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Original Article

Prevalence of Musculoskeletal Disorders and Associated Lost Work Days in Steel Making Industry

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Abstract

Background: The study aims at clarifying prevalence of work-related musculoskeletal disorders (WMSDs) among steel making workers and employees as well as associated lost work days.

Methods: A detailed questionnaire based on Nordic ergonomic questionnaire describing work history, ergonomic conditions at work, sign and symptoms of musculoskeletal system with in previous12 months was applied to the investigation among1030 male workers and employees in a steel making plant in Isfahan, Iran, 2004.

Results: The prevalence of low back pain ranked top, regardless of job titles followed by knee pain. The age groups (24-35) and (34-45) manifested the most frequent number of (MSDs) and MSDs related lost workdays.

Conclusion: This is almost in harmony with the prevalence of MSDs among general population and statistics presented by Bureau of Labor Statistics, the U.S Department of Labor.

Keywords: *Musculoskeletal disorders, Lost workdays, Steelmaking industry*

Introduction

The term musculoskeletal disorder (MSDs) refers to conditions that involve the nerves, tendons, joints, ligaments, and spinal discs (1). They are prevalent and potentially disabling conditions that consume a large proportion of health care resources and are the leading cause of functional loss in adults. The social costs of MSDs are enormous, often overshadowing those of other chronic conditions. Work disability related to MSDs or WMSDs is a challenge to employability, business productivity, and the capacity of health and social security systems (2, 3). In many countries the prevention of work related musculoskeletal disorders has been considered as a national priority absents from work and work lost days is one of the most important problems within the scope of industrial hygienists. It also reflects the presence of harmful agents with in the work place and direct-indirect compensation costs inflicted upon organizations and industries in charge (3). Preventive efforts to decrease sick leave due to neck or back pain may include measures to increase the occurrence of positive challenges at work and to minimize repetitive work procedures (4).

The steel making industry has long been considered to be a hazardous occupation characterized by heavy exposure to chemical and physical hazards. In fact, steel making industry is labor-intensive and complex process demanding a great amount of repetitive manipulation and stressful physical and postural loads which are associated to work safety hazards, including musculoskeletal strain, cumulative traumatic and ergonomic injuries due to lowering or moving objects as well as lifting and carrying tasks (5).

Evaluating the prevalence of WMSDs in steel making industry and its divergence among different age groups was the priority of this study. We also considered the WMSDs related lost work days.

Results from the latest survey of self-reported work- related illness indicate that in 2004/05 an estimated prevalence of 1012000 people in Great

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Britain suffered from a musculosketal disorder which, in their opinion, was caused or made worse by their Current or past work (1). This equates to 2400 per 100 000 people (2.4%) who hove ever worked in Great Britain. Around 45% of these (452000) suffered from a disorder mainly affecting there back, 375000 from a disorder mainly affecting their upper limbs or neck, and 185000 mainly affecting their lower limbs (6).

It is estimated that 11.6 million working days (full-day equivalent) were lost in 2004/05 through musculoskeleted disorders caused or made worse by work. On overage, each person suffering took an estimated 20.5 days off work in that 12-month period. This equates to an annual loss of 0.50 days per worker (5).

According to the Bureau of labor statistics, musculoskeletal disorders $WMSD_S$ made up approximately 1/3 of all lost workdays cases in the United States, 2001 (2).

The study aims at clarifying prevalence of work-related musculoskeletal disorders WMSDs among steel making workers and employees as well as associated lost work days.

Materials and Methods

Industrial hygienist experts questioned total of 1030 male workers and employees who were included in the study, representing all the work force in steel making unit of Zob Ahan Company in Isfahan, Iran, in 2004.

The applied questionnaire was based on the Standardized Nordic ergonomic questionnaire containing demographic data and medical history of musculoskeletal symptoms and injuries, work history associated with WMSDs and lost workdays.

Subjects were mostly questioned in the middle of the work shift promising their answers were kept confident ional.

