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Ergonomic Risk Assessment - A Case Study of a Garment Manufacturing Industry

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Abstract. Pakistan is the eighth largest exporter of textiles, and this sector contributes 8.7% to the country’s GDP. The garment industry contribution to the total textile-based exports from the country is 47%. Skilled labour is available at relatively cheap rates. Work-related musculoskeletal disorders (WMSDs) are prevalent in this sector and this research is aimed at finding the levels of risk attached to working activities and to gain knowledge of the major causes of musculoskeletal disorders. The Rapid Entire Body Assessment (REBA) method was used for this purpose. It was found that postures related to the wrist (0-15° or >15° flexion or extension with twist or deviation), lower arm (<60° or >100° flexion) and neck (extension and flexion with twist or side flexed) are the major causes of musculoskeletal disorders. These findings will help in the design of workplaces and working strategies to minimize risk and so increase satisfaction, productivity and overall well-being at the workplace.

Keywords: Ergonomic Risk Assessment, REBA, Manufacturing Case Study.

1. Introduction

The textile sector in Pakistan makes a significant contribution to the country’s exports and has an 8.7% share of GDP. Pakistan is the 8th largest exporter of textile-related products globally and has a good reputation in the global supply-chain. The textile sector is also labour-intensive and provides employment for about 15 million people in the country (30% of the total workforce). Like many other sectors, work-related musculoskeletal disorders (WMSDs) caused by awkward working postures, repetition of tasks, prolonged working in sitting or standing positions, bad workplace design etc. have been commonly reported. Complaints related to WMSDs are increasing especially in Asian, European and U.S. workers, and has been reported as the third major cause

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for disability and early retirement among U.S. workers. Pakistan is a stakeholder in the
global textile market and faces many challenges to meet customer requirements related
to social compliance, health and safety, environment and well-being at the workplace.
Being a developing country, relatively less attention has been given to these factors.
Workplace risk is one of the key areas requiring attention so that overall well-being at
the workplace can be assured by investigating issues and recommending strategies that
can help designers in the promotion of design solutions. This research aims to assess
the level of risk attached to existing working strategies in the textile sector. For this
purpose, a case study has been conducted at a garment industry, situated near the
capital city of Punjab.

2. Theoretical Background

2.1. Work-Related Musculoskeletal Disorder (WMSD).

WMSDs are those pains, stresses and injuries to body nerves, muscles, joints and
structures caused by work. These affect different body parts like neck, shoulder, back,
wrist etc. and are considered to be a worldwide common health problem which is a
cause of disability [1]. WMSDs are caused mainly due to awkward working postures,
repetitive tasks, manual material handling, heavy load lifting, working in a fixed sitting
or standing posture for long hours and badly designed workplaces [1, 2, 3]. These
affect different body parts in the form of joint pains, upper body and neck aches and
backaches. WMSDs are the third major cause of disability and early retirement in the
U.S., and importantly the number of complaints is increasing [4, 5]. Such issues affect
individuals as well as organizations, not only in terms of well-being and goodwill but
in monetary terms as well. WMSDs are one the most common problems faced by
ergonomists around the world [7].

Developing countries still face challenges related to workplace design, work
organization and health and safety and well-being at workplace. Research studies
conducted at eight Indian garment manufacturing industries concluded that WMSDs
were a common already existing health-related problem at almost all workplaces.
Surprisingly, during the medical examination of 3858 workers from all eight industries,
it was concluded that 1066 workers had the perception that their illness was because of
their occupation; and of these 670 (62.85%) stated that they were suffering from
WMSDs, where the main complaint reported was back pain [5]. Moreover, chronic
back pain has been observed as the most common symptom among those who
remained seated for long hours, and resting every few hours has been suggested as a
relief strategy [2]. Similarly, another study conducted at an Iranian rubber factory,
found that awkward working postures, sitting for long hours and manual material
handling were the main causes of musculoskeletal disorders, and back pain was the
major cause of sick leave [3]. In an oil refinery case, again back pain has been
concluded as the major cause of musculoskeletal disorders, where ergonomics
interventions have positive effects in controlling the risk at the workplace [9]. The
National Institute of Workers Health in Cuba, conducted a study and found that
WMSDs were the second highest cause of disability among the workers [10]. A study
conducted on female workers in Thailand, also concluded that 50% of female workers
were facing MSDs and further emphasized that ergonomics risk assessments should be
carried out and interventions should be implemented [11]. In Pakistan, one study has
been conducted to assess health and safety conditions in the textile sector, and concluded that the overall situation is very poor and in many units workers have little idea about the use of Personal Protective Equipment (PPF) and those aware of PPF do not use it properly [4].

In developed countries, the situation is relatively better as compared to the developing countries; however, there is still a need to promote health and safety and well-being strategies so that productivity can be increased while ensuring safety. According to the Health and Safety Executive (HSE-UK), about 4.1 million working days were lost because of WMSDs in 2001-02; where on average a person took 17.8 days off in a year and overall WMSDs cost 5.7 billion pounds [12]. The same is the case in the U.S., in 2004, where WMSDs caused about 510 billion dollars loss in terms of direct medical expenditure and 339 billion dollars in lost productivity. It was further found that musculoskeletal disorders are the most prominent cause of disabilities compared with any other workplace injury [13].

