

Posture Analysis With Rapid Upper Limb Assessment (RULA) Method at Students of Three Study Programs in Sari Mulia University

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Abstract

The spread of COVID-19 cases is taking place in a very fast time so that it has an impact on all sectors. One of the sectors affected is educational institutions. To prevent the spread of COVID-19 cases, all learning processes are carried out with an online learning system. Online learning causes an increase in sitting activities rather than standing activities, specially activity in front of a smartphone or laptop. Sitting activities that last for a long period of time can result in ergonomic risks. The purpose of the study was to analyze posture using the RULA method. Research was conducted on students of three study programs, namely Industrial Engineering, DIV-Health Promotion, and Management with respondents of 53 people. This study was conducted with a survey to see the posture of students when attending online lectures. From the results of the study obtained that the posture of students with RULA worksheet is in the range of 4 to 7. For RULA score at mostly a score of 6 is as many as 24 students (45.28%). For RULA scores with scores of 5 and 7 is as many as 10 people (18.86%). And for RULA score at a value of 4 is as many as 9 people (16.98%).

Keywords: COVID-19, online learning, ergonomics, RULA.

I. INTRODUCTION

COVID-19 is a disease caused by SARS-CoV2 virus infection. This virus is a new type of virus that attacks the respiratory system with symptoms such as fever, cough, runny nose, shortness of breath, olfactory dysfunction, and can be the cause of death [1]. The status of COVID-19 as a global pandemic was first established by WHO in mid-March 2020 since the virus was contagious and had spread to countries around the world [2]. In Indonesia, COVID-19 cases themselves occurred towards the end of February 2020. Indonesia was one of the fastest countries infected with the COVID-19 virus with more than 100 new cases every day [3]. One of the steps taken by the government in preventing the transmission of the COVID-19 virus was by the enactment of physical distancing in all activities including one of them was in the field of education [4]. Educational institutions began to implement the process of distance learning (online) since the issuance of The Minister of Education Circular Letter No. 4 of 2020 on the Implementation of Education in the Emergency Period of Coronavirus Disease (Covid-19) [5].

Online learning leads to increasing sitting activities compared to standing activities. Students in conducting lecture activities are allowed to sit for a long period of time [6]. Long sitting in front of a laptop or smartphone in addition to attending lectures, students also do other online activities such as access to social media like Whatsapp (76%), Instagram (61%), Facebook (59%), Line (28%), TikTok (25%), and other social media (47%) [3]. Increasing social media activity will make it easier to communicate and take a little break from fatigue during work from home. In general, students have not been able to balance the time between online learning and online activities and doing other activities, so without realizing it students often do activities at home outside of normal work time by using a device or laptop [7]. Use of smartphones and laptops during the online learning period continuously with less posture over a long period of time can cause musculoskeletal complaints [8]. Based on previous research, students in three study programs of Sari Mulia University, almost all students, experience complaints of musculoskeletal disorder. The majority of MSDs complaints were experienced by students in the waist as many as 34 people (61.8%), in the upper neck as many as 33 people (60%) and on the lower neck as many as 25 people (45.5%) [4].

Musculoskeletal complaints are skeletal muscle complaints that a person experiences, ranging from very mild discomfort to very painful discomfort. Repeating long-term loading of static muscles can cause dissatisfaction in the form of joint, ligament, and tendon damage [9]. In addition, musculoskeletal complaints can be caused by awkward posture during work. One method that can be used for this awkward posture assessment is Rapid Upper Limb Assessment (RULA). Rapid Upper Limb Assessment (RULA) is a method used to measure risk factors for musculoskeletal disorders in the neck and upper body. RULA was developed by Mc Atamney and Corlett of the University of Nottingham Institute of Occupational Ergonomics, United Kingdom in 1993 [10]. RULA itself is used to calculate ergonomic risk factors on many jobs done while sitting or standing without any movement. RULA itself is used to calculate risk factors in the form of posture, strength or load, static work, and repetition at work.

II. METHOD

Observations were made on students in three study programs of Sari Mulia Banjarmasin University, Industrial Engineering, DIV-Health Promotion, and Management. Overall, students actively participate in online learning. This study was conducted with a survey to see the posture of students when attending online learnings. The sample of this study was 53 people. Since the sample was less than 100, the sample was taken in its entirety. Because the number of samples was less than 100 people, the total sampling method was applied [11].

For posture assessment of students, the Rapid Upper Limb Assessment (RULA) method was applied. RULA is a subjective observation method of postural analysis. The use of RULA worksheets does not require specific equipment and is very simple to learn. Assessment can be done without disturbing the person being observed. RULA has a high level of reliability when conducting analysis [12].

