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Prevalence of Musculoskeletal Disorders in Steel Industry Workers and its Association with RULA's Method Results

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ABSTRACT

Aim: Musculoskeletal Disorders (MSDs) are the main cause of occupational disorders and disabilities in the developing countries. The goal of this study was to assess the prevalence of the MSDs in steel Industry workers using Nordic Musculoskeletal Questionnaire (NMQ), and its relationship with the Rapid Upper Limb Assessment (RULA) results.

Instruments & Methods: The present research was a descriptive-analytic study conducted on the Iranian steel industry in 2018. A total of 17 workstations were randomly selected and NMQ was used to explore the prevalence of the symptoms of Work-related Musculoskeletal Disorders (WMSDs). Afterwards, the workers' postures were assessed via RULA. Finally, the results were analyzed in SPSS 22 through the chi-square test, independent t-test, and analysis of variance (ANOVA) method.

Findings: This study showed the significant relationship between the results from the Nordic assessment of the back, knee, and neck within the past 12 months and profession type ($p<0.05$). However, the final assessment scores, corrective measures priority, and Nordic assessments of the back, neck, and knee of the workers showed no significant relationship with work experience ($p>0.05$).

Conclusion: The findings of this study revealed that in order to considerably reduce the musculoskeletal disorders in the steel industry workers, immediate measures must be taken to correct the back and neck postures especially in the scrap shear operators, welders, ingot shear operators, electrical technician, tower operator, and guillotine operators.

Keywords: Musculoskeletal Disorders, Ergonomic, Steel Industry.

Introduction

Musculoskeletal Disorders (MSDs) are a group of disorders influencing on musculoskeletal system including nerves, tendons, muscles, and support systems such as the intervertebral discs. MSDs of which millions of people around the world, may be triggered by acute injuries or cumulative traumas, i.e. minor repetitive impacts and biomechanical stresses. Work-related Musculoskeletal Disorders (WMSDs) represent the disorders and diseases of the musculoskeletal system, which are accompanied by cumulative traumas such as repetitive movements, forceful exertions, abnormal postures, and long-term seating and standing positions at work [1]. MSDs are a cause of work-related injuries in the developed and developing societies. The problems caused by work-related traumas are taken extremely seriously in the developing societies [2]. MSDs have been in the first place among the work-related disorders, and they are known as the main cause of work-related disorders and disabilities in the developing countries. Because of imposing a socioeconomic burden on the patients, musculoskeletal disorders are fully associated with organizations and society characteristics [3]. The National Institute for Occupational Safety and Health (NIOSH) classifies the work-related diseases and morbidities by their importance,

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which is determined by their prevalence, intensity, and prevention possibility. In this regard, the work-related respiratory diseases have the first rank followed by the WMSDs [4]. Considering the list of work-related diseases published by the European Occupational Diseases Statistics (EODS) in 2005, MSDs have the highest rate of these diseases (38.1%) [5]. In addition, the existing statistics suggest that MSDs account for 31% and 44% of the occupational diseases and conditions in Finland and the United States, respectively [6]. Although a wide range of factors create WMSDs, abnormal postures at work are among the most important determinants [7]. Posture analysis is a systemic method that provides as a strong effective technique for the ergonomic assessment of occupational activities. The RULA (Rapid Upper Limb Assessment) method is also among the best posture assessment methods allowing the rapid assessment of the MSDs' risk to the upper limbs, especially in the static work postures [8]. In this research, Nordic Musculoskeletal Questionnaire (NMQ) was administered to assess the prevalence of the symptoms of WMSDs. The present research aimed to assess the prevalence of MSDs among workers, and to explore its relationship with the RULA results.

