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Intervention with the Pilates method in workers with RSI/WMSD

Intervenção com o método Pilates em trabalhadores com LER/DORT

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RESUMO

O presente estudo é do tipo quase experimental e teve como objetivo verificar os efeitos da intervenção com o Método Pilates (MP) na presença e intensidade dos sintomas musculoesqueléticos, na força de preensão palmar e na flexibilidade toracolombar de trabalhadores com lesões por esforços repetitivos/distúrbios osteomusculares relacionados ao trabalho (LER/DORT). Participaram trabalhadores encaminhados para atendimento fisioterapêutico a um serviço municipal de nível secundário de atenção à saúde. Foi disponibilizada aos pesquisadores uma lista com 605 usuários com diagnóstico de afecções musculoesqueléticas (sem referência se as afecções tinham ou não relação com o trabalho). Realizou-se contato telefônico para identificar quais eram trabalhadores, convidando-os a participar da pesquisa. Os 244 trabalhadores que aceitaram foram agendados; e, destes, 166 compareceram, sendo avaliados os aspectos sociodemográficos, ocupacionais, história clínica detalhada, sintomas musculoesqueléticos e exame físico, permitindo o estabelecimento do nexo causal (diagnóstico de LER/DORT) para 142 desses trabalhadores. Destes, 17 apresentaram disponibilidade para participar da intervenção nos dias e horários disponibilizados para a aplicação do MP. O protocolo foi constituído por 12 exercícios, por seis semanas, com duração de 60 minutos. Os resultados do MP foram significantes ($p<0,05$) na redução do número de trabalhadores com sintomas nas regiões dos ombros e punhos/mãos, redução significante da intensidade dos sintomas em oito das nove regiões corporais avaliadas e aumento significante da força da mão não dominante. O MP proporcionou efeitos positivos na redução dos sintomas das LER/DORT.

Palavras-chave: Técnicas de exercício e de movimento. Transtornos traumáticos cumulativos. Saúde do trabalhador.

ABSTRACT

The aim of the present quasi-experimental study was to verify the intervention effects with the Pilates Method (MP) on musculoskeletal symptoms, palmar grip strength, and thoracolumbar flexibility of workers with repetitive strain injuries/work-related musculoskeletal disorders (RSI/WMSDs). Workers referred for physiotherapeutic care to a municipal service of secondary health care level participated. The researchers received a list of 605 users diagnosed with musculoskeletal disorders (without reference to whether or not the conditions were related to work). They contacted the users by telephone to identify the workers, inviting them to participate in the research. The 244 workers who accepted received an appointment; of these, 166 attended, and researchers could evaluate the sociodemographic, occupational aspects, detailed clinical history, musculoskeletal symptoms, and physical examination, allowing the establishment of the causal link (diagnosis of RSI/WMSD) for 142 of these workers. Of these, 17 presented a willingness to participate in the intervention in the days and times scheduled for the PM application. The protocol consisted of 12 exercises for six weeks, lasting 60 minutes. The PM

results were significant ($p<0.05$) in reducing the number of workers with symptoms in the shoulder and wrist/hand regions, significantly reducing the intensity of symptoms in eight of the nine body regions evaluated, and significantly increasing the strength of the non-dominant hand. The PM provided positive effects in reducing the symptoms of RSI/WMSD.

Keywords: Cumulative traumatic disorders. Exercise and movement techniques. Worker Health.

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INTRODUCTION

Repetitive strain injuries/work-related musculoskeletal disorders (RSI/WMSD) affect muscle structures, tendons, vessels, peripheral nerves, and even other structures in the body. They generate localized, irradiated, or generalized musculoskeletal symptoms, loss of strength, and fatigue, mainly in the upper limbs of workers, and may also affect the cervical, lumbar and lower limbs[1,2].

The diagnosis of RSI/WMSD should be rapid to prevent the signs and symptoms from becoming severe and chronic. The worker will need multidisciplinary, intersectoral treatment and long-term care. One of the first treatments for these cases is physiotherapy, which, along with other actions of the multiprofessional team, can help improve the health of workers.

Currently, among several tools and physiotherapeutic treatments, there is the Pilates Method (PM) composed of a series of exercises based on the progressive movements that the body can practice, which involve isotonic contractions, especially isometric. These exercises provide a great privilege for the body, stimulating circulation, improving flexibility, range of motion, posture, and physical and mental conditioning[4]. They are, for the most part, performed in the lying position to reduce impacts on the support joints of the body in the orthostatic position, mainly in the spine, allowing recovery of muscle, joint, and ligament structures, in particular of the sacrolumbar region. The exercises must be developed to meet the specific needs of each individual; they are adapted according to the physical conditions of each, there are no contraindications. To that end, that group intervention with PM may improve or minimize the symptoms of RSI/WMSD, providing better physical performance, satisfaction, and recovery of affected workers.

