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Ergonomic Risk Assessment Among Warehouse Workers in a Logistics Company

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Abstract

The logistics industry plays a crucial role in global economic development but faces challenges related to ergonomics and musculoskeletal disorders (MSDs). Warehouse and logistics workers often perform physically demanding tasks, increasing the risk of work-related musculoskeletal disorders (WMSDs). This comprehensive project aims to identify the prevalence of WMSDs among warehouse workers in a logistics company, assess associated ergonomic risk factors, and propose physical ergonomic interventions using rapid entire body assessment (REBA) analysis. Various methods, including a questionnaire survey, Initial ERA Checklist, and ERA Employee Assessment Worksheet, were utilized to gather data for this study. These tools enabled the collection of comprehensive information from warehouse workers. To analyze the collected data, descriptive statistical analysis was conducted, and software tools such as SPSS, Initial ERA Score, Reba Score, and Kinovea Software were employed. This analytical approach allowed for a detailed examination of the data and provided valuable insights into the ergonomic risk assessment among warehouse workers. The results indicate that Workers X, Y, and Z fall into the medium-risk category, emphasizing the need to address job-specific issues for overall workplace health improvement. The logistics company, recognizing the importance of worker safety, conducted proactive checks, and proposed tailored changes, such as workstation adjustments and regular training sessions. In conclusion, these formal recommendations for future research aim to address the challenges faced by researchers in comprehending every risk factor and communicating effectively with workers regarding ergonomics. This contribution is envisioned to enhance scholarly knowledge and foster advancements in promoting safe and healthy work environments.

1. Introduction

Logistics industry plays a crucial role in global economic development. The industry is the backbone of international trade and global supply chains, connecting suppliers, manufacturers, and retailers worldwide. Logistics drives economic growth, facilitates trade, enhances competitiveness, fosters integration, and generates employment opportunities in many countries (Foster & Sampson, 2017). In Malaysia, logistics

industry is regarded as one of the essential business sectors, which contributing significantly to country's economy. Apparently, Malaysia is ranked among the best performers in the global logistics ranking (NST, 2023). The industry facilitates the smooth flow of supply chain and generating jobs for a substantial workforce.

Understanding the jobs and tasks of workers in logistics company is crucial for maintaining a smooth and efficient supply chain. A logistics worker is responsible for varied daily routine tasks and a wide range of activities. Commonly performed tasks of workers in logistics company include warehousing, transporting, shipping, receiving, inspecting, loading, unloading, packing of goods, and managing inventory.

Task	Description
Receiving and Inspecting Incoming Shipments	This task involves receiving and inspecting goods upon arrival to the warehouse. It includes checking the quantity, quality, and condition of the items received, as well as verifying the accuracy of documentation such as packing lists and delivery notes. The goal is to ensure that the received goods match the order specifications and meet the required quality standards.
Inventory Management	Inventory management encompasses various activities related to tracking, monitoring, and controlling inventory levels. It involves forecasting demand, determining optimal stock levels, implementing inventory control measures, and ensuring timely replenishment. The objective is to maintain adequate inventory to meet customer demands while minimizing carrying costs and stock-outs.
Order Picking and Packing	Order picking and packing involve selecting and preparing items from the warehouse inventory for customer orders. This task includes locating the products in the warehouse, picking them from their storage locations, and packing them securely for shipment. Efficient order picking and packing processes help ensure accurate and timely order fulfillment.
Loading and Unloading	Loading and unloading refer to the physical handling and transfer of goods between transportation vehicles (such as trucks or containers) and the warehouse. This task involves careful handling of goods, proper stacking, or arrangement of items, and ensuring the safe and efficient transfer of goods during loading and unloading processes.
Transportation, Shipping and Documentation	Transportation, shipping, and documentation tasks involve managing the logistics of transporting goods from the warehouse to the intended destination. This includes arranging shipments, coordinating with carriers or logistics service providers, preparing necessary shipping documents (such as bills of lading or customs documents), and tracking the movement of goods.
Cycle Counting and Inventory Audit	Cycle counting refers to the regular counting of inventory items to maintain accuracy and identify discrepancies. It involves randomly selecting specific inventory items or areas within the warehouse and conducting counts to reconcile physical stock with the recorded inventory. Inventory audit, on the other hand, involves a systematic review of the entire inventory to identify and address any issues related to accuracy, obsolescence, or shrinkage.
Warehouse Organization and Maintenance	Warehouse organization and maintenance tasks focus on optimizing the layout and storage systems within the warehouse. This includes designing efficient storage configurations, implementing inventory slotting strategies, maintaining cleanliness and orderliness, ensuring compliance with safety regulations, and regularly inspecting and maintaining warehouse equipment. The goal is to maximize space utilization, improve operational efficiency, and create a safe working environment

