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Association between the risk of chronification of musculoskeletal symptoms and sleep quality in Military Firefighters of the Federal District

Associação entre o risco de cronificação de sintomas musculoesqueléticos e a qualidade do sono em Bombeiros Militares no Distrito Federal

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Abstract - Musculoskeletal symptoms (MS) can derive from injuries or dysfunctions that affect biological tissues such as muscles, bones, and nerves, among others. Military Firefighters (MF) exercise their activities exposed to varied and complex biological conditions, in which the physical demands are intense. Shift work is another remarkable characteristic of the career, which is associated with sleep disorders. Our objective was to estimate the association between the risk of chronification of MS and sleep quality in MF with MS. Our study is a Cross-Sectional Observational Study, whose sample was composed of 753 BM from the Federal District. The analysis was performed with a Sample Characterization Questionnaire, Örebro Musculoskeletal Symptoms Screening Questionnaire (OMPSQ) and the Pittsburgh Sleep Quality Index (PSQI), answered remotely. Statistical analysis used the Spearman Correlation test, $p<0.05$. The correlation between OMPSQ and PSQI was rated moderate, demonstrating that sleep quality has an influence on the chronification process. The average of the evaluation of Sleep Quality through the PSQI is 8.79, indicating that military personnel present a deficient quality of sleep. There was a correlation between the PSQI score and the OMPSQ of 0.542 ($p<0.001$), a moderate correlation between the variables. We conclude that MF show correlation between SM and sleep quality, indicating a moderate relationship between the variables, where sleep quality explains 25% of SM. We found that most MF were classified as Low Risk for chronification of SM.

Key words: Firefighters; Musculoskeletal symptoms; Sleep.

Resumo - *Os sintomas musculoesqueléticos (SM) podem derivar de lesões ou disfunções que afetam tecidos biológicos como músculos, ossos, nervos, entre outros. Os Bombeiros Militares (BM) exercem suas atividades expostos a condições biológicas variadas e complexas, nas quais as demandas físicas são intensas. O trabalho em turno é outra característica marcante na carreira, o qual está associado a distúrbios do sono. Nosso objetivo foi estimar a associação entre o risco de cronificação de SM e a qualidade do sono em BM com SM. Nosso estudo é um Estudo Observacional Transversal, cuja amostra foi composta por 753 BM do Distrito Federal. A análise foi realizada com um Questionário de Caracterização Amostral, Questionário Örebro de Triagem de Sintomas Musculoesqueléticos (OMPSQ) e com o Índice de Qualidade do Sono de Pittsburgh (PSQI), respondidos remotamente. A análise estatística utilizou o teste de Correlação Spearman, $p<0,05$. A correlação entre OMPSQ e PSQI foi classificada em moderada, demonstrando que a qualidade do sono apresenta influência no processo de cronificação. A média da avaliação da Qualidade do Sono através do PSQI é de 8,79, indicando que militares apresentam uma qualidade do sono deficitária. Houve correlação entre a pontuação no PSQI e o OMPSQ de 0,542 ($p<0.001$), correlação moderada entre as variáveis. Concluímos que os BM apresentam correlação entre os SM e a qualidade do sono, indicando uma relação moderada entre as variáveis, onde a qualidade de sono explica 25% dos SM. Verificamos que a maioria dos BM foram classificados como Baixo Risco de cronificação de SM.*

Palavras-chave: *Bombeiros; Sintomas musculoesqueléticos; Sono.*

INTRODUCTION

Musculoskeletal symptoms can derive from injuries or dysfunctions affecting biological tissues such as muscles, bones, nerves, tendons, ligaments, joints, cartilage, and intervertebral discs[1]. Excessive physical exertion is considered a risk factor for musculoskeletal disorders. In Military Firefighters (MF) physical exertion may be responsible for 35% of non-fatal injuries and diseases in the corporation. Intense physical demands and extreme temperature conditions expose MF to musculoskeletal risks that, in turn, can compromise the integrity of the musculoskeletal system[2,3].

