Logistic and Operation Management Research, Vol. 3 No. 2 (2024) https://doi.org/10.31098/lomr.v3i2.2773

Research Paper

Optimization of Work Posture at PT. XYZ: Analysis of the Rapid Entire Body Assessment (REBA) Method to Improve Health and Productivity

Nismah Panjaitan[1], Niken Kristin Silitonga[1], Juni Arta Lubis[1], Muhammad Zaky Faris[1]
[1] Universitas Sumatera Utara, Indonesia

Received : August 8, 2024	Revised : November 21, 2024	Accepted : November 29, 2024	Online : November 30, 2024

Abstract

The study at PT. Fenyen Agro Lestari identified poor work postures that affect worker health and productivity. Using the REBA method, the boiler department had the highest risk (score 11), followed by the maintenance (score 6) and Laboratory (score 4). Immediate ergonomic improvements are recommended to reduce musculoskeletal disorders (MSDs). This research aims to analyze the impact of poor working posture on workers' musculoskeletal health in various departments of PT. Fenyen Agro Lestari, Indonesia, recommends ergonomic improvements to reduce the risk of MSDs. The methodology involves REBA for postural assessment, collecting musculoskeletal complaints via questionnaires, and analyzing data to recommend ergonomic improvements. The findings revealed that poor postures cause significant musculoskeletal disorders, especially in the Boiler department, highlighting the need for ergonomic improvements. This study is novel in that it applies the Rapid Entire Body Assessment (REBA) method to a specific context within PT. Fenyen Agro Lestari provides tailored ergonomic recommendations for multiple departments and addresses gaps in existing research on posture-related musculoskeletal disorders in the industry. The study's limitations include a focus on only three departments, potential observer bias, and reliance on subjective questionnaire data, which may not fully capture all musculoskeletal issues or account for variations in individual worker experiences.

Keywords: *Ergonomics; Rapid Entire Body Assessment (REBA), Musculoskeletal Disorders, Work Posture, Productivity*

INTRODUCTION

PT.XYZ is a private company engaged in the process of making crude palm oil from palm oil fruit. Processing is carried out using machines that still require operators and manual tools to run the process. Workers spend almost 90% of their work shift (8 hours) facing machines and factory equipment. If one's posture at work is not optimal, workers will feel uncomfortable while working, experience muscle tension, and experience excessive fatigue during work hours, which will affect factory productivity. To lessen the harmful effects of bad work postures, the Rapid Entire Body Assessment (REBA) approach is used to analyze the risk level of work postures and provide improvement ideas to lower the risk level of work postures. This research focuses on 3 workers from each department who are assessed to have the greatest potential for posture errors in the palm oil processing process: the boiler, maintenance, and laboratory departments.

The study of human factors in the workplace as they relate to engineering, management, psychology, anatomy, physiology, and design is known as ergonomics. Ergonomics relates to the optimization, efficiency, health, safety, and comfort of humans in the workplace, at home, and wherever they are. One thing to consider when evaluating a job's effectiveness is its work posture. It is guaranteed that the operator will produce high-quality output if they have an ergonomic and good working posture. On the other hand, the operator would quickly become tired if their working position was not ergonomic. When the operator is prone to fatigue, the quality of the work performed will also decline and will not meet expectations. Anthropometry is a branch of ergonomics that relates to the measurement of human body dimensions and can be used to design ergonomic facilities. According to Wignjosoebroto (2000), the word anthropometry comes from Greek, specifically the word Anthropos (man), which means human, and the word metering (to

Corresponding author's email: nismah.panjaitan@usu.ac.id

measure), which means measurement. Thus, anthropometry is a science that deals with measuring the dimensions of the human body. According to Nurmianto (2004), anthropometry is a Collection of numerical data related to human body characteristics in terms of size, shape, and strength, as well as the application of these data to address design issues.

Anthropometry can broadly be used as an ergonomic consideration in the design of products or work systems intended for human use. Thus, anthropometric data can be used to determine the appropriate shape, size, and dimensions of the designed product, as well as the humans who will use it. As a result, when designing a product, designers must consider the proportions of the broadest possible user base. The term “musculoskeletal” refers to work-related risks related to muscle disorders caused by improper work posture while performing a work activity. Musculoskeletal complaints are issues related to the skeletal muscles that a person experiences, ranging from very mild discomfort to severe pain. When muscles are subjected to static loads repeatedly and for extended periods, this can lead to complaints such as damage to the joints, ligaments, and tendons. Complaints and damages are usually referred to as musculoskeletal disorders (MSDs) or injuries to the musculoskeletal system. In general, muscle complaints can be categorized into two groups:

1. Temporary complaints (reversible) are muscle complaints that occur when the muscles are subjected to static loads; however, these complaints quickly disappear once the loading is stopped.
2. Persistent complaints, which refer to muscle complaints that are enduring.

Although the workload was stopped, the muscle pain persisted. A boiler is a closed vessel that heats water to produce steam as working energy. Air is used because it is efficient and inexpensive for heat transfer. This steam, at a certain pressure and temperature, is used to transfer thermal energy to another process. The efficiency of a boiler is affected by the mass flow rate, pressure, and temperature of the steam entering and exiting. To determine efficiency, first, the pressure and temperature of the inlet and outlet steam are measured. Then, these data are converted into enthalpy (kJ/kg) to calculate the energy in and out. Employee productivity is influenced by internal factors, such as education, skills, discipline, attitude, motivation, nutrition, and health, as well as external factors like the company environment, policies, production facilities, and work climate. Factors such as technology, management, and opportunities for achievement also play a role, as do social security factors and income levels. Based on this theory, this study examines the influence of education, training, motivation, discipline, skills, work experience, salary, and work environment on productivity.

