PROPOSED IMPROVEMENT OF ERGONOMIC WORK POSTURES ON SMOOTHING WORKERS

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ABSTRACT

CV. Sumber Jaya, located in Serang City, is a UMKM engaged in the service of making fences, trellises, handrails and canopies. The workers at CV. Sumber Jaya is at risk of developing Musculoskeletal Disorders (MSDs) due to several factors, namely working in a squatting work posture, bending back position and static work for a long time. There are 4 workers studied, namely manager, painting section, welding section, and refinement section. In the distribution of the Quick Exposure Check (QEC) questionnaire, it was obtained the results of the management workers with an exposure score of 78, painting workers with an exposure score of 106, welding workers with an exposure score of 113, and the highest value of refinement workers with an exposure score of 116. The purpose of this study was to find out complaints of pain in workers CV. Sumber Jaya and to determine the assessment of work postures on workers with the highest exposure score, namely refinement workers. In this study using the Nordic Body Map (NBM) method and the Rapid Entire Body Assessment (REBA) method.

KEYWORDS: Work Posture, Musculoskeletal Disorders, QEC, NBM & REBA

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1. INTRODUCTION

Work posture will affect employee productivity, poor working posture will result in inconvenience to the employees, lack of comfortable early makes employees more rest and make employee productivity will decline. Work posture is very important for productivity needs to be examined what kind of ergonomic posture for employees so that employees are comfortable. Bridger (1995) explains that the main purpose of conducting research on posture is to develop principles for designing work environments so that postural stress levels in workers are low. The use of work environment design is expected to reduce the incidence of fatigue and discomfort in the workplace (Bridger in Hudang, 2013).

Work activities with non-ergonomic body postures can cause adverse effects for employees, one of the consequences is musculoskeletal complaints. Musculoskeletal disorders (MSDs) are the complaints on parts of the skeletal muscle is perceived by someone from complaints very mild to very ill a sovereign, when muscles receive static load repeatedly in long periods of time can cause damage to the joints, ligaments and tendons (Tarwaka, 2004). The factors that cause the MSDS is the work that is done repeatedly, is not ergonomic working postures, their vibration, lack of knowledge about the workplace, organizing work and working variations (Tarwaka, 2004).

CV. Sumber Jaya is micro, small and medium enterprises (SMEs) in the manufacturing of the fence, trellises, handrail and canopy. CV Sumber Jaya is located at HM. Muslih, Cikulur Baru, Serang city (in front of

Materials Supermarket namely Artha Building). There are 4 workers, the labor activity of cutting material, weld, men putty, smoothing and painting using a grinding machine. The whole process of workmanship using human skill and orders that there is a continual demand to be productive employees. When working with very high intensity there is a possibility of injury to parts of the body while working.

The majority of employee postures by cutting, welding and smoothing objects with squat posture, the work position reduces employee comfort and potentially causes injury because the production process is carried out with a long period of time around 7-8 hours, if done continuously will result in musculoskeletal disorders (MSDs). Due to complaints of discomfort in some parts of the body, employees are more rested which results in decreased employee productivity to measure work posture can be done with QEC.

Quick Exposure Check (QEC) is the method that can be used to determine the risk musculoskeletal disorders (MSDs), which focuses on the upper body, namely the waist, back, neck, arm/ shoulder, and wrist. The advantage of the QEC method is to consider the conditions experienced by workers from two points of view, namely from the point of view of the observer and the employee himself. This can reduce the subjective assessment bias of the observer, this QEC method can also be applied to static and dynamic work (Adha, et al., 2014).

At the initial observation, based on the deployment of questionnaires QEC that have been spread to the four workers have been getting results from welding work, smoothing, manager and painting some of the work the possibility of having the risk of musculoskeletal disorders (MSDs) and most likely to have the risk of musculoskeletal disorders (MSDs) are the work of smoothing, can be seen in Table 1.

