Assessment of parameters to interpret the need for recovery in ergonomics: the need for recovery scale

Avaliação de diferentes parâmetros para interpretar a necessidade de descanso em ergonomia

Cristiane Shinohara Moriguchi[a], Taísa Trevizani[b], Ana Beatriz de Oliveira[c], Helenice Jane Cote Gil Coury[d]

[a] Post-Ph.D student in Physiotherapy at the Federal University of São Carlos (UFSCar), volunteer professor at UFSCar, São Paulo, SP – Brazil, e-mail: crisshinohara@gmail.com

[b] Undergraduate student in Physiotherapy at UFSCar, São Carlos, SP – Brazil, e-mail: tfisio09@gmail.com

[c] Adjunct professor at UFSCar, São Carlos, SP – Brazil, e-mail: biaoliveira@gmail.com

[d] Full professor at UFSCar, São Carlos, SP – Brazil, e-mail: helenice@ufscar.br

Abstract

Introduction: The Need for Recovery Scale (NFR) has been widely used in Ergonomics. However, there is no cut-off value validated in the literature which allows identifying in consensual way high levels of need for recovery. **Objective**: Compare the use of different mathematical parameters to interpret data from NFR, i.e. tertile, quartile, and mean value, as well as cut-off values already suggested in the literature, in order to investigate the behavior of these parameters in the identification of high levels of need for recovery. **Materials and methods**: This study had the participation of 679 workers, out of which 192 were industrial laborers, 128 were nursing professionals, and 359 were call-center operators. Data collection was conducted by means of questionnaires. **Results**: Data distribution significantly varied between groups. The cut-off values defined according to data distribution (tertile and quartile) were similar to some cut-off values described in the literature. The various cut-off values proposed did not identify similar amounts of workers with high levels of need for recovery. The non-normal distribution of two out of these populations showed that the mean value may not be an adequate parameter. **Discussion and conclusions**: The different mathematical parameters used to identify high levels of need for recovery did not lead to equivalent results, suggesting caution to be selected. While studies with

larger populations are not available, the use of data distribution within a group itself is more recommended than the use of fixed points to identify high levels of need for recovery.

Keywords: Fatigue. Reference values. Parameters. Workers. Primary prevention.

Resumo

Introdução*: A Escala de Necessidade de Descanso (Enede) tem sido amplamente utilizada na ergonomia. No entanto, não há ponto de corte validado na literatura que permita identificar de forma consensual altos níveis de necessidade de descanso.* ***Objetivo****: Comparar a utilização de diferentes parâmetros matemáticos para interpretação dos dados da Enede, sendo eles tercil, quartil e média, assim como pontos de corte já sugeridos pela literatura, no sentido de investigar o comportamento desses parâmetros na identificação de altos níveis de necessidade de descanso.* ***Materiais e métodos****: Participaram do estudo 679 trabalhadores, sendo 192 trabalhadores da indústria, 128 profissionais de enfermagem e 359 operadores de teleatendimento. A coleta de dados foi realizada pela aplicação de questionários.* ***Resultados****: A distribuição dos resultados variou consideravelmente entre os grupos. As separatrizes definidas com base na distribuição dos dados (tercil e quartil) apresentaram valores semelhantes a alguns pontos de corte descritos na literatura. Os diferentes pontos de corte propostos pela literatura não identificaram quantidades similares de trabalhadores com altos níveis de necessidade de descanso. A distribuição não normal de duas das populações mostrou que a média pode não ser um parâmetro adequado.* ***Discussão e conclusões****: Os diferentes parâmetros matemáticos utilizados para identificar altos níveis de necessidade de descanso não conduziram a resultados equivalentes, sugerindo cautela na sua seleção. Até que estudos com maiores populações estejam disponíveis, a utilização da própria distribuição dos dados de um grupo é mais recomendada que a utilização de pontos fixos para identificar altos níveis de necessidade de descanso.*

Palavras chave*: Fadiga. Valores de referência. Parâmetros. Trabalhadores. Prevenção primária.*

Introduction

The illness profile among workers has been modified due to stress and mental fatigue generated by work (1, 2). This fact may be observed by means of the higher demand for accident-related work leaves due to mental and behavioral disorders identified in recent Brazilian surveys (3). Contrary to the downward tendency with regard to the occurrence of more general accidents, the amount of aid related to these disorders has increased and they already are the third most frequent cause of aid grants (3).

