

Study on ergonomic risk assessment among warehouse workers in an electronic manufacturing industry

Fadlin Afina Suhaimi¹, Nurul Hafeezah Sahak^{1*}

¹ Department of Chemical Engineering Technology, Faculty of Engineering Technology
Universiti Tun Hussein Onn Malaysia, Pagoh, 84600, Johor, MALAYSIA

*Corresponding Author: nurul@uthm.edu.my

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Abstract

The electronic manufacturing is a diverse industry and is susceptible to ergonomic hazards. Warehouse department workers are likely to get exposure to ergonomic hazard on their daily job task. Objective for this study was to identify the prevalence of musculoskeletal disorder (MSDs). 19 respondents which were workers in warehouse department in an electronic manufacturing industry were involved in this study. The questionnaire Cornell Musculoskeletal Discomfort Questionnaire (CMDQ). From the analysis conducted and calculation of total discomfort score, body parts which are at risk for injury and discomfort on female workers are wrist, lower leg and foot with percentage of 100% each. Meanwhile for male workers shows, the body parts with high risk of injury and discomfort were on the upper back (97.6%), upper arm and thigh with 100% respectively. Employers are responsible to create awareness about ergonomic besides creating procedures and safe work practices which can lessen the pain and discomfort to the workers. By that, the musculoskeletal disorder (MSDs) risks will be reduced.

1. Introduction

The employees in electronic manufacturing are more susceptible to risks associated with Musculoskeletal Disorders (MSDs) compared to counterparts in other industries due to prolonged exposure to risk factors such as repetitive movements and awkward postures. Some employees grappling with ergonomic issues in their work environments may experience MSDs. The pain associated with MSDs tends to worsen over time, and its effects may not manifest immediately, potentially surfacing as the worker ages.

According to the SOCSO annual report for the year 2020, there were 1,186 cases of MSDs recorded, involving 815 male and 371 female individuals. MSDs emerged as the most prevalent category of diseases compared to other occupational ailments such as respiratory and skin diseases. These statistics underscore the gravity of ergonomic diseases, particularly MSDs, among workers in Malaysia.

According to the Department of Statistics (2021), there were 201 recorded cases of occupational musculoskeletal disorders (MSDs) in the year 2021. This underscores the significance of addressing ergonomic hazards from the initiation of the work process.

The identification of the prevalence of MSDs serves as evidence highlighting the severity of ergonomic issues among warehouse workers in an electronic manufacturing industry. The results of this study served as a foundation for ongoing dialogue and initiatives aimed at addressing and mitigating ergonomic risks in the workplace.

2. Methodology

To determine the appropriate sample size for the study, the researchers referred to the Krejcie and Morgan Table (1970) as a guideline. The warehouse department, the focus of the study, consisted of a total of 20 individuals. According to the table, the calculated sample size for 20 workers is 19 samples, indicating the adequacy of the selected sample size.

The Cornell Musculoskeletal Discomfort Questionnaire (CMDQ) was utilized as a tool to measure discomfort among the study participants. Developed by Cornell University Ergonomics students and Professor Alan Hedge, the CMDQ is a designed instrument for screening work-related musculoskeletal disorders (WMSDs). The questionnaire allows study participants to report the frequency, severity, and impact of recent musculoskeletal pain or discomfort on their work.

The CMDQ scoring guidelines from Cornell University Ergonomics Web (2003) suggest multiplying the scores for frequency, intensity, and interference to obtain the overall discomfort score for a specific body part. The formula to determine the discomfort score specified.

$$\text{Total discomfort score} = \text{Frequency score} \times \text{Intensity score} \times \text{Interference score}$$

Table 1 Rating scores for CMDQ calculation
(Adapted from Hedge, A., et al., (1999))

Frequency of discomfort	Intensity of discomfort	Interference of discomfort
0= Never	1= Slightly uncomfortable	1= Not at all
1.5= 1-2 times/week	2= Moderately uncomfortable	2= Slightly interfered
3.5= 3-4 times/week	3= Very uncomfortable	3= Substantially interfered
5 = Every day		
10 = Several times every day		

For this study, the latest version of Statistical Package for Social Sciences (SPSS) was utilized to conduct analyses, generating results in percentage. This approach aligned with the study's objective of comprehensively understanding the prevalence of musculoskeletal disorders (MSDs) among warehouse workers. The flowchart was developed based on a continuous planning approach to ensure the effective execution of the ergonomic risk assessment. Adapted from the DOSH Malaysia 2017 guidelines, modifications were incorporated to align with the specific requirements of this study.

