



## Work Posture Analysis of Welding Workers Using the RULA Method

Surahma<sup>1</sup>, Berliana Suroso<sup>1</sup>, Febriyani Prastike<sup>1</sup>

Public Health Study Program, Faculty of Medicine and Health Sciences,  
Alauddin State Islamic University Makassar, Indonesia

Corresponding Author: Surahma



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### Abstract

Work posture is a point that can determine an analysis of how effective the work is done. This study aims to analyze the working posture of Las Manggaraya workshop workers using the Rapid Upper Limb Assessment (RULA) method. This research collects anthropometric data which is part of ergonomics that specifically studies about ways to find out body size. In using the Rapid Upper Limb Assessment (RULA) method, every movement made will be given a predetermined score. The results showed that 5 out of 8 workflow processes have RULA scores with severe and very western risk level, which means that it is necessary to change work postures as soon as possible or as soon as possible. Overall the RULA score is at a level of severe and very severe risk so that changes in work posture are required.

## Introduction

Workload and equipment factors in the body, as well as time and environmental factors, are very influential on work performance (Sköldström, 1987). Time may be in duration, but also in its periodicity. the length of work depends on the ability of a workforce, workload and the environment (Montgomery, 2007).

Indonesia has experienced rapid development of the industrial world. The development of the industry itself is inseparable from the formal and informal sectors (Efendi, 2012). The informal sector is a way of doing any kind of work in various ways such as having characteristics that are easy to enter, sourced from local resources, is a business of its own, and runs on a small scale. However, the informal sector has less than optimal standards for the welfare of its workers and the health of workers Cahaya et al., 2012).

Based on ILO Data (2014) it was stated that there were 160 workers who were sick as a result of work and workers who died due to work accidents within 5 seconds. In the previous year, namely 2012, the death rate caused by workplace accidents was 2 million cases each year. Based on research every worker should always wear Personal Protective Equipment (PPE) so as to reduce the risk of severity due to workplace accidents.

Based on data from the Ministry of Manpower and Transmigration that more than 6 workers have died as a result of workplace accidents. This figure is high compared to European countries where as many as 2 people die from work accidents every day. one of them caused by welding workshop workers. A location-based study was conducted in 34 welding workshops in Makassar where the results of the study concluded that there were various complaints felt by welding workshop workers such as 36% feeling the heat, 47% Noisy, 66% illumination was quite good, and 44 % do not use an ergonomic chair (Bakri et al., 2018).

In Indonesia, the welding workshop is not too many, although there is a welding workshop where the workers are usually only 1 or 2 people and the welding workshop with 5-10 workers is only a few. Welding workshop is an informal sector industry. Welding workshops serving construction of iron and the like, usually in the form of fences or metal doors, trellises or window bars, stairs, canopies, roof trusses and others. The application of the principles of occupational safety and health in these sectors is still very weak.

One example when conducting observation on September 11, 2019 was at the Las Mangga Raya Workshop located in Tamangapa Raya, Kec. Mangala, Makassar City, South Sulawesi Province. The welding workshop was established in 2000 and currently has 10 employees. Because the form of business is not formal, then there is no definite division of tasks. All workers are welding or welder operators. Welding workers are still lacking in discipline to wear personal protective equipment such as only a few employees who wear welding goggles, footwear, long sleeves, gloves, and welding masks.

Out of the 10 workers, only 5 workers were interviewed, and from the observations, there were 3 workers who complained of pain in the back and waist, pain in the shoulder area and pain in the muscles. Seeing the existing problems as well as several incidents experienced by the workers, the researcher was interested in analyzing the work posture of the Las Manggaraya workshop workers by using the Rapid Upper Limb Assessment (RULA) method. RULA has been developed as a method that can detect Building Expert Team (TABG) work postures including as a risk factor (Chen et al., 2014). This method is also used in order to detect work posture and to know the musculoskeletal burden that can cause interference with limbs (McAtamney & Corlett, 1993). In addition, Rapid Upper Limb Assessment (RULA) is a survey that was developed to find out the ergonomic of workers from their workplaces that can cause a disturbance.

## Methods

This research collects anthropometric data which is part of ergonomics which specifically learns about ways to find out body size which includes linear dimensions, weight, contents, including size, strength, speed and other aspects derived from body movements. To get accurate anthropometric data so that it can be used as a basis for the design of a device, the product includes; Number of samples fulfilled, Samples in certain communities (random), Generalized in populations, So that anthropometric data can be used, anthropometric samples must be clarified. This classification is based on the most important differences in human size. In using the Rapid Upper Limb Assessment (RULA) method, it does not require special equipment to determine body posture assessments such as the neck, upper arms, and back. Every move made will be given a predetermined score.