Although the literature consulted shows results from the application of PM in situations of musculoskeletal symptoms, no studies were found that evaluated its effectiveness in RSIs/WMSDs — these are characterized by: chronic symptoms at different times of development, which amounted to one or more locations, with high strength, and whose the control is not obtained by usual maneuvers, such as the use of drugs, analgesic, and anti-inflammatory drugs, warm compresses, interruption of work, self-massage along with stretching and/or relaxation[2].

Also, RSIs/WMSDs can cause decreased strength[1], which along with flexibility are essential components of health-related physical fitness, activities of daily living, and prevention of musculoskeletal injuries[6]. To that end, palmar grip strength is very useful for assessing the overall muscle strength of middle-aged and elderly people, in addition to a simple and good predictor of health prognosis[7]. Considering all this, studies evaluating these parameters are justified.

The present study aimed to verify the results of the intervention with the PM in the presence and intensity of musculoskeletal symptoms, palmar grip strength, and thoracolumbar flexibility of workers with RSI/ WMSD.

METHODS

The study is part of a project that follows the Resolution No. 466, of December 12, 2012, of the National Health Council; and was approved by the Research Ethics Committee of the Federal University of Triangulo Mineiro (UFTM), under No. 3,426,653. It is a partnership between UFTM and Municipal Health Department, developed in the specialized rehabilitation unit (SRU) and the Reference Center in Worker Health (CEREST) of a municipality in the countryside of Minas Gerais in 2019. The study presents a quantitative approach of quasi-experimental type. All participants were informed about the objectives of the research and signed the free and informed consent form (ICF).

The inclusion criteria were: workers referred for physiotherapeutic care and waiting on the waiting list in the SRU, men and women, from 18 years of age, who performed activity for their livelihood and/or their dependents — among them, formal employees, informal employees, retired due to disability generated by the illness from work, unemployed or removed for health reasons[8], with RSI/WMSD.

The study excluded those who did not agree to participate and did not sign the ICF, had a diagnosis of musculoskeletal disorders unrelated to work, those who had cognitive decline evaluated by the clock test, considering the cut-off score below 6 points)[9] and those who did not have time to participate or did not complete the 12 treatment sessions with PM.

The SRU provided researchers with a list of 605 users diagnosed with musculoskeletal disorders referred for this service. However, in the referral made by the doctors of the Health Care System, there is no reference on the involvement related to confirmation or suspicion of RSI/WMSD. Thus, the researchers initially contacted the users by telephone to identify the workers and invite them to participate in the research. Of the total, 244 workers accepted the invitation, and they had an appointment scheduled at their best convenience to visit SRU for the evaluation. Of these, 166 showed up to the appointment and were evaluated for sociodemographic and occupational aspects, detailed clinical

history, musculoskeletal symptoms, and physical examination. It allowed the establishment of the causal link (diagnosis of RSI/WMSD) for 142 workers, of which 24 presented cognitive decline evaluated by the clock test[9]. Of the 118 eligible for intervention, 17 were available to participate in the days and times made available for the PM application. However, some people failed to follow the group (n = 4) due to personal, family, and schedule incompatibility, so the final sample had 13 workers (Figure 1).

