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Original Paper

Analysis of Work Posture in Rice Processing Unit to Reduce Risk of Musculoskeletal Disorders: A Case of Indonesia

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Abstract*— This modern milling facility, called the Modern Rice Milling Plant (MRMP), operates in the field of logistics or warehousing and consists of seven production processes: raw material reception, drying process, storage (silo), milling, sorting, packaging, and stock handling. Musculoskeletal disorders (MSDs) are among the most common health problems directly associated with working conditions. This study aims to analyze workers' posture by evaluating working postures during the rice processing activities at MRMP Bulog in Jember Regency, to identify workers' Musculoskeletal Disorders (MSDs) complaints during the rice processing process at MRMP Bulog Jember, and to provide posture recommendations to reduce the risk of high-risk MSD-related injuries during rice processing activities at MRMP Bulog Jember. This research was conducted from April to June 2025. The sample consisted of 5 individuals from the raw material reception and rice transportation to the truck sections, which are part of the rice processing population. The final OWAS score at the raw material reception stage (P1 and P2) was 3, indicating that improvements must be made as soon as possible. Similarly, during the rice transportation to the distribution truck (P3, P4, and P5), the OWAS final score was also 3, meaning that improvements are urgently needed to prevent work-related accidents. Therefore, the current method and tools used during the raw material reception stage pose a high risk to workers' bodies, and immediate improvements are necessary. The recommended tool is a long, pointed iron rod used to pierce or unload wet paddy sacks. This tool is suggested to facilitate the workers in performing their tasks and to minimize the occurrence of accidents or Musculoskeletal Disorders (MSDs).

Keywords*— MSDs, rice milling, work posture, OWAS, NBM

I. INTRODUCTION

Increasingly fierce industrial competition requires companies, including state-owned enterprises, to continue to develop, especially in terms of human resources (HR). The physical condition of workers greatly affects productivity, but ergonomic aspects are often overlooked, leading to complaints and health risks. It is important to note that the main factor in improving a company is human resources (HR), because workers in good physical condition can perform their jobs optimally. According to [1], companies must be aware of the sources of hazards that pose a risk to the comfort and health of workers. One of the most common occupational health problems is Musculoskeletal Disorders (MSDs). Musculoskeletal disorders (MSDs) are one of the health problems most often directly associated with working conditions. According to [2], musculoskeletal disorders encompass the nervous system, tendons, muscles, and supporting structures of the body that can cause pain and disorders in the neck, shoulders, arms, hands, back, and legs. MSDs generally do not occur directly but rather as a result of the accumulation of minor and major injuries over a long period of time caused by lifting heavy loads at work, resulting in injuries ranging from pain and soreness to stiffness in the limbs [3].

The industry selected as the research subject for work posture analysis is the Modern Rice Milling Plant (MRMP) Bulog Jember, a modern rice milling facility that has been operating since 2023. There are 15 workers at MRMP Bulog. The operational system has an 8-hour workday or more, depending on consumer demand, starting from 8:00 a.m. to 4:00 p.m. Western Indonesia Time from Monday to Friday. Of the seven stages of production, two processes are still done manually, namely the receipt of raw materials and the transportation of rice to distribution trucks. These manual activities cause complaints of pain in the workers' backs, shoulders, hands, and necks. This study uses the OWAS (Ovako Working Posture Analysis System) method, which is a method that provides output in the form of categories of work postures that are risky for work accidents in the musculoskeletal area [4]. According to [5], the advantage of the OWAS method is that it can help identify high-risk work postures caused by musculoskeletal injuries, so that preventive measures can be taken to improve work posture and reduce the risk of injury. The application of the OWAS method in this study is expected to provide accurate data to reduce the risk of MSDs. By using the OWAS method in the analysis of work posture in rice processing activities, it is possible to systematically evaluate and provide specific directions for improving work posture, thereby minimizing the risk of Musculoskeletal Disorders.

