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Article

Risk Analysis of Musculoskeletal Disorders (MSDS) Among Fresh Fruit Bunch (FFB) Loaders at PT. XYZ

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A B S T R A C T

This study aims to identify the risk of musculoskeletal disorders (MsDs) among fresh fruit bunch (FFB) loading workers at Afdeling 6 of PT. XYZ, Pelalawan. A quantitative approach was used with the Nordic Body Map (NBM) and Rapid Entire Body Assessment (REBA) as research instruments. The NBM results indicated that the most frequently reported discomfort was in the back, upper arms, wrists, and legs. Meanwhile, the REBA assessment showed that all workers fell into the high-risk category with scores ranging from 8 to 9, indicating the need for immediate changes in work methods. These findings suggest that manual FFB loading activities pose a significant risk of work-related injuries. Therefore, improvements in working posture, the use of ergonomic tools, and better work schedule arrangements are necessary to reduce the risk of muscle injuries among workers.

1. BACKGROUND

1.1 Introduction

Operational activities in the palm oil industry, particularly in the early stage of transporting fresh fruit bunches (FFB) from the collection point (TPH) to the truck bed, still heavily rely on manual labor. This task demands significant physical strength, as the FFB must be lifted to a height of approximately 220 cm into a truck bed that is up to 120 cm wide. Lifting with non-ergonomic body postures can lead to complaints involving the spine, muscles, and joints. This activity falls under the category of manual handling, which involves lifting, pushing, and carrying by physical effort, and is associated with a high risk of musculoskeletal disorders (MSDs).

Several factors contribute to the risk of developing MSDs, including working posture, worker age, duration of work, and the weight of the load. Non-neutral working postures and repetitive physical activities over extended periods can exert stress on muscles and joints. If not properly addressed, this condition may reduce worker productivity and hinder the achievement of work targets, such as the daily FFB tonnage.

This study was conducted at PT. XYZ, a palm oil processing company located in Pangkalan Kerinci. At this company, the FFB loading process is performed daily by field workers, typically from 09:00 AM to 03:00 PM, with individual daily load targets ranging from 5 to 15 tons, depending on the harvest capacity of a particular plantation afdeling. The activity is carried out manually using simple tools such as a “tojok” (a traditional pole), and takes place every day, including weekends. Due to its routine nature and reliance on direct physical labor, this work is highly susceptible to MSD complaints (Rahman, 2017).

MSDs refer to disorders affecting the muscles, nerves, tendons, ligaments, joints, cartilage, and spinal nerves. These disorders are not caused by sudden injuries but result from repetitive work activities performed in non-ergonomic postures. Contributing factors include excessive workload, prolonged working hours, and improper working postures.

To identify MSD complaints and analyze high-risk working postures, two assessment methods were employed: the Nordic Body Map (NBM) and the Rapid Entire Body Assessment (REBA). The NBM is used to identify specific body parts experiencing muscular discomfort, while REBA evaluates overall body posture during work activities. The combined use of these methods is expected to provide insights and recommendations for posture improvements aimed at reducing the risk of MSDs and enhancing field workers’ productivity.

Therefore, this study is crucial for analyzing the risk of musculoskeletal disorders among palm fruit loading workers at PT. XYZ, enabling the company to reduce the incidence of MSD-related complaints among employees. The main objective of this research is to identify the risk of MSDs among FFB loading workers in Afdeling 6 of PT. XYZ.

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1.2 Research Purposes

The objective of this study is to analyze the working postures of palm fruit loading workers at PT. XYZ.

2. LITERATURE RIVIEW

Previous studies have shown that musculoskeletal disorder (MSD) complaints are largely influenced by non-ergonomic working postures, repetitive activities, and mismatches between workplace facilities and workers' physical conditions. Rahman (2017) found that prolonged activities involving bending, squatting, and lifting heavy loads can lead to muscle pain and increased risk of occupational accidents, with 81% of concrete workers falling into the moderate-risk category based on REBA analysis. Rimba, J.T. (2017) also identified a significant correlation between repetitive movements and working posture with MSD complaints among plantation workers. Meanwhile, Faiz et al. (2015) highlighted that manual palm oil harvesting, especially on tall trees, poses a high risk of muscular injury, thereby emphasizing the need for ergonomic approaches in the design of tools and work methods.

Ernita et al. (2020) conducted a study at PT. Nusantara VI Ophir to assess the risk of musculoskeletal disorders among workers involved in palm fruit transportation using the REBA method. The assessment covered postures of the neck, torso, legs, upper arms, forearms, and wrists. The final REBA score was 8, which falls into the high-risk category, indicating that immediate corrective actions were needed to prevent MSDs. Setyanto et al. (2015) analyzed the ergonomic aspects of the scarfing process in a steel slab factory division using OWAS, NIOSH, and NBM methods. MSD complaints were identified through the NBM questionnaire, particularly in the lower back, upper neck, right shoulder, and both upper arms. The REBA assessment revealed that the assembling process had the highest score (11), categorized as high risk. Postural and work design improvements were recommended, as the workload was light but repetitive and carried out over extended periods.

