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Proposed Posture Improvement Using REBA Method to Minimize The Occurance of Worker Muscle Complaints in Repairation at Tunas Toyota Cilegon

Naniek Utami Handayani[1] and Salsabila Rizka Azzahra[2]

1Department of Industrial Engineering, Diponegoro University, Semarang, Indonesia
naniekh@ft.undip.ac.id
2Department of Industrial Engineering, Diponegoro University, Semarang, Indonesia
salsabilariz@students.undip.ac.id

Abstract: *In the manufacturing industry, it is very common to encounter many complaints of MSDs (Musculoskeletal Disorders) from the workers. MSDs can occur due to body postures that support excessive loads, unnatural body positions during work, and repetitive activities when workers are trying to repair machinery or produce goods. Therefore, it is important to conduct body posture measurements for workers using the REBA method and to make adjustments to support ergonomic work postures. The REBA method is also used to determine which activity posture has the highest risk and which body parts are at the highest risk of injury. To minimize the occurrence of MSDs and the potential for injuries among workers at Tunas Toyota Cilegon, recommendations for improving workers' body postures include designing ergonomic tools such as adjustable chairs to support ergonomic body postures among workers. These improvements not only reduce the risk of MSDs but also enhance the overall well-being and productivity of the workers.*

Keywords: Musculoskeletal Disorders (MSDs), Nordic Body Map, Rapid Entire Body Assessment, Auxiliary Tools

1. INTRODUCTION

Musculoskeletal Disorders (MSDs) are complaints that occur in parts of the skeletal muscles that a person feels, ranging from complaints to extreme pain [1]. MSDs complaints that often occur in industrial workers are wrist pain, neck pain, back pain, and pain in the elbows and feet [1]. This study, conducted in close collaboration with PT Tunas Toyota Rideon Tbk, aimed to address the high number of MSD complaints, especially among workers in the repair department. The demands of their work, which require them to provide service and repair services for customers' vehicles, often lead to complaints of wrist pain, neck pain, back pain, and pain in the elbows and feet. The workers' posture, such as bowing, stooping, and squatting repeatedly during working time, which is approximately 7 hours and repeated for six working days, was identified as a significant factor. Data obtained from interviews recorded that most MSDs complaints were in the waist area. If this problem is not resolved immediately, it will affect the company's performance and productivity. To conduct the research, body posture measurement methods such as RULA, REBA, QEC, and OWAS were used. The RULA and REBA methods are body posture assessment methods that focus on the upper part and the entire body, with a score that indicates the level of risk of body posture. However, REBA is more comprehensive than RULA because it considers more factors and provides a more detailed score. Meanwhile, OWAS is used to assess body posture in various situations, both work and sports. QEC is a body posture measurement method that focuses on assessing static body posture. In this study, the Rapid Entire Body Assessment (REBA) and Nordic Body Map (NBM) methods were used. Where from the results of these measurements, corrective steps will be taken by designing tools that can reduce bad REBA posture scores and minimize the occurrence of MSDs for workers.

2. METHODS

This research is included in the descriptive study category because the problems of the research object are clearly and systematically described and based on existing facts, namely the problems that occur in the posture of workers at Tunas Toyota Cilegon. The data used in this study are qualitative and quantitative. The quantitative data used is data generated from the assessment of the observed posture, while the qualitative research conducted uses a questionnaire to find out the sick body parts of the workers.

This research is a cross-sectional study because the research is only done once or at a time, even though it has several stages; the first stage is to identify and formulate problems obtained based on literature studies and field analysis, followed by the identification and formulation of problems based on previous analysis. The next stage is to set research objectives and continue with a review of related literature studies. Based on these objectives, the data collection process is carried out in the form of non-ergonomic postures. The results of the data that has been collected are then processed and analyzed to produce proposed improvements to increase productivity.

