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Analysis of Work Posture tn the Car Body Assembly Process Using the Rapid Entire Body Assessment Method

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Abstract

CV. Faisyal Putra Mandiri located at Kandangan Rejo Lebar street No.11 Surabaya City, is one of the manufacturing industry companies engaged in car body production. In their work activities there are still workers who do not apply ergonomic work postures while working. Unergonomic work positions can cause some parts of the body to not be in their normal position so that they are very vulnerable to musculoskeletal disorders. To overcome these problems, work posture improvement is carried out. Based on the results of the study, it was found that after simulating the use of tools in the metal cutting process, namely the Hydraulic Scissor Lift Table, it can reduce the risk of worker injury through a final REBA value of 7 with a moderate risk level to a final REBA value of 2 with a low risk level. Then in the welding process can reduce the risk of worker injury through the final REBA value of 9 with a high risk level to the final REBA value of 3 with a low risk level. In addition, it is recommended to use a chair as a tool, which is proven through work simulation to reduce the risk of injury. In metal cutting, the REBA value drops from 7 with a moderate risk level to 3 with a low risk level, and in welding, from 9 with a high risk level to 3 with a low risk level.

Introduction

The development of the industrial sector encourages companies to improve their performance. Industrial work often involves physical tasks that require human interaction with equipment and manual processes. According to Miswari et al. (2021), Manual Material Handling (MMH) is widely used because it is cheap and easy, but it risks causing musculoskeletal disorder (MSDs) complaints and increasing muscle fatigue due to the many contractions involved. CV. Faisyal Putra Mandiri located at Kandangan Rejo Lebar street No.11 Surabaya City, East Java is one of the manufacturing industry companies engaged in car body production. The company focuses on the production of additional or modified structures on truck vehicles and has special expertise in designing and producing various types of tailgate according to the needs of specific customers or industries. To maintain the quality of its production, of course, the company is very dependent on the ability of employees, the higher the ability of employees to work, the higher the quality of the output. According to Wijaya (2019), to achieve maximum output, of course, you have to see whether the posture of the worker is comfortable in carrying out his work activities. In the stages of production work there are activities that have ergonomic risks, such as unnatural work postures when doing work so that these conditions pose a musculoskeletal risk to workers and result in decreased production effectiveness in the workplace (Bazaluk et al., 2023; Cohen, 1997).

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The car body production division undergoes a work process that includes metal cutting, turning, welding, painting, component installation, and quality checking. Based on the results of interviews and observations of the head of the production division and workers, fatigue and muscle pain in the back and waist and certain parts of the body are often complained about during work activities and it was found that some workers did not apply ergonomic work postures when carrying out their work activities, especially in the metal cutting and welding division where there are 8 workers in the metal cutting and welding division, who work for 8 hours from 08.00 - 16.00 WIB. The production process takes a long time due to the density of activities and is done repeatedly. So that it can cause musculoskeletal disorders.

Figure 1. Metal cutting process

The picture above is a metal cutting activity where workers show work postures that look less ergonomic due to static work attitudes where one or more parts of the body are in a static / silent state, such as holding work tools in a bent state for more than 1 minute.

Figure 2. Metal welding process

The picture above is a metal welding activity where workers show work postures that look less ergonomic due to static work attitudes where one or more parts of the body are static / silent, such as holding work tools for more than 1 minute, in a state of bending and repetitive movements occur more than 4 times per minute.

This study aims to analyze work postures by considering ergonomic aspects in order to improve workers' welfare, productivity, and health. Ergonomics is the science of utilizing information about human capabilities and limitations to create effective work systems (Ginting, 2010; Karwowski, 2006). To control health risks due to ergonomic hazards, a work posture assessment was conducted on the car body production activities at CV. Faisyal Putra

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Mandiri. The assessment was conducted using the Rapid Entire Body Assessment (REBA) method to analyze the risk of muscle injury and the Nordic Body Map (NBM) method to identify the type and level of musculoskeletal complaints. The REBA method helps to improve workers' body movements, increase their sense of safety, comfort, and increase production effectiveness (Gajšek et al., 2022; Amri & Putra, 2022).