Considering the hazardous nature of the profession, MF are subjected to a greater variety of physical and psychosocial stimuli, as well as a greater potential for injury, illness, and fatality[4]. As a result of such demands, the prevalence of musculoskeletal symptoms ranges between 20 and 45%, with lower limb symptoms being the most prevalent[5,6]. The potential association between occupational stress on musculoskeletal symptoms in MF was investigated in the study by Soteriades et al.[7]. In that study, 40% of MF reported musculoskeletal symptoms, the most frequent being spinal pain.

MF work in an environment that requires a rotating shift system, which leads to irregular sleep patterns, vulnerabilities to sleep disorders, and mental health problems such as depression and suicide[8]. A 13-year prospective follow-up study (1996, 1999, 2009) in Finland (n = 360) demonstrated that lumbar spine symptoms are common and persistent in firefighters and that sleep symptoms strongly predict the onset of radiated pain events[9]. The prevalence of sleep disorders was estimated at 48.7% in Lim et al.[10] study conducted with MF in South Korea. In that study, musculoskeletal symptoms, shift work, and depression are associated with sleep disorders. Corroborating with this study, Jang et al.[8] reported that in 21.5% (n = 9,810) of all Korean Firefighters, duties were significantly associated with insomnia, such as fire suppression and emergency medical and rescue services.

In Brazil, studies investigating the association between musculoskeletal symptoms and sleep quality are scarce. Considering that occupational stress is associated with higher prevalence of musculoskeletal symptoms in MF work and that integrated health management is necessary to promote good sleep quality among firefighters[7], the primary objective of the present study is to estimate the association between the risk of musculoskeletal symptom chronification and sleep quality in MF with musculoskeletal symptoms.

METHOD

Study type

This is a Cross-Sectional Observational Study. The sample was composed of MF from the Federal District. The instruments were previously evaluated on the possibility of use in online format, in order to minimize filling bias and loss of information, as well as consistency and reproducibility[11]. The following instruments were used: sample characterization, functions performed in the military, Örebro Musculoskeletal Symptoms Screening Questionnaire (OMPSQ - only a part referring to the identification of symptomatic musculoskeletal regions was used) and Pittsburgh Sleep Quality Index (PSQI).

Sample

The Military Personnel of the Federal District were invited to participate in the study through various means. The contingent of active military personnel is currently 5500. For the sample size calculation, the highest symptomatic prevalence (45%) was used, due to the larger sample size[5,6]. Adjusted for the 5% precision level and 95% confidence interval, a sample size of 356 participants.

The inclusion criteria were: 1) MF belonging to the corps and 2) in full exercise of their function. Thus, it would be possible to evaluate the military personnel exposed to the real conditions of operational and administrative work in the exercise of their function and identify the conditions related to the variables of this work.

The exclusion criteria were: 1) reserve personnel, 2) personnel with a partial or total disability certificate, 3) personnel assigned outside the military service related to the Fire Department, and 4) with less than 1 year as a firefighter.

Instruments

Registration form

This registration form aimed to collect information such as: name, telephone number, date of birth, sex, color (race), marital status, weight, height, smoking habit, level of education, physical activity practice, time in the company, and self-perception of health.

Örebro Musculoskeletal Symptoms Screening Questionnaire

The Örebro Musculoskeletal Pain Screening Questionnaire (OMPSQ) is an instrument consisting of 25 questions that assess the individual's prognosis regarding the musculoskeletal symptom, i.e., the possibility of the individual developing chronic symptoms. This instrument assesses 7 factors, pain, functional capacity, fear and avoidance related to movement, psychological variables, demographic issues, environmental factors, and work-related factors[12].

The score ranges from 2 to 210 points; the higher the score, the worse the prognosis the individual presents. This score can be stratified into risk ranges for chronic pain and disability, with scores less than 90 being classified as "Low Risk," 91-150 "Moderate Risk," greater than 150 points "High Risk"[13].