2.1 Nordic Body Map

Nordic Body Map is a very subjective assessment method, meaning that the success of this method application is highly

dependent on the conditions and situations experienced by respondents. Ergonomists have widely used the Nordic Body Map questionnaire to assess the severity of disorders of the musculoskeletal system and has sufficient validity and reliability [2].

Table 1 Scoring Results of NBM Questionnaire

No	Type of Complaints	Level of Complaint (Workers)				Total Score	Percentage
		No Pain	Some Pain	Pain	Very Painful		
0	Pain/stiff in the upper neck	3	4	5	0	26	3%
1	[ain in the lower neck	3	6	3	0	24	3%
2	Pain in the left shoulder	0	1	6	5	40	5%
3	Pain in the right shoulder	0	0	5	7	43	5%
4	Pain in the left upper arm	1	2	6	3	35	4%
5	Pain in the back	0	1	4	7	42	5%
6	Pain in the right upper arm	1	2	6	3	35	4%
7	Pain in the waist	0	0	2	10	46	5%
8	Pain in the buttock	3	7	2	0	23	3%
9	Pain in the bottom	6	3	3	0	21	2%
10	Pain in the left elbow	0	11	0	1	26	3%
11	Pain in the right elbow	0	2	7	3	37	4%
12	Pain in the left lower arm	5	4	2	1	23	3%
13	Pain in the right lower arm	2	1	6	3	34	4%
14	Pain in the left wrist	3	3	5	1	28	3%
15	Pain in the right wrist	1	4	5	2	32	4%
16	Pain in the left hand	5	3	3	1	24	3%
17	Pain in the right hand	0	4	7	1	33	4%
18	Pain in the left thigh	3	7	2	0	23	3%
19	Pain in the right thigh	2	4	5	1	29	3%
20	Pain in the left knee	0	0	3	9	45	5%
21	Pain in the right knee	0	0	3	9	45	5%
22	Pain in the left calf	1	4	3	4	34	4%
23	Pain in the right calf	1	1	5	5	38	4%
24	Pain in the left ankle	2	8	2	0	24	3%
25	Pain in the right ankle	2	7	2	1	26	3%
26	Pain in the left foot	5	6	1	0	20	2%
27	Pain in the right foot	6	6	0	0	18	2%
	Total					874	100%

After assessing the Nordic Body Map (NBM) score, it was found that all workers felt six complaints: pain in the right and left shoulders, back pain, and pain in the right and left knees.

The next step is to classify the intensity of the complaints. The following is a classification of complaint intensity based on NBM scores.

Table 2 Intensity of Complaints

Type of Complaints	No Pain	%	Pain	%	Description
Pain/stiffness in the upper neck	0	0%	12	100%	Complaints always occur
[ain in the lower neck	0	0%	12	100%	
Pain in the left shoulder	0	0%	12	100%	
Pain in the right shoulder	0	0%	12	100%	
Pain in the left upper arm	0	0%	12	100%	
Pain in the back	0	0%	12	100%	
Pain in the right upper arm	0	0%	12	100%	
Pain in the waist	0	0%	12	100%	
Pain in the buttock	0	0%	12	100%	

Type of Complaints	No Pain	%	Pain	%	Description
Pain in the bottom	1	8%	11	92%	
Pain in the left elbow	1	8%	11	92%	
Pain in the right elbow	1	8%	11	92%	
Pain in the left lower arm	1	8%	11	92%	
Pain in the right lower arm	1	8%	11	92%	
Pain in the left wrist	2	17%	10	83%	
Pain in the right wrist	2	17%	10	83%	
Pain in the left hand	2	17%	10	83%	
Pain in the right hand	2	17%	10	83%	Complaints almost often occur
Pain in the left thigh	3	25%	9	75%	
Pain in the right thigh	3	25%	9	75%	
Pain in the left knee	3	25%	9	75%	
Pain in the right knee	3	25%	9	75%	
Pain in the left calf	3	25%	9	75%	
Pain in the right calf	5	42%	7	58%	
Pain in the left ankle	5	42%	7	58%	Complaints often occur
Pain in the right ankle	5	42%	7	58%	
Pain in the left foot	6	50%	6	50%	
Pain in the right foot	6	50%	6	50%	

Based on the results of the Nordic Body Map (NBM), 14 types of complaint intensity are categorized as complaints that always occur, nine types of complaints are categorized as complaints that almost always occur, and five types of complaints are categorized as complaints that often occur.