Ergonomic

Ergonomics is a science that studies human behavior in the workplace. The target of ergonomics research is humans in the work environment. In short, ergonomics is changing the way the human body works to reduce stress. Adjusting the temperature, light, and humidity of the workplace according to the needs of the human body is one of the efforts (Ir Julianus Hutabarat, 2021). Ergonomics is defined as a scientific discipline that studies the limitations, advantages, and characteristics of humans and uses this information to design products, machines, facilities, environments, and even work systems with the aim of achieving the best quality of work without neglecting health, safety, and human comfort in working and doing activities in everyday life (Irisdiastadi & Yassierli, 2014; Hasibuan et al., 2020).

Antropometri

According to Wignjosoebroto (2006), anthropometry can be stated as a study related to measuring the dimensions of the human body such as body weight, position when standing, when stretching out hands, body circumference, limb length and so on. Meanwhile, according to Eko Nurmianto (2004), anthropometry is a collection of numerical data related to the physical characteristics of the human body size, shape and strength and the application of these data for handling design problems. Anthropometry is one part that supports ergonomics, especially in designing equipment based on the principles of ergonomics (Azmi et al., 2021; Dianat et al., 2018).

Musculoskeletal Disorders

Musculoskeletal Disorders are disorders characterized by injuries to muscles, tendons, ligaments, nerves, cartilages, bones, or blood vessels in the hands, feet, neck, and back caused by work with unnatural postures (Yani et al., 2022). According to Tarwaka & Sudiajeng (2004), musculoskeletal complaints are complaints that occur in skeletal muscles experienced by a person ranging from mild complaints to very severe complaints repeatedly over a long period of time which can cause damage to the muscles.

Nordic Body Map

Nordic Body Map (NBM) is a method of measuring musculoskeletal complaints where workers can indicate the level of complaints from no pain to severe pain in their body parts (Adiyanto et al., 2022). Nordic Body Map is one of the subjective measurement methods in the scientific field of ergonomics using a questionnaire to measure the muscle pain of workers (Wijaya, 2019). Nordic Body Map (NBM) is an ergonomic checklist questionnaire that is most often used to determine the discomfort of workers because it is standardized and neatly arranged. Completing the Nordic Body Map questionnaire aims to find out the body parts of workers who feel pain in doing work at work stations (Azwar, 2020).

To find out the percentage of complaints of each severity in certain body parts, the answers given by the respondents were calculated and the percentage of each limb was calculated using the following formula:

$$\text{Percentage of complaints} = \frac{\text{Number of complaints}}{\text{Number of workers}} \text{ x } 100\% \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \textit{(2.1)}$$

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Rapid Entire Body Assessment

The REBA method was introduced by Hignett & McAtamney (2000) and published in the journal Applied Ergonomics in 2000. The method is the result of collaborative work by a team of ergonomists, physiotherapists, occupational therapists and nurses who identified around 600 positions in the manufacturing industry. The REBA method allows for a joint analysis of positions occurring in the upper limbs (arms, forearms and wrists), torso, neck and legs. It also describes additional elements that can determine the final assessment of a posture or unstable position. One of the functions of REBA is to categorize and assess posture risk in all parts of the worker's body. REBA can be applied to assess the risk of overall posture whether static, dynamic or unstable and to assess the effectiveness of workstation design modifications by assessing REBA scores on workers before and after the changes (Ansari & Sheikh, 2014; Julianus, 2019).

Assessment Procedures Related to Rapid Entire Body Assessment

With the REBA method, To get accurate assessment results with the REBA method, it is very important to determine the angles correctly. This method relies on the given angle information. The inputs used include pictures or videos of postures and angles of the six body parts. This angle information is then converted into an assessment score using the REBA method, and the final score indicates the severity of the action to be taken immediately. According to Rizkya et al. (2018), the work posture assessment procedure using the REBA method has the following steps:

Job Observation

The purpose of observation is to provide a thorough assessment of the things observed. This includes the workplace environment and design, the equipment used, and the risk-taking behavior of workers. To get a clearer picture, videos or photos of the observed objects can be taken.