Initial interviews conducted with manual production workers identified several variables related to musculoskeletal disorder (MSD) complaints. The load lifted was 5 kg to 25 kg or

depending on consumer demand. The percentage of complaints of lower neck pain, right shoulder pain, left shoulder pain, upper neck pain, and back pain was most frequently experienced by workers with work positions in the raw material reception and transportation (stock) to distribution trucks. This is also included in study [6], which explains that if complaints that occur over a long period of time are left unaddressed, they can increase the risk of Musculoskeletal Disorders (MSDs). As a result, this condition can have an impact on the rice production process. The Nordic Body Map (NBM) questionnaire was used to measure the level of worker complaints. The combination of these two methods is expected to provide a comprehensive picture of workers' work posture and health conditions, so that improvements can be proposed in the form of applying ergonomic principles, using assistive devices, and redesigning work facilities. These improvements are expected to increase worker comfort, safety, and productivity, while reducing the risk of Musculoskeletal Disorders (MSDs) in work activities at MRMP Bulog Jember.

Therefore, the researchers chose the process of receiving raw materials and transporting rice to distribution trucks as the object of their research. The research on the receiving and transportation processes used the upper body, so this study used the OWAS method to analyze workers' posture conditions by evaluating work posture in the rice processing process at MRMP Bulog Jember. Identifying the risk level of MSDs for workers in the rice process at MRMP Bulog in Jember, and providing a recommendation for the workers' body posture to reduce the risk of MSDs for workers who are at high risk in the rice processing process.

II. Research Methodology

A. Time and Place

This research was conducted at the Bulog Jember Modern Rice Milling Plant (MRMP), Puger District, Jember Regency, East Java, from April to June 2025. Data processing was carried out at the Agricultural Industry Technology Study Program, Agricultural Technology Facility, University of Jember. Five workers involved in the raw material reception and rice loading onto distribution trucks were used as respondents.

B. Tools and Materials

The tools used included laptops, cameras/mobile phones, paper, and pens to record all work activities so that the workers' postures while performing their work activities could be observed, Microsoft Excel for processing numbers, and Ergofellow software for OWAS analysis of each question in the Nordic Body Map (NBM) questionnaire. The materials used in this study were primary and secondary data. Primary data was obtained from observations, interviews, and direct measurements of workers. Meanwhile, secondary data was obtained from various literature studies, company profiles, the number of workers, and data on work accidents that the company had previously experienced.

C. Research Work Diagram

Based on Figure 1, the study began with conducting a survey and literature review, followed by identifying problems, then interviewing MRMP Bulog Jember workers regarding their work posture and MSD complaints during raw material reception and rice transportation to distribution trucks, distributing NBM questionnaires, recording work posture, and calculating the weight of the load carried by workers. The next stage of data collection involved identifying MSD complaints using the NBM questionnaire, followed by assigning work posture scores at the Bulog Jember MRMP rice receiving and transportation section. After, the data processing stage was carried out by analyzing the results of the NBM questionnaire and continuing to determine the risk level in raw material reception and rice transportation to distribution trucks using the OWAS method. Then, the high risk level and recommendations for tool design to reduce the risk of MSDs injuries for workers were determined.