2.2 Rapid Entire Body Assessment (REBA)

Rapid Entire Body Assessment is a method developed in the field of ergonomics and can be used quickly to assess the work posture or posture of the neck, back, arms, wrists, and legs of an operator as influenced by coupling factors, external loads supported by the body and work activities [3]. The following is one example of an assessment of the REBA method.

Fig. 1. Worker 1

Based on observations of work postures in car repair activities using the ErgoFellow software. The following are the steps in assessing posture using ErgoFellow 3.0:

- Neck, Truck, and Legs Assessment

Fig. 2 Neck, Truck, and Legs Assessment

- Load Assessment

Fig. 3 Load Assessment

- Upper arm, Lower arm, and Wrist Assessment

Fig. 4 Upper arm, Lower arm, and Wrist Assessment

- Coupling Assessment

Fig. 5 Coupling Assessment

- Activity Assessment

Fig. 6 Activity Assessment

- Posture Assessment Results

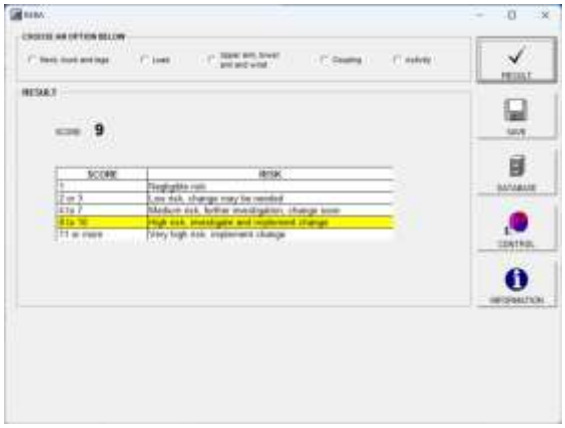

Fig. 7 Posture Assessment Results

The score result is 9 based on the stage-by-stage assessment of work posture using the REBA method above. Score 9 means that the worker's posture is at high risk and requires investigation and immediate improvements.

3. Results and Discussion

3.1 MSDs Complaints with NBM

Based on the results of the NBM questionnaire distribution and direct interviews, car repair technicians have the following complaints:

1) Shoulder pain
   Shoulder pain is felt by car repair technicians when performing the repair process with a position that is not ergonomic and is done repetitively.
2) Back pain
   Car repair technicians experience back pain when performing the repair process in a bent position for a long time.
3) Waist pain
   Repair technicians feel waist pain when performing the repair process in a twisting body position for an extended period of time.
4) Knee pain

Car repair technicians feel knee pain when they are carrying out the repair process in a crouched position for a long time, which leads to complaints about this part of the knee.

3.2 Work posture using REBA

The following is a recapitulation of the results of the REBA assessment.

Table 3 REBA Results Recapitulation

No	Identity	Score	Risk Level
1	Worker 1	9	High Risk
2	Worker 2	5	Medium Risk
3	Worker 3	11	Very High Risk
4	Worker 4	8	High Risk
5	Worker 5	4	Medium Risk
6	Worker 6	6	Medium Risk
7	Worker 7	11	Very High Risk
8	Worker 8	6	Medium Risk
9	Worker 9	9	High Risk
10	Worker 10	11	Very High Risk
11	Worker 11	4	Medium Risk
12	Worker 12	8	High Risk

The following is the risk classification of the REBA method.