Based on the literature review, numerous previous studies have addressed MSD complaints among workers in both plantation and industrial sectors, and many have employed the Nordic Body Map

(NBM) and Rapid Entire Body Assessment (REBA) methods to evaluate ergonomic risks. However, the review identified the following gaps:

- No specific research has focused on the activity of loading palm fruit into trucks in the Pangkalan Kerinci area, Pelalawan Regency.
- There has been no integrated study using both NBM and REBA methods to analyze working postures and injury risks in fresh fruit bunch (FFB) loading activities.

Therefore, this study occupies a unique and novel position in filling the existing research gap, particularly in the context of the local palm oil plantation sector in Pelalawan, with a specific focus on a high-risk work activity in terms of occupational health.

3. METHODOLOGY

a. Preliminary Field Survey

The researcher distributed the Nordic Body Map (NBM) questionnaire to palm fruit loading workers as part of the initial survey. The objective of this questionnaire distribution was to identify which body parts most frequently experience pain or discomfort during work activities. The data collected from this questionnaire were used to:

- Determine the distribution of musculoskeletal disorder (MSD) symptoms across various body regions.
- Strengthen the argument in the problem background that palm fruit loading activities present ergonomic risks that require further analysis.

b. Ergonomic Risk Assessment

Following the initial data collection through NBM, the researcher proceeded with the measurement of work activity risk levels using the following method:

c. Rapid Entire Body Assessment (REBA)

The REBA method was applied to evaluate workers' body postures during palm fruit loading activities. The assessed aspects included the positions of the head, neck, back, upper and lower arms, wrists, and legs. The assessment was conducted based on direct observation or documentation via video or photographs taken during the activity.

The REBA assessment results yield risk scores categorized into several levels:

- **Low Risk**: No action required.
- **Medium Risk**: Action may be needed.
- **High Risk**: Changes should be made as soon as possible.
- **Very High Risk**: Activity is not recommended to continue and requires immediate intervention.

4. Results and Discussion

4.1 Nordic Body Map (NBM)

The Nordic Body Map (NBM) is a body map-based questionnaire used to identify parts of the body that experience discomfort or pain among workers. This questionnaire is one of the most commonly used tools in ergonomic studies due to its standardized and systematic format. According to Tarwaka and Sudiajeng, by analyzing the body map in the NBM questionnaire—as shown in Figure 3.1—it is possible to estimate the type and severity of musculoskeletal complaints experienced by workers. Although the NBM is relatively simple and easy to use, it involves a considerable degree of subjectivity. Therefore, to minimize bias, it is recommended that the questionnaire be completed both before and after performing work activities.

Figure 3.1. NBM Questionnaire
(Source: Tarwaka, 2019)

Scoring Description:
Score 1: No complaint
Score 2: Slight pain
Score 3: Moderate pain
Score 4: Severe pain

NBM Questionnaire Results

The Nordic Body Map (NBM) questionnaire was distributed to four respondents working as Fresh Fruit Bunch (FFB) loaders in Afdeling 6 of PT. XYZ.

Each respondent completed the questionnaire based on the discomfort they experienced before and after the loading activity. A total of 28 items were filled out directly by each respondent. The analysis of the questionnaires revealed that working duration, working posture, and age were influential factors contributing to muscular and joint pain complaints, known as musculoskeletal disorders (MSDs). These findings were derived from both interview data and the questionnaire responses provided by the participants.

The recap of the NBM questionnaire results is presented in Table 3.1. This summary includes only the responses with scores of 2, 3, and 4. Responses with a score of 1 were excluded from the table

Table 3.1 Recapitulation of NBM Questionnaire Results for FFB Loading Workers

Body part	Number of Workers Who Feel		
	Slight pain	Moderate pain	Severe pain
Neck	2	2	-
Torso	1	3	-
Upper Arms	1	3	-
Lower Arms	2	2	-
Wrist	1	3	-
Legs	2	2	-

Analysis of NBM Questionnaire Recapitulation Results (Table 3.1)

Based on the recapitulation results, six major body parts were reported to experience discomfort by the workers. The levels of discomfort were categorized into three: slight pain, moderate pain, and severe pain. The detailed explanation is as follows:

1. **Neck**: Two workers reported slight pain, and two others reported moderate pain. All respondents experienced complaints in the neck area, indicating static load or non-ergonomic head positions during the FFB loading process.
2. **Torso (middle back/body)**: One worker reported slight pain, and three reported moderate pain. The dominant complaints in this area suggest frequent bending or non-neutral body postures.
3. **Upper Arms**: One worker reported slight pain, and three reported moderate pain. The high physical workload involving lifting or pushing heavy loads is suspected to be the main cause of discomfort in the upper arms.
4. **Lower Arms**: Two workers reported slight pain, and two others reported moderate pain. Continuous gripping of tools (such as *tojok* or hook-T) potentially leads to muscle fatigue in the lower arms.
5. **Wrists**: One worker reported slight pain, and three others reported moderate pain. Repetitive strain on the wrists during gripping or lifting FFB likely causes excessive stress on this area.
6. **Legs**: Two workers reported slight pain, and two others reported moderate pain. Discomfort in the legs may be due to prolonged standing or moving while carrying heavy loads without proper ergonomic support.

