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ABSTRACT

This research was conducted at small and medium businesses, namely PT Sumber Karya Indah, a company engaged in the manufacture of women's bags. There are 10 activities in the process of producing women's bags. This work system is analyzed using the Nordic Body Map (NBM) method, Rapid Whole Body Assessment (REBA), Work Risk Ergonomic Risk Assessment (WERA), and Biomechanics to see ergonomic risks. The results of the Nordic Body Map questionnaire after working compared to before showed that there were 6 parts of the body of workers that had the highest value, namely the upper neck, buttocks, waist, right hand, left thigh and right thigh. REBA and WERA analysis was carried out on 10 activities to find potentially problematic activities to work health and comfort. The results of the analysis showed that there were 2 activities with high categories of REBA analysis methods, gluing activities (with a score of 10) and sticking activities (with a score of 9). Based on the WERA analysis, the two activities also showed the 2 highest values in the medium category, each with a value of 36 and 34. While the Biomechanical Analysis of worker posture on the gluing activity obtained a thigh muscle pressure score of 2440 N and the overall moment was 248 NM towards the left. For sticking activity, the score for the thigh muscle was 1974.2 N and the overall moment was 63.2 NM to the left. Based on the results of these four analyzes, it can be concluded that sticking and sticking activities require immediate ergonomic intervention to reduce occupational health risks.

Keywords: ***ergonomic, REBA, WERA, biomechanic***

1. Introduction

Many things are done by humans in their efforts to increase work productivity. Along with the development of science and technological advances, many of the methods found can help human work. Work becomes easier, faster, more convenient and can reduce the risk of illness and injury due to work. PT. Sumber Karya Indah which is a company engaged in the production of women's bags in the Tajur area, Bogor, West Java, Indonesia. In this industry there are 10 activities in the production process of making women's bags. Based on preliminary observations at PT. SKI (Sumber Karya Indah), found the problem of worker posture in the bag production process that does not pay attention to ergonomic values as evidenced by complaints by workers in the factory. The objectives of this study include assessing the level of risk using the Nordic Body Map (NBM) method, Rapid Whole Body Assessment (REBA), Workplace Ergonomic Risk Assessment (WERA) and Biomechanics.

According to The International Ergonomics Association (IEA), ergonomics is defined as; 1) The field of science that studies human interaction with system elements. Various theories and methods are applied in optimizing overall system performance and performance, 2) Ergonomics is applied to meet two main objectives, namely health and productivity. Ergonomics is inseparable from workers, workers' activities and work, these three components become important elements in ergonomic design [1]. Ergonomics is a systematic branch of science to utilize information about the nature, abilities, and limitations of humans to design a work system so that people can live and work on the system well, namely achieving desired goals through work effectively, safely, and comfortable [2].

Antropometry

The discipline of ergonomics that deals with measurements of the dimensions of the human body is called anthropometry. Anthropometry is a collection of numerical data related to the physical characteristics of the human body (size, volume, and weight) and the application of these data to the design of facilities or products. Anthropometry is divided into two methods of measurement, namely static anthropometry and dynamic anthropometry [3].

Complaints in the musculoskeletal system are complaints on parts of the skeletal muscles that are felt by someone ranging from complaints on parts of the skeletal muscles that are felt by someone ranging from complaints that are very mild to very sick. If the muscles receive a static load repeatedly and for a long time, it can cause complaints in the form of damage to the joints, ligaments and tendons. These complaints to damage are usually termed complaints of musculoskeletal disorders (MSDs) or injury to the musculoskeletal system. Musculoskeletal complaints are often also called MSD (Musculoskeletal disorder), RSI (Repetitive Strain Injuries), CTD (Cumulative Trauma Disorders) and RMI (Repetitive Motion Injury) [4].