Table 4 Classification of REBA

Action Level	REBA Score	Risk Level	Improvement Action
0	1	Can be ignored	Not necessary
1	2 – 3	Low	May need
2	4 – 7	Medium	Need
3	8 – 10	High	Need immediately
4	11+	Very high	Need urgently

The following are indications of workers.

1) Worker 1

Fig. 8 Worker 1

Worker 1 performs car repairs in a position that is not ergonomic. The position makes the neck of the worker form an angle of more than 20 degrees down, and the neck of the worker also rotates not parallel to the midpoint of the body. Then the torso of the technician also forms an angle between 20 and 60 degrees. Technician 1 uses both legs as a fulcrum, but both legs bend so that they make an angle of more than 60 degrees. This worker one posture in the REBA method has a value of 9, with an indication of high risk that requires immediate action.

2) Worker 2

Fig. 9 Worker 2

Worker 2 performs car repairs in a position that is not ergonomic. The position makes the neck of the worker form an angle between 0 to 20 degrees down (almost parallel to the torso), and the neck of the worker does not rotate and is parallel to the midpoint of the body. Then the technician's torso also forms an angle between 20 to 60 degrees. Technician 2 uses both legs as a fulcrum, but both legs bend so as to make an angle of more than 60 degrees. This worker two posture in the REBA method has a value of 5 with an indication of moderate risk that requires action.

3) Worker 3

Fig. 10 Worker 3

Worker 3 is performing car repairs in a position that is not ergonomic. This position makes the neck of the worker form an angle between 0 to 20 degrees down (almost

parallel to the torso), and the neck of the worker does not rotate and is parallel to the midpoint of the body. Then the technician's torso also forms an angle between 0 to 20 degrees. Technician 3 uses one of his legs as a fulcrum, but both legs bend so that it makes an angle of more than 60 degrees. In the posture of worker 3, the position of the hands exceeds 90 degrees which makes workers experience complaints. This posture of worker 3 in the REBA method has a value of 11 with an indication of very high risk which requires action at this time.

4) Worker 4

Fig. 11 Worker 4

Worker 4 is performing car repairs in a position that is not ergonomic. This position makes the neck of the worker form an angle between 0 to 20 degrees down (almost parallel to the torso), and the neck of the worker does not rotate and is parallel to the midpoint of the body. Then the technician's torso also forms an angle between 0 to 20 degrees. Technician 4 uses one of his legs as a fulcrum, but both legs bend so as to make an angle between 20 to 45 degrees. In the posture of worker 4, the position of the hands exceeds 60 degrees which makes workers experience complaints. This posture of worker 4 in the REBA method has a value of 8 with an indication of high risk that requires immediate action.

5) Worker 5

Fig. 12 Worker 5

Worker 5 performs car repairs in a position that is not ergonomic. The position makes the neck of the worker form an angle exceeding 20 degrees down, and the neck of the worker does not rotate and is parallel to the midpoint of the body. Then the technician's torso is also straight. Technician 5 uses both legs as a fulcrum, but both legs bend so that it makes an angle of more than 60 degrees. The posture of worker 5 in the REBA method has a value of 4, with an indication of moderate risk that requires action.

6) Worker 6

Fig. 13 Worker 6

Worker 6 performs car repairs in a position that is not ergonomic. This position makes the neck of the worker form an angle between 0 to 20 degrees down (almost parallel to the torso), and the neck of the worker does not rotate and is parallel to the midpoint of the body. Then the technician's torso also forms an angle between 20 to 60 degrees. Technician 6 uses both legs as a fulcrum, but both legs bend so as to make the angle more than 60 degrees. The posture of worker 6 in the REBA method has a value of 6 with an indication of moderate risk that requires action.

7) Worker 7

Fig. 14 Worker 7

Worker 7 performs car repairs in a position that is not ergonomic. The position makes the neck of the worker form an angle exceeding 20 degrees and the neck of the worker does not rotate and align with the midpoint of the

body. Then the torso of the technician also forms an angle between 20 and 60 degrees. Technician 7 uses one of his legs as a support, but both legs bend so that it makes an angle of more than 60 degrees. In the posture of worker 7, the position of the hands forms an angle between 20 to 45 degrees which makes workers experience complaints. This posture of worker 7 in the REBA method has a value of 11 with an indication of very high risk which requires action at this time.

