, e.g. the case of office employees who spend most of the working day sitting[50]. This condition may cause microtrauma to the outer fibrous ring, resulting in disc protrusion and herniation.

Cervicalgia among workers might be due to the myofascial pain syndrome and muscle tension in the neck, eventually extending to the shoulders, a condition characterized by severe pain[51]. Cervical disk injury might also be caused by poor posture, especially among workers whose tasks demand bending the neck for a long period of time, which may cause microtrauma to the outer fibrous ring of the intervertebral discs.

Conditions such as tendinopathies, enthesitis and bursitis might occur in the upper limbs as a consequence of inappropriate joint movements, and are associated with the abovementioned etiological factors. The latter contribute to cause stress, microtrauma and lesions, which trigger inflammation and thus interfere with the biomechanics of the involved joint, resulting in several clinical manifestations[52].

Tendinopathy is an inflammation of one or more tendons[25], including rotator cuff injuries, i.e. one of the main complaints reported by workers and impairs their performance at work[53]. In turn, enthesitis is inflammation of the entheses and causes pain in the sites where muscles, tendons and ligaments attach to bones[54]. Bursitis is the inflammation of the bursa[52].

When inflammation occurs in joints with considerable muscular recruitment and range of motion, it causes

imbalance in the joint movement due to weakness and pain[53] and may lead to arthritis and arthrosis.

The wrist is frequently affected in several peripheral neuropathies likely to cause disabling lesions, including ulnar tunnel syndrome[55], hypothenar hammer syndrome[56], De Quervain's tenosynovitis[57] and carpal tunnel syndrome[58].

The ulnar tunnel syndrome is associated with compression of the nerve that passes through Guyon's canal. Compression leads to sensory and motor deficits in the fifth finger, medial side of the fourth finger and the hypothenar region[55,59].

Hypothenar hammer syndrome develops following ulnar artery damage in Guyon's canal[56,60]. It affects workers whose tasks involve pressure on the hypothenar eminence, which exposes the palm to repeated trauma, with consequent damage to the local vascularization[61,62]. Clinical manifestations range from pain to ischemia of the fingers[63].

De Quervain's tenosynovitis is an inflammation of the sheath around the tendons of the thumb short extensor and long abductor muscles in the wrist, which causes constriction upon moving the wrist[57]. This condition is considered a work-related health problem and may be aggravated by ergonomic factors likely to intensify the symptoms of disease. However, there is insufficient evidence for a relationship with occupational factors[64]. Some clinical manifestations, such as pain and swelling of the radial styloid process, interfere with the movement of wrist[65]. Ulnar deviation might be limited as a function of pain; surgery might be indicated when symptoms are persistent[66,67].

Carpal tunnel syndrome is a disorder with significant impact on the productivity of the affected workers[58]. It is due to the compression of the median nerve within an osteofibrous structure through which it passes together with the flexor tendons of the wrist[67]. Working postures which require sustained wrist flexion may induce tendon inflammation, with consequent compression of the median nerve[58,68].

All these disorders might have acute or chronic nature, and cause pain or dysfunction due to overload to the musculoskeletal system, nerves and related vessels[1]. The symptoms of WMSDs are physical discomfort and pain, that can take the alters of the mental health and lifestyle[2,69].

Some conditions, such as pre-existing osteoarthritis, obesity and diabetes, may intensify musculoskeletal and joint pain, and trigger a process of degeneration of appendicular and vertebral facet joints. However, there are divergences in regard to these association, therefore further studies are still needed[70].

PREVENTIVE FACTORS

We analyzed the effectiveness of ergonomic resources and the benefits of workplace exercise mentioned in studies published in international journals and written in English, Portuguese or Spanish.

We first searched databases using keywords selected from the National Library of Medicine Medical Subject Headings (MeSH). Next we added four keywords corresponding to ergonomic tools not included in MeSH. The search strategies are described in Figure 1.

