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Musculoskeletal Assessment Among Quay Crane Operator at Transhipments Port

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Abstract

Musculoskeletal disorders (MSDs) involve pain affecting various body parts like joints, muscles, nerves, etc. Vehicle mechanics often face MSDs risks due to ergonomic challenges at work. This study in Johor's Port aimed to link physical characteristics with factors causing musculoskeletal pain in quay crane operators. Surveys were distributed among 52 operators, analyzing factors contributing to their musculoskeletal pain. The research used an ergonomic risk assessment questionnaire with 5 sections covering demographics, work conditions, lifestyle, medical history, and musculoskeletal discomfort. The study discovered that certain body parts—upper arm, lower arm, wrist, and lower leg—are frequently affected, posing MSD risks to quay crane operators. The Cornell Musculoskeletal Discomfort Questionnaire (CMDQ) analysis conducted at the port is a comprehensive assessment to determine the prevalence of musculoskeletal disorders among quay crane operators.

1. Introduction

Musculoskeletal diseases (MSDs) pose significant occupational health concerns globally. Research conducted by the Global Burden of Disease 2017 Risk Factor Collaborators indicates that ergonomic factors in the workplace contribute to 15.9 million disability-adjusted life years per year. In Malaysia, the Social Security Organization (SOCSO) reported 708 incidents related to MSDs in 2015, which increased from 675 cases in 2014, 517 cases in 2013, and 528 cases in 2012, indicating a 58% rise in incidents between 2012 and 2015 attributed to occupational health issues.

In 2010, (1) Fabiano et al. examined human factors and accidents at ports, highlighting that the technical or technological factor was more pivotal than the human factor. Ergonomics, focusing on optimizing working conditions and equipment, aims to enhance productivity. Lu and Kuo (2016) (2) discovered that various hazardous activities in container terminal operations, such as crane operation, lashing, electrical repairs, tally operating, and truck driving, contribute to workplace risks. Tailoring worker-specific tasks, workstations, tools, and equipment can mitigate physical stress and eliminate potentially crippling MSDs.

1.1 Problem Statement and objective research

The study was carried out following annual diseases claim report from employees related to the quay crane operator. Workers claim to suffer from unpleasant postures and injuries at work. Thus, multiple reports and claims made by workers about PERKESO were contributing factors to the study. From the data obtained, it is clearly showing the number of case reports related to back pain and disc slips exist every year. According to the annual statistics 2019 – 2022, the reports received by PERKESO exceeded 2 reports each year. This problem arises due to workers lack of understanding and awareness of ergonomics in their surroundings. Poor exposure or attitude problems of the employees themselves who insist on not complying with the existing rules in line with healthy working practices.

The objective of this study was:

- To evaluate musculoskeletal pain among quay crane operator using questionnaires aligned with the ERA (Ergonomic Risk Assessment) guidelines.

2. Literature Review

Today's industries are concerned about musculoskeletal problems among their employees (3) (Choobineh et al., 2007). Based on this study, ergonomics, as defined in this research, is about studying human behavior and performance in interactions with other things, according to Wilson (2000) (4).

The global community of ergonomists, referenced by (5) Westgaard (2000), Guo et al. (2004), and Morken et al. (2007), has recognized the prevalent occurrence of musculoskeletal disorders across various industries. Their combined research endeavors seek to educate and propose improvements aimed at alleviating these impairments. Poor ergonomics in the workplace can contribute to various health issues and musculoskeletal disorders. Organizational factors may raise the likelihood of musculoskeletal diseases (MSDs).

Fabiano et al. (2010) (6) considered that occupational risk management is critical for maritime ports since incidents at industrial ports result in employee injury or death. Therefore, risk reduction at the port must be efficiently managed. One of the main equipment used in port industries is quay crane. Quay cranes are the primary equipment utilized in the container terminal operating system for transporting containers from vessels to land and vice versa. Quay crane workstation design plays a critical role in ensuring the efficiency, safety, and well-being of operators in port environments. Ergonomics and productivity have been linked in research on assembly systems design and operators' well-being referenced by Battini,Delorme, Dolgui, Persona, & Sgarbossa, 2016 (7).