## Results and Discussion

### *Body Posture Size Data*

The following are the results of the respondents' posture size data at XY Welding Workshop:

Table 1.1 Anthropometry of the Human Body Standing Position

Name	Height	Weight	Shoulder Height	Elbow Height	Hip Width	Shoulder Width	Shoulder Width	Arm Length	Upper Arm Length	Lower arm Length	Hand Reach Up	Overall Length Body
A	167.5	60.1	20.8	15.9	105.3	57.3	54.6	36.6	39.4	56.2	220.5	198.2
T	155.3	43.2	12.5	8.1	85.6	38.9	35.0	20.9	20.1	38.6	202.1	176.4
I	159.7	40.6	14.2	10.5	90.4	42.2	39.6	25.4	24.4	41.1	206.8	180.5

R	158.4	45.9	13.9	10.3	87.9	40.4	38.9	24.5	22.8	40.3	203.3	178.9
I	160.1	42.4	15.1	12.3	91.1	40.9	40.1	25.3	23.6	41.9	208.8	182.6
S	159.4	42.2	14.9	11.4	90.3	42.4	39.9	25.3	24.4	41.0	205.5	182.0

Table 1.2 Anthropometry of the Human Sitting Position

No.	Name	Sitting Height	Elbow Sitting Height	Hip Sitting Height	Knee Sitting Height	Upper Leg Length	Lower Leg Length
1.	A	92.2	32.1	35.5	64.3	67.5	47.2
2.	T	74.8	18.1	19.9	50.1	48.2	29.7
3.	I	78.4	20.8	24.3	55.4	51.3	32.7
4.	R	77.7	18.9	21.9	53.7	50.6	31.8
5.	I	80.1	21.1	21.8	57.7	52.1	33.8
6.	S	77.7	22.5	24.4	55.5	51.8	31.4

*Implementation of the RULA (Rapid Upper Limb Assessment) Method*

In producing a fast method for use, the body is divided into two parts that form two groups, namely group A and group B. which is included in group A includes the forearm and upper arm and wrist. While those included in group B include the body, neck, and legs. This can ensure that all body postures are recorded so that limited posture of the legs, body, and neck that may affect the upper body posture can be included in the examination. After that, the data is presented in tabular form and interpreted into 4 categories.

Table 2.1 Interpretation of RULA

Score	Musculoskeletal Disorders Category
1-2	Can be ignored, does not require changes
3-4	Low risk, changes may be needed
5-6	Medium risk can be carried out further checks or make changes immediately
6+	The risk is very high, make changes now

The stages in the assessment using Rapid Upper Limb Assessment (RULA) are as follows:

Assessment of group A posture

*Upper Arm*

Assessment of the upper arm is an assessment made at an angle formed by the upper arm when doing work activities. The scoring scores for the upper arm are as follows:

Table 2.2 Score of the Upper Arm

Movement	Score	Change Score
20 <sup>0</sup>	1	+1 if the shoulder rises  +1 if the arm is twisted/bent
> 20 <sup>0</sup>	2	
45 – 90 <sup>0</sup>	3	
> 90 <sup>0</sup>	4	

*Lower Arm*

An assessment of the lower arm is an assessment carried out at an angle formed by the forearm when doing work activities. The angle formed by the forearm is measured according to the position of the torso. As for the assessment for lower body posture (lower arm), namely:

Table 2.3 Lower arm scores

Movement	Score	Change Score
60 – 100 <sup>0</sup>	1	+1 if the shoulder rises
> 60 <sup>0</sup> atau 100 <sup>0</sup>	2	+1 if the arm is twisted/bent

*Wrist*

Assessment of the wrist (wrist) is an assessment carried out at an angle formed by the forearm when doing work activities. When the angle formed by the wrist and measured according to the position of the forearm. The assessment score for the wrist, namely:

Table 2.4 Lower arm scores

Movement	Score	Change Score
Posisi netral	1	+1 jika pergelangan tangan putaran menjauhi sisi tengah
0 – 15 <sup>0</sup>	2	
> 15 <sup>0</sup>	3	

*Wrist twist*

Rating of wrist rotation when neutral posture then the score on that part is 1, whereas if it rotates then the score on that part is 2.