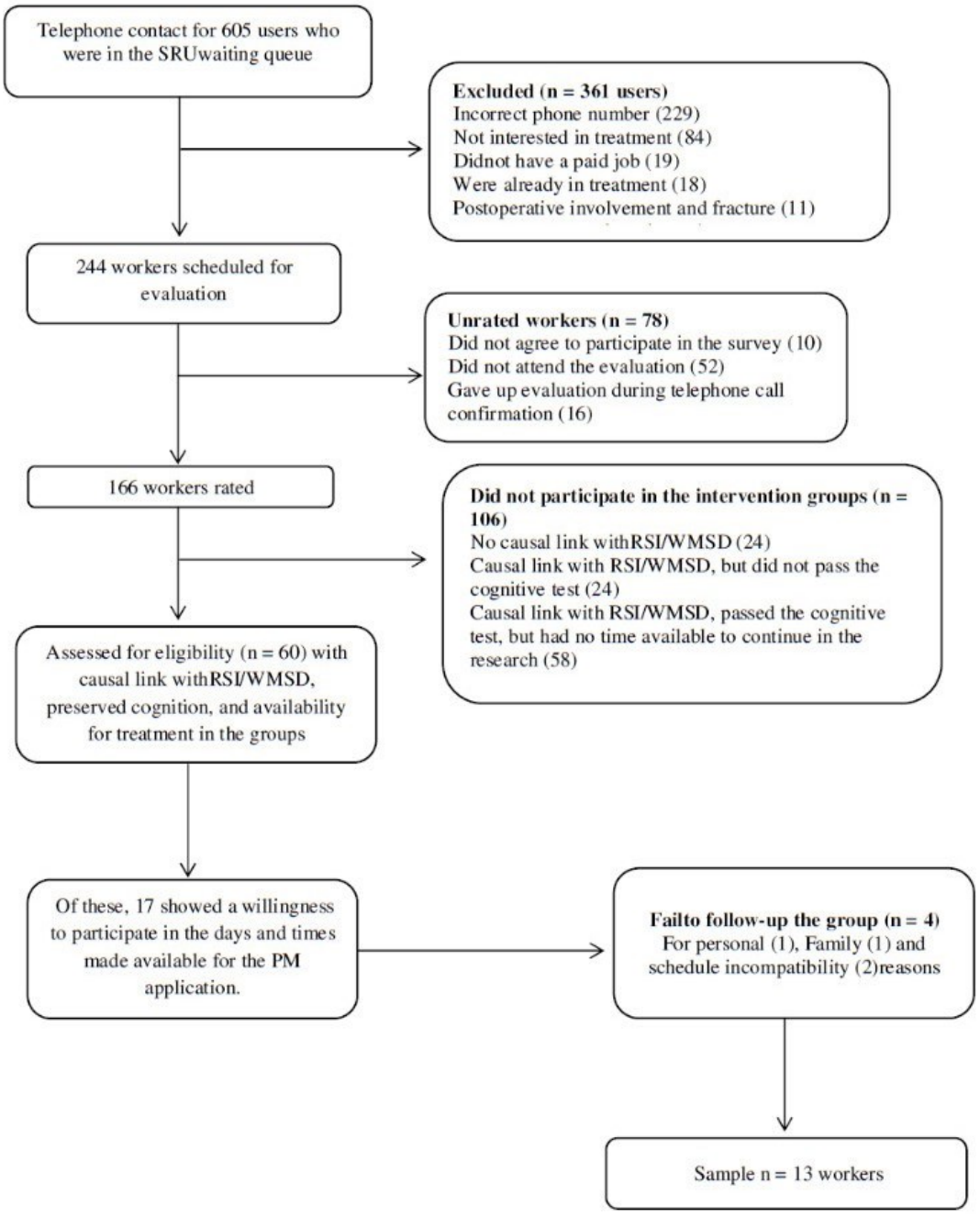


Figure 1. Flowchart of the selection of subjects for the MP group.

Participants with non-work-related impairments received guidance on self-application exercises and the adoption of appropriate postures. They received a primer, prepared by the researchers, with this information and images of the self-applying exercises. They remained in the waiting queue for care at the SRU or were referred for the Rheumatology service.

For the sociodemographic characterization, the researchers used a questionnaire prepared by them, based on the National Household Sample Survey of the Brazilian Institute of Geography and Statistics (IBGE), including issues related to sex, age (years), marital status (living with or without a partner), education (years), per capita income (R$) and race (white and black/brown/yellow/other). Furthermore, it contemplated detailed medical history (history of the current disease) and occupational history.

For the evaluation of musculoskeletal symptoms, the researchers used the Nordic Musculoskeletal Questionnaire (NMQ), developed to standardize the measurement of musculoskeletal symptoms reporting, separating the body into nine regions for a more accurate location and description. The instrument consists of multiple or binary choices regarding the occurrence of symptoms in the various anatomical regions[10].

The intensity of symptoms in each region of the body indicated in the NMQ was evaluated by a numerical scale of 0-10. The validity of this scale is well documented by the significant correlation with other scales[11, 12], allowing to quantify the symptoms. It consists of 11 points in a line numbering from 0 to 10, in ascending order from left to right, in which 0 represents no symptoms, and 10 is equivalent to the worst symptom imaginable. The guidance given to the workers was that they should choose the numbering that best represented their symptoms.

Then, two physiotherapists performed a physical examination, who underwent prior training to ensure its reliability, which was confirmed by the examination of two workers who reached a Kappa value of 88%.

Such an examination consisted of static and dynamic inspection, evaluation of muscle strength, evaluation of flexibility, evaluation of range of motion in upper and lower limbs, special tests applied to upper, lower limbs, spine, cervical region, and lumbar region[13-16].