Taking the Right Body Position for Assessment

There are many criteria that can be used to make a decision on which body position is most suitable for analysis. When choosing the right body position for analysis, several criteria can be considered. These include postures that people are accustomed to, postures that workers have used the longest, postures that require a lot of force or muscle activity, uncomfortable postures, extreme, unstable, or awkward postures, and postures that can be improved by controls, actions, or other changes.

Rating the Posture

Work posture assessment using REBA is divided into 2 parts, namely Score A (neck, trunk and leg analysis) and Score B (upper arm, lower arm, wrist, activity and coupling analysis).

Grading the Posture

In group A, where after determining the value of the movement of each body part such as the neck, torso and legs, the weight of the load is added. In group B values, after determining the value of the movement of each body part such as the upper arm, forearm and wrist, the coupling value is added. In group C value, which is obtained from combining the calculation of Group A value and Group B value. The Group C value that has been obtained is summed with the activity score to get the grand score. This grand score is used to see whether the work posture needs immediate improvement or not.

Determining the REBA Final Score

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The final score for assessment using the REBA method is obtained by summing the C score with the activity score can be seen on the assessment sheet with the Rapid Entire Body Assesment (REBA) method or known as the REBA Employee Assessment Worksheet.

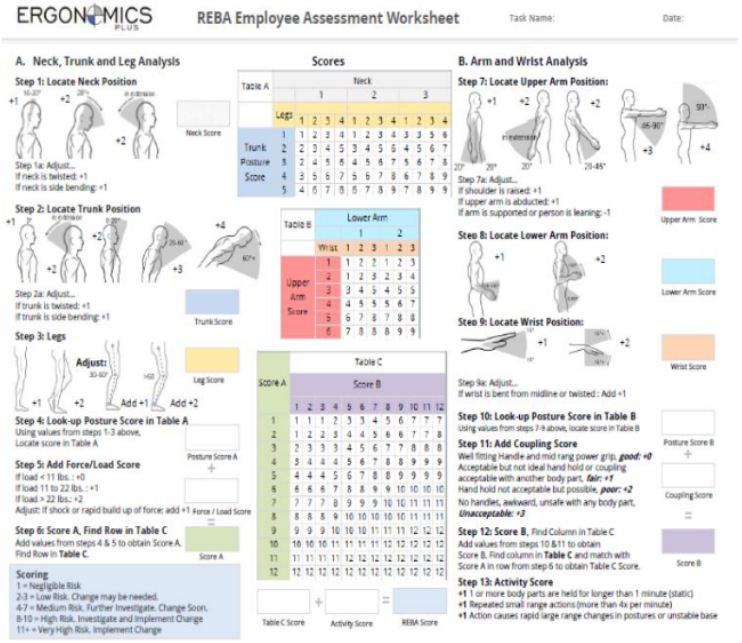

Figure 3. Scoring part A, B, C of the REBA Method

Making REBA Score Classification

When adding the results of the C score with the activity will have a value which to categorize the final result can be seen in table 1. below.

Table 1. Classification of REBA Score

Action Level	REBA Scores	Risk Level	Corrective action
0	1	The risk is negligible	Not Necessary
1	2-3	Low risk	May Be Necessary
2	4-7	Medium risk	Necessary
3	8-10	High risk	Need it soon
4	11+	Very high risk	Need it right now

Methods

This research was conducted at the CV. Faisyal Putra Mandiri company located on Kandangan Rejo Lebar Street No.11, Kandangan, Surabaya City, East Java. For the time this research was carried out in October 2023 until the required data was sufficient. There are several steps that need to be taken to achieve the desired results, by identifying problems, collecting data, processing data, analyzing results, and drawing conclusions. The data collection stage is carried out to obtain the data needed in the processing process. Data is collected through direct observation in the field and interviews with relevant parties in the company. While the data needed in this research are as follows: (1) Data from the Nordic Body Map questionnaire; (2) Data related to the work posture of car body production workers of CV. Faisyal Putra Mandiri.

