Ergonomics Intervention for Increasing Productivity and Safety in Garment Industry

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Abstract

Satisfaction and a safe working environment are essential issues affecting workplace productivity. This study provides an ergonomics intervention through which workers perform the task in a safe working environment which increases workplace productivity. A subjective assessment, job factor questionnaire was conducted among 39 sewing workers in the garment industry. The questionnaire is used to assess the ergonomics risk factors which are main cause of developing musculoskeletal disorders among sewing workers. Results revealed that workers could allow to take personnel time, fatigue and delay allowances (PDF allowances) whenever they want, instead of scheduled breaks. Also, observation collected from factory visits, it is observed that there were several ergonomics and environmental hazards that affects the health and efficiency of the workers. It is recommended to implement several ergonomics interventions in the workplace so that workers can work in a safe environment and increase workplace productivity.

Keywords
Ergonomics, safety, productivity, sewing, job factor questionnaire

1 Introduction

There are millions of workers affected by work-related musculoskeletal disorders (WMSDs) due to which their productivity, performance, quality, cost and inclusive business are affected in an organization (Tompa, et al., 2013). In the industrial sector, upper limbs and lower back are the most common musculoskeletal disorders (Violante, et al., 2000). Many ergonomic risks associated with garment industry resulting from awkward posture, highly repetitive manual task, and insignificant physical demands on workers.

In general, garment industry is considered as a safe workplace as compared to other industries. There are few fatal injuries arise in the garment industries. The garment industry consists of four main departments these are design, cutting, sewing and ironing department. Among all departments, sewing is most important manufacturing process which involves large number of operations (Chen, et al., 2012). The prevalence of musculoskeletal disorders (MSDs) are high in sewing department as workers adopt poor working posture for long duration and highly repetitive hand-arm motions involved (Dianat, et al., 2015; Öztürk & Esin, 2011). Basically, sewing workers assemble different panels to get a desired output. Assembly involves high coordination of hands, eye, neck and trunk for having a better control on the panel. Moreover, workers also perform various task like material handling (cut panel bundles), threading, and cleaning the machine. This leads to higher prevalence of MSDs in neck, back and upper limb among sewing workers (Nagaraja, et al., 2019; Dianat, et al., 2015; Öztürk & Esin, 2011; Lombardo, et al., 2012; Delleman & Dul, 2002).

The prevalence of MSDs are high when the demand of product is increased in the market. Garment factory in Saudi Arabia has varying demands, sometimes demand is high and sometimes is normal. For the high demand, workers need to perform extra work and overtime to fulfil the demand of the market. This leads to increase the prevalence of MSDs among workers. Hence, it is important to analyze the workplace so that the prevalence of MSDs can be reduced. The aim of the present study is to discover the best way of doing various task which helps the worker to increase the productivity and works in a safe environment.
2 Techniques of Ergonomics intervention

Various visits to garment factory which is in Jeddah city, were conducted to have a better understanding about the problems facing by the workers during their work time. Several hazards were identified by visual observation on working environment and conditions. Job Factor Questionnaire (JFQ) is a survey tool which is used to identify various problems which are faced by the workers at the workplace.

2.1 Job Factors Questionnaire

The JFQ was conducted in order to investigate the ergonomic risk factors causing discomfort for the sewing workers. Comper & Padula (2013) investigated ergonomics risk assessment on 52 sewing workers using JFQ. The questionnaire included 15 questions related to repetitive task, rest breaks, working in awkward / same (standing, bent over, sitting, kneeling) posture for long hours, with a scale for response of 0 to 10 with 10 being a very critical factor. The present study used the same questionnaire to record the responses, and descriptive statistics was used to analyze the collected data. A 2-sample t-test was used to compare the means between the samples of two studies as shown in Table 1.