Ergonomic issues in the production of Crude Palm Oil (CPO) are complex and significantly impact workers’ health at various stages of the process. One of the primary concerns is poor working posture. Workers often have to operate in uncomfortable positions, such as bending, squatting, or standing for extended periods without adequate breaks. For instance, when collecting fresh fruit bunches (FFB) on plantations, the plants frequently bend over for long periods, putting excessive strain on their backs, necks, and shoulders. This poor posture can lead to chronic spinal injuries and musculoskeletal pain. Another significant issue is the lifting of heavy loads. Workers on palm oil plantations often have to lift FFB, which can weigh more than 20 kg.

This manual lifting and moving of heavy loads is usually performed without proper equipment, and if workers do not use correct lifting techniques, they can suffer from back, knee, and hip injuries. The repetitive strain of heavy lifting also increases the risk of chronic muscle and joint disorders if workers are not provided with adequate ergonomic training.

Repetitive movements are another common problem. Many tasks in CPO production, such as cutting palm fronds, harvesting fruits, or processing bunches in the factory, require repetitive motions. Excessive repetition of the same movements without sufficient rest can cause overuse injuries, such as tendonitis and carpal tunnel syndrome. These injuries can cause prolonged pain and reduce worker productivity, potentially requiring extended medical treatment. In palm oil processing factories, vibration from large machines poses an ergonomic challenge. Machines used to press oil and conveyor systems generate vibrations that can affect workers' health, especially their hands and arms. Prolonged exposure to vibration can result in conditions like Hand-Arm Vibration Syndrome (HAVS).

Symptoms of this syndrome include numbness, tingling, and permanent nerve damage if not addressed properly. Additionally, workers in the CPO industry often work under harsh environmental conditions. Plantations are exposed to extreme heat and humidity, whereas processing factories tend to have high temperatures due to the oil heating process. Working in such hot environments not only causes discomfort but also carries the risks of dehydration, heat stress, and fatigue. Prolonged exposure to high temperatures can impair workers' focus, increase the likelihood of errors, and ultimately lead to accidents. In addition to physical strain, poor ergonomic conditions can also lead to mental fatigue. Workers in CPO production often work long hours without adequate rest.

This increases stress levels and fatigue, which affects overall work performance and well-being. Chronic fatigue reduces productivity and increases the risk of workplace injuries and errors. Inefficient work systems intensify ergonomic problems. In many cases, workers must move between different workstations or manually transport products over long distances. The lack of mechanization or appropriate tools in these processes results in a higher physical burden on workers.

This is especially evident in the transportation of FFBs from plantations to factories, which are often performed manually using human labor. Another ergonomic issue arises from the use of tools and equipment that are not properly suited to the body sizes of workers. The tools used in CPO production, such as machetes and cutting instruments, are not ergonomically designed to reduce strain on the hands and wrists. Using uncomfortable tools increases the risk of muscle and joint injuries and slows the work process.

In addition, the lack of ergonomic training for workers worsens these problems. Many CPO workers do not receive sufficient training on how to perform their tasks safely and ergonomically. They are often unaware of the importance of maintaining proper posture or using safe lifting techniques. Without adequate knowledge, workers are more susceptible to long-term injuries that can affect their health and productivity.

LITERATURE REVIEW

The literature review used in this study is described below. Work Posture and Worker Health-Poor work posture significantly contributes to musculoskeletal disorders (MSDs), which affect muscles, joints, and other soft tissues. These disorders often result from incorrect working positions, repetitive movements, or excessive workloads. According to Krishnan et al., (2021), improper posture can lead to decreased productivity, increased absenteeism, and higher healthcare costs. Therefore, it is crucial to evaluate and optimize work postures to minimize MSD risks.

The Rapid Entire Body Assessment (REBA) Method is a postural assessment tool designed to evaluate the risk of musculoskeletal disorders by analyzing body positions during work. It considers several body parts, such as the neck, back, legs, and arms, while also factoring in the applied load and force. According to Supattananon et al. (2022), REBA is effective in identifying high-risk working postures and assisting ergonomists in redesigning tasks to improve workplace ergonomics.

Implementation of REBA in Industry Previous studies have shown that implementing REBA in industries, like PT. XYZ can significantly reduce health risks associated with poor work posture. For example, research by Eynipour et al. (2024) applied the REBA method in the manufacturing sector and observed a reduction in musculoskeletal risks after posture improvements were made based on REBA recommendations. This also positively impacted worker productivity, as workers could work more comfortably and efficiently.

Pereira et al. (2019) demonstrated a direct correlation between ergonomic work posture and worker productivity. Workers in proper postures experience less fatigue and fewer injuries, enabling them to work more efficiently. Moreover, improving workplace ergonomics can enhance job satisfaction and reduce sick leave.

The Prevalence of MSDs in the manufacturing industry (Jin et al., 2022) highlights the high prevalence of musculoskeletal disorders (MSDs) among workers in the manufacturing industry. The study found that repetitive movements and poor ergonomic conditions significantly contributed to the development of MSDs, particularly affecting the shoulders and lower back. The findings emphasize the need for ergonomic interventions to reduce MSD risk and improve worker health.

Nguyen et al. (2020) investigated the impact of ergonomic workplace design on the incidence of MSDs in a Vietnamese garment factory. Their study revealed that workers exposed to poorly designed workstations were more likely to report symptoms of MSDs. The introduction of ergonomic adjustments, such as adjustable chairs and workstation height modifications, significantly reduced musculoskeletal pain and discomfort.