Table 1: Results of the QEC Research Questionnaire Observation

The worker	Profession	Exposure Score	Exposure Level	Action Level
1	Welding	113	69.75%	Need further research and changes
2	Smoothing	116	71.60%	Do research and change as soon as possible
3	Manager	78	48.15%	Need further research
4	Painting	106	65.43%	Need further research and changes

To assess the risk of ergonomics in the workplace that can lead to musculoskeletal disorders (MSDs) there are many methods introduced by experts. Rapid Upper Limb Assessment (RULA) is a method developed in the field of ergonomics that investigates and evaluates work positions carried out by the upper body. Assessment using the RULA method requires a little time to complete and do a general scoring on the list of activities that indicate the need for risk reduction due to physical removal by the operator (Mc. Atemney, 1993).

Rapid Entire Body Assessment (REBA) is a method developed in the field of ergonomics and can be used quickly to assess the work position or posture of the operator's neck, back, arms, arms and legs. Assessment using REBA does not require a long time to complete and do a general scoring on the list of activities that indicate the need for risk reduction due to operator work posture (Hignett and Mc Atemney, 2000).

The implementation of OCRA index can reduce the risk of ergonomic problems and musculoskeletal disorders in operators who experience some work complaints (Roossary and Muslim, 2007). QEC is a method for assessing risks associated with muscle disorders in the workplace. This method assesses risk disorders that occur in the back of the back, shoulders / arms, wrists, and neck (Stanton, 2005). Strain Index is a semi-quantitative work analysis method developed based on physiological, biomechanical, and epidemiological principles (Moore and Garg, 1995).

Nordic Body Map (NBM) is a questionnaire for risk identification. The Nordic Body Map questionnaire is a tool used to determine MSDs health problems based on workers' complaints of complaints on 28 parts of the muscle that are felt sick at the type of level of complaint, fatigue or pain (from painless to very painful) (Karwowski W., 2006) .

In this study using the QEC (Quick Exposure Check) method to look for complaints MSDs on workers of CV. Sumber Jaya. NBM (Nordic Body Map) to analyze complaints is subjective to the possibility of MSDs and REBA (Rapid Entire Body Map) to assess of work posture. In the research of Yuslistyari and Adhadin (2018) with the title "Repair Operational Posture of Welding Operators with the QEC Method", based on their study posture of welding operators raises the risk of musculoskeletal disorders, research on welding operators 1 obtained a total exposure score of 106 with exposure level of 59.55%, while the operator 2 obtained a total exposure score of 124 and an exposure level value of 69.66%, there is no action level. Improvements are made with the aim of making conditions safe, comfortable and not cause complaints MSDs while working, namely at a standing work station by designing a tool in the form of a welding work table. After implementing the welding work table to the two operators and recalculating the QEC value, the operator level 1 exposure value was obtained at 48.31% and for operator 2 it was 49.43% with action levels needing further research.

In Novianti and Tanjung's research (2016) for the analysis of subjective complaints the Nordic Body Map (NBM) questionnaire was used. Based on observations using the NBM questionnaire it was found that workers complained of pain as much as 80% on the right shoulder and 60% on the right elbow. In addition, 50% of workers complained of back pain and 40% of the waist, and 10% of workers complained of pain in the left and right elbows. The results of this study indicate that of the seven activities studied there are five activities that have a low risk level (low) and two activities that have a medium risk level. The study proposes improvement on the two postures with priority on the posture process Dimensional & Visual Inspection and End Shearing.

According to Restuputri, et al (2017) the work posture of bending and squatting is less ergonomic and has the potential to cause a risk of musculoskeletal disorders. The REBA method is suitable for solving these problems. The results showed 6 work postures with "moderate" risk level, 4 work postures with "high" risk. The entire work posture in the production process sanitair requiring corrective action work posture.

The aim of this study is to find out the results of NBM complaints on CV Sumber Jaya employees, to find out the score and risk category of REBA on the refinement worker CV. Sumber Jaya, know the score and risk category of REBA after simulations using tools.

2. RESEARCH METHOD

The stages of the study consisted of:

1. Data collection

After the problem is identified, then do the data collection. The data needed in the study are workers at CV. Sumber Jaya, especially workers in workers who are most at risk of experiencing musculoskeletal disorders (MSDS).

