http://www.pjbs.org

PJBS

ISSN 1028-8880

Pakistan Journal of Biological Sciences

ANSInet
Asian Network for Scientific Information
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan

Pakistan Journal of Biological Sciences 11 (24): 2670-2674, 2008
ISSN 1028-8880

Musculoskeletal Problems among Workers of an Iranian Zinc Industry

[1]M.H. Karimfar, [2]S. Shokri, [2]M.R. Gholami, [3]A. Bayat,
[4]N. Moosavinasab and [5]A. Choobineh
[1]Department of Anatomy, Faculty of Medicine,
Qazvin University of Medical Sciences, Qazvin, Iran
[2]Department of Anatomy, School of Medicine,
Zanjan University of Medical Sciences, Zanjan, Iran
[3]Department of Occupational Health, School of Health,
Shiraz University of Medical Sciences, Shiraz, Iran
[4]Department of Community Medicine, School of Medicine,
Zanjan University of Medical Sciences, Zanjan, Iran
[5]Research Center for Health Sciences, Department of Occupational Health,
School of Health and Nutrition, Shiraz University of Medical Sciences, Shiraz, Iran

Abstract: This study was conducted among workers of an Iranian zinc industry with the objective of determination of the prevalence rate of Musculoskeletal disorders (MSDs) among production workers. In this study, all 6 production units of the factory were studied. In each unit, 50% of the workers were randomly selected and included in the study. A total of 98 workers participated. The nordic musculoskeletal questionnaire was used as a collecting data tool to study the prevalence of MSDs. The vast majority of the study population (77.6%) had experienced some form of symptoms of musculoskeletal disorders during the last 12 months. The highest prevalence was reported in the lower back (47.9%) and upper back (34.6%). MSDs had occurred with a high rate among zinc workers. Corrective measures for reducing risk level seemed essential. Elimination of awkward postures and manual materials handling in the workplace were recommended.

Key words: Musculoskeletal problems, zinc industry, nordic questionnaire

INTRODUCTION

Musculoskeletal disorders (MSDs) represent one of the leading causes of occupational injury and disability in the developed and industrially developing countries (Shahnavaz, 1987; Genaidy *et al*., 1993; Smith *et al*., 2003; Maul *et al*., 2003; Menzel, 2004). The term musculoskeletal disorders (MSDs) refer to conditions that involve the nerves, tendons, muscles and supporting structures of the body (Bernard, 1997). MSDs were recognized as having occupational etiologic factors as early as the beginning of the 18th century. These conditions result in pain and functional impairment and may affect back, neck, shoulders, elbows, forearms, wrists and hands (Buckle and Devereux, 2002). The economic loss due to such disorders affects not only the individual but also the organization and the society as a whole (Kemmlert, 1996). At the present time, MSDs are one of the most important problems ergonomists encounter in workplace around the world (Vanwonterghem, 1996). In many countries, the prevention of MSDs among the work force is considered as a national priority (Spielholz *et al*., 2001).

Risk factors of MSDs are known to include workplace activities such as heavy load lifting, repetitive tasks and awkward working postures (Bernard, 1997), while demographic characteristics and psychosocial factors are also known to be important predictive variables (Carter and Banister, 1994; Linton and Kamwendo, 1989; Weiser, 1997). Yet, the relationship between MSDs and work-related factors remains the subject of considerable debate in Iranian industries. In Iranian zinc industry, workers are directly involved in the production process. In this industry, physical activities such as manual material handling (e.g., heavy load lifting, carrying, pulling and pushing) and awkward working postures are very common (Fig. 1, 2). In this situation, high rate of MSDs occurrence is expected.

Corresponding Author: Alireza Choobineh, Research Center for Health Sciences, Department of Occupational Health, Shiraz University of Medical Sciences, P.O. Box 71645-111, Shiraz, Islamic Republic of Iran
Tel: +98 917 118 4450 Fax: +98 711 7260225

Fig. 1: A worker is lifting two zinc sheets (cathode and anode) of 22 kg with awkward body posture

Fig. 2: A worker is lifting a zinc bar of 30 kg with bent back

The present study was conducted in an Iranian zinc industry with the objective of determination of the prevalence of MSDs among zinc workers. It is believed that the results of this study could be an appropriate base for planning and implementing interventional ergonomics programs in the workplace and improving worker's health in this industry.

