The Analysis of Employees’ Work Posture by using Rapid Entire Body Assessment (REBA) and Rapid Upper Limb Assessment (RULA)

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Abstract. This study aims to analyze the work posture of employees by using Rapid Entire Body Assessment (REBA) and Rapid Upper Limb Assessment (RULA) methods. In this study, the angle of the employee was calculated, and the results showed that on the body part B, the angle of the back movement is 77º flexion, the neck is 18º extension, and the leg is 39º, while the leg is not uniformly supported. One of the body parts, such as the upper arm is formed an angle of 65 º flexion, the forearm is 13 º flexion, the wrist is 0 º flexion, and the wrist is in the intermediate range of rotation. Based on the results of RULA, a grand score is 7, categorized as Action level 4. Meanwhile, based on the results of REBA, the grand score obtained is 11, and also categorized as Action level 4. Based on the calculation of work posture using RULA and REBA methods, it revealed that the operator’s work posture has a high-level and dangerous risk. Therefore, the operator needs to immediately improve his work posture. In addition, due to the lifting position that was started with no squatting position, it causes waist injuries, since it becomes the lift's pedestal.

1. Introduction

All employees have a risk of injury when working, due to the unawareness with the applicable regulations. The main causes of injury experienced by the employees are the wrong position when working, work environment that is not ergonomic; and the work tasks do not meet the employees’ abilities, affecting the decrease of performance and production results, as well as decreasing the company's profit.

Ergonomics comes from the Latin ergon which means work, and nomos which means natural law. In addition, it is defined that ergonomics is a systematic science to utilize the information about nature and humans’ abilities and limitations to design a work system, since ergonomics is related to efficiency, optimization, health, safety, and comfort in the workplace, or where they are placed. In general, ergonomics is a study of the system in which humans, work facilities, and their environment is correlated with each other in order to adapt with the work atmosphere and the people. In particular, the aim of studying ergonomics is to humanize humans [1].

The cause of the degradation in employees’ performance is mostly due to the lack of support factors for the work environment. An unsupportive work environment is an environment that does not support the worker's performance properly, based on its temperature, light intensity, noise around the work environment, etc. It greatly affects the employees’ performance [2].

Based on the problem, the researchers conducted this research in a convenience store, since in this location, there are several activities found as the causes of injury, significant fatigue, etc.
According to previous studies, injury and fatigue were mostly caused by the workers' unawareness and behaviors when lifting a load [3].

1.1. Ergonomics
Ergonomics is also related to optimization, efficiency, health, humans’ safety, and comfort at work, home, or recreation areas [4]. Ergonomics is applied by several experts in their respective fields, for example: anatomists, architecture, product design, physics, physiotherapy, occupational therapy, psychology, and industrial engineering (this definition is adopted from International Ergonomics Association). Ergonomics can also be applied in designing work tasks in an organization, such as determining the duration of break, arranging the shift work schedule, and improving the variation of work. Ergonomics can also be applied in designing software since the work tasks that use computers has increased [5].

1.2. Work Posture
An appropriate work posture is assessed by the movement of humans’ body organs while working. The movements consist of: flexion, extension, abduction, adduction, rotation, pronation, and supination. Flexion is a movement in which the angle between two bones is decreased. Extension is a stretching motion where there is an increase in the angle between two bones. Abduction is a sideways movement away from the central axis (the median plane) of the body. Adduction is the movement towards the center axis of the body (the median plane). Pronation is the rotation of the middle (in) the limbs. Supination is rotation towards the side (out) of the limb [6].

Manual Material Handling (MMH is an important study in industrial world. Humans’ power plays a very important role in Manual Material Handling process. Manual Material Handling involves humans’ physical power and muscles, which become the factors that can cause ergonomics danger. The determination of appropriate posture and movement, which is suitable with the ergonomics principles, can minimize the risk of Musculoskeletal Disorder (MSD), especially on the backbones. The study and simulation of Manual Material Handling is really necessary, in order to be able to identify and evaluate the work posture, especially for the work movements, such as lifting, carrying, and lowering [7].