Two investigators independently searched published peer-reviewed research articles in the following databases: PubMed and Regional Library of Medicine (BIREME). During initial screening the investigators selected articles based on their titles and abstracts, and excluded studies which did not meet the inclusion criteria. Therefore, off-topic studies, articles published in languages other than English, Spanish or Portuguese, repeated records, review articles and studies published more than five years earlier were excluded. We chose to search a limited number of databases and set time limits to increase the quality of the records and obtain up-to-date sources. In the last step the studies were subjected to full-text analysis. Study protocols, pilot studies, care series and case reports were also excluded. Instances of disagreement were solved by discussion and consensus. The process of study selection is depicted in Figure 2.

We describe the main results relative to the application of the located resources to different populations is presented in the sequence in this narrative review narrative review.

CLINICAL EVALUATION

Adequate medical history taking is essential to achieve an accurate diagnosis. Physical examination

including palpation of skeletal landmarks, posture analysis to investigate deformities[71] and imaging tests further contribute to diagnostic accuracy[71,72]. Workplace risk and occupational health analysis with focus on the musculoskeletal system are fundamental to improve performance.

WORKPLACE RISK ANALYSIS

Risk analysis of WMSDs should consider both individual and environmental characteristics. In this regard, the main risk variables analyzed in the included studies were posture, daily working hours, task repetitiveness and environmental aspects such as tools and equipment[35].

There are many ways to perform risk assessment in the present time, and the selected method should be based on the aims of the evaluation[73]. Ergonomic contribute to the analysis of the work environment and to the determination of the degree of risk to which workers are exposed during the performance of their job tasks. Among the many methods available to investigate WMSD risk we reviewed:

- Rapid Entire Body Assessment (REBA)

REBA is a systematic method for full-body postural evaluation[74] and was used in studies conducted with different populations of workers: dentists[75], construction laborers[76], meat cutters[77], workers at horse stables[78], rubber factories[79] and bicycle repair units[80]. These jobs demand postures associated with high risk for MSDs and thus require ergonomic evaluation and functional investigation.

Among dentists, risk was associated with repetitive actions and sustained muscle contraction[75]. Almost all of the tasks and postures among construction workers and meat cutters were found to increase the risk of WMSDs[76,77]. Ergonomic interventions are urgently needed in bicycle repair units to provide orientation on the use of tools, workstations and tasks[80]. For rubber factories, the REBA method provided predictors of MSDs in the neck, shoulders, elbows, upper back, lower back, hips, thighs, ankles and feet. This method further demonstrated that the manual tasks involved

Search strategy

BIREME and PubMed

Ergonomic tools

#01 - Musculoskeletal Diseases. ID: D009140

#02 - Ergonomics. ID: D006804

Tools:

#03 - Rapid Entire Body Assessment. ID: Additional

#04 - OVAKO Working posture Analysing System. ID: Additional.

#05 - Rapid Upper Limb Assessment. ID: Additional.

#06 - Strain Index. ID: Additional.

#07 - #01 and #02 and #03 or #04 or #05 or #06.

Benefícios da ginástica laboral

#08 - Musculoskeletal Diseases. ID: D009140.

#09 - Work. ID: D014937.

#10 - Exercise. ID: D015444

#11 - Gymnastics. ID: D006173.

#12 - #08 and #09 and #10 or #11.

Figure 1. Search strategy. Belém (PA), 2018.

in the maintenance of horse stables represent severe ergonomic problems[78].

The REBA method was also used to investigate the effectiveness of interventions. Thus Ratzon et al.[81] could establish that the risk of WMSDs decreased among nurses following an ergonomic intervention program over a short follow-up period.

Quantifying risk through the REBA method allowed Yoon et al.[82] to develop a job rotation model to prevent WMSDs based on tasks groups of high and low workload workstations. This type of model might be suggested and adapted also for other occupational groups to prevent injuries.

Lamarão et al.[83] translated and cross-culturally adapted REBA for use in Brazil. However, they observe that some reformulations are still needed and that biomechanical risk should be interpreted cautiously.

In our view, further studies are still warranted including workers from different occupational groups.

