

Musculoskeletal disorders in informal mining workers*

ORIGINAL

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Abstract

Introduction: Among the segments and modalities of work, the mining activity is considered problematic with regards to the possibilities of disturbances and occupational diseases that can be of physical, biological and social order.

Objective: determine the prevalence of musculoskeletal disorders in informal mining workers of the Seridó region in the state of Paraíba.

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Keywords

work; mining; musculoskeletal disorder related to work.

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Methods: 371 informal workers from the Seridó region participated in the study. The Nordic Musculoskeletal Questionnaire was used for the evaluation of the musculoskeletal symptoms.

Results: musculoskeletal symptomatology was reported by the majority of employees in one or more body segments (60.6%, $n = 225$). The lumbar region was the most affected (36.4%; $n = 135$). Men showed higher frequency of lumbar problems ($p < 0.01$) than women. Workers of older age reported more musculoskeletal disorders in various body segments. The miners working more hours also reported higher prevalence of musculoskeletal disorders in some regions of the body. Those miners with longer service time also reported more musculoskeletal disorders present in some body segments.

Conclusion: informal workers from the Seridó region in the state of Paraíba presented high prevalence of musculoskeletal disorders, with greater problems in the lumbar and dorsal regions. The age, the length of service in the mining and the working hours contributed to the prevalence of musculoskeletal disorders. It is necessary to consider the working hours, the length of service and the age of workers to propose interventional measures.

Introduction

The study presents various concepts, which determine the formation of human identity. Its implications relapse onto the physical, social and psychological balance of the individual, mobilizing human capabilities and triggering disorders between the he and the man [1].

Among the segments and modalities of work, the mining activity is considered problematic with regards to the possibilities of disturbances and occupational diseases that can be physical, biological and social [2]. Among these barriers, it is highlighted the Work-Related Musculoskeletal Disorders (WM-

SDs) that are among the leading causes of morbidity and disability in workers [3,4].

The considerations around this public health problem are due to the fact that these disorders are common in both developed and developing countries [4-10].

The WMSDs cover the medical conditions of the musculoskeletal system acquired by the worker exposed to specific working conditions, contemplating inflammatory and/or degenerative disorders which affect tendons, nerves, muscles, joints, among others [3]. Such attacks result, especially in pain, numbness, heaviness, tingling, fatigue and functional disability [11], significantly reducing the ability to work and the worker's quality of life.

These injuries can be attributed to repetitive work or overload, to environmental factors and / or organization, the inappropriate use of equipment and the tasks associated with PSI pressure bounces on your desktop [12].

Studies show that the working conditions (environment and organization), the biomechanical, psychosocial and individual factors are associated with the occurrence of musculoskeletal symptoms. The physical discomfort, the excessive work journey, inadequate and poorly designed workstation from the ergonomics perspective, intense rhythms of work, invariance of tasks, repeatability of movements, physical exertion, poor posture for a long period of time, mechanical pressure on certain segments of the body, static muscular work, shock and vibration, are some of the collaborative factors for the onset of WMSDs in mining workers or in other productive sectors [10,13-16], corroborating with the low quality of life of the disabled workers, loss of productivity, lost workdays, spending with health care and payments to social security [17].

Nevertheless, no one knows for sure the actual impacts on workers from the informal mining market and this is a confirming factor for the interest in developing research with this group. The informality, generally leads to instability of industrial relations, subjecting them to dangerous conditions, unhealthy and arduous work in the sector [18].

The question is, however, what is the prevalence of musculoskeletal disorders in informal mining workers of the Seridó region in the state of Paraíba? Because of the need to offer help to improve the work environment, the quality of work life of the miners and the self-treatment in health.

From the foregoing, it is outlined as the objective, to verify the prevalence of musculoskeletal disorders in informal workers of mining from Seridó region in the state of Paraíba, in order to bring results to the mining industry about the impact of work on the health-disease process, especially musculoskeletal diseases.

Methods

An epidemiological and cross-sectional study, with a descriptive character, held in the Seridó Region of the State of Paraíba, with informal mining workers from the cities of Junco do Seridó, Salgadinho, Santa Luzia, São José do Sabugi, São Mamede, Várzea, Baraúna, Cubati, Frei Martinho, Juazeirinho, Nova Palmeira, Pedra Lavrada, Picuí, Seridó, Tenório, Pocinhos and Assunção.

