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ORIGINAL ARTICLE

Study On Ergonomics Of Working Posture And Workstation Design In XYZ Factory

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Abstract: Manufacturing sector is one of the highest risk industries contributing to the development of work-related musculoskeletal disorders (WMSDs). These problems have attracted much attention in recent years and is becoming more and more wide-spread. The source of concern is in most industrialized countries. The phenomenon of WMSDs must be treated very seriously as it can have a considerable social-economic impact. The study was conducted at XYZ Sdn Bhd in Malaysia where the general manufacturing activities involve cleaning, loading and unloading, turning process, grooving process, measuring process, collecting data and packing activities. Different employees are exposed to risk factors depending on their job and task. The objectives of this research are to identify the critical activities that affect to the musculoskeletal disorder among XYZ employees by observation and evaluation of the critical activities, to perform the analysis work posture and to propose and improve posture and workplace design at XYZ Sdn Bhd. The data for this study were collected via observation and discomfort survey to the XYZ employees. Other informal data such as experience-posture with photos were taken during their task. Further analysis based on Rapid Upper Limb Analysis (RULA) and Rapid Entire Body Assessment (REBA) were implemented by entering the scores according to the initial degree of body position. Lastly, RULA and REBA tables on the form were then used to compile the risk factor variables, generating a single score that represents the optimum solution of the correct working posture for XYZ employee. In addition, the finding of the study will provide as useful information and reference to the potential researchers, especially in the manufacturing industry. Nevertheless, employer must take serious action to implementing effective improvements in ergonomics in the workplace in future such by expanding education and training programs to assist employees and employers in understanding and utilizing the range possible workplace designed to reduce work-related musculoskeletal disorders. This may indirectly help to optimize human efficiency, effectiveness, health, safety, and well-being within the context of system performance.

Keywords: WMSDs, RULA, REBA

1.0 INTRODUCTION

The Ergonomics Risk Assessment Guideline released by Department of Occupational Safefy and Health Malaysia (DOSH) in 2017 became the primary justification for Malaysian industries to pay more attention to ergonomics since DOSH is now actively enforcing the ergonomics guidelines in the workplace. Based on DOSH statistics the number of work related musculoskeletal disorders cases in manufacturing industry are significantly high (4070 out of 65622 industrial accident reports in 2019) [1]. Generally, the higher rates of such MSD were found in blue-collars and trainee workers compared to white collar workers, as the case with XYZ Sdn Bhd [2]. It has been established that WMSDs are recognized as leading causes of significant human suffering, loss of productivity, and economic burdens on society [3]. Poorly designed workstations has been known to cause employees to adopt awkward postures while working, hence leading to employees suffering from ergonomic injuries. Apart from awkward postures, repetitive motion and static postures are responsible for compounding the magnitude and the severity of ergonomic injuries in the workplace. Depending on the structure affected and the type of affliction, the ailment would be referred to as tendonitis, tenosynovitis, bursitis, carpal tunnel syndrome, tension, and neck syndrome [4]. These types of ailments are commonly known as Work Related Musculoskeletal Disorders (WMSD).

As in the case of XYZ Sdn Bhd, workers are commonly found to be suffering from minor discomfort and pains while working. XYZ Sdn Bhd in Malaysia is a service company that performs high-quality repair and overhaul activities. The repair services include grooving wire guide rollers for wire saws, overhaul of engine bearings, and calibrations measuring and testing devices. Quick turnaround times are achieved for customers, depending on the services. Due to the nature of the work activities in XYZ Sdn Bhd, these tasks are upper-limb intensive and constantly cause every employee to be in different work postures on daily basis. Some of these postures are considered as awkward posture. Reports of WMSD complaints have been received by the safety and health personnel. As a result, employees might experience different discomfort and pain on their body parts while working. Based on the initial walkthrough done by the researcher, more than half of the workers' postures are awkward while working, since most of their work requires manual exertion.

The primary objective of this study is to perform postural evaluation on the critical activities via observation. In order to accomplish the objective, analysis of working postures was performed by Rapid Entire Body Assessment (REBA) and Rapid Upper Limb Assessment (RULA). The selection of assessment method is dictated by the nature of method, task and availability of instrument. REBA is used to quickly assess the posture of the neck, back, arms, wrists, and feet of a worker whereas RULA is used to reduce the occurrence of risks associated with one's work in the upper body. In summary, both are postural analysis tools, with REBA primarily for assessing the posture for the whole body, and RULA is primarily used for assessing the posture of the upper body. Previous studies[5], [6] have showed that observational methods, such as RULA and REBA are highly recommended in the assessment of workplace postures by including by having the benefits of versatile, and more affordable in terms of financial resources required as compared to the more objective measures involving equipments such as electromyography (EMG) for example. The practicality of RULA and REBA is such that it offers a numerical scoring system for quantifying risky working postures, which are then used to derive the level of intervention required for the postures being assessed. Both RULA and REBA are recognized internationally for ergonomics risk assessment according to International Ergonomics Association (IEA) and World Health Organization (WHO) [7].