Henry et al. (2015) explored the high rate of musculoskeletal disorders among workers in palm oil plantations. The repetitive nature of tasks such as harvesting and carrying heavy loads were identified as key contributors to the development of MSDs. Rahman suggested that ergonomic training and the introduction of mechanical aids could mitigate the risks of musculoskeletal injury.

Pickard et al. (2022) examined the economic burden of musculoskeletal disorders in the logistics sector. The study found that MSDs were a leading cause of work absenteeism and contributed to increasing healthcare costs for companies. Implementing preventive measures, such as regular ergonomic assessments and worker education, was recommended to reduce both absenteeism and long-term healthcare expenses.

Yamada et al. (2020) focused on the long-term effects of MSDs on the quality of life of workers in the construction industry. The study revealed that chronic MSDs not only limited workers' physical capabilities but also negatively impacted their mental health and overall well-being. The findings emphasize the importance of early detection and intervention to prevent the progression of MSDs.

Smith et al. (2022) investigated the relationship between ergonomic office setups and the prevalence of musculoskeletal disorders among office workers. The findings demonstrated that poor posture and improperly designed workstations contributed to neck, back, and wrist pain. The introduction of ergonomic chairs, adjustable desks, and proper postural training significantly decreased the incidence of MSDs.

Ali and Alam (2022) explored the role of technology in reducing MSDs among healthcare workers, particularly those involved in patient handling. The study concluded that the use of mechanical lifting devices and ergonomic training programs reduced the physical strain on workers and decreased the incidence of MSDs in hospital settings.

Gasibat et al. (2017) evaluated the effectiveness of workplace exercise programs in preventing MSDs. The research demonstrated that regular stretching and strengthening exercises tailored to the workers' needs reduced the onset of MSDs, particularly in high-risk environments such as manufacturing and assembly lines.

Palmer and Goodson (2015) examined the impact of age on the development of MSDs in the workforce. The study found that older workers were more susceptible to MSDs because of decreased muscle strength and flexibility. Ergonomic interventions tailored to the aging workforce, such as modifying workstations and reducing physical strain, were found to effectively reduce the prevalence of MSDs.

Tang et al. (2022) investigated the connection between psychosocial factors, such as job stress and work satisfaction, and the development of MSDs. The findings indicate that high levels of job stress are associated with an increased risk of MSDs, particularly in the neck and shoulders. Improving workplace culture and reducing stress through ergonomic interventions and mental health support were recommended to reduce the incidence of MSDs.

Martinez (2021) investigated the effects of prolonged standing on MSDs in retail workers. The results showed that standing for extended periods without sufficient breaks or proper footwear significantly contributed to lower back and leg pain. The introduction of anti-fatigue mats, ergonomic footwear, and scheduled rest periods helped reduce the prevalence of MSDs and improved overall comfort for retail employees.

The literature reviewed in this study includes a variety of recent works that focus on the application and effectiveness of the REBA method in assessing ergonomic risks and improving workplace health and productivity. Mahmood et al. (2020) presented a case study demonstrating the REBA method's usefulness in reducing physical strain on workers in the manufacturing environment. Reyes-Zárate (2023) expanded on this by integrating REBA with digital tools like the Kinect system, to optimize real-time ergonomic assessment. Further, Munala (2021) and Gurnani et al. (2023) applied REBA in construction and dairy farming, respectively, highlighting its adaptability across industries for reducing musculoskeletal risks.

In healthcare settings, Ayvaz et al. (2023) used REBA to identify and mitigate risk factors associated with repetitive tasks, leading to both health improvements and productivity gains. Ogedengbe et al. (2023) conducted a comparative analysis of REBA and RULA in office environments and concluded that REBA provides a more comprehensive evaluation of full-body posture.

Moradi et al. (2017) and Mahboobi et al. (2020) also demonstrated the importance of REBA in the IT and automotive industries, where postural assessments have led to innovative solutions such as exoskeleton use and ergonomic redesigns. These studies underscore the broad applicability and effectiveness of REBA in improving workplace ergonomics and reducing injury risks across a range of sectors.

The existing literature suggests that REBA is an effective approach for identifying and mitigating musculoskeletal disorder risks in the workplace. By improving ergonomic work postures, companies like PT. XYZ can enhance both worker health and overall productivity. This review highlights that optimizing work posture through REBA is not only vital for worker health but also contributes to the long-term operational success of a company.

RESEARCH METHOD

The Rapid Entire Body Assessment (REBA) method at PT. XYZ can be expanded to provide deeper insights into its effectiveness in improving health and productivity. One area that deserves exploration is the long-term impact of postural improvements. While immediate benefits may be observed in terms of reduced discomfort and improved efficiency, studying the long-term effects is essential to understand how posture optimization influences chronic musculoskeletal conditions, absenteeism, and overall worker well-being over time.

This will help determine whether the REBA-based interventions lead to sustained improvements and whether additional measures are needed. Another potential research area is the integration of technology into real-time postural monitoring. Wearable devices, sensors, or motion-capture technology can be employed to continuously track and evaluate workers' posture throughout shifts. These real-time data can provide more accurate feedback and help identify moments when workers deviate from optimal posture, allowing immediate corrective actions. Such technology could also assist in refining the REBA method by identifying patterns that manual observation might miss, leading to better-tailored interventions. Further studies could also involve cross-industry comparisons to assess the adaptability and effectiveness of the REBA method across sectors. Although the proposed method has proven useful in specific environments, its applicability to other industries with varying physical demands remains underexplored.