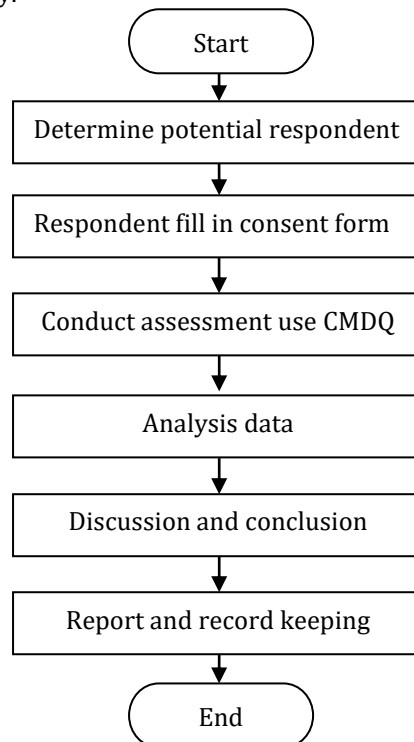


Fig. 1 Research Flowchart

3. Result and Discussion

Data for Cornell Musculoskeletal Discomfort Questionnaire (CMDQ) has been recorded in table 3.1 below for Cornell musculoskeletal discomfort questionnaire data for packing activity (body region), table 3.2 Cornell musculoskeletal discomfort questionnaire data for logistic activity (body region), table 3.3 Cornell musculoskeletal discomfort questionnaire data for hand region. The observed discomfort scores in logistic activities reveal distinct gender-specific patterns. The discomfort scores for male in the packing activity were higher in the left upper back, with a frequency of 138 (97.6%) compared to female. Conversely, female exhibited a greater focus on the lower leg, left lower leg, right foot, and left foot with prevalence of 100% each compared to male, who reported no discomfort in the respective body areas.

Body regions with higher percentages indicate ergonomic risks in those areas, leading to discomfort among respondents in the warehouse department. When workers experience pain or discomfort in the same body area, it signifies frequent use of that specific region in their job activities, whether in packing or logistics and shows that there was risk of MSDs towards that activity.

For male respondents, the most affected body area was the left upper back, likely stemming from lifting activities. In contrast, female experienced more discomfort in the wrist, lower leg, and foot. This discrepancy may be attributed to the nature of female's work involving prolonged standing and the use of ill-fitting footwear. This is exacerbated by the physical weight and hardness of many safety shoes, which are easier for male to wear but may cause discomfort for women. Other than that, female energy was different which easily feel discomfort than male.

Table 3.1 Cornell musculoskeletal discomfort questionnaire data for packing activity (body region)

Body region	Frequency (F)		Comfortability (C)		Interfere Work (I)		Discomfort score (F x C x I)		Percentage (%)	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
Neck	3	7	4	3	2	4	24	84	22.2	77.8
Shoulder (R)	6	3	7	3	4	3	168	27	86.2	13.8
Shoulder (L)	4.5	3	6	3	4	3	108	27	80.0	20.0
Upper Back	3	1.5	4	2	3	3	36	9	80.0	20.0
Upper Arm (L)	11.5	1.5	3	1	4	2	138	3	97.9	2.1
Lower Back	4.5	25	5	7	3	7	67.5	1225	5.2	94.8
Forearm (L)	3.5	1.5	1	1	2	1	7	1.5	82.4	17.6
Wrist (R)	0	1.5	0	2	0	2	0	6	0.0	100
Wrist (L)	0	1.5	0	2	0	2	0	6	0.0	100
Lower Leg (R)	0	6.5	0	5	0	6	0	196	0.0	100
Lower Leg (L)	0	5	0	5	0	5	0	125	0.0	100
Foot (R)	0	5	0	6	0	5	0	150	0.0	100
Foot (L)	0	6.5	0	6	0	6	0	234	0.0	100

The observed discomfort scores in logistic activities reveal distinct gender-specific patterns. For males, discomfort was notably higher in the left upper back, right upper arm, right thigh, and left thigh with percent of 100% for each body part. In contrast, females showed heightened discomfort in the lower leg, left lower leg, right foot, and left foot with prevalence of 100% each. Table 3.2 provides a detailed breakdown of these discomfort scores, emphasizing the need for gender-sensitive ergonomic interventions in the warehouse setting.

It was related to a study from Abdul Rahman, et al. (2022) stated that majority of MSDs among warehouse employees were found in the back area, left and right legs, and shoulders. It was significant to this result study. Further research and targeted measures were recommended to understand and mitigate the specific ergonomic needs of male and female workers in logistic activities.

