

# WORK-RELATED MUSCULOSKELETAL DISORDERS (WMSDs) AMONG INDUSTRIAL PACKAGING WORKERS IN MALAYSIA

Mohd Zubairy Shamsudin<sup>1</sup>, Vidya Vijayakumar<sup>1</sup>, Mohd Yusof Md Daud<sup>2</sup>, Mohd Adam Adman<sup>1</sup>,  
Mohd Amir Arshad<sup>1</sup>, Mohd Jamalilazam Mustaffa<sup>1</sup>

<sup>1</sup>Occupational Safety and Health Programme, Faculty of Engineering and Life Sciences,  
University Selangor, Malaysia

E-mail: mohdzubairy@unisel.edu.my

<sup>2</sup>Razak School of Engineering and Advanced Technology, University Technology Malaysia, Malaysia

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## Abstract

A cross sectional study was conducted at industrial packaging company to investigate work-related musculoskeletal disorder (WMSDs) among 33 workers. Observational method includes task analysis and ergonomic risk assessment to investigate WMSDs. Task analysis approach is used to determine work processes and identify generic risk factors contributes to WMSDs. Meanwhile, Work Movement Task Analysis (WMTA) instrument is applied to investigate specific work-related ergonomic risk factors. Next, body discomfort survey is conducted to determine the trend of discomfort and pain among workers. Bivariate analysis (chi square) is conducted to determine relationship between body discomfort and WMTA risk scores. The results showed most of the workers (94%) are considered in the range of moderate risk according to WMTA's risk categories, meanwhile two cases each for low and high-risk category. While the body discomfort survey findings for neck, back, shoulder & arm and knee & legs respectively show 42%, 74%, 89% and 29% workers have symptoms of discomfort or pain. However, there was no significant relationship between WMTA risk scores with discomfort. There were other factors that causing the WMSDs disorder rather than working postures i.e. body mass index (BMI), smoking habit, psychosocial hazards and general health status are possibly seem to predispose the discomfort. The activities were generally in the moderate risk level, which requires further investigation, and need to change when required. The symptom of shoulder discomfort is substantially among workers mainly affected from pulling, pushing and lifting tasks. According to the results, it is conclude that WMSDs occurred in medium rate in this company. Taking corrective measures for reducing risk level into consideration seemed essential.

**Keywords:** Work-related musculoskeletal disorders, ergonomic risk assessment, task analysis, and observational approach

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## 1 INTRODUCTION

In the past 30 years work-related musculoskeletal disorders (WMSDs) have become a growing concern in industrialized countries [1]. WMSDs include a wide range of inflammatory and degenerative conditions affecting the muscle, tendons, ligaments, joints, peripheral nerves, and supporting blood vessels. These include clinical syndromes such as tendon inflammations and related conditions (tenosynovitis, epicondylitis, bursitis), nerve compression disorders (carpal tunnel syndrome, sciatica), and osteoarthritis, as well as less well standardized conditions such as myalgia, low back pain and other regional pain syndromes not attributable to known pathology [2].

Musculoskeletal disorders are reported to occur in certain industries and occupations with rates up to three or four times higher than the average rate across all industries [2]. In Malaysian industries, manual task using human labor such as lifting, loading and unloading are still widely used in production process due highly flexible and cheap labors. However, most of the industrial workers are exposed to repetitive task, prolonged work and pain because of awkward postures that often lead to muscle fatigue and

musculoskeletal discomfort among those workers [3], [4]. Manual material handling (MMH) is one of the main factor causing WMSDs among workers in the industrial developing country (IDC) [5] such as Malaysia. Thus, it is necessary to study the effect of work-related musculoskeletal disorder among occupational workers.

## 2 METHODOLOGY

Cross sectional study was conducted among 33 males workers in industrial packaging company located at Selangor, Malaysia. The study includes field risk assessment, task analysis and body discomfort survey among respondent.

### 2.1 Task Analysis

Task analysis provides some structure for the description of task or activities, which then makes it easier to describe how activities fit together, and to explore what the implications of this may be for the design of products. This can be particularly useful when considering the design of interfaces to products, and how users interact with them [6].

