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Implementation Of Rapid Entire Body Assessment Method and Design of Assistant Tools In The Carton Box Companies

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Abstract

Gangguan Muskuloskeletal Akibat Pekerjaan (WMSDs) merupakan masalah utama bagi pengusaha dan karyawan di tempat kerja. Gangguan ini biasanya dapat ditemukan pada beberapa proses yang masih dilakukan secara manual. Pekerjaan manual masih menjadi komponen penting dalam berbagai sektor industri dan jasa di era modern. Meskipun kemajuan teknologi telah mengotomatisasi banyak proses, namun masih banyak pekerja yang terlibat dalam tugas-tugas yang membutuhkan kekuatan fisik, gerakan berulang, dan postur tubuh yang tidak wajar. Salah satu perusahaan kardus di daerah Banten memiliki pekerjaan manual yang berisiko mengalami WMSD. Salah satu pekerjaan yang dianalisis adalah pada divisi pengemasan pada proses penjilidan. Dari hasil analisis lembar REBA, kondisi awal pekerjaan memiliki nilai 9 yang tergolong pekerjaan berisiko tinggi. Dengan melakukan perbaikan dengan merancang alat bantu penjilidan yang akan digunakan sebagai alat bantu, maka penilaian postur kerja dapat diturunkan menjadi 3 yang berarti pekerjaan tersebut tergolong berisiko rendah.

Kata Kunci: REBA, *Tool design, Work posture.*

Abstract

Work-related musculoskeletal disorders (WMSDs) are a major problem for employers and employees in the workplace. These disorders can usually be found in several processes that are still carried out manually. Manual work is still an important component in various industrial and service sectors in the modern era. Although technological advances have automated many processes, a large number of workers are still involved in tasks that require physical strength, repetitive movements, and unnatural postures. One of the cardboard box companies in the Banten area has manual work that is at risk of WMSD. One of the jobs analyzed was in the packaging division in the binding process. From the results of the REBA sheet analysis, the initial condition of the job had a value of 9 which was classified as a high-risk job. By making improvements by designing a binding aid to be used as an aid, the work posture assessment can be reduced to 3, which means that the job is classified as low risk

***Keywords**: REBA, Tool design, Work posture.*

1. Introduction

Work-related musculoskeletal disorders (WMSDs) are a major problem for employers and employees in the workplace (Ghasemi, 2020). These disorders can usually be found in several processes that are still carried out manually. Manual work is still an important component in various industrial and service sectors in the modern era. Although technological advances have automated many processes, many workers are still involved in tasks that require physical strength, repetitive movements, and unnatural postures. Manual material handling is an activity that has a high risk from various aspects. Generally, includes disorders of muscles, tendons, tendon sheaths, peripheral nerves, joints, bones, ligaments, etc. There are many causes of MSDs, the most common being the accumulation of repetitive stress over time (Joshi, 2020). From a physiological perspective, this activity requires great energy and

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muscle strength. Meanwhile, an ergonomic perspective shows that this activity can cause serious back pain. Inaccuracy in carrying out manual material handling is generally the cause of inflammation of the nerves and muscles. The main problems stem from the static load that must be borne, the high frequency of repetition, and the prolonged (Simarmata, 2020).

Ergonomic Assessment of Work-Related Musculoskeletal Disorders (WMSD) focuses on evaluating the risk of muscle, nerve, and joint disorders, primarily in the lower back and upper limbs, associated with daily work tasks (Dababneh, 2016). These disorders can develop gradually due to long-term exposure to ergonomic risk factors, or they can appear suddenly due to acute injuries. The impact of WMSD is not limited to the health of individual workers, but also has significant implications for productivity, health care costs, and overall quality of life. Ergonomics is the science that optimizes human efficiency, health, safety, and comfort in various environments, including the workplace, home, and recreation. According to the definition of the International Ergonomics Association, the application of ergonomics involves various disciplines such as anatomy, architecture, product design, physics, physiotherapy, occupational therapy, psychology, and industrial engineering (Khayal, 2019). In the context of organizations, ergonomics plays an important role in designing work tasks. This includes determining the duration of breaks, setting shift work schedules, and increasing work variety. In addition, ergonomics is also applied in software design, given the significant increase in the use of computers for various work tasks (Wibowo, 2021)

According to the National Institute for Occupational Safety and Health (NIOSH), musculoskeletal disorders are “a set of injuries and symptoms affecting the osteo muscular system and related structures such as bones, muscles, joints, tendons, ligaments, nerves, and the circulatory system.” To address these disorders, ergonomic assessment methods are applied to identify and evaluate risk factors present in the work environment (Hita-Gutiérrez, 2020).