2. Data Processing

a. Calculation of the NBM Questionnaire

The questionnaire given to the 4 operators will then be calculated in value, the results of the complaints felt by the 4 pulling

workers will be obtained later. In the parts of whatever complained of pain while doing work, the next step is to calculate the percentage of complaints felt by workers.

b. REBA Method Risk Calculation Calculation

Assessment using REBA that has been done by Dr. Sue Hignett and Dr. Lynn McAtamney goes through the following stages (McAtamney and Hignett, 2000).

- Retrieval of employee posture data using video or photo assistance.
- Determination of the angles of the worker's body parts.
- Determination of weight of objects lifted, couplings and worker activities.
- Calculation of REBA value for the relevant posture.

c. Ergellow 2.0 software is used to determine the angle of body posture that will be used for data processing using image analysis tools. Ergofellow software.

3. Analysis and Design

SketchUp 2018 software is used to make suggestions for improvement in the form of design tools. SketchUp 2018 software is also used to simulate refining workers by making worker mannequins by designing manuals.

3. RESULTS AND DISCUSSIONS

A. Results

In this study the subject is the employees of CV. Sumber Jaya micro, small, and medium enterprises (MSMEs) which is located at HM. Muslih, Cikulur Baru, Serang city (in front of Materials Supermarket namely Artha Building). CV. Sumber Jaya is a MSME in saying the services of making fences, trellises, handrails and canopies.

Table 2: Results of the QEC Research Questionnaire Observation

The worker	Profession	Score	Level	Action Level
1	Welding	113	69.75%	Need further research and changes
2	Smoothing	116	71.60%	Do research and change as soon as possible
3	Manager	78	48.15%	Need further research
4	Painting	106	65.43%	Need further research and changes

Table 3: Recap the NBM Value Before and After Work

No.	Type of complaint	Before work					After work				
		The worker				Total Score	The worker				Total Score
		1	2	3	4		1	2	3	4	
0	Pain or stiffness in the upper neck	1	1	1	1	4	2	2	1	2	7
1	Pain or stiffness in the lower neck	1	1	1	1	4	2	1	1	2	6
2	Left shoulder pain	1	1	1	1	4	1	1	1	1	4
3	Pain in the right shoulder	1	1	2	1	5	2	2	2	2	8
4	Pain in the left upper arm	1	1	1	1	4	1	2	1	1	5
5	Pain in the upper back	1	1	1	1	4	2	3	1	2	8
6	Pain in the left upper arm	1	1	1	1	4	2	3	1	2	8
7	Pain in the lower back	1	1	2	1	5	3	3	2	1	9
8	Low back pain	1	1	2	1	5	2	3	2	2	9
9	Pain in the buttocks	1	1	1	1	4	1	1	1	1	4
10	Pain in left elbow	1	1	1	2	5	3	1	1	1	6

No.	Type of complaint	Before work					After work				
		The worker				Total Score	The worker				Total Score
		1	2	3	4		1	2	3	4	
11	Pain in the right elbow	1	1	1	1	4	1	2	1	2	6
12	Pain in the left forearm	1	1	1	2	5	2	2	1	1	6
13	Pain in the right lower arm	1	1	1	1	4	2	3	1	2	8
14	Pain in the left wrist	1	1	1	2	5	2	2	1	2	7
15	Pain in the right wrist	1	1	1	1	4	1	3	1	2	7
16	Pain in the fingers of the left hand	1	1	1	1	4	2	1	1	1	5
17	Pain in the fingers of the right hand	2	1	1	1	5	1	2	1	2	6
18	Pain in the left thigh	1	1	2	1	5	2	1	1	1	5
19	Pain in the right thigh	1	1	1	1	4	2	2	2	1	7
20	Pain in the left knee	1	1	1	1	4	2	2	1	1	6
21	Pain in the right knee	1	1	2	1	5	2	3	2	2	9
22	Pain in the left calf	1	1	1	1	4	2	1	1	1	5
23	Sakir on the right calf	1	1	1	1	4	2	2	1	2	7
24	Pain in the left ankle	1	1	1	1	4	2	2	1	1	6
25	Pain in the right ankle	1	1	2	2	6	2	2	2	2	8
26	Pain in left foot	1	1	1	1	4	1	1	1	1	4
27	Pain in the sole of the right foot	1	1	1	1	4	2	1	1	1	5

Information; TS score "Doesn't hurt" the NBM value is 1, US score "Is a bit sick" the NBM value is 2, the S Score "hurts" the NBM value is 3, SS score is "very sick" the NBM value is 4 .