1.3. Cumulative Trauma Disorders (CTD’S)
Cumulative Trauma Disorders (also known as Repetitive Motion Injuries or Musculoskeletal Disorders) are injuries on the muscular skeletal system that increase gradually as a result of continuous minor trauma, and caused by inappropriate design, such as the design of work tools / systems that require body movement in an abnormal position, and the frequent use of tools / hand tools or other tools [8].

2. Methods
The methods implemented in measuring the posture are Rapid Entire Body Assessment (REBA) and Rapid Upper Limb Assessment (RULA). REBA is a method developed in ergonomics field and it can be used to assess an operator's work posture rapidly [9][10]. Meanwhile, RULA is a method developed in ergonomics field which aim to investigate and assess the work positions performed by the upper body [11]. Based on RULA and REBA analysis, it can be identified whether the posture of the employee needs any improvement to reduce any risk in working or not, and the improvements can be arranged when designing the work system [4].

2.1 Rapid Upper Limb Assessment (RULA)
Rapid Upper Limb Assessment is a method developed in the ergonomics field which aim to investigate and assess the work positions performed by the upper body. This does not require special tools to measure the posture of the neck, back, and the upper body, as well as the muscle function and the external load supported by the body. RULA does not take long time to complete and conduct a general scoring of the list of activities indicated to reduce the risk of physical lifting done by the operators. RULA is intended for ergonomics field with a wide-area coverage [11].
RULA was developed without any special tools. Thus, it eases the researchers in getting experience in conducting the checking and measurement process without additional cost. RULA checks can be conducted in a confined space without disturbing the employees. RULA's development occurred in three stages. The first stage is the development for recording and making note of the work postures, the second stage is the development of the scoring system, and the third is the development of a scale for the level of action that provides a guide to the level of risk and the important action to take more detailed measurements [12]. The assessment using RULA method has been implemented by Dr. Sue Hignett and Dr. Lynn McAtamney by conducting several stages, as follows [11]:

1. Method Development on recording work postures.

In order to produce a method that can be quickly applied, the body is divided into two parts that called as group A and group B. Group A consists of upper arm, forearm, and wrists, while group B consists of neck, body, and legs. This aims to ensure that all postures have been recorded, in order to identify the leg, body, and neck postures that are restricted, which may affect upper body posture.

The range of movements on each part of the body is divided into several parts, according to criteria adopted from the interpretation of the relevant literature. These parts are given number, such as: the number 1 is in the range of movement or work posture, where the risk factor is considered as the smallest or the minimum. Meanwhile, higher numbers were assigned to the parts where range of motion with a more extreme posture indicating an increased risk factor for generating loads on the structure of the body parts. The scoring system for each posture of the body produces a logical sequence of numbers in order to be easy to remember. In order to ease the identification of the range of postures, the pictures of each part of the body are presented in the sagittal plane.

The identification or measurement was began by observing the operators in several work cycles in order to determine the task and measurement posture. Selection was made in the posture with the longest work cycle where the greatest load occurs. Since RULA can be done quickly, measurements can be conducted at each posture in the work cycle.

| Movement                        | Score | Change Score |
|---------------------------------|-------|--------------|
| 20° extension - 20° flexion      | 1     | +1 if the shoulder is raising |
| Extension > 20° or 20° - 40° flexion | 2     | +1 if the upper arm is abducted |
| 45° - 90° flexion               | 3     | -1 if leaning, or the load of the arm is supported |
| 90° flexion or >                | 4     |              |

Table 1. The Score of Upper Arm Movements

| Movement                        | Score | Change Score |
|---------------------------------|-------|--------------|
| 60° – 100° flexion              | 1     | +1 if the arm moves beyond the center line of the body or its side |
| < 60° flexion atau >100° flexion | 2     |              |

