ORIGINAL ARTICLE

# Ergonomic Risk Factors (ERFs) and Prevalence of Work-related Musculoskeletal Disorders (WMSDs) Among Solvent Manufacturing Workers in Shah Alam, Selangor

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**ABSTRACT**

**Introduction:** Work-related musculoskeletal disorders (WMSDs) remain a significant occupational health issue across various industries, particularly in manufacturing, where ergonomic risk factors (ERFs) are prevalent. These disorders can lead to long-term discomfort, disability, and reduced productivity, making the identification and mitigation of ERFs critical for safeguarding workers' health. This study aimed to determine the prominent ERFs and the prevalence of WMSDs among workers in a solvent manufacturer in Shah Alam. **Materials and methods:** This study was conducted among 130 workers of a solvent manufacturer. The selection of workstations was done by a stratified sampling method. A self-administered Cornell Musculoskeletal Discomfort Questionnaire (CMDQ) was used to assess musculoskeletal discomfort among workers. In addition, Initial Ergonomic Assessment (IERA) was performed in all four departments to identify the prominent ERFs among the workers. The obtained data was analyzed using descriptive analysis, Chi-Square and Multiple Logistic Regression **Results:** Most of the participants were in the age range of 31 to 40 years old. Among the participants, the prominent ERFs were awkward posture, static and sustained work posture, forceful exertion and repetitive motion. The prevalence of WMSDs was 58.5%, with the highest was on the neck (40.8%) followed by right shoulder (28.5%), upper back (17.7%) and left shoulder (11.5%) respectively. The following ERFs were found to have a statistically significant association ($p<0.05$) with WMSDs: awkward posture ($p= 0.000$, OR=27.133), static and sustained work posture ($p= 0.004$, OR=2.985), forceful exertion ($p= 0.033$, OR=0.394) and repetitive motion ($p= 0.033$, OR=2.538). **Conclusion:** This study identified four prominent ERFs with neck being the most affected area with WMSDs among workers in the solvent manufacturing factory. The ERFs were highly associated with the prevalence of WMSDs which shows that it is critical to conduct further investigation and changes on the working methods to decrease the exposure level. An immediate intervention can be executed such as conducting ergonomics awareness training on proper working postures on a regular basis to ensure the reduction of ERFs among the workforces. It is recommended to use Rapid Upper Limb Assessment (RULA) to evaluate the exposure of individual workers to ERFs associated with upper extremity WMSDs.
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**Keywords:** Work-related musculoskeletal disorders, Ergonomic risk factors, Cornell musculoskeletal discomfort questionnaire, Solvent manufacturing factory, Ergonomics risk assessment

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## INTRODUCTION

Ergonomics, commonly referred to as human factors that focuses on understanding, analyzing, designing and improving workplace conditions. Particularly, ergonomics aims to optimize the performance of the working system by ensuring an efficient interaction between people, workstation and environment. Typically, ergonomics study focuses on injury prevention through the evaluation of workplace layout as well as working activities, including among others body postures and repetitive movements. The ergonomics risk can be classified into several factors including awkward postures, static and sustained work posture, forceful exertion and repetitive motion. Poorly designed plant layouts and workstations may compromise workers' safety and lead to injuries. For instance, fatigued, sick, frustrated workers, a decrease in productivity and product quality as well as increased medical claims are due to musculoskeletal diseases and disability.

According to the Centers for Disease Control and Prevention (1), musculoskeletal disorders are most likely to affect the musculoskeletal system's soft tissues, such as tendons, ligaments, cartilage, and spinal discs. Work conditions that can cause Work-related Musculoskeletal Disorder (WMSDs) such as routine lifting of heavy

objects, daily exposure to whole-body vibration, frequent overhead work, working for long periods of time with neck flexion, and performing repetitive forceful jobs. The Canadian Centre for Occupational Health and Safety (2) defined WMSDs as a group of painful muscle, tendon, and nerve problems that occur at work which may lead to carpal tunnel disease, tendonitis, thoracic outlet syndrome, and tension neck syndrome. Bending, straightening, clutching, holding, twisting, clenching, and reaching are examples of arm and hand activities that induce WMSDs. While these normal movements in daily life are not particularly dangerous however, they are dangerous in the workplace because of their constant repetition, frequently with force, and, more importantly, they happen consistently with little time for recovery in between.