The evaluation of the palmar grip force was measured using a hydraulic dynamometer (Dynamometer North Coast Medical®), in kilogram-force adjusted in the second gauntlet position for women and the third for men. As for the positioning to apply the test, the workers were seated in a chair with the arm adducted parallel to the trunk, elbow flexed at 90 degrees, and

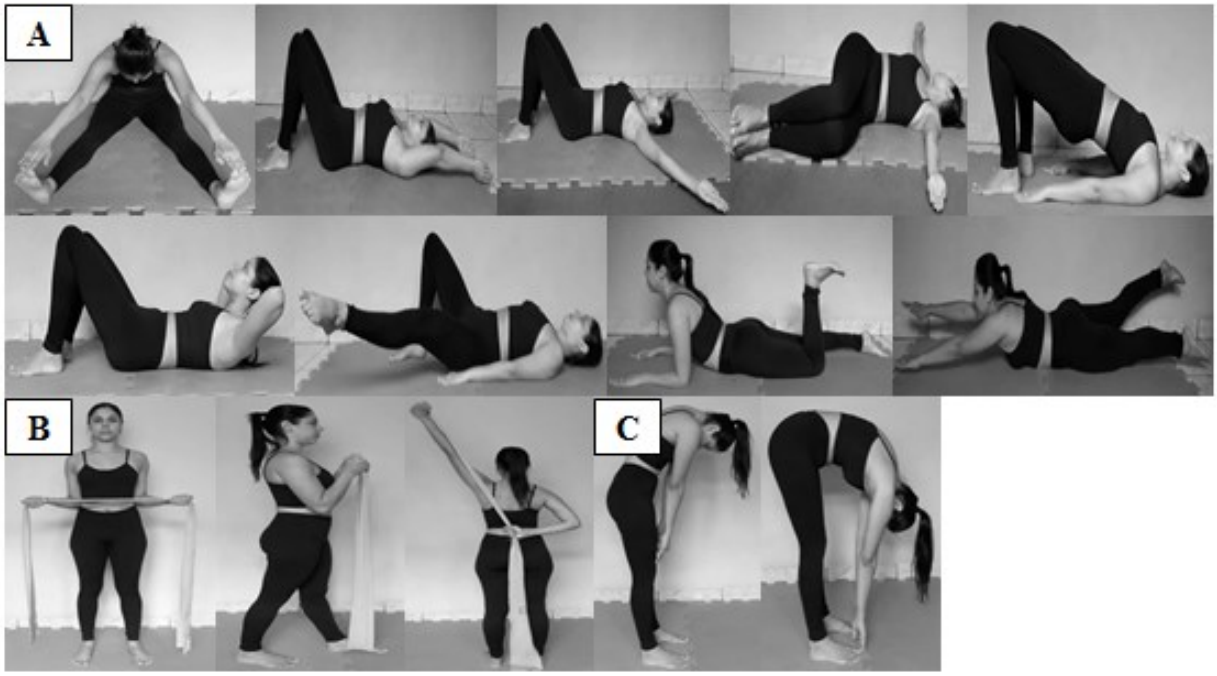
forearm and wrist in a neutral position. Then, three measurements were performed with a minimum one-minute interval between them, on the dominant and non-dominant side[17]. The examiner used a verbal stimulus of "strength, strength, strength" for all the participants in both hands. The average force was calculated, considering the three measurements.

The sit and reach test was performed[18] using the Wells Sanny® bench, accurately in centimeters, to assess thoracolumbar flexibility. The examiner in charge guided and positioned the workers. Each sat on a mat that was on the floor, knees fully extended, ankles positioned at 90 degrees, and feet fully supported. The workers positioned their arms in front of the equipment with hands arranged in parallel, and the equipment was placed against a wall to be safe at the time of the test application. The test was applied three times: the workers made the anterior flexion movement of the trunk up to its amplitude limit, sliding their fingers on the ruler and always maintaining the initial positioning. The test considered the average of three attempts.

The study performed 12 sessions of the protocol with the PM for six weeks, with the periodicity of twice a week and for 60 minutes. A physiotherapist performed the entire procedure of applying the exercises, who has a qualification certificate as a PM instructor in Brazil.

The PM protocol (Figure 2) was based on several studies[19-22] and consisted of basic exercises, stretching exercises, mobility, and strengthening for the main muscles of the upper limbs, trunk, and lower limbs. It used mats and level 3 resistance elastic bands. For each exercise, they performed a total of ten repetitions with an interval of one minute between each posture[21].