Table 2. The Score of Lower Arm Movements

| Movement                        | Score | Change Score |
|---------------------------------|-------|--------------|
| Netral Position                 | 1     |              |
| 0° – 15° flexion / extension    | 2     | +1 if the wrists are on either radial or ulnar deviation |
| >15° flexion / extension        | 3     |              |

Table 3. The Score of Wrist Movements

Group B, the posture range for the neck was based on a study conducted by [11]. The scores and ranges are as follows:

| Movement                        | Score |
|---------------------------------|-------|
| 0° – 10° flexion                | 1     |
| 10° – 20° flexion               | 2     |
| > 30° flexion                   | 3     |
| If in extension                 | 4     |

Table 4. The Score of Neck Movements
Table 5. The Score of Back Movement (torso)

| Movement                | Score |
|-------------------------|-------|
| When sitting down, and the arm is supported well, and the corner of thigh – body is 90° or > 90° – 20° flexion | 1     |
| 20° - 60° flexion       | 2     |
| > 60° flexion           | 3     |

2. The system development for grouping posture scores of the body parts.
   The recorded video shows that group A's postures consist of upper arm, forearm, wrists, and wrists rotation that had been observed, and each posture was scored. Thus, those scores were presented in table A in order to know the group A's score. Meanwhile, the recorded video also shows that group B's postures consist of neck, back (body), and legs that has been observed, and each posture was scored. Those scores were presented in table B in order to know the Group B’s score.

Table 6. Group A’ Posture Score

| Upper Arm | Forearm | Wrist 1 | Wrist 2 | Wrist 3 | Wrist 4 |
|-----------|---------|---------|---------|---------|---------|
| w.twist   | w.twist | w.twist | w.twist |
| 1 2 3 4   | 1 2 3 4 | 1 2 3 4 | 1 2 3 4 |

Table 7. Group B’s Posture Score

| Neck | Back |
|------|------|
| legs | legs |
| 1 2 3 4 5 6 | 1 2 3 4 5 6 |
| legs | legs |
| 1 2 3 4 5 6 | 1 2 3 4 5 6 |

Table 8. Grand Score

| D  | 1 2 3 4 5 6 7+ |
|----|----------------|
| 1  | 1 2 3 4 5 5 5  |
| 2  | 2 2 3 4 5 5 5  |
| 3  | 3 3 3 4 5 5 5  |
| 4  | 4 4 4 4 5 5 5  |
| 5  | 5 5 5 5 6 6 6  |
| 6  | 6 6 6 7 7 7 7  |

3. Grand Score Development and List of Actions
   Each combination of C and D scores is given a rating called as a grand score, consists of 1 to 7. The grand score is presented in table 8.

2.2 Rapid Entire Body Assessment (REBA)
   Rapid Entire Body Assessment is a method developed in ergonomics field and can assess the work position or posture of an operator's neck, back, arms, wrists, and feet quickly [13]. In addition, this method is also influenced by the coupling factor, such as external loads that are supported by the employees’ body and activities. REBA does not take long time to complete and make a general scoring on a list of activities that indicates the need for risk reduction due to the operator's work posture. [10]. Assessment using REBA method had been implemented by Dr. Sue Hignett and Dr. Lynn McAtamney through several stages, as follows [10]:

1. Collecting the Employees’ posture data by using documentation (video or photo)
In order to obtain a detailed description of the employees’ attitude (posture) and their neck, back, arms, wrists and feet. It was conducted by documenting the employees’ body posture. Hence, the researchers get detailed (valid) posture data from the recorded videos and photos, as well as obtaining the accurate data from the calculation and subsequent analysis stages.