WMSDs pose a major threat to everyone around the world, particularly the health of the workforce. It can happen when a human body is subjected to a mechanical burden that is too severe for them physically, for instance low back pain and upper limb diseases. While upper limb diseases are frequently associated with repetitive work, uncomfortable postures, and excessive taskforce, low back pain is commonly associated with manual handling. According to research by the National Research Council and the Institute of Medicine (3), approximately 70 million employees in the United States encounter WMSDs every year, and nearly 1 million employees leave from work in 1999 to treat and start to heal from impaired functioning in the low back or upper extremities. In addition, a study by the International Labour Office (4) states that an estimated two million workers lose their lives to job-related diseases or injuries each year, while another 268 million non-fatal workplace injuries force them to miss work.

In Malaysia, WMSDs have become a significant occupational safety and health issue. According to the Department of Occupational Safety and Health (DOSH) (5), statistical data on reported cases of occupational WMSDs from 1995 to 2009 showed an increasing trend due to the increasing numbers of manufacturing workers. Another significant factor in Malaysia's rising rate of occupational diseases is the growing workload brought on by expanding consumer demands. In 2016, occupational diseases and poisoning recorded the highest number from 2005 until 2020 with 7820 cases reported in Malaysia. In addition, manufacturing sectors are one of the major contributors towards the mass recorded numbers for occupational diseases and poisoning from 2017 to 2020 with 3349, 5198, 6040 and 1495 cases recorded, respectively. Based on this data, it can be seen that the trend increases every year except for the record in 2020 which may have decreased due to Covid -19.WMSDs is one of the occupational diseases and poisoning occurring in the industries. It includes a wide range of health issues, including discomfort, minor wounds, and pain caused by work-related conditions.

In the manufacturing industry, the impact of WMSDs is due to the nature of tasks and activities involving a range of processes and responsibilities. For example, handling solvents and cleaning agents in routine jobs poses risks including among others, repetitive movements, awkward posture, and contact pressure. The repetitive nature of these tasks, combined with the need for bending, reaching, and twisting in uncomfortable positions, can strain muscles and joints, leading to musculoskeletal disorders. Additionally, the exertion required for lifting heavy containers, and the pressure applied during cleaning, can further contribute to physical strain. Prolonged contact with hard surfaces, along with the requirement to remain in one position for extended periods, can cause discomfort and fatigue. A previous study by Ali and Zulkaple (6) have also highlighted that a common ERF in paint mixing tasks leading to tiredness, muscle strains and imbalances is prolonged sitting.

These health issues, on the other hand, can progress to more serious medical illnesses, which could result in permanent impairment. Thus, this research is needed to investigate ERFs and prevalence of WMSDs among workers in a solvent manufacturing factory. The hypothesis posits a significant association between the prevalence of WMSDs and the most prominent ERFs among the solvent manufacturing workers. A workplace with inadequate ergonomics often leads to physical and psychological stress, decreased productivity, and poor job performance. Therefore, this study might be a good starting point for developing targeted interventions to improve workplace ergonomics, reduce WMSDs and enhance worker well being in this study area.

## MATERIALS AND METHODS

### Sampling method

This study was conducted among workers in a solvent manufacturer in Shah Alam from December 2021 to October 2022. 130 participants were recruited by using a stratified random sampling method. Production, Logistics, Administration and Testing were the four work units identified to represent all departments in the solvent manufacturing factory. The workers were divided into four strata, based on a list of names provided by the factory management which then were selected through a simple random generator.

The sample size of the strata based on department was determined using the formula indicated below:
Sample size of strata (based on department)

$$= \frac{\text{Size of strata population } x \text{ Entire sample size of the respondents}}{\text{Entire population size}}$$

Inclusion criteria were workers with a minimum of one year working experience; aged 20 and above and provided their consent to take part in the study. Exclusion criteria were workers who suffered an acute or chronic traumatic injury due to non-occupational accidents affecting the musculoskeletal system. The dependent variable for this study was the prevalence of WMSDs while the independent variable was the ERFs.

Respondents were asked to complete a Cornell Musculoskeletal Discomfort Questionnaire (CMDQ). Following to that, an Initial ergonomics risk assessment (IERA) was performed to all four departments. The assessment was based on several ERFs. The results of IERA were graded based on each factor observed and examined.