Comparing results from sectors such as manufacturing, construction, and health care could provide a more comprehensive understanding of the method's versatility and areas that require adjustment for industry-specific challenges. In addition to technical assessments, research should focus on employee engagement and education regarding ergonomic practices. The success of postural improvement interventions often depends on how well employees understand and implement ergonomic guidelines. Investigating the role of training programs, motivational strategies, and feedback mechanisms could reveal how to foster a culture of ergonomics in the workplace. This could lead to more consistent adoption of healthier work postures, which would benefit both individuals and organizations.

Finally, conducting a cost-benefit analysis can provide valuable insights into the financial implications of ergonomic interventions. Such an analysis could perform the upfront costs of implementing REBA-based solutions against the potential savings from reduced injury-related healthcare expenses, fewer compensation claims, and increased productivity. Understanding economic benefits could help organizations make informed decisions about investing in ergonomic improvements, and balancing worker health with operational efficiency. By focusing on these areas, future research can significantly enhance the practical application of the REBA method and contribute to a broader goal of promoting healthier, more productive workplaces.

The Rapid Entire Body Assessment (REBA) approach is a study technique used in production department workload analysis. The Rapid Entire Body Assessment (REBA) is a valuable tool for evaluating a worker's standing posture as it relates to the coupling variables and external stresses while they are at work. The REBA assessment form will be completed following the observation and measurement of the workers' postural angles. A tool called the Standard Nordic Questionnaire (SNQ) can determine which muscle areas are causing complaints based on the operator's subjective level of discomfort, which ranges from Not Painful (NP), Slightly Painful (SP), Painful (P), and Very Painful (VP) (1). It is feasible to examine the body map. The current condition of the workers' posture in each department is presented in Table 1.

Table 1. Current Condition of Workers' Posture in Each Department

No.	Department	Process	Image
1.	Boiler	Tidying up the fireplace in the boiler furnace.	

No.	Department	Process	Image
2.	Maintenance	Operation of the lathe machine in the workshop.	
3.	Laboratory	Testing sample losses	

Source: PT. XYZ

The reasons for selecting the operators are as follows:

1. The Boiler Operator was chosen because he has the shortest body stature and is the least suited to the size of the work instruments.
2. The Maintenance Operator was selected due to a malfunction that required repairs with a lathe machine; the person responsible for the repairs was that gentleman.
3. The Laboratory Operator was chosen because he was the sole operator conducting the loss analysis.

FINDINGS AND DISCUSSION

The results and discussion of the workload analysis in the boiler production department using the SNQ questionnaire and anthropometric measurements with the REBA method are as follows.

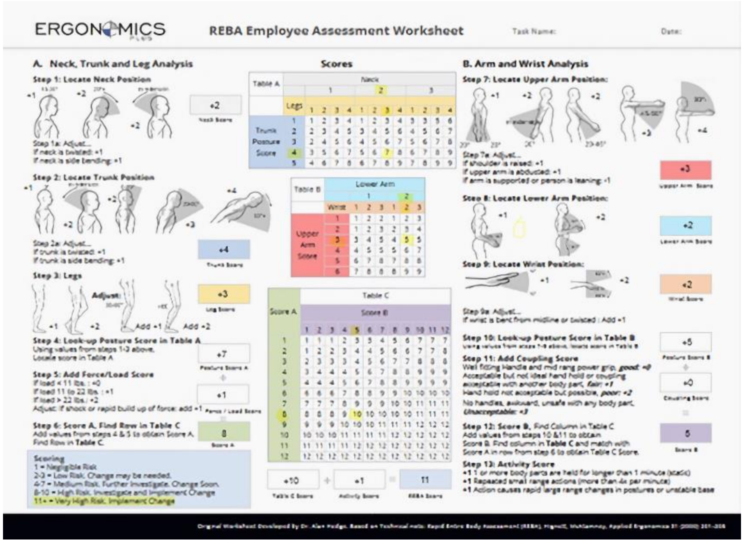
Boiler Departement

The working posture of the Boiler Department operator while discharging residual fuel in the combustion furnace is shown in Figure 1.

Source: PT. XYZ

Figure 1. Work Posture of Workers in the Boiler Department

The image conveys that the operator must pull out and insert the fireplace stick into the fuel burner for the production process. The assessment of workers' postures using the REBA method in the boiler department is shown in Figure 1.



Source: Processing Data

Figure 2. REBA Assessment Form for Boiler Department Workers

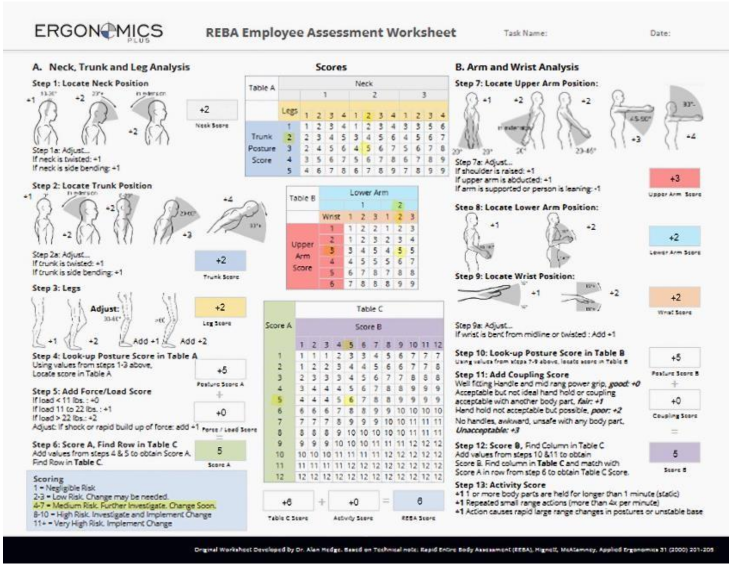
Maintenance Department

An image of the working posture of the maintenance department while operating the lathe machine is shown in Figure 3.