This study aims to examine the types of manual work that are at high risk for WMSD, identify ergonomic factors that contribute to the risk, and propose intervention strategies to improve worker safety and health. By understanding the relationship between job design, work environment, and musculoskeletal health, it is hoped that a more effective approach to the prevention and management of WMSD in the workplace can be developed.

REBA is an ergonomic assessment method developed to evaluate overall body posture, especially for tasks involving rapid or unexpected posture changes. This method allows a systematic analysis of whole-body postural risk by considering load, grip type, and muscle activity (Darsini, 2021).

In this study, REBA will be used to:

1. Assess the posture of workers during high-risk manual tasks.
2. Identify the body segments most exposed to the risk of WMSD.
3. Calculate the overall risk score for each task or work posture.
4. Determine the level of urgency of corrective action based on the REBA score.

One of the carton box companies in the Banten area has manual work that is at risk of WMSD. The background of this study is the binding process in the packaging section by carrying out 3 stages. Figure 1 shows the preparation of the binding process where a worker makes preparations before the binding process. The worker tidies up the partition to be bound with a bent leg position, then bends so that the neck will always form an abnormal angle followed by carrying out binding process step 1 (figure 2) with the same position in the preparation stage but the leg part clamps the partition component to be bound so that it makes it easier for the worker to bind at the end of the partition component and continues with binding process step 2 (figure 3) the worker will rotate to one end of the other component to carry out the binding process by doing the same thing in Step 1. This will have an impact on body parts including the knees, back, neck and shoulders which are not normal (not ergonomic) which will interfere with health if done repeatedly and for a long duration.

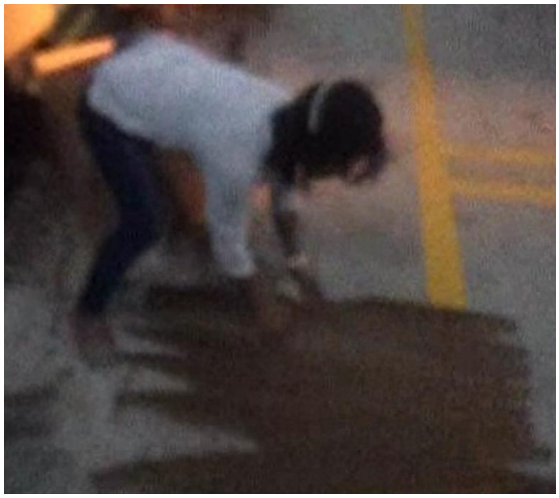

Figure 1Preparation of Binding Process

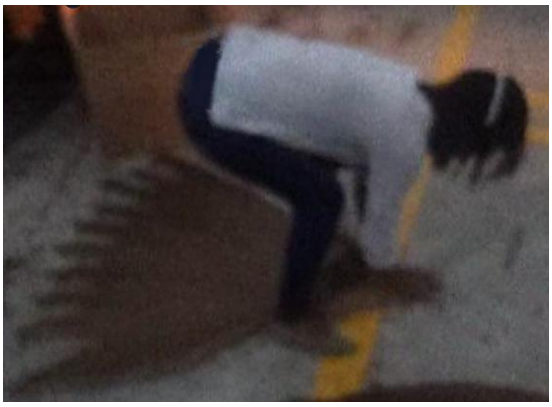

Figure 2 Binding process step 1

Figure 3 Binding process step 2

By using the REBA sheet method, you can determine the level of urgency of the process activity, and it is necessary to take corrective action in the process by designing a tool to make the work more ergonomic.

In previous studies using the REBA method, only a work posture analysis was used to analyze the impacts caused by non-ergonomic postures (Setiorini, 2019), but it is slightly different from the research conducted by (Pratiwi, 2021) which provided suggestions for improving work that was initially a squatting position to be given a chair while working. Likewise, research conducted by (Afma, 2020) provided improvements in work posture when carrying out the goat skinning process by making aids. Therefore, in this study, the REBA method was used as an analysis of the work posture of the binding process before improvements to the manual process and designing binding aids to help the binding process in the packing area.

