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Analysis of Work Positions in Microbiological Sample Testing in Food Industry Laboratories using the Rapid Whole Body Assessment (REBA) Method and Nordic Body Maps (NBM)

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ABSTRACT

In a food industry laboratory, some activities are at risk of causing MSDs (Muscullos Skeletal Disorder). Based on the results of general interviews addressed to 10 microbiology laboratory assistants, the results obtained by workers experiencing complaints of pain in the upper neck, lower neck, shoulders, back, right upper arm, waist, buttocks, elbows, wrists, and calves. Based on the number of complaints due to work disturbances, it is necessary to identify a more in-depth assessment of work factors and risk levels using the Rapid Entire Body Assessment (REBA) method. The results of this study based on the Nordic Body Maps questionnaire aimed at 10 microbiology laboratory assistants in the food industry laboratory, the highest value is complaints of pain in the waist, this is related to work position no. 7, namely the position of placing the Erlenmeyer that has been tested into a basket located on the floor. Then the assessment of work positions in group A = 7 and group B = 2 so that the results of the group C table assessment = 9 + 1 (load value) = 10 (including the risk level category 3 / high), so further investigation is needed.

Key Words: Employee Complaints, Nordic Body Maps, Rapid Entire Body Assessment, Sample Testing.

1. INTRODUCTION

In the industrial world, comfort and safety at work must be a concern for the company, to avoid injury while working. A food industry laboratory cannot escape the activities that result in MSDS. Musculoskeletal disorders (MSDs) are disorders/injuries that occur in both the musculoskeletal and skeletal systems and are usually improper work postures, overexertion, overstretching or over-compression, and others. (Bagus Setiawan, 2018).

For laboratory testing, there are chemical, physical, and microbiological tests, microbiological tests that are often carried out in the food industry are Total Plate Count (TPC) tests. in TPC testing there is one activity that causes many complaints from laboratory assistants, namely the activity of placing erlenmeyers in baskets located on the floor, including complaints on the neck, hands, back, waist, buttocks, calves, and arms. The main risk factors for children under 5 years of age and adults between 15 and 49 years of age (working age) are due to occupational risks. In 2010, Indonesia ranked 6th in the incidence of low back pain and 7th in the incidence of neck pain as musculoskeletal disorder (MSD). (Laksana & Srisantyorini, 2020).

2. LITERATURE REVIEW

2.1. Sections and Subsections

According to Prabaswari et al., (2020), Ergonomics is "A systematic branch of science to utilize information about human nature, abilities and limitations to design work systems so that people can live and work on that system properly, namely achieving the desired goals through that work, effectively, safely and comfortably".

2.2. Work Biomechanic

Work biomechanics is a discipline that studies the physical interaction of workers with equipment, machines, and materials intending to improve worker performance by minimizing the risk of musculoskeletal disorders. Work

biomechanics is a discipline that does not stand alone, but is an integration of various disciplines that aim to minimize the risk of human muscular skeletal complaints caused by their activities. (Bagus Setiawan, 2018).

Work Related-Musculoskeletal Disorder (WMSDs) is a disorder of the muscular-skeletal system due to work activities. Musculoskeletal disorders (MSDs) are disorders that occur in the muscular-skeletal system, both in the skeletal muscles and in the skeletal bones, which usually occur due to incorrect work posture, overexertion, overstretching or over-compression, and others.

3. METHOD

Explaining research chronologically, including research design, research procedure (in the form of algorithms, Pseudocode, or other), how to test, and data acquisition (Dyah Priamsari, 2016), (Grobelny J. and Michalski R, 2020). The description of the course of research should be supported by references, so the explanation can be accepted scientifically [10], [6] Figures 1-2 and Table 1 are presented center, as shown below and cited in the manuscript (Dyah Priamsari, 2016), (Prabaswari et al, 2020). Figure 2(a) shows math representation ability students and Figure 2(b) reasoning ability students.

