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Redesigning the Work Table of Stamped Batik Makers to Reduce the Risk of Musculoskeletal Disorders (Case Study at Pt. XYZ)

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ABSTRACT: Batik is one of the works owned by the Indonesian Nation, which has noble values and is recognized by other nations. The rapid development of batik makes batik makers need to pay attention to the production process carried out, In carrying out the activities of making stamped batik, it has not been supported by a special work table. Still using an ordinary stamp table that is less comfortable to use for stamped batik. So that in doing their work craftsmen have low productivity and efficiency. This research was conducted at PT XYZ to evaluate and reduce the risk of musculoskeletal disorders in stamped batik makers through ergonomic work table redesign. The research method used is case study-based quantitative, with a population of PT XYZ employees who work as stamped batik makers. Primary data was collected through observation, questionnaires and interviews. Posture measurements were carried out using the NBM (Nordic Body Map) questionnaire, to determine musculoskeletal complaints including 28 muscle parts in the musculoskeletal system on both sides of the body right and left. Then posture measurements were taken using the REBA (Rapid Entire Body Assesment) method. The results of the NBM questionnaire showed that before the improvement of the stamp batik had a high chart of complaints of pain in the musculoskeletal muscles and also the results of the REBA score showed a high risk of musculoskeletal disorders, especially in the neck, shoulders, bronze, arms and legs. After the implementation of a more comfortable stamp work table design and stamp stove table (Adjustable) there was a significant decrease in the REBA score decreasing from 8 to 1. This shows a significant reduction in the risk of musculoskeletal disorders, so that ergonomic work table design can reduce the risk of musculoskeletal disorders at PT XYZ and increase worker comfort.

KEYWORDS: Ergonomic cap table, Muskuloskeletal Disorders, Nordic Body Map, Rapid entire Body assesment.

I. INTRODUCTION

The development of batik is getting faster, making batik makers need to pay attention to the production process carried out. In international trade, Batik is now an important commodity in income, so that batik becomes optimal, things that need to be considered are work facilities in the batik process, one of which is an ergonomic stamp table and stamp stove table. However, in the process of batik stamping, it is not supported by ergonomic work tools so that it feels tiring. In doing their work, craftsmen have low productivity and efficiency. Factors causing low productivity and efficiency are due to facilities and work layouts that are less ergonomic.

A study conducted at PT XYZ found that the design of the work table for stamped batik makers does not match the body dimensions because it causes musculoskeletal disorders (MSDs) problems. This can result in decreased productivity, lost work time, decreased alertness levels, and increased risk of work accidents (Gunawan, 2021). Every day, stamped batik makers work 8 hours a day with 1 break. This study conducted an initial survey of respondents (stamped batik makers) using the Nordic Body Map (NBM) to determine musculoskeletal complaints which include 28 muscle parts. Ergonomics is the study of the relationship between humans and their environment, allowing the maker of tools and work systems to be adjusted to the comfort of users (Balaputra and Sutomo 2017).

The analysis also revealed that a long standing position, about 1-4 hours causes discomfort in the legs, eyes, waist, back and neck. Based on the explanation above, the researcher conducted this study with the aim of making a stamp batik table design and a stamp stove table to minimize the complaints felt by employees of PT XYZ.

II. METHODS

This research was conducted at PT XYZ during June to July 2024. The method used in this research is case study-based quantitative, chosen because it is able to provide numerical data that can clearly measure research needs and provide results that can be analyzed statistically. This is especially useful in understanding the problems and solutions of the work system of batik making with the stamp technique that causes musculoskeletal disorders in employees at PT.XYZ. The proposed improvement of this system is the

design of an ergonomic stamp batik work table that does not slouch and is equipped with a stamp stove table with an upright standing position so that fatigue in the work process can be minimized, thus making workers more comfortable, safe effective and efficient.

The population of this study were employees of PT XYZ who worked as stamped batik makers. The technique used was purposive sampling (Sugiyono, 2019), with 10 respondents of PT XYZ employees who often experience fatigue at work and often complain in the neck, shoulders, waist and legs. Primary data in this study were taken through observation, questionnaires, and interviews. Furthermore, posture measurements using the REBA (Rapid Entire Body Asessment) method were analyzed to identify high-risk work postures, formulate and recommend the design of an ergonomic stamp batik table in the workplace.

III. RESULT AND DISCUSSION

The level of employee complaints when doing batik stamping using a table that is less ergonomic can be known based on the results of Nordic Body maps (NBM) in Figure 1.

Table 1. Nordic Body Map questionnaire results.