Ergonomics analysis tools such as RULA and REBA can help in quantifying the ergonomic injury risk level, as it can be done before and after the ergonomics improvement to find out if the risk of injury has decreased. The evaluation includes body posture, the strength needed and the muscle movement of the worker while working. These postural analysis tools are designed for easy use without need for an advanced degree in ergonomics or expensive equipment. From the results, better work postures have been proposed to lower the risk of WMSDs among the workers.

2.0 METHODS

2.1. Study Overview

This is a cross sectional study involving workers in one department in XYZ Sdn Bhd. The workers were selected based on the verbal complaints registered by the safety and health office of

XYZ Sdn Bhd. Before conducting the study, the workers involved was given an explanation about the rationale of the study, and oral consent was obtained from the workers prior the observation. Cameras and video recording equipment were set up at appropriate positions to record videos ad images of workers' postures. First, an initial observation was carried out to determine the ergonomic risk factors involved in the three tasks listed. Secondly, a discomfort survey was done among the workers to determine the exact body parts having pain and discomfort. Lastly, a postural analysis was carried out using REBA and RULA.

2.2 Manual Handling Activities at XYZ Sdn Bhd

The department consists of three main tasks, namely ; cleaning, measuring and packing. Figure 1 below illustrates the tasks being performed at XYZ Sdn Bhd. These three tasks were selected due to the prevalence of awkward postures adopted by the workers.

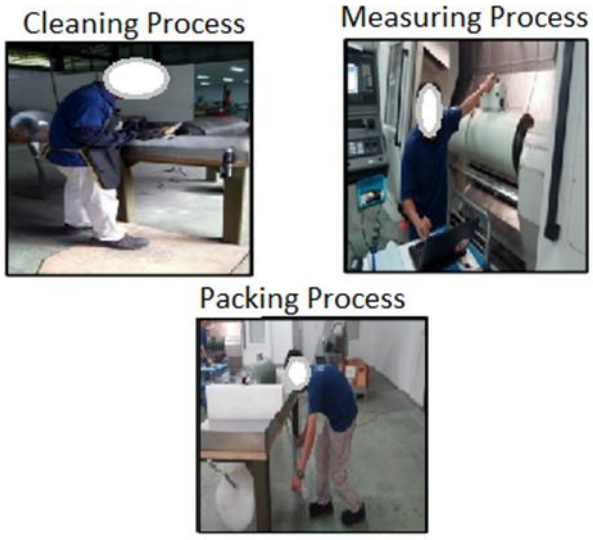


Figure 1 Manual Handling Activities at XYZ Sdn Bhd.

Discomfort survey

The survey comprised three sections namely body parts, right hand, left hand. Each of these sections focus on three consequent questions; (1) during the last work week how often did you experience ache, pain, discomfort in specific body region, (2) if you experienced ache, pain, discomfort, how uncomfortable was this, and finally (3) if you experienced ache, pain, discomfort, did this interfere with your ability to work. The respondents were required to mark answer boxes for

specific body region on the depicted human figure in the survey where the most experience pain during the last week when the task was carried out. For question 1, the frequency of discomfort for each body region ranged from never, to 1-2 times last week, 3-4 times last week, once everyday, and lastly several times every day. Question 2 answers for discomfort level were categorised into slightly uncomfortable, moderately uncomfortable, and very uncomfortable. The final question 3 column was separated into not at all, slightly interfered, and substantially interfered. Snapshots of employees during their tasks were taken in the observation which were used with the discomfort survey results for analysis.

Rapid Upper-Limb Assessment (RULA)

The RULA method was executed accordingly on work posture during the measuring task. Based on the evaluations, scores ranging from 1 to 7 were entered for each body region in section A for the arm and wrist, and section B for the neck and trunk. After the data for each region were collected and scored, risk factor variables were compiled into tables on the form, generating a single score that represents the level of WMSD risk and the appropriate action needed.

Rapid Entire Body Assessment (REBA)

The cleaning and packing task were subjected to REBA. Six body regions were considered similar to RULA, but with more details by taking forceful exertions, type of movement and action, repetition and coupling into consideration. These were analysed to provide an overall score. Several points were added for conditions that worsen the nature of the posture, and points were subtracted when something contributed towards lessening the loading impact of the posture (such as gravity-assisted postures). The final score between 1–15 were calculated using the REBA assessment form which correspond to level of WMSD risk and action to be taken.