This method produces a value that can be used as a reference that the worker's posture is good or not, so that it can be used as a basis for redesigning the workstation. In RULA there are two parts that are assessed. Part A to assess the arms and wrists. Part B to assess the neck, trunk, and legs. From the results of assessments of A and B then an analysis was conducted that produced final values ranging from 1 to 7. Numbers 1-2 state that posture is accepted if it is not maintained or repeated for a long time. Figures 3-4 state further investigation and changes are needed. Figures 5-6 state that investigations and changes are needed immediately. Number 7 states that investigation and change are needed directly [13].

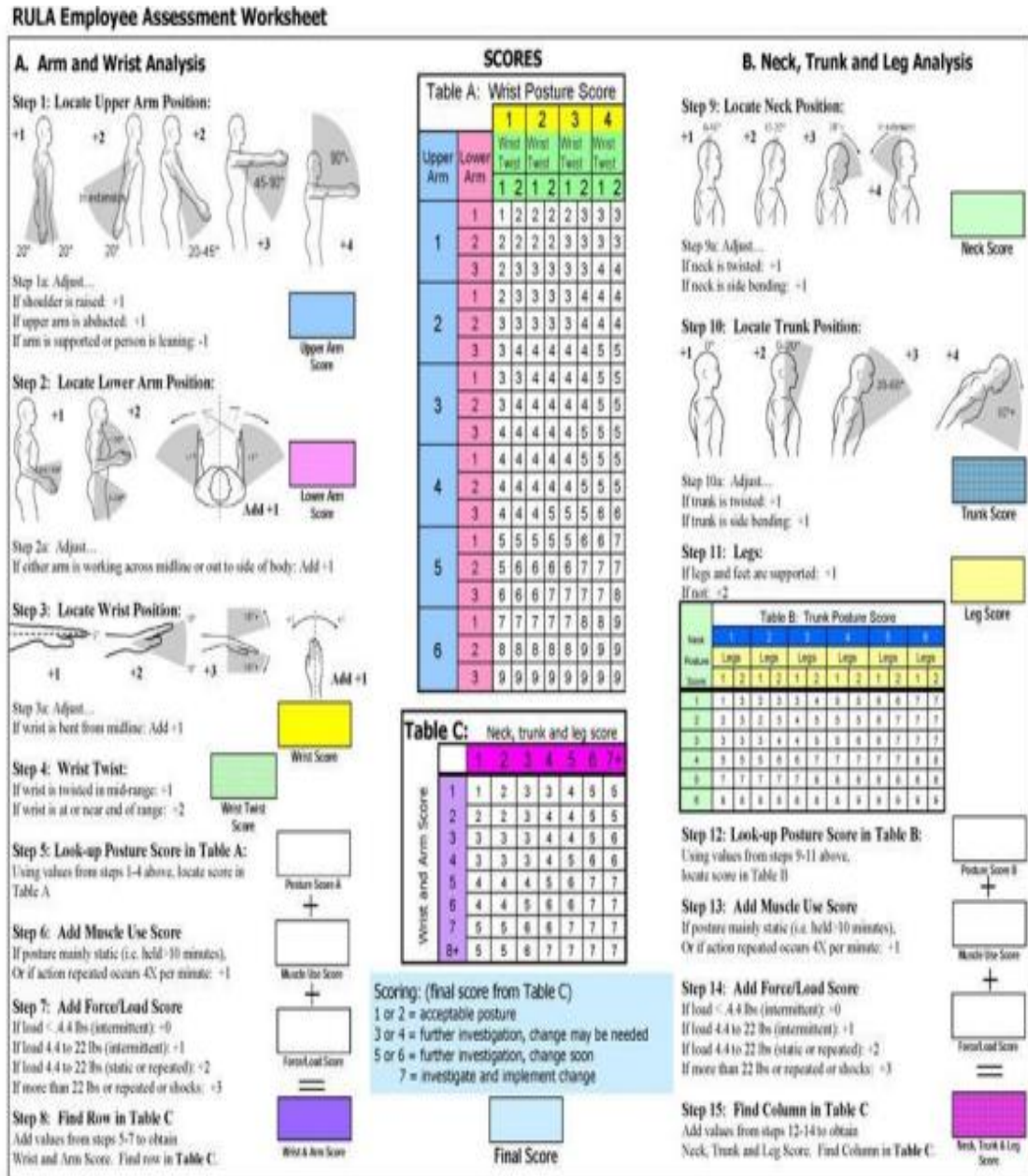


Figure 1. RULA Worksheet

For ergonomic risk level criteria based on the results of RULA assessment are :