Source: PT. Fenyen Agro Lestari,

Figure 3. Work Posture of Workers in *the* Maintenance Department

The image indicates that the operator is operating a lathe machine located in a factory workshop. The assessment of workers' postures using the REBA method in the maintenance department is shown in Figure 4.


ERGONOMICS PLUS — REBA Employee Assessment Worksheet — Task Name: — Date:

A. Neck, Trunk and Leg Analysis

Step 1: Locate Neck Position — +2 Neck Score

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

Step 2: Locate Trunk Position — +2 Trunk Score

Step 2a: Adjust...
If trunk is twisted: +1
If trunk is side bending: +1

Step 3: Legs — Adjust: — +2 Leg Score

Step 4: Look-up Posture Score in Table A
Using values from steps 1-3 above,
Locate score in Table A — +5 Posture Score A

Step 5: Add Force/Load Score
If load < 11 lbs. : +0
If load 11 to 22 lbs. : +1
If load > 22 lbs.: +2
Adjust: If shock or rapid build up of force: add +1 — +0 Force / Load Score

Step 6: Score A, Find Row in Table C
Add values from steps 4 & 5 to obtain Score A.
Find Row in Table C. — 5 Score A

Scoring
1 = Negligible Risk
2-3 = Low Risk. Change may be needed.
4-7 = Medium Risk. Further Investigate. Change Soon.
8-10 = High Risk. Investigate and Implement Change
11+ = Very High Risk. Implement Change

Scores

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

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

Table C: Score A \ Score B	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	1	2	2	3	4	4	5	6	6	7	7	8
3	2	3	3	3	4	5	6	7	7	8	8	8
4	3	4	4	4	5	6	7	8	8	9	9	9
5	4	4	4	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	8	9	9	9	10	10	11	11	11
8	8	8	8	9	10	10	10	10	10	11	11	11
9	9	9	9	10	10	10	11	11	11	12	12	12
10	10	10	10	11	11	11	11	12	12	12	12	12
11	11	11	11	11	12	12	12	12	12	12	12	12
12	12	12	12	12	12	12	12	12	12	12	12	12

+6 Table C Score + +0 Activity Score = 6 REBA Score

B. Arm and Wrist Analysis

Step 7: Locate Upper Arm Position:

Step 7a: Adjust...
If shoulder is raised: +1
If upper arm is abducted: +1
If arm is supported or person is leaning: -1 — +3 Upper Arm Score

Step 8: Locate Lower Arm Position: — +2 Lower Arm Score

Step 9: Locate Wrist Position: — +2 Wrist Score

Step 9a: Adjust...
If wrist is bent from midline or twisted : Add +1

Step 10: Look-up Posture Score in Table B
Using values from steps 7-9 above, locate score in Table B — +5 Posture Score B

Step 11: Add Coupling Score
Well fitting Handle and mid rang power grip, good: +0
Acceptable but not ideal hand hold or coupling acceptable with another body part, fair: +1
Hand hold not acceptable but possible, poor: +2
No handles, awkward, unsafe with any body part, Unacceptable: +3 — +0 Coupling Score

Step 12: Score B, Find Column in Table C
Add values from steps 10 &11 to obtain Score B. Find column in Table C and match with Score A in row from step 6 to obtain Table C Score. — 5 Score B

Step 13: Activity Score
+1 1 or more body parts are held for longer than 1 minute (static)
+1 Repeated small range actions (more than 4x per minute)
+1 Action causes rapid large range changes in postures or unstable base

Original Worksheet Developed by Dr. Alan Hedge. Based on Technical note: Rapid Entire Body Assessment (REBA), Hignett, McAtamney, Applied Ergonomics 31 (2000) 201-205

Source: Processing Data

Figure 4. REBA Assessment Form for Maintenance Department Workers

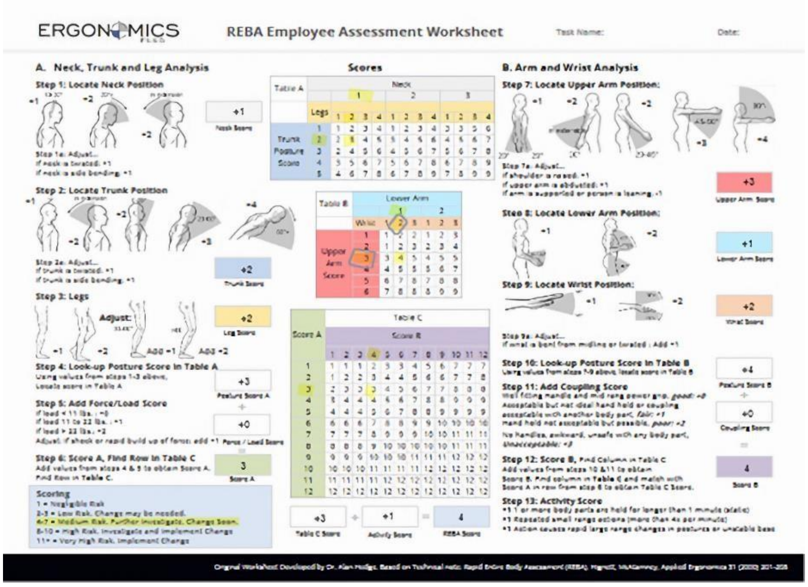
Laboratory Department

The details of the work posture of the operators in the Laboratory Department while conducting Loss testing or testing the amount of CPO that is wasted during the production process are shown in Figure 5.