1.1 Problem statement and objective research

Ergonomics and musculoskeletal disorders (MSDs) are significant challenges in the transport and storage industry (HSE, 2017). Tasks like lifting, pushing, and prolonged standing contribute to work-related MSDs. This affects worker health and increases costs for companies (Sanmugum et al., 2020). A crucial solution is a comprehensive Ergonomic Risk Assessment (ERA) focusing on job demands, the work environment, and equipment. Despite rising WMSD cases, research in ergonomics and WMSDs is limited in Malaysian logistics companies. This project aims to provide evidence on these issues in a selected Malaysian logistics company.

The objective of this study is:

- To identify the prevalence of work-related musculoskeletal disorders (WMSDs) among warehouse workers in a logistics company.

2. Methods

Project planning is an importance process that sets the foundation for the successful execution of research project on ergonomic risks in the Warehouse and Operations Department of a logistics company. The planning involves a comprehensive and systematic approach to ensure that all aspects of the project are considered carefully.

2.1 Research design

The most widely used research design approaches encompass quantitative, qualitative, and mixed methods" (Leavy, 2017, p. [300]). In this research project, a mix of numerical, textual, and visual descriptions, along with specific data collection and analysis methods, will constitute the materials used for conveying research data. Therefore, a mixed methods approach, integrating both quantitative and qualitative research design approaches, will be employed. This involves utilizing a combination of surveys, observational methods, and scoring techniques for different stages of data collection and analysis. Table 1 summarizes the research designs and strategies, providing a comprehensive overview of the materials employed to achieve the objectives of this research project.

Table 1 *Research designs and strategies in achieving the objectives.*

No	Key Objectives	Research Design	Data Collection		Data Analysis	
			Method	Instrument/ Procedure/Source	Method	Instrument/ Procedure/Source
1	Identification of WMSDs prevalence	Quantitative	Survey (n = 15)	Questionnaire Survey (Self-Assessment Musculoskeletal Pain / Discomfort Survey)	Descriptive Statistics	Descriptive Statistical Analysis (SPSS / MS Excel)
2	Assessment of ERFs of WMSDs	Qualitative and Semi-Quantitative	Observations (n = 3)	Initial ERA (Initial ERA Checklist)	Initial ERA Analysis	Initial ERA Score
3	Proposition of ergonomic interventions based on REBA	Qualitative and Semi-Quantitative	Observations (n = 3)	Advanced ERA (REBA Employee Assessment Worksheet)	REBA Analysis	REBA Score, Kinovea Software

2.2 Methods

For a better grasp of this study, the researcher extensively reviewed previous studies, articles, journals, and past research. All materials and sources were specifically related to understanding the levels of knowledge, attitude, and practice in fire extinguisher management. The project implementation structure presents a systematic approach to managing and executing the project. The research methodology's implementation process involves four main phases progressing sequentially: Phase one (P1: Planning), phase two (P2: Quantitative data collection and analysis), phase three (P3: Qualitative data collection and analysis), and phase four (P4: Intervention and reporting). Figure 3.1's flowchart visually illustrates the sequential progression of activities in the project implementation process.