2. Research Methods

This study used the Rapid Entire Body Assessment (REBA) method to assess ergonomic risks in manual workers. REBA is an ergonomic assessment tool developed by Hignett and McAtamney to evaluate body posture, force used, type of movement or action, repetition, and coupling. This method was chosen because of its ability to assess musculoskeletal risks quickly and comprehensively for various types of work (Kusuma, 2020). REBA is a comprehensive ergonomic assessment method, evaluating various aspects of work posture to assess the risk of work-related musculoskeletal disorders. The following is a more detailed explanation of the REBA assessment process (Widiana, 2021):

1. Posture Assessment: REBA divides the body into two main groups:

• Group A: Trunk (back), neck, and legs
• Group B: Upper arms, lower arms, and wrists

Each body segment is assessed based on its angle or position relative to the neutral position.

2. Additional Factors: REBA also considers other important factors:

• Load: The weight of the object being lifted, or the force being applied
• Coupling: The quality of grip or interaction with the object
• Activity: The frequency of movement, static posture, or rapid changes in posture

3. Assessment Process:

a. A Score:
• Assess trunk, neck, and leg posture
• Use the REBA table to determine the initial Group A score
• Add the load score to the Group A score

b. B Score:
• Assess upper arm, lower arm, and wrist posture
• Use the REBA table to determine the initial Group B score
• Add the coupling score to the Group B score

c. C Score:
• Combine A Score and B Score using a special REBA table
• C Score represents overall postural risk

d. Final REBA Score:
• Add activity score to C Score to get final REBA Score

4. REBA Score Interpretation:
• 1: Negligible risk, no action needed
• 2-3: Low risk, may need action
• 4-7: Moderate risk, need action
• 8-10: High risk, need immediate action
• 11+: Very high risk, need immediate action

And the posture assessment application above can use the REBA sheet which can be seen in Figure 4.