The collected data from the questionnaire investigation was later analyzed and considering different age groups compared with statistics presented by the federal bureau of labor statistics (BLS).

Results

The prevalence of lower back pain was always ranked at the top followed by knee, regardless of the job title. The results suggested that pain occurring in the lower back, knee, neck and shoulder are the most predominant ergonomic problems in this industry.

Table 1 shows the WMSDs prevalence and divergence by the type of disorders.

The data bout WMSDs related lost workdays was also obtained by the questionnaire and classified in accordance to the different parts of body which were affected. Table 2 presents the frequency of WMSDs related work lost days.

We also found out that WMSDs related lost workdays make up 1.37% of all work days which equates 13.7 lost workdays with in each 1000 work days in this plant. (Such data is based on 1030 employees and 50 weeks in a year).

According to the data available by the Bureau of labor and statistics (BLS) a total number of 402700 cases of WMSDs were reported which makes 32% of all work related disorders resulting the days away from work in year 2004. Table 3 is based on Bureau of labor and statistics (BLS) data.

Fig. 1 and 2 are a demonstration of WMSDs related matters in steel making department of Zob Ahan in 2004, where the findings are quite in harmony with the BLS data.

Table 1: The WMSDs prevalence and its divergence by the type of disorders

	Feet	Knees	Thighs	Back	Upper back	Wrists	Elbows	Shoulder	ck
Total number of disorders	178	369	149	415	162	167	91	251	253
Frequency	17.5	36	14.8	40.7	15.7	16.5	9.1	22.4	24.5

Table 2: Te frequency of WMSDs related lost work days

Number of days away from work	Feet	Knees	Thighs	Back	Upper back	Wrists	Elbows	Shoulder	Neck
1 to 7	11	23	18	55	13	10	7	22	25
8 to 30	12	10	10	33	4	4	5	8	13
More than 30	6	4	4	12	1	4	1	-	1

Table 3: Number of work- related musculoskeleted disorders involving days away from work and median days away from work by age group 2004

Age groups	Number	Median days away from work
Total Meds	402700	10
16 to19	7970	5
20to 24	37750	5
25to34	98790	7
35to44	115610	10
45to54	92280	13
55to 64	40280	15
65 and over	4530	20
age not reported	5460	7

