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Original Article

Investigating the Ergonomic Work Posture on Traditional Fishing Boats Manufacturing in Lhokseumawe City, Aceh Province, Indonesia

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Abstract: The Sailing ships in Aceh are usually conventional; this shipbuilder usually requires 3 people. Sailing ships in Aceh are usually made conventionally. Shipbuilders need 3 workers. Construction time for ships weighing 1 to 3 gross tons (GT) takes 1 - 2 months. Strategies and improvements in shipbuilding methods have been well-studied in the shipbuilding literature. The location and process of making the ship are in the Banda Sakti sub-district, Lhokseumawe City. It has multiple workstations, such as measuring and cutting stations and assembly stations. Operators must work 8 hours daily in various postures, including standing, bending, and lifting heavy objects. On the basis of the preamble of the Nordic Body Map (NBM), intense exercise damages the musculoskeletal system by comparing the Rapid Upper Limb Assessment and Rapid Entire Body Assessment for workers' assessment of their working posture. In the process of making fishing boats. Results of REBA Labor Calculation: Worker 1 gets a score of 9, Worker 2 gets a score of 11, and Worker 3 gets a score of 5. In RULA, Workers 1 and 2 get the same score of 6, and Worker 3 gets the same score of one score out of 4. REBA received a final score of 2 at low-risk level 1, and REBA 2 workers received a final score of 2 at level 1, low-risk, and performance level 1. Working conditions at lifting stations must be improved to prevent musculoskeletal system diseases in the timber lifting station employees.

Keywords: Traditional fishing boats; ergonomic work posture; Rapid Upper Limb Assessment (RULA); Rapid Entire Body Assessment (REBA).

1. Introduction

The operator's work posture in every movement has a different body posture. This movement can be influenced by the workstation conditions where the operator is carrying out his activities. Every operator in his work environment always wants work that can be done with minimum effort but can give maximum

results as expected (Nurmianto, 1996). The Pusong Lama community in Banda Sakti District, Lhokseumawe City, is a community that lives on the coast. Most of them work as traditional fishermen. The various potentials and natural resources around the coast are the main attraction for the community to meet other needs. One of them is developing the traditional fishing boat industry along the coast. On the basis of data from the Fish Landing Base Technical Implementation Unit (UPT. PPI) Pusong Lhokseumawe, this traditional shipbuilding industry is increasing in Lhokseumawe. The number of ships produced from time to time has increased from several existing locations, and the number of ships worked has increased by around 5%.

The ships produced in Pusong are based on orders locally and outside the Lhokseumawe area. Each ship being worked on weighs 20 tons, is 20 meters long, 2.5 meters high, 6.5 meters wide, and has 50 GT (gross tonnage) with a construction time of 6 -1 years because it depends on the supply of raw materials. The shipbuilding cost for procuring engines and other equipment for a ship ranges from $1 billion to $3 billion. The process of making fishing boats in Lhokseumawe Pusong has three operators: wood-cutting, wood-lifting, and shipbuilding. Based on several facts related to working conditions found in shipbuilding workers in Lhokseumawe Pusong, it is found that the dominant work is done standing, bending, and lifting heavy loads for 1 working day (8 hours). Based on the results of the NBM questionnaire for workers, it turns out that there are complaints by workers on certain limbs such as the neck, spine, legs, and hands, which, if they occur for a long time, will endanger the health of workers (McAtamney & Corlett, 2004). Based on the existing problems, this study aimed to examine the current working posture of fishing vessel construction operators. For improving the work posture, the Rapid Upper Limb Assessment and Rapid Entire Body Assessment methods are used to reduce risks arising from the operator's working position, both in the upper body position and all parts of the operator's body.

2. Literature Review

2.1. Ergonomics

Ergonomics is the branch of science that uses information about human nature, capabilities, and limitations to create systems of work that are "effective, comfortable, safe, healthy, and efficient." Ergonomics is an interdisciplinary science that combines several branches of science, such as medicine, biology, psychology, and sociology (Ghosh & Dickerson, 2015; Steege & Dykstra, 2016). There is a hierarchy of goals for applying ergonomics (Holden et al., 2015), with the lowest goal being a system of work acceptable within certain limits, provided that this system does not pose a potential threat to health and human life. The overriding goal is enforcing technical or organizational restrictions that allow employees to accept current working conditions (Weidman et al., 2015).