Source: PT. XYZ

Figure 5. Work Posture of Laboratory Employees

The image conveys that analysts in the laboratory department are checking the amount of CPO that is wasted during the production process by testing the lost samples that have been collected. The assessment of the workers' postures using the REBA method in the laboratory is shown in Figure 6.



Source: Processing Data

Figure 6. REBA Assessment Form for Laboratory Staff

Information on the assessment of the REBA form is presented in Table 2.

Table 2. Explanation of REBA Form Scores

Scoring	Action
1	*Negligible risk*
2–3	*Low-risk, changes may be needed*
4–7	*Medium risk, Further investigation, and change soon*
8–10	*High-risk Investigate and implement change*
11+	*Very high risk, Implement change*

Source: Collection Data

The results of the recap of the work postural assessment of the workers using the REBA form from each station are presented in Table 3.

Table 3. Summary of the Posture Assessment Results of Workers Using the REBA Form

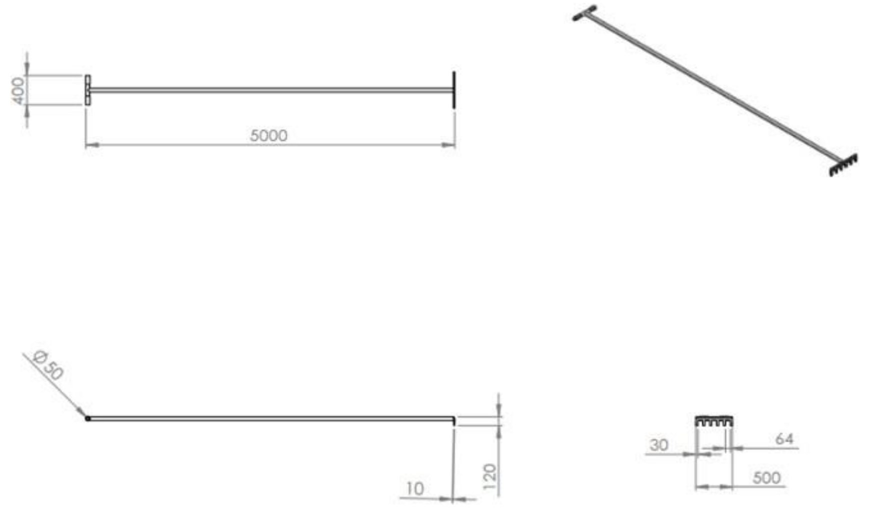
No.	Department	Activities	REBA Score	Note
1.	*Boiler*	Installation and removal of fuel.	11	*Very high risk, Implement change*
2.	*Maintenance*	Operating a lathe machine.	6	*Medium risk, Further investigation, Change soon*
3.	*Laboratory*	Analysis of losses	4	*Medium risk, Further investigation, Change soon*

Source: Collection Data

According to the findings of the study conducted with the help of the SNQ questionnaire collection, the following changes can be made, starting with sorting and working your way down to processing, engineering, and laboratory for each department.

1. *Boiler* Department

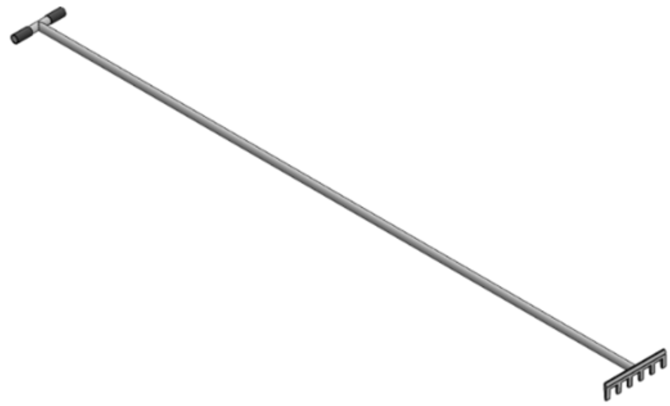
The analysis results from the boiler department indicate that the REBA score is 11, which indicates that an investigation is needed*, and* the severity level is classified as high. Therefore, for tasks such as repairing the operator's fireplace, it is advisable to consider the physical workload. To alleviate the operator's workload, a proposal for a fireplace stick tool was designed. This tool will be used to tidy up the fireplace, *and* pull out, and remove the charcoal used in the boiler, allowing the operator to stay at a safer distance from the boiler's furnace. The size and dimensions of the proposed boiler stick design can be seen in Figure 7.



Source: Processing Data

Figure 7. Proposed Size and Improved Stick

The proposed design tool for the stick boiler is shown in Figure 8.



Source: Processing Data

Figure 8. Improvements to the Stick Boiler

2. *Maintenance* Department

The analysis results from the maintenance department indicated a REBA score of 6, indicating that further investigation was needed, and the severity level was still categorized as medium. Therefore, for tasks such as operating machinery, operators should pay attention to the position of the equipment, ensuring that it is not too high to prevent excessive shoulder elevation. Additionally, they should use standard tools and adequate personal protective equipment to avoid hand injuries from vibrations caused by impact tools.

