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Short-Duration Resistance Training in Company Exercise Programs Promotes Strength Gains and Reduces Pain in Workers

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ABSTRACT

Sena KF, Martins CO, Toscano LT, Santos EP, Alves SB, Silva AS. Short-Duration Resistance Training in Company Exercise Programs Promotes Strength Gains and Reduces Pain in Workers. **JEPonline** 2015;18(3):101-111. This study tested the effect of the including resistance training exercises (RE) in company exercise programs on strength, pain, and perception of mood. Twenty workers (24.5 ± 1.5 yrs old) were randomly divided into experimental group (n = 10) and control (n = 10). While the control group remained with 5 weekly sessions of stretching (15 min long), the experimental group replaced 3 of the sessions with a RE protocol (3 sets, 5 exercises of the large muscle groups that was 15 min long) that lasted 8 wks. Body composition, maximum strength, and questionnaires on pain sensation (NMQ - Nordic Musculoskeletal Questionnaire) and mood (POMS - Profile of Mood States) were taken after 4 wks and at the end of training. The experimental group showed an average strength gain of 22.9 % compared to 4% in the control group. The strength gain was followed by a significant decrease in the fatigue scale of the mood test and a reduction in body pain, with no changes in the control group. There was no change in body composition in either group. The findings indicate that the inclusion of 3 weekly sessions of RE lasting 15 min promotes additional health benefits to a company's exercise program.

Key Words: Occupational Disease, Exercise, Worker's Health

INTRODUCTION

Currently, many companies invest in exercise programs for their employees. In some of these initiatives, activities take place within working hours and are characterized by short sessions that last 5 to 15 min, daily or less frequently during the week (19). Due to the short period of time, sessions of workplace exercises basically consist of stretching exercises. These exercises provide several benefits to the employees, such as the reduction of occupational accidents, prevention of muscle and joint fatigue, decrease in absenteeism, and higher self-esteem (1,9,13). But, the lack of regular aerobic and/or anaerobic exercises fails to address adequately the need to decrease the risk factors for chronic degenerative diseases and/or disabilities.

Studies have shown that resistance exercise can promote several health benefits, such as an increase in lean body mass (24), an increase in muscle strength and flexibility (25), a decrease in muscular fatigue and aches, and the prevention and treatment of Work-Related Musculoskeletal Disorders (WRMD) (4). In an attempt to combine the benefits of stretching with the adaptations of strength training, surveys have shown an increase in the use of resistance training exercises in company exercise programs (1,2,26,27).

Although researchers use exercise protocols that go beyond the standard 15 to 20 min provided by most companies for their employees' exercise program, it remains to be determined if a well-designed short-term resistance training program will benefit the employees. To help clarify this point, the purpose of this study was to evaluate the effectiveness of the inclusion of training sessions of short-term resistance exercises will produce an increase in the employees' strength, decrease percent body fat, and increase the mood among workers of a packaging industry.

METHODS

Subjects

The study was developed in the production sector of a packaging industry of 92 workers. Among these workers, 67 workers have been consistently involved in the company's exercise (i.e., stretching) sessions for at least 1 yr. A sample of 20 male employees aged between 18 and 35 was randomly drawn (www.randomizer.com) and, then, distributed randomly into an experimental group (24.4 ± 5 yrs) and a control group (23.8 ± 5 yrs). All of them performed only the stretching exercise in their daily routines. None of the subjects was dieting. These employees pack plastic bags in an 8 hr shift with a 1 hr break for a meal in the middle of the workday. After authorization by the company, the subjects agreed not to change their daily habits regarding nutrition and participation in daily activities. The director of the company was asked not to change the employees' activities during the two months of intervention. The project was previously approved by the Research Ethics Committee of the Center for Health Sciences from the Federal University of Paraíba, under protocol 445/06. All subjects were asked to sign the Free and Clarified Consent Term, in accordance with Resolution 196/96 of the National Health Council.