Source: Primary data processed 2024

Based on observations using the Nordic Body Map (NBM) of musculoskeletal complaints (MSDs) to 10 workers, it can be concluded that in general, the average worker experiences complaints in various parts of the body such as the neck, shoulders, back and legs. This pain can be attributed to the working positions complained of by the workers, including the bending of the neck, with an angle of about 200, the position of the body forming an angle of 460, and the feet that support the body for a relatively long time. The average score obtained from the 10 samples is 8, reflecting a high level of risk, therefore corrective action needs to be taken immediately to reduce the risk.

REBA (Rapid Entire Body Asessment).Score Group A.

Group A in the REBA method consists of scoring the neck, body, legs. The neck measurement gets a score of 3 because the neck forms an angle of 200, the scoring for the body gets a score of 4, because the body forms an angle of 200 - 600, and the foot score gets a value of 1 because the foot has a balanced position. Furthermore, the total score of group A is determined based on the REBA guidelines which can be seen in Table 1. The results show that the value of group A (neck, body, and legs). Got a total score of 5.

Table 1. REBA Group A Analysis Assessment.

Neck Posture Score	**Body (Trunk)**											
	1		**2**		**3**		**4**		**5**		**6**	
	Foot		**Foot**		**Foot**		**Foot**		**Foot**		**Foot**	
	1	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**
1	1	3	2	3	3	4	5	5	6	6	7	7
2	2	3	2	3	4	5	5	5	6	7	7	7
3	3	3	3	4	4	5	5	6	6	7	7	7

4	5	5	5	6	6	7	7	7	7	7	8	8
5	7	7	7	7	7	8	8	8	8	8	8	8
6	8	8	8	8	8	8	8	9	9	9	9	9

(Sumber : A Step-by-Step Guide to the REBA Assesment Tool, 2013)

Score Group B.

Group B in the REBA method consists of scoring the upper arm, forearm and wrist, the upper arm scores 3, because the upper arm forms an angle of 200 - 450, the forearm scores 1, because the forearm forms an angle of 600 - 1000. The wrist gets a score of 3, because the wrist bends to the center line forming an angle of 1800, because the wrist rotates in the middle range. Furthermore, the total score of group B is determined based on REBA guidelines which can be seen in table 2. The results show that the total score of B (upper arm, forearm, and wrist) gets a total score of 5.

Table 2. REBA group B Analysis Assessment

Table B		Lower Arm					
		1			2		
	Wrist	1	2	3	1	2	3
Upper arm	1	1	2	2	1	2	3
	2	1	2	3	2	3	4
	3	3	4	5	4	5	5
	4	4	5	5	5	6	7
	5	6	7	8	7	8	8
	6	7	8	8	8	9	9

(Source : a Step –by-step Guide to the REBA Assesment Tool, 2013).

Score final REBA.

The next step, enter the final score of table A and the final score of table B, The final score of REBA is the result of the work posture.

1. Score A is obtained by 5 coupled with a load of , 5 kg and activities performed repeatedly, so the total score of table A is 5 + 0 + 1 = 6 Then in the score table A circled number 6.
2. Score B is obtained by 5 plus a load of < 5 kg and the activity is carried out repeatedly, so that the total score of group B is 5 + 0 + 1 = 6 then in the score table B circled number 7.

The final REBA score can be seen in Table 3 where it is found that the REBA score of workers before the implementation of improvements is 8. This score indicates that the employee's posture before improvement has a high level of ergonomic risk and needs to be done immediately.

Make improvements to workers' posture to reduce the risk of injury or discomfort at work.

Table 3. Score final REBA

Table Score A	Table C											
	Score table B											
	1	2	3	4	5	6	7	8	9	10	11	12
1	1	1	1	2	3	3	4	5	6	7	7	7
2	1	2	2	3	4	4	5	6	6	7	7	8
3	2	3	3	3	4	5	6	7	7	8	8	8
4	3	4	4	4	5	6	7	8	8	9	9	9
5	4	4	4	5	6	7	8	8	9	9	9	9
6	6	6	6	7	8	8	9	9	10	10	10	10
7	7	7	7	8	9	9	9	10	10	11	11	11
8	8	8	8	9	10	10	10	10	10	11	11	11
9	9	9	9	10	10	10	11	11	11	12	12	12
10	10	10	10	11	11	11	11	12	12	12	12	12
11	11	11	11	11	12	12	12	12	12	12	12	12
12	12	12	12	12	12	12	12	12	12	12	12	12

(Source : A Sep-by-Step Guide to the REBA Assesment Tool, 2013).