The first session served as an introduction and familiarization with the PM, demonstrating the principles: breathing, contraction of the center of force, concentration, control, precision, and fluidity. All sessions were standardized with basic module exercises for beginners, execution of resisted exercises, and completion with mobility and flexibility exercises. The exercise sequences are arranged in Figure 2 (A, B, and C).



A) Basic PM exercises and sequence of application: Spine stretch for ward; Arm arcs (sagittal and lateral); Book openings; Spine curls; Chest lift; The one leg circles; Single leg kick; Swimming. **B)** Basic exercises of PM with an elastic band resistance in the sequence of application: Dumb waiter with; Biceps curl with an elastic band; Triceps pull with elastic band. **C)** Basic exercises of the PM in the sequence of application: Standing roll down.

Figure 2. Protocol of the Pilates Method.
Source: the authors.

At the end of the intervention, the workers had a new schedule to perform the reassessments that occurred in the same week after the last session, performed by the same physiotherapists as the initial evaluation.

For the data analysis, a database was initially set up with double typing and validation to correct any errors. The Statistical Package for the Social Sciences (SPSS), version 24.0, analyzed the data.

The descriptive analysis used measures of frequency and percentage, central tendency (mean), and variability (standard deviation), and the Shapiro-Wilk test performed the normality of the data distribution. The study applied the McNemar test; Wilcoxon test and *t* paired (depending on whether the variables were normal or not) for the comparison of the results before and after the intervention, considering a significance level of 95% ($p < 0.05$). It opted for the calculation of the effect size (*d* of Cohen), adopting as cutoff points for classification values equal to or greater than 0.8, large effect; between 0.8 and 0.2, medium effect; and less than 0.2, small effect[23].

RESULTS

Table 1 presents the sociodemographic descriptions and occupational characteristics of workers with

RSI/WMSD. Thirteen workers participated in study, with a mean age of 49.31 ± 6.24 years and 8.61 ±4.72 years, which included 11 (84.6%) women and 2 (15.4%) men.

Table 1. Sociodemographic, occupational characterization of workers with RSI/WMSD

Sociodemographic and occupational characterization	n (%)	
Sex		
Female	11 (84.6)	
Male	2 (15.4)	
Race		
White	5 (38.5)	
Black, brown, yellow, other	8 (61.5)	
Marital status		
In Union	9 (69.2)	
No union	4 (30.8)	
Current employment situation		
Employee	4 (30.8)	
Unemployed	5 (38.5)	
Remote	3 (23.1)	
Retiree	1 (7.7)	
	Mean	**SD**
Age (years)	49.31	6.24
Income per capita ($)	664.30	282.00
Time of profession (months)	190.08	179.50
Years of study (years)	8.61	4.72

Table 2 shows the results of the intervention with PM in the presence and intensity of musculoskeletal symptoms, palmar grip strength, and thoracolumbar flexibility.

The results indicated that PM significantly reduced the presence of symptoms in the shoulder ($p = 0.016$) and wrist/hand regions ($p = 0.031$) and the intensity of symptoms in eight of the nine regions evaluated ($p < 0.05$). In six of them, the effect size was large; in two, it was average, and the strength of the non-dominant hand increased ($p = 0.023$, average effect size). There was no significant difference in thoracolumbar flexibility ($p = 0.119$).

Table 2. Results of the intervention with Pilates method in the presence and intensity of musculoskeletal symptoms, muscle strength and flexibility in workers with RSI/WMSD

	Pre-Pilates		**Post-Pilates**		**p**		
Presence of symptoms	n (%)		n (%)				
Neck	7 (53.84)		2 (15.38)		0.125		
Shoulder	11 (84.62)		4 (30.77)		0.016*		
Thoracic	11 (84.62)		7 (53.84)		0.125		
Elbow	6 (46.15)		2 (15.38)		0.219		
Lumbar	13 (100)		10 (76.92)		0.250		
Handles / hands	10 (76.92)		4 (30.77)		0.031*		
Hips / thighs	11 (84.62)		7 (53.85)		0.125		
Knee	10 (76.92)		4 (30.77)		0.070		
Ankles / feet	10 (76.92)		7 (53.84)		0.375		
	Mean	**SD**	**Mean**	**SD**		**Cohen's D**	**%**
Intensity of symptoms							
Neck	3.92	3.23	0.54	1.66	0.011**	1.32	86.22
Shoulder	5.54	4.54	1.23	2.98	0.012**	2.19	90.25
Thoracic	5.92	3.99	3.23	3.49	0.019**	0.72	45.44
Elbow	3.15	3.31	0.77	2.77	0.015**	0.78	75.56
Lumbar	9.46	1.05	6.62	4.03	0.011**	0.96	30.02
Handles / hands	4.77	3.17	1.31	2.98	0.016**	1.12	72.54
Hip / thighs	7.54	3.53	3.85	4.41	0.008**	0.92	48.94
Knee	5.92	3.77	2.00	3.44	0.010**	1.09	66.22
Ankles / feet	6.23	4.55	4.39	4.59	0.103	0.40	29.53
Palmar grip strength [Kgf]							
Dominant hand	23.56	10.83	27.87	8.42	0.079	-0.44	-18.29
Non-dominant hand	22.97	10.50	26.90	9.96	0.023***	-0.38	-17.11
Thoracolumbar flexibility [cm]	16.58	8.67	18.99	8.10	0.119	-0.28	-13.93