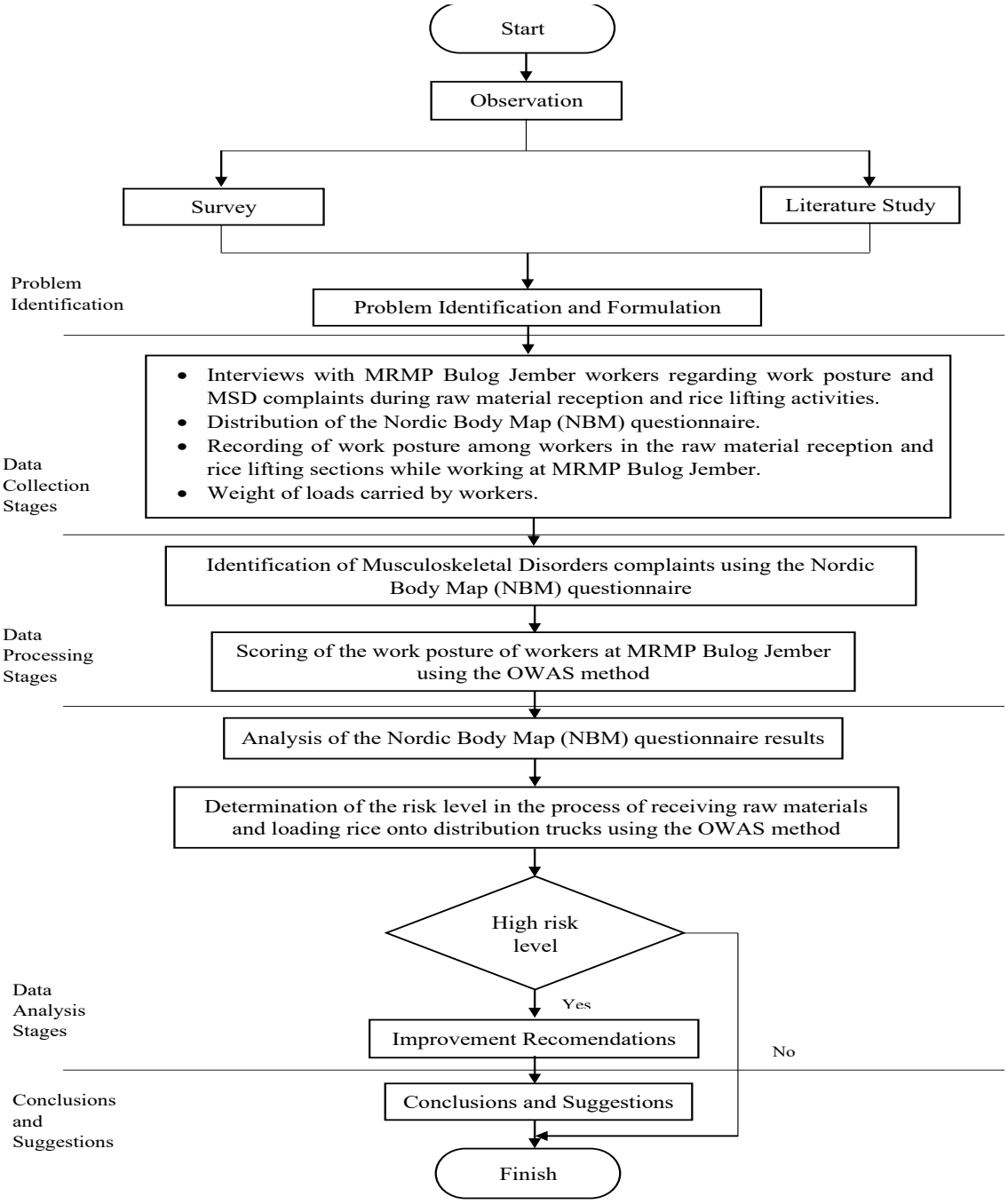


Fig. 1. Research work diagram

III. Results And Discussion

A. Respondent Characteristics

In this study, data collection was conducted by distributing the Nordic Body Map (NBM) questionnaire to workers at MRMP Bulog Jember in the raw material reception section (2 people) and the rice transportation to distribution trucks section (3 people). The following are the names and data of the respondents:

TABLE I. Respondents

No.	Name	Gender	Age (years)	Division
1.	Wiwit	man	43	Receiving of Raw material
2.	Kodir	man	35	Receiving of Raw material
3.	Giatno	man	61	Loading
4.	Suwandi	man	40	Loading
5.	Hendra	man	39	Loading

Source : Data (2025)

Based on respondent data, all workers at MRMP Bulog Jember are male with an average length of service of 3 years since the factory was established. Two workers are assigned to the raw material reception section, while the other three workers are assigned to transport rice to distribution trucks. Work activities in both sections are physically demanding. During the raw material reception stage, workers must repeatedly unload 50 kg sacks of grain using long iron rods to pierce the sacks. Meanwhile, during the transportation of rice to distribution trucks, workers also manually lift sacks of rice with similar weights. These activities pose a high risk of Musculoskeletal Disorders (MSDs) due to non-ergonomic body positions and repetitive workloads. In addition to workload factors, it was also found that all workers were active smokers. This habit contributes to a decrease in lung capacity, thereby reducing oxygen levels in the body. This condition has an impact on decreased physical fitness, increased fatigue, and inhibited energy metabolism due to the accumulation of lactic acid in the muscles. As a result, workers are more prone to muscle pain and MSDs, especially in the back. The results of this study are in line with previous findings [7] which state that there is a significant relationship between smoking habits and back muscle complaints. Therefore, workers' lifestyle factors also influence the risk of MSDs in addition to ergonomic aspects in the work process.

B. Questionnaire results

The rice milling production process at MRMP Bulog Jember begins at 7:30 a.m. Data collection for the questionnaire was conducted at 8:00 a.m. while activities were underway, after which the average NBM scores were calculated as shown in Table II.