Pittsburgh Sleep Quality Index

The *Pittsburgh Sleep Quality Index (*PQSI) instrument was used to evaluate the sleep quality condition. This instrument consists of 24 items that seek to differentiate good sleepers from bad sleepers. This instrument evaluates 7 dimensions of sleep, namely: (1) subjective sleep quality, (2) latency, (3) duration, (4) efficiency, (5) sleep disturbances, (6) medication use, and (7) daytime dysfunctions. This instrument presents validation for the Portuguese language, which presents α-cronbach 0.82, ICC 0.878[14-16].

Each dimension presents specific scores according to its own criteria. In the sum of all items, individuals who score < 4 are classified as "Good Sleepers", scores > 5 indicate a "Bad-Sleeper". There is a classification according to sleep quality, with a score < 5 the individual is classified as "Good Quality", ≥ 5 and < 10 points "Poor Quality" and ≥ 10 "Presence of Sleep Disorder"[10,14,17].

Procedures

The participants filled out all the questions of the instruments online (no blank data), through a link in their e-mails, and answered the instruments. To facilitate the completion and analysis of the data, the participants were instructed to answer the instruments spontaneously, at the most opportune moment of the day.

The data entry flow followed a single routine and consisted of filling out the e-mail containing the scanned Informed Consent Form (ICF). In case of rejection, they were forwarded to a thank you page for their participation. Upon accepting the ICF, they were forwarded to the completion of the instruments cited, where there were mandatory questions to be filled out in order to continue, thus avoiding blank data.

Statistical analysis

The data used for sample characterization were age, sex, time in the corps (measured in years), Body Mass Index, Military education level, function predominance, physical activity practice, and duration of physical activity.

In order to evaluate the normality of the data, the Shapiro-Wilk test was performed. The presentation of categorical variables was done through relative and absolute frequency. Continuous variables were presented through measures of central tendency: mean, median, and standard deviation.

The measures of associations of the risk of chronification and sleep quality was given by *Spearman*'s Correlation test, using the following values as the basis for interpretation of the correlation: ≥0≤0.3 "Negligible"; >0.3≤0.5 "Weak"; >0.5≤0.7 "Moderate"; >0.7≤0.9 "Strong"; >0.9 "Very Strong"[18]. In order to expose an explanation between the continuous variables will be given by the Coefficient of Determination (r^2).

Data were collected using the *Google Sheets®* platform and analyzed using *RStudio Software* (v1.3). All statistical tests performed used a significance level of $p<0.05$.

RESULTS

Data were collected from 753 participants. A total of 293 data were excluded, including 245 duplicate data, 4 participants who refused to accept the consent form, and 1 participant who was a reservist but responded. After data exclusion, 460 military personnel were eligible for the survey, which represents 8.36% of the corps out of a total of 5500 MF. The sample was made up mostly of soldiers (62.4%). It was not possible to identify the outreach number.

The data regarding the sample characterization are presented in Table 1, in which it is noticed that the predominant gender of the activity is male (78.9%). In addition, there is a predominance of young military personnel, non-smokers, and physically active, and it is observed that 44.5% of the sample is "Overweight" and 10.9% are classified as "Obese".

Within the corporation's organizational chart, we can categorize the data according to the level of military hierarchy, according to the corporation's internal data. In a general analysis, there is a predominance of policemen in relation to the number of officers, and this characteristic was repeated in the number of military personnel in this sample.

Table 1. Demographic and clinical characteristics of the participants, separated by male and female sample.

