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Article

Analysis of Employee Work Posture at Sorting and Boiler Stations of PT Mitra Bumi Using the OWAS Method

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ABSTRACT

Activities at sorting stations and boilers are high risk activities. Incorrect body posture, done repeatedly and relying on manual human power causes musculoskeletal disorders (MSDS). This research aims to analyze MSDs disturbances in body parts of workers at sorting stations and boilers using the Ovako work posture analysis system (OWAS) method. OWAS can identify four body parts in a worker's posture, namely the back, upper arms, legs and weight category. Based on the results of the OWAS assessment, a score of 4144 was obtained at the sorting station, and 4141 at the boiler station. Both scores are in category 4, which means improvements need to be made as soon as possible. The injury risk index reached a value of 400 for both stations, indicating a very high level of danger.

Keywords

MSDS

OWAS

Body Posture

Sorting Station

Boiler Station

1. BACKGROUND

1.1 Introduction

Ergonomics is a systematic branch of science to utilize information about human nature, abilities and limitations to design a system so that humans can live and work in that system well, and achieve the desired goals through that work, effectively, safely and comfortably (Pramestari, 2018). Ergonomic products will adjust to the needs of the community and cannot be separated (Kumalasariresi, 2021). The application of ergonomics in work is intended for the safety and comfort of the body. So that workers can work calmly without any musculoskeletal disorders (MSDS).

MSDs are injuries to muscles, nerves, tendons, ligaments, joints, cartilage, and intervertebral discs. Muscle injuries can be in the form of muscle tension, inflammation, and degeneration. Meanwhile, bone injuries can be in the form of bruises, microfractures, fractures, or bent bones. (MSDs) are disorders that affect the normal function of the musculoskeletal system involving nerves, tendons, and muscles (Gunawan, 2022). MSDs can occur due to two causes, namely constant injury and fatigue caused by the frequency and long duration of muscles in lifting activities and sudden injuries caused by heavy activities or unpredictable movements (Suharyanto, 2018).

PT. Mitra Bumi is a limited liability company (PT) engaged in the field of receiving Fresh Fruit Bunches (FFB) of Oil Palm which are then processed into Crude Palm Oil (CPO) and Palm Kernel (PK). In its operations, PT. Mitra Bumi has several production stations, namely sorting stations, sterilizer stations, thersing stations, press stations, clarification stations, kernel stations, and boiler stations. Based on the results of interviews with the production team at PT Mitra Bumi's PKS, the sorting and boiler stations are the stations that use the most human labor during the work process. Workers at both stations are at risk of experiencing MSDS disorders.



Figure 1 Working posture at the sorting station

Figure 1 shows the TBS sorting process carried out by sorting workers. In the picture, a worker is seen lifting TBS using a tool commonly called a *tojok*. During the sorting process, workers work in a standing position supported by their knees, their bodies slightly bent which causes pain in the leg and arm muscles. They also lift TBS weighing between 20 kg and 30 kg.



Figure 2 Workers at the boiler station

Figure 2 shows the process of removing scale at the boiler station. In the picture, a worker is seen pulling the TBS boiler stick using an aid. The scale pulling activity is carried out with the help of a boiler stick with a bent working posture, and the head tilted to the side, which can cause pain in the neck and shoulders and affect worker performance. Therefore, it is necessary to analyze the posture of the whole body while working. Then calculated using the Ovako Working Analysis System (OWAS) method by determining the hazard score for the worker's body.

1.2 Research Purposes

This study aims to analyze MSDs disorders in body parts at sorting and boiler stations.

2. LITERATURE REVIEW

2.1 Musculoskeletal Disorders(MSDS)

According to the National Institute of Occupational Safety and Health (NIOSH) and the World Health Organization (WHO), musculoskeletal disorders (MSDs) are disorders that cause a person to perform work activities that can affect working conditions and significant work that affects the normal function of the musculoskeletal system involving nerves, tendons, and muscles. Complaints that occur in the musculoskeletal system are in muscle locations, the body that

felt by someone, the complaint can start from a mild pain complaint. Factors causing complaints in the musculoskeletal system include repetitive activities, muscle stretching, combination causes, secondary causes such as vibration, differences in body temperature or microclimate, and pressure.