ANTHROPOMETRY

Anthropometric data serves as a guide in determining the dimensions for designing tables to improve the working position of employees during work. From the results of data uniformity testing, all anthropometric values measured are within the control limits, indicating that the data is homogeneous. The results of data sufficiency testing state that all anthropometric data meet the N>N' requirement, confirming that the amount of data collected is more than sufficient. Furthermore, the percentile calculation of anthropometric data is then used as the basis for dimensions in the design of the stamp table and stamp stove table, the results of which can be seen in table 6.

Table 4. Recapitulation of percentile calculations

Percentil	Body Dimensions (cm/kg)							
	Tbt	Tmt	Tbb	Tsb	Tpb	Jka	Plb	Tlb
Mean	160.60	150.10	133.60	106.10	99.30	198.40	44.70	48.00
SD	4.45	7.98	5.80	7.37	6.20	11.95	2.36	2.26
P5	155	138.9	126.9	96.7	90.9	182.9	40.9	44
P95	166.1	158	141.1	116.2	106.55	211.3	47	50

Source : Primary data processed 2024

The anthropometric data processing process aims to obtain table dimensions that are in accordance with ergonomic principles, as an effort to adjust the position and work environment to reduce the potential risk of musculoskeletal disorders in workers. Based on the fixed measurements, it can be expected that improvements in ergonomics can be implemented by ensuring more automated functionality in order to adapt to the body conditions of workers and minimize adverse effects on the musculoskeletal health of workers.

DESIGN OF STAMP TABLE

After considering the initial conditions, it is known that the standing position when the batik maker performs activities in the stamp batik process with an uncomfortable work table with a long duration of time of about 1-4 hours. So the next step is to utilize Anthropomeri data to design a stamp table:

1. The length of the stamp table is taken from TMT (Upright eye height) with a percentile value (95) = 158 cm.
2. The width of the stamp table is taken from TSB data (standing elbow height) with a percentile value (95) = 116.2 cm.
3. The height of the stamp table can be adjusted according to the height of the batik maker, so the data used is Anthropometric data TPM (Standing waist height) with a percentile value (95) = 106.55 cm.

For the stamp stove table design:

1. The length of the stamp stove table is taken from PLB data (forearm length) with a percentile value (95) = 47 cm.
2. The width of the stamp stove table is taken from PLB (forearm length) data with a percentile value of (95) = 50 cm.
3. The height of the stamp stove table is taken from TLB (Standing Knee Height) data with a percentile value (95) = 47 cm.

Figure 2. Cap table after repair

Figure 3. Stamp Stove Table after repair

Figure 4 Working position after improvement.

After making improvements to the working position as shown in Figure 2, Figure 3 and Figure 4, the next step involves calculating the employee's body angle to determine the improvement score. This process aims to quantitatively measure and evaluate the extent to which the adjustments affect the working posture. By obtaining an improvement score, a more detailed understanding of the positive impact of the change in work position on ergonomics and the potential risk reduction of musculoskeletal disorders can be obtained. This calculation process is a critical step in assessing the effectiveness and efficiency of improvements that have been implemented in the work environment.

REBA DATA COMPARISON.

After calculating the initial REBA score and anthropometric calculations, the appropriate work table size is obtained for improvement. The repair workbench is applied and then the final score is measured for REBA Comparison of REBA initial and final scores are shown in Table. 7

Table 7. REBA Final Score Comparison

Description	Before improvement	After improvement
Body Score Table A	6	1
Body Score Table B	6	1
Total Score	8	1

Risk Level	High	Small
Action	Need for immediate improvement	Can be ignored and does not need repair

IV. CONCLUSION

Based on the explanation, it can be concluded that the difference between the initial table design and the final table design has an impact on reducing the risk of musculoskeletal in the stamp batik maker, this can be seen from the evaluation results using the REBA method, it can be seen that the worker's posture before the improvement is made has a high level of risk, with a score reaching 8. This method indicates the potential for musculoskeletal disorders, showing the urgency of the need for improvement to improve ergonomics in the workplace. The proposed recommended improvements, especially in designing work facilities such as stamping tables and stamping stove tables, have significantly reduced the initial REBA Score from 8 to 1. These results indicate that the risk of developing musculoskeletal disorders and similar conditions in employees has been successfully minimized, reaching a low level of risk. Changes to the workbench design have had a positive impact on workers' posture.

The researchers suggest that the company needs to prioritize ergonomic aspects during work activities in order to reduce the potential risk of musculoskeletal disorders in the future. Long periods of work with static postures need to be accompanied by periodic breaks to reduce muscle stiffness during the work process. Improvements to work facilities are implemented by ensuring more automated functionality to adapt to the user's body, which is expected to provide comfort in reducing adverse effects on workers' musculoskeletal health.

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