The effects of fatigue accumulation due to work mental overload may contribute to the occurrence of various problems, among them disorders related to mental health and psychosomatic disorders (4). In addition to the damage caused to individuals, fatigue can also bring economic consequences, such as higher absenteeism rates and occupational accidents, disability retirement, loss of ability to work, decreased effectiveness (5, 6, 7), and, as a consequence, decreased productivity (8). Thus, the attempt to reduce fatigue becomes a key factor for the individuals'

quality of life, for the companies, and for the pension and health care systems, which may act in a preventive way, intervening before the onset of diseases preventing them to evolve.

Thus, tools which are able to assist in the early identification of situations where there is fatigue accumulation in workers can be quite useful for the occupational health care services. In order to assess fatigue at the working environment, many questionnaires have been proposed in the literature (9). Among the instruments available, the Need for Recovery Scale (NFR) is an economically viable tool, being simple to apply and able to assess the early symptoms of fatigue at work, which precede the development of emotional exhaustion, sleep disorders, and psychosomatic symptoms (10, 11). This questionnaire has been translated and validated into Brazilian Portuguese, being entitled as "Escala de Necessidade de Descanso" (ENEDE) (12).

The need for recovery has been assessed in various populations of workers with different objectives. In cross-sectional studies, the scale was used to assess the prevalence of workers in need

of recovery (13), as well as to investigate the association between the need for recovery and occupational stress (14), anxiety, depression, demand of medical care (15), insomnia (16), and individual factors (17, 18, 19). The scale has also been used for comparing the need for recovery between genders, different types of work (11,19), or different kinds of exposure to risk factors, such as long working hours and number of working days per week (20). In longitudinal studies, the scale has been used to check the risk among groups with high need for recovery to undergo heart problems (21) and general health problems (11), and to suffer an occupational accident (7), or, also, to check the effectiveness of ergonomic interventions for reducing the need for recovery (22). Based on these studies, we may claim that there is a wide use of NFR as a useful tool to identify the early symptoms of fatigue in workers, aiming at prevention and rehabilitation in occupational health care.

Despite its widespread use as a tool in occupational situations, there is not a reference value described in the literature, expressed by a cut-off value validated to identify the groups with high levels of need for recovery (23). In previous studies available, various cut-off values were suggested to assess what could be regarded as high levels of need for recovery. The diversity of values proposed may be related to a lack of standardization in the methods used to find them. A study (24) used as cut-off value the number 50, but it did not propose a justification for this choice. In turn, a posterior study by the same group of authors used a lower cut-off value, i.e. 45, based on the analysis of sensitivity and specificity of the scale to predict cases of development of long-term psychosomatic complaints (17), however, the values proposed are not comparatively discussed. Even lower levels, such as 36, have also been suggested, based on interviews with trade unions, health professionals, representatives of companies, and researchers (23). There were studies (13, 25) using a higher cut-off value, 54. While some researchers (25) justify their choice having the distribution of data among the Dutch population as a basis (upper third), another study (13) is based on the analysis of sensitivity and specificity of the scale to predict cases that would receive treatment due to psychological complaints.

As there is no consensus with regard to the cut-off value, some authors, when using NFR as a dichotomous variable in their analysis, have adopted data distribution itself to establish the cut-off parameter, mainly using for this the tertile and quartile values (7, 16, 26). On the other hand, there are authors who also use NFR as a continuous variable, in order to compare mean values or linear regressions and correlations (20, 27). The arbitrary choice of parameter may be observed in another study (28), where the authors classify the need for recovery both in three levels (low, medium, and moderate), based on tertiles to calculate the risk of removal through the odds ratio, and they also regard it as a continuous variable and use the Student's t-test to compare the need for recovery found in two consecutive evaluations. In another study (29), the authors identify high levels of need for recovery based on the upper quartile to assess the prevalence and cumulative incidence of fatigue and they also use Pearson's correlation to check the connection between NFR and other study variables. Thus, we observe a lack of consensus for choosing the parameter used. The authors also do not justify the reasons for adopting a given parameter, or they even discuss, on a comparative basis, the results in this context.

To explore the results derived from the use of different parameters in the identification of workers with high levels of need for recovery, three populations of workers exposed to different workloads were evaluated in this study. Call-center operators, who undergo sedentary work with high mental demand (30), nursing professionals, and industrial laborers, who undergo work with high physical and mental demands (19, 31), were evaluated here by means of NFR. Therefore, the aim of this study was comparing the use of different mathematical parameters for assessment, namely, tertile, quartile, and mean value; and comparing cut-off values already suggested in the literature, in order to investigate the behavior of these parameters in the identification of high levels of need for recovery.

Methods

Subjects

The study had the participation of 679 workers (mean age 31 ± 9 years). Among them, 192 were industry laborers (mean age 34 ± 8 years), 128 were

nursing professionals (mean age 35 ± 10 years), and 359 were call-center operators (mean age 27 ± 8 years).