8) Worker 8

Fig. 15 Worker 8

Worker 8 performs car repairs in a position that is not ergonomic. The position makes the neck of the worker form an angle between 0 to 20 degrees down (almost parallel to the torso), and the neck of the worker does not rotate and is parallel to the midpoint of the body. Then the torso of the technician also forms an angle between 0 to 20 degrees. Technician 8 uses both legs as a fulcrum, but both legs bend so as to make an angle of more than 60 degrees. This posture of worker 8 in the REBA method has a value of 6, with an indication of moderate risk that requires action.

9) Worker 9

Fig. 16 Worker 9

Worker 9 performs car repairs in a position that is not ergonomic. The position makes the neck of the worker form an angle between 0 to 20 degrees down, and the neck of the worker also rotates not parallel to the midpoint of the body. Then the technician's torso also forms an angle between 0 to 20 degrees. Technician 9 uses one of his legs as a fulcrum, both legs bend so that it makes an angle of more than 60 degrees. This posture of worker 9 in the REBA method has a value of 9 with an indication of high risk that requires immediate action.

10) Worker 10

Fig. 17 Worker 10

Worker 10 performs car repairs in a position that is not ergonomic. The position makes the neck of the worker form an angle exceeding 20 degrees, and the neck of the worker rotates and is not parallel to the midpoint of the body. Then the torso of the technician also forms an angle between 0 and 20 degrees. Technician 10 uses one of his legs as a fulcrum, but both legs bend, making the angle more than 60 degrees. In the posture of worker 10, the position of the hands makes an angle between 45 to 90 degrees which makes workers experience complaints. This posture of worker 10 in the REBA method has a value of 11 with an indication of very high risk which requires action at this time.

11) Worker 11

Fig. 18 Worker 11

Worker 11 performs car repairs in a position that is not ergonomic. The position makes the neck of the worker form an angle between 0 to 20 degrees down (almost

parallel to the torso), and the neck of the worker does not rotate and is parallel to the midpoint of the body. Then the technician's torso is straight. Technician 11 uses both legs as a fulcrum, but both legs bend so that they make an angle of more than 60 degrees. This posture of worker 11 in the REBA method has a value of 4 with an indication of moderate risk that requires action.

12) Worker 12

Fig. 19 Worker 12

Worker 12 performs car repairs in a position that is not ergonomic. The position makes the neck of the worker form an angle exceeding 20 degrees and the neck of the worker does not rotate and align with the midpoint of the body. Then the torso of the technician also forms an angle between 20 and 60 degrees. Technician 12 uses one of his legs as a support, but both legs bend so that it makes an angle of more than 60 degrees. In the posture of worker 12, the position of the hands forms an angle between -20 to 20 degrees which makes workers experience complaints. This posture of worker 12 in the REBA method has a value of 8, with an indication of high risk that requires immediate action.

3.3 Proposed Improvements

After knowing the various complaints that occur due to non-ergonomic postures and the level of risk that exists, this study provides suggestions for improvement in the form of habits to stretch, design tools and improve the posture of workers. The following are proposed improvements from researchers for this study:

1) Stretching

Stretching before and after work can reduce the risk of musculoskeletal complaints. Regular stretching between jobs also reduces muscle tension, improves blood circulation, and reduces anxiety. The following are examples of stretching movements that workers can do.