- OVAKO Working Posture Analyzing System (OWAS)

OWAS is an evaluation tool for heavy lifting. It analyzes the body posture for the back, arms, legs and head according to weight or force requirements[84,85]. This scale has been applied to different categories of workers.

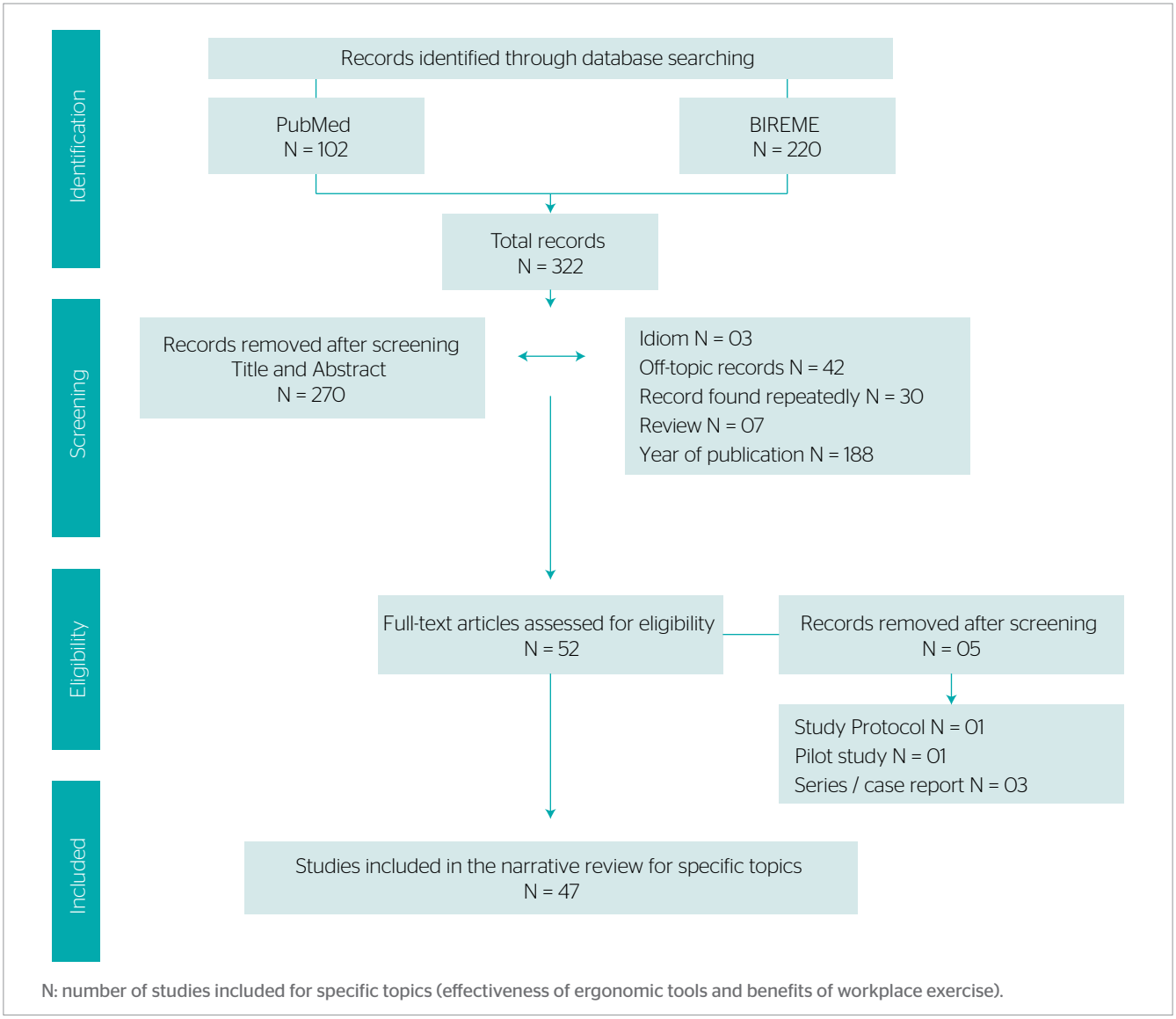

Figure 2. Flowchart depicting study selection for narrative review. Belém (PA), 2018.