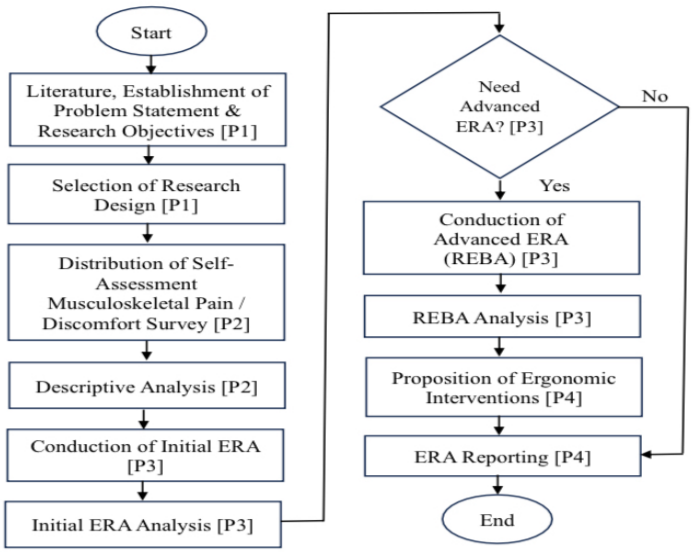

Fig. 1 *Research project implementation process flow chart.*

In the planning phase, the activities encompass on the literature review, establishment of problem statements, defining the research objectives, and selection of research design approaches. The next activities are quantitative data collection and analysis phase, which emphasizes on data collection for identification of the prevalence of work-related musculoskeletal disorders and discomforts using survey by means of Self-Assessment Musculoskeletal Pain / Discomfort Survey form.

Then, the activities will be followed by the phase of qualitative data collection and analysis, which focuses on the conduction of an observational method through initial and advanced ERA for both qualitative and semi-quantitative data collection, and REBA employee assessment worksheet and Kinovea software to be utilized in data analysis. Finally, the establishment of ergonomic interventions and control measures for identified risks, as well as reporting and conclusion of findings of the research project will be carried out in the phase of intervention and reporting.

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3. Result & Discussion

3.1 Respondent demographic information

The subsequent subchapters present the information of respondent demographic and prevalence of WMSDs. Figure 1 shoes the demographic information of the respondents. Most participants in the study are in their twenties (53.33%), all male, with a predominantly healthy BMI (53.33%). The majority have 1-5 years of work experience (80%), suggesting a younger workforce. This demographic composition highlights potential areas for health interventions, especially among those overweight or obese. The study's findings should be interpreted with consideration for the age and gender imbalance in the sample, emphasizing the importance of tailoring interventions and drawing nuanced conclusions based on the specific characteristics of the participants.

Table 2 *Respondent demographic information.*

Respondents	Age	Gender	BMI Range	Work Experience (Years)	Job Task/Title		
					Sorting	Checking	Cable Cutting
A	33	Male	Healthy	1	✓		
B	32	Male	Healthy	2	✓		
C	28	Male	Healthy	2	✓		
D	27	Male	Healthy	3	✓		
E	27	Male	Healthy	1	✓		
F	27	Male	Obesity	1		✓	
G	27	Male	Healthy	4		✓	
H	31	Male	Overweight	2		✓	
I	40	Male	Overweight	20		✓	
J	23	Male	Overweight	2		✓	
K	36	Male	Obesity	13			✓
L	43	Male	Healthy	20			✓
M	23	Male	Healthy	1			✓
N	22	Male	Overweight	1			✓
O	30	Male	Obesity	1			✓

3.2 Prevalence of WMSDS

Figure 2 shoes the prevalence of WMSDs during work in the last 12 months. Analyzing Work-Related Musculoskeletal Disorders (WMSDs) among 15 individuals reveals varying impacts on different body regions. The Lower Back stands out with 86.67% reporting pain, highlighting the need for targeted interventions to address discomfort affecting daily activities. The Elbow is also significantly impacted (93.33%), emphasizing the importance of addressing ergonomic factors to ease strain. The Upper Back shows considerable impact (46.67%), suggesting ergonomic improvements for better seating and posture. Interestingly, the Upper Arm reports the lowest impact, but it's essential to recognize the variation in musculoskeletal health. Bilateral pain patterns indicate the interconnectedness of body regions, emphasizing the need for holistic interventions. Areas with high prevalence, like the Elbow and Lower Back, may impact work productivity, underscoring the importance of targeted prevention programs. In summary, addressing these areas through ergonomic assessments and education can enhance overall well-being and workforce productivity.