Table 1. Level ergonomic risk according RULA

Score	Criteria
1-2	Risk ignore, acceptable posture
3-4	Low risk, further investigation, change may be needed
5-6	Moderate risk, further investigation, change soon
7	High risk, investigate and implement change

III. RESULTS AND DISCUSSION

Student posture during online learning was obtained through photos such as the picture below:



Figure 2. Body Posture Student A

Assessment of student posture in figure 2 based on RULA worksheet on part A (upper arm, forearm and wrist):

1. Group A posture
 - a. Upper arm posture where the upper arm forms an angle of 40° scores 2
 - b. Lower arm posture where the forearm forms 110° scores 2
 - c. Wrist posture of 45° then scores 3
 - d. When wrist twist is on the center line then scores 1

All the values of this A posture are included in table 2 below:

Table 2. Score Grup A Posture Student A

Table A		Wrist Score							
		1		2		3		4	
Upper Arm	Lower Arm	Wrist Twist		Wrist Twist		Wrist Twist		Wrist Twist	
		1	2	1	2	1	2	1	2
		1	1	1	2	2	2	2	3
	2	2	2	2	2	3	3	3	3
	3	2	3	3	3	3	3	4	4
2	1	2	3	3	3	3	4	4	4
	2	3	3	3	3	3	4	4	4
	3	3	4	4	4	4	4	5	5
3	1	3	3	4	4	4	4	5	5
	2	3	4	4	4	4	4	5	5
	3	4	4	4	4	4	5	5	5
4	1	4	4	4	4	4	5	5	5
	2	4	4	4	4	4	5	5	5
	3	4	4	4	5	5	5	6	6
5	1	5	5	5	5	5	6	6	7
	2	5	6	6	6	6	7	7	7
	3	6	6	6	7	7	7	7	8
6	1	7	7	7	7	7	8	8	9
	2	8	8	8	8	8	9	9	9
	3	9	9	9	9	9	9	9	9

- a. Repetition of activities, more than 4 times/minute scores 1
 - b. For load scores where the student load is < 2 kg, it scores 0
- Total Score for Group A is 4

2. Group B posture

- a. Neck posture (neck) forming an angle of 32° then scores 3
- b. The posture of the trunk forms an angle of 35° then scores 3
- c. Score assessment for the feet which were not supported by a chair scores 1

The assessment of group B posture can be seen in the table 3 below:

Table 3. Score Grup B Posture Student A

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

- a. For repeated activities, more than 4 times/minute scores 1
 - b. For the load score where the student load is < 2 kg, it scores 0
- Total Score for Group B is 5

The rating for the final score can be seen in the following table 4. The final score obtained in the student posture above is 5.

Table 4. Total RULA Score Student A

Table C	Neck, Trunk, Leg Score							
	1	2	3	4	5	6	7+	
Wrist / Arm Score	1	1	2	3	3	4	5	5
	2	2	2	3	4	4	5	5
	3	3	3	3	4	4	5	6
	4	3	3	3	4	5	6	6
	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

ERGONOMICS RULA Employee Assessment Worksheet Task Name: Y Date:

A. Arm and Wrist Analysis

Step 1: Locate Upper Arm Position: +1, +2, +3, +4. Upper Arm Score: 2

Step 2: Locate Lower Arm Position: +1, +2, +3, +4. Lower Arm Score: 2

Step 3: Locate Wrist Position: +1, +2, +3, +4. Wrist Score: 3

Step 4: Wrist Twist: +1, +2, +3, +4. Wrist Twist Score: 3

Step 5: Look-up Posture Score in Table A: 3

Step 6: Add Muscle Use Score: 1

Step 7: Add Force/Load Score: 0

Step 8: Find Row in Table C: 4

B. Neck, Trunk and Leg Analysis

Step 9: Locate Neck Position: +1, +2, +3, +4. Neck Score: 3

Step 10: Locate Trunk Position: +1, +2, +3, +4. Trunk Score: 3

Step 11: Legs: +1, +2. Leg Score: 1

Step 12: Look-up Posture Score in Table B: 4

Step 13: Add Muscle Use Score: 1

Step 14: Add Force/Load Score: 0

Step 15: Find Column in Table C: 5

Scoring: (Final score from Table C)
 1-2 = acceptable posture
 3-4 = further investigation, change may be needed
 5-6 = further investigation, change may be needed
 7 = investigate and implement change

Final RULA Score: 5

Original Worksheet Developed by Dr. Alan Hedge. Based on RULA, a survey method for the investigation of work-related upper limb disorders, McAtamney & Corlett, Applied Ergonomics 1993, 24(2), 91-99