2. Determination of the angles of employees’ body part

After recording the videos and photos of the employees’ posture, the calculations of the angles of each body segment were obtained, such as back (torso), neck, upper arms, forearms, wrists, and feet. In implementing REBA method, the body segments were divided into two groups, such as group A and group B. Group A consists of back (torso), neck, and legs; while group B consists of upper arms, forearms, and wrists. Based on the data of the angle of the body segment in each group, the scores of group A and group B can be seen in these following tables:

| Table 9. The Score of Back Movement (torso) |
| Movement | Score | Change Score |
| Straight/Natural | 1 |  |
| 0° – 20° flexion | 2 |  |
| 0° – 20°extension | +1 if rotated or oblique |
| 20° – 60° flexion | 3 |  |
| > 20°extension | 4 |  |

| Table 10. The Score of Neck Movement |
| Movement | Score | Change Score |
| 0° – 20° flexion | 1 | +1 if rotated or oblique |
| > 20° flexion atau extension | 2 |  |

| Table 11. Feet’s Position Score |
| Movement | Score | Change Score |
| The feet is supported, the load is uniformly distributed, walking or sitting | 1 | +1 if the knee is between 30° and 60° flexion. |
| The feet is supported, the load is not uniformly distributed, and the posture is unstable | 2 | +2 if the knee > 60° flexion (not sitting) |

| Table 12. The Score of Upper Arm Movement |
| Movement | Score | Change Score |
| 20°extension - 20°flexion | 1 | +1 if the position of the arm is: - abducted - rotated |
| > 20° extension | 2 |  |
| 20° – 45° flexion | 3 | +1 if the shoulder is lifted up |
| > 90° flexion | 4 | -1 if leaning, the load of the arm is supported as the gravitation |

| Table 13. Lower Arm Movement |
| Movement | Score |
| 60° – 100°flexion | 1 |
| < 60°flexion atau >100°flexion | 2 |

| Table 14. The Score of Wrists Movement |
| Movement | Score | Change Score |
| 0° – 15°flexion / extension | 1 |  |
| >15°flexion / extension | 2 | +1 when the wrists are rotated or its position is strange |
Table 15. Table A

| Neck = 1 | Legs | Back |
|----------|------|------|
| 1        | 1 2 3 4 5 |
| 2        | 1 2 3 4 5 6 |
| 3        | 3 4 5 6 7 8 |

Table 16. Table B

| Neck = 2 | Legs |
|----------|------|
| 1        | 1 3 4 5 6 |
| 2        | 2 4 5 6 7 8 |
| 3        | 3 5 6 7 8 9 |

| Neck = 3 | Legs |
|----------|------|
| 1        | 3 4 5 6 7 |
| 2        | 3 5 6 7 8 9 |
| 3        | 5 6 7 8 9 |

The scores presented in table A and table B are used in table C, and the C score can be identified.

Table 17. Table C

| Score A |
|---------|
| 1 2 3 4 5 6 7 8 9 10 11 12 |
| 1 1 1 2 3 4 6 7 8 9 10 11 12 |
| 2 1 2 3 4 4 6 7 8 9 10 11 12 |
| 3 1 2 3 4 4 6 7 8 9 10 11 12 |
| 4 2 3 3 4 5 7 8 9 10 11 12 |
| 5 3 4 4 5 6 8 9 10 11 12 12 |
| 6 3 4 5 6 7 8 9 10 11 12 12 |
| 7 4 5 6 7 8 9 10 11 11 12 12 |
| 8 5 6 7 8 8 9 10 10 11 12 12 |
| 9 6 7 7 8 9 10 10 11 12 12 12 |
| 10 7 7 8 9 9 10 11 12 12 12 12 |
| 11 7 7 8 9 9 10 11 11 12 12 12 |
| 12 7 8 8 9 9 10 11 11 12 12 12 |

3. Determination of the weight of the object that is lifted, coupling, and the employees’ activities.
In addition, in order to calculate each body segment’s score, other factors that need to be considered are weight lifted, coupling, and the employees’ activities. Each of these factors also has each own scoring category.