SD – standard deviation. Flexibility (n = 12; loss = 1). * $p \leq 0.05$, McNemar test. ** $P \leq 0.05$, Wilcoxon test. *** $p \leq 0.05$, paired *t* test.

DISCUSSION

The objective of this study was to check the results of the intervention with PM in the presence and intensity of musculoskeletal symptoms, palmar grip strength, and thoracolumbar flexibility of workers with RSI/WMSD. The PM results were significant for a reduction in the number of workers with symptoms in the shoulder and wrist/hand regions, a significant reduction in the intensity of symptoms in eight of the nine body regions evaluated, and a significant increase in non-dominant hand strength.

It was observed that the participants presented generalized symptoms and that the PM results were significant for reducing the presence of the number of workers with symptoms only in the regions of the shoulders and wrists/hands. The persistence of the symptoms may be related to the

chronicity of the disease because when the signs and symptoms of the RSI/WMSD are identified in the initial and acute phase, and the appropriate changes are taken given the risk factors, the chance of reversal of the pathological condition is likely. However, many workers who continue to perform their activities, present injuries in the chronic condition in the future, whose extension and impairment of function becomes greater, as well as the reduction of the natural regeneration capacity of the tissue[2]. It is worth mentioning that all workers in the present study reported onset of symptoms more than two years before.

The mean intensity ranged from 3.92 (moderate) to 9.46 (intense). It can be explained by the frequent solicitation of accessory muscles that assist in the performance of labor activities in workers with RSI/WMSD. Thus, due to fatigue and pain, the contralateral limb is often used in an attempt to compensate for the dysfunctions of the affected limb. Compensatory muscle actions may justify the enlargement of the affected area or even the primarily uninvolved segment. Changes in the central motor control mechanism result in an imbalance between the motor activity of contraction and relaxation of the agonists and antagonists muscles. It can justify the involvement of the anterior and posterior muscle chains, especially in chronic and more severe cases[2].

Despite the chronicity of the symptoms and the reduction in the presence of the number of workers with symptoms only in the regions of the shoulders and wrists/hands, the study evidenced a significant reduction in symptom intensity in eight of the nine body regions evaluated (neck, shoulders, thoracic, elbows, lumbar, wrists/hands, hips/thighs, and knees). In six, the effect size was of great magnitude, and in two, it was of medium magnitude, according to Cohen's criterion[23].

It is worth noting that the lumbar region, with greater intensity of symptoms, presented a considerable reduction after the intervention with PM. The decrease in the intensity of low back pain is crucial because pain, in a chronic form, causes various ailments that synergistically make up the pain-inflammation-spasm-pain feedback cycle. This can boost, perpetuate or worsen the signs and symptoms, as well as produce greater disability and compromise the range of joint movement and posture of the individual[24]. Spasm, characterized by concentric sliding of muscle fiber from the tendon extremities towards the muscular belly, leads to the development of continuous tension without relaxation[2].

A study that applied different doses of sessions with PM in 296 patients with chronic nonspecific low back pain indicated the effectiveness of this treatment in reducing pain. It also showed that the method applied twice a week was more effective in the physical and functional recovery of patients compared to the group that received sessions only once a week[25]. A

randomized controlled trial showed that 12 sessions of individual PM intervention were effective in reducing chronic low back pain in individuals of both sexes, aged 30 to 60 years[21]. The decrease in the intensity of symptoms with PM can stimulate circulation, improve flexibility, fitness, and postural alignment, help in the prevention and treatment of injuries, and provide relief in chronic pain[26.]

