Investigation of Risk Factors of Work-Related Upper-Limb Musculoskeletal Disorders in a Pharmaceutical Industry

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Abstract: This study was performed among workers of an Iranian pharmaceutical industry with the aim of determining WRMDs prevalence and exposure assessment of WRMDs risks. In this cross-sectional study, 84 female and male workers randomly selected from five packing operations. Modified Nordic Musculoskeletal Questionnaire (NMQ) was applied to study the prevalence of WRMDs and Rapid Upper Limb Assessment (RULA) method was used for the evaluation of the exposure to risk factors associated with work-related upper limb disorders. Results showed a significant association exists between neck, lower arm and A scores group with those obtained by self-reported pain (p<0.01). Similar RULA grand scores of 3 and 4 and action level of 2 were found for workers in five packing operations. Also, the results of this study revealed that RULA method is a fairly suitable tool for the evaluation of WRMDs among packing workers in pharmaceutical industry.

Key words: Upper-limb musculoskeletal disorders, RULA, NMQ, packing worker, risk factors

INTRODUCTION

Musculoskeletal disorders (MSDs) are a major cause of work-related disabilities and lost-time illnesses and injuries and disabilities in the both developed and industrially developing countries (Genaidy et al., 1993; Bernard, 1997; Maul et al., 2003; Choobineh et al., 2004; Pourmahabadian et al., 2005; Pourmahabadian and Azam, 2006). MSDs constitute a major proportion of all registered and/or compensable work-related diseases in many countries, representing a third or more of all registered occupational diseases in North America, the Nordic countries and Japan (Punnett et al., 2005). It has been estimated that 31% (1994) and 44% (1996) of all occupational illness in Finland and United States; respectively belong to work-related musculoskeletal disorders (WRMSDs) (Mattila and Vilki, 1999).

It has been found that WRMSDs associated with numerous occupational risk factors, including physical work load factors such as force, posture, movement and vibration (Gerr et al., 1991; Burdorf, 1992; Kilbom, 1994), psychosocial stressors (Bongers et al., 1993; Bernard et al., 1994; Eklund, 1996) and individual factors (Armstrong et al., 1993) which are also known to be important as predictive variables. The level of exposure to physical workload can be normally assessed with respect to intensity (or magnitude), repetitiveness and duration. Various methods are now available for assessing exposure to the risks associated with work-related musculoskeletal disorders, or identifying potentially hazardous jobs or risk factors within a job. These include observational methods, instrumental or direct methods, self-reports and other psychophysiological methods.

In pharmaceutical industry, where pharmaceutics are packed, workers are involved in a fairly long hour of static work. In packing works, awkward posture and repetitive movements are very common. The majority of job activities are characterized by a sitting posture worker’s head and trunk flexed forward and shoulders flexed and abducted. In this situation, high rate of WRMSDs occurrence could be expected.

The aim of present study is to give (a) determination of WRMSDs prevalence rate among packing workers in antibiotic, tablet, syrup, ampoule and Povidione (as a antimicrobial agent) packing operations through using a modified Nordic Musculoskeletal Questionnaire (NMQ) (Kuorinka et al., 1987), (b) assessment of the level of workers’ exposure to risk factors associated with work-related upper limb musculoskeletal disorders were examined by Rapid Upper Limb Assessment (RULA) (McAtmney and Corlett, 1993).
MATERIALS AND METHODS

This cross-sectional study was performed in a pharmaceutical industry located in Tehran, Iran during 2006-2007. Totally, 950 male (66.7%) and female (33.3%) workers were employed in 3 units of pharmaceutics, hygienic products and administrative. In this study, 84 male and female workers from packing operations (Antibiotics, Tablet, Ampoule, Syrup and Povidone) were randomly selected and participated.