Ethical aspects

All workers were previously informed about the procedures of the study in which they would participate; they read and signed a free and informed consent term to participate in the study. Workers' participation was voluntary and free from any burden, taking place during their usual working hours. This study was approved by the Research Ethics Committee of the Federal University of São Carlos (UFSCar), under the CAAE 1080.0.000.135-10 and the Opinion 154/2010.

Procedures

Data collection was conducted by means of two questionnaires. We applied an initial questionnaire to collect demographic and occupational data on workers. A second questionnaire consisted of the version of NFR translated and culturally adapted into Brazilian Portuguese (12).

The questionnaires were completed in the very workplace, after explanation about them and the importance of answering to all questions, as well as the confidentiality of the answers.

Tools used

NFR is a self-explanatory scale, with 11 objective questions and 4 possible answers. The answer alternatives are scored according to Likert's method (never = 0, sometimes = 1, often = 2, and always = 3), except the fourth question, which has a reverse scoring. The NFR total score ranges from 0 to 33, which is transformed by means of cross-multiplication on a scale from 0 (minimum) to 100 (maximum), and the higher the score, the higher the fatigue symptoms presented by the worker (12).

Individuals who did not answer to 5 or more questions were excluded from the study, and those who did not answer to 4 or less questions had their score proportionally adjusted to the number of questions answered to (20).

Data analysis

Based on the parameters already used by the studies available in the literature to identify risk groups with regard to the need for recovery (tertile, quartile, mean value, and cut-off values), we conducted a descriptive analysis of results obtained by the populations assessed in this study.

For each group of workers, we determined the upper tertile (26, 28) and quartile (29, 32) to identify the separatrices delimiting the 33% and 25% higher levels of need for recovery, respectively. To determine the separatrices through the upper tertile and quartile, the data were arranged and, subsequently, we identified the values regarding the need for recovery separating, respectively, the 33% and 25% higher values found in the sample under assessment. As observed in asymmetric distributions, the interquartile interval represents better the data variability (33); the lower quartile will also be presented.

As central tendency measures, we used the mean and median values. The mean value was presented because it is the central tendency measure most frequently used for data representation (33) and also because it is a parameter used in previous studies to represent the need for recovery (20). However, although it is versatile, the mean value undergoes a greater influence from extreme values with regard to the median value (34). Thus, the median comprises the central tendency measure most suitable for asymmetric distributions (35) and, therefore, it was also presented.

Based on the cut-off parameters described in the literature, workers were classified into two categories (low and high level of need for recovery). The cut-off values used were: 36 (23), 45 (17), 50 (24), and 54 (13, 25).

Box diagrams presenting the tertile and quartile values associated to the cut-off values available in the literature were presented to allow viewing the equivalence between these parameters (Graph 1). The distribution of absolute frequencies regarding the need for recovery associated to the mean and median values for each population was also calculated (Graph 2). Stem and leaf diagrams were also presented (Table 2) for better viewing repeated occurrences for some values of the results.

Some studies have also taken into account the results of the scale of need for recovery as a continuous quantitative variable, using statistical tests such as Student's t-test, ANOVA, and Pearson's correlation to analyze the data and not as ordinal or

dichotomous variable (11,15, 22 ,27). Thus, we used the Kolmogorov-Smirnov test to check the normality of data among each worker population. The data were analyzed through the statistical software SPSS, version 11.5 (SPSS Inc, Chicago, IL, USA), and the graphs were plotted in the software SigmaPlot.

Results

The cut-off values 36, 45, 50, and 54 led to different numbers of workers classified as having a high level of need for recovery in each of the three populations under assessment (Table 1). On the other hand, the same fixed cut-off value considerably varied to identify the high levels of need for recovery between populations due to the different distribution of the data they presented.

Another aspect drawing attention is the insensitivity of some cut-off values for different results presented by each population. Regarding the call-center operators, all cut-off values ≥ 45 were not sensitive to categorize the need for recovery (Table 1). On the other hand, the cut-off value 36 classified as having a high need for recovery more than half of the industrial workers and the nursing professionals.

The separatrices determined by the upper tertile and quartile had values equivalent to some cut-off values previously described in the literature (Graph 1). However, these equivalences ranged between parameters and populations. This may be illustrated by the fact that for call-center operators, who generally showed the lowest NFR values, there was a coincidence between the value of the upper tertile and the cut-off value 36; for the nursing professionals, there was equivalence between the value of the upper quartile and the cut-off value 50; in turn, for industrial workers, who showed

comparatively higher values of NFR, there was an equivalence between the upper tertile and the cut-off value 50. Thus, there was not a common tendency between the separatrix parameters and the cut-off values available in the literature. However, there seems to be a dependency relationship between the overall mean values of NFR and some of the cut-off values, so that low values of need for recovery presented by the population corresponded to lower cut-off values and vice versa, suggesting a parameter-dependent relationship.