Study Design

For a period of 8 wks, the subjects from the experimental group replaced 3 out of 5 weekly sessions of stretching exercises with resistance exercises, which lasted for 15 min. The 2 remaining sessions with stretching exercises on alternate days of resistance training sessions were maintained. Meanwhile, the control group remained with the usual 5 weekly sessions of stretching exercises. Before, during, and after training, both groups were tested for strength, body composition, and body pain. The Profile of Mood States (POMS) was measured before and at the end of training.

Familiarization Exercises
The two groups held a session of adaptation to the exercises that would be used in training. The three sessions were held in a week, keeping a 48-hr interval between them. They performed 2 sets with 15 repetitions, interval of 90 sec between sets and light loads (between 1 and 2 on the scale of perceived exertion OMNI - RES), which has been validated for the prescription and monitoring of training intensity in resistance exercise (11). Although the control group did not participate in training with resistance exercises, they made this adjustment to ensure safety in maximal strength tests to be performed at the beginning and at the end of the study.

Experimental Protocol
The experimental protocol consisted of replacing 3 weekly sessions of stretching exercises by conventional resistance training exercise sessions. The training took place on alternate days and was scheduled in a way that the 5 exercises would be performed in a maximum of 15 min. The exercises were: knee extension, flat bench press bar, leg press, dorsal pulley, and free squat. It took 7 wks of training, as indicated below:

1st and 2nd Weeks consisted of training with 3 sets of 15 to 20 repetitions, with subjects between 4 and 6 on the OMNI – RES scale. Cadence was set at 4 sec for the eccentric phase and 2 sec for the concentric phase. For the interval between series it was taken into account that there were 10 workers for 5 exercises, so two workers occupied one machine. Thus, while one worker would be in the interval between the series the other worker would be performing that very same exercise.

3rd thru 7th Week the subjects progressed to 3 sets with 8 to 12 maximum repetitions, which represented the 6 to 8 range on the OMNI – RES scale. The same cadence and interval from the previous week were kept. During these 5 wks, the training overload was implemented by increasing only the loads for each exercise. In order to achieve it, the subjects were always instructed to perform as many repetitions as possible in all exercises. When the repetition was over 12, they would let the coach know so he could increase the workload for the next session.

Each pair was encouraged to help each other in the exchange of loads to minimize the time of each exercise. Once the pair had finished the 3 series, they would go to the closest machine (to complete the circuit of all the exercises). Therefore, the duo would finish the exercise in less than 3 min and, in 15 min they would also finish the workout of the day. Heating was standardized for all sessions. The subjects performed between 10 and 15 repetitions with a minimum load (around 20% of the training load) before the first set of each exercise.

Previous Company Exercise Protocol
Volunteers of the control group continued to perform the stretching exercise sessions previously offered by the company 5 times·wk^{-1}, while the experimental group began performing only 2 weekly sessions. The 5 weekly sessions of stretching exercises consisted of 4 sessions of stretching exercises and a 5th session of massage. Each session was performed once a day and lasted for 15 min. The stretching exercises were performed using passive and dynamic methods, with stretches lasting an average of 10 sec for each exercise. The massage sessions used gliding and kneading techniques. Each session was done in pairs with the objective to stretch the dorsal muscles, shoulders, arms, and hands.

Protocol for Strength Tests
Maximal strength tests in the adopted exercises from the experimental protocol were performed before and after the 4th-wk and at the end of training. The 3 tests were done after 72 hrs without physical exercise. Both the experimental group and the control group took part in this test. The

maximum strength estimation protocol proposed by Kraemer Fleck (10) was applied. Briefly, subjects were instructed to avoid intense or unusual strain during the 48 hrs preceding the assessment. For the test, volunteers would start a warm-up (the same described for the training sessions) and, then, would wait for 90 sec to perform as many repetitions possible with an estimated load close to the maximum estimated for the subject. Each repetition was done at a constant rate of 4 sec for the eccentric phase and 2 sec for the concentric phase with no gap and without any interruption between one repetition and the other. It was considered the end of the test when the subjects were no longer able to keep a proper joint motion for each exercise. The interval between the test of one exercise to the next test was 2 to 3 min, and the exercises were alternated by segment.

