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Impact of Exercise and Ergonomics on the Perception of Fatigue in Workers: a Pilot Study

Impacto do Exercício e da Ergonomia na Percepção de Fadiga em Trabalhadores: um Estudo Piloto

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Abstract

The supervised implementation of psychophysiological recovery breaks and physical exercise in the workplace can be motivational factors for employees to be productive and remain for a longer time at work. The aim of this study was to evaluate whether ergonomic conditions (including rest breaks) and exercise programs can reduce fatigue before, during and after work hours. Twenty participants, age range: 31- 48 years, were divided into four groups: 1) Exercise with rest breaks (n=5); 2) Exercise without rest breaks (n=5); 3) No exercise with rest breaks (n=5), 4). No exercise without rest breaks (n=5). The exercise group performed physical training, including resistance exercises, stretching and aerobic exercises for 4 weeks. The rest break was performed for 10 minutes and both exercise and rest were developed in the work place. To determine the fatigue effects on each intervention group, surveys with a 10-point Borg scale were used. In general, participants that conducted exercise program (1 and 2) showed less fatigue compared with those that did not perform the program (3 and 4), principally in the times during and after work hours ($P < 0.03$). This pilot study demonstrated that exercise programs may help to reduce fatigue during and after work hours.

Keywords: Physical Fitness. Occupational Health. Ergonomics.

Resumo

A implementação supervisionada de pausas e o exercício físico no local de trabalho podem ser fatores motivacionais para que os funcionários sejam produtivos e permaneçam por mais tempo no trabalho. Avaliar se as condições ergonômicas (incluindo intervalos para descanso) e programas de exercícios podem reduzir a fadiga antes, durante e depois do horário de trabalho. Métodos: Vinte participantes, com faixa etária entre 31 - 48 anos, foram divididos em quatro grupos: 1) Exercício mais intervalos para descanso (n= 5); 2) Exercício sem intervalos para descanso (n= 5); 3), Nenhum exercício com intervalos para descanso (n= 5), 4) Nenhum exercício sem intervalos para descanso (n= 5). Os grupos 1 e 2 realizaram exercícios resistidos, alongamento e exercícios aeróbicos por 4 semanas. O intervalo para descanso foi realizado por 10 minutos e ambos foram desenvolvidos no local de trabalho. Para determinar os efeitos da fadiga em cada grupo de intervenção foi utilizada uma escala de Borg de 10 pontos. Em geral, os participantes que realizaram o programa de exercícios (grupos 1 e 2) apresentaram menor fadiga em comparação com aqueles que não realizaram o programa (grupos 3 e 4), principalmente durante e após o horário de trabalho (P <0,03). Este estudo piloto demonstrou que um programa de exercícios pode ajudar a reduzir a fadiga durante e após o horário de trabalho.

Palavras-chave: *Aptidão Física. Saúde do Trabalhador. Ergonomia.*

1 Introduction

The ability to work is the ability of a person to work in their professional life associated with the specific demands of work tasks[1]. The work for the human being has a supporting role, being this source of sustenance, besides providing to the individual a way to feel useful, raising his self-esteem and can lead to the human being in sense of self-realization[2]. However, work overload can cause the worker a sedentary lifestyle, the demands of work, the charge in this environment, the volume of work and the pressure to increase production, alternating shifts, the existence of physical risks, the lack of independence can lead to musculoskeletal disorders and reduce ability to work, causing damage even to the country's economy[1].

A long day of work linked to forced labor positions and reduced lack of recovery present a high risk of incapacity for the worker[3]. Fatigue is a common complaint in this population due to its high prevalence and its association with severe dysfunctions among workers[3,4]. Muscle fatigue can be defined as any decrease in the neuromuscular system's ability to generate force. This condition may promote changes in the propagation of muscle action potentials, in contractile muscle mechanisms and also in ionic concentration, important for the maintenance of muscle contraction[5,6]. It affects physical and mental health, increasing the chance of accidents and musculoskeletal complaints, and reducing performance and productivity[7].

Exercise programs are indicated as an intervention

approach for the prevention and management of this disability in the workplace[8]. The potential beneficial effects of exercise programs on work ability can be understood from a combination of various physical and psychological mechanisms[9]. Michishita et al.[10] demonstrated that the practice of active interval in the work units is important to improve the physical-functional variables. In fact, the evaluation of recovery and exercise breaks is adequate, especially when both variables are evaluated together. However, few studies have evaluated the impact of exercise programs and recovery intervals on worker fatigue in the workplace.

The aim of this study was to evaluate whether ergonomic conditions (including rest breaks) and exercise programs can reduce fatigue before, during and after working hours.