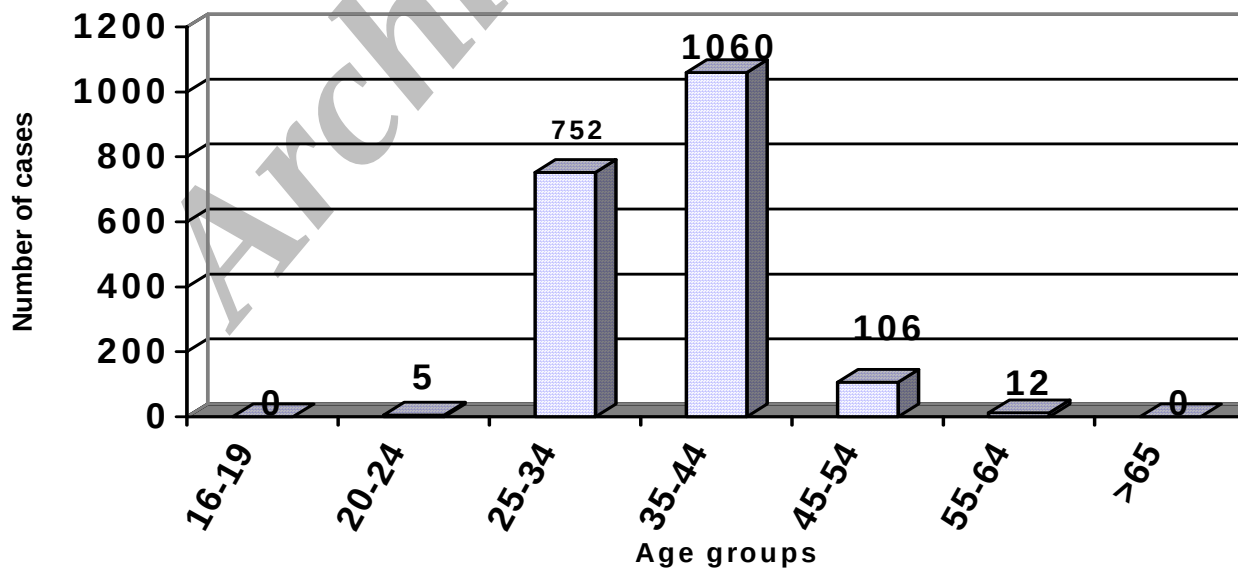

Fig. 1: Number of WMSDs related absences by age group in steel making department of Zob Ahan.

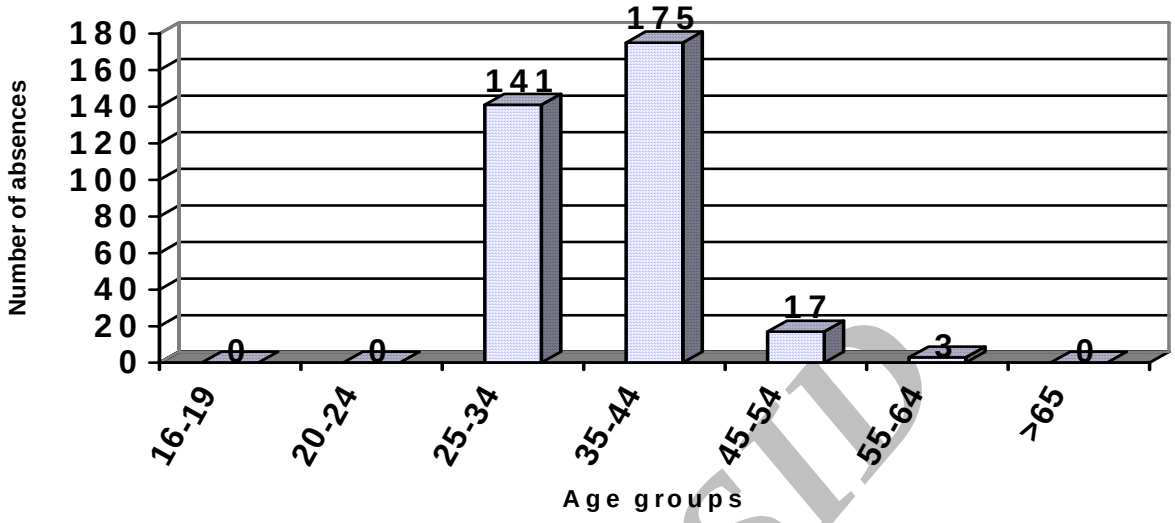

Fig. 2: Number of lost work days by age groups in steel making department of Zob Ahan.

Discussion

To get enlightened about ongoing trends in WMSDs, it is first worth mentioning two recently proposed models dealing with this concept. According to these models, there are some underlying factors causing and deteriorating WMSDs at workplace (7). Of the many theories and models of WMSDs causation that have been discussed in the literature, two were chosen to review. Kumar (8) proposed four different theories of WMSD, all of which could operate simultaneously within an individual, though the factors leading up to the injury could result from any of the four theories.