Anthropometric Evaluation

Anthropometric evaluations were taken before the training, 4 wks after it, and at the end. All skinfold measurements were performed in the right hemisphere while in a standing position, using the technique proposed by Carnival (5): subscapular region (SE); triceps (TR); pectoralis (PT); axillary midline (PM); supra-iliac (SI); abdominal (AB); and thigh (CX). To determine the fat percentage estimation, Jackson and Pollock's protocol was used, (Giannich and Maris) (8). For the weight measurement, the subjects had as little clothing on as possible and were placed still in the center platform of a digital scale (model 200143 Ultimate, Tanita ® brand, with full capacity of 136 kg and accuracy of 100 g).

Muscle Soreness Assessment

In order to assess the presence of musculoskeletal pain, the adapted assessment from the short version of the Nordic Musculoskeletal Questionnaire (NMQ), validated by Pinheiro et al. (17) was used. The subjects were asked about the frequency of pain in the following regions: cervical spine, shoulder, arm, elbow, forearm, wrist, dorsal region of the stride, lumbar region of the trunk, and lower limbs. The possible answers were: always, often or rarely. In order to answer the survey, employees were asked to arrive at work 30 min before the usual time and were taken to a private room. They were instructed in each question and were also asked to fill an answer sheet, as a researcher from the team remained on site to answer questions.

Mood

Mood was evaluated by POMS questionnaire (Profile of Mood State), reduced version, and adapted from the English version to Portuguese by Viana et al. (23). This test assesses the psychological mood based on sensations that people feel over the last 7 days. The test score is given by factorial analysis, considering the scores from 0 (none) to four (extremely) as to how it is possible to respond to reviews related to stress, depression, hostility, fatigue, and confusion (negative feelings), and vigor (positive sentiment). From the results, a total score of mood/humor (PTH) is calculated. The protocol considers a score higher than 100 as disturbance of mood, and lower numbers an improvement of mood.

Statistical Analyses

The data are presented as means ± SD. Initially, the data were tested for normality and homogeneity through the Shapiro-Wilk and Levene Levine tests, respectively. Then, the ANOVA test for repeated measures with Tuckey *post hoc* or its nonparametric equivalent of Friedman was used, depending on the normality and homogeneity or even if the data were continuous or categorical. Statistical significance was set at $P<0.05$. The tests were run on Instat software, 3.0 (Graphpad, San Diego, CA).

RESULTS

Immediately before the beginning of the study, both groups presented statistically similar conditions in terms of maximum strength, body composition, body aches, and mood. The effects of the training protocol with resistance exercise on muscle strength are shown in Table 1. In the evaluation made after 4 wks of intervention, the experimental group showed no increase in force in any of the tested exercises. However, at the end of the training protocol there was a significant increase of maximum strength for all exercises, except the squat. Meanwhile, the control group showed no strength gain in any of the exercises. The experimental group demonstrated significantly better results compared to the control group in knee extension and dorsal pulley.

Table 1. Results of Strength Tests via Maximum Load Estimated for Resistance Exercises in Experimental and Control Groups.

Equipments		Experimental (kg)	Control (kg)
Leg	**Initial**	158.5 ± 36.3	177.5 ± 26.1
	4 weeks	180.1 ± 26.1	178.9 ± 18.6
	8 weeks	195.6 ± 21.9*	182.1 ± 18.1
Extensor	**Initial**	51.2 ± 8.2	48.9 ± 9.9
	4 weeks	59.5 ± 7.9	51.5 ± 9
	8 weeks	65.4 ± 7.9**#	53.4 ± 9.3
Squat	**Initial**	45.6 ± 10.5	52.9 ± 11.5
	4 weeks	54.5 ± 11.4	53.7 ± 11.5
	8 weeks	55.7 ± 10.4	54.5 ± 11.4
Dorsal Pulley	**Initial**	55.6 ± 8	51 ± 7
	4 weeks	61.5 ± 8	53 ± 6
	8 weeks	66 ± 8*##	52.5 ± 6
Flat Bench Press	**Initial**	51.2 ± 13.3	50.1 ± 11.6
	4 weeks	57.2 ± 10.8	52 ± 10.5
	8 weeks	63.6 ± 12.5*	53.1 ± 10.1