Based on OWAS, manual laborers were found to exhibit high frequency of MSDs due to job tasks repeated daily and which involve harmful postures[86]. In a semi-trailer assembly factory, Brandl et al.[87] identified the most common working postures and found that 26% of them could have harmful effect on the musculoskeletal system. According to these authors[87] ergonomic interventions centered on individual working postures may achieve better prevention outcomes than collective approaches.

Use of OWAS allowed demonstrating that almost all cooking work postures are associated with high risk of MSDs due to excessive repetitive movements. A similar result was found for construction workers[76]. In a truck assembly line, OWAS indicated that corrective measures were immediately necessary to prevent the occurrence of rotator cuff syndrome[88].

Our analysis indicates that also other occupational groups should be investigated to verify the applicability of OWAS.

- Rapid Upper Limb Assessment (RULA)

RULA analyzes posture and force to estimate risk of damage to the upper limbs[89]. While this scale is one of the most widely used to investigate ergonomic risk in different occupational groups, further studies are still needed.

The RULA score was higher for computer office workers with musculoskeletal pain compared to those without this condition[41,90]. Ergonomic training may help reduce the risk of MSDs in this population of workers when outcomes are measured in terms of RULA scores[91]. Significant association was found between RULA scores and MSDs among dentists[92,93]. The RULA score indicated that workstations at a submersible pump manufacturing plant exhibited high level of risk[94]. For cooks, almost all body positions were found to pose high risk for MSDs in association with repetitive movements of the upper limbs[95]. A relationship between low back pain, RULA scores and educational level was found for pharmaceutical employees[96].

In bicycle repair shops, the RULA scores pointed to immediate need for ergonomic intervention to provide technical guidance on the use of tools, workstations and execution of tasks[80]. In a study, RULA was used to guide an ergonomic intervention targeting assembly line workers at an electronic parts manufacturer. After RULA was applied, Daneshmandi et al.[97] found reduction of the overload to the neck and trunk.

In clinical work environments, the RULA score was indicated to identify task difficulty and discomfort levels. However, this method is limited to steady postures[98]. In aircraft manufacturing, the condition with the highest adjustability created an environment with the lowest ergonomic risk, and consequently the best performance among workers in a simulated drilling task[99]. Ergonomic intervention may afford workers with neck and upper limb pain adaptations for the execution of their tasks, which may contribute to reduce the occurrence injuries[100]. RULA can also be used to test specific adjustments in the work environment to help reduce MSDs[101].

- Strain Index (SI)

The Strain Index was devised to analyze posture and repetitive tasks of the upper limbs[102], however, there is still scant research in this regard. SI scores were associated with lateral epicondylitis among workers[103]. In aircraft manufacturing, SI enabled adjusting tasks performed by workers subjected to a simulated drilling task to lower the risk of MSDs[99]. When applied to manufacturing workers, association was found between SI risk category and higher incidence of hand and arm symptoms[104]. While a revised version of SI (RSI) was recently developed[105] the changes introduced need to be reevaluated.

TOOLS FOR FUTURE PERSPECTIVES

Several other tools are also described in the literature, however, more studies are still needed of their content and applicability, especially facing the current scenario. Such scales include:

- Novel Ergonomic Postural Assessment Method (NERPA), used for the postural analysis of the upper limbs[106];
- European Assembly Worksheet (EAWS), which measures biomechanical loads to the upper limbs[107];
- OCRA Index, which evaluates biomechanical stress to the hands, arms and shoulders during repetitive tasks[107];

- National Institute for Occupational Safety and Health (NIOSH) Lifting Equation, which investigates the adequacy of physically demanding, two-handed manual lifting tasks[108];
- Liberty Mutual Manual Materials Handling Tables, which serve to perform ergonomic assessments of lifting, lowering, pushing, pulling and carrying tasks so that they are tolerable to workers[109,110];
- Key Indicator Methods (KIM), which consist in three different tools to analyze lifting, holding and carrying loads (KIM-LHC), pulling and pushing loads (KIM-PP) and health risk associated with manually handling in diverse work environments (KIM-MHO)[73,111].

