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Evaluation of workload among industrial workers with the Need for Recovery Scale

Sobrecarga em trabalhadores da indústria avaliada por meio da escala de necessidade de descanso

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Abstract

Background: Work conditions can overload a worker's capabilities and result in health complaints. The early identification of hazardous work conditions allows the definition of priorities for more efficient ergonomic interventions. **Objectives:** To assess the need for recovery among industrial workers under different work conditions using the Need for Recovery Scale (NFR), and to verify the association between the scores and personal factors, occupational factors and daily activities. **Methods:** 191 workers (mean age of 34.5 ± 8.3 years) from a manufactory industry participated in this study. Workers answered both a questionnaire regarding demographic and occupational factors, and daily activities as well as the NFR. Ergonomic assessment of workplace sectors was carried out based on the Ergonomic Workplace Analysis. The Pearson chi-square test (significance level 5%) was used to verify the association between NFR scores and the variables of interest. **Results:** The only association was between work sector and NFR score. According to the ergonomic assessment, the work sector with the highest need for recovery also presented the worst environmental and organizational conditions. **Conclusions:** The Need for Recovery Scale proved to be a helpful tool for differentiating work sectors presenting different workload demands and contributed to the definition of intervention priorities for preserving worker health.

Keywords: Fatigue; primary prevention; occupational health; occupational risks.

Resumo

Contextualização: As condições de trabalho podem gerar demandas excessivas e comprometer a saúde dos trabalhadores. A identificação precoce de condições críticas de trabalho permite determinar prioridades para intervenções preventivas e aumentar as chances de maior eficácia dessas medidas. **Objetivos:** Avaliar a necessidade de descanso para trabalhadores industriais submetidos a diferentes condições de trabalho utilizando a Escala de Necessidade de Descanso (ENEDE) e verificar a associação de seus resultados com fatores pessoais, ocupacionais e de hábitos cotidianos desses trabalhadores. **Métodos:** Participaram do estudo 191 trabalhadores (média de idade de $34,5 \pm 8,3$ anos) de uma indústria de transformação de madeira. Os trabalhadores responderam a um questionário sobre dados demográficos, ocupacionais e de aspectos de vida cotidiana e à ENEDE. Realizou-se avaliação ergonômica dos setores de trabalho com base no protocolo Ergonomic Workplace Analysis. O teste qui-quadrado de Pearson a 5% de significância foi utilizado para verificar associação entre a pontuação obtida pela ENEDE e os fatores avaliados. **Resultados:** Os resultados mostraram que houve associação apenas entre o setor de trabalho e as pontuações da ENEDE. Segundo a avaliação ergonômica, o setor que apresentou maior necessidade de descanso também apresentou piores condições de trabalho quanto a aspectos ambientais e organizacionais. **Conclusões:** A escala para avaliação da necessidade de descanso mostrou-se um instrumento útil para diferenciar setores de trabalho com diferentes níveis de exigências e contribuir para a definição de prioridades de intervenção para a preservação da saúde de trabalhadores industriais.

Palavras-chave: fadiga; prevenção primária; saúde do trabalhador; riscos ocupacionais.

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Introduction : : : .

Exposure to different working conditions may generate demands on workers that can result in both adaptation and work-related diseases^{1,2}. Excessive demand may result in different consequences to worker health³. Extensive review studies have associated different physical, biomechanical and psychosocial/organizational risk factors with several physical and mental health hazards⁴⁻⁸.

Considering the diversity of existing occupational situations and the possible risk factors in each situation, tools that help identify ergonomic intervention priorities can be useful for health professionals involved in work-related disease control⁹ since the earlier the identification, the more effective preventive interventions may be. A useful tool for such identification is the Need for Recovery Scale (NFR)¹⁰, which has been used to assess work-induced fatigue. It considers fatigue as a result of exposure to physical and mental demands imposed by work^{11,12}.