### 2.2 Work Movement Task Analysis (WMTA)

Work Movement Task Analysis (WMTA) was developed on the basis of the existing observational tools e.g. Quick Exposure Check, Rapid Upper Limb Assessment and Rapid Entire Body Assessment [7]–[9]. WMTA tool have undergone validity and reliability testing and demonstrated good result [10], [11]. This tool is appropriate for evaluating tasks where postures are dynamic, static or where gross changes in position take place. WMTA provided a method to calculate the rating of musculoskeletal loads task which breakdown the specific risk for neck, back, shoulder and arms, and knee and legs loading. In addition, this tool provides a score as a “snapshot” of the task, which is the rating of posture and movement is required. The neck risk is calculated into a score of 2-3, which is low category, 4-5, which is moderate, and 6-8 high risk category. For back risk score is calculated into a score of 4-7, which are low, 8-9 for moderate and 10-15 represented as high risk category. Next, for shoulder and arms region, the risk scores is calculated into a score of 8-15, which is low, 16-19 for moderate and 20-27 are considered as high risk category. Meanwhile for knee and legs risk scores respectively 4-6, 7-9 and 10-14 for low, moderate and high risk categories. These scores are grouped into three action levels that provide an indication of the time frame in which it is reasonable to expect risk control to be initiated.

### 2.3 Body Discomfort Survey

The survey demonstrates human figure and respondent is requested to mark at specific body region where the most experience discomfort or pain. The case study applied Corlett and Bishop [12] body discomfort chart, which demonstrates the entire body including the neck, back, shoulder and arms and knees and legs. Upon field observations, discomfort

survey collected from the respondents. Respondents will be interviewed to express a sense of discomfort and pain in their body.

## 3 RESULT

Table 1 shows task analysis results summarized the description of the activities and risk factors contribute towards WMSDs. A total of 27 main activities observed in this premise. These activities were an important process, which includes preparation and maintenance of machine components, raw materials and products handling.

### 3.1 Ergonomic risk assessment using WMTA tool

The findings of WMTA risk category were shown in figure 1. The distribution of the risk scores demonstrated most of the tasks in the moderate risk condition, which were 31 (94%). Only two cases each in the categories of low risk and high scores (6%).

The findings according to the limbs were shown in table 2. For neck region, 31 (94%) in the moderate risk category and the balance (6%) in the low risk category. Meanwhile, for back region a total of 18 (56%) of respondents assessed in the high risk category, 9 (26%) in the medium risk category, and the remaining 7 (21%) were in the low risk category. Next, for shoulder and arms, 12 (37%) respondents in the high risk category, while a total 18 (55%) respondent assessed in the moderate risk and the remaining 3 (8%) in the low risk category. Knees and legs region demonstrated a total 21 (63%) respondent in the moderate risk category. The remaining 11 (34%) in the low risk and one person 3%) were reached high-risk category.

TABLE 1. Task analysis outcomes for 27 different types of work

Actions	Description of the jobs	Risk factors
1. Lifting, pulling and pushing the paper reel shaft	Workers handling the shaft as a median tool for lifting the paper reel (1 ton). Every time when the paper reels being empty, the worker needs to replace with the new paper reel. When reload they need to lift and push the shaft inside the paper reel and bolted with nut to be fit.	Back bending Back twisting Forceful exertion Forceful gripping
2. Lifting and Pulling the printing cylinder shaft	This job done when the printing cylinder change over take part. The worker will change the printing cylinder according to the company’s brand based on the production scheduled. The worker needs to pull the shaft from the printing cylinder and lift the shaft, so that he can replace with other printing cylinder for the changeover.	Back bending Back twisting Repetitive motion Gripping (contact stress) Forceful exertion
3. Lifting the bottom patch reel	The work done when the changeover of the empty bottom patch reel with new reel	Forceful exertion & gripping Back bending & twisting