2 Material and Methods

2.1 Study Design

This experimental pilot study was conducted at a furniture company in Arapongas, PR, Brazil.

2.2 Participants

A convenience sample of 20 participants were invited to participate of this study. The inclusion criteria were: Age above 18 years, be a worker in the company for at least 6 months, not performing physical activity in the last 2 months, absence of any mental or physical illness that could interfere in the exercises, severe orthopedic disease, neurological or respiratory dysfunction. Participants were informed about the experimental protocol and gave written concert before their participation. Ethics approval was obtained from the Local Ethics Committee (CEP/: 2.531.274).

Participants were randomly allocated (block randomization) into 4 groups (G1- Exercise with rest breaks, n=5, women: 2; G2- Exercise without rest breaks, n=5, women: 2; G3- No exercise with rest breaks, n=5, women: 2; G4- No exercise without rest breaks, n=5, women: 2). Block randomization was used to reduce bias and achieve balance in the allocation of participants to treatment arms, this is especially applied when the sample size is small[11].

2.3 Physical and individual measures

The methodology used in this ergonomic action follows the Ergonomic Work Analysis. This method consists of several steps. The first step is to identify the initial demand and the respective reformulation, global analysis and choice of critical work conditions. The hypotheses are formulated to be validated or rejected through a systematic analysis. The validation of the hypothesis is then performed to obtain an accurate diagnosis of the studied situation. From the diagnosis, it is possible to make suggestions for improvement in work conditions. In this case, the rest break was recommended to participants. The rest-break protocol consisted of 10-minute of rest, 5 times a week for 4 weeks (a total of 20 times) and the program was performed in the afternoon. During the rest breaks participants were oriented do not perform any exercises.

The exercise program was performed twice per week (in the morning), on alternate days, with approximately 40 min of exercise in each session, totaling 8 sessions. The program included both resistance exercises (eccentric and concentric) / stretching and aerobic exercises. Exercises such as core exercises (prone and lateral bridge), squats, unilateral knee flexion, extension, adduction, unilateral hip abduction, plantar flexion while standing, adduction and extension of the arms, flexion and extension of the elbow were all performed (inexpensive materials such as mats, sticks, balls, elastic bands, dumbbells and ankle weights were used). This exercise program was progressive by volume training and not intensity by load (the series and repetition started from 2-4 to 12-20, respectively)

To quantify individual fatigue and body-part discomfort, surveys with a 10-point Borg scale were used. The scale shows values from 0= nothing at all to 10=extremely strong. The survey was administered to each participant before, during and after the workday.

2.4 Statistical analysis

First, the Shapiro-Wilk test was used to evaluate the normality of the variables and determine which tests would be used. Descriptive analysis is presented as median and interquartile ranges. Kruskal-Wallis test was used to assess differences between the results of the fatigue for each group (Exercise with rest, Exercise without rest, No exercise with rest and No exercise without rest). All statistical analyses were performed with SPSS 20.0 for Windows (SPSS Inc., Chicago, IL, USA) with a level of significance of 0.05.

3 Results and Discussion

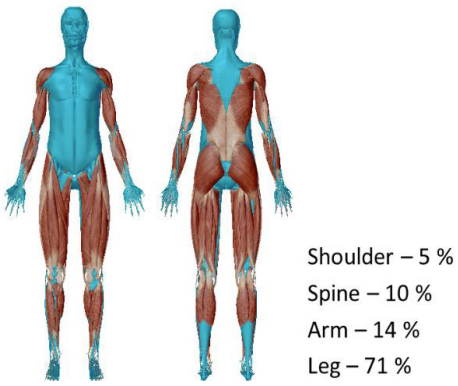
There were no significant differences between the groups (group 1, Exercise with rest; group 2, Exercise without rest; group 3, No exercise with rest; group 4, No exercise without rest) for age, weight, height and Body Mass Index (BMI) (Table 1). According to the Ergonomic Work Analysis, there was a high risk for the upper limbs, mainly due to the repetitiveness/frequency factor and the inadequate amount of recovery time. However, the employers related fatigue principally in the lower limbs (71 %), see Figure 1.

Table 1 - Characteristic of participants (N=20)

	Exercise with rest (n=5)	Exercise without rest (n=5)	No exercise with rest (n=5)	No exercise without rest (n=5)	*P Value*
Age (yrs)	37 [26-53]	42 [37-44]	37 [29-48]	44 [42-48]	0.500
Height (cm)	1.56 [1.54-1.60]	1.73 [1.69-1.75]	1.60 [1.53-1.76]	1.70 [1.59-1.73]	0.081
Weight (Kg)	68 [57-72]	73 [67-84]	69 [61-78]	72 [68-82]	0.323
BMI (Kg/cm²)	28 [26-28]	25 [22-28]	25 [23-28]	27 [22-29]	0.619

Values are presented in median and [interval interquartile range 25-75]. Kruskal-Wallis test.
Source: Research data.