By means of Graph 1, we also observe greater variability of the data presented by industry laborers, who had a higher interquartile interval value than nurses and call-center operators.

Graph 1 shows a coincidence between the cut-off value 36 and the separatrix is determined by the upper tertile for call-center operators and between this point and the median value for nursing professionals. However, the percentage of workers with high levels of need for recovery identified by the cut-off value 36 among the call-center operators was 37.3% (Table 1), something which does not correspond exactly to the 33% of the upper tertile illustrated in Graph 1. The same occurs with nursing professionals, when the cut-off value 36 identified 54.7% of workers as fatigued (Table 1), instead of the 50% shown by the median value in Graph 1. Thus, we found out that the use of cut-off values did not determine exactly the tertile or 50% of the higher values, as shown in Graph 1. This is so because different individuals may have the same score (Table 2), thus increasing the number of subjects for a specific value, something which inflates the percentage of workers identified as having high levels of need for recovery.

Table 1 – Percentage of workers who presented low and high levels of need for recovery, according to the cut-off values 36, 45, 50, and 54 in call-center operators, nursing professionals, and industrial workers

	Percentage of workers (%)							
	Cut-off value 36		Cut-off value 45		Cut-off value 50		Cut-off value 54	
	low	high	low	high	low	high	low	high
Call-center (n = 359)	62.7	37.3	81.6	18.4	88.9	11.1	90.5	9.5
Nursing (n = 128)	45.3	54.7	67.2	32.8	72.7	27.3	82.0	18.0
Industry (N = 192)	31.8	68.2	50.5	49.5	63.0	37.0	62.8	31.8
Total (n = 679)	51.1	48.9	70.1	29.9	78.5	21.5	82.6	17.4

Source: Research data.
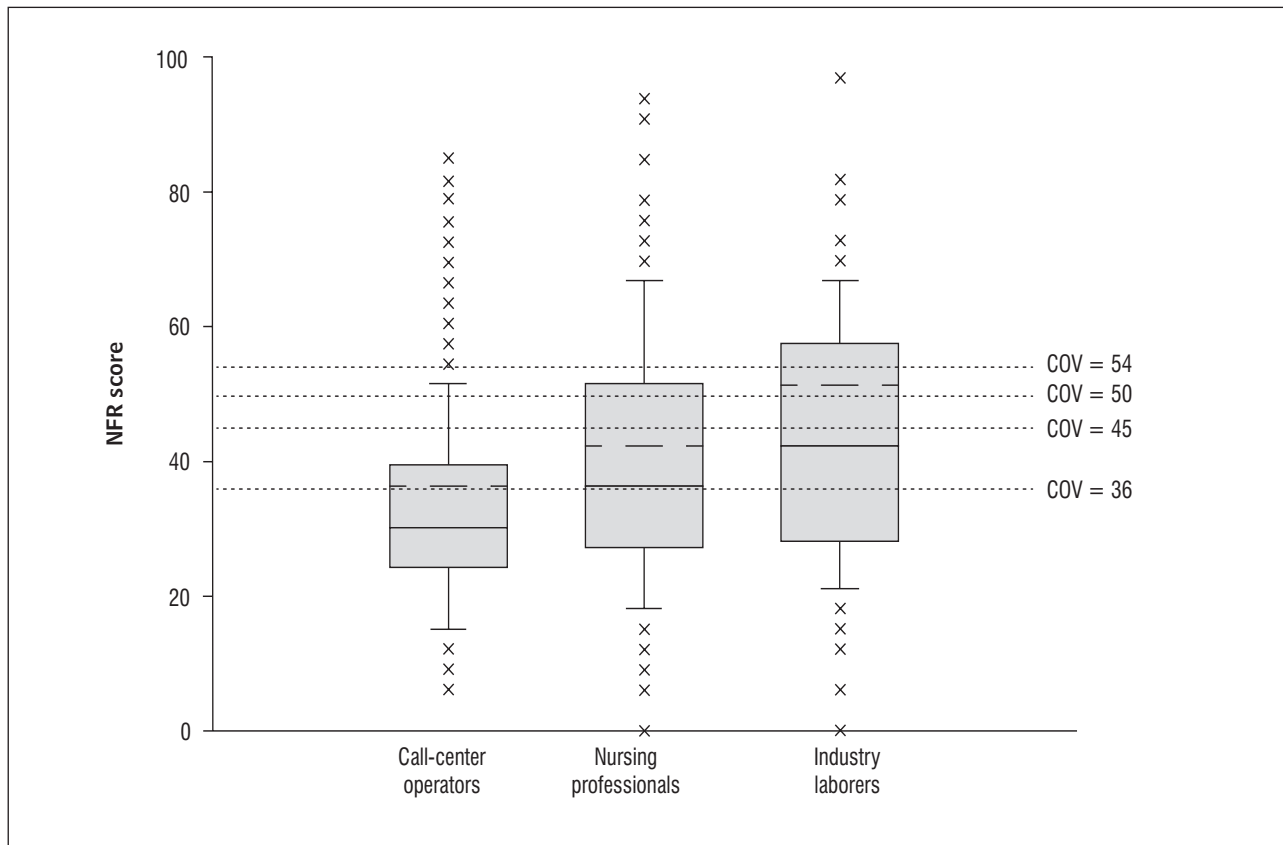
Graph 1 - Need for recovery among call-center operators, nursing professionals, and industry laborers