	(39kg). The worker needs to lift and fix the bottom patch reel at particular space.	Kneeling (contact stress)
4. Lifting the pallet and put at Seemi entry	Seemi is the palletize section. It is the robotic palletizing process. Two workers need to refill the pallets when is necessary.	Back bending & twisting Forceful exertion Forceful gripping
5. Manual feeding the tube at feeder	Sometimes the workers will feed the tubes manually if, occurs problem with rotary feeder that is the conveyor pass the tubes to the bootomer automatically.	Back bending & twisting Forceful exertion Forceful gripping
6. Stacking the paper waste inside the press machine	The worker will stack the waste papers from the production plant inside the press machine manually. He will arrange the paper fit to the machine, so that can the machine can press the papers.	Extreme neck flexion (prolonged) Moderate back bending Gripping (contact stress)
7. Manual stacking for bags after Quality Check (QC) inspection	Normally the palletizing done by robotic process. But first pallet bags for each brand of companies will go through Quality Control inspection before further palletizing process. QC inspector will check the quality of the bags and the worker will stack the paper on pallet.	Back twisting Hand above shoulder (repetitive) Gripping (contact stress)
8. Pouring chemical inside the cylindrical tank	The worker will pour the chemical from the container (25kg) inside the cylindrical tank for reservation at wastewater treatment plant.	Moderate neck flexion (prolonged) Hand above shoulder (repetitive) Arms movement (repetitive)
9. Lifting the glue bags & pour inside the tank	The worker will lift the glue bags (25kg) from the specific place (unused conveyer) and pour the powder inside the tank for glue mixing process.	Shoulder abduction (repetitive & prolonged) Extreme back bending during lifting the chemical bottles Back twisting during pouring Forceful exertion Forceful gripping (contact stress)
10. Install / Dismantle the strapping rope	This job takes place when the strapping rope finish on strapping machine (strapped the finished goods). It is a non-routine work.	Hand above shoulder (repetitive) Gripping (contact stress)
11. Lifting the ink pail/glue waste pail	The worker will lift the ink pail and put on trolley when the ink mixture is ready to deliver to printer for printing process. The glue waste also collected into pail, the worker will lift the pail and put on the trolley to transfer to glue waste storage.	Shoulder abduction (repetitive & prolonged) Extreme back bending during lifting the chemical bottles Back twisting during pouring Forceful exertion Forceful gripping (contact stress)
12. Install / Dismantle the wrapping film	This job takes place when the wrapping film finished used by the wrapping machine to wrap the finished goods. It's a non-routine work.	Back bending & twisting Forceful exertion Forceful gripping Kneeling (contact stress)
13. Pulling and pushing the hand pallet truck for scheduled waste	The worker will pull and push the hand pallet truck after packed the scheduled waste in the bag for measure weight. Approximately the load >60kg.	Pressure on the back & shoulder
14. Install and dismantle bottom patch printing cylinder	Bottom patch is the part, which will attach at bottom of the tube with customers company's brands. So, the bottom patch printer is located in the middle of bottomer. The operator will install or dismantle the	Back bending & twisting Neck flexion and side bending (prolonged) Forceful exertion Forceful gripping (contact