The role of the physical therapist in worker health is becoming increasingly widespread. One indication of this is the increasing number of researchers and related publications in Brazil and in Latin America^{13,14}. Other indications include recognition of Occupational Physical Therapy as a specialty by the Federal Council of Physical Therapy and Occupational Therapy - COFFITO (Resolution No. 351, 2008) and the Brazilian Classification of Occupations by the Ministry of Labor and Employment¹⁵. Since the identification of risks in the workplace that may harm workers' health (Resolution No. 259, 2003 - COFFITO) is an important job requirement¹⁶, the physical therapist may employ different methods, such as questionnaires like the NFR, to assess the perceptual aspects of risk exposure.

Studies using the NFR have shown that high scores on the scale are associated with a higher incidence of work accidents¹⁷, health problems¹⁸ and absenteeism¹⁹. In this context, the NFR may be useful for the early identification of overload in workers. Furthermore, it has proven to be sensitive to organizational changes in the workplace, such as the implementation of activity rotation programs²⁰ and increases in the number of hours worked²¹, which are important issues assessed by Organizational Ergonomics. Thus, the NFR can also be considered an important tool in planning and assessing preventive interventions in the workplace. For these reasons, the aim of the present study was to assess industrial workers' need for recovery under different work overloads using the NFR and to determine any association of its results with personal and occupational factors and daily habits.

Methods : : : .

Subjects

The study included 191 workers (mean age 34.5 ± 8.3 years) at a manufactory industry, of which 140 were women and 51 men. Only employees belonging to the two most numerous industry sectors (sectors A and B) and who had time available to answer the questionnaire were assessed. The workers from sector A were mainly machine operators who worked in groups of 2 to 4 and whose activities alternated between quality control of the final product, inspection of machine operation and material restocking. In sector B, most assessed workers worked with selecting materials and material assembly. On-the-job experience was 10.3 ± 8.8 years in sector A and 5.5 ± 5.9 years in sector B.

Worker participation was voluntary and affected neither wages nor overtime. All subjects were informed in advance about trial procedures and read and signed the consent form. The study was approved by the Ethics Committee on Human Research from the Universidade Federal de São Carlos (UFSCar), São Carlos, SP, Brazil (Proc. N. 0054.0.135.000.07).

Procedures

The workers answered a questionnaire containing demographic data (age, gender, educational level and marital status), occupational data (job function) and aspects of everyday life (housekeeping activities, smoking and physical activity practice) as well as the NFR¹⁰. The two occupational sectors in which participants worked were ergonomically assessed by an experienced physical therapist according to the Ergonomic Workplace Analysis (EWA) protocol, which was proposed by the Finnish Institute of Occupational Health²².

Questionnaire responses were given at the workplace after the workers had been instructed on how to complete the questionnaire. The importance of accurate answers to the questions and the confidentiality of worker answers were also stressed.

Assessment protocols

The NFR is a self-explanatory questionnaire consisting of 11 multiple choice questions with four possible answers each. The total score ranges from 0 to 100; the higher the score, the greater the amount of emotional, cognitive and behavioral fatigue symptoms and the greater the need for worker recovery¹⁰. The cultural adaptation of the NFR into Brazilian Portuguese from English (Need for Recovery Scale) followed

the procedures of systematic cultural translation of subjective tools¹⁰. The translated and culturally adapted version (NFR) showed psychometric parameters consistent for use with Brazilian workers¹⁰.

Ergonomic analysis of the work environment was based on Finnish Institute of Occupational Health²² guidelines, which cover 14 items: work space, general physical activity, lifting loads, work postures and movements, risk of accidents, work content, time constraints at work, communication between workers, decision making, repetitiveness of work, attention, lighting, thermal environment and noise. Each item received a score from the observer ranging from 1 to 5. A score of 1 means that the assessed working condition is close to optimal (without risk), while a score of 4 or 5 indicates conditions potentially detrimental to worker health²².

