Posture Analysis of Fish Transporting Workers at the Sadeng Beach Fish Auction Place

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Abstract

At the Fish Auction Place (TPI) of Sadeng Beach, Gunung Kidul, fish are manually transported using wooden bearers and pieces of plastic drums used as fish containers. The weight of the transported fish ranged from 90 - 110 kg for each transfer. The fish transport was carried out on the shoulders of two workers of different heights and ages. During fish transporting, the workers had awkward working postures. The worker's posture was characterized by flexion, inclination, and torsion. The Nordic Body Map (NBM) survey revealed reports of stiffness and pain in the shoulders, lower back, and knees. This study aims to evaluate the potential risk of injury in the process of fish transporting. The evaluation used the Rapid Entire Body Assessment (REBA) technique. The findings indicated that both workers' activities fell into the high-risk category, with a REBA score of 14.00, remarked with a very high-risk category. Immediate activity improvement is necessary for safety from injury risks.

Keywords: Fisherman, Fish Transfer Activity, Working Posture, REBA

I. INTRODUCTION

Sadeng is a district in Gunung Kidul Regency with a high potential for fishery resources [1]. The activities of fishermen in Sadeng Beach are very high, starting from preparing boats, capturing fish using fishnets, transporting catches, unloading catches, as well as fish buying and selling activities [2]. Like most fishermen's activities on the Indonesian coast, Sadeng Beach fishermen still use work facilities with the power source and control focused on the fishermen. The existing conditions require much physical energy, and there is a potential danger of musculoskeletal disorders that fishermen can experience. Fishing work is one of the jobs with a high potential for injury [3], [4] and a work sector with a high risk [5]. Based on the prevalence of musculoskeletal disorders in Indonesia, 11.9% are fishermen and farmers, while 31.2% are laborers, including laundry workers [6]. According to study results, those fishermen had disorders on the lower back, wrist, and upper back of both sides of their bodies [7].

When the boat docks at the pier, unloading or removing the fish caught from the hold is the fishermen's first activity. Fishermen, assisted by several helpers, perform the unloading altogether. After being removed from the hold, the fish are put in a drum-like container and then are brought to the outer floor of the fish auction before being weighed in the fish auction.

Two workers transported fish into the auction by shouldering the weights. The weight of transported fish in each container ranged between 90-100 kg. The weight range was obtained from the record of the fish auction employer during the weighing process. Figure 1 presents an image of transported fish in a container to be weighed. The amount of weight is far above the maximum lifting load limit set by the National

Institute for Occupational Safety and Health (NIOSH), which is 23 kg [8].

Figure 1. Fish in a transporting container (each container weighed 90-110kg)

Each activity was carried out without adequate planning in terms of equipment, workload, work area, and assignment division. Analysis related to Manual Material Handling (MMH) activities is part of a series of studies conducted on fishermen's activities on Sadeng Beach and is still under implementation.

This study focuses on analyzing work postures during unloading and transportation into the fish auction; those postures demonstrate awkward postures such as bending, twisting, bending, looking up, and other postures that potentially cause discomfort or injuries [9]. Based on the complaint survey results, two workers who were tasked with transporting fish to the fish auction experienced pain in their shoulders, lower backs, and knees. The description of the working conditions for unloading fish on Sadeng Beach demonstrates the potential for injury, in which awkward positions, static, repetition, and heavy loads are the risk factors for injury in material handling activities [10].

The work activities of unloading and transporting fish at Sadeng Beach had high repetition. One ship may load up to 3 tons of fish, causing the unloading process with containers containing 90-110 kg of fish to require workers to repeat the activity 11-30 times. The high number of repetitions of this work causes fatigue and complaints of discomfort in the workers' bodies [11].

II. LITERATURE REVIEW

Several studies have been conducted on fishermen's work activities both while working on ships/boats and at the docks. Prevalence studies have shown that fishermen experience hearing loss, upper limb disorders, and a higher risk of sleep apnea than the general population both before and during the fishing season [4]. Occupational factors include noise

exposure, upper limb demands of gillnetting, and long working hours, exacerbating chronic health conditions experienced [4].