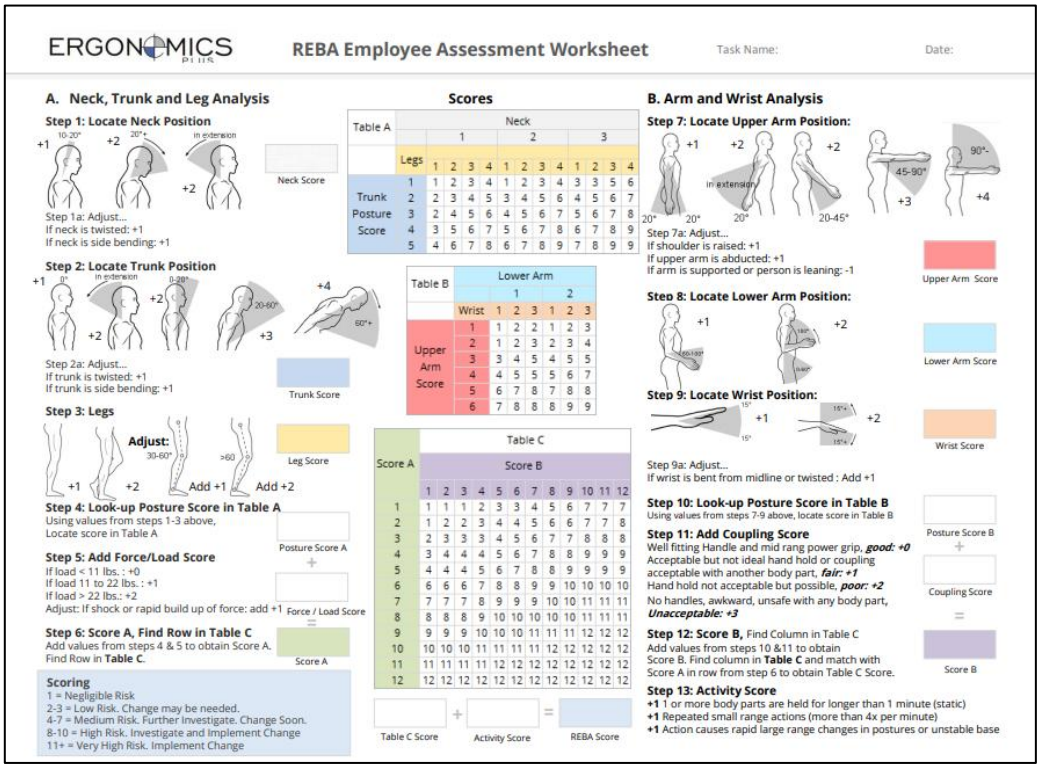

Figure 4 REBA Sheet

3. Results and Discussion

The results obtained in this research case study are to design a binding aid in the packaging section. In the process of making the aid, the height of the worker is needed from the floor to the waist which will be used as a guide for the height of the binding aid. While the width of the machine does not require the size of the worker because the width of the tool can be adjusted to the length of the worker's hand. The number of measurements of the waist height of workers taken is around 15 workers, the value of which will later be taken to be used as a measure of the height of the aid. The object of the study was carried out in the binding process with 3 steps of the work process. The preparation stage is carried out by arranging for the products to be tied with a standard of 10 products per tie. Then the next step is to carry out the process of Steps 2 and 3 with the binding process on both sides. By using the REBA method, the value of body posture in the binding activity can be determined as depicted in Figure 5.

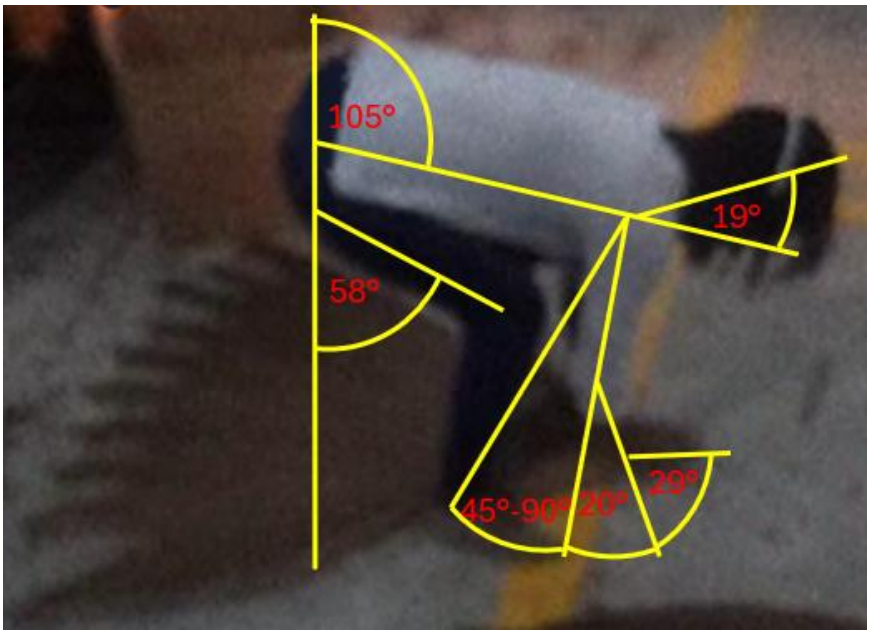

Figure 5 Posture Assessment Before Improvement

Table 1 Angular dimensions of bind operators

Group	Dimension	Angle
A	Neck	19°
	Trunk	105°
	Legs	58°
	Load	0
B	Upper Arm	45°-90°
	Lower Arm	20°
	Wrist	29°
	Coupling	0

Table 2 REBA value of bind process operator

Group	Dimension	Angle	Score	Table A	Score A	Score C	Grade Score REBA
A	Neck	19°	1				
	Trunk	105°	4	6	6		
	Legs	58°	3				
		Load		0			
Group	dimension	Angle	Score	Table B	Score B	8	9
B	Upper Arm	45°-90°	3				
	Lower Arm	20°	2	5	5		
	Wrist	29°	2				
		Coupling		0			
			Activity Score			1	

From Figure 5, an assessment of the body posture during binding activities was carried out using the REBA sheet which is explained in Table 1.

In table 2, the value of table A is obtained from the Neck value of 1 because the neck has a 19° angle, the trunk value is obtained 4 because the operator's activity bends to form 105°, the legs value is 3 due to forming an angle of 58° and the load value is 0 because the load weight is less than 5kg. from the three parts of the value, it is obtained for part A in table A of 6. While the value of table B is obtained from the upper arm value of 3 because the upper arm has a slope of between 45°-90°, the lower arm value is obtained 2 because the lower arm forms an angle of 20°, the wrist value of 2 is caused by forming an angle of 29° and the coupling is 0 because the grip on the product is perfect, from the three parts of the value, it is obtained for part B in table B of 6. The value of C is obtained from table C of 8 obtained from the combination of matrix values A and B, and then the REBA value is 9 which has been added to the activity value of 1 because there are several parts of the body that are held for more than one minute (the body is bent, and the legs are bent). With a REBA value of 9, the activity is considered high risk and needs to be changed (Marpaung, 2024).