Based on the Nordic Body Map (NBM) questionnaire administered to five workers at MRMP Bulog Jember, twelve body parts were found to have the highest complaint scores, namely the upper neck (20), lower neck (20), left shoulder (20), right shoulder (20), left upper arm (19), back (20), right upper arm (20), waist (20), left hand (20), right hand (20), left leg (19), and right leg (19). These complaints indicate that workers often experience pain in the main areas of the musculoskeletal system. Field observations of two workers in the raw material reception section and three workers in the manual rice transportation section revealed that repetitive workloads and non-ergonomic postures were the main factors causing the complaints. Repetitive activities with static positions and heavy loads cause muscle tension and increase the risk of musculoskeletal disorders (MSDs), especially in the neck, shoulders, arms, back, waist, hands, and feet. In line with the findings [8], long-term repetitive work activities can cause muscle and tendon fatigue, pain, and even the risk of serious injury. Therefore, improvements to work facilities, such as providing tools to assist in unloading raw materials and adjusting workers' postures ergonomically, are important to minimize the risk of MSDs and improve work safety.

TABLE II. NBM QUESTIONNAIRE DATA COLLECTION RESULTS

NO	Types of complaints	Level of complaints (workers)					Score
		P1	P2	P3	P4	P5	
1	Pain in the upper neck	4	4	4	4	4	20
2	Pain in the lower neck	4	4	4	4	4	20
3	Pain in the left shoulder	4	4	4	4	4	20
4	Pain in the right shoulder	4	4	4	4	4	20
5	Pain in the left upper arm	3	4	4	4	4	19
6	Back pain	4	4	4	4	4	20
7	Pain in the right upper arm	4	4	4	4	4	20
8	Lower back pain	4	4	4	4	4	20
9	Buttock pain	4	3	4	3	3	17
10	Pain in the left elbow	3	3	4	4	3	17
11	Pain in the right elbow	3	3	4	4	3	17
12	Pain in the left forearm	4	3	4	4	3	18
13	Pain in the right forearm	4	3	4	4	3	18
14	Pain in the left wrist	3	3	3	4	4	17
15	Pain in the right wrist	3	3	3	4	4	17
16	Pain in the left hand	4	4	4	4	4	20
17	Pain in the right hand	4	4	4	4	4	20
18	Pain in the left thigh	3	4	4	4	3	18
19	Pain in the right thigh	3	4	4	4	3	18
20	Pain in the left knee	4	3	4	3	3	17
21	Pain in the right knee	4	3	4	3	3	17
22	Pain in the left calf	3	3	4	4	3	17
23	Pain in the right calf	3	3	4	4	3	17
24	Pain in the left ankle	3	3	4	3	3	16
25	Pain in the right ankle	3	3	4	3	3	16
26	Pain in the left leg	3	4	4	4	4	19
27	Pain in the right leg	3	4	4	4	4	19
Individual Score		95	95	106	103	95	494
Average NBM		98,80					

Source : Data (2025)

Based on the Nordic Body Map (NBM) questionnaire administered to five workers at MRMP Bulog Jember, twelve body parts were found to have the highest complaint scores, namely the upper neck (20), lower neck (20), left shoulder (20), right shoulder (20), left upper arm (19), back (20), right upper arm (20), waist (20), left hand (20), right hand (20), left leg (19), and right leg (19). These complaints indicate that workers often experience pain in the main areas of the musculoskeletal system. Field observations of two workers in the raw material reception section and three workers in the manual rice transportation section revealed that repetitive workloads and non-ergonomic postures were the main factors causing the complaints. Repetitive activities with static positions and heavy loads cause muscle tension and increase the risk of musculoskeletal disorders (MSDs), especially in the neck, shoulders, arms, back, waist, hands, and feet. In line with the findings [8], long-term repetitive work activities can cause muscle and tendon fatigue, pain, and even the risk of serious injury. Therefore, improvements to work facilities, such as providing tools to assist in unloading raw materials and adjusting workers' postures ergonomically, are important to minimize the risk of MSDs and improve work safety.