Legend: Dotted line = cut-off values 36, 45, 50, and 54; dashed line within the boxplot = percentile 66; crosses = observations outside the interval between the 10 and 90 deciles.

Source: Research data.

Note: The boxplot lines define the quartiles and the error bars define the 10 and 90 deciles.

A comparison between the data of Table 1 and Graph 1 shows that the cut-off value 45 allowed identifying around 33% of the nursing professionals with high levels of need for recovery, despite the value of the upper tertile do not correspond to the number 45, but to 42.4. Despite the numerical difference between the cut-off value 45 and the upper tertile (42.2), both identify around the 33% higher levels of need for recovery for this population. This discrepancy was due to the characteristic of the scale, whose data do not show linearity, given its ordinal nature, something which can be seen through the leaves of the diagrams presented in Table 2.

Data on the need for recovery among call-center operators (p = 0.016) and nursing professionals (p < 0.001) showed non-normal distribution. Only data on industry laborers had a normal distribution (p = 0.176). Histograms of the three populations are presented in Graph 2.

The right asymmetry of data can be confirmed through greater closeness to the median value of the first quartile (Graph 1) and the displacement of the mean value with regard to the median to the right (Graph 2), for data on call-center operators and nursing professionals. As for the industry laborers, the median value presented equidistant from the lower and upper quartiles (Graph 1) and the mean and median values were closer (Graph 2). With the usual distribution presented by the data on industry laborers, the mean value showed to be a central tendency measure appropriate for this population, but not for call-center operators and nursing professionals.

Discussion

This study used different criteria for categorizing the levels of need for recovery and, thus, identifying

Table 2 – Stem and leaf diagram of need for recovery presented by call-center operators, nursing professionals, and industry laborers

Stem	Leaves Call-center operators n = 359	Leaves Nursing professionals n = 128	Leaves Industry labores n=192
0		0	0
0			
0	66666	6	666
0	999999	9	
1	22222222222	222	2222
1	55555555555555555555555555	55555	555
1	8888888888888888888888888	88888	88888
2	1111111111111111	111111	111111
2	444444444444444444444444444444444	4444444	44444444444444
2	77777777777777777777777777777777	77777777	777777777777
3	00000000000000000000000000000	000000000000	00000
3	333333333333333333333333333333333333333333	333333333	33333333
3	66666666666666666666666666666666666	6666666666666	666666666666
3	999999999999999999999	99999	999999999999
4	222222222222222	2222222222	222222222222
4	55555555555	555555	555555555555555
4	888888888888888	8	888888888
5	111111	11111111111	1111111111
5	444444	444	4444444444
5	777777		77777777777777777
6	00000000	000	00000000
6	3333	333	33
6	6	66	66666666
6	99	99	9999
7	222	2222	22
7	5	5	
7	8	88	888
8	1		11111
8	4	4	
8			
9		0	
9		3	
9			66
9			

Source: Research data.

Note: Quartiles are highlighted in bold and underlined. In the stem we present the ten digits and in the leaves the unit digits of the levels of need for recovery, and each unit represents a worker. The units had their values rounded down.