2.2 Work Posture

Work posture is the body's attitude when working. Different work postures will produce different strengths. When working, the posture is designed to occur naturally so that it can reduce the occurrence of musculoskeletal injuries Malik (2021). Comfort is achieved when workers do the appropriate and comfortable work posture. In doing a job, an efficient and effective work posture in doing work, standing, squatting, sitting and others must be considering its ergonomics. (Gunawan, 2022). According to Malik (2021), there is a classification of body part attitudes that need to be observed for analysis and evaluation, namely:

1. Back posture

- Upright
- Bend forward or backward
- Turn and move sideways
- Rotate and move or bend sideways and forward.



Figure 3 back posture

Source: Santosa (2018)

2. Arm Posture

- Both hands are under the shoulders
- One arm is above the shoulder
- Both hands are on the shoulders



Figure 4 Arm position

Source: Santosa (2018)

3. Foot Posture

- Sit
- Stand with both legs straight
- Stand with the weight on one foot
- Stand with both knees bent

- Stand on one leg with the knee bent
- Squat on one or two legs
- Move or relocate



Figure 5 Foot position

Source: Santosa (2018)

4. Load Weight

- Load weight is less than 10 Kg ($W = 10 \text{ Kg}$)
- Load weight is 10 Kg – 20 Kg ($10 \text{ Kg} < W = 20 \text{ Kg}$)
- Load weight is greater than 20 Kg ($W > 20 \text{ Kg}$)

2.3 Ovako Work Analysis System (OWAA) Method

The Ovako Work Analysis System (OWAS) method is a method used to assess body posture while working. This method was first introduced by a writer from Osmo Karhu Finland, in 1977 with the title "Correcting working posture in industry: A practical method for analysis" which was published in the journal "Applied Ergonomics". This method was initially intended to study a job in the steel industry in Finland, where finally ergonomists, and authors were able to draw a valid conclusion and introduce this method widely and named it the OWAS method (Santosa, 2018).

According to Tarwaka quoted by Suharto, this method allows for identification in several positions, namely the back, arms and legs by assigning codes to each position. However, this method does not assess in detail the severity of each position. For example, this method identifies whether workers are working with their knees bent or not, but does not distinguish between different levels of flexion (Santosa, 2018).

Table 1 OWAS Work Posture Analysis Assessment

Back	Arms	1			2			3			4			5			6						Legs	Use of Force
		1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3		
1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	1	1	1	1	1	1		
	2	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	1	1	1	1	1	1		
	3	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	1	1	1	1	1	1		
2	1	2	2	3	2	2	3	2	2	3	3	3	3	3	3	3	2	2	2	2	3	3		
	2	2	2	3	2	2	3	2	3	3	3	4	4	3	4	4	3	3	4	2	3	4		
	3	3	3	4	2	2	3	3	3	3	3	4	4	4	4	4	4	4	4	2	3	4		
3	1	1	1	1	1	1	1	1	1	2	3	3	3	4	4	4	1	1	1	1	1	1		
	2	2	2	3	1	1	1	1	1	2	4	4	4	4	4	4	3	3	3	1	1	1		
	3	2	2	3	1	1	1	2	3	3	4	4	4	4	4	4	4	4	4	1	1	1		
4	1	2	3	3	2	2	3	2	2	3	4	4	4	4	4	4	4	4	4	2	3	4		
	2	3	3	4	2	3	4	3	3	4	4	4	4	4	4	4	4	4	4	2	3	4		
	3	4	4	4	2	3	4	3	3	4	4	4	4	4	4	4	4	4	4	2	3	4		

Source: (Hikmah, 2018)

Source (Hikmah, 2018)

Information:

- a. Back (green) = Back position, divided into 4 categories,
 1. Upright
 2. Bend forward or backward
 3. Turn and move sideways
 4. Rotate and move or bend sideways and forwards
- b. Arms (blue) = Arm position is divided into 3 category
 1. Both hands are under the shoulders
 2. One arm is above the shoulder
 3. Both hands are on the shoulders
- c. Legs (yellow) = Leg stance, divided into 7 categories
 1. Sit
 2. Stand with both legs straight
 3. Stand with the weight on one foot
 4. Stand with both knees bent
 5. Stand on one leg with the knee bent
 6. Squat on one or two legs
 7. Move or relocate
- d. Use of force (grey) = Weight of load
 1. Less than 10 Kg
 2. Load weight 10 Kg – 20 Kg
 3. Greater than 20 Kg

The results of the OWAS work posture analysis consist of four levels of work posture scales that are dangerous for workers. After obtaining a code based on the assessment of the observed body posture classification, the code is then entered into the OWAS work posture analysis table to obtain a category for each work posture (Pramestari, 2018).

This study aims to analyze the level of risk of musculoskeletal disorders experienced by workers at the sorting and boiler stations at PT Mitra Bumi, so that the OWAS method is the right method to use. From the analysis of this method, it will be seen which postures in work activities need to be improved..

3. METHODOLOGY

The research method is the basis for determining that the research results do not deviate from the research objectives that have been set. This type of research is a quantitative descriptive study that contains a mathematical and clear description of the work posture that occurs in employees at the sorting and boiler stations. The work posture is then analyzed using the OWAS method. The OWAS method is a method used to assess body posture while working. OWAS identifies four body postures at work, namely the back, arms, legs and weight of the load and then groups them into certain categories (needs improvement, does not need improvement, needs improvement as soon as possible and repairs now). So through this method, researchers can analyze body positions at work that are considered inappropriate and at risk of suffering from MSDs.

More detailed research steps can be seen in Figure 6 below.

Table 2 OWAS Assessment Categories

Category Value	Category Action
1	No repairs needed
2	Needs to be improved
3	Improvements need to be made as soon as possible
4	Fixes need to be made now

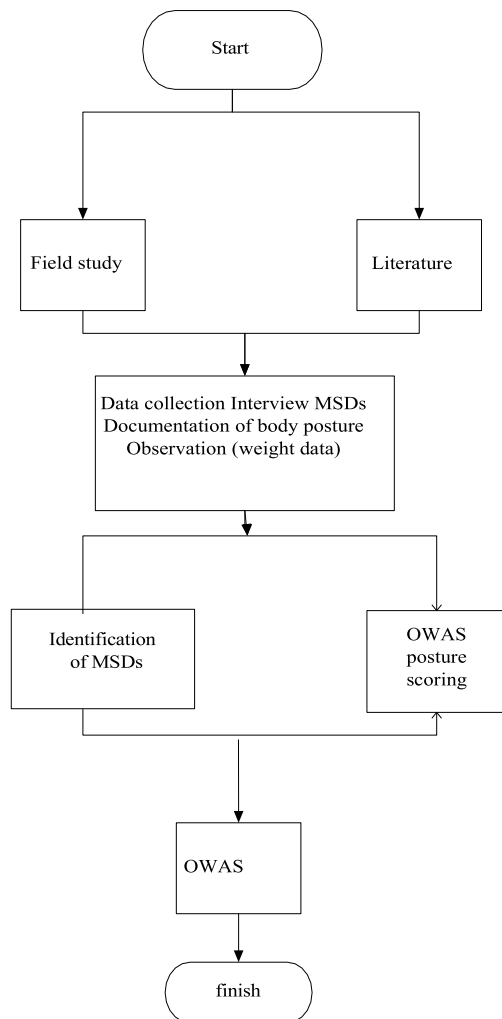


Figure 6 Flow chart

Field study is the first step to start the research. Field study aims to find out the real condition of the company, and to obtain information about everything related to this research. PT. Mitra Bumi is a company that processes palm oil from raw materials to CPO. Complaints at PT. Mitra Bumi are that workers move materials manually, thus indicating that manual activities carried out by PT. Mitra Bumi workers cause discomfort and have a risk of injury to the musculoskeletal system.