The first theory proposed was called the 'multivariate interaction theory of musculoskeletal injury precipitation' (see Fig.3). In this theory, interactions between genetic, morphological, psychosocial and biomechanical factors impacted the individuals' musculoskeletal system. The impact could result in strain, structural and/or biochemical changes and eventually pain. The exposures in this theory were biomechanical factors, the doses were the impacts on the musculoskeletal system, the response was strain in the form of structural, biochemical or physiological changes and capacity was a affected by genetics, morphological characteristics and the individual's psychosocial profile. Much like Sauter and Swanson (9), this theory identified nociception (i.e. sensation of pain) as a precursor of injury, but did not identify the additional cognitive dimension of attribution or show the possible moderating effects of other exposures and responses on nociception or the development of WMSDs. The second theory proposed was termed the 'differential fatigue theory'. This theory proposed that different activities differentially loaded on different joints and the work situation was not changed, the changes in the workings of the muscles could lead to changes in the kinematics of the joints, which could lead to injury. This theory added another type of response that could be measured when investigating the impact of WMSDs interventions- fatigue. The proposed 'cumulative load theory' was similar to the often talked about wear and tear mechanism of injury. That is, while biological tissue is capable of self-repair, the tissue can suffer from degradation if loadings are repeated. Overtime, if the loading is not lowered, permanent deformation of the tissue may result and the stress-bearing capacity may be reduced. Both conditions may lower the level at which tissue fails or injury results.

The final theory proposed by Kumar (2001) was called the 'over-exertion theory'. Simply put, this theory of WMSDs causation suggested exertion, which was defined as a function of force, duration, posture and motion that exceeds the limits of tissue, could cause the tissue to fail.