	printing cylinder according to the production schedule.	stress)
15. Transfer the office file to the store	The worker will lift the box, which is filled, by the office (10kg) and walk from office to store to keep the box.	Kneeling (contact stress) Awkward body posture Forceful exertion Forceful gripping Contact stress
16. Transferring the printing cylinder using the trolley and hand pallet truck	The worker transfers the printing cylinder using the trolley or hand pallet truck from the vertical corousel to printer for changeover process.	Awkward body posture Forceful exertion Forceful gripping Contact stress
17. Transferring the pallet using the hand pallet truck	Transfer the sun of pallets for palletizing purpose to Seemi using hand pallet truck.	Forceful gripping Contact stress
18. Transferring bottom patch reel	Transferring the bundle of bottom patch reels using pallet from the storage areas to bottomer.	Back bending & twisting Forceful on the shoulder during stabilize the load Forceful gripping (contact stress)
19. Lifting and pushing the trolley (Transfer ink/glue waste from dispenser to printer)	The worker will push the trolley with pails, which filled with ink from ink dispenser to the all printers, and get back the pails filled with glue waste from the bottomer to glue waste storage.	Pressure on the back during pushing Back bending & twisting during lifting the pails Forceful gripping (contact stress)
20. Pushing the FG pallet at transporting conveyer	The worker will push the finish good on conveyor for the strapping activity to the machine.	Forceful gripping Contact stress
21. Pushing the paper reel	The tuber worker will push the paper reels from the PSA area to the specific places at the tubers.	Pressure on the back (forceful exertion) Forceful gripping (contact stress)
22. Pushing the Mobile Elevating Working Platform (MEWP) for work at height (WAH) activity	The maintenance worker will push the MEWP from maintenance workshop if have any WAH activity.	Pressure on the back (forceful exertion) Forceful gripping (contact stress)
23. Lifting and transferring the spare parts using the hands pallet truck	The maintenance worker will transfer the spare parts from the workshop to machines.	Back bending & twisting Forceful exertion Forceful gripping (contact stress)
24. Pulling the strapped paper waste from press machine and transferring	Worker will pull the strapped paper waste from press machine to transfer to paper waste bin.	Pressure on the back (forceful exertion) Back bending & twisting during lifting Forceful gripping (contact stress)
25. Pushing the waste trolley	The worker will push the trolley that filled with waste papers after the quality check to the international zone.	Pressure on the back (forceful exertion)
26. Pushing the drum hand jack for moving the ink drum	The worker uses the drum hand jack to move the ink drum to the ink dispenser.	Pressure on the back (forceful exertion)
27. Pushing the toolbox trolley	The maintenance worker will push the toolbox trolley when maintenance activity carried out.	Pressure on the back (forceful exertion)

### 3.2 Discomfort survey

Figure 2 shows the distribution of the body discomfort survey according to the specific body region. The pattern of distribution of the respondents who have experienced symptoms of discomfort of neck, back, shoulder and arms and knees and legs, respectively 42%, 74%, 89% and 29%.

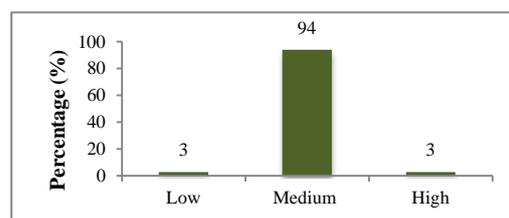


FIGURE 1. WMTA score categories

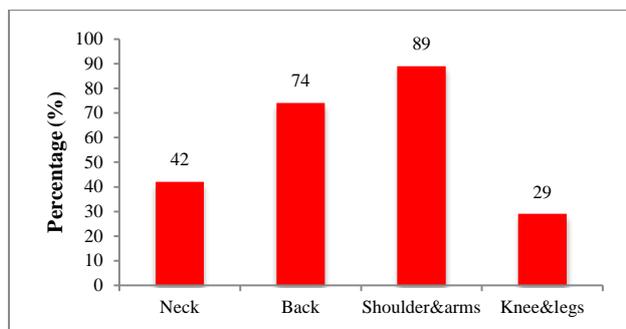


FIGURE 2. Discomfort survey description by body regions

TABLE 2. WMTA score categories for each body region

	Low	Medium	High
Neck	2 (6%)	31 (94%)	0 (0%)
Back	7 (21%)	9 (26%)	18 (56%)
Shoulder & arms	3 (8%)	18 (55%)	12 (37%)
Knee & legs	11 (34%)	21 (63%)	1 (3%)

### 3.3 Relationships between WMTA risk scores and body discomfort

Table 3 shows the results of the relationship of the WMTA risk score and body discomfort analysis. However, there were no significant relationship WMTA risk score and body discomfort for neck, back, shoulder and arms and knees and legs.