There was the participation of 371 miners, 7.42% of the population universe, considering a degree of confidence of 95% and margin of error of 4.8%, obtained with the help of computer program called DIMAM 1.0 [19]. It is noteworthy that among those surveyed, most were male (93%), married (53.1%) and had an incomplete primary school education (53.1%).

The established inclusion criteria were: be an informal worker from the mining sector, be linked to local mining cooperatives, be 18 years or older and accept voluntarily to participate in the research by signing the Informed Consent. The exclusion criteria were: be working in the sector for less than 12 months, be on sick leave or absent from work in the collection period.

For data collection there was the use of the Nordic Musculoskeletal Questionnaire prepared by Kourinka[20] validated by Pinheiro[21]. Kourinka do not indicate that instrument as a basis for clinical diagnosis, but as useful element for the identification of musculoskeletal disorders, therefore, able to provide significant element of diagnosis of the environment/workstation[20]. The questionnaire helps identify the presence of symptoms of pain, numbness, tingling or discomfort in regions of the body of the workers. It includes a human figure composed of nine anatomical regions: cervical, shoulders, arms, elbows, forearms, wrists/hands/fingers, dorsal region, lumbar region, lower limbs, allowing the researched miner to show on the map the presence of musculoskeletal symptoms in the

body regions displayed, during the last 12 months. In those regions with the presence of musculoskeletal symptoms, the participant indicates whether the symptoms are or not associated with the performed work activity.

Data collection was carried out after the favorable opinion of the Ethics Committee in Research of the University de Franca, report number 284.639. Data were collected between August 2013 and June 2014, tabulated and analyzed using the *Statistical Package Program for the Social Sciences* (SPSS) version 21.0.

Considering the nonparametric nature of the data, verified by the Kolmogorov-Smirnov and Shapiro-Wilk tests, the Mann Whitney tests were used to compare the prevalence of musculoskeletal symptoms (disorders) between different sexes, and according to the age, length of service and working hours. The data were presented in relative frequencies (N), absolute (%), average, median and

standard deviation. For all analyzes a 5% significance level was considered.

Results

Informal miners showed daily average working hours of 8.24 ± 1.04 hours per day, with an average service time in the sector of 67.06 ± 74.74 months.

Out of the 371 workers evaluated, 225 (60.6%) reported some form of musculoskeletal disorder. On the cases with symptoms attributed to work, the lumbar region was the most frequent (36.4%; $n = 135$) followed by the dorsal region (28.3%; $n = 105$), as shown in **Table 1**.

Table 2 presents the results of comparisons between presence and absence of symptoms for each of the body segments, considering age, length of service and working hours as independent variables. Analysis results showed that workers with symp-

Table 1. Distribution of the occurrence of musculoskeletal symptoms by body segment among miners. Seridó region in the state of Paraíba, Brazil, 2014

Body segments	Musculoskeletal symptoms		Symptoms assigned to work	
	n	%	n	%
Neck/cervical region	50	13.3	42	11.3
Shoulder	61	16.4	55	14.8
Arms	77	20.8	67	18.1
Elbows	26	7.0	24	6.5
Forearm	40	10.8	31	8.4
Wrist/hand/fingers	63	17.0	49	13.2
Dorsal region	117	31.5	105	28.3
Lumbar region	154	41.5	135	36.4
Lower limbs	107	28.8	79	21.3

Source: Direct research, 2013/2014.

Table 2 – Comparison between the occurrences of musculoskeletal symptoms related to age, working hours and length of service. Region of Seridó in the state of Paraíba, Brazil, 2014

Body segments		Age in years	Working hours	Length of service in months
		Median	Median	Median
Neck/cervical region	No	35.16	8.11	63.44
	Yes	37.50*	8.39**	100.0**
Shoulders	No	34.47	8.15	36.07
	Yes	42.00**	8.09 (ns)	57.60*
Arms	No	34.90	8.14	36.08
	Yes	39.00*	8.12(ns)	55.50**
Elbows	No	35.07	8.13	37.48
	Yes	41.80*	8.25	24.00
Forearms	No	35.11	8.12	36.96
	Yes	40*	8.33*	45.60
Wrists/hands/fingers	No	35.23	8.13	37.23
	Yes	36.67	8.19	39.00
Dorsal region	No	35.10	8.12	37.45
	Yes	36.67	8.20	36.86
Lumbar region	No	34	8.12	36.33*
	Yes	36.75	8.16	44.43*
Lower limbs	No	33.80	8.10	35.59
	Yes	35.32**	8.30**	66.86**

Source: Direct research, 2013/2014.

