

Prevailing factors of musculoskeletal disorders in steel foundry workers

أسباب انتشار الاضطرابات العظم-عضلية لدى عمال السبائك

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Abstract (English): This study aims to determine the causes and spread of musculoskeletal disorders (MSD) among workers in a steel foundry based in Oran (Algeria). The Nordic questionnaire (Kuorinka et al, 1987) was used to diagnosis and evaluate the pain and discomfort of (MSD) among the sample of the present study (n=30). Their demographic characteristics were as follows: mean age = 40.46 years, average weight = 71.83 kg, average height = 171 cm, average seniority in the company = 11 years).

The results showed that 51.85 % of workers suffered from pain and discomfort in the lower back, and 40.74 % at the shoulders. The causes of pain and discomfort are due to a combination of factors like high work pace, heavy load carriage (more than 10 kg), in addition to the adoption of static postures for long periods, and the presence of repetitive tasks.

The study concluded that attention should be paid to the working conditions in the steel foundry under investigation, particularly in providing weight lifting equipment, redesigning job and work methods to avoid painful postures, beside the reduction of work rate and the reorganization of rest pauses.

Keywords: Musculoskeletal disorders, working postures, work pace, weight handling, repetitive tasks.

ملخص باللغة العربية

تهدف هذه الدراسة إلى تحديد أسباب انتشار الاضطرابات العظم-عضلية بين العاملين في مسبك الفولاذ في وهران (الجزائر). استُخدم الاستبيان الاسكندينا في الموحد (Kuorinka et al, 1987) لتشخيص وتقييم الألم والانزعاج بين عينة الدراسة الحالية (العدد=30).

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كانت خصائصهم الديمغرافية كما يلي: متوسط العمر= 40.46 سنة، متوسط الوزن= 71.83 كغ، متوسط الطول =1.71 سم، متوسط الأقدمية في المؤسسة = 11 سنة).
أظهرت النتائج أن 751.85 من العمال عانوا من الآلام وعدم الراحة في أسفل الظهر، و40.74٪ منهم عانوا من الآلام في الكتفين. ترجع أسباب الألم وعدم الراحة إلى مجموعة من العوامل مثل: سرعة وتيرة العمل، حمل الأثقال (أكثر من 10 كغ)، بالإضافة إلى تبني الوضعيات الثابتة لفترات طويلة، وأداء المهام المتكررة.
وخلصت الدراسة إلى أنه ينبغي إيلاء الاهتمام بظروف العمل في مسبك الفولاذ قيد الدراسة، لا سيما توفير معدات رفع الأثقال، وإعادة تصميم أساليب العمل لتجنب الوضعيات الحرجة، وخفض معدل العمل وإعادة تنظيم فترات الراحة.
كلمات مفتاحية: الاضطرابات العظم عضلية؛ سرعة وتيرة العمل؛ وضعيات العمل؛ حمل الأثقال؛ تكرار المهام.

1- Introduction:

Musculoskeletal disorders (MSD), as phenomenon related to occupational health is attracting more and more attention from occupational health and safety professionals. The National Institute of Occupational Safety and Health (NIOSH, 2018) defines MSDs are soft-tissue injuries caused by sudden or sustained exposure to repetitive motion, force, vibration, and awkward positions.

While (HSE.2010.p1) describes MSDs as impairments of the bodily structures, such as muscles, joints, tendons, ligaments and nerves, which are caused or aggravated primarily by the performance of work and by the effects of the immediate environment in which work is carried out.

MSDs as a research theme and as a health issue is present in all scientific conferences of human factors, ergonomics and occupational safety and health. Scientific papers (Bergsten et al. 2015; Gembarovski, 2015; Moom et al, 2015; Lop et al, 2017; Kherbache et al, 2018; Md Zein et al, 2018) cover many MSD issues.

Because of its widespread trends among the working population, MSDs have become an obstacle to the economic performance of businesses, as they have significant financial costs (absenteeism, sickness leave, insurance compensation, etc.). Furthermore, as Boden, et al., (2001) pointed out, MSDs are not just a source of pain and suffering for the sufferer but also a significant burden to their families, employers, and the wider community. (Öztuğ & Cowie,2011.p81)

As defined earlier, MSDs causing factors are well known, sustained exposure to repetitive motion, force, vibration, and awkward positions. However, these differ from a professional activity to another, as has been showed in the literature, to cite a few, Bergsten et al. (2015) in Swedish flight baggage handlers, Moom et al. (2015) in office computer users, Mebarki & Argoub (2015), Argoub & Mebarki (2018), Lop et al., (2017) in bricklayers.

Physically demanding occupations are a favorable terrain to the emergence of MSDs. In the Algerian case, a few of these occupations have been investigation, bricklayers (Mebarki & Argoub, 2015 & 2018), nursing staff (Benhassine, 2011), and date Palm workers (Mokdad & Mebarki, 2018), office workers (Argoub & Mebarki, 2018). While studies on workers executing such physically demanding tasks, like steel and iron industry workers, are absent. Which has drawn our attention to the subject.

The present study attempts to detect the prevalence of musculoskeletal disorders and determine their causing factors among foundry steel workers in a steel foundry based in Oran, Algeria.

2- Method:

1- Sample : thirty (30) workers in a production workshop of a steel foundry based in Oran, Algeria participated in the study. Their demographic characteristics were as follows: mean age = 40.46 years, average weight = 71.83 kg, average height = 171 cm, average seniority in the company = 11 years).

2- Tool: in order to diagnosis and evaluate the pain and discomfort of (MSD) among the sample of the study the Nordic questionnaire (Kuorinka et al, 1987) was used. To fill in the questionnaires, a semi-conducted interviews strategy was adopted.

