

ANALYSIS OF MUSCULOSKELETAL COMPLAINTS DISORDERED WITH REBA METHOD AND RULA METHOD (CASE STUDY OF VOCATIONAL HIGH SCHOOL BRANTAS KARANGKATES MALANG DISTRICT)

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ABSTRACT: Class furniture, namely tables and chairs, are significant physical facilities because the furniture is used for teaching and learning activities. Pain in the neck, waist, right upper arm, right forearm and right wrist during the learning process due to non-ergonomic facilities. Therefore, this research aims to minimize the complaints of Musculoskeletal Disorder with the Ergonomic Learning Chair. In this study, descriptive research with the REBA method and the RULA method were used. With the REBA method, the final score obtained in Group C is 8, then this value is entered at Action Level 3, after which researchers can only find out that the student's body posture level is in the High category so that action is needed immediately. With the RULA method, the student's body activity results are at a Group C score of 7. The value is entered for Action Level 4 so that the student's posture is in the dangerous category for safety, health and comfort. Therefore, action is needed now to overcome this problem with the suggestion manufacture of Ergonomic Study Chair. From the results of the chair use test design analysis by distributing questionnaires to 35 students as a sample, it was found that there was a decrease in complaints of Musculoskeletal Disorder in the student body. With the contribution of the study table, it can be adjusted up and down (adjustable) to make the chair more comfortable.

Keywords: Questionnaire, Observation, Musculoskeletal Disorder, REBA, RULA.

1. Introduction

Tables and chairs are significant physical facilities because student learning activities are primarily spent in the classroom, such as reading, drawing, writing, and other activities. Therefore, schools must provide classroom furniture that can meet the needs of students [1], With the phenomena that occur in the Brantas Vocational High School computer laboratory class as follows:

- a. From observations [1] in the learning process, the neck position rotates sideways when students see the teacher explaining the material on the blackboard with a rather long time duration of about 20-30 minutes, which results in pain in the upper neck, back pain and which is then continued with a note-taking position material given by the teacher with the body rotating back to face the table, the body leaning forward, the wrist bent, the writing position of the hand hanging out of the table board area which resulted in the rapid fatigue

- b. From the results of distributing questionnaires [1] to 35 students, it was found that complaints from students were obtained from the data on the results of student complaints through questionnaires: complaints on the neck were 100%, on the back 85%, the right upper arm 71%, the right forearm 71% and the right hand 71%, as presented in Figure 1.

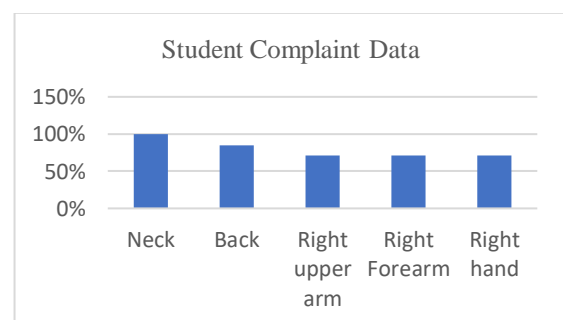


Figure 1 Student Complaints Diagram

Nordic Body Map (NBM) is an initial identification in determining Musculoskeletal Disorder symptoms by taking an ergonomic approach more objectively in determining the risk of Musculoskeletal Disorders. Rapid Entire Body Assessment (REBA) is a method developed in ergonomics and can be used quickly to assess the work position or posture of an operator's neck, back, wrists and feet. In addition, the method is

also influenced by the coupling factor, external loads that are supported by the body and the activities of the workers [2], as shown in Figure 2.

Rapid Upper Limb Assessment (RULA) is a method developed in the field of ergonomics that investigates and assesses the work positions performed by the upper body [3].