Literature study is needed to find the theoretical basis of research and to increase knowledge about the methods that will be used during the research. Formulation of theoretical framework through literature study that supports this research both from

books, journals, articles and other sources.

The data collection stage is carried out to collect data needed for research. This stage is the initial step in the OWAS methodology. Data collection is carried out through interviews, direct observation, and research documentation.

- a. Interviews were conducted to obtain primary data through questions and answers to workers in the company. Through interviews, researchers can obtain information on complaints felt by workers at the sorting and boiler stations.
- b. Direct observation functions to directly observe the weight of the load lifted by the worker.
- c. Documentation is done with a camera that is useful for obtaining documents in the form of images of worker postures during the sorting and boiler process. Collecting worker posture data using video or photo assistance. Taking pictures is intended to get a real picture of the work posture in the field in real terms. To get a picture of the worker's attitude (posture) from the neck, back, arms, wrists to feet in detail. This is done so that researchers get detailed (valid) body posture data, so that from the recording results and photo results, accurate data can be obtained for the next analysis stage. The camera used in this study is a camera owned by a smartphone with a camera resolution 13 megapixels. The resulting image can show the overall work posture regarding the aspects to be assessed

Based on the data obtained through several data collection steps, the next stage is to identify MSDS complaints felt by workers. Based on these complaints, a score and analysis of the risk level of musculoskeletal disorders experienced by workers at the sorting and boiler stations at PT Mitra Bumi are then carried out using the OWAS method.

4. Results and Discussion

4.1 Work Posture Assessment at Sorting Station

The Posture Coding Process is the process of translating work postures from recording results according to work postures according to classification 4 body parts. The classification includes the posture of the back, arms, legs and weight of the load. The OWAS assessment is intended to determine the work posture carried out by workers in accordance with the assessment system that has been determined and is based on images that have been taken by photography.

Table 3 OWAS Assessment of Fresh Fruit Bunch Sorting Workers

Back	Arms	1			2			3			4			5			6			7			Legs
		1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	Load weight
1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	1	1	1	1	1	1	
	2	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	1	1	1	1	1	1	
	3	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	1	1	1	1	1	1	
2	1	2	2	3	2	2	3	2	2	3	3	3	3	3	3	3	2	2	2	2	3	3	
	2	2	2	3	2	2	3	2	3	3	3	4	4	3	4	4	3	3	4	2	3	4	
	3	3	3	4	2	2	3	3	3	3	3	4	4	4	4	4	4	4	4	2	3	4	
3	1	1	1	1	1	1	1	1	1	2	3	3	3	4	4	4	1	1	1	1	1	1	
	2	2	2	3	1	1	1	1	1	2	4	4	4	4	4	4	3	3	3	1	1	1	
	3	2	2	3	1	1	1	2	3	3	4	4	4	4	4	4	4	4	4	1	1	1	
4	1	2	3	3	2	2	3	2	2	3	4	4	4	4	4	4	4	4	4	2	3	4	
	2	3	3	4	2	3	4	3	3	4	4	4	4	4	4	4	4	4	4	2	3	4	
	3	4	4	4	2	3	4	3	3	4	4	4	4	4	4	4	4	4	4	2	3	4	

The worker's back posture is bent, moving sideways and forwards so that it is given a score of 4. The worker's arm posture is at a level below the shoulder so that it is given a score of 1. The leg posture is standing and resting on both feet with bent knees so that it is given a score of 4. And the weight of the load lifted by the worker is more than 20 kg,

so that it is given a score of 3. Based on the work posture analysis in table 1, the combination of OWAS assessments with a score of 4143 is obtained in category 4. This category is very dangerous for the MSDS system (this work posture results in a clear risk of injury) so that immediate or immediate repairs are required.