Nordic Body Map (NBM)

The Nordic Body Map method is a subjective valuation method, meaning that the success of the application of this method depends very much on the conditions and situations experienced by workers at the time of the study and also depends on the expertise and experience of the observer concerned. The Nordic Body Map questionnaire covers 28 portions of skeletal muscles on both the right and left sides of the body. Starting from the upper limbs, namely the neck muscles to the muscles in the legs [5].

Rapid Entire Body Assessment (REBA)

REBA or Rapid Entire Body Assessment was developed to assess the type of work posture that cannot be predicted. The REBA method can quickly assess the risk of upper body parts. The REBA method is relatively easy to use because to find out the value of a body posture it is not necessary to specify a specific angle, only a range of angles. REBA is used when evaluating workplace ergonomics identifies further posture analysis [6].

Workplace Ergonomic Risk Assessment (WERA)

WERA is a method that explains the development of workplace ergonomic risk assessments to detect physical risk factors associated with Work-related Musculoskeletal Disorders (WMSDs) disorders at work. The WERA method has an assessment system and a level of action that provides guidance on the level of risk and the need for more detailed assessments [7].

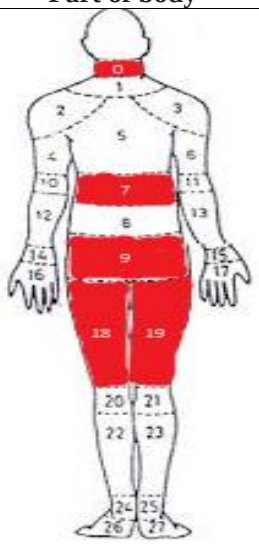
2. Research Methodology

This research was conducted at PT. Sumber Karya Indah is located at the Tajur location, Bogor. This research was conducted by direct interviews to fill the NBM questionnaire on 10 production activities. In searching for the most problematic activities, an analysis using REBA and WERA methods will then be proven by Biomechanics analysis. The next set of research is to design and create aids for production activities so that they are ergonomic so that the work system becomes effective and efficient and can reduce physical complaints that occur to workers.

3. Results and Discussion

There were physical complaints based on the results of interviews and questionnaire assessments using the NBM method by 10 respondents. In the activity of producing women's bags at PT. Sumber Karya Indah, from 28 parts of the worker's body, there are 5 parts with the highest total points, namely the upper neck, waist, buttocks, left thigh and right thigh. Scores of NBM physical complaints can be seen in Table 1.

Table 1. Worker Complaints based on the NBM questionnaire

Part of body	Location	Score
	0 = Upper neck	15
	7 = Waist	11
	9 = Buttocks	10
	18 = Right thigh	9
	19 = Left thigh	9

The five body parts of workers with the highest complaints are analyzed to find out the cause of the complaint. The reason for this is the position of the object being worked on is too low, the chair base is hard, and the work position is not natural so it is not comfortable working. Detailed analysis of the causes of complaints can be seen in Table 2.

Table 2. Cause Analysis of Complaints

No.	Part of body	Causes Analysis of Complaints
1.	Upper neck	The position of the object being worked on is too low so that the worker looks down
2.	Buttocks	A place to sit hard causes pain in the buttocks

3.	Waist	The position of the object being worked out is too far away so workers have to bend down so that pain in the waist arises
4.	Left thigh	An uncomfortable sitting position for too long causes pain in the left thigh
5.	Right tight	An uncomfortable sitting position for too long causes pain in the right thigh

After knowing the main complaints from the body parts of workers with the NBM questionnaire known, followed by ergonomic analysis using the REBA and WERA methods. The results of the analysis of REBA and WERA values found 2 work activities with the highest value on sticking and sticking activities. Detailed results of REBA and WERA calculations in ten activities can be seen in Table 3.