MATERIALS AND METHODS

This study was conducted from October 2006 to February 2007 among workers of an Iranian zinc industry in Zanjan City, Iran. In the plant process, the raw materials enter the leaching tanks along with sulfuric acid, aluminum and iron sulfate. The solution obtained is neutralized and then sent for electrolysis to produce electrolytic zinc sheets as the final product. Finally, in the melting unit zinc sheets turn to zinc bars.

In this plant, production employees worked in 3 shifts at 6 different units. In this study, in each unit, 50% of the workers with at least one year of job tenure was randomly selected from the corresponding list and included in the study. Workers with background diseases or occupational or non-occupational accidents affecting the musculoskeletal system were excluded from the study. Totally, 98 male production workers participated in this study. Data were collected via., anonymous questionnaires. The questionnaire consisted of two parts and covered the following items (1) individual data (including weight, height, age, job tenure, health and medical background) and (2) musculoskeletal problems in different body region. The general nordic questionnaire of musculoskeletal symptoms (Kuorinka *et al*., 1987) was used to examine reported cases of MSDs among the study population. This questionnaire has been widely used to investigate MSDs problems in many Iranian industries and medical settings, for instance rubber industry (Choobineh *et al*., 2007a), telecommunication industry (Choobineh *et al*., 2007b), hand-woven carpet industry (Choobineh *et al*., 2007c), petrochemical industry (Choobineh *et al*., 2009), clinical laboratories (Choobineh *et al*., 2002), hospital nurses (Choobineh *et al*., 2006) and surgical technicians (Movahed *et al*., 2007).

Reported MSDs symptoms were limited to the past 12 months. All units were visited and the questionnaires were completed by interviewing the workers.

Statistical analysis were preformed using SPSS (Version 13). The independent t-test and Chi-square test were used to study association between demographic and work variables with reported musculoskeletal symptoms. Test of proportion was applied to investigate the difference between the prevalence rates of musculoskeletal problems among zinc workers and general Iranian male population (Choobineh *et al*., 2004).

RESULTS

Table 1 summarizes individual characteristics of the workers who participated in the study. As indicated in Table 2, the most commonly affected regions among workers were lower back (47.9%) and upper back (34.6%).

As shown in Table 3, there were significant differences between mean age and mean job tenure of the reported and not-reported groups ($p<0.001$) such that both were higher among the reported group.

Table 1: Some individual characteristics of the workers who participated in the study

Personal characteristics	Mean	SD	Min-Max
Age (year)	29.00	6.50	20.00-49.00
Weight (kg)	72.60	8.10	55.00-92.00
Height (cm)	173.50	6.90	157.00-188.0
BMI (kg m^{-2})	24.20	3.05	15.19-31.27
Job tenure (year)	5.10	3.50	0.40-17.00

n = 98

Table 2: Frequency of reported musculoskeletal symptoms in different body regions of the workers during the last 12 months prior to the study

Body regions	No.	Percentage
Neck	9	9.1
Shoulders	12	12.2
Elbows	11	11.2
Wrists/hands	16	16.3
Upper back	34	34.6
Lower back	47	47.9
Thighs	12	12.2
Knees	23	23.4
Legs/feet	24	24.4

n = 98

Table 3: Associations between some demographic variables and reported musculoskeletal problems among the workers studied

	Musculoskeletal problems		
Variables	Reported	Not reported	p-value*
Age (year)	29.21±6.790	28.27±5.440	<0.001
Weight (kg)	72.25±9.470	71.80±10.48	0.823
Height (cm)	175.43±10.55	174.56±7.520	0.870
BMI (kg m^{-2})	23.52±3.020	23.50±3.000	0.860
Job tenure (year)	7.65±6.540	4.72±4.750	<0.001

*Independent t-test, Data are expressed as Mean±SD, n = 98

Table 4: Percentage of sick leaves due to musculoskeletal problems in different body regions in the last 12 months reported by the workers studied

Body regions	Sick leaves due to musculoskeletal problems (%)
Neck	12.2
Shoulders	11.2
Elbows	16.3
Wrists/hands	21.4
Upper back	22.4
Lower back	25.5
Thighs	14.3
Knees	22.4
Legs/feet	21.4

(n = 98)

Table 4 presents the frequency of sick leave due to musculoskeletal problems in different body region during the last 12 months. As shown in Table 4, problems of lower back, upper back and knees were the causes of the highest rates of sick leave.