Regarding the palmar grip strength, Caporrino[17] reports that the dominant side is stronger than the non-dominant one in both sexes, in all age groups. In the present study, a lower mean was also observed in the non-dominant hand. This fact can occur due to the imbalance between the demand and the metabolic need and between the anatomo-functional capacity of the muscles that are involved in the movement, which predisposes to muscle fatigue and weakness and the impairment of their functional performance[2].

Studies have shown positive effects of PM practice on palmar grip strength after 60 minutes of practice, twice weekly, with more than 12 sessions[27,28]. However, the results of this study highlight that only 12 sessions were sufficient to generate a significant increase in non-dominant hand strength ($p = 0.023$).

Muscle strength is an important factor to consider because it is an indicator of overall health for both sexes. The fact that the dominant hand does not present significant results may be associated with generalized symptoms that compromise the musculature and consequently the quality of life. In addition, sex and age of the individual can also influence because the older the person is, the greater the weakening of the muscles due to the decline of muscle fibers[29].

Regarding flexibility, PM did not provide significant gains for the studied population, possibly because of pain in the lumbar region that can compromise the range of joint movement and posture, very common in individuals affected by RSI/WMSD. The lack of physical activity, age, and gender are factors that can also impair the flexibility of individuals.

Therefore, it is essential to incorporate a routine of therapeutic exercises in the daily life of people affected by RSI/WMSD, indicated for the treatment of chronic symptoms related to work, as opposed to resting, which is recommended in cases of acute inflammatory processes. In this study, the PM promoted an improvement of workers' pain symptoms as well as some muscle strength parameters, following a basic protocol, with the use of low-value accessories and in groups.

The absence of a control group due to the limitation of the time necessary for interventions and the availability of workers to participate twice a week are limitations of the present study. In addition, the evaluations occurred only at the end of the intervention, and long-term follow-up measurements were not carried out.

Future studies may focus on evaluating the results of longer intervention time in promoting better gains in palmar grip strength, flexibility, and decreased musculoskeletal symptoms of workers. Time series evaluations can also be made, with follow-up of participants, to verify the effects of the intervention in the long term.

The key point of this work was its development within a service reality in which participants commonly receive care and treatment. It allowed to experience the difficulties encountered in the public health system and ensured the participants the conditions of follow-up, treatment, integral assistance, and guidance, according to each case.

CONCLUSION

The intervention with PM in workers with RSI/WMSD evidenced a reduction of the intensity of musculoskeletal symptoms in all regions evaluated, except for the ankles/feet, and an increase in the grip strength of the non-dominant hand. These results demonstrate its effectiveness as a non-pharmacological therapy in workers with RSI/WMSD and support new studies.

REFERENCES

1. Brasil. Ministério da Saúde. Secretaria de Vigilância em Saúde. Departamento de Vigilância de Doenças e Agravos não Transmissíveis e Promoção da Saúde. Saúde Brasil 2018 uma análise de situação de saúde e das doenças e agravos crônicos: desafios e perspectivas. Brasília: Ministério da Saúde; 2019. 424 p.

2. Brasil. Ministério da Saúde. Secretaria de Vigilância em Saúde. Departamento de Vigilância em Saúde Ambiental e Saúde do Trabalhador. Dor relacionada ao trabalho: lesões por esforços repetitivos (LER): distúrbios osteomusculares relacionados ao trabalho (Dort). Brasília: Ministério da Saúde; 2012. 68 p.

3. Brasil. Ministério da Saúde, Secretaria de Atenção à Saúde. Saúde do trabalhador e da trabalhadora. Brasília: Ministério da Saúde; 2018.

4. Menegatti F. Pilates: força e flexibilidade. Rev Muscle. 2004;6:42.

5. Freitas Silva RB de, Guerino MR. Método Pilates: benefícios e aplicabilidade para melhorar a qualidade de vida. Fisioter Bras 2019;20(2):249- 62.

6. Morken T, Mageroy N, Moen BE. Physical activity is associated with a low prevalence of musculoskeletal disorders in the Royal Norwegian Navy: a cross sectional study. BMC Musculoskeletal Disorders. 2007;8(1):56.

7. Sasaki H, Kasagi F, Yamada M, Fujita S. Grip strength predicts cause-specific mortality in middle-aged and elderly persons. Am J Med 2007;120(4):337-42.

8. Brasil. Política Nacional de Segurança e Saúde do Trabalhador (PNSST). (2004). Disponível em: http://bvsms.saude.gov.br/bvs/publicac

oes/politica_nacional_seguranca_saude.pdf. Acesso em 21 jul 2020.