3.0 RESULTS

Observation made upon employees at work revealed that three of the tasks responsible of WMSDs namely cleaning, measuring and packing. This discovery combined with the survey by two respondents to pinpoint specific body region where the most experience pain identified awkward

position during these tasks resulted in shoulder and back pain. Wrist pain was reported during cleaning and measuring task. Besides that, back bending, and pressure on the back and shoulder were the shared risk factors during cleaning and packing task. Exclusive risk factors and WMSDs were also determined during each of these tasks. Physical aggressors during cleaning task might be the reason the additional body regions pain on the neck, wrist, upper limb and lower back. Forceful lifting during measuring task and forceful pulling during packing task were observed. Repetitive motion was also found to be a risk factor during packing task. Table 1 shows the simplified results of the observation.

Table 1 Results of observation

Task	Risk factors	WMSDs
Cleaning	• Awkward position • Back bending • Pressure on the back and shoulder • Physical aggressors	• Wrist pain • Shoulder pain • Neck pain • Lower back pain • Upper limb
Measuring	• Awkward position • Forceful lifting	• Wrist pain • Shoulder pain • Back pain
Packing	• Awkward position • Back bending • Pressure on the back and shoulder • Forceful pulling • Repetitive motion	• Shoulder pain • Back pain • Low back pain

Further analysis of the observation was performed to figure out how the risk factors cause the WMSDs. During cleaning task, employees were assigned to clean both of rear-surface of the roller by using hand drill and special brush. The task takes longer time as 45 minutes to clean the surface due to the high thickness of dust and also the dust is very solid. However, 45 minutes cleaning is only for one surface and it is needed to be repeated for another surface. Employees may feel fatigued due to the

high vibration during such task. This caused the employees complaining about the discomfort and pain especially on the wrist, upper limb, shoulder and neck.

The measuring task was done on the left and right side of the roller after the process of roller grooving. The process takes about 5 to 10 minutes on both sides. Apart of that, the measurement tool is the important tool that been used along the process and the employee needed to hold the measurement tool for a long time. This had affected some part of their body. From the observation, the employees encountered ache and pain on their entire arm and shoulder.

During packing task, the employees need to bend during the task. Body bending is considered as an awkward position when doing such tasks and eventually they will affect the back of employees. From the observation, the significant WMSD has been observed is the back pain.

Analysis of discomfort survey revealed both employees had experienced the highest discomfort reading mostly on the shoulder (right and left), upper arm (right and left), forearm (right and left), wrist (right and left). These discomforts had been experienced by XYZ employees for several times every day (reading number 8). The second highest reading are on the lower back, and foot (right and left). However, there were different experiences of pain for an employee stated that he felt discomfort on the neck and upper body for several times but another employee had experienced pain for 3 to 4 times on the neck and upper body in the last week. After all, from the observation of the survey, it is clearly seen that both of them had experienced pain for neck and upper back. Apart of that, the lowest reading from the survey are on the thigh (right and left), knee (right and left), lower leg (right and left) and foot (right and left), where they experienced the discomforts in 1 to 2 time a week. It can be concluded that the most significant discomforts area with the highest reading number 8 (several times every day) during cleaning process for the body parts are specifically on the shoulder, upper arm, forearm and wrist.

During measuring task, both employees had experienced the highest discomforts reading number mostly on the shoulder (right and left), upper arm (right and left), forearm (right and left), wrist (right and left). These discomforts had been experienced byXYZ employees for 3 to 4 times a week (reading number 4). The second highest reading are on the neck, upper back and lower back while they never experienced the discomfort on foot, lower leg, knee, thigh and hip/buttock.

Nevertheless, employee 2 had experienced pain on the neck with rating no. 2 which indicates he encountered the discomfort about 1 to 2 times last week, but never for employee 1.

Lastly, employees had experienced the highest discomfort reading is on the lower back during packing task. The pain on lower back had been experienced by XYZ employees for several times every day (reading number 8). The second highest reading are on the upper back where the experienced once every day, followed by the discomfort on the shoulder for both right and left, upper arm (right and left), neck, thigh (right and left) and lower leg (right and left). Nevertheless, an employee had experienced some discomforts on the forearm (right and left), wrist (right and left), knee (right and left) while never for another employee. Besides, discomfort on foot (right and left) and hip/buttock had never affected to both employees.