These assessment tools are able to detect risk and might support recommendations for interventions to avoid the occurrence of injuries. Therefore, they should be considered as a modality of primary prevention. Analysts may have resource to techniques such as photogrammetry, videogrammetry and anthropometry to perform these assessments. Also proper use of personal protective equipment, temperature, noise and lighting should be evaluated, because these factors may interfere with the execution of tasks and thus increase the risk of WMSDs.

EVALUATION OF THE OCCUPATIONAL HEALTH OF THE MUSCULOSKELETAL SYSTEM

Functions and dysfunctions of the musculoskeletal system have been investigated based on the electrical conductivity of muscles (electromyography), clinically evaluated in terms of presence of pain and restricted joint mobility, and associated with reported symptoms. The Nordic Musculoskeletal Questionnaire is one of the most widely used scales to evaluate reported musculoskeletal symptoms among workers[112,113].

WORKPLACE EXERCISE

The main objective of workplace exercise is to contribute to improve performance along the working day and prevent WMSDs. Several exercise modalities may be implemented in the workplace as a function of the time of the day or purpose[114]. We briefly describe the main characteristics, applicability and benefits of the various available modalities.

TYPES

Time of the day

Preparatory

Workplace exercise can be undertaken at the beginning of the working day as a preventative measure. This type of workplace exercise is known as preparatory because its main purpose is to warm up the whole body before the job tasks begin[115-119].

Compensatory exercise

Compensatory workplace exercise is also known as a short active breaks[120] because it involves discontinuing job tasks to exercise. The aims of these breaks are to help release tension in the musculoskeletal system (muscles and joints) caused by task-related factors and to compensate for awkward postures. This type of exercise is essential to the physical and mental health of workers[121,122].

Relaxation

Relaxation workplace exercise seeks to relieve fatigue and daily tension. This type of exercise should be performed at the end of working day[122]. It might also be combined to complementary therapies representing mind-body interventions, such as acupuncture, yoga, Pilates, progressive muscle relaxation and meditation[123].

Purpose

Corrective or Postural

This modality seeks to rebalance the muscles by stretching and strengthening those recruited during the performance of job tasks[114].

Compensatory exercise

This modality aims at providing postural rebalancing during work, preventing fatigue and reducing WMSDs. Postural rebalancing is needed especially when tasks require awkward static positions over a long period of time[114].

Therapeutic

Therapeutic workplace exercise seeks to rehabilitate workers with WMSDs according to their individual

complaints. This type of exercise should be performed in an appropriate location to contribute to readjust workers to their taks[114]. This modality is therefore not considered a form of primary prevention.

Management of MSDs to enable workers to return to work may include manual therapies, exercise and self-management education. Workers with injuries should develop the ability to manage their own state of health and quality of work life. Rehabilitation centered on return to work has paramount importance, since the affected individuals will have to work with the very equipment that initially caused the problems. Therefore self-management is fundamental for workers to perform their previous tasks safely[124].

Work-oriented rehabilitation programs have been developed to reintegrate workers to the workplace[125]. Such programs are based on an evaluation of diagnosis, therapeutic interventions, strengthening goals and qualification to restart job tasks. These programs should be developed and run by a multidisciplinary staff[125,126].

Maintenance or conservation

This type of workplace exercise consists in continuous programs to maintain the benefits achieved with therapeutic exercise. Physical conditioning and stretching resources may be used. Employers should provide appropriate locations for exercising at adequate intervals[114].

Applicability

Workplace exercise should be performed daily or at least three times per week, duration depending on the selected type of exercise[114]:

Duration:

- Preparatory: 10 to 12 minutes;
- Compensatory exercise: 5 to 10 minutes;
- Relaxation: 10 to 12 minutes.