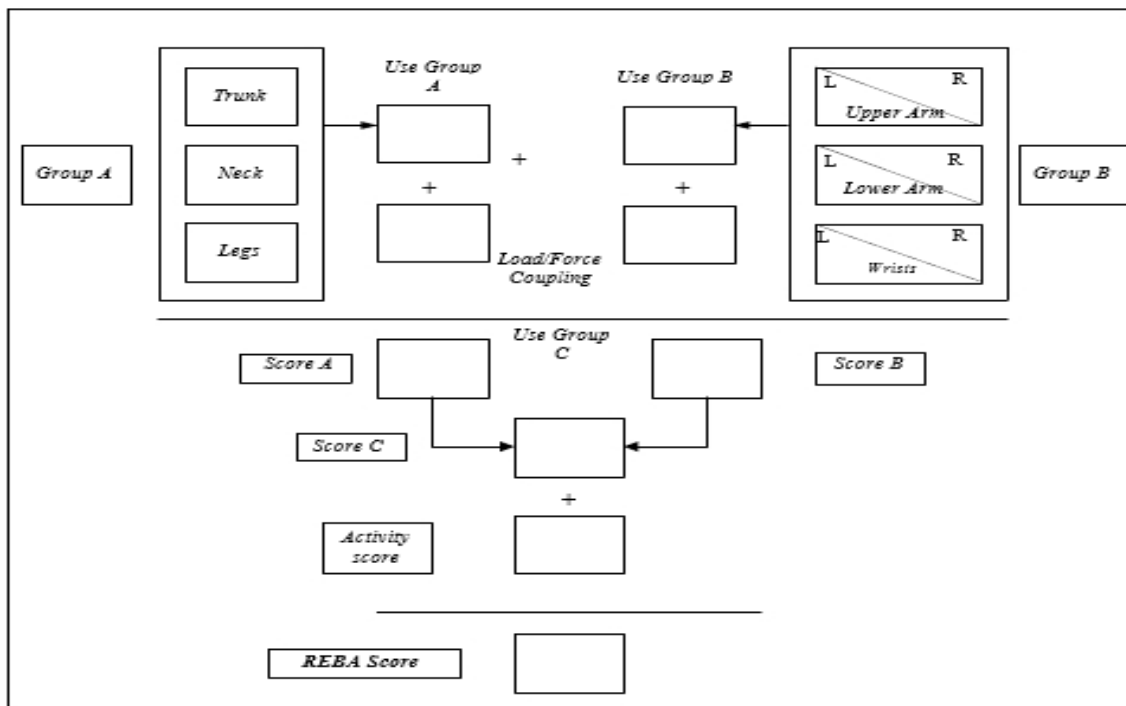


Figure 2 Calculation Steps of the REBA Method

2. Basic Theory

2.1 Musculoskeletal Disorder

Musculoskeletal complaints are complaints in the skeletal muscles, ranging from very mild complaints to very painful. Muscles that receive static loads repeatedly and continuously for a long time can cause complaints of damage to joints, ligaments and tendons. Complaints to damage are usually termed musculoskeletal disorders or injuries to the musculoskeletal system [4].

2.2 REBA

REBA is a method developed in ergonomics and can be used to assess the quickly work position or posture of an operator's neck, back, arms, wrists and feet. Apart from that, this method is also influenced by the coupling factor, external loads that are supported by the body and the

activities of the workers. Assessment using REBA does not take a long time to complete and does a general scoring on a list of activities, indicating the need for risk reduction caused by the operator's work posture [2].

REBA checks can be carried out in a confined space without disturbing workers. REBA development occurs in four stages. The first stage is taking the worker's posture data using the help of videos or photos, and the second stage is determining the angles of the worker's body parts, the third stage is determining the weight of the object being lifted, determining the coupling, and determining the worker's activity. Moreover, finally, the fourth stage is calculating the REBA value for the posture in question. By obtaining the REBA value, it can be seen the level of risk and the need for action that needs to be taken to improve work [2].

2.3 RULA

RULA is a method developed in ergonomics that investigates and assesses the work positions performed by the upper body. This method does not require special tools to provide assessments in the neck, back, and upper body posture and this method use diagrams of body posture and three score tables to determine risk factor evaluations [3], as shown in Figure 3.

There are four main applications of the Rapid Upper Limb Assessment (RULA) [3], namely:

1. Measuring Musculoskeletal risk, usually as part of a broader improvement of ergonomics.
2. Comparing the Musculoskeletal Load between the old workstation design and the latest obtained design results.
3. Evaluating output such as productivity or appropriateness of the use of design results.
4. Train workers about the musculoskeletal load caused by differences in work postures.

To facilitate the assessment of body posture, the assessment of body posture is divided into 2 group segments, namely Group A and Group B values [3].

The development of this RULA consists of three stages [3]:

1. Identify work posture
2. Scoring system
3. The scale of the level of action provides a guide on the level of risk that exists and is needed to encourage a more detailed assessment of the obtained analysis.

3. Research Methods

In this study, it can be said as descriptive research [5]. This study aims to describe the problems and solutions of non-ergonomic infrastructure that cause musculoskeletal disorders in students of the computer laboratory of Vocational High School (SMK) Brantas Karangates. The research steps are.