Results and Discussion

Nordic Body Map Quistionnaire

This research began with the use of the Nordic Body Map (NBM) questionnaire, which was distributed to 8 workers in the metal cutting and welding production division of CV. Faiysal

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Putra Mandiri. The results were obtained that the subjective assessment of the workers showed that there were complaints of the following illnesses.

Table 2. Data from the Nordic Body Map Questionnaire

Metal Cutting						
No	**Employee Name**	**Age**	**Length of work**	**Number of complaints**	**Type of complaint**	**Information**
1	Nurdiansyah	37	4	13	0, 2, 3, 5, 7, 10, 11, 14, 15, 18, 19, 24, 25	11 quite sick 2 sick
2	Faisyal	23	4	13	0, 1, 3, 5, 7, 10, 11, 15, 17, 18, 19, 24, 25	12 quite sick 1 sick
3	Subandi	35	5	15	1, 2, 3, 5, 6, 7, 10, 11, 12, 13, 14, 15, 17, 20, 21	13 quite sick 2 sick
4	Sandy	26	1	11	1, 5, 6, 7, 13, 15, 16, 17, 19, 26, 27	9 quite sick 2 sick
Metal Welding						
No	**Employee Name**	**Age**	**Length of work**	**Number of Complaints**	**Type of Complaint**	**Information**
1	Rendi	35	4	18	0, 1, 2, 3, 4, 5, 6, 7, 11, 13, 14, 15, 16, 17, 20, 21, 23, 24	14 quite sick 4 sick
2	Sugeng	40	5	14	0, 2, 3, 4, 5, 6, 7, 11, 12, 13, 14, 15, 20, 21	10 quite sick 4 sick
3	Habib	37	5	12	2, 3, 6, 7, 10, 11, 14, 15, 16, 17, 24, 25	11 quite sick 1 sick
4	Refangga	22	1	10	2, 3, 4, 5, 6, 7, 12, 13, 17, 21	9 quite sick 1 sick

Source: Processed Data, 2024

Table 3. Tabulation of Nordic Body Map Results

No	**Complaint**	**Number of Complaint Levels**				**Percentage**			
		1	**2**	**3**	**4**	**1**	**2**	**3**	**4**

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0	Pain/stiffness in the upper neck	4	4	0	0	50%	50%	0%	0%
1	Pain/stiffness in the lower neck	4	4	0	0	50%	50%	0%	0%
2	Pain in left shoulder	2	5	1	0	25%	63%	13%	0%
3	Pain in right shoulder	1	4	3	0	13%	50%	38%	0%
4	Pain in left upper arm	5	3	0	0	63%	38%	0%	0%
5	Back pain	1	2	5	0	13%	25%	63%	0%
6	Pain in right upper arm	2	6	0	0	25%	75%	0%	0%
7	Pain in the waist	0	3	5	0	0%	38%	63%	0%
8	Pain in the buttocks	8	0	0	0	100%	0%	0%	0%
9	Pain in the ass	8	0	0	0	100%	0%	0%	0%
10	Pain in left elbow	4	4	0	0	50%	50%	0%	0%
11	Pain in right elbow	2	6	0	0	25%	75%	0%	0%
12	Pain in left forearm	5	3	0	0	63%	38%	0%	0%
13	Pain in right forearm	3	5	0	0	38%	63%	0%	0%
14	Pain in left wrist	3	5	0	0	38%	63%	0%	0%
15	Pain in right wrist	1	5	2	0	13%	63%	25%	0%
16	Pain in left hand	5	3	0	0	63%	38%	0%	0%
17	Pain in right hand	2	5	1	0	25%	63%	13%	0%
18	Pain in left thigh	6	2	0	0	75%	25%	0%	0%
19	Pain in right thigh	5	3	0	0	63%	38%	0%	0%
20	Pain in left knee	5	3	0	0	63%	38%	0%	0%
21	Pain in the right knee	4	4	0	0	50%	50%	0%	0%
22	Pain in left calf	8	0	0	0	100%	0%	0%	0%
23	Pain in right calf	8	0	0	0	100%	0%	0%	0%
24	Pain in left ankle	4	4	0	0	50%	50%	0%	0%
25	Pain in right ankle	4	4	0	0	50%	50%	0%	0%
26	Pain in left leg	7	1	0	0	88%	13%	0%	0%
27	Pain in right leg	7	1	0	0	88%	13%	0%	0%