workers with high levels of need for recovery: data distribution (tertile and quartile) and cut-off values established in the literature. The results presented showed that there was no direct equivalence between these parameters. As for the use of the scale of need for recovery as a continuous quantitative variable, it can be seen that among the three populations under assessment, two had non-normal distribution. For these two populations, the use of central tendency measures and the use of statistical tests which are based on assumptions of normal distributions would not be the most appropriate parameter and analysis
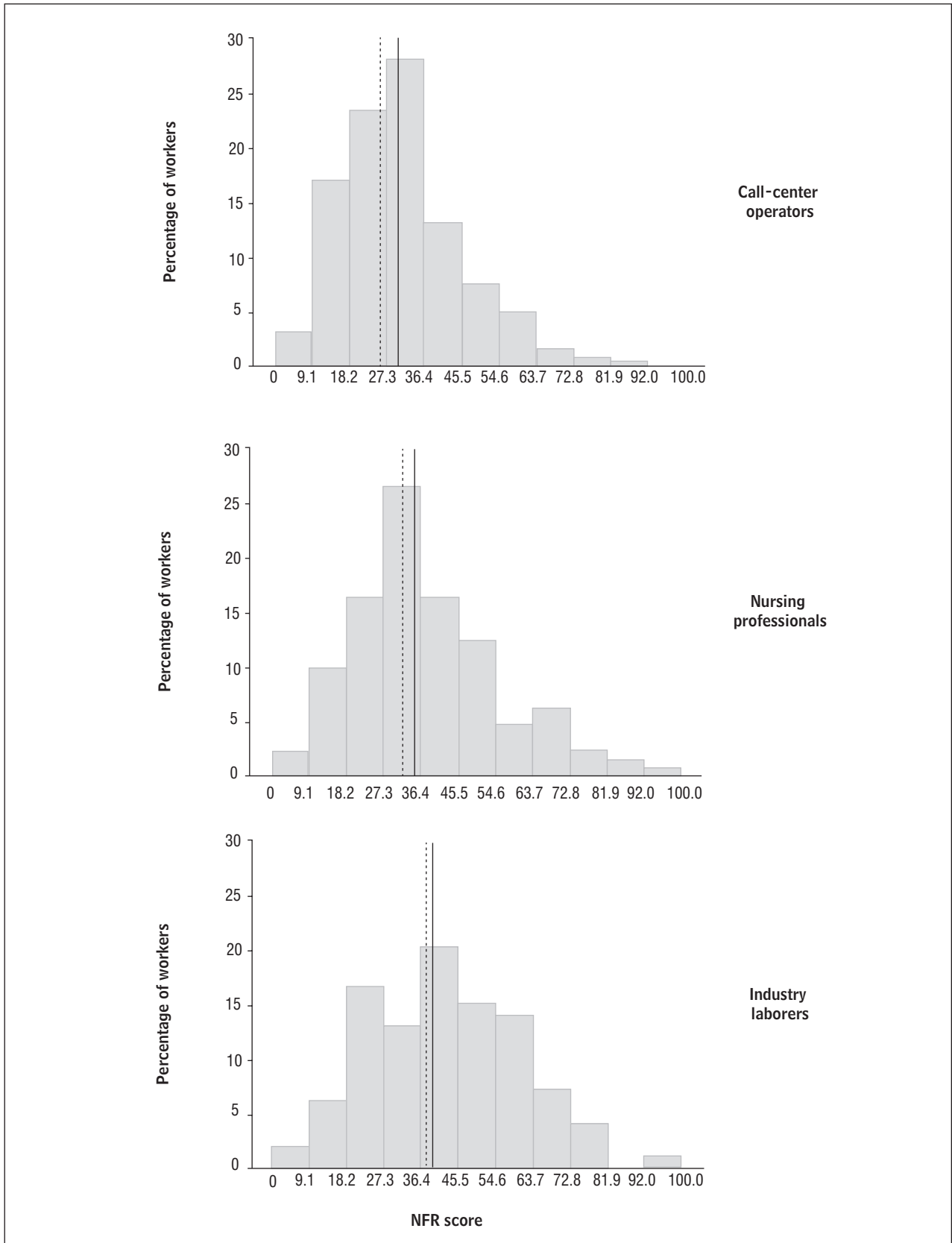
Graph 2 - Histograms of the scores obtained by call-center operators, nursing professionals, and industry laborers

Legend: Continuous line = average; dotted line = median value.

Source: Research data.

for identifying populations with higher levels of need for recovery. Therefore, the definition of mathematical parameters to assess the need for recovery requires caution and checking of compliance with the assumptions of parametric statistical tests.

The cut-off values used in this study were proposed based on some studies available in the literature (13, 17, 23, 24). Through these studies, it is possible to see the diversity of cut-off values proposed in the literature (between 36 and 54), something which reveals the dependence on its determination both of the methods used and the population, as well as the clinical outcomes under assessment. Another noticeable point is that even in studies where the specificity and sensitivity of cut-off values were tested, details regarding methods, population under assessment, and results are not presented. Thus, there is no cut-off value that may be recommended having studies available in the literature as a basis, without arbitrary choice.