Fig. 20 Stretching

2) Auxiliary tools

Fig. 21 Creeper

Creeper 1 above has an overall size of 390 x 360 x 360 mm which has been adjusted to the dimensions for making a small chair, such as D16, which is the popliteal height, D19, which is the hip width, and D14, which is the popliteal length of an adult with an age range of 23-51 years. This tool has product specifications made of stainless steel, which makes it sturdy and robust to support loads of up to 115 kg. This tool also has a tool tray located under the base of the chair so that it can easily do work without having to take tools in place. In addition, this tool is equipped with wheels that will facilitate the movement of workers who will use it. In this first tool, there is a feature that the height of this chair can be adjusted. This allows workers with different heights to work comfortably.

3) Posture Improvements

Fig. 22 Posture Improvement

After improving posture using the Creeper, a posture assessment using REBA was carried out again. The following are the results of the REBA assessment after improvement.

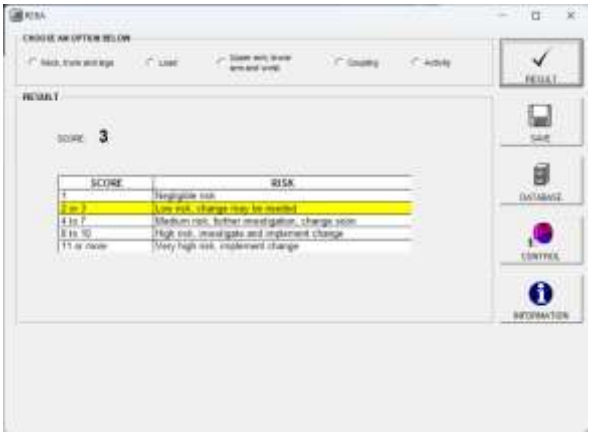

Fig. 23 Posture Assessment Results After Improvement

After reassessment, the value of the REBA posture improvement is 3. Improvements are made by changing the back posture of workers who previously bent from the midline to straight with the midline so that it can reduce the score of REBA. This must be corrected immediately because if it continues, it will cause injury or pain in the area. In addition to improving posture, tools are also needed to minimize the occurrence of Musculoskeletal Disorders complaints. The tool used to improve posture in workers is the Multi-Function Creeper. This creeper serves to help the work of reparation workers do their work comfortably and reduce the occurrence of Musculoskeletal Disorders complaints. The result of the REBA score after improvement is 3. This REBA 3 score is included in the medium risk category, which is not too risky for the health of the worker's bodies.

4. CONCLUSION

Based on the results of data processing that has been analyzed and discussed in this study, the following conclusions are obtained:

A. Based on the results of the NBM questionnaire, workers in the Tunas Toyota repair department found that out of 12 workers, there were nine workers were categorized as having a high level of body risk, and three workers were categorized as having a moderate level of body risk. In addition, it was found that there were 14 types of complaint intensity categorized as complaints that always occur, nine types of complaints categorized as complaints that almost always occur, and five types of complaints categorized as complaints that often occur. Then, in complaints that always occur, there are nine complaints that have a percentage of 100% pain, which consists of types of complaints on the left & right shoulders, back pain, back pain, and pain on the left & right knees. It can be concluded that workers experience complaints due to postures that are less ergonomic, this is explained through several complaints of limbs that experience a percentage of 100% pain.

B. Based on the assessment of work postures that have been carried out using the REBA method, it is known that reparation workers have three workers with a very high-risk level, each with a score of 11, then there are four workers with a high-risk level with two workers each with a score of 9 and 2 other workers with a score of 8. As for the medium risk level, there are five workers, with two workers each with a score of 6, 2 workers with a score of 4, and 1 worker with a REBA score of 5.

C. Based on the known REBA score, there is a need for improvement in work postures, tools, and work habits. Recommendations for improvements that can be made to reduce the possibility of MSDs complaints include performing excellent and correct work postures in accordance with ergonomic postures. In addition, tools such as the Multi-Function Creeper are provided to support workers in doing work. The tool has a function, one of which is to maintain posture so that it remains in the correct position, one of which has an adjustable feature. Then the following improvement recommendation is to start getting used to stretching or resting periodically to stretch the muscles so as not to get tired.

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