Right and left hand analysis of discomfort survey shows both employees had experienced the highest discomfort reading on both right and left hand specifically on all the area of the hand (Area A to F) during cleaning task for several times in every day with representative number 8. The second hand analysis during measuring task shows the base of fingers, thumb prominence and heel of hand area (Area D, E and F) are the most affected areas which occurred 3 to 4 times a week for both hands. Lastly, employees only experienced discomfort at a frequency of 1 to 2 times a week on the heel of hand area (Area F) for both hands during the packing task.

The final REBA score for cleaning task is 10 which indicates that WMSDs for cleaning process is in the high level and require fast action. For packing process, the final REBA score is 11 which indicates WMSDs is in the high level and action is required immediately. Meanwhile, final RULA score obtained for measuring process is 7 which indicates the high level of WMSDs which is needed for further investigation and immediate action. Table 2 shows the REBA and RULA scores in relation to each task.

Table 2 REBA and RULA score of the tasks

Task	REBA score	RULA score
Cleaning	10	-
Measuring	-	7
Packing	11	-

Since awkward position is the common denominator for risk factors for all these tasks, posture correction is a quick fix to reduce the high REBA and RULA score which indicates better posture and lower WMSDs risk.

Following the RULA and REBA results, new postures for these tasks were proposed and then simulated. Table 3 shows the existing and proposed postures for each task including the analysed degrees for RULA and REBA calculation.

Table 3 Work postures of cleaning, measuring and packing task with analysed degrees

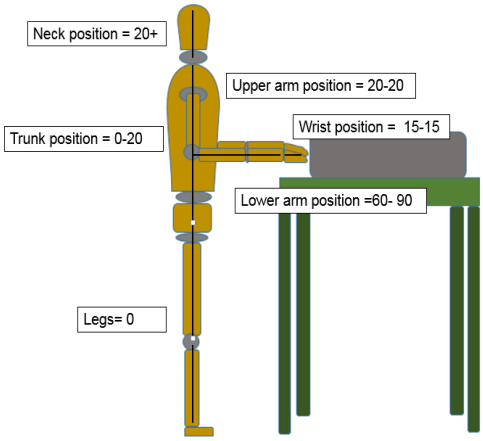
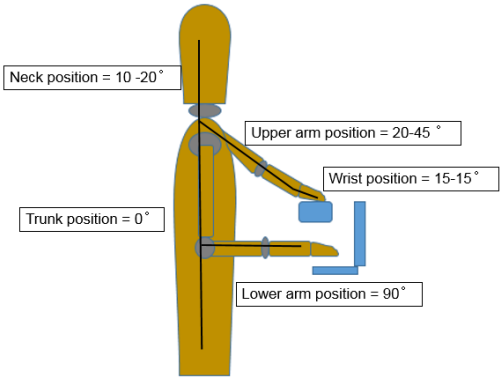
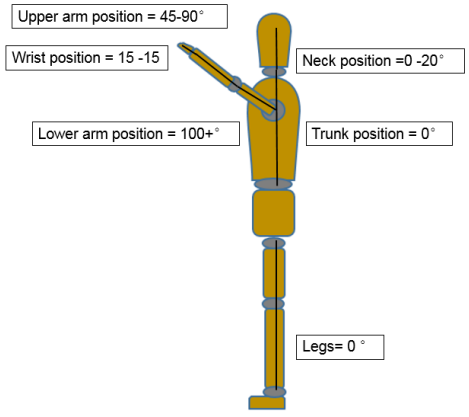
Task	Existing posture	Proposed posture
Cleaning		
Measuring		
Packing		

Table 4 shows the REBA and RULA score for all the tasks after posture correction. The scores are lower compared to the initial scores in Table 2. REBA score of 5 indicates a medium level of risk for WMSDs yet necessary to improve which it is depends on situation or working condition whereas REBA and RULA score of 3 both indicates a low level of risk for WMSDs investigate further which it is depends on situation or working condition.

Table 4 REBA and RULA score of the tasks after posture correction

Task	REBA score	RULA score
Cleaning	5	-
Measuring	-	3
Packing	3	-

4.0 CONCLUSION

Manufacturing industries often expose their workers to various physical ergonomics risk factors, such as awkward postures, repetitive motion and forceful exertion. XYZ Sdn Bhd is of no exception. An ergonomics risk assessment was carried out at XYZ Sdn Bhd, using observation and postural analysis tools of RULA and REBA. Workers were suffering from pain and discomfort in the upper body regions, namely the upper arms, lower arms and shoulder. This is due to the fact that the cleaning, measuring and packing are labor intensive for the upper body. The extensive application of postural analysis tools such as RULA and REBA will allow better WMSD risk management in manufacturing industries, in line with the requirements of the Guidelines On Ergonomics Risk Assessment At Workplace 2017, published by DOSH in 2017.

COMPETING INTEREST

There is no conflict of interest

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