TABLE 3. Relationship between WMTA scores and relative body discomfort

Body part	BDS	*Low & Moderate		X <sup>2</sup>	P-value
		*Low	**High		
Neck	Yes	12	0	2.54	0.28
	No	21	0		
Back	Yes	12	15	10.82	0.21
	No	1	5		
Shoulder&arms	Yes	17	14	4.21	0.90
	No	2	0		
Knee & legs	Yes	9	0	6.14	0.41
	No	23	1		

\* Combination of low & moderate WMTA risks scores

\*\* WMTA high risk score: BDS = body discomfort survey

## 4 DISCUSSION

The study was carried out at the industrial packaging premise to observe trends of WMSDs among workers. The result demonstrated in overall workers assessed was in the moderate risk condition based on the field assessment using WMTA instrument. For moderate risk level, WMTA suggests the risk need to be investigated and change soon with a practicable intervention to minimize the risks. However, the moderate risk category does not require immediate action compared to high risk category. Based on the body discomfort survey, shoulder and arms region show the highest prevalence. This

phenomenon shows that most of the activities which were dominant on the use of these parts. This was proved by the findings of task analysis shows the activity of pulling, pushing and lifting was significant in the premise. Details of the findings have found that the risk lead to WMSDs work was the handling and maintenance works. Muscles physiology research [13] to investigate muscles activity on the shoulder and hands utilization especially hands manipulation e.g. gripping proved that increasing the specific muscles (trapezius and infraspinatus) activity which lead to prevalence of discomfort.

In addition, repetitive movements factor strengthening the effects of muscle fatigue which lead to WMSDs [14]. In addition, the use of back body for pulling, pushing and lifting affected symptoms of discomfort in this part. Back discomfort demonstrated second highest after shoulder and arms. Back twisting and lateral bending increasing the spine disc injury based on the biomechanical characteristics [11][15] in addition to extreme awkward bending that can adversely affect the back [16]. This phenomenon indicates that the job involves frequent bending and twisting posture affects the biomechanical mechanisms of the back. Epidemiological studies on the automotive component assembly workers [17] shows the activity involves a lot of back bending and twisting posture has a significant correlate with symptoms of back discomfort such as drilling automotive components which involves awkward bending and back twisting. However, so far as researchers' knowledge, there has been no study of the scope of the industry carried out. In short, work activities that involve the use of P-back tend to show symptoms of discomfort.

A result of the relationship of WMTA risk score with discomfort survey does not show any significant findings for each body region (neck, back, shoulder and arms and knees and legs). It assumed that there were other factors that contributed on the symptoms of body discomfort such as body mass index (BMI), psychosocial factors, smoking habit and general health status were possibly seem predisposed the discomfort. Constrained to get more respondents also encountered since the premise did not have many employees and the absentees also to be considered.

## 5 CONCLUSION

Occupations performed by the workers were suggested to impose medium health risk on the workers' musculoskeletal system. It was therefore evident that a major ergonomic intervention was necessary to improve the work conditions. Details musculoskeletal disorders analysis should be conducted to determine risk factors that really contributed on this symptom. WMTA instrument has been designed to carry out a critical assessment on the various aspects of work and further suggests the

reasonable measures to employers. WMSDs risk assessment, encompassing aspects of task analysis, field observations and body discomfort survey. Nevertheless, direct measurement element is proposed to further strengthen the risk assessment planned. However, direct observation approach brings its own challenges that need to be considered by researchers. It is suggested here that active participation has not only the potential to deal with obvious problems, but also the lesser, hidden one that have never been given consideration before.

## ACKNOWLEDGMENTS

The authors gratefully thank to Universiti Selangor, UNISEL (GPB-UNISEL15/SK-003) for the sponsorship: We have to express out appreciation to Romizan Jathin, Head of Department, Department of Physiotherapy, Faculty of Health Sciences, Universiti Teknologi MARA (UiTM) for the vital technical support and loan of the electromyographic system during the WMTA instrument validation phase. We would also immensely grateful to Mohd Sharikh Dali Mahad, Senior physiotherapist, Department of Physiotherapy, Faculty of Biomedical and Health Sciences, Universiti Selangor for sharing his pearls of wisdom with us during the course of this research.

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