## Posture Assessment of Group B

### Neck

Assessment of the neck (neck) is an assessment conducted on the position of the neck when doing work activities at a certain angle. The scoring score for the neck is:

Table 2.5 Lower arm scores

<b>Movement</b>	<b>Score</b>	<b>Change Score</b>
0 – 10 <sup>0</sup>	1	+1 if the neck is twisted/bent  +1 if the torso is bent
10 – 20 <sup>0</sup>	2	
> 20 <sup>0</sup>	3	
Extention	4	

### Trunk

Assessment of the trunk (trunk) is an assessment of the angle formed by the spine of the body when doing work activities with a slope that has been classified. The assessment scores for the trunk are:

Table 2.6 Score of the Lower Arm

<b>Movement</b>	<b>Score</b>	<b>Change Score</b>
Normal Position 90 <sup>0</sup>	1	+1 if the neck is twisted/bent  +1 if the torso is bent
0 – 20 <sup>0</sup>	2	
20 – 60 <sup>0</sup>	3	
> 60 <sup>0</sup>	4	

### Legs

Assessment of the feet (legs) is an assessment made on the position of the foot when doing work activities in a normal/balanced position or resting on one straight leg.

The scoring scores for the legs are:

Table 2.7 Legs score

<b>Movement</b>	<b>Score</b>
Normal Position/Balance	1
Imbalance	2

Table 2.8 RULA Grand Score

Risk Level	Action
Level 1 (Low)	A final score that shows 1-2 values can identify that posture does not require improvement for a long period of time.
Level 2 (Moderate)	A final score that shows the value of 3-4 identifies that it requires an investigation and changes in work posture may be possible.
Level 3(Hard)	The final score indicates 5-6 which means that investigation and changes in work posture must be carried out as soon as possible.
Level 4 (Very Hard)	A final score that indicates a score of more than 7 is identified and changes must be made immediately.

The results of welding workshop workers' activities at the Las XY Workshop, amounting to 6 respondents using RULA calculations in two ways, the first is manual calculation using RULA Employee Assessment Worksheet, and the second calculation uses the HSE Ergo RULA application, while the data from the worker's activities are as follows:

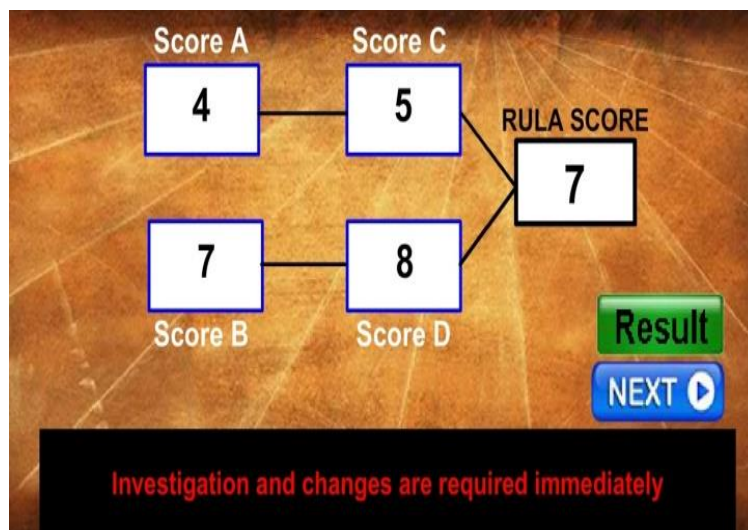
*Pattern Making*

Figure 1.1 Calculations Using the HSE Ergo RULA Application



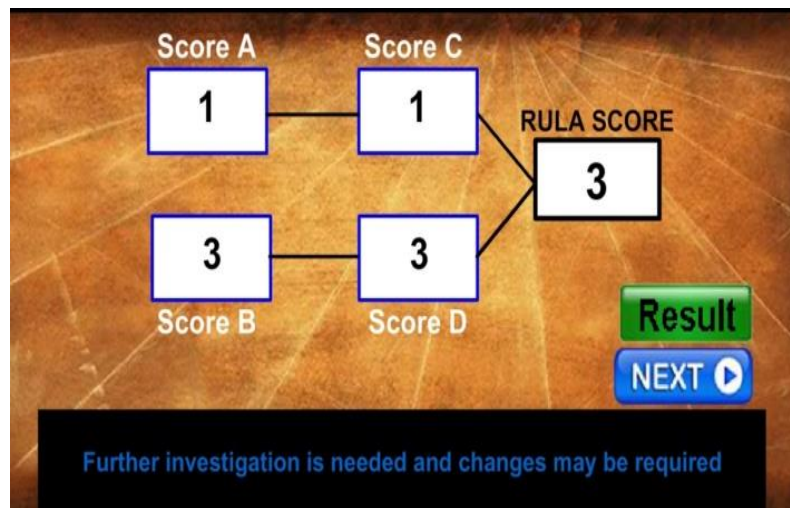
*Iron Cutting*

Figure 1.3 Calculations Using the HSE Ergo RULA Application



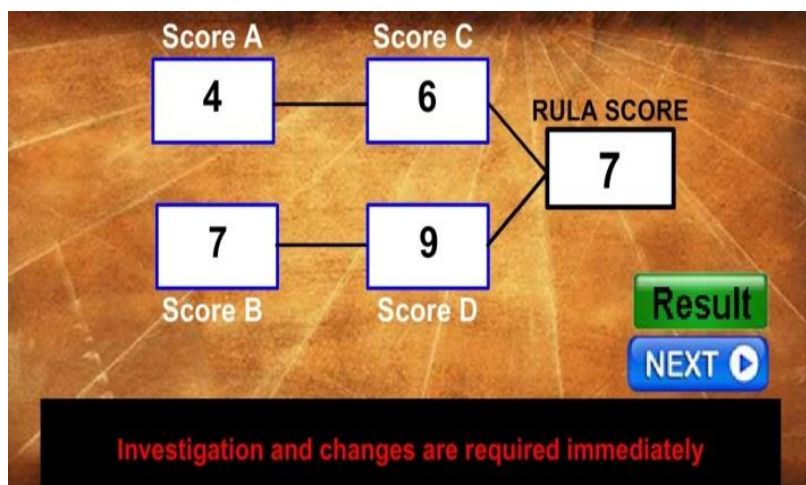
*Welding*

Figure 1.5 Calculations Using the HSE Ergo RULA Application



*Drilling*

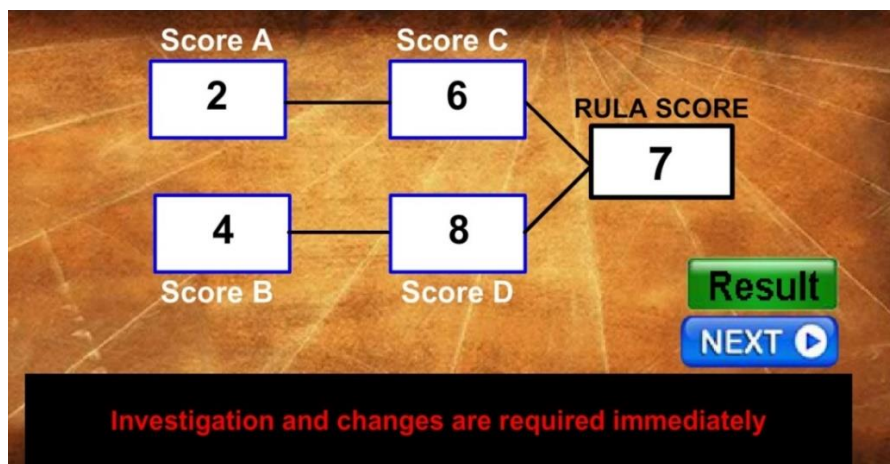
Figure 1.6 Calculations Using the HSE Ergo RULA Application