The prevalence of MSDs was obtained by using Nordic Musculoskeletal Questionnaire (NMQ) (Kuorinka et al., 1987). NMQ consisted of two parts and covered: a) personal details including sex, age, job experience, health and medical background and b) musculoskeletal problems in different body regions. Reported cases of MSDs among workers were identified and questioned from individuals or workers by considering period prevalence (12 months), point prevalence and intensity of musculoskeletal troubles (i.e., aches, pain, discomfort, numbness or tingling) in different anatomical areas (i.e., neck, shoulders, elbows, wrist/hands, upper back, lower back, hips/thighs/buttocks, knees and ankles/feet) from NMQ.

Physical exposures to work-related musculoskeletal risks were assessed through using Rapid Upper Limb Assessment (RULA.), which is known as pen-paper observational method (McAtmney and Corlett, 1993). According to this method a score is calculated for the posture of each body part. A score of 1 indicated the best or most neutral posture, e.g., arms by the sides, elbows in approximately 90° flexion, wrists in neutral position, forearms mid-way between pronation and supination, neck in 10° flexion, trunk and legs sitting and well supported. A score of 4 indicated the worst position: e.g., shoulder flexion above 90° or flexion between 45° and 90° and abduction. The combined individual scores for shoulder, elbow and wrist gave score A and those for neck, trunk and legs gave score B. Muscle use and force exerted in each packing worker position were attributed a score of 1 and 0, respectively, because they are static postures without loading; these scores were added to scores A and B to obtain scores C and D, respectively (McAtmney and Corlett, 1993) (Table 1). Based on the design of the RULA method, each combination of scores C and D (a number of 1-7), called grand score and reflects the musculoskeletal loading associated with the worker’s posture. Whereas low grand scores (of 1 or 2) indicate that the work posture is acceptable, action is suggested for the higher scores: further investigation and changes if required, for grand scores of 3 or 4; prompt investigation and changes for grand scores of 5 or 6 and immediate investigations and changes for a grand score of 7.

Collected data were analysed and compared statistically through using SPSS (Ver. 13). Chi-square and Fisher’s exact tests (p<0.05 as significance limit) were implied to assess association between personal and work variables with self-reported musculoskeletal disorders.

RESULTS AND DISCUSSION

As shown in Table 2, the prevalence of the reported pain in upper back is higher (54.8%) and for thighs is lower (26.2%). In addition, in tablet packing, the prevalence rate of upper back is higher (19%) than the other packing operations (Table 3).

Significant association is observed between reported pain and jobs for all body regions except for elbows (p = 0.18) and ankle (p = 0.07) as shown in Table 2: Mean and standard deviation of age and job experience of the packing workers participated in sex groups (n = 84)

<table>
<thead>
<tr>
<th>Sex</th>
<th>Age (year)</th>
<th>Job experience (year)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean±SD</td>
<td>Min</td>
</tr>
<tr>
<td>Female</td>
<td>42.7±8.2</td>
<td>29</td>
</tr>
<tr>
<td>Male</td>
<td>41.9±7.0</td>
<td>24</td>
</tr>
<tr>
<td>Total</td>
<td>42.3±7.5</td>
<td>24</td>
</tr>
</tbody>
</table>

SD = Standard Deviation

Table 3: Frequency of the reported pain between different job categories among packing workers by sex group (n = 84)