Figure 3. RULA Worksheet Student A

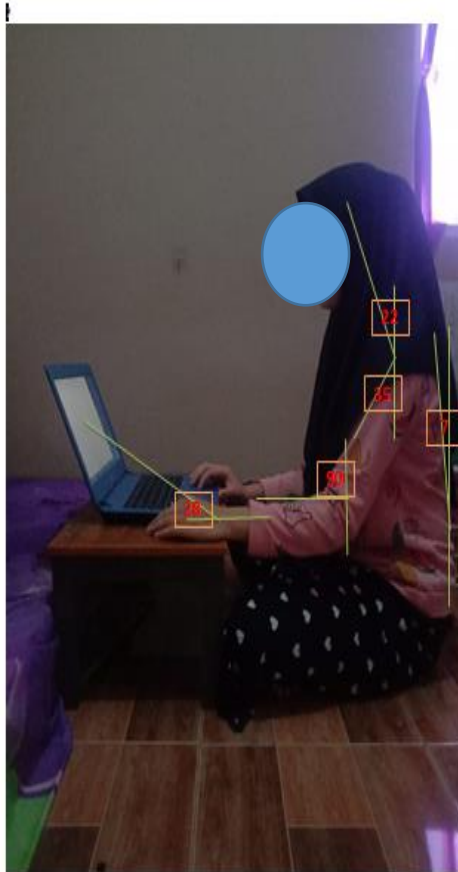


Figure 4. Body Posture Student B

Assessment of student posture in figure 4 based on RULA worksheet on part A (upper arm, forearm, and wrist):

1. Group A posture
 - a. Upper arm posture where the upper arm forms an angle of 35° scores 2
 - b. Lower arm posture where the forearm forms 90° scores 1
 - c. Wrist posture of 28° then scores 3
 - d. Wrist twist in the middle scores 1

All the values of this A posture are included in table 5 below:

Table 5. Score Grup A Posture Student B

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

- a. Repeated activities, more than 4 times/minute scores 1
- b. For the load score where the student load is < 2 kg, it scores 0

Total Score for Group A is 4

2. Group B posture

- a. Neck posture forms an angle 22° and scores 3
- b. Trunk posture forms an angle 7° then scores 2
- c. Score assessment for the feet which are not supported by a chair scores 2

The assessment of group B posture can be seen in the table 6 below :

Table 6. Score Grup B Posture Student B

Table A		Wrist Score							
		1		2		3		4	
Upper Arm	Lower Arm	Wrist Twist		Wrist Twist		Wrist Twist		Wrist Twist	
		1	2	1	2	1	2	1	2
1	1	1	2	2	2	2	3	3	3
	2	2	2	2	2	3	3	3	3
	3	2	3	3	3	3	3	4	4
2	1	2	3	3	3	3	3	4	4
	2	3	3	3	3	3	4	4	4
	3	3	4	4	4	4	4	5	5
3	1	3	3	4	4	4	4	5	5
	2	3	4	4	4	4	4	5	5
	3	4	4	4	4	4	5	5	5
4	1	4	4	4	4	4	5	5	5
	2	4	4	4	4	4	5	5	5
	3	4	4	4	5	5	5	6	6
5	1	5	5	5	5	5	6	6	7
	2	5	6	6	6	6	7	7	7
	3	6	6	6	7	7	7	7	8
6	1	7	7	7	7	7	8	8	9
	2	8	8	8	8	8	9	9	9
	3	9	9	9	9	9	9	9	9

- a. For repeated activities, more than 4 times / minute scores 1
- b. For load scores where the student load is < 2 kg, it scores 0

Total Score for Group B is 5

The rating for the final score can be seen in the following table. The final score obtained in the student posture above is 5.

Table 7. Total RULA Score Student B

Table C		Neck, Trunk, Leg Score						
		1	2	3	4	5	6	7+
Wrist / Arm Score	1	1	2	3	3	4	5	5
	2	2	2	3	4	4	5	5
	3	3	3	3	4	4	5	6
	4	3	3	3	4	5	6	6
	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

ERGONOMICS RULA Employee Assessment Worksheet Task Name: **M** Date:

A. Arm and Wrist Analysis

Step 1: Locate Upper Arm Position:

Step 1a: Adjust...
 If shoulder is raised: +1
 If upper arm is abducted: +1
 If arm is supported or person is leaning: -1

Step 2: Locate Lower Arm Position:

Step 2a: Adjust...
 If either arm is working across midline or out to side of body: Add +1

Step 3: Locate Wrist Position:

Step 3a: Adjust...
 If wrist is bent from midline: Add +1

Step 4: Wrist Twist:

If wrist is twisted in mid-range: +1
 If wrist is at or near end of range: +2

Step 5: Look-up Posture Score in Table A:
 Using values from steps 1-4 above, locate score in Table A

Step 6: Add Muscle Use Score
 If posture mainly static (i.e. held 10 minutes), Or if action repeated occurs 4K per minute: +1

Step 7: Add Force/Load Score
 If load < 4.4 lbs. (intermittent): +0
 If load 4.4 to 22 lbs. (intermittent): +1
 If load 4.4 to 22 lbs. (static or repeated): +2
 If more than 22 lbs. or repeated or shocks: +3

Step 8: Find Row in Table C
 Add values from steps 5-7 to obtain Wrist and Arm Score. Find row in Table C.

Table A: Wrist Score

Upper Arm	Lower Arm	Wrist Score							
		1	2	3	4				
1	1	1	2	2	2	3	3	3	3
1	2	2	2	2	2	3	3	3	3
1	3	3	3	3	3	4	4	4	4
1	4	4	4	4	4	5	5	5	5
2	1	2	3	3	3	4	4	4	4
2	2	3	3	3	3	4	4	4	4
2	3	3	3	3	3	4	4	4	4
2	4	4	4	4	4	5	5	5	5
3	1	2	3	3	3	4	4	4	4
3	2	3	3	3	3	4	4	4	4
3	3	3	3	3	3	4	4	4	4
3	4	4	4	4	4	5	5	5	5
4	1	2	3	3	3	4	4	4	4
4	2	3	3	3	3	4	4	4	4
4	3	3	3	3	3	4	4	4	4
4	4	4	4	4	4	5	5	5	5
5	1	2	3	3	3	4	4	4	4
5	2	3	3	3	3	4	4	4	4
5	3	3	3	3	3	4	4	4	4
5	4	4	4	4	4	5	5	5	5
6	1	2	3	3	3	4	4	4	4
6	2	3	3	3	3	4	4	4	4
6	3	3	3	3	3	4	4	4	4
6	4	4	4	4	4	5	5	5	5

Table B: Neck, Trunk, Leg Score

Neck Posture	Table B: Trunk Posture Score					
	1	2	3	4	5	6
1	1	3	3	4	5	6
2	2	3	3	4	5	6
3	3	3	3	4	5	6
4	4	4	4	5	6	7
5	5	5	5	6	7	8
6	6	6	6	7	8	9

Table C: Neck, Trunk, Leg Score

Neck	Trunk	Leg	Score			
1	1	2	3	4	6	7
1	2	3	4	5	5	5
2	2	3	4	4	5	5
3	3	3	4	4	5	6
4	4	4	4	4	5	6
5	5	5	5	5	6	7
6	6	6	6	6	7	7
7	7	7	7	7	7	7
8	8	8	8	8	8	8

Scoring: (final score from Table C)
 1-2 = acceptable posture
 3-4 = further investigation, change may be needed
 5-6 = further investigation, change soon
 7 = investigate and implement change

B. Neck, Trunk and Leg Analysis

Step 9: Locate Neck Position:

Step 9a: Adjust...
 If neck is twisted: +1
 If neck is side bending: +1

Step 10: Locate Trunk Position:

Step 10a: Adjust...
 If trunk is twisted: +1
 If trunk is side bending: +1

Step 11: Legs:
 If legs and feet are supported: +1
 If not: +2

Step 12: Look-up Posture Score in Table B:
 Using values from steps 9-11 above, locate score in Table B

Step 13: Add Muscle Use Score
 If posture mainly static (i.e. held 10 minutes), Or if action repeated occurs 4K per minute: +1

Step 14: Add Force/Load Score
 If load < 4.4 lbs. (intermittent): +0
 If load 4.4 to 22 lbs. (intermittent): +1
 If load 4.4 to 22 lbs. (static or repeated): +2
 If more than 22 lbs. or repeated or shocks: +3

Step 15: Find Column in Table C
 Add values from steps 12-14 to obtain Neck, Trunk and Leg Score. Find Column in Table C.