Table 18. Load/force

| Load/force | 0 | 1 | 2 | +1 |
|------------|---|---|---|----|
| 0          |   |   |   |    |
| 5-10 kg    |   |   |   |    |
| >10 kg     |   |   |   |    |

| Shock or rapid build up of force | 0 | 1 | 2 |
|----------------------------------|---|---|---|

Table 19. Table Coupling

| Coupling | 0 | 1 | 2 | 3 |
|----------|---|---|---|---|
| Good     |   |   |   |   |
| Fair     |   |   |   |   |
| Poor     |   |   |   |   |
| Unacceptable |     |   |   |
| Strange, unsafe grip, no handles |   |   |
| Coupling is unacceptable if using other parts of the body |   |

Score B

| 1 2 3 4 5 6 7 8 9 10 11 12 |
|-----------------------------|
| 1 1 1 2 3 4 6 7 8 9 10 11 12 |
| 2 1 2 3 4 4 6 7 8 9 10 11 12 |
| 3 1 2 3 4 4 6 7 8 9 10 11 12 |
| 4 2 3 3 4 5 7 8 9 10 11 12 |
| 5 3 4 4 5 6 8 9 10 11 12 12 |
| 6 3 4 5 6 7 8 9 10 10 11 12 12 |
| 7 4 5 6 7 8 9 10 11 11 12 12 |
| 8 5 6 7 8 8 9 10 10 11 12 12 |
| 9 6 7 7 8 9 10 10 11 12 12 12 |
| 10 7 7 8 9 9 10 11 11 12 12 12 |
| 11 7 7 8 9 9 10 11 11 12 12 12 |
| 12 7 8 8 9 9 10 11 11 12 12 12 |
| 12 7 8 8 9 9 10 11 11 12 12 12 |
| 12 7 8 8 9 9 10 11 11 12 12 12 |
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| Unacceptable |     |   |   |
| Strange, unsafe grip, no handles |   |   |
| Coupling is unacceptable if using other parts of the body |   |

Score B

| 1 2 3 4 5 6 7 8 9 10 11 12 |
|-----------------------------|
| 1 1 1 2 3 4 6 7 8 9 10 11 12 |
| 2 1 2 3 4 4 6 7 8 9 10 11 12 |
| 3 1 2 3 4 4 6 7 8 9 10 11 12 |
| 4 2 3 3 4 5 7 8 9 10 11 12 |
| 5 3 4 4 5 6 8 9 10 11 12 12 |
| 6 3 4 5 6 7 8 9 10 10 11 12 12 |
| 7 4 5 6 7 8 9 10 11 11 12 12 |
| 8 5 6 7 8 8 9 10 10 11 12 12 |
| 9 6 7 7 8 9 10 10 11 12 12 12 |
| 10 7 7 8 9 9 10 11 11 12 12 12 |
| 11 7 7 8 9 9 10 11 11 12 12 12 |
| 12 7 8 8 9 9 10 11 11 12 12 12 |
| 12 7 8 8 9 9 10 11 11 12 12 12 |
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| >10 kg     |   |   |   |    |

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|----------|---|---|---|---|
| Good     |   |   |   |   |
| Fair     |   |   |   |   |
| Poor     |   |   |   |   |
| Unacceptable |     |   |   |
| Strange, unsafe grip, no handles |   |   |
| Coupling is unacceptable if using other parts of the body |   |
Table 20. Activity Score

| +1 | One ore more body parts are static, e.g. holding more than 1 minute. |
| +1 | Repeated small range action, e.g. repeated more than 4 times per minute (not including walking) |
| +1 | Action cause rapid large range changes in postures or an unstable base |

4. Calculation of the REBA score for the posture

After obtaining the scores from table A, then it is added to the score of the weight of the load lifted, and it resulted the A score. Meanwhile, the scores obtained from table B is added to the score from the coupling table, and it resulted the part B score. Part A and Part B scores are used to calculate the C score, based on the table C. REBA score is obtained from the sum of the part C scores with the scores of employees’ activities. Based on REBA score, it can be seen that the level of risk on the musculoskeletal and actions need to be done in order to reduce the work injury risk and improve the quality of the work. Furthermore, the ways of using REBA method and the level of risk can be seen in Figure 3 and Table 22.