<table>
<thead>
<tr>
<th>No.</th>
<th>Questions</th>
<th>Present Study (n=39)</th>
<th>Study in Brazil (n=52)</th>
<th>P value</th>
<th>Conclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Mean (SD)</td>
<td>Mean (SD)</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>95% CI</td>
<td>95% CI</td>
<td></td>
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<tr>
<td>Q1</td>
<td>Performing the same task over and over</td>
<td>7.26 (0.69)</td>
<td>4.75 (0.48)</td>
<td>&lt;0.001</td>
<td>Reject null hypothesis: means differ</td>
</tr>
<tr>
<td>Q2</td>
<td>Working very fast for short periods (lifting, grasping, pulling, etc.).</td>
<td>2.15 (0.47)</td>
<td>5.46 (0.47)</td>
<td>&lt;0.001</td>
<td>Reject null hypothesis: means differ</td>
</tr>
<tr>
<td>Q3</td>
<td>Having to handle or grasp small objects</td>
<td>3.77 (0.48)</td>
<td>2.75 (0.43)</td>
<td>&lt;0.003</td>
<td>Accept null hypothesis: means not significantly different</td>
</tr>
<tr>
<td>Q4</td>
<td>Insufficient breaks or pauses during the workday</td>
<td>6.05 (0.45)</td>
<td>4.58 (0.52)</td>
<td>&lt;0.001</td>
<td>Reject null hypothesis: means differ</td>
</tr>
<tr>
<td>Q5</td>
<td>Working in awkward or cramped positions</td>
<td>6.59 (0.44)</td>
<td>6.33 (0.51)</td>
<td>0.47</td>
<td>Accept null hypothesis: means not significantly different</td>
</tr>
<tr>
<td>Q6</td>
<td>Working in the same position for long periods (standing, bent over, sitting, kneeling, etc.)</td>
<td>6.82 (0.43)</td>
<td>6.52 (0.50)</td>
<td>0.395</td>
<td>Accept null hypothesis: means not significantly different</td>
</tr>
<tr>
<td>Q7</td>
<td>Bending or twisting your back in an awkward way</td>
<td>5.90 (0.66)</td>
<td>6.33 (0.49)</td>
<td>0.297</td>
<td>Accept null hypothesis: means not significantly different</td>
</tr>
<tr>
<td>Q8</td>
<td>Working near or at your physical limits</td>
<td>3.82 (0.44)</td>
<td>5.42 (0.52)</td>
<td>&lt;0.001</td>
<td>Reject null hypothesis: means differ</td>
</tr>
<tr>
<td>Q9</td>
<td>Reaching or working over your head or away from your body</td>
<td>2.03 (0.51)</td>
<td>3.65 (0.53)</td>
<td>&lt;0.001</td>
<td>Reject null hypothesis: means differ</td>
</tr>
<tr>
<td>Q10</td>
<td>Hot, cold, humid, wet conditions</td>
<td>4.90 (0.47)</td>
<td>6.96 (0.50)</td>
<td>&lt;0.001</td>
<td>Reject null hypothesis: means differ</td>
</tr>
<tr>
<td>Q11</td>
<td>Continuing to work when injured or hurt</td>
<td>3.64 (0.60)</td>
<td>6.62 (0.49)</td>
<td>&lt;0.001</td>
<td>Reject null hypothesis: means differ</td>
</tr>
<tr>
<td>Q12</td>
<td>Carrying, lifting, or moving heavy materials or equipment</td>
<td>1.82 (0.37)</td>
<td>4.15 (0.58)</td>
<td>&lt;0.0</td>
<td>Reject null hypothesis: means differ</td>
</tr>
<tr>
<td>Q13</td>
<td>Work scheduling (overtime, length of workday)</td>
<td>4.26 (0.73)</td>
<td>4.40 (0.50)</td>
<td>0.74</td>
<td>Accept null hypothesis: means not significantly different</td>
</tr>
<tr>
<td>Q14</td>
<td>Using tools (design, weight, vibration, etc.)</td>
<td>4.33 (0.63)</td>
<td>2.31 (0.48)</td>
<td>&lt;0.0</td>
<td>Reject null hypothesis: means differ</td>
</tr>
<tr>
<td>Q15</td>
<td>Working without any type of training</td>
<td>1.62 (0.36)</td>
<td>2.73 (0.47)</td>
<td>&lt;0.0</td>
<td>Reject null hypothesis: means differ</td>
</tr>
</tbody>
</table>

Table 1. Comparison of JFQ between present study and study (Comper & Padula, 2013)
The comparison revealed that means between two studies were different, working and bending/twisting their backs in awkward or cramped positions, and working in the same position for long periods (standing, bent over, sitting, kneeling) were the common factors for sewing operators and acted as a critical factor in both studies. JFQ also revealed that workers should be provided proper training from the company as well as workers should not exposed to heavy manual material handling task.

Figure 1. Shows the percentage of discomfort for different factors.

Reponses of operator for various discomfort factor found from JFQ are shown in Figure 1. This revealed that 65.6% of operators were taking unscheduled break for giving rest to their body parts. This shows insufficient and improper distribution of rest break and working time in the factory. So, operators take the rest whenever they want to release the discomfort of their body parts. This is also supported from JFQ that “Insufficient breaks or pauses during the workday” had an average score of 6.05 which means this is a critical factor. “Working in Awkward or cramped posture” is also a critical factor in JFQ which is supported from Figure 1, 40.6% workers reported “making adjustment on workplace”. Other factor is “Working in the same position for long periods” in JFQ is supported by the Figure 1 that 31.3% of workers reported “move around or do exercise” after work. However no direct response related to “Performing the same task over and over” which is also important factor in JFQ and in line with the study task in garment factory involved repetitive motion (Andersen, et al., 2007).

2.2 Environmental hazards

During visits, some hazardous substances were detected in the sewing area such as dusts and organic dust. This is due to poor ventilation, it is a hazard which causes a risk of developing WMSDs. It leads to high levels of carbon dioxide and low levels of oxygen in the interior closed working environment, due to which workers have mental and physical fatigue. Face to face interview was conducted with 11 workers who used their own fan to remove the dusts from the desk. Out of 11 workers, 7 were complained of permanent illness, asthma. Khan et. al. (2015) conducted a study on 145 garment workers in Dhaka and reported that 51% of workers had headache, 11% of them suffered from depression and 0.7% workers affected by asthma.