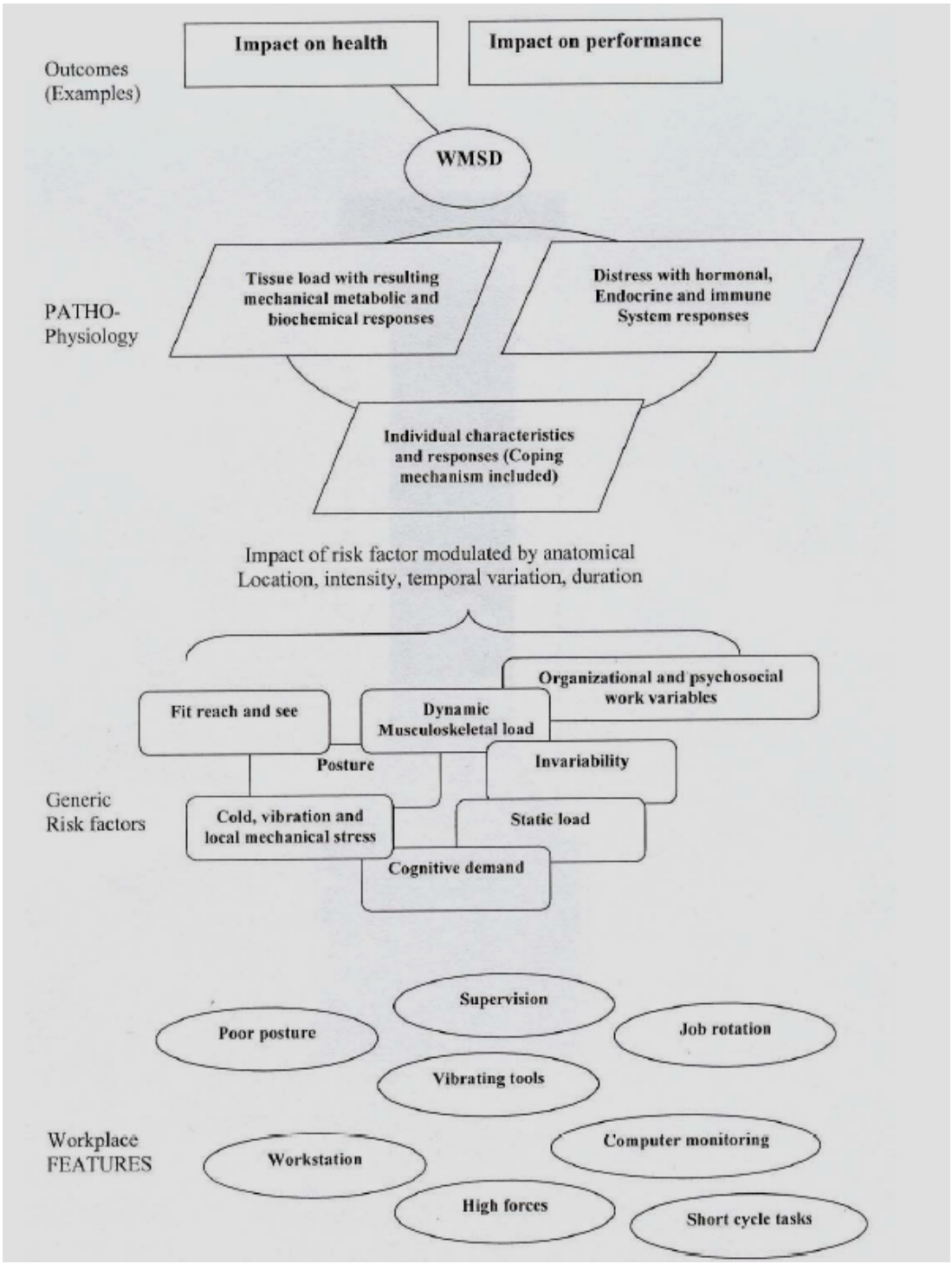

Fig. 3: Kumar (2001) multi-variate interaction theory of musculoskeletal injury precipitation. Reprinted with permission from Ergonomics, 44, 17-47, 2001. Available online at:http://tandf.co.uk/journals