* $p < 0.05$; ** $p < 0.01$ It indicates significant difference according to the Mann Whitney test.

toms of disorder in the neck and lower limbs, have significantly higher age ($p < 0.05$), more working hours per day ($p < 0.05$) and longer service time ($p < 0.05$) in relation to workers who did not report any symptoms. The age is also significantly higher for workers who had symptoms in the shoulders, arms, elbows and forearms ($p < 0.05$).

Discussion

When planning to meet a group of workers, it is interesting to have in mind the importance that the

profile found can outline studies to solve the problems or at least to alleviate them. The results confirmed the existence of musculoskeletal disorders in some body segment of the miners, since most workers reported its occurrence in some region of the body (60.6%). The percentage of musculoskeletal symptoms found in this approach with the miners is considered relatively critical since national surveys with different professional groups reveal prevalence ranging from 38.5% to 94.0% [5-6,8-10] on the other hand, international study highlights the prevalence of musculoskeletal disorders among mining workers of 40.4% to 50.0% [4,7].

The findings accused musculoskeletal symptoms especially in the lumbar and dorsal region, indicating these locations as the most affected by pain, numbness, tingling or discomfort by the physical effort required by the activity, resulting from long periods in inadequate postures (in a bent position, sitting and especially standing/upright), submitting these regions to exaggerated efforts. Also associated to this are, the invariability of tasks, the mechanical pressure on the body segments mentioned, the static muscular work and the vibrations. Similar data were found in other studies [4,7], with higher frequency of musculoskeletal symptoms in the lumbar region [7] and dorsal region [4].

Although the affected regions were similar, the percentage of workers with disorders differs between researches, as the lumbar region was cited by 36.4% of the workers, the dorsal by 28.3% and lower limbs by 21.3%. The reasons for this difference are due to the type of activity performed in the sector. Skandfer found many mining workers reporting musculoskeletal problems, with 50.0% with pain in the dorsal region [7]. In a study about the prevalence of musculoskeletal disorders among workers of underground mines in Zambia, found a prevalence of painful symptoms in 40.4% of the sample, with the dorsal region being the most affected [4]. Melzer found a prevalence of 38.5% of pain in researched population of potters [10].

The data can be related to ergonomic conditions of the workplace, as most scholars agree that exposure to ergonomic risk factors is a major contributor to the onset of painful manifestations and associated lesions [7,9,13, 14,16,22].

The living conditions of the workers, the conditions of the workstations and working environment can induce direct consequences to the health of the miners, since the work in the industry exposes them daily to ergonomic hazards [10,23,24]. Among the ergonomic factors, the following stands out: the static muscle work, repetitive, monotonous, with inadequate postures (in the bent position, sitting

and especially standing/upright), with mechanical pressure, vibrations and exhausting working hours, with considerable physical effort.

Guimarães consider, therefore, that repetition is one of the most impactful risk factors on the occurrence of WMSDs [10,25]. Apud add the following to the previously mentioned: the intense physical effort, lifting, manual transport of weight, requirement of poor posture, excessive rhythms, shift work and working hours [8,26,27].

Other relevant data included the comparison between age and symptoms of pain, numbness, tingling or discomfort. The workers who had problems in the neck/cervical region, shoulders, arms, elbows, forearms and lower limbs were significantly older. Therefore, this variable was the one that was more associated to the symptoms.

The higher the age, possibly, the longer the activity in the mining, marked by repeatability, exhaustion and the requirement of inadequate positions, characteristics which impact on the musculoskeletal system, leading to its wear and tear. Despite this, Melzer and Iguti, in a study about working conditions and musculoskeletal pain in Brazilian ceramic workers, found no relationship between age and such disorders [10].