Based on the REBA analysis of the posture of the binding process workers that has been carried out, the worker's posture produces a value of 9. This value indicates that the posture is included in the high-risk hazard category, the steps that must be taken are investigation and changes must be implemented. Long materials cause workers to have to bend their bodies and necks and upper arms of workers form a relatively large angle, then the feet need to clamp the middle of the product so that the product does not fall apart. so, the improvement needed is to make a tool to reduce the risk of danger (Tiogana, 2020).

3.1 Improvement of Work Posture Using Assistive machine.

From the REBA assessment, a value of 9 was obtained, which means that a change in position is needed in the work activity. Therefore, a tool is made for the activity so that the binding process is more ergonomic. Figure 6 shows the binding machine used for the binding process. This machine is designed and adjusted to the height of the belt operator's waist and the length of the machine can be adjusted to the length of the operator's hand. With this machine, it is expected to change the position in the belt process so that the operator no longer needs to work in a bent position

Figure 6 Binding machine

Figure 7 Reba assessment of the binding process after Improvement

Figure 7 is an improvement activity in the binding process using a machine and an analysis of the work activity posture was carried out using REBA after being given an aid in the binding process. The binding process operator no longer needs to bend down and place the product on the floor with his feet clamping the product as in the process before Improvement.

Table 3 REBA score of the binding process operator after Improvement

Group	Dimension	Angle	Score	Table A	Score A	Score C	Grade Score REBA
	Neck	10°	1				
A	Trunk	12°	2	3	3		
	Legs	19°	2				
		Load		0			
Group	Dimension	Angle	Score	Table B	Score B	3	3
	Upper Arm	20°-45°	2				
B	Lower Arm	38°	2	2	2		
	Wrist	9°	1				
		Coupling		0			
		Activity Score				0	

After the Improvement was done using a binding machine, we analyzed the improvement of body posture after making Improvement using a binding machine. Table 3 illustrates the REBA value of the Improvement activities that have been done. Table A is obtained from the Neck value of 1 because the neck has a 10° angle, the trunk value is 2 because the operator's activity bends to form 12°, the legs value of 2 is caused by forming an angle of 19° and the load value is 0 because the load weight is less than 5 kg. From the three parts of the value,

it is obtained for part A in table A of 3. While the value of table B is obtained from the upper arm value of 2 because the upper arm has an angle of inclination between 20 ° -45 °, the lower arm value is obtained 2 because the lower arm forms an angle of 38 °, the wrist value of 1 is caused by forming an angle of 9 ° and the coupling is 0 because the grip on the product is perfect, from the three parts of the value, it is obtained for part B in table B of 2. The value of C is obtained from table C of 3, a combination of matrix values A and B is obtained, and then a REBA value of 9 is obtained which has been added to the activity value of 0. With a REBA value of 3, the activity is considered to have a low risk for binding activities. By changing the way of working from a manual process to a process with aids, the reba value can be increased from 9 (high risk) to 3 (low risk). There are several things that have changed in the use of the binding aids, namely the worker's body which initially required a bent back, bent knees and neck and feet clamping components to help the binding process will cause tension and stretching of the muscles because it is done repeatedly. However, with the binding aids, the worker's condition is more normal where the legs, back and neck are straight so that workers are working more ergonomically. This is an effort from the Company to support the improvement of the work process by providing aids in the manual process to improve the work process in supporting the implementation of occupational safety and health management to reduce risks related to the health of workers, especially in the manual process area.

4. Conclusion

This study aims to improve changes in work posture in the binding process in a manual job. The initial stage is carried out by assessing the work posture using the REBA sheet. From the initial REBA value of 9, it indicates that this activity needs to be improved immediately because it is classified as a high-risk job and there needs to be an effort to improve the work posture. By designing a more ergonomic binding aid. The next stage is to make a binding tool as an aid to carry out the process. And then a re-assessment is carried out with the REBA sheet to assess the work posture of the process after the binding aid is made. The REBA value obtained is 3 after the activity is given a binding aid, thus a value of 3 gives the category of low-risk work

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