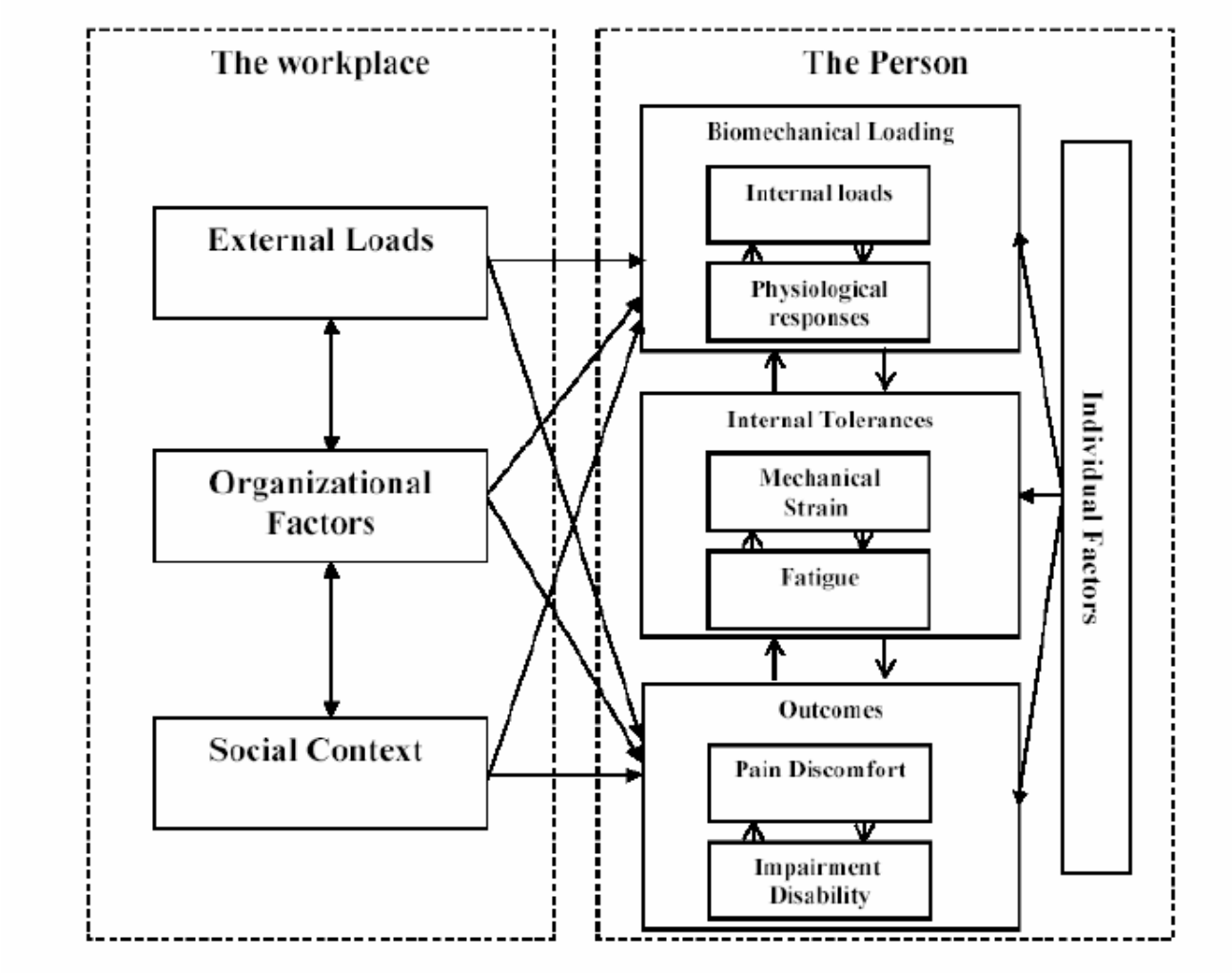

Fig. 4: National Research Council/Institute of Medicine (2001) model of work-related musculoskeletal disorder causation. Reprinted with permission from Musculoskeletal Disorders and the Workplace (Washington, DC: National Academy Press).

National Research Council model More recently, the National Research Council and Institute of Medicine (NRC/IOM2001) published a book (10) on musculoskeletal disorders and the workplace. In that publication was a model of WMSDs causation (see figure4), which was the same model used in their earlier publication (11). This model showed that three interacting workplace factors, external loads, organizational factors and social context, could directly impact biomechanical loading as well as outcomes such as pain and impairment. Within the person, biomechanical loading, internal tolerances and outcomes operated through feedback loops to continuously affect each other. Individual factors, such as adaptation, were shown to independently affect biomechanical loading, internal tolerances and outcomes.

Recent studies about prevalence of WMSDs among working population Due to complications and potential drawbacks related to WMSDs there has been a number of research considering the prevalence and symptoms of such a disorder. It was reported from numerous sources that the different case definitions lead to different results in the prevalence of musculoskeletal

disorders and frustrate comparisons between studies (12) and although controversial, approaching a consensus is not out of reach.

In a recent study among workers of an Iranian communication company statistical analyses showed significant association between job tenure and reported musculoskeletal problems in knees and upper back ($P< 0.05$), such that with increasing job tenures the prevalence rate of problems in these regions increased (13).

Using the standardized Nordic questionnaire for analysis of musculoskeletal symptoms in 2006, a cross-sectional study of the largest car-manufacturing group in Iran, the prevalence of LBP (low back pain), work exposures and lifestyle factors of the 18,031 employees were recorded. Demographic data and lifestyle factors (age, sex, education, weight, work experience, smoking and fitness training) were also collected. The 1-year prevalence of self-reported LBP in this Iranian industrial population was 21% (20% males and 27% females). The prevalence rate of absence due to LBP was 5% per annum. The multiple logistic regression models indicated that the following remained risk indicators for LBP in the previous 12 months: increasing age, no regular exercise, heavy lifting, repetitive work and monotonous work (14).

In another study in four small size factories in Ardabil, Iran (using radiographic evaluation, and ergonomic survey by NIOSH checklist), the highest frequency of low back pain was observed in the age of 30-34 yr old, medium height and heavy weight with 34.4, 84.4, and 33.0 percent, respectively. With regard to work-related factors, load lifting with 44.7 and body posture with 18.4 percent contributed to low back pain as the most important occupational causes among the patients. Observing recommended regulations and limitations of load lifting, modifying and optimizing ergonomic conditions in the workplace, selecting workers with suitable body strength on the basis of a pre-employment examination and implementing a continuous educational program for employees were the most important methods recommended to prevent low back pain (15).