In the results of this study, the number of workers identified as having high levels of need for recovery for each cut-off value proposed in the literature varied between the three populations under study, something which reveals the influence of data distribution in sensitivity (Table 1). Moreover, the number of workers identified as having high levels of need for recovery between cut-off values varied considerably, i.e. the different cut-off values do not show similar results. Some of cut-off values showed they are not even sensitive to identify a portion of workers with high levels of need for recovery, as occurred with the cut-off value 36 for nursing professionals and industry laborers (Graph 1).

Another important aspect to be taken into account in the use of fixed cut-off values is the scale accuracy. In the case of NFR, which has four alternative answers, the final score ranges from 0 to 33, and, when turned by means of cross-multiplication into a scale from 0 to 100, the final score has intervals of 3.03 (Table 2). Thus, the Brazilian version has a more accurate score, being sensitive to the cut-off values 50 and 54. However, for the dichotomous scale, there is no difference between using these cut-off values, since its accuracy consists of 9 points when turned into a scale from 0 to 100.

Alternatively to the cut-off values proposed in the literature, there is the parameter based on distribution of data for identifying workers with higher levels of need for recovery (tertile and quartile). However,

these parameters are not able to reveal if more workers are at risk or not, besides those who are above the values determined by tertile and quartile, unlike the situation in which a fixed cut-off value is used. Another aspect to be taken into account with regard to the use of data distribution is the presence of repeated data, something which can interfere with the classification of results if there are many repeated values. Furthermore, the comparison of results from studies using the very distribution of data may be compromised.

Therefore, due to the limitations previously indicated with regard to the cut-off values proposed in the literature and the fact that they were determined through the scale with two alternative responses and in samples non-representative of the Brazilian population, we take into account the use of data distribution for identifying individuals with high levels of need for recovery as the best parameter to interpret the results of NFR, until databases representative of the Brazilian working population, using the scale with four response alternatives, are available.

Conclusion

This study showed that the choice for a parameter to identify workers with high levels of need for recovery is a complex aspect, since different results may be found according to the parameter used and the population under study. With the absence of fixed values established for the Brazilian population and the variability of inter-group results found among the various cut-off values, the use of parameters based on the very data distribution is more recommended.

Acknowledgements

References

1. Cai o número de acidentes de trabalho e aumenta afastamento por transtornos mentais. Ministério da Previdência Social: Notícias. 5 mar 2012 [cited 2013 Nov 27]. Available at: http://www.previdencia.gov.br/?s=transtornos+mentais

2. Guimarães BM, Laura BM, Azevedo LS, Andrade MA. Análise da carga de trabalho de analistas de sistemas e dos distúrbios osteomusculares. Fisioter Mov. 2011;24(1):115-24.

3. Ministério da Saúde (Brasil). Organização Pan-Americana da Saúde no Brasil. Doenças relacionadas ao trabalho. Manual de Procedimentos para os serviços de saúde. Brasília: Ministério da Saúde; 2001.

4. Sato L. Prevenção de agravos à saúde do trabalhador: replanejando o trabalho através das negociações cotidianas. Cad Saude Publica. 2002;18(5):1147-66.

5. Glise K, Hadzibajramovic E, Jonsdottir IH, Ahlborg G Junior. Self-reported exhaustion: a possible indicator of reduced work ability and increased risk of sickness absence among human service workers. Int Arch Occup Environ Health. 2010;83(5):511-20.

6. Varekamp I, van Dijk FJH. Workplace problems and solutions for employees with chronic diseases. Occup Med. 2010;60(4):287-93.

7. Swaen GMH, van Amelsvoort LGPM, Bültmann U, Kant IJ. Fatigue as a risk factor for being injured in an occupational accident: results from the Maastricht Cohort Study. Occup Environ Med. 2003;60(Suppl. 1):i88–i92.

8. Iida I. Ergonomia: projeto e produção. São Paulo: Edgard Blücher, 2005.

9. De Vries J, Michielsen HJ, van Heck GL. Assessment of fatigue among working people: a comparison of six questionnaires. Occup Environ Med. 2003;60(Suppl. 1): i10-i15.

10. van Veldhoven M, Broersen S. Measurement quality and validity of the need for recovery scale. Occup Environ Med. 2003;60(Suppl. 1):i3-i9.

11. Sluiter JK, De Croon EM, Meijman TF, Frings-Dresen MHW. Need for recovery from work related fatigue and its role in the development and prediction of subjective health complains. Occup Environ Med. 2003;60(Suppl. 1):i62-i70.

12. Moriguchi CS, Alem MEB, van Veldhoven M, Coury HJCG. Cultural adaptation and psychometric properties of Brazilian Need for Recovery Scale. Rev Saude Publica. 2010;44(1):131-9.