Data are average and standard deviation of average. The initial values were always similar between the experimental and control groups. *Indicates P<0.05 compared to baseline values in the same group. **Indicates P<0.01 compared to baseline values in the same group. #Indicates P<0.05 between the experimental and control groups; #Indicates P<0.01 between the experimental and control groups.

The effect of the training protocol in body composition is shown in Figure 1. The experimental group showed a small decrease in the percentage of fat, but without differences between the initial testing and the others in that same group. Meanwhile, the control group showed no change in body fat percentage. As for the lean mass, none of the groups showed any intra or inter group alteration in any of the assessments.

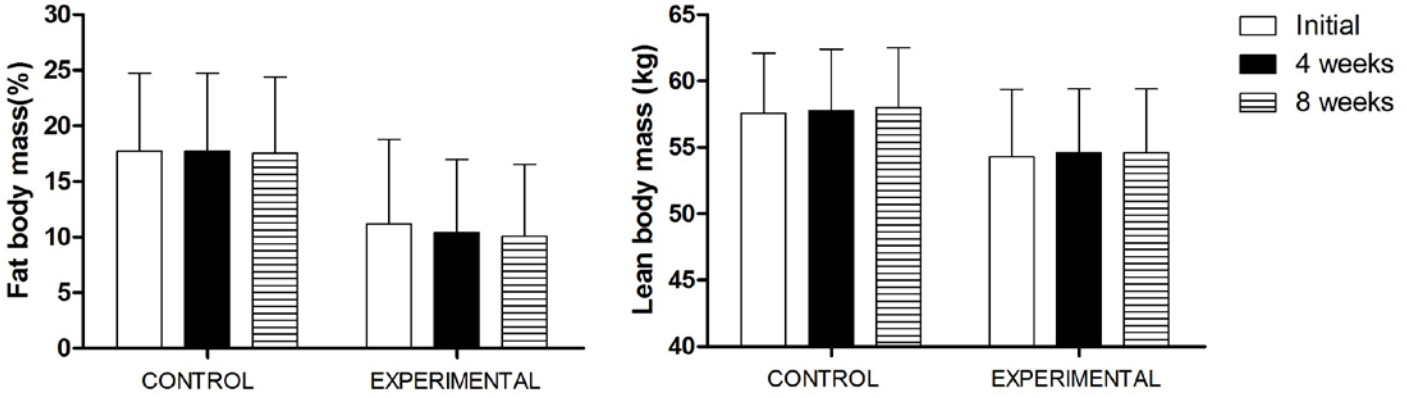

Figure 1. Evolution of Body Composition during 8 Wks of Resistance Exercises Protocol in the Company Exercise Sessions or Control Protocol with Stretching Sessions. The data are presented as mean ± SD. There are no statistical differences intra or inter groups.

None of the workers reported feeling constant body aches. "Always" as a possible answer in the adopted pain assessment protocol. “Often or rarely” referred pains were answers of both the experimental and control group before the intervention procedure with no differences found among groups at baseline. After the intervention, the average number of complaints remained unchanged in the control group, but pain felt rarely and pain felt often decreased, respectively by 35% and 62.5% in the experimental group. These data are shown in Figure 2.