2.2. Rapid Upper Limb Assessment

Rapid Whole-Body Assessment is a method developed in the field of ergonomics to rapidly assess the working position or posture of an operator's neck, back, arms, wrists and legs. In addition, the method is also affected by coupling factors, external loads carried by the body, and worker activity. According to Hignett & McAtamney (2000), Ramdhani (2018), Wibowo & Mawadati (2021) and Wijaya & Muhsin (2018), the REBA assessment does not take long. It performs a general assessment against a list of activities that indicate the need for risk mitigation caused by operator work postures:

1. Action Level 1: acceptable posture
2. Action Level 2: Needs further investigation and may need to be changed
3. Action Level 3: Immediate investigation and change are needed.
4. Action Level 4: Immediate investigation and change are needed for evaluation

2.3. The Rapid Entire Body Assessment

The Rapid Entire Body Assessment technique is a posture analysis system sensitive to musculoskeletal threats in various tasks, particularly for evaluating work postures in healthcare and other services. The posture classification system, which includes arms, forearms, wrists, torso, neck, and legs, is based on body part diagrams. The method reflects the range of applied external forces, muscle activity through static, dynamic, rapidly changing, or unstable posture, and the feedback effect. According to Agustiansyah et al., (2023), McAtamney & Corlett (1993), Restuputri (2017), and Wibowo & Mawadati (2021), REBA technique provides five levels of action to assess the extent of corrective action:

1. Action level 0: Further evaluation does not require corrective action
2. Action Level 1: Action may be required for further evaluation

3. Action stage 2: Actions required for further evaluation
4. Action Stage 3: Immediate action is required, including further evaluation
5. Action Level 4: Action required, including further evaluation

2.4. Nordic Body Map

Nordic Body Map (NBM) is a method used to measure muscle pain in operators. Nordic Body Map (NBM) is a method in the form of a questionnaire for knowing which part of the operator's body has complaints, ranging from no pain to very painful (Kee, 2022; Setiawan et al., 2021). It is caused by work posture errors when carrying out work activities. Complaints in the muscles are grouped into two, namely temporary complaints and persistent complaints (Jones & Kumar, 2010; Joshi & Deshpande, 2021; McAtamney & Corlett, 1993; Purwandari et al., 2021).

3. Materials and Methods

3.1. Research Location and Time

This study was conducted on the process of making traditional fishing boats. which is located on Jalan PPI Pusong, Banda Sakti District, Lhokseumawe City. When the research was carried out starting for 1 month, namely in August 2022. The stages carried out started from the preparation of research proposals, collection of questionnaire data, data processing, and writing of the final research report

3.2. Object of Research

The object of the research that was observed was the process of making fishing boats in Pusong, Lhokseumawe City. Data Types and Sources The types of data collected in conducting this research are as follows: Initial Identification at the initial identification stage includes:

1. Embarrassed by the problem and literature study in accordance with the topic taken
2. Formulate the problem
3. Determine research objectives
4. Determine the benefits of research

3.3. Method of Data Analysis

This study was analyzed using the Nordic Body Map questionnaire. It is used to determine the workers' complaints and the risk of musculoskeletal disorders in workers. Complaints can be identified by giving questionnaires to workers and asking directly. Rapid whole-body assessment, rapid upper extremity assessment, ergonomic risk value measurement by working posture determination method. A proper combination of points will result in a final grade of 1-7. The final score relates to his 4 levels of action and 4 levels of risk. The results, measures and risk levels of the upper extremity rapid assessment are summarized in Table 1.

Table 1. REBA and RULA score for measuring the effectiveness levels.