Data analysis

Continuous variables (NFR scores and age) were categorized to enable implementation of the nonparametric test of association required by the other variables. For the NFR score obtained, a criterion of Kiss, de Meester e Braeckman²³ was used to assess need for recovery level. This criterion divides scores into two categories: ≤ 45 points and >45 points. The age variable was divided into three categories: ≤ 29 years old, 30 to 39, and 40 or older. The association between NFR scores, demographic and occupational variables and lifestyle habits was tested by the Pearson chi-square test at a 5% significance level with SPSS v11.5 software. The results obtained by ergonomic analysis will be shown descriptively for comparison between sectors A and B.

Results

The association test showed that demographic factors and lifestyle habits were not associated with NFR scores (Table 1). Only the sector in which worker activities were performed influenced the need for recovery ($p < 0.001$); sector A had the highest number of workers with scores above 45.

While both sectors showed problems regarding physical items such as repetitiveness of work and work postures and movements, with slightly higher scores for sector B, sector A also showed organizational problems. The problems of this type for which sector A showed worse conditions than sector B were: time constraints at work, communication and personal contacts, thermal environment and noise. The major time constraints in sector A seem to have resulted from the fact that the work rate in most production processes is determined by the machine and not the worker. Thus, the worker has less freedom to control the time and mode of task execution, unlike sector B,

where workers have greater control of the production process. Regarding communication and contact, sector A had more limited personal contact between workers due to the greater

Table 1. Workers categorized according to the Need for Recovery Scale scores and gender, housekeeping, physical activity, smoking, having children, work sector, age, educational level and marital status.

(p=0.39)		Gender		
NFR	Female		Male	
≤45	73		23	
>45	67		28	
(p=0.55)		Housekeeping activities		
NFR	Yes		No	
≤45	85		9	
>45	78		11	
(p=0.24)		Physical activity		
NFR	Yes		No	
≤45	45		49	
>45	35		54	
(p=0.56)		Smoking		
NFR	Yes		No	
≤45	9		84	
>45	11		78	
(p=0.33)		Children		
NFR	Yes		No	
≤45	54		39	
>45	58		31	
(p<0.001)		Work sector		
NFR	A		B	
≤45	26		60	
>45	53		34	
(p=0.68)		Age		
NFR	≤29 years	30 to 39 years	≥40 years	
≤45	35	32	25	
>45	29	35	27	
(p=0.76)		Educational level		
NFR	Primary Education	Secondary Education	Graduated/ technician	
≤45	7	76	9	
>45	9	69	10	
(p=0.41)		Marital status		
NFR	Single	Married	Divorced	Widower
≤45	35	50	10	0
>45	28	52	8	2

physical distance between workstations and greater noise intensity. Contact with supervisors occurs only indirectly, resulting in less technical and social support from management. In sector B, communication was facilitated by the physical proximity of workstations, lower noise and more frequent contact with management, allowing greater interaction between workers and supervisors. Regarding environmental conditions, sector A was more exposed to seasonal temperature variations and higher noise levels due to the greater number of machines. The noise levels varied for sector A and B, respectively, from 78 to 89dB and from 70 to 72dB.

Discussion

The results of this study showed that need for recovery levels were affected only by labor sector. The ergonomic analysis showed more critical biomechanical aspects in sector B and more critical environmental and organizational aspects in sector A. Although the biomechanical risk factors in sector B are known to be associated with the development of work-related diseases, they do not seem to have substantially affected worker need for recovery when compared to the more critical organizational factors identified in sector A.

This may be due to the greater influence of the psychological rather than the physical demands of the work environment on NFR scores, although both reflect fatigue intensity¹². Another aspect to consider is that the concept of fatigue assessed by the NFR is based on the Effort-Recovery Model proposed by Meijman¹². According to this model, the effect of overload on the worker is influenced by both work and individual characteristics. Among the work characteristics, work control has a major influence on the need for recovery, because the level of control determines the worker's chance of recovery²⁴.