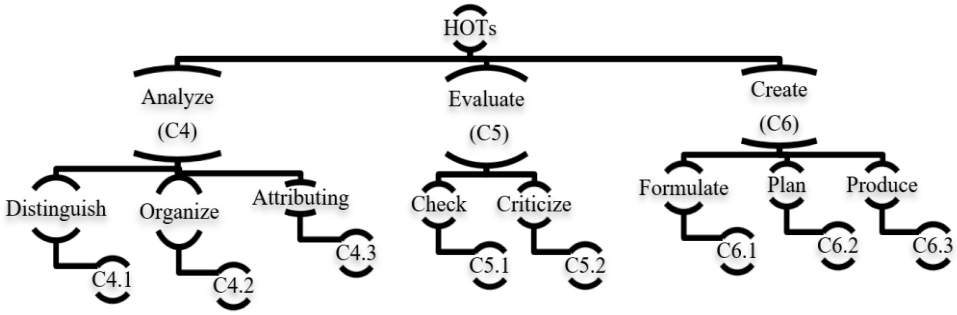
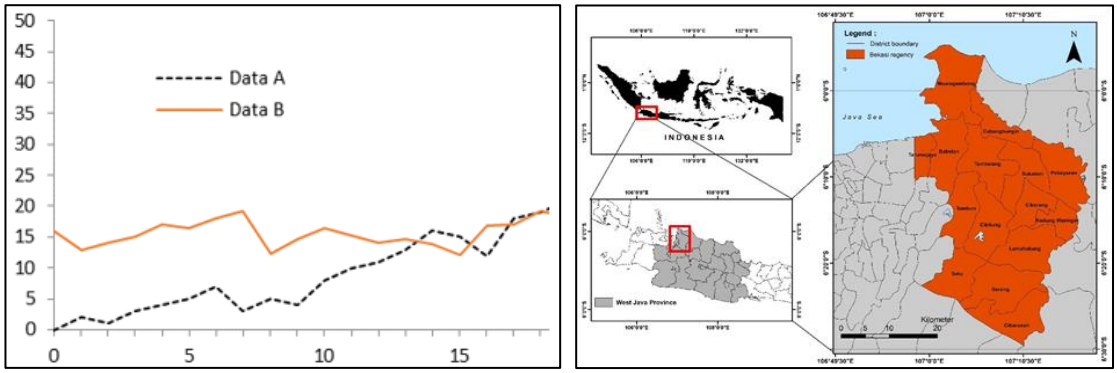


Figure 1. Cognitive process dimension



(a) **Analysis** (b) **Spread.**

Figure 2 Graph and map

Table 1. Internal consistency reliability of biology test

Sl. No.	Indicator	Value
1	Number of Items	60
2	Kuder Richardson (KR-20)	0.620
3	Cronbach's Alpha Based on Standardized Items	0.617
4	Mean Item Difficulty	0.56
5	Mean Item Difficulty	0.4

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4. RESULTS AND DISCUSSION

4.1. TPC Test Process Analysis

Based on direct observation shown in Table 1, the TPC testing process is as follows:

Table 1. Activity Observation Result

NO	ACTIVITIES	WORK ATTITUDE	FREQUENCY	TIME ESTIMATION TIME
1.	Take the *Erlenmeyer in* the bottom basket to be pelleted in the laminar chamber.	Head down	8 times	2 minutes
2.	Opening the newspaper cover on the *Erlenmeyer*	Untie the rope using both hands	30 times	3 minutes
3.	Weighing the sample	Pouring the sample into an Erlenmeyer	30 times	30 minutes
4.	Take the cup in the lower basket to be placed in the laminar.	Turning the body backward and then looking down	5 times	3 minutes
5.	Unpacking the cup	Opening a newspaper with both hands	10 times	3 minutes
6.	Pipetting sample from *Erlenmeyer* to cup	Grasping the tip of the pipette containing the sample and transferring it to the cup.	120 times	120 minutes
7.	Transferring the tested *Erlenmeyer* to the basket under laminar	The body position bends to the side with the hand placing the *Erlenmeyer* into the basket below.	30 times	15 minutes
8.	Taking *PCA (Plate Count Agar)* media from the *water bath*	Walking while carrying an *Erlenmeyer* containing PCA media	1 time	2 minutes
9.	Pouring PCA media into the cup containing the sample	Right-hand position holding an Erlenmeyer	120 times	30 minutes

4.2. Nordic Body Maps Questionnaire Results

Based on Figure 1 the results of the Nordic Body Maps questionnaire, the highest value is complaints at the waist with a score of 30. After observation, this is related to work position no. 7, namely the process of placing the Erlenmeyer that has been tested into a basket located on the floor. In this position, the body posture of the laboratory assistant is bent and one leg supports the weight of the body and the right hand puts the Erlenmeyer into the basket on the floor. The bent position resulted in complaints of back pain experienced by laboratory workers because it was done repeatedly 30 times with a total estimated time of 15 minutes from the total TPC processing time of 3 to 4 hours.