To identify and establish the association of occupational risk factors with the prevalence of low back (LB) problems in a semi-automated South African Steel industry, among 366 steel plant workers, a guided questionnaire and a functional rating index was employed. Multivariate logistic regression analyses indicated significant adjusted odds ratios (OR) for twisting and bending (OR 2.81; CI 1.02-7.73); bulky manual handling (5.58; 1.16-26.71); load carriage (7.20; 1.60-32.37); prolonged sitting (2.33; 1.01-5.37); kneeling and squatting (4.62; 1.28-16.60); and working on slippery and uneven surfaces (3.63; 1.20-10.90). Similar to the results of our current study in steel making unit of Zob Ahan Company, this study supports the view of a multifactorial etiology in idiopathic LB problems, and emphasizes the importance of multiple intervention strategies in industrial settings (16).

Data on workers in the selected industries in the private sector in Ibadan City Oyo State Nigeria were collected by a self administered questionnaire showed that job activities which involved sitting ($P= 0.03$) and lifting ($P= 0.006$) were significantly associated with occurrence of low back pain respectively (17).

In another study in China the prevalence and risk factors of musculoskeletal disorders of foundry workers was considered, and referring to the main findings, the prevalence of low back pain ranked the first (5).

Another study worth mentioning was one year prevalence of musculoskeletal symptoms in aluminum industry port room workers where the prevalence of WMSDs was high in lower back among workers and a correlation analysis showed that the prevalence of WMSDs in all areas of the body except feet increased with the age among port room workers (18).

Utilizing standardized Nordic Questionnaire a cross-section survey included 122 males between the ages of 20-45 who had been employed for at least 1 yr in three food stores, experts reported an increase in WMSDs symptoms among those who were working in cold storerooms (19).

Multivariate analyses of one-year period prevalence for neck pain, back pain and pain in the upper and lower extremities among Quebec working population indicated that physical and psychosocial work factors, as well as psychological variables, were associated with musculoskeletal pain in different body regions. The results of this study also suggested that interventions aimed at reducing musculoskeletal pain should take into account personal and work-related psychosocial variables, in addition to physical workload (20).

In a study to measure lost productive time (absence and reduced performance due to common pain conditions) during a 2-week period, among a random sample of 28 902 working adults in the United States, thirteen percent of the total workforce experienced a loss in productive time during a 2-week period due to a common pain condition. Headache was the most common (5.4%) pain condition resulting in lost productive time. It was followed by back pain (3.2%), arthritis pain (2.0%), and other musculoskeletal pain (2.0%). Workers who experienced lost productive time from a pain condition lost a mean (SE) of 4.6 (0.09) h/wk. Workers who had a headache had a mean (SE) loss in productive time of 3.5 (0.1) h/wk. Workers who reported arthritis or back pain had mean (SE) lost productive times of 5.2 (0.25) h/wk. Other common pain conditions resulted in a mean (SE) loss in productive time of 5.5 (0.22) h/wk. Lost productive time from common pain conditions among active workers costs an estimated 61.2 billion dollars per year (21).

Also in a follow-up questionnaire study among all the workers (5654 workers) at eight aluminum plants in Norway WMSDs accounted for 45% of all working days lost the year prior to follow-up (22). Blue-collar workers had significantly higher risk than white-collar workers for both short- and long-term sickness absence from WMSDs (long-term sickness absence: RR= 3.04, 95% CI 2.08-4.45) (23).

In conclusion, comparing figures 1 and 2 makes a confirmation that number of work-related musculoskeletal disorder is quiet in harmony with the results in the US in 2004. Considering the data from Table 1, the most sizable disorders are present among age groups 35-44 and 43-54 and in body parts knee and back (low back). Such disorders in this unit are mainly caused by lack of employing ergonomic remedies in the current process. Adding to this the wrong working posture and work pressures which have deteriorated the situation.

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The authors declare that they have no Conflict of Interests.

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