4.2 Work Posture Assessment of Boiler Station Workers

Table 4 OWAS Assessment of Boiler Workers

Back	Arms	1			2			3			4			5			6			7			Legs
		1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	Load weight
1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	1	1	1	1	1	1	
	2	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	1	1	1	1	1	1	
	3	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	1	1	1	1	1	1	
2	1	2	2	3	2	2	3	2	2	3	3	3	3	3	3	3	2	2	2	2	3	3	
	2	2	2	3	2	2	3	2	3	3	3	4	4	3	4	4	3	3	4	2	3	4	
	3	3	3	4	2	2	3	3	3	3	3	4	4	4	4	4	4	4	4	2	3	4	
3	1	1	1	1	1	1	1	1	1	2	3	3	3	4	4	4	1	1	1	1	1	1	
	2	2	2	3	1	1	1	1	1	2	4	4	4	4	4	4	3	3	3	1	1	1	
	3	2	2	3	1	1	1	2	3	3	4	4	4	4	4	4	4	4	4	1	1	1	
4	1	2	3	3	2	2	3	2	2	3	4	4	4	4	4	4	4	4	4	2	3	4	
	2	3	3	4	2	3	4	3	3	4	4	4	4	4	4	4	4	4	4	2	3	4	
	3	4	4	4	2	3	4	3	3	4	4	4	4	4	4	4	4	4	4	2	3	4	

Table 4 shows the assessment of work posture based on OWAS at the boiler station. Posture

The worker's back is bent, moving backwards and forwards so it is given a score of 4. The arm position on

The worker is at a level below the shoulder so it is given a score of 1. The standing position and supporting both feet with bent knees so it is given a score of 4. And the weight of the load lifted by the worker is less than 10 kg, so it is given a score of 1. Based on the analysis of the boiler station work posture, a combination of OWAS assessments with a score of 4141 is obtained in category 4. This category is very dangerous for the MSDS system (this work posture results in a clear risk of injury) so that immediate or immediate repairs are needed.

4.3 Risk index assessment based on OWAS analysis

The calculation of the injury risk index is generated based on the frequency level of each action category from the observation results.

Table 5 Risk Index

Activity	OWAS Combination	Category
TBS Sorting	4143	4
Scale removal at boiler station	4141	4

OWAS assessment of both activities at the sorting and boiler stations is in category 4. The following is the calculation of the overall risk index at the sorting and boiler stations at PT Mitra Bumi:

$$\begin{aligned} \text{Index} &= [(0 \times 1) + (0 \times 2) + (0 \times 3) + (1 \times 4)] \times 100 \\ &= (0 + 0 + 0 + 4) \times 100 \\ &= 400 \end{aligned}$$

The risk index value is divided into several categories from small with a score of 100-175, medium category with a score of 176-250, high category with a score of 256-325 and very high category with a score of 326-400. The risk index results at the two stations are 400, it is known that it is included in the very high category level, meaning that improvements are needed at the sorting and boiler stations.

5. CONCLUSION

Based on the results of the analysis using the ovako work analysis system method, it can be concluded that work at the sorting and boiler stations is an activity that is high risk for musculoskeletal disorders (MSDS). The results of the analysis and data processing at the sorting station, obtained a combination of OWAS assessments with a score of 4143 in category 4. This category is very dangerous for the MSDS system, this work posture results in a clear risk of injury. Employees work with a standing position supporting both feet and bent knees, arm position below the shoulders, back position bent, moving sideways and forward, and the weight of the load lifted by workers is more than 20 Kg.

Meanwhile, the results of data analysis and processing at the boiler station, obtained a combination of OWAS assessments with a score of 4141 in category 4, so this work is also very dangerous for the MSDS system and has a clear risk of injury. The arm position of the worker is at a level below the shoulder, the worker's back position is bent, moving back and forth, the leg position is standing and resting on both feet with bent knees, and the weight of the load lifted by the worker is less than 10 Kg.

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