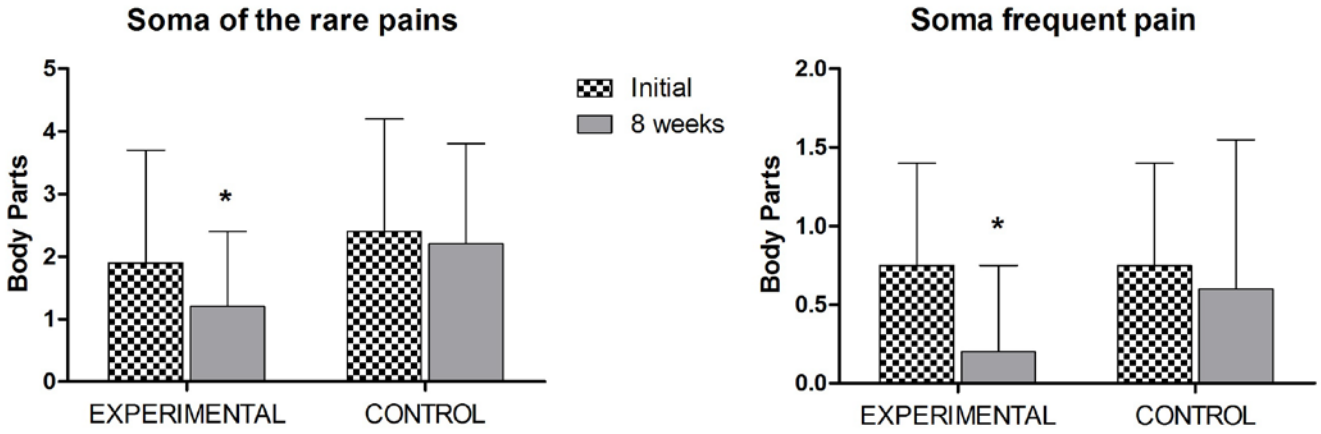

Figure 2. Total of Referred Pain in Body Parts Present in the Questionnaire, Before and at the End of the Experimental Protocol. Vertical axis represents the number of body parts in where subjects felt pain rarely (panel A) or often (panel B). None of the subjects answered “always” for pain in any body part before or after the study. The data are presented as mean ± SD. *Indicates P<0.05 regarding values from the initial evaluation of the experimental group, based on Friedman’s non-parametric test. Descriptive reduction was 35% for pain felt rarely and 62.5% for pain felt often.

The Profile of Mood States (POMS) protocol revealed that before the start of the study, both groups showed similar levels of score that did not change by the end of the study, neither for the experimental group nor the control group. Despite not changing in the experimental group, there was a reduction in fatigue while tension, depression, hostility, confusion, and vigor did not change. Control group have not showed any modification in any dimension. There data are shown in Table 2.

Table 2. Total Mood Disturbance and its Dimensions Among the Workers Undergoing Training with Resistance Exercises in the Experiemental Group and the Control Group.

Dimensions	Experimental		Control	
	Initial	8 wks	Initial	8 wks
Tension	0.9 ± 2.4	2.1 ± 2.9	3.9 ± 2.6	1.7 ± 2.6
Depression	6.1 ± 6.3	2.3 ± 1.8	3.6 ± 3.8	2.4 ± 3.9
Hostility	8.3 ± 6.1	4.9 ± 3.6	3.6 ± 2.9	3.1 ± 3.3
Fatigue	7.6 ± 2.3	3.5 ± 2.8*	5.4 ± 4.3	4.5 ± 2.9
Confusion	-0.1 ± 3.2	-0.8 ± 2.9	0.2 ± 2.9	-0.9 ± 3.0
Vigor	6.4 ± 2.4	8.9 ± 2.0	6.1 ± 4.9	6.9 ± 4.2
PTH	116.4 ± 18	106.1 ± 11	110.6 ± 10	103.9 ± 12

The data are presented as mean ± SD. *Indicates P<0.05 compared to the baseline values. **Indicates P<0.01 compared to the baseline values. PTH = the total mood disturbance.

DISCUSSION

The findings from this study indicate that the implementation of resistance training exercises of short duration promotes an increase in muscle strength, a decrease in body aches, and a decrease in the fatigue scale of the mood test.

Muscular Strength

Even without experiencing muscle hypertrophy (3,21), it is well known that resistance training is associated with a noticeable increase in strength after the first training sessions. It is worth mentioning that this classic strength increase is based on training protocols that consist of ~3 sets at an estimated duration of 60 min.