According to Tarwaka (2014) the level of complaints of *musculoskeletal disorders* (MSDs) is said to be low if the total NBM score is 28-49. It is said to be moderate if the NBM score is 50-70, high if the NBM score is 71-91 and very high if the NBM score is 92-112.

Table 4: Results of NBM scores Before and After Work

The worker	Profession	Grievance Level	TS	US	S.	SS	Before work	TS	US	S.	SS	After Work
1	Welding	Low	27	2	0	0	29	7	38	6	0	51
2	Smoothing	Low	28	0	0	0	28	9	24	21	0	54
3	Manager	Low	22	12	0	0	34	22	12	0	0	34
4	Painting	Low	26	8	0	0	32	14	28	0	0	42

On the NBM score before work, the level of *musculoskeletal disorders* (MSDs) complaints of all workers CV. Sumber Jaya "Low". After working the NBM score on managing workers and painting workers the NBM score is still "Low", in contrast to welding workers and NBM score refinement workers change to "Medium", the possibility of the risk of experiencing MSDs still exists. Doing the Refining of NBM scores to find out the most felt by the workers of CV. Sumber Jaya. Then analyze with REBA (Rapid Entire Body Map) method by determining group A, group B, and activity score.

Table 5: Group A Score Recap

No.	Posture	Angel	Description	Score	Change Score	Total
1	Neck	22.14°	> 20° In front of or back of the body	2	There is no	2
2	Back	35.34°	20° - 60° in front of body; > 20° back of the body	2	+1 if the Back is spinning or bending	3
No.	Posture	Angel	Description	Score	Change Score	Total

3	Legs	160.79°	One leg holds the body weight, such as standing on one foot or an unstable work attitude	2	+2 if the knee is bent >60°	4
4	Force		<5kg	0	+1 in the event of additional or sudden burdens	1

The results of the score recap in table 5. to facilitate the transfer of values from group A work posture, then the score will be included in table A.

Table 6: Table A Score

Table A	Neck												
		1				2				3			
	Legs	1	2	3	4	1	2	3	4	1	2	3	4
Trunk Posture Score	1	1	2	3	4	1	2	3	4	3	3	5	6
	2	2	3	4	5	3	4	5	6	4	5	6	7
	3	2	4	5	6	4	5	6	7	5	6	7	8
	4	3	5	6	7	5	6	7	8	6	7	8	9
	5	4	6	7	8	6	7	8	9	7	8	9	9

A load score (load/force) is added to the table A score to produce an A score as follows:

$$\text{Score A} = \text{Table Score A} + \text{Load Score}$$

$$\text{Score A} = 7 + 1 = 8$$

Table 7: Group B Scores Recap

No.	Posture	Angel	Description	Score	Change Score	Total
1	Hands Up	91.16°	45° - 90° in front of body	3	There is no	3
2	Lower Hand	46.79°	< 60° - > 100° in front of body	2	There is no	2
3	Wirst	21.65°	>15° back of or In front of the body	2	There is no	2
4	Grip		Fair (Handrails are still acceptable even if not ideal)	0	There is no	1

Table 8: Table B Score

Table B	Lower Arm						
	Wirst	1			2		
		1	2	3	1	2	3
Upper Arm Score	1	1	2	3	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

Score grip (coupling) is added to the score table B to produce a score of B as follows:

$$\text{Score B} = \text{Table B Score} + \text{Grip Score}$$

$$\text{Score B} = 6 + 1 = 7$$

Table 9: Table C Score

Table C												
Score A	Score 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	12	12	12	12	12	12	12	12	12
12	12	12	12	12	12	12	12	12	12	12	12	12