3. Result and Discussions

![Figure 1. The operator’s posture](image)

An operator, had recorded a video and captured the picture when another operator lifted a 20 kg gallon up, and the corners of the body can be drawn, such as the back, neck, legs, wrists, upper arms, and forearms. After drawing the angles, it is found that in Group A assessed with RULA method, the angle of the back movement is 77° flexion, the neck is 18° extension, and the leg angle is 39° with a knee angle of more than 60°. Group B, such as the upper arm is formed an angle of 65° flexion, the forearm is 13° flexion, and the wrist is 0°.

- **Analysis by using RULA**

  Part A:
  1. The score of upper arms movement : 3
  2. The score of forearms movement : 2
  3. The score of wrists movement : 2
  4. The score of wrists rotation movement : 1
  5. The score of muscles used : 0
  6. The score of energy used : 1

  Part B:
  1. The score of back movement : 4
  2. The score of neck movement : 2
  3. The score of leg movement : 2
  4. The score of muscles use : 0
  5. The Score of energy use : 1
Figure 2. RULA scoring

Table 21. RULA action level

| Action level | keterangan |
|--------------|------------|
| Action level 1 | A score of 1 or 2 indicates that posture is acceptable if it is not maintained or repeated for long periods. |
| Action level 2 | A score of 3 or 4 indicates that further investigation is needed and changes may be required. |
| Action level 3 | A score of 5 or 6 indicates that investigation and changes are required soon. |
| Action level 4 | A score of 7 indicates that investigation and changes are required immediately. |

In the grand score analysis of RULA method, the grand score was 7, and it was categorized as Action level 4, which means that this condition is dangerous. Hence, further investigation and changes are needed. Further examination and changes imply that the employees’ work posture needs to be checked and changed. In addition, the work habits of the operator can cause muscle injury when it is conducted for a long time, and it should be immediately identified and trained by giving instructions on how to lift a fairly heavy load or the criteria of good work posture for employees. Changes can also occur when using tools to lift and move the gallons.

- Analysis by using REBA

Part A :
1. The score of back movement : 4
2. The score of neck movement : 1
3. The score of leg movement : 2 + 2 (since the corner of the knee >60°)
4. The score of load weight : 2

Part B :
1. The score of upper arms movement : 3
2. The score of forearms movement : 2
3. The score of wrists movement : 1
4. The score of coupling table : 2
In the grand score analysis by using REBA method, the grand score obtained is 11, and it is categorized as Action level 4, indicating a very high level of risk. This means that from now on, it is necessary to make improvements for the operator, either in the work system, work elements, or the work environment. This can minimize the risk of work accidents for the operator when working. This study is in accordance with previous research which states that the RULA and REBA methods can show maximum results in assessing good work positions. [13], and this study agrees with previous research which states that the RULA and REBA methods are methods that can provide comprehensive results in determining a good work position in order to know whether repairs need to be done immediately or not. [8,14]. In addition, this research complements previous research that only uses the RULA method, so that the results obtained will be renewable information [15].

4. Conclusions

Based on the calculation of work posture by using RULA and REBA methods, it can be concluded that the operator's work posture has a high and dangerous level of risk. Therefore, the operator needs to immediately improve his work posture. Due to the lifting position without a squatting position in the beginning, this hurts the back since it is the lift's pivot. Based on the conclusion, we recommend to analyze the risks caused by errors in work movements, so the workers do not get injured because of wrong work attitudes. In the next research, this research should be developed by carrying out a biomechanical analysis, which is about human physical strength which includes human physical strength or power when working and studying how to work and equipment must be designed to suit human physical abilities when carrying out these work activities, then anthropometry, namely numerical data collection relating to the physical characteristics of the human body (size, volume, and weight) and the application of these data to the design of facilities or products and finally the physical work environment taking into account these physical factors including air temperature in the workplace, workspace area, noise, congestion, and congestion.