Final Scores:
 Upper Arm Score: 2
 Lower Arm Score: 1
 Wrist Twist Score: 1
 Wrist Score: 3
 Posture Score A: 3
 Muscle Use Score: 1
 Force / Load Score: 0
 Wrist & Arm Score: 4
 RULA Score: 5
 Neck Score: 3
 Trunk Score: 2
 Leg Score: 2
 Posture B Score: 4
 Muscle Use Score: 1
 Force / Load Score: 0
 Neck, Trunk, Leg Score: 5

Original Worksheet Developed by Dr. Alan Hedge. Based on RULA: a survey method for the investigation of work-related upper limb disorders, McAtamney & Corlett, Applied Ergonomics 1993, 24(2), 91-99

Figure 5. RULA Worksheet Student B

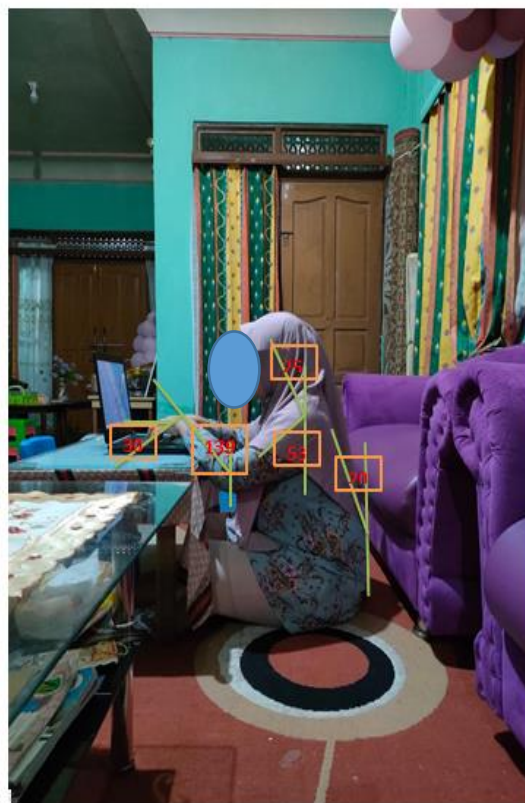


Figure 6. Body Posture Student C

Assessment of student posture in figure 6 based on RULA worksheet on part A (upper arm, forearm, and wrist):

1. Group A Posture
 - a. Upper arm posture where the upper arm forms an angle of 53° scores 2
 - b. Lower arm posture where the forearm forms 139° scores 2
 - c. Wrist posture of 30° then scores 3
 - d. When the wrist twist not close to the middle scores 2

All the values of this A posture are included in table 8 below:

Table 8. Score Grup A Posture Student C

Table A		Wrist Score							
		1		2		3		4	
Upper Arm	Lower Arm	Wrist Twist		Wrist Twist		Wrist Twist		Wrist Twist	
		1	2	1	2	1	2	1	2
1	1	1	2	2	2	2	3	3	3
	2	2	2	2	2	3	3	3	3
	3	2	3	3	3	3	3	4	4
2	1	2	3	3	3	3	4	4	4
	2	3	3	3	3	3	4	4	4
	3	3	4	4	4	4	4	5	5
3	1	3	3	4	4	4	4	5	5
	2	3	4	4	4	4	4	5	5
	3	4	4	4	4	4	5	5	5
4	1	4	4	4	4	4	5	5	5
	2	4	4	4	4	4	5	5	5
	3	4	4	4	5	5	5	6	6
5	1	5	5	5	5	5	6	6	7
	2	5	6	6	6	6	7	7	7
	3	6	6	6	7	7	7	7	8
6	1	7	7	7	7	7	8	8	9
	2	8	8	8	8	8	9	9	9
	3	9	9	9	9	9	9	9	9

- a. Repeated activities, more than 4 times/minute scores 1
- b. For the load score where the student load is < 2 kg, it scores 0

Total Score for Group A is 4

2. Group B Posture
 - a. Neck posture forms an angle 25° and scores 3
 - b. Trunk posture forms an angle 20° then scores 2
 - c. Score assessment for the feet which are not supported by a chair scores 2

The assessment of group B posture can be seen in the table 9 below:

Table 9. Score Grup B Posture Student C

Table C		Neck, Trunk, Leg Score						
		1	2	3	4	5	6	7+
Wrist / Arm Score	1	1	2	3	3	4	5	5
	2	2	2	3	4	4	5	5
	3	3	3	3	4	4	5	6
	4	3	3	3	4	5	6	6
	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

- a. For repeated activities, more than 4 times / minute scores 1
 - b. For load scores where the student load is < 2 kg, it scores 0
- Total Score for Group B is 5.

The rating for the final score can be seen in the following table. The final score obtained in the student posture above is 6.