Source: Processed Data, 2024

5 workers feel pain in the back, so the percentage is 63%

5 workers feel pain in the waist, so the percentage is 63%

From the results of the questionnaire, it can be concluded that the percentage of most workers complain of pain in the body parts is the back and waist. This can be caused by an unergonomic work posture that results in the level of performance of the back and waist more than other parts of the body. It could happen due to the wrong posture on the back and waist.

Work Posture Assessment with REBA

Work posture assessments were carried out on two workers in different work activities, namely

in the activity of metal cutting on Fig. 4. and welding on Fig. 5. Calculation of work posture assessment using manual calculation and ErgoFellow software.

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Figure 4. Working Posture of Metal Cutting

Source : Processed Data

Figure 5. Working Posture of Welding Process

Source : Processed Data

From the picture above, the REBA score will be determined in accordance with the REBA assessment procedure, which is done by adding up the calculated values in part A and also in

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part B so that a value of C is obtained, the value in part C is then summed up with other activities so that the final REBA score is obtained as shown in the table below.

Work Posture Assessment of Production Workers Metal Cutting Process

Work Posture Assessment in REBA Group A

Neck Posture

The neck forms an angle of >20° which is 76°, where this posture gets a REBA score of 2.

Trunk Posture

The torso forms an angle >60° to the front of the body which is 71°, where this posture gets a REBA score of 4.

Leg Posture

One leg holds the weight of the body where the working attitude is unstable.

gets a score of +2 so this posture gets a REBA scoring of 2.

Load Value

The load weighs <5kg where this condition gets a REBA score of 0.

Table 4. REBA Calculation Table Group A Production Workers Metal Cutting

Table A		**Neck**											
		1				**2**				**3**			
Torso	Feet	1	2	3	4	1	2	3	4	1	2	3	4
	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

Source: Processed Data, 2024

For the total score obtained in the group A table is 6 and there is a load value of 0, so the total score obtained in the group A table is 6.

Work Posture Assessment in REBA Group B

Upper Arm Movement Range

The upper arm moves at an angle between 20-45° to the front of the body which is 26°, where this posture gets a REBA score of 2.

Forearm Movement Figures

The forearm moves at an angle between 60-100° to the front of the body, which is 74°.

which is 74°, where this posture gets a REBA score of 1.

Wrist Movement Range

The wrist moves to form an angle >15° which is 17° where this posture gets a REBA score of 2.

The value of the grip performed by workers in metal cutting is a grip that is still acceptable although less than ideal, where this posture gets a REBA scoring of 1.

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Table 5. REBA Calculation Table Group B Production Workers Metal Cutting

Table B		**Lower Arm**					
		1			**2**		
Upper Arm	Wrist	1	2	3	1	2	3
	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	7	7	8	8
	6	7	8	8	8	9	9

Source: Processed Data, 2024

For the total score obtained in the group B table is 2 and there is a coupling value of 1, the total score obtained in the group B table is 3.

Table 6. Final Table of REBA Calculation for Groups A and B Metal Cutting Workers

Table C		Scores B (Table B Value + Grip Score)											
		1	2	3	4	5	6	7	8	9	10	11	12
Scores from Table A+ Load Score	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	5	8	8	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	11	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	11	11	11	11	11	11	11	11
	12	12	12	12	12	12	12	12	12	12	12	12	12

Source: Processed Data, 2024

Workers in metal cutting activities get a score of 6 with an additional activity value of 1 due to static work attitudes where one or more parts of the body are static / silent, such as holding for more than 1 minute, then the final REBA final score value is 7 which is included in the moderate category, if no immediate corrective action is taken it can cause serious consequences such as arthritis, carpal tunnel syndrome, and back injuries and can affect company productivity. So further investigation is needed.