Table 3.2 Cornell musculoskeletal discomfort questionnaire data for logistic activity (body region)

Body region	Frequency (F)		Comfortability (C)		Interfere Work (I)		Discomfort score (F x C x I)		Percentage (%)	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
Neck	8	5	6	3	6	2	288	30	90.6	9.4
Shoulder (R)	5	8.5	3	5	2	5	30	212.5	12.4	87.6
Shoulder (L)	5	8.5	2	5	2	5	20	212.5	8.6	91.4
Upper Back	5	0	2	0	2	0	20	0	100	0
Upper Arm (R)	1.5	0	2	0	2	0	6	0	100	0
Upper Arm (L)	1.5	0	2	0	2	0	6	0	100	0
Lower Back	13	8.5	7	6	9	6	819	306	72.8	27.2
Thigh (R)	5	0	1	0	1	0	5	0	100	0
Thigh (L)	5	0	1	0	1	0	5	0	100	0
Knee (R)	1.5	3	1	3	2	2	3	18	14.3	85.7
Knee (L)	3	1.5	3	1	4	2	36	3	92.3	7.7
Lower Leg (R)	0	1.5	0	1	0	1	0	1.5	0	100
Lower Leg (L)	0	1.5	0	1	0	1	0	1.5	0	100
Foot (R)	0	5	0	3	0	2	0	30	0	100
Foot (L)	0	5	0	3	0	2	0	30	0	100

Discomfort scores for the right and left hands were compared between packing and logistic activities. Shaded area guide can be refer to CMDQ for right and left hand in CMDQ website (2003). Table 3.3 showed the result for CMDQ for packing activity on hand. In packing, the highest discomfort was in area D, specifically the centre of the right hand, with a score of 6 (100%). No records were found for logistic activity in this area. In logistic activities, the highest discomfort score was in Shaded area E, also with a score of 6 (100%). For the left hand, the highest discomfort score in packing was in area C with a score of 6 (100%), and in area D with a score of 3 (100%), with no records for logistic activity in this area. In logistic activities, the highest discomfort score was in area F with a score of 24 (100%).

This indicates that the hand regions do not exhibit discomfort scores as high as other body parts. Therefore, it can be inferred that the condition of the hands remains satisfactory. However, the recorded instances of discomfort serve as a warning to exercise caution and take proactive measures before the situation escalates into a more serious concern in the future.

Table 3.3 Cornell musculoskeletal discomfort questionnaire data for packing activity (Hand)

Hand Area	Frequency (F)		Comfortability (C)		Interfere Work (I)		Discomfort score (F x C x I)		Percentage (%)	
	Packing	Logistic	Packing	Logistic	Packing	Logistic	Packing	Logistic	Packing	Logistic
Right Hand										
A	1.5	1.5	1.0	2.0	1.0	1.0	1.5	3.0	33.3	66.7
C	3.5	1.5	2.0	2.0	3.0	1.0	21.0	3.0	87.5	12.5
D	3.0	0.0	2.0	0.0	4.0	0.0	6.0	0.0	100.0	0.0
E	0.0	1.5	0.0	1.0	0.0	1.0	0.0	1.5	0.0	100.0
F	3.5	3.0	1.0	3.0	1.0	3.0	3.5	18	16.3	83.7
Left Hand										
A	1.5	1.5	1.0	2.0	1.0	1.0	1.5	3.0	33.3	66.7
C	1.5	0.0	2.0	0.0	2.0	0.0	6.0	0.0	100.0	0.0
D	1.5	0.0	2.0	0.0	1.0	0.0	3.0	0.0	100.0	0.0
E	1.5	1.5	2.0	1.0	2.0	1.0	6.0	1.5	80.0	20.0
F	0.0	3.0	0.0	4.0	0.0	2.0	0.0	24.0	0.0	100.0

4. Conclusion

The objective of this study, which aimed to identify the prevalence of musculoskeletal disorders (MSDs) among warehouse workers in the electronic manufacturing industry, was achieved through the results and discussions of the Cornell Musculoskeletal Discomfort Questionnaire (CMDQ). This was evidenced by the screening results indicating body parts posing risks to MSDs, including the lower back, shoulders, and upper back for both activities in the warehouse department. The data was presented in percentage form to fulfill the objective.

Furthermore, for the results from the Cornell Musculoskeletal Discomfort Questionnaire (CMDQ), it can be observed that male respondents in packing activities experienced discomfort, particularly in the left upper back, while females experienced discomfort in the lower leg, left lower leg, right foot, and left foot. In logistic activities, male workers had higher discomfort scores in the left upper back, right upper arm, right thigh, and left thigh. Conversely, females exhibited higher discomfort scores in the lower leg, left lower leg, right foot, and left foot. Discomfort scores for the right and left hands remained low, with no high discomfort scores as seen in the CMDQ body region scores.

For the activity of packing, consider redesigning workstations to prevent strain on the head and shoulders, particularly during scanning tasks that involve bending. Task rotation, involving different motions and individuals, can be implemented to ensure that workers are not consistently exposed to the same hazards throughout their tenure. By reducing or eliminating these risk factors, the likelihood of injuries can be significantly decreased.

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Conflict of Interest

There is no conflict of interests regarding the publication of the paper.

Author Contribution

The author confirms sole responsibility for the following: study conception and design, data collection, analysis and interpretation of results, and manuscript preparation.

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