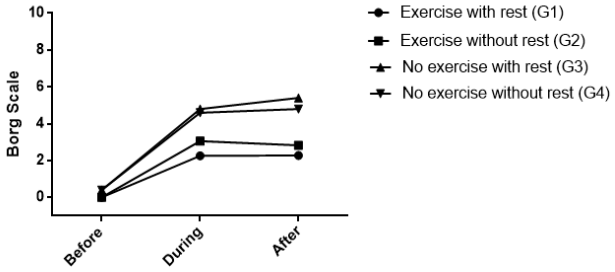
Figure 1 - Local fatigue reported by participants



Source: Research data.

Regarding fatigue, the group that performed physical exercise presented lower fatigue than the group that did not perform principally during (P <0.025, group 1 <3,4) and after (P <0.015, group 1 <3,4) working hours and apparently the recovery break was insufficient to produce effect in the fatigue (no statistical difference between no exercise with and without rest), Figure 2.

Figura 2 - Comparison between groups (Exercise with rest, Exercise without rest, No exercise with rest, No exercise without rest) for the fatigue (evaluated: before, during and after)



Statistical significant differences G1 < G3 and G4; ‡ Statistical significant differences between G1 < G3 and G4.
Source: Research data.

The objective of this pilot study was to evaluate whether ergonomic conditions and exercise programs can reduce fatigue before, during and after work hours. Our findings showed that workers who exercise, with or without recovery intervals reduced fatigue and also indicated that exercise can be as important as rest. The effectiveness of resistance exercise programs with progressive loads for fatigue reduction has already been shown in the literature[3,12,13], however, studies that used exercise with and without time to rest break need to be elaborated.

In general, the protocol of the exercise programs showed a minimum of 20-min training sessions, 2 and 3 times a week for periods of 8 and 10 weeks or more to reduce fatigue or musculoskeletal complaints in the workplace[3,13,14]. On the other hand, the time to rest is unclear in the literature. The most studies have used 10 min to promote rest break between subjects[15,16]. Lacaze et al.[15] Which evaluated 64 operators, who were allocated in 2 groups (32 individuals) control group, performed 10 min rest during 10 sessions and the experimental group performed exercises (stretching, joint mobilization and relaxation). They founded that the level of discomfort and number of body segments with discomfort decreased, and the percentage of painful segments was reduced in the experimental group compared to the control group. This finding corroborate with our results although the type of the work and time of training were different (flight-booking operators x furniture workers and 10 min vs 40 min, respectively).

The inclusion and comparison between time to rest-break and exercises is little explored in the literature, most studies use one or another intervention to analyze their effect in workers. In fact, articles on both rest break and exercises are directed on computer workers and the most studies corroborate with our findings. Osama et al. 2015 showed that patients in the exercise group showed superior results compared to the patients in rest breaks group on self-perceived and general body discomfort [17]. A randomized controlled trial conducted by Shariat et al (2018) demonstrated that after 6 months, only exercise and the combination of exercise and ergonomic modification were effective on pain scores in comparison with the control [18]. Though the exercise had showed more significant results, it's important to emphasize that the rest-break is a key component in ensuring the performance of the musculoskeletal system [19]. Evidence support that rest pauses combined with information leaflets resulted in decreased musculoskeletal pain in workers [20].

This study presented some limitation, being a pilot study we used individuals who volunteered to participate in the study. Therefore, the sample may not be generalizable for the general population. However, since this is one of the few investigations on worker fatigue available in the national and international literature, our findings provide valuable insights

in this area of study and may guide future studies. Another limitation was that we did not use equipment to quantify our findings such as electromyography, using its slope root mean square (RMS) / time and Mean Frequency / time ratio, as the main EMG indicator of muscle fatigue[21-23]. However, the Borg scale, despite being a subjective evaluation is one of the measures most commonly used in clinical trials to measure muscular fatigue, besides being a cheap and practical way of evaluation[15,24], and that has generated significant results and ideas for future studies.

Based on our results, we believe it is important to carry out exercise programs in the work environment. Evidence supports the use of exercise to reduce work-related fatigue[25]. The physiological and motivational factors associated with adherence to a program are important conditions for performing exercises in the work environment. In fact, the practice of physical exercises can help in the positive association between physical activity, health and maintenance of functional capacity.

4 Conclusion

The findings suggest that the ergonomic aspects associated with exercise programs can help reduce fatigue mainly during and after work hours. These results can contribute to health promotion and prevent deterioration of work capacity.

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