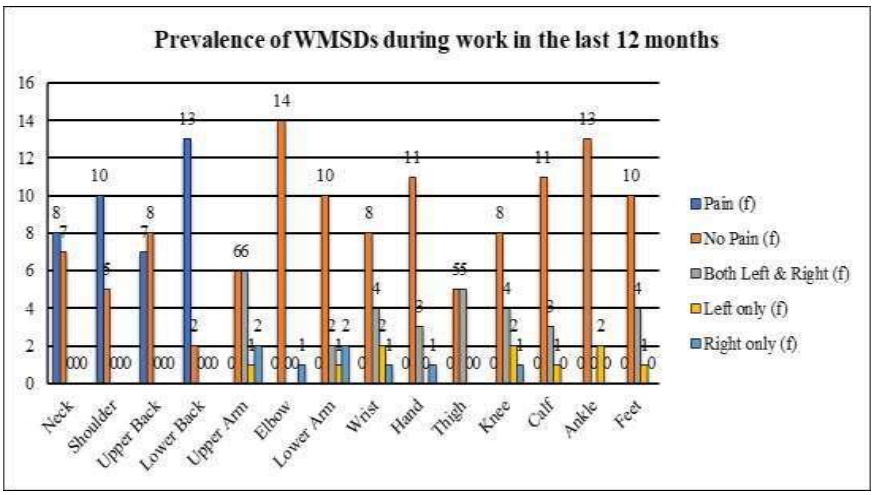

Fig. 2 *Prevalence of WMSDs during work in the last 12 months.*

Meanwhile, Figure 3 shoes prevalence of WMSDs comes from work in the last 12 months. Examining Work-Related Musculoskeletal Disorders (WMSDs) in a group of 15 individuals highlights the prevalence of pain in different body regions over the past year. The Lower Back shows significant impact, with 66.67% reporting pain, emphasizing the need for targeted interventions. The Elbow stands out in the upper limbs, with 80% reporting pain, indicating a need to address ergonomic factors. Despite variations, certain areas like the Upper Arm show no reported pain, emphasizing the diverse nature of musculoskeletal issues. Identifying bilateral pain patterns suggests systemic contributors, urging a holistic approach to interventions. Discomfort, especially in high-impact areas like the Elbow and Lower Back, may affect productivity and absenteeism, emphasizing the importance of tailored workplace health initiatives. In summary, a comprehensive strategy addressing both impactful and overlooked areas can foster a healthier and more comfortable work environment, enhancing overall well-being and productivity.

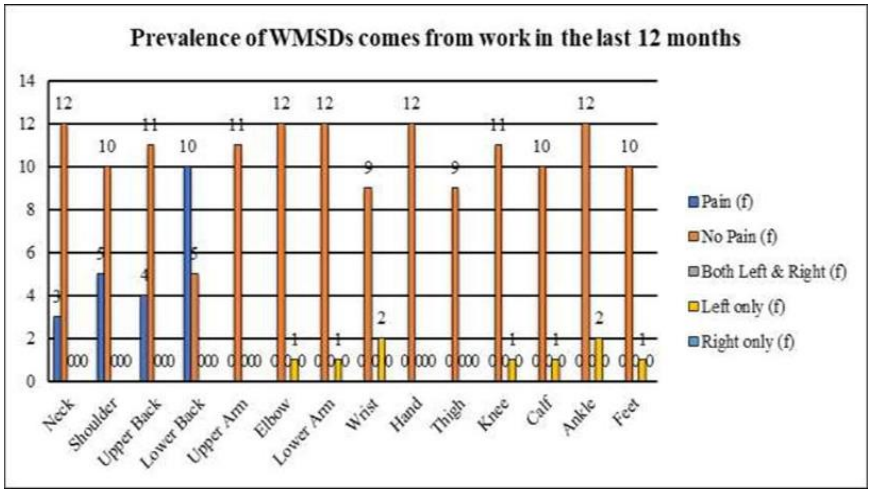

Fig. 3 *Prevalence of WMSDs comes from work in the last 12 months.*

3.3 Initial ERA results

Table 2 shows the initial ERA scores of ERFs. The initial ERA scores of ERFs showed that all three workers (X, Y, and Z) had high scores for awkward postures and repetition, indicating a high risk of WMSDs. The need for advanced ERA was also identified for static and sustained work posture. These findings highlight the urgent need for interventions to mitigate these risks and improve the ergonomic conditions within the logistics company.