13. Verdonk P, Hooftman WE, van Veldhoven M, Boelens LRM, Koppes LLJ. Work-related fatigue: the specific case of highly educated women in the Netherlands. Int Arch Occup Environ Health. 2010;83(3):309-21.

14. van der Hulst M, van Veldhoven M, Beckers D. O Overtime and need for recovery in relation to job demands and job control. J Occup Health. 2006;48(1):11-9.

15. Sterud T, Hem E, Ekeberg O, Lau B. Health problems and help-seeking in a nationwide sample of operational Norwegian ambulance personnel. BMC Public Health. 2008;8(3):1-9.

16. Silva-Costa A, Griep RH, Fischer FM, Rotenberg L. Need for recovery from work and sleep-related complaints among nursing professionals. Work. 2012;41(1):3726-31.

17. Kiss P, De Meester M, Brackman L. Differences between younger and older workers in the need for recovery after work. Int Arch Occup Environ Health. 2008;81(3):311-20.

18. Mohren DCL, Jansen NWH, Kant IJ. Need for recovery from work in relation to age: a prospective cohort study. Int Arch Occup Environ Health. 2010;83(5):553-61.

19. Moriguchi CS, Alem MER, Coury HJCG. Sobrecarga em trabalhadores da indústria avaliada por meio da escala de necessidade de descanso. Rev Bras Fisioter. 2011;15(2):154-9.

20. Jansen NWH, Kant I, van Amelsvoort LGPM, Nijhuis FJN, van der Brandt PA. Need for recovery from work: evaluating shot-term effects of working hours, patterns and schedules. Ergonomics. 2003;46(7):664-80.

21. van Amelsvoort LGPM, Kant IJ, Bültmann U, Swaen GMH. Need for recovery after work and the subsequent risk of cardiovascular disease in a working population. Occup Environ Med. 2003;60(Suppl. 1): i83-i87.

22. Kuijer PPFM, van der Beek AJ, van Dieën JH, Visser B, Frings-Dresen MHW. Effect of job rotation on need for recovery, musculoskeletal complaints: a prospective study among refuse collectors. Am J Ind Med. 2005;47(5):349-402.

23. van Veldhoven M. Need for recovery: an overview of concept, measurement and research. In: Houdmont J, Mcintyre S, editors. Occupational health psychology: European perspectives on research, education and practice. Maia: ISMAI press; 2008. p. 1-25.

24. Kiss P, De Meester M. Need for recovery in ageing workers. In: Costa G, Goedhard W, Ilmarinen J, editors. International Congress Series. Amsterdam: Elsevier Science; 2005. p. 202–7.

25. De Raeve L, Kant I, Jansen NWH, Vasse RM, van den Brandt PA. Changes in mental health as a predictor of changes in working time arrangements and occupational mobility: results from a prospective cohort study. J Psychosom Res. 2009;66(2):137-45.

26. De Raeve L, Jansen NWH, Kant I. Health effects of transitions in work schedule, workhours and overtime in a prospective cohort study. Scand J Work Environ Health. 2007;33(2):105-13.

27. De Croon EM, Sluiter JK, Broersen JPJ, Blonk RWB, Frings-Dresen MHW. Stressful work, psychological job strain, and turnover: a 2-year prospective cohort study of truck drivers. J Appl Psychol. 2004;89(3):442-54.

28. De Croon EM, Sluiter JK, Frings-Dresen MHW. Need for recovery after work predicts sickness absence: a 2-year prospective cohort study in truck drivers. J Psychosom Res. 2003;55(4):331-39.

29. Kant IJ, Bültmann U, Schröer KAP, Beurskens AJHM, van Amelsvoort LGPM, Swaen GMH. An epidemiological approach to study fatigue in the working population: the Maastricht Cohort Study. Occup Environ Med. 2003;60(Suppl. 1):i32-i39.

30. Venco S. Centrais de atendimento: a fábrica do século XIX nos serviços do século XXI. Rev bras Saúde ocup. 2006;31(114):7-18.

31. Duarte NS, Mauro MYC. Análise dos fatores de riscos ocupacionais do trabalho de enfermagem sob a ótica dos enfermeiros. Rev bras Saude ocup. 2010;35(121):157-67.

32. Jansen NWH, Kant I, van den Brandt P. Need for recovery in the working population: description and associations with fatigue and psychological distress. Int J Behav Med. 2002;9(4):322-40.

33. Callegari-Jacques S. Bioestatística: princípios e aplicações. Porto Alegre: Artmed; 2003.

34. Domholdt E. Physical therapy research: principles and applications. Philadelphia: W.B. Saunders; 2000.

35. Arango HG. Bioestatística: teórica e computacional. Rio de Janeiro: Guanabara Koogan; 2005.