9. Mendes-Santos LC, Mograbi D, Spenciere B, Charchat-Fichman H. Specific algorithm method of scoring the Clock Drawing Test applied in cognitively normal elderly. Dement neuropsychol. 2015;9(2):128-35.

10. Pinheiro F, Troccoli BT, Carvalho CV. Validação do Questionário Nórdico de Sintomas Osteomusculares como medida de morbidade. Rev. Saúde Pública. 2002;36(3):307-12.

11. Douglas ME, Randleman ML, De Lane AM, Palmer GA. Determining pain scale preference in a veteran population experiencing chronic pain. Pain Manag Nurs. 2014;15(3):625-31.

12. Sayin YY, Akyolcu N. Comparison of pain scale preferences and pain intensity according to pain scales among Turkish Patients: a descriptive study. Pain Manag Nurs. 2014;15(1):156-64.

13. Hoppenfeld S. Propedêutica ortopédica: coluna e extremidades. São Paulo: Atheneu; 1999.

14. Buckup K. Testes clínicos para patologia óssea, articular e muscular. São Paulo: Manole; 2002.

15. Maitland GD. The Slump Test: Examination and Treatment. Aust. j. physiother. 1985;31(6):215-9.

16. Magee DJ. Avaliação musculoesquelética. São Paulo: Manole; 2010.

17. Caporrino FA, Faloppa F. Estudo populacional da força de preensão palmar com dinamômetro Jamar®. 1998;33:5.

18. Ribeiro RP, Sedrez JA, Candotti CT, Vieira A, Ribeiro RP, Sedrez JA, et al. Relação entre a dor lombar crônica não específica com a incapacidade, a postura estática e a flexibilidade. Fisioterapia e Pesquisa. 2018;25(4):425-31.

19. Zengin Alpozgen A, Razak Ozdincler A, Karanlik H, Yaman Agaoglu F, Narin AN. Effectiveness of Pilates-based exercises on upper extremity disorders related with breast cancer treatment. Eur J Cancer Care (Engl). 2017;26(6).

20. Araujo Cazotti L, Jones A, Roger-Silva D, Ribeiro LHC, Natour J. Effectiveness of the Pilates Method in the Treatment of Chronic Mechanical Neck Pain: A RandomizedControlled Trial. Arch. phys. med. rehabil. 2018;99(9):1740-6.

21. Silva PHB da, Silva DF da, Oliveira JK da S, Oliveira FB de, Silva PHB da, Silva DF da, et al. The effect of the Pilates method on the treatment of chronic low back pain: a clinical, randomized, controlled study. BrJP. 2018;1(1):21-8.

22. Baillie L, Bacon CJ, Hewitt CM, Moran RW. Predictors of functional improvement in people with chronic low back pain following a graded Pilates-based exercise programme. J. bodyw. mov. Ther. 2019;23(1):211-8.

23. Cohen J. Statistical Power analysis for the behavioral sciences. 2nd ed. Hillsdale, NJ: Erlbaum; 1988.

24. Ribeiro RP, Sedrez JA, Candotti CT, Vieira A, Ribeiro RP, Sedrez JA, et al. Relação entre a dor lombar crônica não específica com a incapacidade, a postura estática e a flexibilidade. Fisioter E Pesqui. 2018;25(4):425-31.

25. Miyamoto GC, Franco KFM, van Dongen JM, Franco YR dos S, de Oliveira NTB, Amaral DDV, et al. Different doses of Pilates-based exercise therapy for chronic low back pain: a randomised controlled trial with economic evaluation. Br J Sports Med. 2018;52(13):859-68.

26. Comunello JF. Beneficios do método pilates e sua aplicação na reabilitação. Instituto Salus; 2011.

27. Bueno GAS, Menezes RL de, Vilela Lemos T, Gervásio FM, Bueno GAS, Menezes RL de, et al. Relação da força muscular com equilíbrio estático em idosos - comparação entre pilates e multimodalidades. Revista Brasileira de Ciências do Esporte. 2018;40(4):435-41.

28. Santos JCL, Vancini RL, Sarro K J. Impacto de 12 semanas de prática de pilates solo na força de preensão palmar, resistência abdominal e na flexibilidade avaliada por fotogrametria em mulheres saudáveis. Pensar a Prática. 2017;20(2): 246-56.

29. Lima TR de, Silva DAS, Kovaleski DF, González-Chica DA, Lima TR de, Silva DAS, et al. The association between muscle strength and sociodemographic and lifestyle factors in adults and the younger segment of the older population in a city in the south of Brazil. Cien Saude Colet. 2018;23(11):3811-20.