Instruments and Methods

The present research was a descriptive-analytic study conducted in 2018 on 17 workstations in the steel industry. All of the 168 workers of the 17 workstations were studied after verbal explanation of research goals to them. The workers participated in this research with full consent, and they were assured of the guaranteed confidentiality of the questionnaire data. First of all, the demographic information of the patients (including their age, education, work experience, and profession) were collected. The operators' history of diseases contributing to MSDs (such as osteoarthritis and rheumatism) or any incident causing MSDs were also assessed. Nevertheless, the aforesaid conditions were observed in none of the participants. Nordic questionnaire was employed to assess the prevalence of the symptoms of WMSDs. This questionnaire was designed in 1987 by Kuorinka et al. in the Scandinavian Institute of Occupational Health (9). Nordic assessments of the neck, shoulder, elbow, wrist, upper back, back, hip/thigh, knee, and ankle were carried out. Moreover, as the demographic variables were recorded, the disorders of other organs were examined by an expert and the questionnaires were completed [9].In the next stage, after observing and examining the workers' postures, the tasks posed the highest risk to the most active upper limbs were assessed. The workers' postures were assessed via RULA. In this assessment, the body organs were grouped into two categories, group A (arms, forearms, and wrists) and group B (neck, trunk, and feet). To analyze the occupational postures, every major body part was assessed for its deviation from the normal position. Hence, a number was assigned to each part based on the increase in the deviation from the normal position. By adding the muscular activity and repetition scores to the scores of groups A and B, the new C and D scores were obtained. The final score reflected the intensity of the posture risk and the critical level. The final score also determined the required corrections. A final score of 1 or 2 determined the priority of the corrective measure no. 1, whereas a final score of 3 or 4 determined the priority of the corrective measure no. 2. In addition, a final score of 5 or 6 reflected the priority of the corrective measure no. 3, while a score higher than 7 showed the priority of the corrective measure no. 4 [10]. Finally, in order to attain the research goals, the demographic information, Nordic

questionnaire results, and RULA results were analyzed through SPSS 22 using the chi-squared test, independent t-test, and analysis of variance methods.

Findings

The study population included 168 working staff of a steel industry. A total of 17 occupational tasks were assessed. All participants were male workers with an average age of 33.7 years. The average work experience of the respondents was also 3.4 years. Moreover, 35.7%, 53.6%, and 10.7% of the participants educated for 9, 12 and 14 years respectively. According to the Nordic assessments, the most prevalent MSDs were back (4.58%), knees (32.1%) and neck (25%) disorders within 12 months (Fig. 1).

According to RULA results, the final score and corrective measure priority for scrap shear operators were 7 and 4, respectively. In the case of welders, ingot shears operators, electrical technicians, power operators, and guillotine operators the final score and corrective measure priority were 6 and 3, respectively (Table 2).

In the RULA assessment, most respondents (42.9%) gained a final score of 3, while the corrective measure priority for these participants was 2 (60.7%) (Fig. 2)

The final scores and corrective measure priorities obtained through the RULA assessment displayed a significant relationship with the results of the Nordic assessment of the neck, knee, and back in the past 12 months ($p<0.05$). The final assessment scores and corrective measure priorities also staged a significant relationship with profession type ($p<0.05$). However, the work experience of the respondents had no significant relationship with the final assessment scores, corrective measure priorities, and Nordic assessments of the back, knee, and neck ($p>0.05$).

Discussion

Musculoskeletal disorders are among the main occupational health problems in heavy industries. In the steel industry, the most prevalent MSDs are observed in the back, knee, and neck of the workers. The highest priority of corrective measures is also 2. The duties of the scrap shear operators had a high corrective measure priority, necessitating immediate ergonomic corrective measures. According the duties of the welders, ingot shear operators, electrical technicians, tower operators, and guillotine operators, rapid ergonomic corrective measures are also required. In the shear operators, the back, neck, and wrist positions and in the welders and ingot shear operators the neck, back, and arm positions must be corrected. Similarly, in the electrical technicians the neck and arm positions, while in the tower and guillotine operators the arm, forearm, and wrist positions must be corrected. Some of the recent studies are introduced in the following. For example, the 2015 research by Kushwaha, who carried out a RULA assessment of the crane cabins in the steel industry, clarified that the most frequent pains and distresses were observed in the upper back, thighs/hips, neck, and knees [11]. Samaei (2017) also reported that many industrial workers experience MSDs especially in the back as an occupational risk factor. Therefore, the identification of the occupational risk factors, workplace standards, and ergonomic interventions was highly recommended [12]. In 2011, the research by Saidu revealed that a considerable percentage of industrial workers are MSD sufferers. Back pain was the most common condition among the participants [13]. In the study by Dianat (2015), RULA assessments, questionnaires, and direct observation of the working conditions served to unveil the high prevalence of the MSD symptoms, especially in the neck (or shoulder), back,