	Sample (n=460)	Male (n=357)	Female (n=103)
		Mean (S.D) / n (%)	
Age	34.97 (±8.27)	35.73 (±8.55)	32.34 (±6.59)
BMI			
Normal	219 (47.6)	143 (40.1)	76 (73.8)
Overweight	191 (41.5)	169 (47.3)	22 (21.4)
Obese	50 (10.8)	45 (12.6)	5 (4.9)
Marital Status			
Single	163 (35.4)	114 (31.9)	49 (47.6)
Married	264 (57.3)	219 (61.3)	45 (43.7)
Divorced	32 (6.9)	23 (6.4)	9 (8.7)
Widower	1 (0.2)	1 (0.3)	0 (0)
Smoking Habit			
Smoker	12 (2.6)	11 (3.1)	1 (1.0)
Ex-smoker	240 (52.1)	191 (53.5)	49 (51.5)
Never Smoked	208 (45.2)	155 (43.4)	53 (51.5)
Education			
Medium	23 (5.0)	23 (6.4)	0 (0)
Superior	437 (95.0)	334 (93.6)	103 (100.0)
Physical activity practice			
Practice	424 (92.2)	333 (93.3)	91 (88.3)
Don't Practice	36 (7.8)	24(6.7)	12(11.7)
Professional Experience			
Military Service Time	10.93 (±10.83)	12.05 (±11.04)	7.03 (±9.03)
Military Degree of Instruction			
Officer	139 (30.2)	105 (29.4)	34 (33.0)
Graduate	321 (69.7)	252 (70.6)	69 (67.0)
Predominance of Function			
Administrative	185 (40.2)	144 (40.3)	41 (39.8)
Operational	275 (59.7)	213 (59.7)	62 (60.2)

Note: Age and length of military service: mean (standard deviation). Remaining data presented as relative frequency (%). BMI: Body mass index.

The correlation was classified as moderate (Table 2). However, the most relevant variables (OMPSQ, PSQI) showed a moderate and significant correlation between them. Thus demonstrating that sleep quality and central sensitization have an influence on the chronification process of the condition. The OMPSQ score explains the PSQI score by 25% (r^2 = 0.25) (Table 3). It is observed that most MF were classified as Low Risk (76.4%) for chronification of symptoms.

Table 2. Risk classification according to the Örebro Questionnaire.

Classification	Mean (SD*)	n	% (CI 95%**)
Low Risk	57.1 (± 21.9)	307	76.4 (72- 80.3)
Medium Risk	110.9 (± 14,5)	92	22.9 (19 - 27.2)
High Risk	156 (± 4.97)	3	0.7 (0.3 -2.2)

*SD: Standard deviation. **CI 95%: Confidence interval.

Table 3. Linear association between the outcome variables of the study.

Variable	Correlation	Coefficient of Determination (r^2)
OMPSQ - PSQI	0.5***	0.250

***p<0.001. PSQI: *Pittsburgh Sleep Quality Index*; OMPSQ: Örebro Musculoskeletal Symptoms Questionaire.

The mean of the Sleep Quality evaluation, through the PSQI (*Pittsburg Sleep Quality Index*) is 8.79 with a standard deviation of (±3.54), thus indicating that the MF are considered Poor Sleepers and present poor sleep quality (Table 4).

Table 4. Sleep quality prevalence.

Classification	Average	n	% (CI 95%*)
Good	3.66 (± 1.24)	74	18.41 (14.9 - 22.5)
Bad	8.00 (± 1.36)	196	48.76 (43.9 - 53.6)
Presence of SD**	12.83 (± 1.57)	132	32.84 (28.4 -37.6)

*CI 95%: Confidence interval. **SD: Sleep disorder.

According to Table 4, it can be seen that a good part of the military population of the Fire Department has some impairment in their quality of sleep. Considering the dichotomous classification of "Good Sleeper" and "Bad Sleeper". In the sample evaluated there was a correlation between the PSQI score and the OMPSQ, of 0.542** ($p<0.001$), being a moderate correlation between the variables, with a coefficient of determination (r^2:0.250), where the sleep quality variable explains the OMPSQ score by 25% (Table 3), thus indicating that there are other factors to be analyzed in order to identify a more precise explanation between the variables. Figure 1 demonstrates that the higher the OMPSQ score. the greater the impairment in sleep quality.