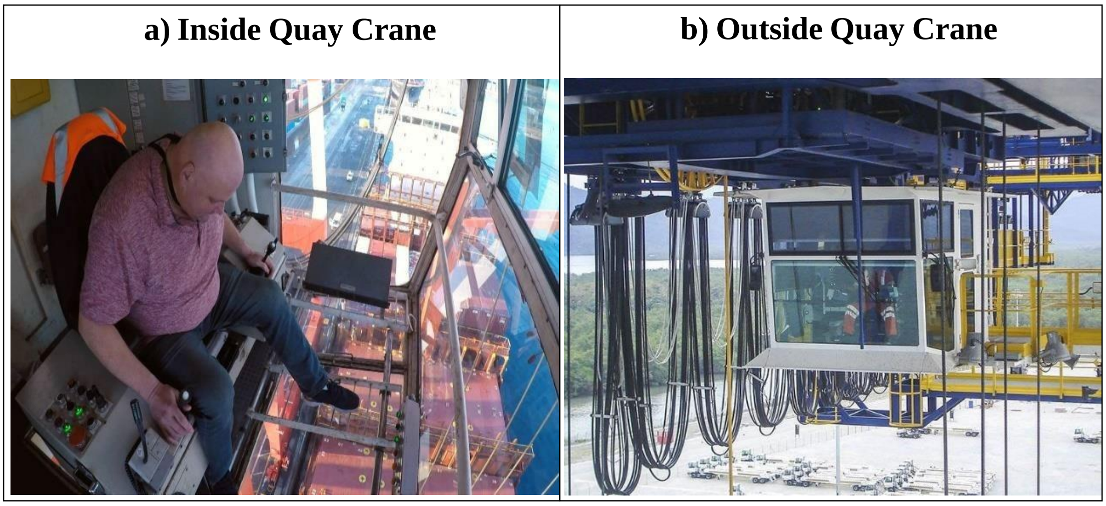


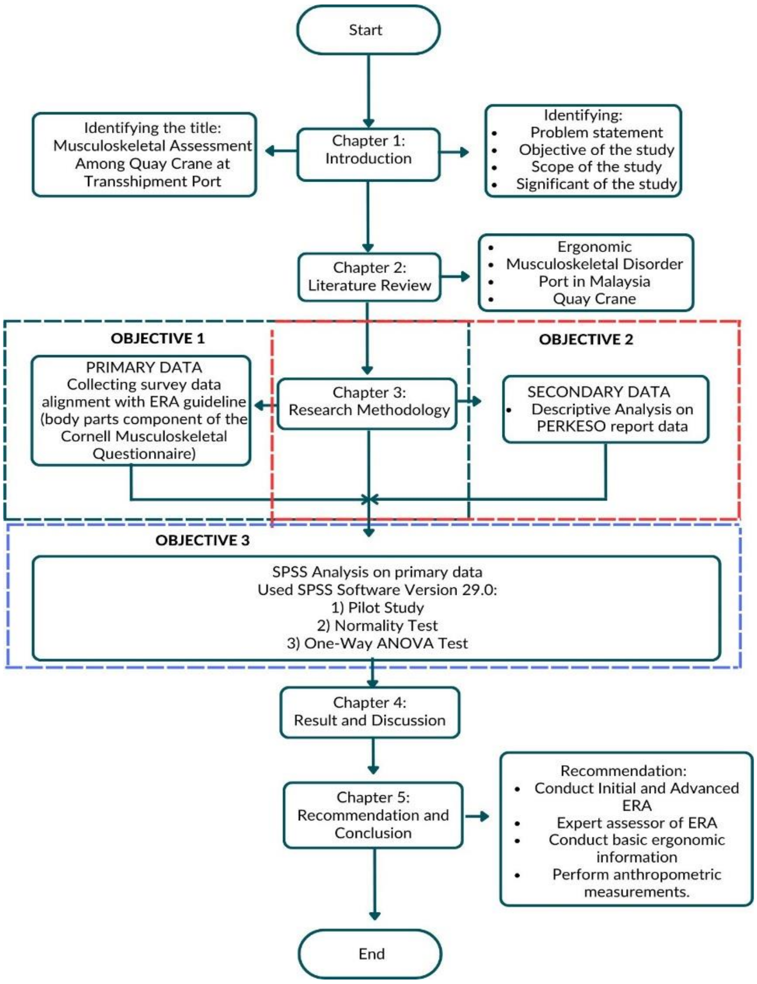
Fig. 1 *A picture of quay crane inside and outside view*

3. Methods

Planning for the research was initiated in the early phase of this study, followed by the development of research design and subsequent analysis.