Score A and score B are combined using table C, after finding the results of the table C score is added to the *Activity Score* which can be calculated using the equation

$$\text{Score C} = \text{Score A} + \text{Score B}$$

$$\text{Score C} = 7 \text{ and } 8 = 10$$

Table 10: Activity Score

No.	Posture	Description	Score
1	Activity	Looping (repeating) a small portion of activity, such as repeating more than 4 times in 1 minute (in this case walking is not included)	1

REBA *Action Level* Calculation

Further score REBA mapped to the level of action (*action level*). To calculate REBA scores:

$$\text{REBA Score} = \text{C} + \text{Activity Score}$$

$$\text{REBA score} = 10 + 1 = 11$$

Table 11: Action Level REBA

Action Level	REBA score	Risk level	Corrective action
0	1	Can be ignored	No need
1	2-3	Low	Maybe it's necessary
2	4-7	Is	Need
3	8-10	High	Need immediately
4	11-15	Very high	You need it right now

Sources: McAtamney and Hignett (2000)

Work posture on worker smoothing CV Sumber Jaya in Table 11 with REBA score 11 then the *action level* of 4, the level of risk is very high and measures Improving the need to do today.

Figure 1: Fishbone Diagram

In the *fishbone* diagram that shows the refinement section shows the condition of the work posture is very risky due to humans or workers CV. Sumber Jaya did not understand that squatting posture, bending back and bent arms were not good. The machine used is a grinding machine, the grinding machine vibrates and there is no additional grip. The method of work, when working a static worker's body for a long period of time. Raw materials or materials that will be made by heavy workers.

Proposed Improvement

Proposed improvements in refining workers for grinding machines plus additional grip so that when gripping more tightly and safely, at work it takes a short break to stretch muscles and add tools to change work postures to be more ergonomic.

Based on the data processing *Rapid Entire Body Assessment* (REBA) work posture on the smoothing workers CV Sumber Jaya scores REBA C with a score of 11, with the *action level* of 4, the level of risk is very high and measures p Improving the need to do today. Based on *fishbond* analysis also in the *Refinement* section shows the condition of the work posture is very at risk of impacting MSDs. This will be given a proposal for improvement in the form of a table design as a tool for improving posture. The design of tools can be seen in Figure 2.

Table 12: Names of Tools

No.	Item Name	Long	Wide	High
1	Material table	240 cm	120 cm	82 cm
2	Material support	240 cm	50 cm	82 cm
3	stoper material	5 cm	5 cm	5 cm

Table 13: Names of Material Used

No.	Material Name	Long	Wide	High	Thick
1	Iron plate	244 cm	122 cm	2 cm	-
2	Holo Iron	600 cm	6 cm	6 cm	3 mm
3	Iron pipe	600 cm	5 cm	5 cm	2 mm

Figure 2: Worker's Aids

After making the design of the assistive tool, the next step is to make a simulation of the refining worker to determine the REBA score after making improvements by preparing the refinement tool, for the simulation of refining workmanship can be seen in Figure 4.3.

Figure 3: Improvement of Body Posture Angle

Table 14. Recap of Group A Scores After Improvement

No.	Posture	Angel	Description	Score	Change Score	Total
1	Neck	7.53°	0°- 20° In front of	1	There is no	2
2	Back	18.90°	20° - 60° In front of or back of the body	2	There is no	2
3	Legs	0.0°	Both legs hold body weight, for example walking or sitting	1	There is no	1
4	Force		<5kg	0	+1 if additional loads occur suddenly or quickly	1

Table 15: Table A Scores After Improvement

Table A	Neck												
	Legs	1				(2)				3			
		1	2	3	4	(1)	2	3	4	1	2	3	4
Trunk Posture Score	1	1	2	3	4	1	2	3	4	3	3	5	6
	(2)	2	3	4	5	3	4	5	6	4	5	6	7
	3	2	4	5	6	4	5	6	7	5	6	7	8
	4	3	5	6	7	5	6	7	8	6	7	8	9
	5	4	6	7	8	6	7	8	9	7	8	9	9