Work Posture Assessment of Production Workers in the Metal Welding Process

Work Posture Assessment in REBA Group A

Neck Posture

The neck forms an angle of >20° which is 48°, where this posture gets a REBA score of 2.

Trunk Posture

The torso forms an angle >60° to the front of the body which is 99°, where this posture gets a REBA score of 4.

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Leg Posture

Both legs hold the weight of the body with a slightly bent knee position and form a >30º, where this posture gets a REBA score of 2.

Load Value

The load is not more than 5 kg, which gets a REBA score of 0.

Table 7. REBA Calculation Table Group A Production Workers Metal Welding

Table A		**Neck**											
		1				**2**				**3**			
Torso	Feet	1	2	3	4	1	2	3	4	1	2	3	4
	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

Source: Processed Data, 2024

For the total score obtained in the group A table is 6 and there is a load value of 0, so the total score obtained in the group A table is 6.

Work Posture Assessment in REBA Group B

Upper Arm Movement Range

The upper arm moves at an angle between 45-90° to the front of the body which is 55°, where this posture gets a REBA score of 3.

Forearm Movement Range

The forearm moves at an angle between >100° to the front of the body, which is 110°.

which is 110°, where this posture gets a REBA score of 2.

Wrist Movement Range

The wrist moves to form an angle of 0-15° which is 10° where this posture gets a REBA score of 1.

The grip value performed is the type of grip that falls into the good grip category because it uses half the energy to grip, this posture gets a REBA score of 0.

Table 8. REBA Calculation Table of Group B Production Workers Metal Welding

Table B		**Lower Arm**					
		1			**2**		
Upper Arm	Wrist	1	2	3	1	2	3
	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	7	7	8	8
	6	7	8	8	8	9	9

Source: Processed Data, 2024

For the total score obtained in the group B table is 4 and there is a coupling value of 0, so the total score obtained in the group B table is 4.

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Table 9. Final REBA Calculation Table for Group A and B Metal Welding Workers

Table C		Scores B (Table B Value + Grip Score)											
		1	2	3	4	5	6	7	8	9	10	11	12
Scores from Table A+ Load Score	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	5	8	8	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	11	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	11	11	11	11	11	11	11	11
	12	12	12	12	12	12	12	12	12	12	12	12	12

Source: Processed Data, 2024

Workers in welding activities get a score of 7 with an additional activity value of 2 due to static work attitudes where one or more parts of the body are static / silent, such as holding for more than 1 minute, and repetitive movements occur more than 4 times per minute, then the final REBA score value of 9 is obtained which is included in the high category, so that corrective action must be taken immediately so as not to cause chronic injuries such as arthritis, carpal tunnel syndrome, and back injuries that have the potential to become permanent injuries that can limit workers' mobility and reduce their ability to work effectively.

Suggested tool design for work posture improvement

Based on the results of the work posture assessment above, where the method obtained results in the high category, changes or corrective actions are needed at this time. The corrective action is in the form of designing tools for both activities which are expected to reduce the level of risk from the previous results. The tools designed consider the size of the tools based on anthropometric data from workers at metal cutting and welding work stations with ergonomic shapes. Anthropometric data and percentile determination on the size of workers can be seen in Tables 6 and 7 as follows.

Table 10. Proposed Dimensions of Hydraulic Scissor Lift Table Design

Anthropometry Data	Dimension	Percentile	Size
Length of elbow span	Tool length	5%	156 cm
The length of the forward stretch of the hand	Tool width	5%	134 cm
Elbow height to toe	Tool height	5%	98 cm

Source: Processed Data, 2024

Table 11. Proposed Dimensions of Chair Design

Anthropometry Data	Dimension	Percentile	Size
Width of the hips	Width of the seat base	5%	30 cm
Popliteal height	Tool height	5%	37 cm
Popliteal buttocks	Toolbase length	5%	35 cm

Source: Processed Data, 2024

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Based on the data above, all the dimension of the tools are using a 5% percentile. From these results it can be seen that the design of the tool is designed for a population of 5% to be able to use the tool with a good range, and in a population of 95% can also use the tool with a sufficient range.