The temperature variations and high level of noise found in sector A may also have contributed to the high NFR scores. According to Parsons²⁵, heat stress and high noise levels can generate greater overload for the individual as well as feelings of discomfort, health effects and decreased worker performance.

In the present study, there was no association between gender and NFR scores. The fact that both genders reported housekeeping activities may have contributed to the lack of gender difference. Nevertheless, whether due to this or other related variables, the fact is that studies still differ on the influence of gender on worker need for recovery^{11,23,26}. According to a literature review²⁷, a greater observed susceptibility to illness by a certain gender should be viewed with caution, since differences in exposure may lead to overestimations²⁸.

Leisure-time physical activity levels also showed no association with worker need for recovery, despite the known benefits of physical activity on quality of life and well-being²⁹. One factor that may have influenced this result is the company's daily employee exercise program, which is similar in both sectors and includes warm-up exercises at the beginning of the shift and two breaks for stretching. The link between on-the-job exercise and relief of physical and mental fatigue has been recognized³⁰. However, further studies are needed to confirm this hypothesis.

Neither smoking nor educational level influenced the intensity of need for recovery. In both cases, the shape of data distribution may have influenced the results, since most workers were non-smokers and had completed high school. Studies with a wide distribution of individuals among different educational categories should be conducted to better assess the association between these factors and NFR.

The presence or absence of children did not influence the intensity of worker need for recovery. Although some association could be expected, these results are consistent with the findings of Kiss, Meester and Braeckman²³. According to these authors, having one or more children at home does not increase the chance of having higher scores on the scale than workers with no children.

The lack of association between age and higher NFR scores differs from the results of Kiss, Meester and Braeckman²³, who found differences between younger and older workers in a public sector. One possible reason for this is that more young workers were analyzed, with relatively few workers over 45 years of age. Despite the lack of association between age and level of need for recovery reported here, age is a factor to be considered in such assessments, since older workers tend to have higher rates of need for recovery^{19,31}.

Marital status was also not associated with NFR scores. Only one study in the literature (by Croon, Sluiter and Frings-Dresen)¹⁹ has reported that divorced individuals in large companies with high scores on the scale showed a greater tendency toward future absenteeism. Nevertheless, Croon, Sluiter and Frings-Dresen¹⁹ did not assess the relationship between NFR and marital status.

Regarding the methodological aspects of the scale, no NFR score cutoff points have been established in the literature for identifying workers at risk of developing health problems, although cutoffs of 45 and 50 have been suggested^{23,31}. Another study used the distribution of data itself to identify workers most in need for recovery and found that workers with scores corresponding to the upper quartile were those that had the most fatigue²⁶.

The results of the present study are limited to industrial workers and, therefore, cannot be generalized to other

populations. Further studies that analyze a larger number of workers performing more diversified occupational activities at different intensities are needed in order to comparatively assess the results of NFR in these populations.

It is also important to note that NFR is a tool that should be used by health professionals to benefit the worker and not as a means of hiring discrimination. Another point to consider is that the use of the NFR allows the identification of worker overload conditions, but does not directly suggest resolutions for the identified problem. The proposal of effective intervention measures is a task that requires specific training in worker health areas, such as Ergonomics and Occupational Physical Therapy. The NFR can be seen as one more tool for identifying risks¹¹ and, thus, can help determine priorities for ergonomic intervention. It can also serve as a tool for assessing and comparing pre- and post-intervention conditions^{20,21}.

Conclusion

The NFR proved to be a sensitive tool for assessing the need of recovery for workers under different working conditions, enabling a comparative analysis between different levels of occupational activities, and thus it could be an important tool for occupational health professionals. More studies using the NFR are needed to better define the cutoff points for need-for-recovery categories, as well as to investigate the clinical outcome in other worker populations.

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