**Study instrument**

The Cornell Musculoskeletal Discomfort Questionnaires (CMDQ) in English and Malay versions which were adopted by Shariat et al. (7) and Hedge et al. (8), was used to identify WMSDs. The self-administered questionnaire encompassed three sections. Section A was divided into four parts, in which Part 1 required respondents to give information on socio-demographic background including age, gender, marital status, race, and education level. Personal information such as name and Identity Card number were not included in the questions to ensure their identity remains private. Part 2 contained seven questions regarding respondents' working conditions such as their work schedule and the break duration. Part 3 consisted of two questions on smoking status and leisure time activity. While Part 4 included two questions on respondents' medical history. Section B contained: two questions of self-assessment musculoskeletal pain or discomfort survey form. The last section was CMDQ in which consisted of three questions to assess the prevalence of MSDs among the respondents. The CMDQ was divided into three categories: sedentary workers, standing workers, and hand symptoms. The female and male sedentary CMDQ versions were used in this study. CMDQ's validity and reliability have been thoroughly examined in previous studies and they have been determined to be acceptable for use in the assessment of musculoskeletal discomfort (7).

According to the scoring 2017 guideline by DOSH (9), the rating scale for each question is shown in Table I and the total discomfort score can be determined by multiplying frequency score with discomfort and interference score. After obtaining the total discomfort score, the number of people that are affected by WMSDs was classified into four categories which is, no discomfort, mild, moderate, and severe. The category then dichotomizes into 'No' MSDs and 'Yes' MSDs as shown in the Table II.

**Table I: Rating score frequency, discomfort and interference.**

| Frequency | Discomfort | Interference |
|---|---|---|
| Never = 0 | Slightly comfortable = 1 | Not at all = 1 |
| 1-2 times/week =1.5<br>3-4 times/week =3.5 | Moderately uncomfortable = 2 | Slightly interfered =2 |
| Every day = 5<br>Several times every day = 10 | Very uncomfortable = 3 | Substantially interfered = 3 |

**Table II: Classification of total discomfort score.**

| MSDs | Category | Total discomfort score |
|---|---|---|
| No | No discomfort or discomfort absent | 0 |
| | Mild discomfort | |
| Yes | Moderate discomfort | 1 |
| | Severe discomfort | |

The selected CMDQ has been validated and widely used in previous studies, demonstrating reliability in assessing musculoskeletal discomfort. The CMDQ's structured format allowed for a systematic assessment of WMSDs among participants, aligning with the study's objective of determining WMSDs prevalence.

The other instrument used in this research was Initial Ergonomics Risk Assessment (IERA). A few checklists were utilized to observe employees from various views such as the front, back, and sides by using audio visual and image capturing devices. The IERA included four departments: Production, Logistics, Administration, and Testing, which represented the entire factory. The IERA was carried out through walkthrough observation as well as recorded closed-circuit television (CCTV) videos to observe employees while they are at work from various angles, including the front, rear, and sides. The assessment was conducted in accordance with the 2017 guideline on ergonomic risk assessment by the DOSH, Malaysia (9). The IERA which was based on the guideline was chosen because it provides a standardized approach to identifying ergonomic hazards and informing intervention strategies.

**Data analysis**

All data was processed using the Statistical Package for Social Sciences Software (SPSS) Version 27. Descriptive analysis was performed to describe the prevalence of WMSDs among the workers. While, Chi-Square and Multiple Logistic Regression tests were employed in the statistical analysis to examine the relationship between prominent ERPs and the prevalence of WMSDs among the workers in the solvent manufacturing factory. The confidence interval selected was 95% and the results were considered significant at $p<0.05$.

### Ethical consideration

This study was approved by JKEUPM Ethics Committee Involving Human Subjects, University Putra Malaysia (JKEUPM-2022-383).

## RESULTS

### Socio-demographics

A total of 130 workers participated in this study from four work units namely production, logistics, admin and testing. According to Table III, the majority of respondents were in between the age of 31 and 40 (43.1%), Malay (49.2%) and mostly workers with tertiary education qualifications (51.5%). Most of the workers were married (73.8%) and have a smoking habit (55.4%). In addition, the majority of the workers have been working for 1 to 10 years (47.7%) and were employed full-time (93.8%). 60% of the participants reported taking one break during the work shift.