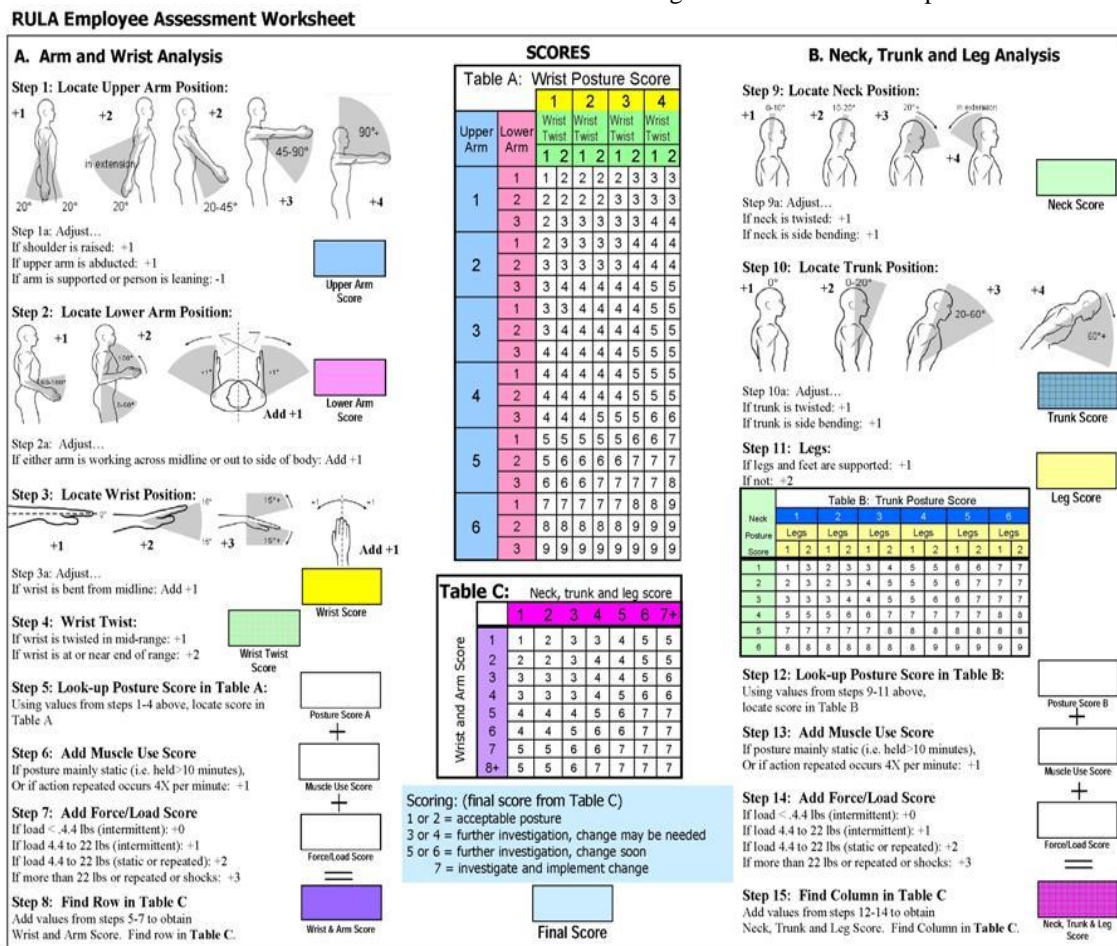


Figure 3 Analysis sheet of RULA

3.1 Data Collection

Posture Data Related to Musculoskeletal Disorder: Data obtained from the distribution of questionnaires and observations to 35 students as samples in the study.

3.2 Data processing using the REBA method and RULA method

The methods used to process posture data related to Musculoskeletal Disorders which help investigate and assess the learning positions performed by the upper body, include: neck, back, upper right arm, right lower arm, and right hand are:

The development of the REBA method occurs in four stages[6], namely:

- 1) The first stage is to collect worker posture data using videos or photos.
- 2) The second stage is to determine the angles of the worker's body part.
- 3) The third stage is determining the weight of the object being lifted, determining the coupling, and determining the activities of the workers.
- 4) The fourth stage is the calculation of the REBA value for the posture in question. By obtaining the REBA value, it can be seen the level of risk and the need for action that needs to be taken to improve work.

The development of the RULA method consists of three stages [6], namely:

- 1) Identify work posture
- 2) Scoring system
- 3) The scale of the level of action provides a guide on the level of risk that exists and is needed to encourage a more detailed assessment of the obtained analysis.