Purpose:

- Corrective or postural: 10 to 12 minutes;
- Compensatory exercise: 5 to 10 minutes;
- Therapeutic: 30 minutes;
- Maintenance or conservation: 45 to 90 minutes.

The weekly frequency and session duration depend on individual needs or those of groups of workers, therefore they vary accordingly. Time, rather than purpose, is the criterion most often considered in organizations[114].

Table 1 describes the main methods used to design daily plans. Figure 3 demonstrates exercises which may be performed in the workplace. All exercises sould be performed under supervision. The movements of the exercise for postural control shoud be precisely executed and with the necessary ergonomic adjustments to reduce the chance of injury[115,119].

There are no specific protocols recommended. In addition, repeating a same routine might be demotivating, therefore

Table 1. Methods used in various modalities of workplace exercise[113]. Belém (PA), 2018.

	Preparatory	Compensatory exercise	Relaxation
Coordination	X		
Balance	X		
Concentration	X		
Flexibility	X	X	X
Muscle resistance	X		
Stretching		X	X
Breathing		X	X
Posture		X	
Self-massage			X
Meditation			X

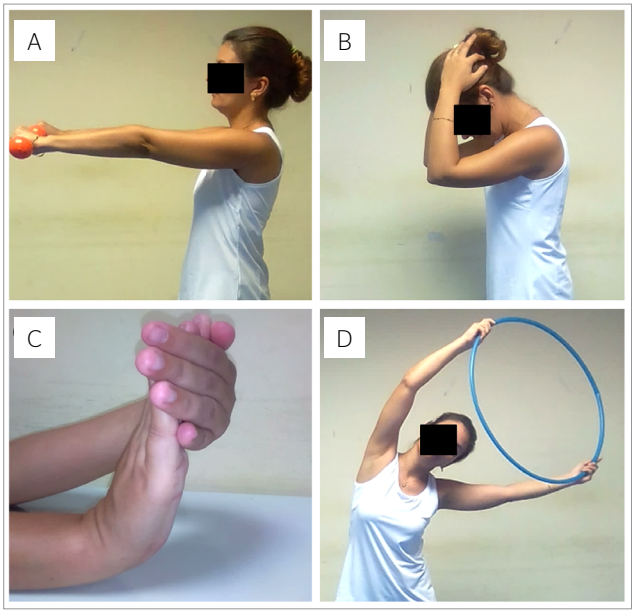

Figure 3. Exercises which may be performed in the workplace. (A) Strengthening of the shoulder flexor muscles. (B) Stretching of the posterior neck muscles. (C) Stretching of the wrist flexor muscles. (D) Stretching of the lateral trunk muscles. Belém (PA), 2018.

introducing periodic changes is advised. Movements should be adjusted to the purpose of the exercise program. Figure 1 depicts some examples of movements which may be performed as part of workplace exercises.

Benefits

While there is no consensus on the best protocol or intervention to prevent MSDs[14], workplace exercise programs are beneficial for both employers and workers[127]. Benefits for organizations include reduced absenteeism[128], time-off requests, costs[129] and sickness absence[130], and improved subjective employability and work ability[131]. Benefits for workers are many. Exercising helps reduce muscle activity during tasks and increases the velocity of movements, accelerations during active neck movements[115,132], aerobic capacity[131] and fitness[133]. The rate of injuries was found to decrease among workers who exercise[129], associated with reduced rates of MSDs[128,134-137] and lower pain scores[128,131,138-140]. In addition, individuals who exercise report less fear of physical movement[131].

FINAL CONSIDERATIONS

The prevalence of WMSDs is high in developed and developing countries and results in substantial costs and negative impact on the quality of life of workers. The workplace may be a crucial setting for early detection of these problems and rehabilitation of workers[141]. Workplace exercise programs have proven to be effective as primary prevention means[142]. Exercises should be well planned and appropriate for each particular group of workers. The work environment and the ability and physical profile of each individual worker should be taken into consideration. The frequency, intensity and type of exercises should be carefully established to ensure the corresponding benefits to workers and employers[143].

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