**Table III: Socio-demographic background of the workers (n=130)**

| Characteristics | n (%) |
|---|---|
| **Gender** | |
| Male | 94 (72.3) |
| Female | 36 (27.7) |
| **Age** | |
| 20 -30 years old | 38 (29.2) |
| 31-40 years old | 56 (43.1) |
| 41- 50 years old | 29 (22.3) |
| 51- 60 years old | 7 (5.4) |
| **Race** | |
| Malay | 64 (49.2) |
| Chinese | 51 (39.2) |
| Indian | 6 (4.6) |
| Others | 9 (6.9) |
| **Educational level** | |
| No formal education | 4 (3.1) |
| Secondary education | 4 (3.1) |
| Tertiary education | 67 (51.5) |
| Degree level | 55 (42.3) |
| **Marital status** | |
| Married | 96 (73.8) |
| Single | 34 (26.2) |
| **Department** | |
| Production | 28 (21.5) |
| Logistic | 30 (23.1) |
| Admin | 33 (25.4) |
| Testing | 39 (30.0) |
| **Working experience** | |
| 1-10 years | 62(47.7) |
| 11-20 years | 16 (12.3) |
| 21-30 years | 45 (34.6) |
| >30 years | 7 (5.4) |
| **Employment type** | |
| Full-time worker | 122 (93.8) |
| Part-time worker | 8 (6.2) |
| **Smoking** | |
| Yes | 72 (55.4) |
| No | 58 (44.6) |

CONTINUE

**Table III: Socio-demographic background of the workers (n=130) (CONT.)**

| Characteristics | n (%) |
|---|---|
| **Break time** | |
| Once | 78 (60.0) |
| Twice | 20 (15.4) |
| Thrice | 32 (24.6) |
| **Hobby** | |
| Yes | 118 (90.8) |
| No | 12 (9.2) |

### Prominent ERFs among workers and incidences of WMSDs in body parts

The prominent ERFs that has been identified were working with awkward posture, static and sustained work posture, forceful exertion and repetitive motion. Based on the IERA performed at the four departments with the help of videos and images from various perspectives, it was found that activities such as lifting paint, repetitive work, and working in awkward postures (bending and twisting) were common.

The prevalence of WMSDs (Table IV) among workers was 58.5%, with the highest complaint being for neck at (40.8%), followed by right shoulder (28.5%), upper back (17.7%) and left shoulder (11.5%).

**Table IV: Overall WMSDs prevalence in any complaints**

| Parts of the body | WMSDs prevalence | |
|---|---|---|
| | Frequency (n) | Percentage (%) |
| Neck | 53 | 40.8 |
| Shoulder_R | 37 | 28.5 |
| Shoulder_L | 15 | 11.5 |
| Upper Back | 23 | 17.7 |
| Upper Arm_R | 2 | 1.5 |
| Upper Arm_L | 0 | 0 |
| Lower Back | 2 | 1.5 |
| Forearm_R | 0 | 0 |
| Forearm_L | 0 | 0 |
| Wrist_R | 11 | 8.5 |
| Wrist_L | 1 | 0.8 |
| Hips/Buttocks | 8 | 6.2 |
| Thigh_R | 0 | 0 |
| Thigh_L | 0 | 0 |
| Knee_R | 1 | 0.8 |
| Knee_L | 0 | 0 |
| Lower Leg_R | 0 | 0 |
| Lower Leg_L | 0 | 0 |
| Foot_R | 13 | 10 |
| Foot_L | 1 | 0.8 |
| Overall WMSDs in any part of the body | 76 | 58.5 |

**Association between prominent ERFs and the prevalence of WMSDs among the workers in the solvent manufacturer**

Chi square test and multiple logistic regression were used to associate between the ERFs and prevalence of WMSDs. Table V presents the association between the prominent ERFs and the prevalence of WMSDs. It was found that there were ERFs that significantly associated with WMSDs at p<0.05 such as awkward posture (p= 0.000,OR=27.133), static and sustained work posture (P= 0.004, OR=2.985), forceful exertion (p=0.033, OR=0.394) and repetitive motion (p= 0.003, OR=2.538).