The study's population and data collection method were deliberated with supervisors. In order to fulfill the stated objectives, a series of questionnaires were disseminated among the intended respondents. The collected data was subsequently analyzed utilizing IBM SPSS Statistics software to meet the study's goals. Basically, objectives of the study are achieved as the flow shown below depicts the technique used to perform the research. Please refer to Figure 2 below for the research flowchart.

Fig. 2 *Framework of Musculoskeletal Assessment among Quay Crane Operator at Transshipment Port*



3.1 Data Analysis

The aim of analyzing the data was to detect potential statistical variances in body parts through the Cornell Musculoskeletal Discomfort Questionnaire (CMDQ). This examination employed a One-way Analysis of Variance (ANOVA), a test described by Miller (1997) used to determine significant differences among the means of three or more independent groups.

3.2 Secondary Data

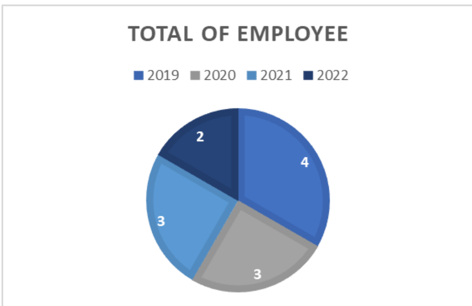


Table 4.0: Descriptive Statistics Data SOCSO

In the years 2019 to 2022, as reported by SOCSO, there were cases of muscle pain among quay crane operators. In 2019, four individuals filed claims related to muscle pain. In 2020, three individuals were categorized for service-related slip disc conditions, and the same number was reported for 2021. In 2022, there were two reported cases of claims related to muscle pain. These annual cases raise concerns as they consistently involve health issues and the same muscle-related problems.

4. Result and Discussion

The data collection is analyzed from the factors taken into account by the researchers. To get findings, the acquired data was analyzed using the Statistical Package for the Social Sciences (SPSS) Statistics software v29. This programmed deliver's reliability test results, including mean and standard deviation. The results are presented section by section depending on the answer provided by respondents on the survey form. This study gathered information from 52 questionnaires filled out by respondents. The analysis's purpose is to establish if the research's objective was met.

4.1 One-Way ANOVA Analysis

Conducting an ANOVA test to explore the relationship between hand parts and age, with a specific focus on the prevalence of musculoskeletal pain among quay crane operators and evaluate the significant of the pain. Body part Cornell musculoskeletal by ERA was used to identify prevalence of MSDs issues as practiced by the quay crane operators. They were chosen to describe their discomfort by choosing the options given to body parts from shoulder, upper arm, lower arm, wrist, thigh, knee, lower leg, feet, neck, lower back and hip.