DISCUSSION

The Nordic musculoskeletal questionnaire showed that symptoms from the musculoskeletal system were common among the zinc workers studied. The vast majority of the study population (77.6%) had experienced some form of symptoms of musculoskeletal disorder during the last 12 months. Comparison of the results of this study with the results of the National Health Survey of Iran (National Research Center of Medical Sciences of Iran, 2001) revealed that the differences between the prevalence of musculoskeletal problems were significant (Table 5). This indicates that problem of musculoskeletal disorders in the factory was serious and needed appropriate attention.

Table 5: Comparison of point prevalence of musculoskeletal symptoms in neck, back and large joints in general Iranian male population and the zinc industrial workers studied

Body regions	Zinc workers studied (age = 20-49)	General Iranian male population (age =15-69)	p-value*
Neck	14.3%	4.72%	<0.0001
Upper and lower back	30.1%	15.27%	<0.0001
Large joints†	24.48%	12.30%	<0.0001

*Test of proportion, †Including: Shoulders, elbows, wrists, knees and ankles

Back, knees and legs symptoms were found to be the most prevalent problem among the workers studied (Table 2). This could be attributable to repetitive lifting of heavy objects in extreme or awkward postures and long time of standing work. Generally speaking, it is in accord with other studies conducted in Iranian industries (Choobineh *et al*., 2002, 2006, 2007a-c, 2009; Movahed *et al*., 2007). For instance, in a study on workers of an Iranian rubber factory, Choobineh *et al*. (2007a) found that problems of the back and knees were the causes of the highest rates of sick leave.

In the Electrolysis, Melting, Leaching, Quality control units and among the head workers lower and upper back were the common problem while in the Laboratory unit, legs symptoms was the common problem among the workers studied. The results revealed that symptom of back caused the highest rate of sick leave.

Present results suggested that age and job tenure were significantly associated with musculoskeletal symptoms in different body regions. This is in agreement with the findings of Bragem (1996), Burdorf and Sorock (1997) and Lemasters *et al*. (1998). No association was found between weight, height and Body Mass Index (BMI) and the prevalence rate of MSDs (Table 3).

CONCLUSION

This study showed that poor working conditions and musculoskeletal problems among zinc workers occurred in high rate. Thus, improvement of working conditions and taking corrective measures to reduce the risk level into consideration seemed essential. Present observations depicted that the majority of ergonomics shortcoming and important factors for musculoskeletal symptoms in this industry originated from repetitive lifting of heavy objects in extreme or awkward postures. It is, therefore, recommended that any interventional ergonomic program in the workplace should focus on eliminating awkward postures and manual handling of heavy loads.

REFERENCES

Bernard, B.P., 1997. Musculoskeletal Disorders and Workplace Factors: A Critical Review of Epidemiologic Evidence for Work-Related Musculoskeletal Disorders of the Neck. Upper Extremity and Low Back. US Government Printing Office, Washington, DC.

Bragem, B., 1996. Musculoskeletal pain and smoking in Norway. J. Epidemiol. Commun. Health, 50: 166-169.

Buckle, P.W. and J.T. Devereux, 2002. The nature of work-related neck and upper limb musculoskeletal disorders. Applied Argon., 33: 207-217.

Burdorf, A. and G.S. Sorock, 1997. Positive and negative evidence of risk factors for back disorders. Scand. J. Work Environ. Health, 23: 243-256.

Carter, J.B. and E.W. Bamister, 1994. Musculoskeletal problems in VDT work: A review. Ergonomics, 37: 1623-1648.

Choobineh, A.R., S. Tourani, K. Heidarian and F. Gharahgozloo, 2002. Ergonomic workstation evaluation in clinical laboratories of KUMS and its relation to musculoskeletal problems and productivity. Proceedings of the 3rd International Cyberspace Conference on Ergonomics, 2002, South Africa, pp: 421-434.

Choobineh, A.R., M.A. Lahmi, H. Shahnavaz, R. Khani Jazani and M. Hosseini, 2004. Musculoskeletal symptoms as related to ergonomic factors in Iranian hand-woven carpet industry and general guidelines for workstation design. Int. J. Occup. Safety Ergon., 10: 157-168.

