ERGONOMIC INTERVENTION ON MUSCULOSKELETAL PROBLEMS AMONG WELDERS

Malikraj S a, Senthil Kumar T b, Ganguly A.K c

ABSTRACT:
Work-related musculoskeletal disorders (WMSDs) are a worldwide general health problem and a key reason for the disability in the workplace. Awkward working posture is a foremost risk factor for developing WMSDs. Evaluation of exposure level to WMSDs risks can be an appropriate base for setting up and implementing interventional ergonomics program in the workplace. This study was conducted among welders of an Indian metal fabrication industries with the objectives of a) assessment of exposure level to WMSDs risks and b) Determination of WMSDs occurrence.

INTRODUCTION
Musculoskeletal disorders (MSDs) represent one of the leading causes of occupational injury and disability in the welding fabrication industries [Shahnavaz H; Genaidy AM]. The economic loss due to such disorders affects not only the individual but also the organization and the society as a whole [Kemmlert K]. At present time, MSDs is one of the most important problems ergonomists are encountered in the workplace around the world [Vanwonerghem K]. In many countries, the prevention of work-related musculoskeletal disorders (WMSDs) has been considered as a national priority [Spielholz P]. WMSDs is a worldwide concern and the problems of workplace injuries are extremely serious [Shahnavaz H]. Poor working conditions and the absence of an effective work injury prevention program has resulted in a very high rate of MSDs [Jafry T]. Risk factors of WMSDs are known to include workplace activities such as heavy load lifting, repetitive tasks and awkward working postures [Bernard B], while demographic characteristics and psychosocial factors are also known to be important predictive variables [Carter JB, Weiser S]. It has been widely accepted that awkward and constrained postures result in musculoskeletal stress on different body regions of seated workers [Li G, Haslegrave C.M] and are a major factor in the development of musculoskeletal disorders. [Das B, Sengupta AK; Li G, Buckle P]. Poor postures have also been found to be associated with decreased efficiency of performance, an important cause of which was recognized to be the body discomfort resulting from the restricted postures [Haslegrave C.M]. The need to improve working posture has been documented in a number of studies which have shown a relation between stressful postures at work and functional disturbance or pain in various parts of the musculoskeletal system. [Aarons A, Stranden E]. The effect of poor postures will continue unless proactive steps are taken to evaluate and reduce the problem. More suitable working postures may have a positive effect on workers' musculoskeletal systems and may allow for more effective control of work performance and reduction in the number of occupational injuries [Mattila M, Vilkkii M]. In welding fabrication industry, where Boiler components and accessories are manufactured and assembled, workers are involved in long hours of static work. In this industry, awkward posture and repetitive movements are very common. The majority of job activities are characterized by a sitting posture with the worker's head and trunk flexed forward and shoulders flexed and abducted.

In this situation, high rate of WMSDs occurrence are expected. As far as this research concern, no ergonomics study has been conducted in southern region of Indian welding industry to determine the prevalence of WMSDs and assess physical exposure to work-related musculoskeletal risks. Therefore, the present study was done in welding companies with the objectives of a) determination of WMSDs prevalence rate among workers and b) assessment of level of workers' exposure to WMSDs risks. It is believed that the results of this study can be an appropriate base for planning and implementing interventional ergonomics program in the workplace and improving workers' health and quality of work in welding industry.

MATERIALS AND METHODS
This Intervenional study was conducted in the 35 welding fabrication industries. In this study, 35 workers from the 35 units with at least three year of job tenure were randomly selected and included in the study. Workers with background diseases or accidents affecting musculoskeletal system were excluded from the study. Data were collected via anonymous questionnaires. The questionnaire consisted of two parts and covered the following items: a) personal details (including sex, age, job tenure, health and medical background); and b) musculoskeletal problems in different body regions. The
general Nordic Questionnaire of musculoskeletal symptoms [Kuorinka I] was used to examine reported cases of MSDs among the study population. Reported MSDs symptoms were limited to the past 12 months. The units were visited and the questionnaires were completed by interviewing the workers. In order to assess physical exposure to work-related musculoskeletal risks, rapid upper limb assessment (RULA) technique, which is known as a pen-paper observational method, was applied [McAtamney L]. According to this method, a score is calculated for the posture of each body part. Score 1 indicates the most neutral posture and score 4 shows the worst position. The combined individual scores for shoulder, elbow and wrist give score A and those for neck, trunk and legs give score B. Muscle use and force exerted are attributed a score of 0 or 1. These scores are added to scores A and B to obtain scores C and D, respectively. Combination of scores C and D, called Grand Score (ranging from 1 to 7), shows the musculoskeletal loading associated with the worker’s posture. Low Grand Scores (1 or 2) indicate acceptable working posture (action level 1). For Grand Scores of 3 or 4, further investigation is needed and changes may be required (action level 2). Prompt investigation and changes are required soon for scores of 5 or 6 (action level 3). Finally, immediate investigation and changes are required for Grand Score of 7 (action level 4).

To conduct the assessment by RULA system, in each workstation, the worker was videotaped during her/his routine job activities. In the lab, the tape was reviewed; awkward postures were selected and analyzed. The RULA Grand Score was then calculated for each case. Consequently, the level of interventional action required to reduce the risks of musculoskeletal injury due to physical loading on the worker was determined. Upon completion of the field survey, Statistical analyses were performed for collected data. Independent t-test is used to assess associations between personal and work variable with reported musculoskeletal problems.