**Table V: Chi square Test for association of ERFs and prevalence of WMSDs among the workers in the solvent manufacturing factory.**

| ERFs | Prevalence of WMSDs | | $X^2$ (p value) |
|---|---|---|---|
| | Yes | No | |
| | n (%) | | |
| **Awkward Posture** | | | |
| Yes | 74 (80.4) | 18 (19.6) | 51.056 (0.000)* |
| No | 5 (13.2) | 33 (86.8)) | |
| **Static and Sustained Work Posture** | | | |
| Yes | 52 (72.2) | 20 (27.8) | 8.879 (0.004)* |
| No | 27 (46.6) | 31 (53.4) | |
| **Forceful Exertion** | | | |
| Yes | 13 (43.3) | 17 (56.7) | 4.973 (0.033)* |
| No | 66 (66.0) | 34 (34.0) | |
| **Repetitive Motion** | | | |
| Yes | 66 (66.0) | 34 (34.0) | 4.973 (0.033)* |
| No | 13 (43.3) | 17 (56.7) | |

*Significant level at p<0.05

Based on the multiple logistic regression analysis on the awkward posture, static and sustained work posture, forceful exertion and repetitive motion, it was found that workers who were exposed to awkward posture had 27 times (95% CI 9.285– 79.293) more likely to develop WMSDs. While the likelihood of WMSDs complaints increased by 3 times (95% CI 1.439– 6.191) with static and sustained work postures. Furthermore, the odd ratio for forceful exertion and repetitive motion had a difference where forceful exertion contributed to 0.394 times (95% CI 0.171 – 0.905) development of WMSDs among the workers while the repetitive motion was 2.538 times (95% CI 1.104 – 5.835) possible to develop WMSDs (Table VI).

**Table VI: Logistic regression analysis.**

| ERFs | Odds Ratio | 95% Confidence Interval | | p value |
|---|---|---|---|---|
| | | Lower | Upper | |
| Awkward Posture | 27.133 | 9.285 | 79.293 | 0.000* |
| Static and Sustained Work Posture | 2.985 | 1.439 | 6.191 | 0.004* |

CONTINUE

**Table VI: Logistic regression analysis. (CONT.)**

| ERFs | Odds Ratio | 95% Confidence Interval | | p value |
|---|---|---|---|---|
| | | Lower | Upper | |
| Forceful Exertion | 0.394 | 0.171 | 0.905 | 0.033* |
| Repetitive motion | 2.538 | 1.104 | 5.835 | 0.033* |

## DISCUSSION

In the production section, the workers had to work with shoulders raised more than two hours per day, working with their head bent downwards more than 45 degrees more than two hours per day and working with their back bent forward more than 30 degrees or bent more than 2 hours per day while handling the production of the solvent. As a result of the employee being subjected to awkward posture, this form of work posture poses an ergonomic risk. Apart from that, the workers in this section continue to perform repetitive arm movements mixed with pauses or continuous arm movements when assembling solvent products on production lines.

While in the logistics section, workers were responsible for overseeing all aspects of supply chain management and handling the solvent products shipment to the retailers and customers. In this section, the prominent ERFs that were observed through the IERA were awkward posture and forceful exertion. The forceful exertion occurred due to loading and unloading of the products to the customers during repetitive lifting and lowering.

Then, the admin section department demonstrated that most of the workers have awkward postures, static and sustained work posture as well as repetitive motion. The worker in this section who was involved with keying in data spent more time sitting in front of the computer which may cause chronic back pain. There may also be a tendency for computer users to suffer from cumulative motion disorders.

While for the testing department, which involved quality control and technical workers were found to demonstrate several risk factors. The prominent ERFs identified for the workers involved in inspecting, testing or measuring products being produced were awkward posture, static and sustained work posture and repetitive motion. This was due to the work requiring the head to be bent downwards for 45 degrees, working with wrist radial deviation of more than 15 degrees, working with the arm abducted sideways and working in a seated position with a minimal movement for more than two hours continuously per day.

The study found that there was a high prevalence of WMSDs (58.5%) among workers at a solvent manufacturer in Shah Alam, Malaysia, where the most complaints occur, affecting 20 different body parts. The findings were consistent with those of Nur et al. (10),