1) COWAS assessment results

The overall assessment results of work posture using the Ovako Work Analysis System (OWAS) method can be seen in Table 4.31, which shows the following work risk measurements:

TABLE III. OWAS ASSESSMENT RESULTS ON WORK ACTIVITIES IN THE RAW MATERIAL RECEIVING AND RICE TRANSPORTATION TO DISTRIBUTION TRUCKS SECTION

No.	Work Process Variable	Skor				
		P1	P2	P3	P4	P5
1	Back	2	2	4	4	4
2	Arm	1	1	3	2	2
3	Leg	4	4	7	7	7
4	Load	2	2	2	2	2
OWAS final score		3	3	3	3	3

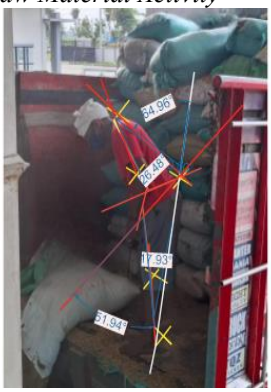
Source : Data (2025)

Based on Table 4.31 above, it can be seen that the final OWAS score at the raw material reception stage (P1) and (P2) is 3, which means that improvements are needed as soon as possible. At the stage of transporting rice to distribution trucks (P3), (P4), and (P5), the final OWAS score is 3, which indicates that improvements are needed as soon as possible to prevent work accidents. Therefore, based on the table above, work activities in raw material reception and rice transportation to distribution trucks need to be improved as soon as possible to prevent the risk of Musculoskeletal Disorders (MSDs). This is because the workers' posture is not ergonomic, so it needs to be improved as soon as possible. In this study, the method used to measure work posture was the OWAS (Ovako Working Posture Analysis System) method.

According to [9], the advantage of the OWAS method is that it can analyze the posture of all major body parts, such as the back, arms, legs, and the load being lifted, whether in a sitting or standing position. This makes OWAS superior in providing a comprehensive overview of risks, not limited to the upper body only. The OWAS method also allows for quick identification of work postures that can cause accidents or musculoskeletal disorders, so that corrective actions can be taken immediately if high risks are found. High potential hazards lie in the factors of the workplace and human facilities, so preventive measures need to be taken by designing work facilities that are suitable for the human body posture and workload to prevent accidents and illnesses caused by improper work posture [10]. This can be achieved through a clear scoring system and categories of action, ranging from categories that do not require improvement to those requiring immediate corrective measures. This facilitates the prioritization of work posture improvements.

From seven work activities, two were found to be hazardous to the musculoskeletal system or high risk, requiring immediate improvement.

2) Receiving Raw Material Activity



From the image above, it can be seen that the OWAS score for raw material receiving activities is as follows.

TABLE IV. SCORE LEVEL OF ACTIVITY

Activity	Receiving raw material
OWAS	3
Description	Category 3 : This movement dangerous to MSDs and requires immediate improvement.

Source : Data (2025)

3) Raw Material Receiving Activity

From the image above, it can be seen that the OWAS score for raw material receiving activities is as follows.

TABLE V. SCORE LEVEL OF ACTIVITY

Activity	Receiving raw material
OWAS	3
Description	Category 3 : This movement dangerous to MSDs and requires immediate improvement.

Source : Data (2025)

4) Transporting Rice to Distribution Trucks

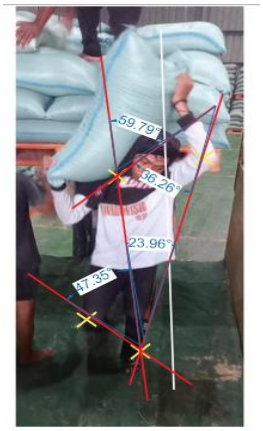
From the image above, it can be seen that the OWAS score for the activity of transporting rice to trucks is as follows.

TABLE VI. SCORE LEVEL OF ACTIVITY

Activity	Loading to truck for distribution
OWAS	3
Description	Category 3 : This movement dangerous to MSDs and requires immediate improvement.

Source : Data (2025)

5) Transporting Rice to Distribution Trucks



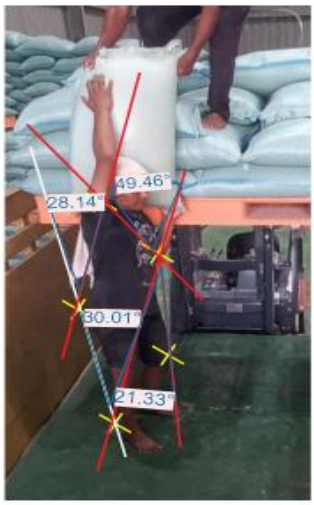
From the image above, it can be seen that the OWAS score for the activity of transporting rice to trucks is as follows.