The design of the tools to be used in metal cutting and welding activities according to the anthropometric data of workers can be seen in Figures 6 and 7.

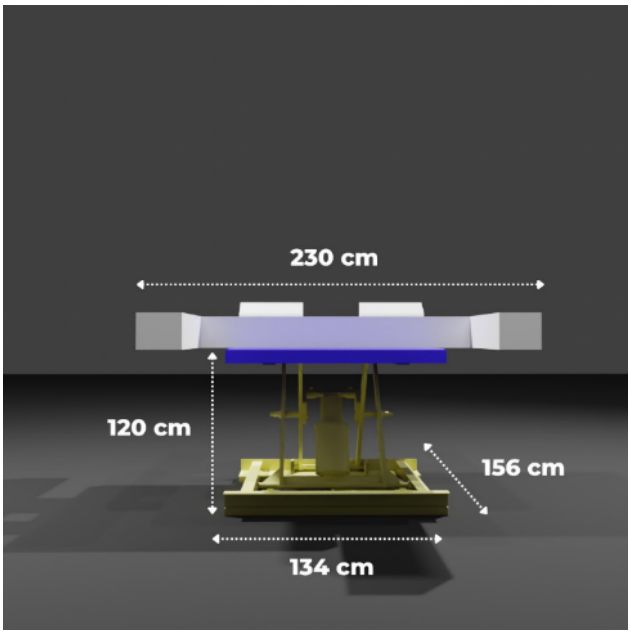

Figure 6. Hydraulic Scissor Lift Table

In the picture above, a tool for metal cutting and welding activities is obtained, namely a Hydraulic Scissor Lift Table with a hydraulic system that can adjust the height of the board according to the anthropometric data of workers who have been determined so that it can help the work posture of metal cutting and welding activity workers more ergonomically.

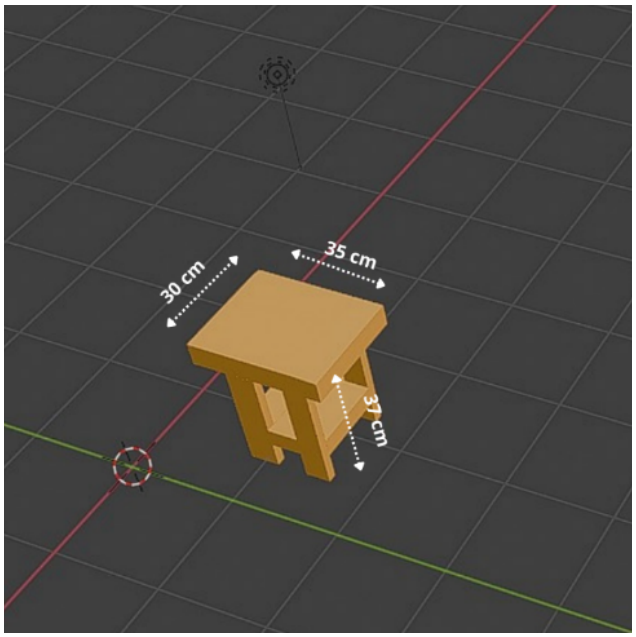

Figure 7. Chair

In the picture above, a tool for metal cutting and welding activities is obtained, namely a chair that has been measured in accordance with the anthropometric data of workers who have been

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determined. From the proposed tools, workers can improve work postures that are not ergonomic by adjusting the position in accordance with ergonomic work postures.

The next stage is to carry out a simulation to find out the difference in work posture and REBA risk value before and after using the tool can be seen in Fig. 8 and 9.