Choobineh, A.R., A. Rajaeefard and M. Neghab, 2006. Association between perceived demands and musculoskeletal disorders among hospital nurses of Shiraz University of Medical Sciences: a questionnaire survey. Int. J. Occup. Safety Ergon., 12: 409-416.

Choobineh, A.R., S.H. Tabatabaei, A. Mokhtarzadeh and M. Salehi, 2007a. Musculoskeletal problems among workers of an Iranian rubber factory. J. Occup. Health, 49: 418-423.

Choobineh, A.R., S.H.R. Tabatabaei, M. Tozihian and F. Ghadami, 2007b. Musculoskeletal problems among workers of an Iranian communication company. Ind. J. Occup. Environ. Med., 11: 32-36.

Choobineh, A.R., M. Hosseini, M.A. Lahmi, R. Khani Jazani and H. Shahnavaz, 2007c. Musculoskeletal problems in Iranian hand-woven carpet industry. Applied Ergon., 38: 617-624.

Choobineh, A.R., G.R. Peyvandi Sani, M. Sharif Rohani, M. Gangi Pour and M. Neghab, 2009. Perceived demands and musculoskeletal symptoms among employees of an Iranian petrochemical industry. Int. J. Ind. Ergon. 10.1016/j.ergon.2009.01.001

Genaidy, A.M., A.A. Al-Shedi and R.L. Shell, 1993. Ergonomics risk assessment: Preliminary guidelines for analysis of repetition force and posture. J. Hum. Ergol., 22: 45-55.

Kemmlert, K., 1996. Prevention of occupational musculo-skeletal injuries. Labour inspectorate investigation. Scand. J. Rehabil. Med. Suppl., 35: 1-34.

Kuorinka, I., B. Jonsson, A. Kilbom, H. Vinterberg, F. Biering-Sorensen and G. Anderson *et al*., 1987. Standardized Nordic questionnaires for the analysis of musculoskeletal symptoms. Applied Ergon., 18: 233-237.

Lemasters, G.K., M.R. Atterbury and A.D. Booth, 1998. Prevalence of musculoskeletal disorders in active union carpenters. Occup. Environ. Med., 55: 421-427.

Linton, S.J. and K. Kamwendo, 1989. Risk factors in the psychosocial work environment for neck and shoulder pain in secretaries. J. Occup. Med., 31: 609-613.

Maul, A., T. Laubli, A. Klipstein and H. Krueger, 2003. Course of low back pain among nurses: A longitudinal study across eight years. Occup Environ. Med., 60: 497-503.

Menzel, N.N., 2004. Back pain prevalence in nursing personnel: Measurement issues. Am. Assoc. Occup. Health Nurses J., 52: 54-65.

Movahed, M., A. Choobineh, S.H.R. Tabatabaie and M. Kumashiro, 2007. Musculoskeletal problems among surgical technicians of Shiraz city hospitals. Proceedings of the 8th Pan-Pacific Conference on Occupational Ergonomics (PPCOE 2007), Oct. 17-19, Bangkok, Thailand pp: 1-1.

National Research Center of Medical Sciences of Iran, 2001. National Health Survey of Iran: Overall Country. Health Ministry of I. R. Iran, Research Chancellor, Tehran, Iran.

Shahnavaz, H., 1987. Workplace injuries in the developing countries. Ergonomics, 30: 397-404.

Smith, D.R., M. Sato, T. Miyajima, T. Mizutani and Z. Yamagata, 2003. Musculoskeletal disorders self-reported by female nursing students in central Japan: A complete cross-sectional survey. Int. J. Nurs. Stud., 40: 725-729.

Spielholz, P., B. Silverstein, M. Morgan, H. Checkoway and J. Kaufman, 2001. Comparison of self-report, video observation and direct measurement methods for upper extremity musculoskeletal disorder physical risk factors. Ergonomics, 44: 588-613.

Vanwonterghem, K., 1996. Work-related musculoskeletal problems: Some ergonomics considerations. J. Hum. Ergol., 25: 5-13.

Weiser, S., 1997. Psychosocial Aspects of Occupational Musculoskeletal Disorders. In: Musculoskeletal Disorders in the Workplace: Principles and Practice, Nordin, M., G.B.J. Andersson and M.H. Pope (Eds.). Mosby-Year Book, Inc., St. Louis, MO., ISBN-13: 9780801679841, pp: 51-61.