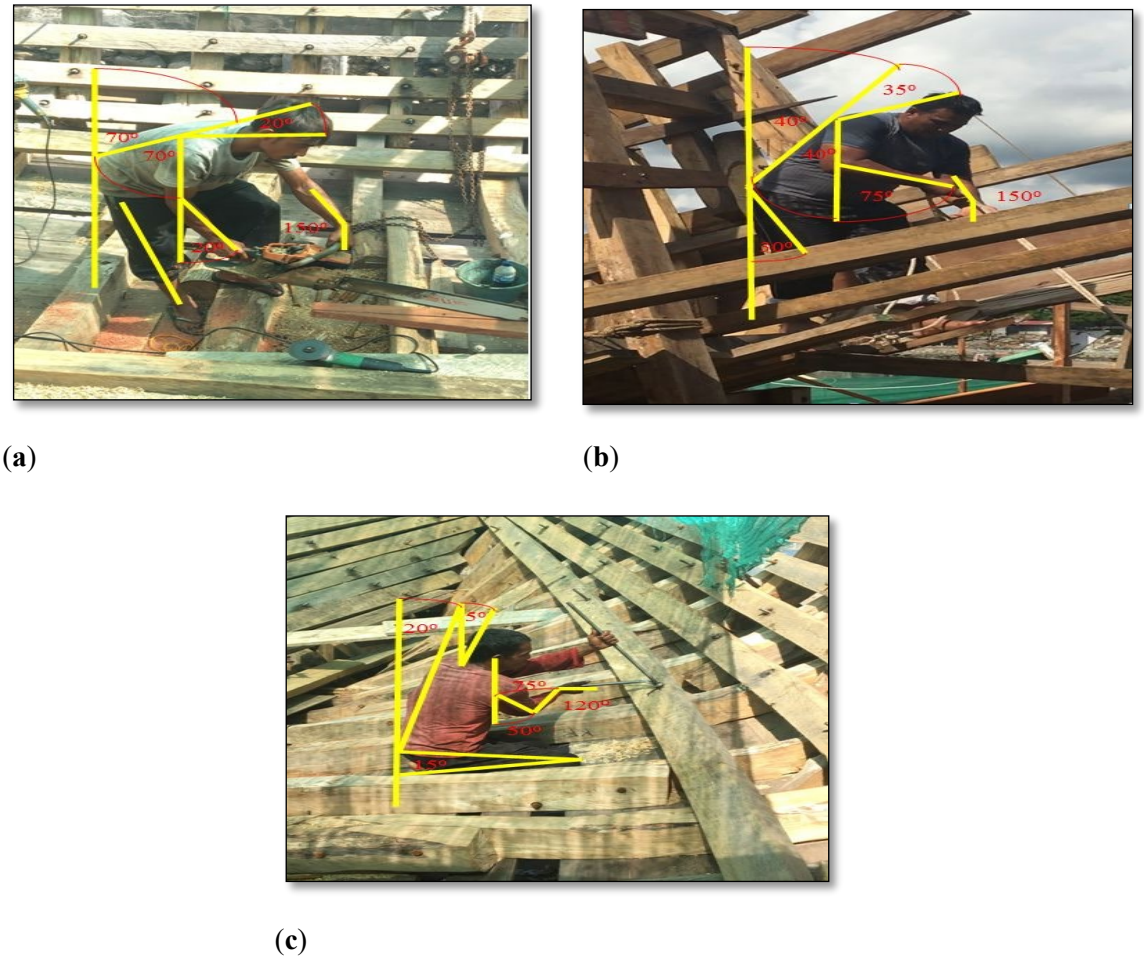
RULA Score	Action Level	REBA Score	Action Level	Risk Level
1	0	1	0	Negligible
1-2	1	2-3	1	Low
3-4	2	4-7	2	Medium
5-6	3	8-10	3	High
7	4	11-15	4	Very High

In a rapid assessment of the whole body (Agustiansyah et al., 2023; Joshi & Deshpande, 2022), the body is divided into segments into two groups: The neck, torso and legs. The second group includes the indistinguishable right and left forearm, forearm, and wrist. This procedure consists of assigning points to each body segment based on the assumed posture and, via a table or numerical tables, of the musculoskeletal postural strain caused by the combination of the two determined sets of postures. To get two different points to represent degrees. These two values should be added to the handle value. The corresponding load coerce the value to get two new values (Class A and B). You can get a C by using a third chart or table. Add this

to your activity score to get your final overall score. Final scores range from 1 to 15 and are associated with 5 actions and 5 levels of risk.

4. Results

Work posture focuses on the working posture of shipyard employees. The work is carried out every day repeatedly until the ship is finished. At this stage, work posture was assessed for 3 workers in the shipyard using the Rapid Entire Body Assessment and Rapid Upper Limb Assessment methods—the working posture of the three workers. The operator's position measured is the angle of the neck, back, upper arm, forearm and wrist. The results of these measurements are shown in Figure 1 below.