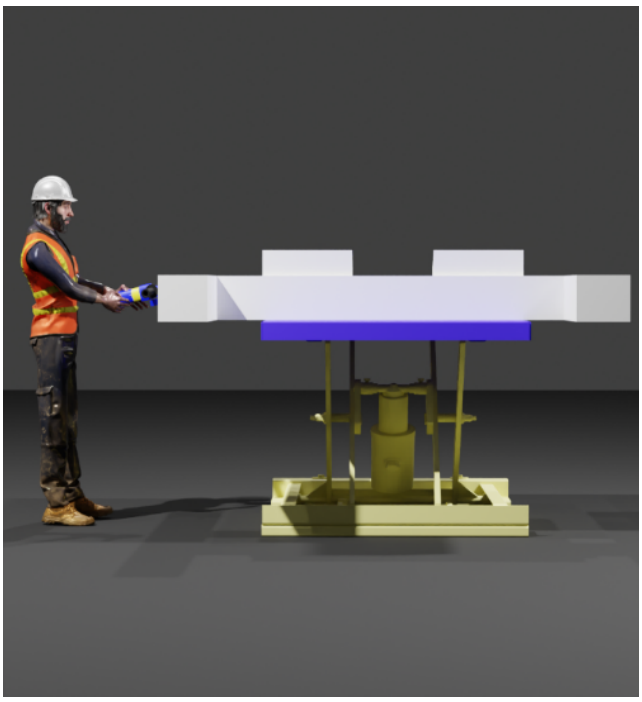

Figure 8. Simulation of Hydraulic Scissor Lift Table

In the simulation of the use of a Hydraulic Scissor Lift Table. Proposed work posture improvements for metal cutting process workers with hydraulic scissor lift table tools get a final REBA score of 2 where this value is lower than the initial work posture risk value of 7. Furthermore, in the metal welding process with hydraulic scissor lift table tools get a final REBA assessment of 3 which is lower than the final REBA assessment in the initial work posture of 9 so that it can reduce the risk value of the initial work posture.

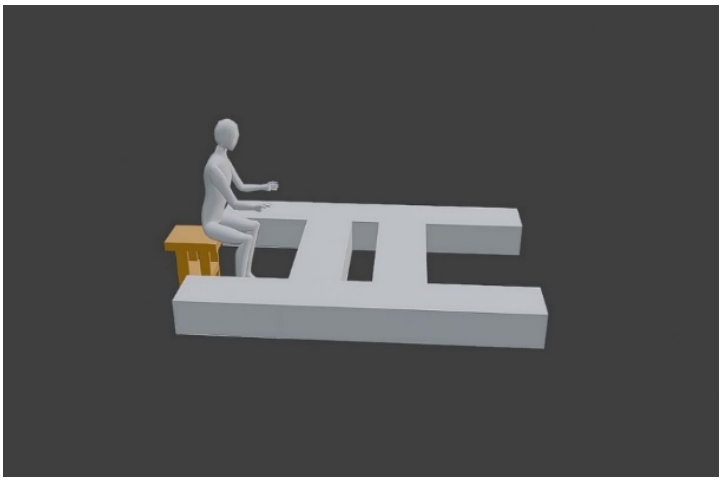

Figure 9. Simulation of Chair

Proposed work posture improvements for metal cutting process workers with chair aids get a final REBA score of 3 where this value is lower than the initial work posture risk value of 7. In addition, the metal welding process with chair aids gets a final REBA assessment of 3 which is lower than the final REBA assessment in the initial work posture of 9 so that it can reduce the risk value of the initial work posture.

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Conclusion

Based on the results of research and discussion, it is concluded that after simulating the use of assistive devices in the metal cutting process work activity, namely the Hydraulic Scissor Lift Table, it can reduce the risk of worker injury through the final REBA value of 7 with a medium risk level to the final REBA value of 2 with a low risk level. Then after simulating the use of assistive devices in welding activities, namely the Hydraulic Scissor Lift Table, it can reduce the risk of worker injury through a final REBA value of 9 with a high risk level to a final REBA value of 3 with a low risk level. In addition, it is also recommended to propose a tool in the form of a chair so that simulations are carried out on the work activities of the metal cutting process, the results can reduce the risk of worker injury through the final REBA value of 7 with a moderate risk level to the final REBA value of 3 with a low risk level. Then after simulating the use of assistive devices in welding activities, namely chairs, it can reduce the risk of worker injury through a final REBA value of 9 with a high risk level to a final REBA value of 3 with a low risk level. For further research, it is hoped that further analysis can be carried out on the design of tools ranging from material costs to production costs.

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