2.2. Techniques for Risk Assessment:

To assess physical exposure to WMSDs, a variety of techniques are available, broadly divided into the main categories of self-reports; pen and paper based observational techniques and video-recording or computer aided techniques. Other techniques are direct methods or instrumental techniques [14]. These techniques are used to analyze working postures, loads and forces, movement frequency, duration, vibration etc. by using different coding techniques. Further details can be found in [14, 15, 16]. The measurement technique selected for this research was REBA (Rapid Entire Body Assessment) [17]. This is a well-established pen and paper based observational technique, used to assess entire body postures, types of movements or actions and repetition. It is a modified form of RULA (Rapid Upper Limb Assessment) – another observational technique, relatively simple and easier to use [18]. REBA is a scoring technique in which the observer selects an appropriate body posture for assessment, and then collects data in the form of videos or photographs and finally uses a coding scheme to evaluate the level of risk attached with different body parts independently and whole body collectively. Codes against the postures of different body parts like neck, trunk, leg, arm and wrist along with considering load/force requirements, coupling and activity scores are added in different tables and a final score is obtained that provides the information regarding the level and severity of risk attached to any particular posture adopted while doing any task.

3. Research Methodology

This research aims at assessing the level of risk attached to existing working strategies in the textile sector, and to achieve this, a five step approach has been used; selection, observation, data collection, data analysis and recommendations for improvement. Further details about each step is briefly explained in the following sections.

Selection of appropriate tasks and workers is highly important as incorrect selection may mislead the situation and result in the whole exercise not providing any fruitful contributions. For this case study, a mainly manual garment manufacturing industry situated near the capital city Lahore, of the Punjab province in Pakistan, was selected. However, some activities were carried out using a semi-automatic system.
The product selected for this study was Basic 5 Pocket Denim (Jeans). The work tasks selected for this study were mainly related to manual cutting and stitching of the product.

**Observation** is required to have a good understanding of working environment, procedures, processes and issues related to musculoskeletal disorders. These may include interviews, focus group discussions, sessions with workers, photographs and video recordings. In this case study, as a first step, interviews and discussion sessions were carried out, and helped in the selection of tasks for further data collection and also provided workers’ opinions about the potential causes of workplace risk. Then the selected activities, workstations and workers were observed performing their normal activities. After a preliminary investigation, detailed observation in the form of video recording and photography was carried out. Initial feedback provided by workers highlighted that those who performed their work in sitting positions complained about pain in the neck and back; whereas those who were working in a standing posture for a long time, complained of leg, trunk and foot pain. It was further mentioned and observed that injuries to fingers are a very common problem overall at the workplace.

**Data collection** was carried out by video recording selected workers on selected workstations for specific tasks. Workers were briefed about the purpose of study and requested to perform their work normally. Snap-shots were taken from the recorded videos for analysis. Three videos of each worker performing the same task (for three work cycles) were captured. Selection of the appropriate recording angle and position was important in this case – to overcome this, multiple cameras were used for capturing the same activity from different angles so that the positions and movements of different body parts could be captured.

**Measurement** involved the use of selected snap-shots were used to carry out further data analysis, where REBA coding scheme was used to assess the level of risk attached to the adopted working strategy and body posture. Table 1 defines the level of risk, with REBA scores and appropriate actions required to reduce the level of risk. It is clear from the table if the final REBA score is greater than 11, at level 4, there is a very high level of risk and an immediate change in working strategy and posture is required. Similarly, level 3 (REBA score 8-10), shows high risk and demands investigation and implementation of change in working posture – further categories and their respective REBA scores and actions required, are described in table 1.

<table>
<thead>
<tr>
<th>Level #</th>
<th>REBA Score</th>
<th>Action Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1</td>
<td>Negligible risk</td>
</tr>
<tr>
<td>1</td>
<td>2-3</td>
<td>Low Risk: Changes may be needed</td>
</tr>
<tr>
<td>2</td>
<td>4-7</td>
<td>Medium Risk: Further Investigation. Change soon</td>
</tr>
<tr>
<td>3</td>
<td>8-10</td>
<td>High Risk: Investigate and Implement Change</td>
</tr>
<tr>
<td>4</td>
<td>11+</td>
<td>Very High Risk: Implement Change NOW</td>
</tr>
</tbody>
</table>

**Data analysis** was carried out on the data collected in the form of still frames and videos. For this purpose, 180 different photographs of workers captured while they were performing tasks have been selected for the final REBA risk assessment analysis. Figures 1 and 2 show the adopted working strategies and body postures.
4. Results

Initial investigations reveal that overall 32% of postures are in categories 3 and 4 (high level of risk), while the majority of postures are in the category of medium risk (level 2). Further details are shown in figure 3.

Further work will be carried out on investigating the major causes of risk attached with different postures by analyzing the postures falling into action categories 3 and 4. This will help in understanding what are the major causes of musculoskeletal disorders in the garment industry work and how these can be avoided with the help of better workplace design and working strategies.

5. Conclusion

Bad working postures, poor working strategies and inadequate workplace design are the major of work-related musculoskeletal disorders WMSDs at work. This case study investigated the causes of WMSDs in the garment manufacturing industry and the REBA method was used to investigate the level of risk attached with the postures adopted by different workers. A significant number of workers performed their work in a bad way and there is a need to change working strategies so that a safe and healthy working environment can be maintained. Further investigations will be made to explore which body parts are more frequently exposed to risk and how this can be avoided. A healthy and safe working environment will not only promote well-being in the
workplace, but will also increase productivity and job satisfaction. Further reduction in WMSDs will give benefits to companies by reducing medical expenditure and claims.

References