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**Figure 3. REBA scoring**

**Table 22. REBA action level**

| Action level | REBA Score | Risk Level | Action (including further assessment) |
|--------------|------------|------------|---------------------------------------|
| 0            | 1          | Negligible | None necessary                        |
| 1            | 2-3        | Low        | May be necessary                      |
| 2            | 4-7        | Medium     | necessary                             |
| 3            | 8-10       | High       | Necessary soon                        |
| 4            | 11-15      | Very high  | Necessary now                         |

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5. References

[1] Emmatty F J and Panicker V V. 2019 Ergonomic interventions among waste collection workers: A systematic review Int. J. Ind. Ergon. 72 158–72

[2] MassirisFernández M, Fernández J Á, Bajo J M and Delrieux C A 2020 Ergonomic risk assessment based on computer vision and machine learning Comput. Ind. Eng. 149

[3] Gómez-Galán M, Callejón-Ferre Á J, Pérez-Alonso J, Díaz-Pérez M and Carrillo-Castrillo J A 2020 Musculoskeletal risks: RULA bibliometric review vol 17

[4] Lowe B D, Dempsey P G and Jones E M 2019 Ergonomics assessment methods used by ergonomics professionals Appl. Ergon. 81 102882

[5] Hulme A, Thompson J, Plant K L, Read G J M, Mclean S, Clacy A and Salmon P M 2019 Applying systems ergonomics methods in sport: A systematic review Appl. Ergon. 80 214–25

[6] Abobakr A, Nahavandi D, Hosny M, Iskander J, Attia M, Nahavandi S and Smets M 2019 RGB-D ergonomic assessment system of adopted working postures Appl. Ergon. 80 75–88

[7] Kong Y K, Lee S yong, Lee K S and Kim D M 2018 Comparisons of ergonomic evaluation tools (ALLA, RULA, REBA and OWAS) for farm work Int. J. Occup. Saf. Ergon. 24 218–23

[8] Cremasco M M, Giustetto A, Caffaro F, Colantoni A, Cavallo E and Grigolato S 2019 Risk assessment for musculoskeletal disorders in forestry: A comparison between RULA and REBA in the manual feeding of a wood-chipper Int. J. Environ. Res. Public Health 16

[9] Reyes-zárate G G and Garcia-cavazos I 2020 REBA WORKPLACE ERGONOMICS USING KINECT 17–8

[10] McAtamney L and Hignett S 2004 Rapid Entire Body Assessment Handb. Hum. Factors Ergon. Methods 31 8-1-8–11

[11] Lynn M and Corlett N 1993 RULA: A survey method for the investigation of work-related upper limb disorders Appl. Ergon. 24 91–9

[12] Abd Rahman M K F, Shahriman A B, Desa H, Daud R, Razlan Z M, Wan K, Cheng E M and Afendi M 2015 Comparative Study of Rapid Upper Limb Assessment (RULA) and Rapid Entire Body Assessment (REBA) between Conventional and Machine Assisted Napier Grass Harvest Works Appl. Mech. Mater. 786 275–80

[13] Kee D, Na S and Chung M K 2020 Comparison of the Ovako Working Posture Analysis System, Rapid Upper Limb Assessment, and Rapid Entire Body Assessment based on the maximum holding times Int. J. Ind. Ergon. 77 102943

[14] Julianus H 2019 Work Posture Analysis by Using Rapid Upper Limb Assessment (RULA) and Rapid Entire Body Assessment (REBA) Methods (Case Study: Rice Milling in Malang - East Java of Indonesia) IOP Conf. Ser. Mater. Sci. Eng. 469

[15] Widiastuti R, Nurhayati E, Wardani D P and Sutanta E 2020 Workload measurement of batik workers at UKM batik jumputan Yogyakarta using RULA and NASA-TLX J. Phys. Conf. Ser. 1456

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