3. Laboratory Department

The analysis results from the laboratory indicated that the REBA score was 4, which indicates that further investigation is needed*, and* the severity level is still considered low. Therefore, when analyzing samples, operators should pay attention to the position of the equipment, ensuring that it is neither too high nor too low and that it is kept at a distance from the body to avoid discomfort in the back and neck.

Based on the analysis of the SNQ questionnaire, each department was required to make improvements to enhance safety and work efficiency. The boiler department, which has a REBA score of 11, requires serious attention due to high severity risks; it is recommended to use specially designed fireplace tools to reduce the physical burden on operators when working with boilers. The maintenance department, which has a REBA score of 6, is at moderate risk and is advised to adjust the position of tools and use adequate protective equipment to prevent injuries from vibrations. The Laboratory Department, which received a REBA score of 4, has a low risk but still requires adjustments to the position of equipment to prevent discomfort in the operators' backs and necks while analyzing samples.

CONCLUSION

The study's ultimate finding is that the risks associated with non-ergonomic work postures were evaluated by assessing the physical workload of operators at PTs. Fenyen Agro Lestari used the Rapid Entire Body Assessment (REBA) method and the Standard Nordic Questionnaire (SNQ). The operators in the three departments considered to have the highest potential postural risk—maintenance, laboratory, and boiler—are the subjects of this study. The results show that the Maintenance and Laboratory departments have moderate risks, with scores of 6 and 4, respectively, whereas the boiler department has the highest REBA score (11), suggesting a very high risk that necessitates prompt corrective action. Redesigning tools and modifying work posture are among the suggested changes as a remedy to lower the chance of harm.

LIMITATION OF RESEARCH

Limitations

1. Generalization of Findings. The study may focus on a specific industry or set of workers within PT. XYZ, which limits the generalizability of the results. Different industries, work environments, and job roles may require distinct posture optimization approaches. Thus, the results may not apply to all settings without requiring adjustments.
2. REBA Method Subjectivity. Although REBA is a widely used ergonomic assessment tool, it relies on observational data, which can lead to subjective interpretation by the evaluator. Minor differences in how body postures are recorded or scored can affect assessment outcomes, possibly leading to inaccurate risk categorization.
3. Short-Term Focus. This study primarily assesses the short-term effects of postural optimization, such as immediate reductions in discomfort or productivity improvement. The long-term sustainability of ergonomic interventions, particularly how they impact workers' health and productivity over months or years, should not be thoroughly addressed.
4. Limited Consideration of Psychosocial Factors. This study focuses mainly on physical ergonomics and does not extensively explore psychosocial factors, such as worker stress,

motivation, and job satisfaction, which also influence productivity and health outcomes. These factors could provide a more comprehensive view of work conditions.

Further Research

1. Long-Term Impact Studies. Future research could explore the long-term effects of REBA-based postural optimization, evaluating whether these interventions maintain their effectiveness in improving both worker health and productivity over time. This could involve tracking injury rates, productivity, and job satisfaction over several months or years.
2. Cross-Industry Comparisons. Expanding research across industries with varying work conditions would provide a broader understanding of how REBA and other ergonomic interventions perform in diverse environments. This could include sectors such as healthcare, construction, and logistics, where physical demands differ significantly.
3. Integration with Psychosocial Factors. Future studies could integrate psychosocial factors such as mental well-being, worker satisfaction, and stress levels with physical ergonomics. Understanding the interaction between physical posture and mental health could lead to more holistic workplace interventions.
4. Technology-Aided Ergonomics. Further research could explore the use of advanced technologies, such as motion-capture systems, wearable sensors, and AI, to improve the precision of postural assessments. These technologies can enhance the objectivity and accuracy of ergonomic evaluations, thus reducing the reliance on human observation.

REFERENCES

Ali, A. M., & Alam, M. M. (2022). The multifactorial causes of caregiver work-related disabilities: A systematic literature review. *International Journal of Human Factors and Ergonomics, 9*(3), 215–230. https://doi.org/10.1504/IJHFE.2022.126122

Ayvaz, Ö., Özyıldırım, B. A., İşsever, H., Öztan, G., Atak, M., & Özel, S. (2023). Ergonomic risk assessment of working postures of nurses working in a medical faculty hospital with REBA and RULA methods. *Science Progress, 106*(4), 00368504231216540. https://doi.org/10.1177/00368504231216540

Eynipour, A., Arjmand, N., Dianat, I., Soltanian, A. R., & Heidarimoghadam, R. (2024). Assessing musculoskeletal disorder risks in an automobile part manufacturing factory: A comparison study of biomechanical and ergonomic tools. *Health Scope, 13*(2). https://doi.org/10.5812/healthscope-139610

Gasibat, Q., Simbak, N. B., Aziz, A. A., Petridis, L., & Tróznai, Z. (2017). Stretching exercises to prevent work-related musculoskeletal disorders: A review article. *American Journal of Sports Science and Medicine, 5*(2), 27–37.