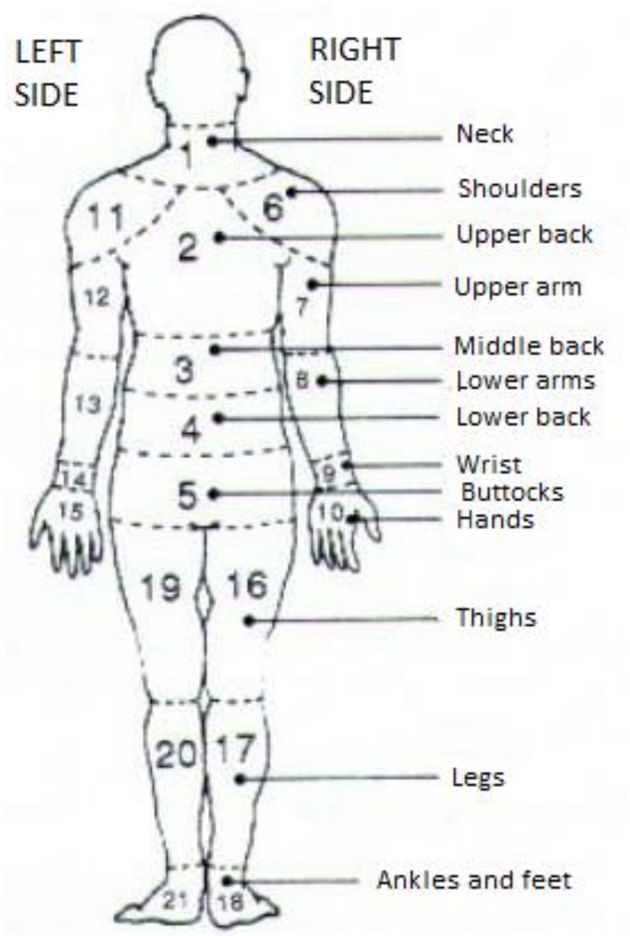


Fig. 4.1 *Component of body part in Cornell Musculoskeletal by ERA*

Table 2 *Analysis Result of Data ANOVA Hands Part (Age)*

Rank			Items	Sum of Squares	df	Mean Square	F	Sig.	Interpretation
1	**Shoulder**	R	Between Groups Within Groups Total	2.737 51.782 54.519	3 48 51	0.912 1.079	0.846	0.476	Not Significant
2	**Shoulder**	L	Between Groups Within Groups Total	4.122 58.705 62.827	3 48 51	1.374 1.223	1.123	0.349	Not Significant
3	**Upper Arm**	R	Between Groups Within Groups Total	7.716 34.957 42.673	3 48 51	2.572 0.728	3.532	0.022	Significant
4	**Upper Arm**	L	Between Groups Within Groups Total	5.562 23.111 28.673	3 48 51	1.854 0.481	3.851	0.015	Significant
5	**Lower Arm**	R	Between Groups Within Groups Total	9.468 33.205 42.673	3 48 51	3.156 0.692	4.562	0.007	Significant
6	**Lower Arm**	L	Between Groups Within Groups Total	7.218 25.013 32.231	3 48 51	2.406 0.521	4.617	0.006	Significant
7	**Wrist**	R	Between Groups Within Groups Total	7.218 31.013 38.231	3 48 51	2.406 0.646	3.724	0.017	Significant
8	**Wrist**	L	Between Groups Within Groups Total	6.545 32.128 38.673	3 48 51	2.182 0.669	3.259	0.029	Significant

*:$p<0.05$

Table 4.12 presents the results from an ANOVA test investigating the association between hand parts and age, focusing on the occurrence of musculoskeletal pain among quay crane operators. The table reveals an M value of 0.912 for shoulder R, accompanied by a non-significant p-value of 0.476, indicating the absence of statistical significance.

Similarly, shoulder L displayed an M=1.374 with a p-value of 0.349, suggesting that age does not significantly influence the various hand parts among quay crane operators. However, there were notable findings for specific hand parts – upper arm R (M=2.572, p=0.022), upper arm L (M=1.854, p=0.015), lower arm R (M=3.156, p=0.007), lower arm L (M=2.406, p=0.006), wrist R (M=2.406, p=0.017), and wrist L (M=2.182, p=0.029).

These parts displayed a significant impact, surpassing the significance threshold ($p < 0.05$). This significance may be attributed to factors such as vibration, the presence of numerous buttons, repetitive motions, and the frequency of container handling, suggesting specific occupational conditions leading to distinct musculoskeletal effects among quay crane operators.