The daily working hours showed significant results with relation to problems in the neck/cervical region, forearms and lower limbs. Those who showed changes worked more hours per day. In this context, it is understood that a complicating factor may be the broad working hours, because, generally, professionals work around eight hours and this can force the musculoskeletal system.

A maximum of six hours of work per day are recommended by the Regulatory Standard 22 (NR-22) of the Ministry of Labor and Employment [3]. This Regulatory Standard specifies the standards of safety and occupational health in the mines, aiming to reduce the risks of harm to the health of miners. To work less than eight hours daily can maintain an adequate production capacity, with tolerable fa-

tigue and recovery from fatigue to work the next day[28,29].

Fernandes also found a close association between workload and WMSDs, in other words, the musculoskeletal symptoms increased progressively with the increase of workload[8]. However, a more recent study found no significant relationship between working hours and WMSDs [6,30].

Another factor that seemed important referred to the length of service in the activity, as people who had problems in the neck/cervical region, shoulders, arms, lumbar region and lower limbs possessed more years of service. This result is contrary to the study of Melzer and Iguti that found no association between musculoskeletal symptoms and length of service, but corroborates with research performed by Barbosa who reported a significant association between length of service and emergence of WMSDs[6,10]. These results can still be related to the types of instruments used, or the lack of them, as well as to operational modes of the workers.

Conclusion

A high prevalence of musculoskeletal disorders among miners was found, with greater involvement of the lumbar and dorsal region. The age, length of service and working hours contributed for the prevalence of musculoskeletal disorders. By the findings, the imposition of measures that take into account the age, length of service and working hours should be done to reduce the prevalence of musculoskeletal disorders and improve the health of informal mining workers.

References

1. Mark K. O Capital: crítica da economia política. São Paulo: Boitempo Editorial, 2013.
2. Souza APB, Pedrosa AS, Pinheiro IFS, Santos MLS. Avaliação de impactos ambientais através da percepção de trabalhadores de uma empresa mineradora: um estudo de caso no município de Pedra Lavrada – PB. *Qualit@s*. 2010;9(2):1-10.
3. Brasil. Ministério da Saúde. Secretaria de Vigilância em Saúde. Departamento de Vigilância em Saúde Ambiental e Saúde do Trabalhador. Dor relacionada ao trabalho: lesões por esforços repetitivos (LER): distúrbios osteomusculares relacionados ao trabalho (Dort). Brasília: Editora do Ministério da Saúde, 2012.
4. Kunda R, Frantz J, Karachi F. Prevalence and ergonomic risk factors of work-related musculoskeletal injuries amongst underground mine workers in Zambia. *J Occup Health*. 2013;55(3):211-7.
5. Silveira AOA, Dias EG. Sintomas de distúrbios osteomusculares em bancários da cidade de Porteirinha-MG. *Biofar*. 2014;10(1):1-11.
6. Barbosa REC, Assunção AA, Araújo TM. Distúrbios musculoesqueléticos em trabalhadores do setor saúde de Belo Horizonte, Minas Gerais, Brasil. *Cad. Saúde Pública*. 2012; 28(8): 1569-80.
7. Skandfer M, Siurin S, Talykova L, Øvrum A, Brenn T and Vaktskjold A. How occupational health is assessed in mine workers in Murmansk Oblast. *Int J Circumpolar Health*. 2012;71(0):1-8.
8. Fernandes RCP. Precarização do trabalho e os distúrbios Musculoesqueléticos. *Cad CRH*. 2011;24(1):155-70.
9. Lourinho MG et al. Riscos de lesão musculoesquelética em diferentes setores de uma empresa calçadista. *Fisioter. Pesqui*. 2011; 18,(3):252-7.
10. Melzer ACS, Iguti AM. Working conditions and musculoskeletal pain among Brazilian pottery workers. *Cad. Saúde Pública*. 2010;26,(3):492-502.
11. Alencar JF, Coury HJCG, Oishi J. Aspectos relevantes no Diagnóstico de DORT e Fibromialgia. *Rev. Bras. Fisioter*. 2009;13(1):52-8.
12. Caetano VC, Ribeiro LC, Cruz DT, Asmu CIRF. Desordens músculo-esqueléticas em adolescentes trabalhadores. *Journal of Human Growth and Development*. 2008; 18(3): 264-274
13. Silva HPL, Jesus CS. Sintomas osteomusculares em cirurgiões-dentistas da rede pública. *Rev. AMRIGS*. 2013;57(1):44-8.
14. Cabral LN, Pereira SS, Alves TLB. Degradação ambiental e implicações para a saúde humana decorrentes da mineração: o caso dos trabalhadores de uma pedreira no município de Campina Grande/PB. *Hygeia*. 2012;8(5):104-18.
15. Trindade LL, Krein C, Schuh MCC, Ferraz L, Amestoy SC, Adamy EK. Trabalhadores da indústria têxtil: o labor e suas dores osteomusculares. *J Nurs Health*. 2012;2(2):377-87.
16. Branco JC, Silva FG, Jansen K, Giusti PH. Prevalência de sintomas osteomusculares em professores de escolas públicas e privadas do ensino fundamental. *Fisioter Mov*. 2011; 24(2):307-14.
17. Souza NSS; Santana VM. Incidência cumulativa anual de doenças musculoesqueléticas incapacitantes relacionadas ao trabalho em uma área urbana do Brasil. *Cad. Saúde Pública*. 2011;27(11): 2124-34.