Table 3. REBA and WERA Calculation Results

No.	Activity	Method	Score	Category
1.	Making a Pattern Master	REBA	5	Medium
		WERA	26	Low
2.	Making tracing patterns	REBA	5	Medium
		WERA	24	Low
3.	Cutting tracing patterns	REBA	6	Medium
		WERA	33	Medium
4.	Sewing	REBA	7	Medium
		WERA	31	Medium
5.	Gluing	REBA	10	High Risk
		WERA	36	Medium
6.	Sticking	REBA	9	High Risk
		WERA	34	Medium
7.	Clicking	REBA	7	Medium
		WERA	30	Medium
8.	Plastic mounting	REBA	6	Medium
		WERA	30	Medium
9.	Scribble and Glue Cleaning	REBA	7	Medium
		WERA	31	Medium
10.	Rechecking	REBA	5	Medium
		WERA	31	Medium

After finding the activities with the highest value, an analysis using biomechanical methods was carried out. These activities are gluing and sticking activities because they have the highest REBA and WERA calculation scores. REBA and WERA scores for gluing activity are 10 and 36, while for sticking activity are 9 and 34. Next, biomechanical analysis is carried out on both activities. The results of biomechanical analysis can be seen in Table 4 and Table 5.

Table 4. Overall Biomechanical Analysis Results of Gluing Process

No	Work Position	Scores	Descripton

1.		F_Y= 248N T_1 = 20,62Nm	The foot hold a load of 248 N and generate a torque of 20.62 Nm so that the foot against the torque is 20.62 Nm to the left so that it does not tumble.
2.		F_Y= 252,3N F_{Y1}= 193,3N F_{Y2}= 59N T_1 = 63,02Nm T_2 = 2,45Nm	The legs hold a load of 59 N and generate torque of 2.45 Nm, while the buttocks hold a load of 193.3N and withstand a torque of 63.02Nm.
3		F_Y= 275,84N F_{Y1}= 211,84N F_{Y2}= 64N T_1 = 56,711Nm T_2 = 2,08Nm	The legs hold a load of 59 N and generate a torque of 2.45 Nm while the buttocks accept a load of 193.3 N and have a torque load that must be resisted at 63.02 Nm.

Table 4. Overall Biomechanical Analysis Results of Sticking Process

No	Work Position	Scores		Descripton
1.		Thigh: Fx= 1634,8 N Fy= 1245,1 N Fm= 2440 N	Spine: Fx = 655N Fy = 870,6N Fe = 862,2 N Ra = 1089,66 N Rs = 0,59 N	Fx = Force Against the X-axis Fy = Force Against Y-axis Fm = Force on Thigh Muscles Fe = Force on Back Muscles Ra = Axial Reaction Force along the Middle Axis of the Spine Rs = Reaction force Shear perpendicular to the Spinal Axis
2.		Thigh: Fx= 1618,8 N Fy= 564,8 N Fm= 1974,2 N	Spine: Fx = 294,15N Fy = 564,8 N Fe = 525,27 N Ra = 814,07 N Rs = 2,57 N	
3		Thigh: Fx= 43,01 N Fy= 5,18N Fm= 50,6N	Spine: Fx = 274,5N Fy = 793,3N Fe = 517,86 N Ra = 839,5 N Rs = 168,9 N	

4. Conclusion

1. Based on research for production activities, it was found that there were 5 highest complaint locations including the upper neck, waist, buttocks, right thigh, and left thigh.

2. Out of 10 activities in the production of women's bags, there are 2 activities that have the highest REBA and WERA analysis values, namely gluing and pasting activities. For gluing activity, REBA score is 10 (high category) and WERA score is 36 (medium category). Whereas for sticking activity, REBA score is 9 (high category) and WERA score is 34 (medium category).
3. Analysis using the Biomechanical method shows that the value for gluing activity has a thigh muscle pressure value of 2440 N and has an overall moment of 248 NM to the left, while for sticking activity a score for a thigh muscle of 1974.2 N and an overall moment of 63.2 NM to the left.
4. Based on the results of the analysis of the four ergonomic methods, it can be concluded that the work system of bag production at PT. This SKI needs immediate intervention to reduce occupational health risks.

5. References

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