<table>
<thead>
<tr>
<th>Job category</th>
<th>Povidone</th>
<th>Ampoule</th>
<th>Syrup</th>
<th>Tablet</th>
<th>Antibiotic</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>%</td>
<td>n (%)</td>
<td>n (%)</td>
<td>n (%)</td>
<td>n (%)</td>
<td>n (%)</td>
<td>n (%)</td>
</tr>
<tr>
<td>Neck</td>
<td>10.7</td>
<td>9</td>
<td>16.7</td>
<td>14</td>
<td>9.5</td>
<td>8</td>
</tr>
<tr>
<td>Shoulders</td>
<td>8.3</td>
<td>7</td>
<td>8.3</td>
<td>7</td>
<td>8.3</td>
<td>7</td>
</tr>
<tr>
<td>Elbows</td>
<td>8.3</td>
<td>7</td>
<td>8.3</td>
<td>7</td>
<td>8.3</td>
<td>7</td>
</tr>
<tr>
<td>Wrist/hands</td>
<td>6.3</td>
<td>3</td>
<td>12.4</td>
<td>12</td>
<td>17.9</td>
<td>15</td>
</tr>
<tr>
<td>Upper back</td>
<td>10.4</td>
<td>8</td>
<td>10.4</td>
<td>10</td>
<td>13.1</td>
<td>15</td>
</tr>
<tr>
<td>Low back</td>
<td>10.4</td>
<td>10.4</td>
<td>10.4</td>
<td>10</td>
<td>13.1</td>
<td>15</td>
</tr>
<tr>
<td>Thighs</td>
<td>8.3</td>
<td>7</td>
<td>8.3</td>
<td>7</td>
<td>8.3</td>
<td>7</td>
</tr>
<tr>
<td>Knee</td>
<td>8.3</td>
<td>7</td>
<td>8.3</td>
<td>7</td>
<td>8.3</td>
<td>7</td>
</tr>
<tr>
<td>Legs</td>
<td>8.3</td>
<td>7</td>
<td>8.3</td>
<td>7</td>
<td>8.3</td>
<td>7</td>
</tr>
<tr>
<td>Ankle</td>
<td>10.4</td>
<td>10.4</td>
<td>10.4</td>
<td>10</td>
<td>13.1</td>
<td>15</td>
</tr>
</tbody>
</table>

The RULA method scoring sheet as described by McAtmney and Corlett (1993)
Table 4. The Pearson chi-square and Fisher's exact tests as presented in Table 5 shows that there are significant association between sex and reported pain among packing workers in neck, shoulders, thighs and legs ($p<0.05$), but no significant association was found for wrist/hands, upper back and ankle. The \( \chi^2 \) statistical test was used to determine association between the subject's score defined by this grouping and any reported pain, ache or discomfort from that body part region. The results are given in Table 6 and demonstrates that there are significant association between the individual RULA body part scores (1 and/or >1) and the reported pain or discomfort for the neck, lower arm, wrists/hands scores and score A ($p<0.01$) and not significant for the trunk, upper arm scores as well as score B. The statistical significance of the neck, lower arm, body part scores as well as score A reflects the high loading of these body regions while performing a packing-based task. Finally, Table 7 presents the results of the physical exposure risk assessment by RULA and shows the grand score is between 3 and 4 for all packing workers and indicates that the level of exposure to musculoskeletal risks is needed to be considered (action level 2).

A population of 84 female and male packing workers who worked on 5 different packing operations in a pharmaceutical industry were studied by NMQ and RULA. The self-reported questionnaire results showed that musculoskeletal disorders were common among packing workers. Upper back, wrists/hands, low back, knees, neck and shoulders symptoms were found to be most prevalent problems among workers, respectively. Functionally, the neck-shoulder region experiences static muscle fatigue contributed to by the load of the arms and their position. The lower arm region includes the muscles...
In this study, the RULA grand score was between 3 and 4 and indicating that the level of exposure to musculoskeletal risks needed to be considered (action level 2). Similarity in packing tasks and no requirements for high muscle force for packing small cases could be the reason for obtaining the same action level for all packing workers in the present study. However, by considering the obtained RULA and NMQ results in this study, major risk factors that workers are encountered could be due to awkward working postures and static work.

**CONCLUSION**

This study highlighted the RULA method allowed to perform a rapid and fairly correct evaluation tools for packing workers and evidenced that in the posture adopted in this type of job was associated with a major risk for back, neck, lower arm and postural problems could be largely caused by improper workstation furniture design. Ergonomic interventions through corrective measures could be taken into account for reducing exposure level and consequently preventing WRMSDs is highly recommended by performing workers training on working posture, administrative measures for establishing work-rest cycle, using proper seats which equipped with backrest together with reducing the height of working table in accordance to anthropometric data.
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REFERENCES