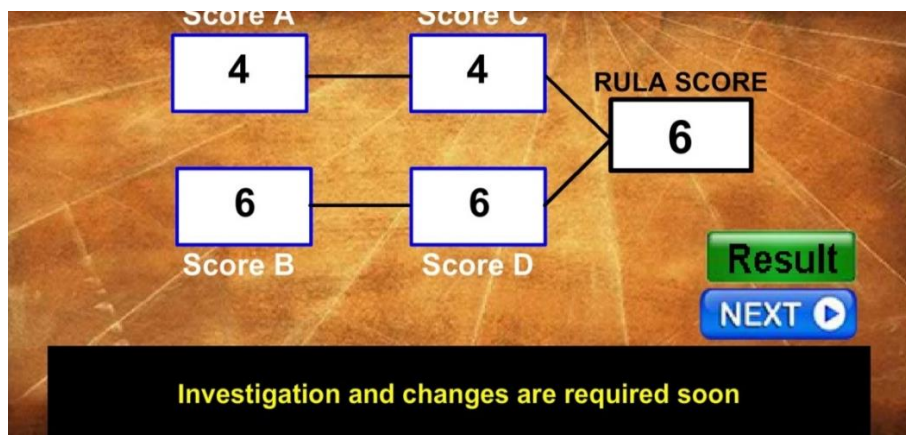
*Caulking*

Figure 1.8 Calculations Using the HSE Ergo RULA Application



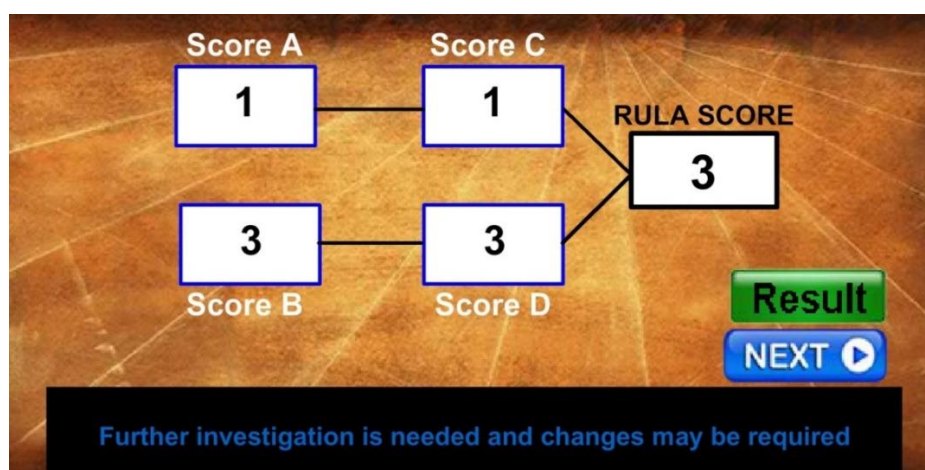
*Sanding*

Figure 1.10 Calculations Using the HSE Ergo RULA Application



*Painting*

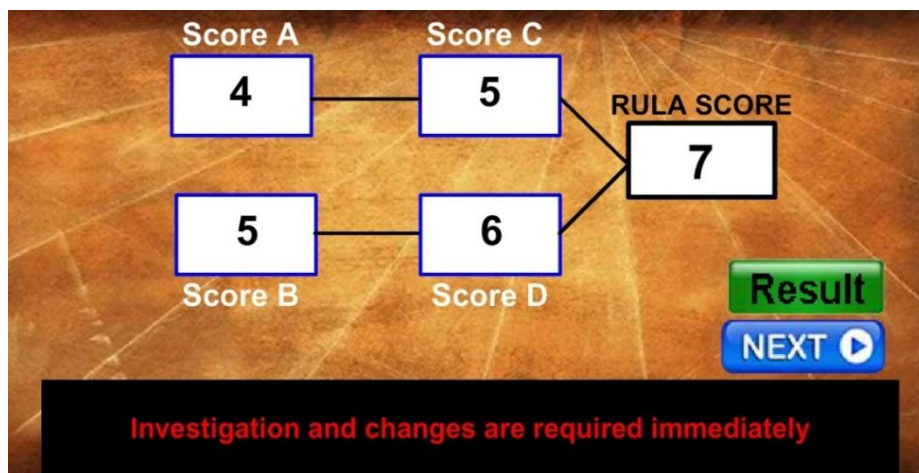
Figure 1.12 Calculations Using the HSE Ergo RULA Application





*Appointment of Work Results onto the Car*

Figure 1.14 Calculations Using the HSE Ergo RULA Application



Based on the observation data of respondents' work postures, the final RULA results are obtained using the HSE Ergo RULA application, as follows:

Table 2.9 Results of RULA Measurement Data for Fences Making

No.	Activity	RULA Final Score	Risk Level	Action
1.	Pattern Making	4	Moderate	Changes to work posture may be possible.
2.	Cutting of raw materials	7	Very Hard	Changes must be made immediately.
3.	Welding	3	Moderate	Changes to work posture may be possible
4.	Drilling	12	Very Hard	Changes must be made immediately.
5.	Pendempulan	7	Very Hard	Changes must be made immediately.

6.	Sanding	12	Very Hard	Changes must be made immediately.
7.	Painting	3	Moderate	Changes to work posture may be possible
8.	Appointment	11	Very Hard	Changes must be made immediately.

Based on the data above, 5 out of 8 workflow processes have RULA scores with a high-risk level and are very western, which means that changes in work posture are needed as soon as possible or as soon as possible. Work posture leads to a point that can determine an analysis of how effective the work is done (Das & Sengupta, 1996; Ratzon et al., 2000). If the work posture that has been carried out by the operator is good and belongs to the ergonomic category, it can be obtained from the operator that the work posture will be good. However, if the operator's work posture is not ergonomically correct, the operator can easily get tired. However, if the operator is easily experiencing fatigue, the work that has been done by the operator is likely to experience a decline and not as desired.

### Conclusion

Overall, the results of the study present RULA scores with a high degree of risk and are very western which means that it is necessary to change work postures as soon as possible or as soon as possible.

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