TABLE VII. SCORE LEVEL OF ACTIVITY

Activity	Loading to truck for distribution
OWAS	3
Description	Category 3 : This movement dangerous to MSDs and requires immediate improvement

Source : Data (2025)

6) Loading of Rice to Distribution Trucks



From the image above, it can be seen that the OWAS score for the activity of transporting rice to trucks is as follows.

TABLE VIII. SCORE LEVEL OF ACTIVITY

Activity	Loading to truck for distribution
OWAS	3
Description	Category 3 : This movement dangerous to MSDs and requires immediate improvement

Source : Data (2025)

7) Recommendations for Improvement

The OWAS score obtained is 3, meaning that the current process of receiving raw materials using the tools currently in use poses a high risk to workers' bodies. Therefore, improvements need to be made as soon as possible to the tools, such as long, sharp metal tools used to pierce or open sacks containing wet grain that will soon be processed. This will improve time efficiency and reduce repetitive movements that can cause MSDs in workers.

Fig. 2. Posture Improvement for Raw Material Receiving Workers

The proposed improvement involves changing the tool from a short one to a tall one that is almost parallel to the position of the worker performing the activity. This long iron tool can ensure that the loading and unloading process runs smoothly without delay. According to [11], a standing work posture can change the regularity of work, so that working regularly can reduce static positions during long periods of work by moving flexibly between sitting and standing postures. The availability

of tools that are suitable for the type of load maximizes work effectiveness [12]. If muscles receive static loads repeatedly over a long period of time, it will cause complaints in the form of damage to joints, ligaments, and tendons. These complaints are commonly referred to as MSDs or musculoskeletal disorders [13]. Thus, this can reduce the risk of musculoskeletal disorders in workers in the raw material reception section.

8) Recommendations for Improving Work Posture in the Rice Transportation Process to Distribution Trucks

The OWAS score obtained was 3, meaning that the current work posture during the rice transportation process poses a high risk to workers' bodies. Therefore, it is necessary to improve body posture safely and apply more ergonomic work postures to reduce musculoskeletal disorders (MSDs).

Fig. 3. Posture Improvement for Raw Material Receiving Workers

Based on the results of research, the load lifted by workers is 50 kg. As a result, lower back pain is also caused by excess weight, long-term muscle and bone strain, causing permanent narrowing of the disc space and also causing degeneration of the spine. In addition, this is also caused by poor physical activity or incorrect posture, but the cause is incorrect positioning during activities [14]. This affects improper work posture over a long period of time, which can cause musculoskeletal disorders in the skeletal muscles, especially if it involves repetitive movements or certain positions such as bending, kneeling, and clenching the hands [15]. Working hours or duration are related to the length of time spent in awkward working postures, which causes strain on the lumbar region. The working hours that should be applied in the workplace are regulated in Law No. 13 of 2003 concerning Manpower [16]. Based on the literature, researchers found that lifting weights of 50 kg and performing repetitive activities 30 times caused workers to feel bored and tired, which could lead to musculoskeletal injuries, especially in the back, waist, hands, arms, and legs. These recommendations are made to increase worker productivity and minimize the risk of musculoskeletal disorders.

IV. CONCLUSIONS

Based on the results of the discussion of the research conducted at MRMP Bulog Jember, the following conclusions were drawn:

- Based on the results of the recapitulation of data processing on the types of complaints using the Nordic BodyMap (NBM) questionnaire, it is known that the average complaint after performing work is 3 (pain) and 4 (severe pain) in the following body parts: neck, left shoulder, right shoulder, back, waist, upper arm, lower arm, right hand, left hand, left foot, and right foot, as felt by workers in the raw material reception and rice transportation processes.
- Based on the results of calculations using the OWAS method, it was found that in the first stage of raw material reception, a category value of 3 was obtained with a category action of needing improvement as soon as possible, and in the stage of transporting rice to distribution trucks, a category value of 3 was obtained with a category action of needing improvement as soon as possible. These two processes pose the highest risk due to the risk of MSDs in workers.
- The recommendation given to minimize the risk of musculoskeletal disorders (MSDs) in high-risk work activities is to provide tools such as long, pointed iron rods to make it easier for workers to avoid bending over when receiving raw materials or unloading grain.

Based on the research conducted, the following recommendations can be made for further research: conducting a similar analysis with the implementation of new methods and measuring worker productivity levels.

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