Table 3 *Analysis Result of Data ANOVA Legs Part (Age)*

Rank			Items	Sum of Squares	df	Mean	F	Sig.	Interpretation
1	**Thigh**	R	Between Groups	5.046	3	1.682	2.374	0.082	Not Significant
			Within Groups	33.307	47	0.709			
			Total	38.353	50				
2	**Thigh**	L	Between Groups	5.761	3	1.920	2.639	0.060	Not Significant
			Within Groups	34.932	48	0.728			
			Total	40.692	51				
3	**Knee**	R	Between Groups	4.871	3	1.624	2.153	0.106	Not Significant
			Within Groups	36.206	48	0.754			
			Total	41.077	51				
4	**Knee**	L	Between Groups	6.659	3	2.220	2.726	0.054	Not Significant
			Within Groups	39.091	48	0.814			
			Total	45.750	51				
5	**Lower Leg**	R	Between Groups	8.530	3	2.843	4.106	0.011	Significant
			Within Groups	33.239	48	0.692			
			Total	41.769	51				
6	**Lower Leg**	L	Between Groups	8.530	3	2.843	4.106	0.011	Significant
			Within Groups	33.239	48	0.692			
			Total	41.769	51				
7	**Feet**	R	Between Groups	6.568	3	2.189	2.909	0.052	Not Significant
			Within Groups	36.124	48	0.753			
			Total	42.692	51				
8	**Feet**	L	Between Groups	5.372	3	1.791	2.579	0.064	Not Significant
			Within Groups	33.321	48	0.694			
			Total	38.692	51				

*: $p<0.05$

The examination of leg parts among quay crane operators in relation to their age and the likelihood of musculoskeletal pain revealed noteworthy findings. The analysis reported an M value of 1.682 for the right thigh (thigh R), which exhibited statistical significance with age (p=0.082), although it did not surpass the significance threshold of $p < 0.05$.

Contrastingly, the left thigh (thigh L) showed an M value of 1.920 with a p-value of 0.060, indicating no significant correlation with age. Similarly, the right knee (Knee R) had an M=1.624 and a p-value of 0.106, suggesting a non-significant association with age. The left knee (Knee L), with an M=2.220 and a p-value of 0.054, also did not demonstrate a statistically significant relationship with age.

Moreover, both Feet R (M=2.189, p=0.052) and Feet L (M=1.791, p=0.064) displayed no significant correlation with age. However, the lower leg right (Lower leg R) with an M=2.843 and a p-value of 0.011, as well as the lower leg left (Lower leg L) with an M=4.106 and a p-value of 0.011, showed a notable impact, surpassing the threshold for significance ($p < 0.05$).

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The significant impact observed in the lower left and right leg parts among quay crane operators regarding their age might stem from their work conditions. Spending extended periods sitting in confined cabin spaces during their duties could exert increased pressure on these areas, potentially causing musculoskeletal effects that become more pronounced with age. This distinct impact on the lower legs may result from the prolonged sitting and limited movement space within the cabin, unlike other leg parts not significantly correlating with age.

4. Conclusion

The study aimed to investigate the prevalence of musculoskeletal disorders (MSDs) causing pain among quay crane operators, utilizing questionnaires aligned with the ERA (Ergonomic Risk Assessment) guideline to evaluate their musculoskeletal pain. As a result, several key conclusions surfaced from this research. It was evident that the upper arm, lower arm, wrist, and lower leg were the most commonly affected body parts among quay crane operators, often experiencing discomfort or pain. The study underscores the necessity for targeted programs that address MSDs and promote health, with a specific emphasis on improving the working environment and optimizing posture. Moreover, educational programs might offer substantial contributions to preventing MSDs. These findings serve as a foundational point for further in-depth investigations into ergonomic hazards encountered by crane operators at port container terminals.

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Conflict of Interest

I hereby declared there is no conflict of interests regarding the publication of this paper.

Author Contribution

The authors confirm contribution to the paper as follows: ***study conception and design:*** *Nurul Diana Abdullah, Aliff Hisyam A Razak, Salwah Mahmood;* ***data collection:*** *Nurul Diana Abdullah;* ***analysis and interpretation of results:*** *Nurul Diana Abdullah, Aliff Hisyam A Razak, Salwah Mahmood;* ***draft manuscript preparation:*** *Nurul Diana Abdullah. All authors reviewed the results and approved the final version of the manuscript.*

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