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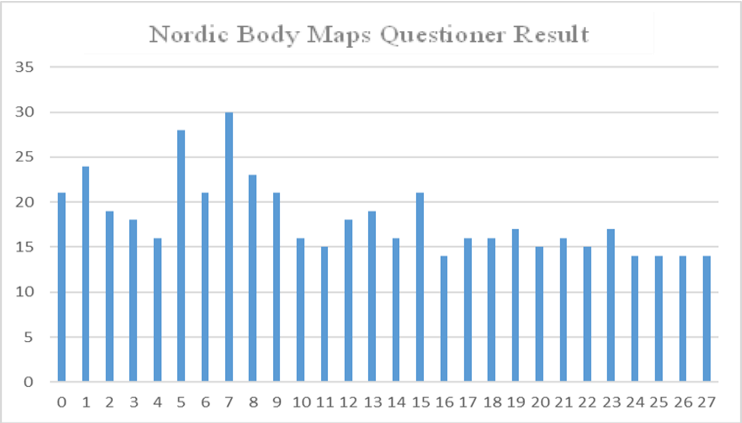

Figure 1. Image of Questionnaire Results

4.3. Assessment of Work Positions Using REBA

1. Group A Score

The position on the neck forms an angle of 11º, then the score obtained = 1. The position on the body forms an angle of 34º = 3 (rotating position bends), then the score obtained = 3 + 1 = 4. The position of the two legs forms an angle of 84º = 2 (one leg holds the weight of the body, plus 2 because it is bent 30º-60º flexion), then the score is 2 + 2 = 4. Posture Score group A: 7 + 2 = 9.

Figure 2. Group A Assessment Picture

2. Group B Score

The position on the neck forms an angle of 11º, then the score obtained = 1. The position on the body forms an angle of 34º = 3 (rotating position bends), then the score obtained = 3 + 1 = 4. The position of the two legs forms an angle of 84º = 2 (one leg holds the weight of the body, plus 2 because it is bent 30º-60º flexion), then the score is 2 + 2 = 4. Posture Score group A: 7 + 2 = 9.

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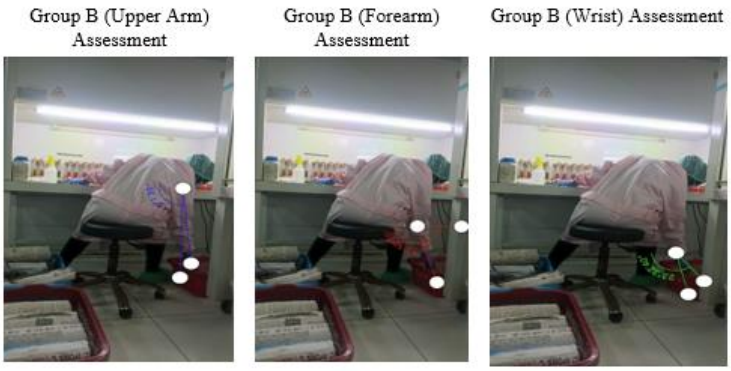

Figure 3. Group B Assessment Picture

3. Group C Score

Group C score = 9. Muscle activity score = 1 (the activity is performed quickly and there is a change in work attitude). GRAND REBA SCORE 9+1= 10 from the results of the research that has been carried out, it is obtained that the Grand REBA Score is 10, so further investigation is needed and the implementation of changes/actions is carried out immediately to improve the work position on TPC sample testing to overcome employee complaints.