Table 10. Total RULA Score Student C

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

ERGONOMICS RULA Employee Assessment Worksheet Task Name: Nur Azizatul Date: 8/3/2022

A. Arm and Wrist Analysis

Step 1: Locate Upper Arm Position: Upper Arm Score: 3

Step 2: Locate Lower Arm Position: Lower Arm Score: 2

Step 3: Locate Wrist Position: Wrist Twist Score: 2, Wrist Score: 3

Step 4: Wrist Twist: Wrist / Arm Score: 4

Step 5: Look-up Posture Score in Table A: Posture Score A: 1

Step 6: Add Muscle Use Score: Muscle Use Score: 0

Step 7: Add Force/Load Score: Force / Load Score: 5

Step 8: Find Row in Table C: Wrist & Arm Score: 5

B. Neck, Trunk and Leg Analysis

Step 9: Locate Neck Position: Neck Score: 3

Step 10: Locate Trunk Position: Trunk Score: 2

Step 11: Legs: Leg Score: 2

Step 12: Look-up Posture Score in Table B: Posture B Score: 4

Step 13: Add Muscle Use Score: Muscle Use Score: 1

Step 14: Add Force/Load Score: Force / Load Score: 0

Step 15: Find Column in Table C: Neck, Trunk and Leg Score: 5

Table A: Wrist Score

Upper Arm	Lower Arm	Wrist Score						
		Wrist Twist	Wrist Twist	Wrist Twist	Wrist Twist			
1	1	1	2	2	2	3	3	3
1	2	2	2	2	3	3	3	3
1	3	3	3	3	3	4	4	4
1	4	4	4	4	4	4	4	4
2	1	2	3	3	3	4	4	4
2	2	3	3	3	3	4	4	4
2	3	3	4	4	4	4	5	5
2	4	4	4	4	4	4	5	5
3	1	3	4	4	4	4	5	5
3	2	4	4	4	4	4	5	5
3	3	4	4	4	4	4	5	5
3	4	4	4	4	4	4	5	5
4	1	4	4	4	4	4	5	5
4	2	4	4	4	4	4	5	5
4	3	4	4	4	4	4	5	5
4	4	4	4	4	4	4	5	5
5	1	5	5	5	5	6	6	6
5	2	5	6	6	6	6	7	7
5	3	6	6	6	6	6	7	7
5	4	7	7	7	7	7	7	7
6	1	7	7	7	7	7	8	8
6	2	8	8	8	8	8	8	8
6	3	9	9	9	9	9	9	9

Table C: Neck, Trunk, Leg Score

Neck, Trunk, Leg Score	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	6	6
4	4	4	4	5	6	6	6
5	5	5	5	6	7	7	7
6	6	6	6	7	7	7	7
7	7	7	7	7	7	7	7
8	8	8	8	8	8	8	8

Scoring: (Final score from Table C)
 1-2 = acceptable posture
 3-4 = further investigation, change may be needed
 5-6 = further investigation, change may be needed
 7 = investigate and implement change

Figure 7. RULA Worksheet Student C

The RULA score of all students can be seen in the table below:

Table 11. RULA score all the student

RULA Score	Number of students	Percentage (%)
4	9	16.98
5	10	18.86
6	24	45.28
7	10	18.86
Total	53	100

In table 11 above, it can be seen that the assessment of student posture with RULA worksheet is in the range of 4 to 7. For RULA score at mostly a score of 6 with were 24 students (45.28%). For RULA scores with scores of 5 and 7 were as many as 10 people (18.86%). And RULA score at a value of 4 were 9 people (16.98%).

In this study, the level of ergonomic risk in students at three study programs was assessed with RULA method. RULA scores in mostly awkward postures (RULA scores are 4 to 7). A total of 9 students has a RULA score of 4 which means further investigation, change may be needed. For RULA scores of 5 to 6 there are 34 students and RULA scores categories 5 to 6 which means moderate risk, further investigation and immediate change are needed. While 10 students have a RULA score of 7 which means that the level of risk is high (very risky), immediate investigation and implement change are needed. There was a significant association between RULA scores and musculoskeletal complaints on body parts [14]. There were three components in the RULA instrument that relate to ergonomic risk levels: posture, muscle strength and load score [15].

Based on posture scores, the average student's wrist was more than 20°. For the forearm posture of students, most are in a flexion position of more than 100°. While the wrist posture is more than 15° with a position away from the center line. For comfortable posture to work, it requires an arm angle of less than 20° in the sagittal and frontal fields [16].

For the student's neck posture, the angle is formed more than 20° resulting in the neck being bent. Flexed neck is very commonly known as the cause of neck pain [17]. The risk of neck pain also increases when the neck is twisted or bent by more than 45% with more than 25% work time. [18]. Other studies also mention that with the posture of the neck flexed more than 20° with working time of 40%, then the risk of neck pain will increase over time [19].