3.3 Form of the Proposed Ergonomic Study Desk Chair Design.

The contents of this chapter are the shape and dimensions of the Ergonomic Study Desk Chair coupled with the contribution of the study table, which can be adjusted up and down (Adjustable).

3.4 Test Results of the Ergonomic Study Desk Chair design.

From the initial number of testing the actual study table chair form, 35 students and these students will also test the new Study Table Chair Design, which will later on the results of this test to

minimize complaints of musculoskeletal disorders in the student body.

4. Research and Discussion Results

4.1. Research Result

Posture data related to musculoskeletal disorder are here to get data from photoshoots for students during learning, as shown in Figure 4 and 5.



Figure 4 Students Sit



Figure 5 Students Write

4.2 Analyzing Data

REBA Method Data Processing.

Assessment of Group A's posture when students turn (Figure 2).

The description of the analysis of Figure 2 above, namely:

- a. Position of the body forming an angle of 50° , then given: score 3 (Enter table 1 Group A).
- b. The neck position looking to the side is given: score 3 (Enter table 1 Score Group A).
- c. The position of the two legs resting on the table's leg and forming an angle of 120° is given: score 3 (Enter table 1 Group A).

Table 1 Score Group A

Tabel A	Neck												
	1				2				3				
	Legs												
Trunk	1	1	2	3	4	1	2	3	4	3	3	5	6
Posture	2	2	3	4	5	3	4	5	6	4	5	6	7
Score	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

The final posture score for Group A: Group A table + load value (load value less than 5 kg) then the final score: $7 + 0 = 7$ (enter the table 3 score Group C)

Posture assessment when writing group B scores (Figure 3)

The description of the assessment analysis of Figure 3 above, namely:

- The posture of the forearm at a 40 ° angle is given: score 2 (entered in Table 2 Group B).
- posture of the forearm at an angle of 16 °, given: score: 2 (entered Table 2 Group B).
- The wrist posture formed an angle of 15 °, given a score of 2 (entered Table 2 Group B).

Table 2 Score Group B

Table B	Lower Arm						
	Wirst	1			2		
		1	2	3	1	2	3
Upper Arm	1	1	2	2	1	2	3
Score	2	1	2	3	2	3	4
	3	3	4	5	4	5	5

- Customers are given a score: 0
 Then the final score of posture B is: $3 + 0 = 3$ (in Table 3 Score Group C)

Group Score Assessment C

Table 3 Score Group C

Score A (Score From Table A + Load Force)	Tabel C Score B (Table B + Coupling Score)											
	1			2			3			4		
	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	2	2	2	3	4	4	5	6	6	7	7	8
3	3	3	3	3	4	5	6	7	7	8	8	8
4	4	4	4	4	5	6	7	8	8	9	9	9
5	5	5	5	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	7	8	9	9	9	10	10	11	11

To determine the final score from the REBA method, there must be an increase between the "score Table C" with an increase in the type of muscle activation so that the value of the posture is obtained. Group C value + Repetitive movement that occurs more than four times.

Then the final score from the REBA Method is: $7 + 1 = 8$

From the final score obtained in Group C's score of 8, this value is included in Action Level 3; the student's posture is in the High category, so action is needed immediately.

Data Processing RULA Method.

Posture assessment when writing group A scores (Figure 3).

The description of the analysis of Figure 3 above, namely:

- Upper arm forming a 40 ° angle is given: Score 3 (enters table 4 Group A)
- The forearm angles 108 ° and working away from the centre line is given: Score 3 (enters table 4 Group A)
- Wrist at 16 ° angle, working away from the centre: Score 3 (enters table 4 Group A)
- Wrist rotation near the turn is given: Score 2 (enters table 4 Group A)
- Repetition activities carried out more than once then given: score 1
- Load <2 kg given: score 0

Table 4 Score Group A

Upper Arm	Lower Arm	Wrist					
		1	2	3	4		
		Wrist Twist	Wrist Twist	Wrist Twist	Wrist Twist		
1	1	1	2	2	3	3	3
	2	2	2	2	3	3	3
	3	2	3	2	3	3	3
2	1	2	2	2	3	3	4
	2	2	2	2	3	3	4
	3	2	3	3	3	3	4
3	1	2	3	3	3	4	4
	2	2	3	3	3	4	4
	3	2	3	3	4	4	5

The final total score for Group A is:
 Group A posture score + activity score + Load score
 $4 + 1 + 0 = 5$ (enter the 6 Final Score table)

Group B posture assessment when looking (Figure 2)

The description of the analysis of Figure 4.6 above, namely:

- a. The posture of the neck looking to the side, given a score: $4 + 1 = 5$ (entered table 5 Group B)
- b. Back posture forms an angle of 50° , given a score: 3 (entered table 5 Group B)
- c. The position of the legs on a sitting position means that they are in a balanced state: score 1 (entered table 5 Group B)
- d. Repetition activities carried out more than once then given: score 1
- e. Load < 2 kg given: score 0

Table 5 Score Group B

Neck	Trunk					
	1	2	3	4	5	6
	Legs	Legs	Legs	Legs	Legs	Legs
	1	2	1	2	1	2
1	1	3	2	3	3	4
2	2	3	2	3	4	5
3	3	3	3	4	4	5
4	5	5	5	6	6	7
5	7	7	7	7	7	8
6	8	8	8	8	8	9

The final total score for Group B is:
 Group B posture score + activity score + Load score
 $7 + 1 + 0 = 8$ (enter table 6 Score Group C)

Group Posture Assessment C

Table 6 Score Group C

Nilai	Nilai A						
	1	2	3	4	5	6	7+
1	1	2	3	3	4	5	6
2	2	2	3	4	4	5	6
3	3	3	3	4	4	5	6
4	3	3	3	4	5	6	7
5	4	4	4	5	6	7	7
6	4	4	5	6	6	7	7
7	5	5	6	6	7	7	7
8+	5	5	6	7	7	7	7

From the final score obtained in Group C's score of 7, this value is included in Action Level 4. After the Action Level is determined, the new researchers can find out that the student's body posture level is in the high category and is dangerous for the safety, health and comfort of students so that action right now.

By looking at the results of the REBA method and the RULA method, which are so very worrying, the researcher proposes the need for action to prevent complaints in the student body with the Ergonomic Learning Chair Design so that it is

expected to be able to minimize fatigue on the student's body when the learning process takes place in the Computer Laboratory.

Form of the Proposed Ergonomic Study Desk Chair Design.

Dimensions of Study Chair Design

After the percentile calculation is obtained, the next step is to determine the following dimensions:

Table 7 Dimensions of New Design Chairs

No	Design Results	Dimension (cm)
1	Dimensions (cm)	43
2	Chair Pedestal Length	45
3	Seat Width	43
4	Seat Back Height	56
5	Seat Beck Width	48
6	Table Length	61 & 30
7	Table Width	28
8	Table height from surface	68
9	Thickness of Table	2
10	Table Haight on Chair Pad/ down Position	0
11	Table Haight on Chair Base / Raised Position	16

After the Ergonomic Study Desk Chair dimensions are determined, then we make the study table chair with tool materials that have become the procedure for making Ergonomic study table chairs. With the results in the Figure 6, by contributing to this study, the table can be adjusted up and down adjusted by the user of the desk chair for study alone.



Figure 6 Ergonomics Study Desk Chair



Figure 7 Contribution Study Table Chair Ergonomics

Test Results of the Ergonomic Study Desk Chair design

By conducting tests on the use of study desk chairs to 35 predetermined samples, namely the predecessor samples which were used as initial testing of actual table chairs and the results obtained from testing of ergonomic study desk chairs were tested on students who had been recapitulated with the results of comparisons of complaints against actual desk chair use with the new ergonomic study desk chair.

Table 8 Recapitulation of the Comparison questionnaire Test of the Actual Study Table Chair with the Latest Study Table Chair

No	Complaints Sic	Chair Old Study Table	New Study Chair Design
1	Neck	35 students (100%)	3 student (0,085%)
2	Backs	30 Students (85%)	4 students (0,11%)
3	Right Upper Arm	25 students (71%)	4 students (0,11%)
4	Lower Right Arm	25 students (71%)	5 students (0,17%)
5	Right Hand	25 students (71%)	7 students (0,2%)

5. Conclusion

Based on the data processing and analysis results, the following conclusions can be drawn:

With the REBA Method and RULA Method approach to detect work posture and investigate upper limb disorders. With the REBA method, the final score obtained in Group C is 8, then this value is entered at Action Level 3, after which researchers can only find out that the student's body posture level is in the High category so that action is needed immediately. With the RULA method, the student's body activity results were the Group C score of 7, and then the score entered Action Level 4 so that the student's body posture level was in the dangerous category. To solve this problem, a proposal with an Ergonomic Study Chair Design is needed [7].

With the Ergonomic Study Table Chair test for learning in the Computer Laboratory, it has been found that the use of the latest study desk chairs can reduce complaints of Musculoskeletal disorder in the students of Vocational High School (SMK) [8,9].

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