Table 3 *Initial ERA scores of ERFs.*

ERFs	Min. Requirement for Advanced ERA	Result of Initial ERA			Neediness for Advanced ERA (Yes, No)		
		X	Y	Z	X	Y	Z
Awkward Postures	≥ 6	2	4	1	No	No	No
Static and Sustained Work Posture	≥ 1	2	2	2	Yes	Yes	Yes
Forceful exertion	1	0	0	0	No	No	No
Repetition	≥ 1	0	3	2	No	Yes	Yes
Vibration	≥ 1	0	0	0	No	No	No

3.4 Advanced ERA (REBA) results

The REBA Worksheet helps us see how work activities might affect our bodies. We checked three workers (X, Y, Z), and their scores are in Table 3.1. Worker X has the highest score, putting them at a "Medium" risk level for body issues. Workers Y and Z have slightly lower scores but are also at "Medium" risk. Even though Y and Z's risks aren't as high as X's, they still need attention. Surprisingly, X and Y, despite high risk, got the lowest activity scores.

The activity score shows how much strain a task puts on the body. For X and Y, even with high risk, this score is low, suggesting a chance for improvement. Fixing specific ergonomic issues tied to X and Y's tasks might reduce their overall risk. In short, based on our data, Worker X is at "Medium" risk, and Workers Y and Z are also at "Medium" risk. Finding a low activity score for X and Y points to areas needing targeted ergonomic improvements to lower the risk of body issues. This info guides changes to make the workplace better for everyone's health.

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(a) (b) (c)

Fig. 5 *Motion analysis using Kinovea software following body posture.*

Table 4 *Advanced ERA (REBA) results*

Worker	Score A	Score B	Score C	Activity Score	Total Score	Risk Level
X	6	1	6	1	7	Medium
Y	5	5	6	1	7	Medium
Z	4	1	3	2	5	Medium

3.5 Proposition of ergonomic interventions

Based on the results of the REBA assessment, targeted ergonomic interventions can be strategically proposed to address identified risks and enhance the overall well- being of the workers. For Worker X, categorized at a "Medium" risk level, a focused worker- specific ergonomic training program is recommended. This training should be tailored to address specific factors contributing to their risk, providing guidance on posture correction, force exertion reduction, and task repetition management.

Furthermore, a thorough analysis of the tasks performed by Workers X and Y, both falling into the "Medium" risk category, is essential. Task modification is advised to alleviate ergonomic challenges, considering alternative work methods, tools, or equipment that can reduce strain. Additionally, the introduction of regular breaks for all workers and encouraging task rotation can help distribute physical demands more evenly, thereby mitigating the risk of overexertion.

Crucial to these interventions is the provision of ergonomic tools and equipment, supporting proper body mechanics and minimizing the impact of force exertion during tasks. Workstations should be adjustable to accommodate individual worker preferences, promoting optimal posture. Workplace design modifications, such as rearranging workstations or incorporating ergonomic furniture, can also contribute to enhanced comfort and a reduced risk of musculoskeletal strain.

To ensure the effectiveness of these interventions, regular follow-up assessments are recommended. Periodic REBA assessments will allow for the monitoring of improvements in risk levels, enabling adjustments to interventions as needed. Additionally, fostering open communication between workers and management about ergonomic concerns is essential. Seeking input from employees on potential solutions and involving them in decision-making processes can contribute to a more collaborative and effective approach.

Incorporating health and wellness programs into the workplace is another key intervention. These programs should focus on promoting overall health, including exercises to improve flexibility and strength, stress management resources, and the encouragement of a healthy work-life balance.

Establishing a systematic approach to documentation and reporting is vital for tracking the success of ergonomic interventions. A reporting system can capture new concerns or issues promptly, allowing for swift resolution and continuous improvement.

By implementing these ergonomic interventions, the goal is to create a safer and more comfortable work environment, reducing the risk of musculoskeletal disorders, and enhancing the overall health and productivity of the workers. This commitment to ongoing monitoring and adjustments reflects a dedication to ergonomic excellence in the workplace.