The dominant student's trunk posture forms an angle between 20° until 60°. The trunk which is comfortable at work is less than 20°. If the trunk bends mainly more than 60° or is bent backwards, then the risk of MSDS complaints will increase rapidly. Awkward posture (spinning or bending) is a strong risk factor causing back pain [16]. The student's foot posture is also not well supported. Some students joined online learning by sitting on the floor and the position of awkward feet (bent).

In the body there are various kinds of joints that support humans in work. The further the joint movement from the normal range or the farther away from the neutral posture, the worse the posture will be. This will result in the onset of tension in the muscles, tendons and ligaments around the joints resulting in an emphasis on the nerves and irritating the tendon [20,21]. Awkward postures such as lifting the arms, flexion of the head and neck, and trunk bent forward can cause ergonomic problems and affect the level of ergonomic risk so that it will have effects to the assessment with RULA worksheet [22].

As in some previous studies, high RULA scores were associated with pain in the neck, upper back, and lower back [23]. Based on the results of this study, students' RULA scores are in the range of grades 4 to 7 which indicates the need for further investigation and changes.

The results of this study are in line with the research results conducted by Yuniarti where the posture of computer user respondents with 31 people with high RULA score results 74.2% of respondents [24]. The results of a study by Supiana using RULA to assess the level of ergonomic risk found results of seven high-risk respondents [25].

Risk management in the student work area is the process of eliminating or reducing risk factors identified and evaluated using the RULA method. Improvements made in the work area aim to reduce the risk of injury to the lowest acceptable level without the risk of injury or accident. Some risk controls can be used as follows:

1. We recommend that online learning is done on a table and use a chair that has a buffer on the back. Sitting on the floor with the position of the legs bent for a long time will cause fatigue in the legs. According to Meily, a sitting position with an ergonomic posture will meet some things such as physiologically sitting will be more comfortable within a certain period of times and appropriate or compatible with the work done [26]. The sitting position on the floor if maintained in long period will have a serious impact on the respondents (students).
2. The design of the workstation should adjust the height of the table by considering the respondent's elbow. The dimensions of the table and study chairs that correspond to the dimensions of the bones will make muscle tissue work with a light load. If the table and chairs are not ergonomic, it means that the surrounding muscle tissue is forced to work beyond the limit of stretching [26].
3. The student's sitting position is recommended in a neutral position to reduce pain in parts of the body. As stated by Grandjean & K.H.E, that sitting posture with the back position upright causes pressure between lumbar 3 and lumbar 4 by 140% while pressure of 190% occurs when sitting posture bends forward. The larger the angle formed when sitting will cause the pressure on the lumbar to get smaller. An emphasis on lumbar may result in the risk of spinal cord injury [27]. In addition, the wrong body position during sitting creates abnormal pressure from the tissues causing pain. Pressure on the spine will increase when sitting, compared to when standing or lying down. Sitting for a long period of time results in oxygenation to the disc, ligaments, muscles, and other tissues which are disrupted, resulting in pain or discomfort in the lower back area [28].
4. The need for additional lighting in the room used during online learning. Because there are some students whose posture bends to focus vision on a laptop or smartphone screen when online learning takes place. With additional lighting, students will be able to set the location of the light without requiring students to bend. In addition, additional lighting will create a balance between the brightness (bright-ness) of the display screen and the brightness that is in front of the user. The most important thing is to avoid excessive brightness on the front of the user compared to the brightness of the display screen. Likewise with less brightness than the brightness of the display screen [29].
5. When attending online lectures, doing tasks and other online activities, all students do not only focus in front of a laptop or smartphone screen. Students need to stretch regularly. Stretching is the perfect counterweight to a state of silence and inactivity moving for long periods of time. Regular stretching in between jobs will be beneficial for: reducing muscle tension, improving blood circulation, reducing anxiety, depressed, and exhausted, improving mental alertness, reducing the risk of injury, making work easier, blending thoughts into the body, and making the body condition better. Based on the physiology of work fatigue, the accumulation of lactic acid can lead to a decrease in the work of the muscles and the possibility of nerve and central factors affecting the process of fatigue. Therefore, stretching movements can help relax muscles so that muscles are more flexible in moving because the increased supply of oxygen after stretching will also increase flexibility, namely the ability to move the muscles and joints in all areas of movement [30].

IV. CONCLUSION

Student posture when participating in online learning assessed by RULA method gives results in the range of 4 to 7. This means that there needs to be further investigation and immediate changes that need to be made. High RULA scores are caused by students' non-neutral body positions such as upper arms and neck bends, bent trunk, unsupported legs (some students follow online learning by sitting on the floor). Ergonomically, by sitting in a chair it will reduce the level of fatigue and body load on students.

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