Some studies (16,27) have used 1 hr of strength training among industry workers, but the exercises are primarily specific to the region of the shoulders and neck. Unfortunately, current studies do not clarify whether shorter sessions of strength training are also able to promote a gain in strength. Perhaps, that is why Andersen et al. (2) developed a study with a protocol of only 20 min duration in workers. But, the exercises were performed with elastic band and the subjects were instructed to implement the strength building exercises from other modalities in their free time. Hence, the present study probably the first to demonstrate a significant increase in muscle strength in response to a resistance training protocol in workers that was defined by an appropriate duration of training within the reality of workers' designated time commitment.

Muscular Pain

Recent studies have shown significant reduction of muscle pain in workers who practice stretching exercises as well as the prevention of muscle and joint fatigue (6,13,20). An important aspect of this study is that the subjects in the experimental group were previous stretching practitioners engaged in stretching sessions with a frequency of 4 times·wk^{-1} plus a massage session. Therefore, we can infer

that they had already lower body pain when they started the protocol with resistance exercises. If we consider that the subjects in the control group showed no change in their pain while maintaining the stretching exercises, it is reasonable to confirm that the practice of resistance exercises, even with a short duration, promotes a further decrease in workers´ pain.

The reduction of pain as a result of the resistance training exercise in our study is supported by several other investigations, but with similar duration to what is commonly held in gyms. Taylor et al. (22) made a survey of systematic reviews that addressed the resistance exercise in different specialties. They found a reduction in pain and improvement in function in chronic low back pain and neck pain. Meanwhile, Lombardi Junior et al. (12) observed a reduction in pain and improved life quality in patients with shoulder impingement syndrome.

Body Fat Percentage

Some recent studies (14,18) report a reduction in body fat with the practice of resistance training. It is highly likely that the short duration of the protocol in the present study is the responsible factor for the lack of a significant decrease in percent body fat in the subjects. However, the fact that they had already low levels of body fat may also explain the lack of effect with the treatment intervention. Therefore, future studies that evaluate the efficiency of resistance exercise protocols of short duration in company workers who are overweight or obese should seek to clarify this issue.

Mood

The assessment tool for mood evaluation adopted in this study has been validated for multiple languages and diverse populations, even to diagnose possible problems with physical training (23). Therefore, the assessment tool has good acceptance within the scientific community. Indeed, it provided important information of which the first fact is the lack of change in the total score of the test indicated that the inclusion of training exercises did not cause any deleterious effect for over training the study subjects. The second finding relates to fatigue of which one of the dimensions assessed in the instrument was reduced among subjects in the experimental group. This indicates that the practice of resistance training exercises can minimize the feeling of fatigue in workers of industrial machinery who spend 8 hrs a day doing manual, repetitive work. The logical explanation for this finding is the increase in strength achieved with the resistance training protocol provided a greater muscular reserve (i.e., endurance).

Other studies with stretching exercises evaluate, besides pain, other variables that can be improved with exercise training in companies. These studies demonstrate reduced absenteeism and improved relations between the workers and their willingness to work (7,15). While we can assume that the increase in strength and pain reduction may have contributed to the increase in the willingness to work, we did not evaluate this possibility, so that the absence of this association and the assessment of absenteeism may be seen as limitations of this study.

CONCLUSIONS

The practice application of this study is the availability of information that attests to the possibility of including resistance training exercises in daily company exercise programs. To implement the proposed protocol used in this study, only 5 simple bodybuilding and low cost machines were required. Also, given that the stretching sessions are now an important part of the exercise routine of the workers, and benefits have been demonstrated, we believe that the data from this study should not discourage the practice of stretching. Therefore, we suggest weekly sessions to be alternated between weight training exercises and stretching exercises. The availability of resistance training

exercises in a company's exercise program should in fact motivate the workers' adherence to the initiative of company in promoting the workers' health.

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