(**a**) (**b**)

(**c**)

Figure 1. (a) Measurement of worker work posture 1, (b) Measurement of worker work posture 2 and (c) Measurement of worker work posture 3

4.1. Analysis of Work Posture using Rapid Entire Body Assessment (REBA)

The working posture is the condition of the working posture of shipbuilding workers. This work is repeated every day until the ship is finished. At this stage, an assessment of the work posture of 3 workers in shipbuilding will be carried out. Recapitulation of Work Posture Assessment using REBA Method is in Table 2:

Table 2. Summary of work posture evaluation using REBA

No	Respondents	Grand Score	Action Level	Risk Level
1	Worker 1	9	3	High
2	Worker 2	11	4	Very High
3	Worker 3	5	2	Medium

Table 2 displays the risk level for shipbuilding respondents is obtained. The scores obtained ranged from 4-7 and 11-15. It shows that shipbuilding workers in the centre of Lhokseumawe City are at a high level of risk, so immediate action is needed. The highest REBA score occurred in worker 2, the final score was 11, with a very high-risk level, so it is necessary to take action immediately. While for worker 1, the final score is 9, with a high level of risk. For this, it is necessary to act immediately, and for worker 3, the final score is 5 with a moderate risk level.

4.2. Analysis of Work Posture using Rapid Upper Limb Assessment (RULA)

On the basis of the results of data processing on the manufacture of fishing boats in the city of Lhokseumawe using the RULA method, a summary of the Work Posture Assessment using RULA Method can be seen in Table 3.

Table 3. Summary of work posture evaluation using RULA Method

No.	Respondents	Grand Score	Action Level	Risk Level
1.	Worker 1	6	5 - 6	Medium
2.	Worker 2	6	5 - 6	Medium
3.	Worker 3	4	3 - 4	Small

Table 3 shows the risk level for shipbuilding respondents is obtained. The scores obtained ranged from 3-4 and 5-6. This shows that shipbuilding workers in the center of Lhokseumawe city are at a moderate risk level, so immediate action is needed. The highest RULA scores occurred in workers 1 and 2, the final score was 6 with a moderate risk level, for this reason it is necessary to act in the near future. While for worker 3, the final score is 4 with a small risk level, for this it takes some time is needed. Recapitulation of Work Posture Assessment with 2 methods can be seen in Table 4.

Table 4. Summary of work posture evaluation with 2 methods (REBA and RULA)

No.	Methods	Work posture assessment results		
		Worker 1	Worker 2	Worker 3
1.	REBA	9	11	5
2.	RULA	6	6	4

The differences between the 2 RULA, REBA, methods from the measurement and calculation results for the 3 operators are as follows. For worker 1 with REBA value 9, For worker 2 with REBA value 11, For worker 3 with REBA value 5. Methods from the measurement and calculation results for the 3 operators are: For worker 1 with RULA value 6, For worker 2 with RULA value 6, For worker 3 with RULA value 4. based on the REBA method, a high risk level needs to be corrected now, the worker's position is bent with a weight of 8 kg, static work attitude and holding for more than 1 minute. The medium risk RULA method needs to be improved in the near future.

5. Conclusions

This study investigates respondents' level of risk of fishing boat construction. The scores obtained by REBA ranged between 4-7 and 11-15, and the scores obtained ranged between 3-4 and 5-6. It shows that downtown Lhokseumawe's shipyard workers have a high-risk level. Therefore, urgent action is required to improve work positions to reduce complaints. The highest REBA score occurred in worker 2; the final score was 11, with a very high level of risk, and it is necessary to act now, to improve the operator's work position at work. Whereas for worker 1 the final score is 9 with a high level of risk, for that it is necessary to take immediate action to improve the operator's work position in reducing work complaints, and for worker 3 the final score is 5 with a moderate level of risk, this also needs to be done to improve the operator's work position to reduce complaints. The highest RULA scores occurred in workers 1 and 2; the final score was 6 with a moderate risk level. Thus, it is necessary to take action in the near future, by improving the operator's position at work and also being able to add work aids. Whereas for worker 3, the final score is 4 with a small level of risk. For this reason, improving the operator's work position in the future is necessary.

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