4. Conclusion

This study delved into the ergonomic risks and prevalence of musculoskeletal disorders (WMSDs) among warehouse workers in a logistics company. Uncovering diverse issues in physical ergonomics and WMSD prevalence, the research employed initial and advanced ergonomic risk assessments (ERA) using the REBA method. The findings, highlighting varying levels of ergonomic risk with higher scores indicating a greater need for intervention, significantly contribute to the understanding of ergonomic risk factors and WMSDs. Additionally, the study offers practical insights for implementing ergonomic interventions in the logistics and warehousing sector. Looking forward, recommendations for future research are proposed to overcome challenges in comprehending and effectively communicating ergonomic principles to workers. Suggestions include in-depth

examinations of specific workplace elements, the development of advanced communication strategies tailored to workers, exploration of real-time monitoring systems, understanding cultural influences, conducting longitudinal studies, integrating augmented reality technologies in training programs, and emphasizing collaborative approaches involving workers in ergonomic decision-making processes. These recommendations aim to address existing challenges and contribute to advancements in creating safer and healthier work environments.

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Conflict of Interest
I declared that there is no conflict of interests regarding the publication of the paper.

Author Contribution
This journal requires that all authors take public responsibility for the content of the work submitted for review. The contributions of all authors must be described in the following manner:

The authors confirm contribution to the paper as follows: ***study conception and design:*** *Amira Wildayati Ruslan, Zulkarnain Zulkifli, Rahim Jamian;* ***data collection:*** *Amira Wildayati Ruslan;* ***analysis and interpretation of results:*** *Amira Wildayati Ruslan, Rahim Jamian;* ***draft manuscript preparation:*** *Amira Wildayati Ruslan. All authors reviewed the results and approved the final version of the manuscript.*

Appendix A: Self-Assessment Musculoskeletal Pain / Discomfort Survey Form

Self-Assessment Musculoskeletal Pain / Discomfort Survey Form
(Department of Occupational Safety and Health (DOSH), 2017)

Name: ..... Height: ..... cm Weight:..... kg
Age: ..... Gender: Male / Female Job task/title: .....
Department: ..... Work Experience (Years): .....

Instruction:

1. Tick (√) on nay body parts (Column A) if you feel discomfort/pain during your work in the last 12 months.
2. For those body parts you were feeling pain/discomfort, tick (√) (Column B) if in your opinion, the pain is due to your work.

Body Parts	A		B	
	I have pain/ discomfort in the following body parts.		I think the pain/ discomfort comes from work.	
Neck				
Shoulder				
Upper back				
Upper arm	L	R	L	R
Elbow	L	R	L	R
Lower arm	L	R	L	R
Wrist	L	R	L	R
Hand	L	R	L	R
Lower back				
Thigh	L	R	L	R
Knee	L	R	L	R
Calf	L	R	L	R
Ankle	L	R	L	R
Feet	L	R	L	R

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Reference

This guide contains examples of common types of APA Style references. Section numbers indicate where to find the examples in the Publication Manual of the American Psychological Association (7th ed.).

Journal

[1] Coelho, D. A. (2019). Matching TRIZ engineering parameters to human factors issues in manufacturing. WSEAS Transactions on Business and Economics, 6(11), 547-556.

[2] Cremasco, M. M., Giustetto, A., Caffaro, F., Colantoni, A., Cavallo, E., & Grigolato, S. (2019). Risk assessment for musculoskeletal disorders in forestry: A comparison between RULA and REBA in the manual feeding of a wood- chipper. International Journal of Environmental Research and Public Health,16(5), pp. 793.

[3] Etikan, I., Musa, S.A., & Alkassim, R.S. (2016). Comparison of Convenience Sampling and Purposive Sampling. American Journal of Theoretical and Applied Statistics. 5(1), pp. 1-4. doi: 10.11648/j.ajtas.20160501.11

[4] Purnomo, H. & Apsari, A. E. (). REBA analysis for construction workers in Indonesia. Journal of Built Environment, Technology and Engineering, 1, pp. 104-110.