The validity and reliability of the Nordic questionnaire has been verified through previous studies worldwide, while in Algeria, Argoub and Mebarki (2018) and Mebarki and Argoub (2015) have done the necessary psychometric tests, of their studies on bricklaying workers, in some construction work sites and demonstrated high levels of validity and reliability of the tool. In the present study, the reliability the tool ($r = 0.80$) was assessed using Cronbach's alpha.

3-Results and Discussion:

To detect the presence of musculoskeletal disorders among the sample (n=30) the results of the study revealed a high percentage of pain in different body areas as shown in table 1.

Table (1) shows the frequency and percentage of pain in different body zones during the last 12 months.

Pain zone	Duration (during last 12 months)	
	Number of frequencies	Percentage
Neck	00	00%
shoulders	11	40.74%
Upper back	05	18.51%
Elbows	00	00%
Low back	14	51.85%
Wrists/Hands	03	11.11%
Hips/thighs	01	03.70%
knees	03	11.11%
Ankles/feet	05	18.51%

Table (2) shows the frequency and percentage of pain in different body zones during the last 7 days.

Pain zone	Duration (during last 7 days)	
	Number of frequencies	Percentage
neck	00	00%
shoulders	10	37.03%
Upper back	05	18.51%
elbows	01	03.70%
Low back	13	48.18%

wrists/ Hands	04	14.81%
Hips/ thighs	01	03.70%
knees	03	11.11%
Ankles/feet	05	18.51%

As shown in table (1) and table (2) the presence of pain at the lower back level during the last 12 months was estimated at 51.85% among workers of the workshop, followed by 40.74% at shoulders' level.

With respect to workers' pain exposure over the last 7 days; we also noted that the lower back region has a significant proportion of pain equivalent to 48.18% of case, followed by the shoulders' region with 37.03% of the cases.

Although, the presence of pain in the rest of body regions, during the last 12 months was less than what has been noticed in the back and shoulders areas. The results showed the following values at upper back, Ankles/feet regions, pain and suffering were 18.51%, while at knee, and Wrists/Hands regions, the proportion of workers suffering in both regions were 11.11% of the sample.

The tasks performed in steel in molds did not triggered significant pain level in other regions of the body, like the Elbows area, hips/thighs and neck regions, either during the last 7 days or the last 12 months.

Table 3: shows the causing factors of MSD among workers of the steel casting workshop.

Causes of MSD	Number of frequencies	percentage
work pace	20	74.07 %
work posture	13	48.14%
weight handling	16	59.25%
Repetitive tasks	03	11.11%

As shown in table 3, that the main causing factors of MSD among workers of the steel casting workshop are respectively: work pace (74.04%), weight handling (59.25%), work postures (48.14%) and repetitive tasks (11.11%).

The results of the present study confirm those of (Choi & al, 2016, De Beer & Maja , 2016, Sharma and Singh, 2015, Ning & al, 2014, Choi,2009 and Burdof,1998) in iron and steel industry who noticed occurrence of chronic lower back pain region. While (Aghilinejad& al, 2015, Aghilinejad et al., 2012) studies revealed a significant MSD in the back and shoulders body regions of an Iranian metallurgical plant.

Similar results were found in various sectors of activity, in bus drivers (Fadhli et al. 2016), in rural hand-woven carpet weavers (Chaman et al., 2015), among nursing staff (Carugno et al, 2012), and in office workers (Mahmud et al, 2014)

The agreement between most of these studies, which revealed a presence of MSD, is probably due to the similarity of occupational tasks handled by all of these work categories (weight handling, high work pace, work postures and repetitive tasks).

The results of our study differ from those of other studies, such as, that of (Cail & Aptel,2005),carried out on computer users suffering from pain, in the upper right of the body, and not complaining of pain in the other parts of the body. Similarly, results of this study differ from those of (Sukadarin's, et al, 2016) study on MSDs among palm planters, while performing tasks like: fresh fruit bunch harvesting, front arranging, loose fruits collecting and tractor driving. They suffered from pain, in several areas of the body, including the neck, hip, shoulders, right wrist, right arm and left hand.

Explication of the phenomenon of spread of MSDs pain in certain areas of the body rather than in others is mainly, due to, the type of tasks and their specific needs, besides, the postural demands imposed on particular regions of the body, rather than others.

To explain the results of our study on the prevalence of pain in the shoulders and lower back, refer to Table (3), are mainly due to the high work pace, and followed by weight handling, poor work

postures and finally, the repetitive task performance. This explication is on line with previous research work (De Beer and Maja, 2016; Aghilinejad et al., 2015; Sharma and Singh, 2015; Ning et al., 2014; Aghilinejad et al., 2012 and Choi et al., 2009). Postural situations like, bending and squatting, the position of the hands at or above the level Shoulders, and other critical working positions, as well as repetitive movements during in tasks performance, lifting heavy raw materials or transporting them over long distances are all known to be work related musculoskeletal disorders triggering factors.

The results of the study show that foundry workers are daily subjected to significant work constraints, for the nature of tasks' performed in the production line require a high working pace, as the success of steel casting requires fast performance, so that the temperature does not drop below a certain level according to technical standards. This situation is amplified by the fact that the individual incentives (as a motivation factor) are associated with the speed of task's execution, due to urgent customers' orders.

4- Conclusion:

The study revealed the causes of the prevalence of musculoskeletal disorders among the foundry workers, who reported suffering from pain in the lower back and shoulders region of the body. The factors of the disorder are due to a number of reasons, such as, the high working pace, the weight lifting tasks and awkward postures adopted.

The results of the present study, clearly advocate for a well-elaborated MSD prevention program in the steel foundry under study, and a highly advanced strategy of eliminating the MSDs causing factors in all the similar sectors of activity.

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