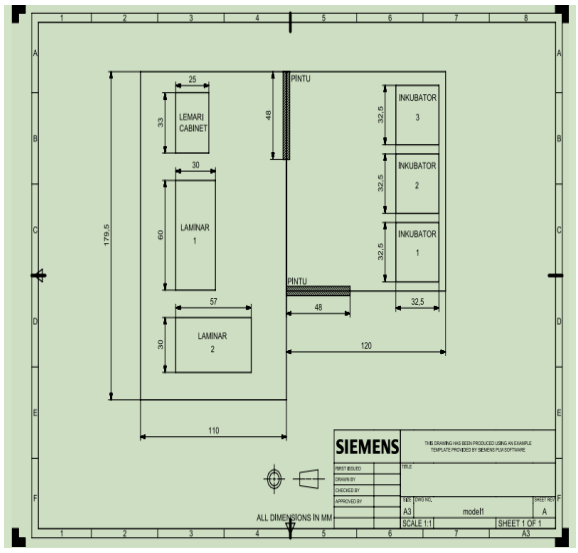

Figure 4. Culture room layout before recommendation

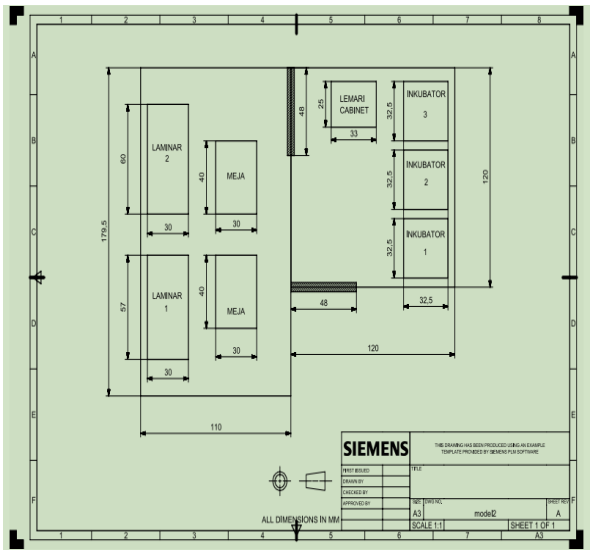

Figure 5. Culture room layout after recommendation

In the picture above, it is recommended that the cabinet be moved to the incubation room so that the laminar position can be aligned and organized. Then to reduce bending movements such as work attitude number 7, the author recommends the procurement of a table as a place to place the equipment used for testing.

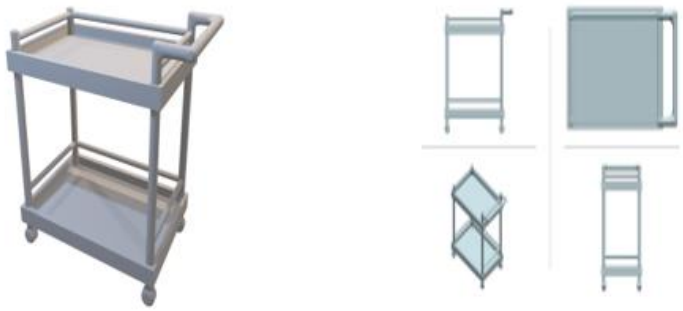

Figure 6. Recommendation Table

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In Figure 5 there are 2 upper and lower shelves that can be used to place work containing testing equipment. The upper shelf can be used to place Erlenmeyer. While the bottom can be used to place baskets containing test equipment. On the table legs, there are wheels to make it easier for workers to move the table so that it is flexible. While the top has a handle to push the table when it is about to be moved.

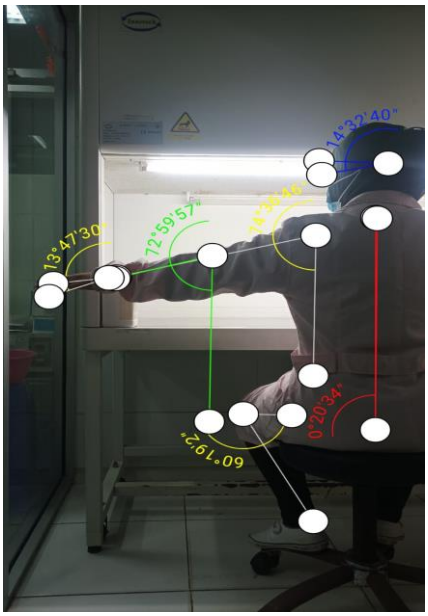

Figure 7. Recommended Ergonomic Work Position

In the figure above there are recommendations for ergonomic work positions, it is known in the figure that the score from group A assessment is 2 and the score from group B assessment is 3, so that the result of group C score is 2. So, the final REBA score obtained is 2 with a negligible risk level.

5. CONCLUSION

Based on the results of data analysis in the previous chapter, the research that has been carried out has concluded from the identification results in the process of working on TPC samples in the food industry laboratory after based on the Nordic Body Maps questionnaire, the highest value is in complaints about pain in the waist, this is related to work position no. 7, namely placing the Erlenmeyer that has been tested into a basket located on the floor. The position of the basket on the floor causes workers to bend their bodies repeatedly 30 times with a total estimated time of 15 minutes. From the measurement results using the REBA method, it is known that the assessment of group A = 7 and group B = 2. Then the assessment in the group C table = 9 with a load value of 1. Then the final REBA score is 10 (high-risk level 3 / high), therefore further investigation is needed, and immediate implementation of changes/actions is carried out. To overcome workers' complaints of a high level of risk, the author recommends changes in work position and laminar room layout, as well as the provision of a table as a container for placing baskets containing test equipment and media used for microbiological testing.

Suggestions can be given to food industry laboratories to reduce worker complaints in the TPC test, namely changing the position of laminar and cabinet cabinets, procuring tables for testing aids, and briefing workers on ergonomics and correct work positions.

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