The acceptable range of indoor temperature is 68°F to 76°F according to the OSHA guidelines. However, the sewing area temperature was 86.9°F which is higher than 76°F which means hot working environment. Working in a hot environment with lack of adequate ventilation leads to negative impact on workers’ health and finally on productivity. While sewing area has 4 central air conditioners with 2 split air conditioners still temperature was higher than the recommended. This is because there is no attention on the maintenance of air conditioners. So, it is recommended to maintain the air conditioners which helps to reduce the temperature of the workplace. Working in a comfortable and good environment leads to increase in productivity of workers.

Vibration is one of the main factors which causes occupational injury or, accident to the labors. The vibration from the sewing machine transmitted vibration on the desk where workers placed their arms to work or apply force for having control on cut panels. Vibrations are transmitted from desk to the human body which lead to muscle weakness and prolonged exposure may lead permanent injury (Waye, 2011).
2.3 Ergonomics Interventions to reduce the hazards

Several hazards can be reduced by implementing proper ergonomics interventions in the factory. Personal protective equipment (PPE) is important for employers and workers to be aware of the hazards related to sewing machines and take preventive actions to reduce the MSDs. From visual observation, some workers rubbed eyes with their fingers which is in line of survey analysis that some of them have pain in their eyes. This showed that workers are experienced with ergonomic issues. PPE is a last defense of reducing hazards after implementing engineering and administrative control. PPE needs to be provided by the manager of the factory. The requirement of PPE depends on the hazards from which worker is experienced. The benefits of using PPE is to reduce risk of accident and illness, minimizes future medical costs and safer working environment (Personal Protective Equipment, 2004).

**Common problem:** Workers need to assemble the cut panels by giving ample attention and close viewing of the assembly (Figure 2), eye protection is critical and important. Workers in garment industry may be affected by different types of hazards such as, chemical or metal splash, dust, projectiles, gas, and radiation. Eye strain can be prevented by providing appropriate lighting system at all work stations.

![Figure 2. A worker is working very close to sewing machine without using any eye protection.](image)

**Possible Solution:** Garment workers can prevent eye injuries by using proper safety spectacles, goggles, face screens, face shields (Figure 3).

![Figure 3. A google that can prevent eye strain to the worker](image)

**Common problem:** There is a high risk of hand and finger injuries, as the operators work on sewing machine for long hours in close contact with needles, scissors and other sharp objects as shown in Figure 4.

![Figure 4. worker working without any finger protection.](image)
Possible solution: Use personnel protective equipment such as proper gloves with a cuff and sleev ing that covers the arm to protect against cold, vibration, rough surfaces or cuts and punctures. It is also important to provide chainmail (metal mesh) gloves to workers who highly exposed this hazard to protect them from injuries as shown in Figure 5.

![Figure 5](image1.jpg)  
**Figure 5.** A metal mesh that can prevent worker’s fingers cuts and punctures

Common Problem: There is a high risk of accident, if workers are not wearing safety shoes during working hours. During visit, it was observed that some of the workers were not wearing shoes as shown in Figure 6.

![Figure 6](image2.jpg)  
**Figure 6.** Shows a worker without any feet protection.

Possible Solution: Safety shoes is the protective tool for feet, it can protect the worker from falling, punctures, cutting hazards, electrical hazards and prevent slips or falls. There are different types of footwear Safety boots and shoes with protective toecaps as shown in Figure 7 and penetration-resistant, mid-sole wellington boots and specific footwear, e.g. foundry boots and chainsaw boots.

![Figure 7](image3.jpg)  
**Figure 7.** Safety Shoes for feet protection

Common Problem: During visits, it was observed that some areas of the factory has dust (Figure 8) as well as workers were working on fabrics which has chemical dust. So, there is high risk of respiratory problems as dust hurts human lungs and reduce the Oxygen held by the cells.
Figure 8. Shows dust on some areas in the factory

Possible Solution: Provide adequate dust masks to workers as shown in Figure 9 (e.g. cutters) to protect workers from breathing chemical dust. Also, company is responsible for a good housekeeping so that workers are not suffered with dust.

Figure 9. Dust mask

3 Conclusion

The prevalence of MSDs and related risk factors are reduced when above interventions will be implemented on the workplace. These recommendations and interventions are very helpful to improve the work system in terms of increase the efficiency, safety of workers, and overall productivity of the factory.

Acknowledgements

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References


**Biography**

Farheen Bano is an Assistant Professor, Industrial Engineering Department, King AbdulAziz University, Jeddah, Saudi Arabia. She earned a B. Tech. in Mechanical Engineering from Aligarh Muslim University, Aligarh, Uttar Pradesh, India, M. Tech in Industrial and Production Engineering from Aligarh Muslim University, Aligarh, Uttar Pradesh, India and PhD in Industrial Engineering from Jamia Millia Islamia, New Delhi, India. Her specialization is in Human Factor Engineering. She has published journal and conference papers. Her research interests include ergonomics, workplace design, industrial safety and health, and lean. She is a reviewer of Journal of Back and Musculoskeletal Rehabilitation.