who discovered a high prevalence of WMSDs in general among manufacturing workers. The overall finding of WMSDs prevalence differed (76.97%) between Nur et al. (10) and the current study rate. According to another study, Foong et al. (11), workers in Malaysian manufacturing companies had a high prevalence of WMSDs (79.6%). Malaysian manufacturing workers' lower backs were the most commonly complained, followed by their necks, shoulders, upper backs, wrists, upper arms, forearms, feet, knees, lower legs, thighs, hips, and buttocks. In addition, the finding of this study was relevant to Hossain et al. (12) that reported lower back pain (24.7%) was the most common complaint reported by the workers in Bangladesh. One of the factors contributing to the high prevalence of WMSDs in electrical and electronic manufacturing companies was neck (49.3%) and shoulder (46.7%) pain (10). Musculoskeletal problems were most common in the shoulders (89%), lower back (74%), and neck (42%), according to a study of industrial packing workers. Manual handling activities such as pushing, pulling, and lifting tasks may contribute to the high prevalence of WMSDs among Malaysian manufacturing workers. The data found in this study was comparable to other studies because the body areas reported as experiencing pain were similar. WMSDs may be the leading cause of occupational injuries, work-related disabilities, and lost-time illnesses in Malaysia and other developing countries with high WMSDs prevalence rates (11).

Furthermore, this study revealed that there was a significant relationship ($p<0.05$) between the prominent ERFs and their occurrence among the workers in the solvent manufacturer. Overall ERFs that were linked to the development of WMSDs as a whole or in specific body areas were identified which consist of awkward position, static and sustained work posture, forceful exertion and repetitive motion. The latest results were also supported by Ohisson et al. (13), who found a substantial correlation between repeated industrial work on the neck or shoulder (prevalence odds ratio, POR=4.6) in a wide range of occupations involving severe upper-limb exertions and repetitive motions. The neck and shoulder were among the most severely afflicted body areas that industrial employees believed contributed to the development of WMSDs. According to Tan and Balaraman (14), the primary element that can contribute to the development of WMSD was the working posture. According to this study, 58.4% of workers report neck stress as well as discomfort or pain in various body parts. Furthermore, this study found a significant link between workers with awkward posture and the prevalence of WMSDs (OR=8.2), implying that those with awkward posture had an 8 times increased risk of developing WMSDs. Overall, this study found a significant association between ERFs and musculoskeletal problems in workers' body parts.

## CONCLUSION

In conclusion, this research was carried out with the purpose to determine the association between the prominent ERFs and the prevalence of WMSDs among workers in a solvent manufacturing factory. According to the results obtained the study shows that there was a high prevalence of WMSDs found among the workers. There were four prominent ERFs of the work tasks performed by workers in solvent manufacturing factory which are working with awkward posture, static and sustained work posture, forceful exertion and repetitive motion. Moreover, there were significant differences in the prevalence of WMSDs and ERFs among the workers. The ERFs that were highly associated with prevalence of WMSDs were awkward posture, static and sustained work posture, forceful exertion and repetitive motion.

Therefore, these findings highlight the urgent need for targeted interventions to improve workplace conditions and protect worker health. Firstly, it is advisable for the workers in the testing department to avoid bending over and standing or sitting for long periods of time by taking frequent brief breaks. Additionally, workers in the same work process should consider job rotation on a regular basis, especially in the production department. Secondly, the high prevalence of WMSDs indicates the need for the company to conduct annual refresher training on proper posture and techniques, focusing on ergonomics specifically on the safe use of lifting and carrying products. Thirdly, this study has significant implications for workplace safety and health policy, in which the company should prioritize the prevention of WMSDs through regular ergonomic assessments and interventions.

The researcher was unable to avoid some limitations in this study, such as data information from respondents' confessions of musculoskeletal complaints in the questionnaire due to no clinical evaluations or diagnoses being performed on the workers to support their complaints about specific body parts. Additionally, while efforts were made to include all departments, there may have been challenges in accessing certain departments with fewer workers, potentially affecting the generalizability of the findings to the entire study population. Moreover, there may have been difficulties in conducting ergonomic risk assessments through CCTV due to limitations in visibility and the inability to zoom in on critical body regions to check for risks. However, this limitation was overcome by engaging in quick conversations with the workers to gain a better understanding of their job nature.

Thus, future researchers may further the studies on these aspects and focus on improving work methods or systems such as conducting ergonomics awareness training on

proper working postures on a regular basis to ensure the reduction of ERFs among the workforce. Further research may focus on conducting Advanced Ergonomic Risk Assessment (ERA) since the body parts affected in this study were the upper limbs. It is recommended to use Rapid Upper Limb Assessment (RULA) to evaluate the exposure of individual workers to ERFs associated with upper extremity WMSDs.

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