Gurnani, U., Singh, S. K., Sain, M. K., & Meena, M. L. (2023). A postural risk assessment of manual dairy farm workers using REBA technique. In *Advances in Modelling and Optimization of Manufacturing and Industrial Systems: Select Proceedings of CIMS 2021* (pp. 717–729). Springer Nature Singapore. https://doi.org/10.1007/978-981-19-6107-6_51

Henry, L. J., Jafarzadeh Esfehani, A., Ramli, A., Ishak, I., Justine, M., & Mohan, V. (2015). Patterns of work-related musculoskeletal disorders among workers in palm plantation occupation. *Asia Pacific Journal of Public Health, 27*(2), NP1785–NP1792. https://doi.org/10.1177/101053951347565

Jin, X., Dong, Y., Wang, F., Jiang, P., Zhang, Z., He, L., & Yang, L. (2022). Prevalence and associated factors of lower extremity musculoskeletal disorders among manufacturing workers: A cross-sectional study in China. *BMJ Open, 12*(2), e054969. https://doi.org/10.1136/bmjopen-2021-054969

Krishnan, K. S., Raju, G., & Shawkataly, O. (2021). Prevalence of work-related musculoskeletal disorders: Psychological and physical risk factors. *International Journal of Environmental Research and Public Health, 18*(17), 9361. https://doi.org/10.3390/ijerph18179361

Mahboobi, M., Taghipour, M., & Azadeh, M. A. (2020). Assessing ergonomic risk factors using combined data envelopment analysis and conventional methods for an auto parts manufacturer. *Work, 67*(1), 113–128.

Mahmood, S., Aziz, S. A., Abdul, H. S., Zulkifli, M. Z., & Marsi, N. (2020). RULA and REBA analysis on work postures: A case study at poultry feed manufacturing industry. *Journal of Computational and Theoretical Nanoscience, 17*(2–3), 755–764. https://doi.org/10.1166/jctn.2020.8716

Martinez, K. B. (2021). *Risk assessment for work-related musculoskeletal injury using wearable sensors*.

Moradi, M., Poursadeghiyan, M., Khammar, A., Hami, M., Darsnj, A., & Yarmohammadi, H. (2017). REBA method for the ergonomic risk assessment of auto mechanics' postural stress caused by working conditions in Kermanshah, Iran. *Annals of Tropical Medicine and Public Health, 10*(3).

Munala, J. M. (2021). *Work-related musculoskeletal disorders, risk levels, and "fear avoidance beliefs" among workers in Oserian Farm Nakuru County* [Doctoral dissertation, JKUAT-COHES].

Nguyen, B. V., Tran, T. T. T., Hoang, N. T., Nguyen, B. N., & Nguyen, Q. T. (2020). Musculoskeletal pain and work-related risk factors among waste collectors in Hanoi, Vietnam: A cross-sectional study. *Open Access Macedonian Journal of Medical Sciences, 8*(E), 498–508.

Nurmianto, E. (2004). *Ergonomi: Konsep dasar dan aplikasinya* (Edisi pertama). Institut Teknologi Sepuluh November. Surabaya: Guna Widya.

Ogedengbe, T. S., Markus, S., Dabo, A. L., Afolalu, S. A., Ikumapayi, O. M., Musa, A. I., & Sulaiman, Y. A. (2023, November). Comparative study of the REBA and RULA assessment tools efficiency for workers' tasks. In *2023 2nd International Conference on Multidisciplinary Engineering and Applied Science (ICMEAS)* (Vol. 1, pp. 1–6). IEEE. https://doi.org/10.1109/ICMEAS58693.2023.10379279

Palmer, K. T., & Goodson, N. (2015). Ageing, musculoskeletal health and work. *Best Practice & Research Clinical Rheumatology, 29*(3), 391–404. https://doi.org/10.1016/j.berh.2015.03.004

Pereira, M., Comans, T., Sjøgaard, G., Straker, L., Melloh, M., O'Leary, S., & Johnston, V. (2019). The impact of workplace ergonomics and neck-specific exercise versus ergonomics and health promotion interventions on office worker productivity: A cluster-randomized trial. *Scandinavian Journal of Work, Environment & Health, 45*(1), 42–52.

Pickard, O., Burton, P., Yamada, H., Schram, B., Canetti, E. F., & Orr, R. (2022). Musculoskeletal disorders associated with occupational driving: A systematic review spanning 2006–2021. *International Journal of Environmental Research and Public Health, 19*(11), 6837. https://doi.org/10.3390/ijerph19116837

Reyes-Zárate, G. G. (2023, September). A digital REBA system based on Kinect and its benefits for ergonomic assessment. In *International Conference on Communication and Applied Technologies* (pp. 3–11). Springer Nature Singapore. https://doi.org/10.1007/978-981-99-7210-4_1

Smith, T. D., Balogun, A. O., & Dillman, A. L. (2022). Management perspectives on musculoskeletal disorder risk factors and protective safety resources within the stone, sand, and gravel mining industry. *Workplace Health & Safety, 70*(5), 242–250. https://doi.org/10.1177/21650799221089196

Supattananon, N., Yawara, P., Youngwilai, A., & Akararungreangkul, R. (2022). Productivity improvement through a work study with ergonomic risk assessment: A case study of a high-voltage line distribution operation. *Engineering & Applied Science Research, 49*(5). https://doi.org/10.14456/easr.2022.67

Tang, L., Wang, G., Zhang, W., & Zhou, J. (2022). The prevalence of MSDs and the associated risk factors in nurses of China. *International Journal of Industrial Ergonomics, 87*, 103239. https://doi.org/10.1016/j.ergon.2021.103239

Wignjosoebroto, S. (2000). *Ergonomi: Studi gerak dan waktu—Teknik analisis untuk peningkatan produktivitas kerja*. Guna Widya.

Yamada, K., Adams, H., Ellis, T., Clark, R., Sully, C., & Sullivan, M. J. (2020). Reductions in fatigue predict occupational re-engagement in individuals with work-related musculoskeletal disorders. *Journal of Occupational Rehabilitation, 30*(1), 135–145. https://doi.org/10.1007/s10926-019-09856-z