All respondents reported discomfort in several key body parts involved in the FFB loading process. This indicates that the job carries a high risk of musculoskeletal disorders, especially when performed without proper ergonomic practices. Therefore, improvements in working posture, use of ergonomic tools, and implementation of regular rest breaks are highly recommended.

2. REBA (Rapid Entire Body Assessment)

The Rapid Entire Body Assessment (REBA) method is used to evaluate workers' body postures, specifically focusing on the neck, back, arms, wrists, and legs. The primary objective is to identify the risk of musculoskeletal injuries. The assessment is conducted using a REBA worksheet, which allows for a quick and practical evaluation. This method is well-suited for analyzing worker postures during the process of transferring oil palm fresh fruit bunches (FFB) into truck beds. The results can be utilized to recommend immediate corrective actions to prevent work-related injuries.

Figure 3.11. REBA Employee Assessment Worksheet
(Source: Restuputri and Lukman, 2017)

REBA Score Calculation for the Loading Worker Named Nuriadi

Figure 5.1. Nuriadi's Loading Process

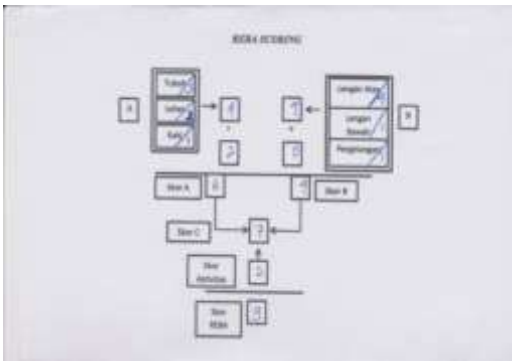

Figure 2.3. REBA Score Recap Table – Nuriadi

REBA Scoring Recapitulation Table

no	Name	Final Score	Result
1	Nuriadi	9	High risk — corrective action required.
2	Santo	8	High risk — corrective action required.
3	Sihombing	9	High risk — corrective action required.
4	sumarno	9	High risk — corrective action required.

Based on the assessment using the Rapid Entire Body Assessment (REBA) method conducted on four workers involved in loading oil palm fresh fruit bunches (FFB) at Afdeling 6 of PT. XYZ, the final scores indicate a **high-risk** category. The detailed results are as follows: the workers named Nuriadi, Sihombing, and Sumarno each received a REBA score of 9, while Santo received a score of 8. All scores fall within the high-risk category, suggesting that the current work activities pose a significant risk of musculoskeletal disorders (MSDs), and immediate corrective measures are necessary to improve working methods and postures.

The high REBA scores among the FFB loaders are influenced by several factors directly related to heavy physical workload and a non-ergonomic work environment. The main contributing factors include:

1. **Excessive physical demands**, as FFB loading involves repeatedly lifting heavy loads over extended periods.
2. **Non-neutral body postures**, such as bending and reaching toward the truck bed, place excessive strain on the back, neck, and wrists.
3. **Repetitive and extreme movements** performed continuously without sufficient rest or stretching, increasing the risk of muscle injuries and work fatigue.
4. **Use of non-ergonomic tools**, such as the hook-T, which applies direct pressure to the hands and wrists, potentially worsening lower arm muscle strain.
5. **Uneven or unstable working surfaces** commonly found in plantation areas, which hinder workers from maintaining proper posture and balance during tasks.

Consequences of High-Risk Work Movements Include:

- **Muscle soreness** in the neck, back, shoulders, arms, or waist.
- **Soft tissue injuries**, such as sprains, muscle strains, or even joint inflammation.
- **Long-term risks** of serious injuries, such as spinal damage or bone fractures, especially if no changes are made to work methods and environmental conditions.

5. CONCLUSION

Based on the analysis of the Nordic Body Map (NBM) questionnaires distributed to four respondents working as fresh fruit bunch (FFB) loaders in a palm oil plantation, it was found that the most frequently reported musculoskeletal complaints were located in the back, neck, upper arms, forearms, wrists, and legs. The reported discomfort ranged from mild to moderate pain, indicating significant physical stress on the workers' musculoskeletal systems.

Further analysis using the Rapid Entire Body Assessment (REBA) method revealed that all respondents had final scores ranging from 8 to 9, which fall into the high-risk category and necessitate immediate corrective actions.

These findings indicate that the FFB loading activity in Afdeling 6 of PT. XYZ poses a considerable risk of musculoskeletal disorders due to non-ergonomic working postures, heavy physical workload, and insufficient opportunities for muscle relaxation. Therefore, improvements in work methods, the adoption of ergonomic assistive tools, and better management of workload and work-rest cycles are essential to reduce the risk of musculoskeletal complaints and to enhance both worker safety and productivity.

6. Recommendations

This study recommends the immediate improvement of working postures during palm oil fruit loading activities, the implementation of ergonomic assistive tools, and the provision of regular health check-ups for workers.

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