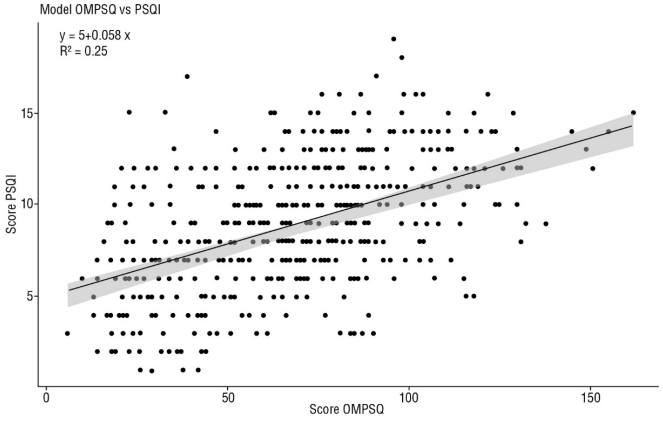

Figure 1. OMPSQ X PSQI score.

DISCUSSION

The primary objective of this study is to estimate the association between the Örebro questionnaire and sleep quality in MF with musculoskeletal symptoms. The MF were shown to be "Bad sleepers" for the most part, signaling poor sleep quality, which can lead to sleep disturbances and musculoskeletal pain, with a relation of 25% being significant among themselves.

Table 2 shows the classification of risk of chronification of musculoskeletal symptoms through the Örebro questionnaire, whose majority were classified as Low Risk (76.4%). The military who were classified as High Risk presented a score very close to the cutoff score for the risk range, where perhaps this classification does not represent the reality, due to the amount of military personnel present in this group. Table 3 in question shows the moderate association between sleep

quality and the Örebro questionnaire, where it showed a moderate correlation of (r:0.50) between the variables. Table 4, in turn, shows the prevalence of the quality of sleep of the research participants. in which almost half of the group was classified as "Poor" (48.76%) and we still had a good portion reporting the presence of some sleep disorder (32.84%).

In the literature there are associations between pain intensity and sleep quality. Individuals considered to be poor sleepers tend to have more intense symptoms and longer symptom duration. The workday in a scale format associated with physical demands, may be related to the process of pain chronification[19] in MF. The data from this research supports the findings of[20], who sought to determine the association between chronic low back pain and sleep, showing that pre-existing sleep disturbances are correlated and are strong predictors of higher reported pain intensity.

Sleep disturbed by chronic pain is related to restricted social functioning, poor quality of life, and higher levels of disability[21]. In this case, sleep quality explains 25% of musculoskeletal symptoms in MF, in other words, 75% of reported symptoms come from other factors.

Several occupational and lifestyle factors can negatively influence ability to work, including older age, obesity, physical and mental health problems, as well as low physical ability and low levels of leisure - physical activity time. In addition, physical work - usually involving repetitive work, improper postures, and heavy lifting has been associated with increased risk of musculoskeletal disorders and reduced work capacity[22].

These aspects directly influence the quality of sleep, and these distortions in sleep quality interfere with the hormonal axes that modify the military's performance and physical capacity[23,24].

This work has some limitations, among them we can mention the non-screening of the links where the questionnaires were distributed, as well as the participants who refused to participate, started, but did not finish filling out the instruments.

For future studies, it is suggested to evaluate the correlation between other biological, psychological, social, environmental, and physical aspects intrinsic to the profession to better understand the multifactorial influences of the persistence of musculoskeletal symptoms, both for the development of prevention and treatment strategies, and to avoid absence from work.

CONCLUSIONS

The MF presented a correlation between musculoskeletal symptoms and quality of sleep, indicating that there is a moderate relationship between the variables, where quality of sleep explains 25% of musculoskeletal symptoms in firefighters. We found that the MF, for the most part were classified as Low Risk for chronification of musculoskeletal symptoms.

COMPLIANCE WITH ETHICAL STANDARDS

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Ethical approval

Ethical approval was obtained from the local Human Research Ethics Committee – Faculdade de Ceilândia – Fundação Universidade de Brasília and the protocol (no. 07987419.5.0000.8093) was written in accordance with the standards set by the Declaration of Helsinki.

Conflict of interest statement

The authors have no conflict of interests to declare.

Author Contributions

Conceived and designed the experiments: DIPO, WRM; Performed the experiments: DIPO, VBC; Analyzed the data: GFA, ALSA, SC; Contributed with reagents/materials/analysis tools: GFA, ALSA; Wrote the paper: DIPO, VBC, MAAM.

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