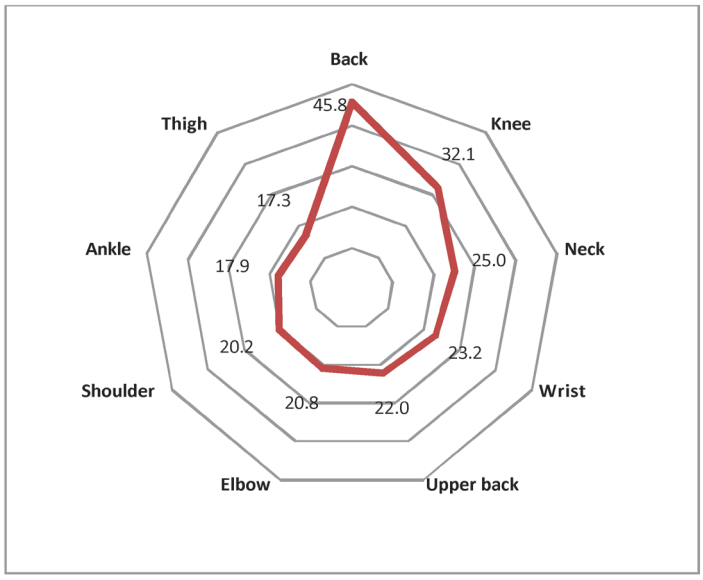

Figure 1. Evaluation of body pain and discomfort by Nordic questionnaire

Table 1. RULA Evaluation Results for Tasks

Row	Type of Task	Final score of evaluation	Priority level of corrective action
1	Iron waste cutting	7	4
2	Welding	6	3
3	Cut the ingot	6	3
4	Electrical technician	6	3
5	Towers operator	6	3
6	Guillotine Operator	4	3

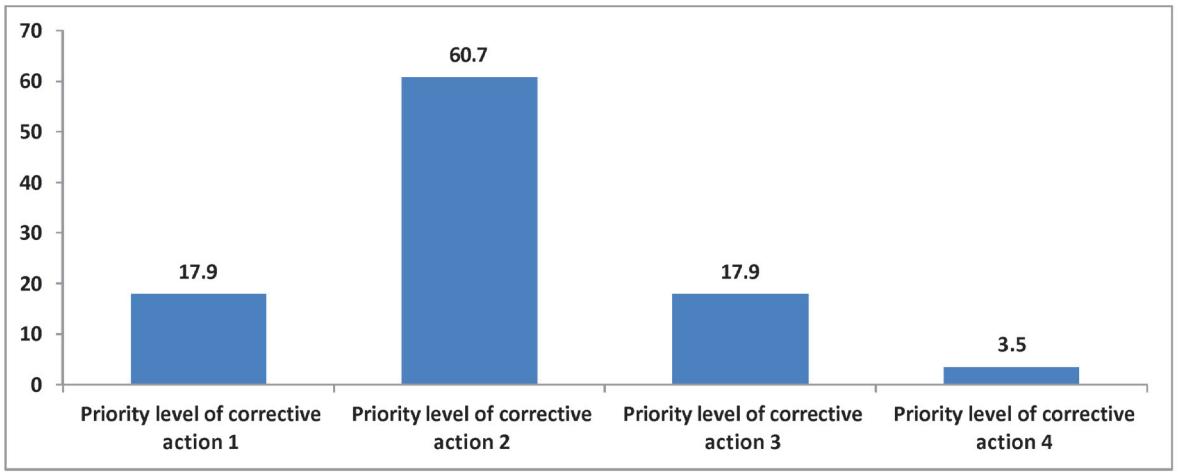

Figure 2. Priority level corrective action with RULA method

and wrist (or ankle) of the participants. The research findings stressed the necessity of the knowledge of the working conditions and activities of these professions as well as the need for ergonomic interventions for reducing MSDs in the future [14]. In Choi's analysis of the prevalence of MSD symptoms in the steel industries, back (53%) , neck and shoulder disorders (36%) were the most common MSDs in the course of a year [15]. The research by Mean on metal stamping explored a high RULA score. The risk of MSDs in this profession was also high; hence the necessity of corrective measures [16]. In 2018, Choina's investigations indicated that the selected workers mainly complained about the lower limb pain. The workers described this pain as a permanent or acute pain. Moreover, knee pain had the second priority due to the high frequency of the pain complaints [17]. Prevention of work-related traumas increases productivity, diminishes the loss of working hours and costs, and improves the standards [18,19,20].

Conclusion

This study indicated that, immediate corrective measures must be taken to correct the back and neck postures -especially in scrap shear operators, welders, ingot shear operators, electrical technicians, and tower and guillotine operators-, and thus considerably reduce the musculoskeletal disorders in the steel industry workers.

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Conflicts of Interest

The authors declare no conflict of interest.

Authors' contributions

BPA, NA, designed the study.

SS, AVP, NMM analyzed and interpreted the data.

BPA, NA, NH, SS, AVP, NMM, participated in data collection and data management.

AVP, NMM were a major contributors in writing the manuscript. All authors read and approved the final manuscript.

Ethical permission

All the procedures were approved by the Ethics Committee of Tarbiat Modares University of Medical Sciences.

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