Score A = Table Score A + Load Score

Score A = 3 + 1 = 4

Table 16: Group B Score Recap After Improvement

No.	Posture	Angel	Description	Score	Change Score	Total
1	Hands Up	39.55°	> 20° back of body; 20° – 45° in front of body	2	There is no	2
2	Lower Hand	35.94°	60° - 100° in front of body	1	There is no	1
3	Wirst	11.90°	0° - 15° back of or In front of the body	1	There is no	1
4	Grip		Fair (Handrails are still acceptable even if not ideal)	1	There is no	1

Table 17. Table B Scores after Improvement

Table B	Lower Arm						
	Wirst	(1)			2		
		(1)	2	3	1	2	3
Upper Arm Score	1	1	2	3	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

Score B = Table B Score + Grip Score

Score B = 1 + 1 = 2

Table 18. Scores Table C

Table C												
Score A	Score 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	12	12	12	12	12	12	12	12	12
12	12	12	12	12	12	12	12	12	12	12	12	12

$$\text{Score C} = \text{Score A} + \text{Score B}$$

$$\text{Score C} = 4 + 2 = 4$$

Table 19: Activity Score after Improvement

No.	Posture	Description	Score
1	Activity	Looping (repeating) a small portion of activity, such as repeating more than 4 times in 1 minute (in this case walking is not included)	1

$$\text{REBA Score} = \text{C} + \text{Activity Score}$$

$$\text{REBA score} = 4 + 1 = 5$$

After the improvement, the REBA score drops, which initially REBA score 11 before improvement and after improvement REBA score becomes 5. With *action level 2*, the level of risk is and measures Improving the need later.

Table 20: Recap of Results Before and After Work Posture Improvement

Date	Before Repair	After Repair
Action Level	4	2
REBA score	11	5
Risk level	Very High	Is
Corrective action	Need Right Now	Need

B. DISCUSSIONS

NBM Questionnaire Analysis

Based on the results of the processing of the NBM questionnaire data, complaints were obtained before all workers received "Low" complaints. After working for management and painting workers is "Low", for welding and refinement workers the complaint is "Medium". Scores of complaints before the work that most of the pain in the right ankle with a score of 6. The portions were a lot of complaints after the work is in the lower back with a score of 9, complaints at the waist with a score of 9 and complaints on ⁰ part of the right knee with a score of 9. this is due to their posture when working with a squatting posture and bent so that workers feel stiffness and pain in the part, if done continuously will cause *musculoskeletal disorder* (MSDs).

REBA Analysis

The object of this research is the refinement worker with the highest QEC score than other workers, with an *exposure score* of 116, an *exposure level* of 71.60%, the *action level* is carried out research and changes as soon as possible. Based on the REBA data processing of refining workers with a REBA score of 11, the level of risk is very high and action is necessary at this time. The cause of the high REBA score is the posture of the worker working with the jongkon posture while bending, working with the back posture angle of 35.35 °, the posture angle of the foot 160.79 ° one leg holding the body weight and the upper hand posture angle of 91.16 °.

After designing the tools and simulating it by making a refinement mannequin, REBA calculations are performed. In the calculation of REBA, it was found that the REBA score was reduced, previously without the aid of REBA score was 11, the risk level was "Very High", by using the REBA score the tool dropped to 5, with the risk level "Medium".

4. CONCLUSIONS

Based on the research conducted, the following conclusions can be obtained:

- On distributing the NBM questionnaire, the results of the NBM score before work and after work have been obtained. The results of the NBM questionnaire before working on welding workers NBM score 29, refinement workers score NBM 28. While the NBM score manager is 34 and the NBM score is 32. While the results of the NBM questionnaire after working for the NBM score welding worker are 51, the NBM score refinement worker is 54, the NBM score manager is 34, and the NBM score painting worker is 42. Before working, the most complaints were right ankle pain with a total score of 6. After work the highest complaint is pain in the lower back with a total score of 9, pain in the waist with a total score of 9, and pain in the right knee with a total score of 9.
- In the study obtained REBA scores on refinement workers CV. Sumber Jaya with REBA score of 11, *the action level* of 4, the level of risk "Sangat Tinggi" and an act p Improving the need to do today.
- After designing the tools and simulating the REBA score on the refining worker CV. Sumber Jaya with a REBA score of 5, *action level* 2, "Medium" risk level and need action.

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