18. Costa BS, Rezende EN. Meio ambiente do trabalho e a saúde do trabalhador na mineração brasileira. *Rev. Inst. Direito Bras.* 2012;1(2):759-92.
19. Arango HG. *Bioestatística teórica e computacional*. 3. ed. Rio de Janeiro: Guanabara Koogan, 2009.
20. Kuorinka I, Jonsson B, Kilbom A, Vinterberg H, Biering-Sørensen F, Andersson G, Jørgensen K. Standardised Nordic Questionnaires for the Analysis of Musculoskeletal Symptoms. *Appl Ergon.* 1987;18(3): 233-37.
21. Pinheiro FA, Tróccoli BT, Carvalho CV. Validação do Questionário Nórdico de Sintomas Osteomusculares como medida de morbidade. *Rev. Saúde Públ.* 2002;36(3):307-12.
22. Melo MV, Cunha FMAM. Condições de trabalho dos funcionários de empresas madeireiras em publicações científicas no período de 2002 a 2012. *Rev. Digital.* 2014;19(193):1.
23. Elenge M, Leveque A, Brouwer C. Occupational accidents in artisanal mining in Katanga, D. R. C. *Int J Occup Med Environ Health.* 2013; 26(2):265-74.
24. Fernandes MH, Rocha VM, Costa-Oliveira AGR. Fatores associados à prevalência de sintomas osteomusculares em professores. *Rev Salud Pública.* 2009;11(2):256-67.
25. Guimarães BM, Azevedo LS. Riscos de distúrbios osteomusculares em punho de trabalhadores de uma indústria de pescados. *Fisioter Mov.* 2013;26(3):481-9.
26. Apud E. Ergonomics in mining: the Chilean experience. *Hum Factors.* 2012;54(6): 901-7.
27. Solari G, Reyes J, Solari B. Contribución a la ergonomía desde el análisis de la condición física en una muestra de trabajadores mineros con/sin síndrome de dolor lumbar (Región de Antofagasta, Chile). *Rev. Cienc. Salud.* 2009;13(1):16-32.
28. Assunção AA, Carvalho FM. Tarefas repetitivas sob pressão temporal: os distúrbios musculoesqueléticos e o trabalho industrial. *Ciênc. Saúde Coletiva.* 2010;15(3):931-42.
29. Silva ARS, Souza KRF, Bezerra MPM, Arruda CB, Lima CJ, Oliveira JS. Sistematização da assistência de enfermagem em trabalhadores com distúrbios osteomusculares. *Ciênc Biol Saúde.* 2014;1(3):35-45.
30. Pereira JDAS, Pineiz RA, Araújo RO, Canarim RC, Fajardo RS, Alves Rezende MCR. Boas práticas de laboratório e biossegurança: prevenção dos riscos ergonômicos. *Arch Health Invest.* 2014;3(2):57-63.

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