**RESULTS**

The results that WMSDs occurred at a high rate. The highest rates of WMSDs prevalence were reported in shoulders (32%), back (81.3%). RULA showed that the Grand Score of 52% of cases were high and very high (action levels 3 and 4). Significant association was found between risk level and musculoskeletal symptoms in lower back ($P < 0.05$). Table 1 shows the mean and standard deviation of age and job tenure of the workers participated in the study. Table 2 presents the prevalence of MSDs symptoms in different body regions of the workers during the last 12 months. Table 2 shows, the most commonly affected regions among the workers 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. Table 3 presents the results of assessment of physical exposure to work-related musculo-skeletal risks.

1. in 8% cases, action level was 1.
2. in 52% of the workers studied, RULA Grand Score was between 3 and 4 indicating that the level of exposure to musculoskeletal risks was needed considering (action-level-2).
3. in 28% of the workers studied, RULA Grand Score was between 5 and 6 indicating that the level of exposure to musculoskeletal risks was high and ergonomics intervention to decrease exposure level seemed essential (action-level-3).
4. in 12% of the workers studied, RULA Grand Score was 7 indicating that the level of exposure to musculoskeletal risks was very high and immediate ergonomics intervention to decrease exposure level seemed essential (action-level-4).

**DISCUSSION**

The questionnaire showed that symptoms from the musculoskeletal system were common among the workers studied. Shoulders, back, wrists/hands and knees symptoms were found to be the most prevalent problems among the workers. High rate of shoulders problem could be attributable to awkward posture due to high table used in the workstations and high rate of back problems could be related to the long awkward posture of this region and lack of use of backrest while working. These implies that any interventional program

<table>
<thead>
<tr>
<th>Terms</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>AGE</td>
<td>30.9</td>
<td>6.423</td>
</tr>
<tr>
<td>Experience</td>
<td>10.61</td>
<td>5.31</td>
</tr>
</tbody>
</table>

**TABLE-2: Prevalence of MSDs Symptoms**

<table>
<thead>
<tr>
<th>S.No</th>
<th>Body parts</th>
<th>% of prevalence</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>lower back</td>
<td>81.3%</td>
</tr>
<tr>
<td>2</td>
<td>shoulders</td>
<td>32%</td>
</tr>
<tr>
<td>3</td>
<td>Wrist/Hand</td>
<td>28.2%</td>
</tr>
<tr>
<td>4</td>
<td>Neck</td>
<td>14.6</td>
</tr>
<tr>
<td>5</td>
<td>Upper back</td>
<td>21%</td>
</tr>
<tr>
<td>6</td>
<td>Knees</td>
<td>6.1%</td>
</tr>
</tbody>
</table>

**TABLE-3: Assessment of physical exposure**

<table>
<thead>
<tr>
<th>Action Level</th>
<th>Score</th>
<th>% of frequency</th>
<th>intervention</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1 or 2</td>
<td>8</td>
<td>Acceptable</td>
</tr>
<tr>
<td>2</td>
<td>3 or 4</td>
<td>52</td>
<td>Change needed</td>
</tr>
<tr>
<td>3</td>
<td>5 or 6</td>
<td>28</td>
<td>Change soon</td>
</tr>
<tr>
<td>4</td>
<td>7</td>
<td>12</td>
<td>Investigate and implement change</td>
</tr>
</tbody>
</table>

The questionnaire showed that symptoms from the musculoskeletal system were common among the workers studied. Shoulders, back, wrists/hands and knees symptoms were found to be the most prevalent problems among the workers. High rate of shoulders problem could be attributable to awkward posture due to high table used in the workstations and high rate of back problems could be related to the long awkward posture of this region and lack of use of backrest while working. These implies that any interventional program
for preventing or reducing musculoskeletal problems among the workers should focus on reducing physical exposure to the MSDs risk factors of these regions. The results also indicated that age was not significantly associated with musculoskeletal symptoms in different body regions. In some other studies, i.e., on ship building workers and VDT operator, the same result has been reported [Berg M, Sanden A]. Based on the results of physical exposure to work-related musculoskeletal risks assessment by RULA, in 52% of the workers studied the level of exposure to musculoskeletal risks was high and very high (action level 3 and 4). This indicated that the jobs and working conditions in the welding fabrication work table and sitting stool were conducive for developing WMSDs. Therefore, ergonomics interventions seemed necessary to improve working conditions and decrease exposure level. The results also demonstrated that there was a direct association between RULA risk level and decrease exposure level. The results also seemed necessary to improve working conditions and developing WMSDs. Therefore, ergonomics interventions were recommended. Any ergonomics intervention program in the workplace should be focused on eliminating awkward working postures and static work were found to be the major risk factors that the workers were encountered. Since the postural problems have been found to be mostly caused by improperly designed and ill-arranged workstation furniture [Kroemer KH], reducing the RULA Grand Score via redesigning workstations was strongly recommended. Regarding this, the following corrective measures could be taken into thought for reducing exposure level and consequently preventing WMSDs in this company: a) Increasing the height of tables in accordance to the workers' anthropometric characteristics. b) Using seats with appropriate backrest in the workstation. c) Designing adjustable type sitting-standing workstations to avoid posture fixation. d) Conducting workers training program on Working posture. e) Devising an appropriate work-rest cycle. Based on the findings, it was concluded that WMSDs occurred in high rate in those industries. Workers' level of exposure to WMSDs risks was high. Taking corrective measures for reducing risk level into consideration seemed essential. Any ergonomics intervention program in the workplace should be focused on eliminating awkward postures of shoulders, back and neck. Redesigning workstations based on ergonomics principles were recommended.

CONCLUSION:

Given the association between RULA score and the prevalence of the problems, reducing RULA score by designing ergonomic workstation, training program may reduce the prevalence of WMSDs among the workers

REFERENCES:

- Haslegrave CM. What do we mean by a 'working posture'? Ergonomics 1994;37:781-99