Fishermen's work is often related to Manual Material Handling (MMH) activities involving heavy loads with minimal equipment. MMH activities in fishermen are suspected to be unsafe, as indicated by an increase in heart rate of 40.5% - 42.7%. Most fishermen's work activities have high risks, both from increased heart rate during the activity [3], increased averaged value of Electromyography (EMG) measurements [12], and a high-risk index on the checklist results of Occupational Repetitive Action (OCRA) [12].

In general, there are complaints felt by fishermen that describe work-related musculoskeletal disorders (WMSDs). Several fishermen's activities are often carried out in hunched positions [13]. Workers who work in a standing and bending position can cause musculoskeletal injuries and a tilted neck [14]. A hunched working posture must be corrected because it can cause high-risk effects if maintained [15], [16]. A previous study revealed a strong correlation between musculoskeletal disorders and a person's work posture, in which work posture is one of the dominant factors that correspond to MSD complaints [17]. All body elements, including neck, shoulders, upper arms, lower arms, torso, elbows, wrists, and feet, are correlated with MSD complaints [18]. Working with a hunched or bent posture for hours every day can significantly increase MSD symptoms [13].

III. METHODS

The study was conducted by analyzing the fishermen's work posture when unloading fishes that has been caught from the ship. Rapid Entire Body Assessment (REBA) was used as an approach to obtain a measure of the potential hazards of MSDs, as well as a categorization of recommended actions to be taken. REBA was conducted on a number of postures experienced by fishermen when placing the fish catch in the weighing area in the fish auction. Data collection for REBA analysis was conducted through videos that recorded worker activities. Based on the video recording analysis, the worker's postures to be analyzed further were then selected and determined.

The selected work postures were then used as material in the REBA calculation by analyzing the posture in two groups of body segments, namely group A (neck, trunk, legs) and group B (upper arm, lower arm, wrist). The results of the calculations for

groups A and B were then used to calculate the REBA score by considering the weight factors of the lifting load, coupling, and the work activities performed.

IV. RESULT AND DISCUSSION

A. Result

MSD data were collected using the Nordic Body Map (NBM) Questionnaire. The NBM questionnaire was given to two workers who were tasked with transporting the unloaded fish from the boat since they were the only people who were always tasked with transporting fish from the boat to the scales at the fish auction and then to the buyer's car. A summary of the workers' demographic data is shown in Table 1.

Table 1. Demographics of fish transporting workers

	Worker 1	**Worker 2**
Gender	Male	Male
Age	37 y.o.	56 y.o.
Race	Javanese	Javanese
Education	SMP	SR
Height	170 cm	153 cm
Body Weight	73 kg	53 kg

The questionnaire to explore the complaints felt by workers was filled out at the research location. In addition to providing information on body parts that felt uncomfortable/painful, workers also provided a rating of the pain they felt. The worker's assessment rating of the pain/discomfort felt due to the fish transporting activity is shown in Figure 2.
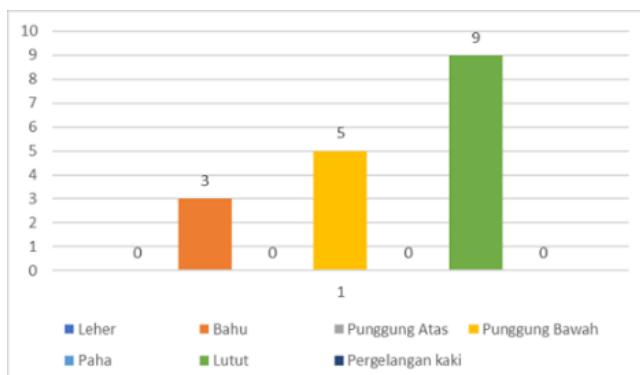

Figure 2. Assessment rating of pain/discomfort felt by workers

Risk analysis of fish-transporting work activities was carried out based on activity data taken through video recordings. The REBA score calculation was carried out on both workers when transporting the load in the form of caught fish to be placed on the weighing scales. A sample of working postures by worker 1 is shown in Figure 3.

Worker 2 performed fish transporting activities altogether with worker 1. Both of them carried the fish that had been unloaded from the boat and then transported the load into the weighing place in the fish auction. A sample of working postures by worker 2 is presented in Figure 4.

Figure 3. A working posture of worker 1

Figure 4. A working posture of worker 2

An example of the angle measurement of one of the working postures by worker 1 is presented in Figure 5.

Figure 5. Angle measurement of work postures of worker 1

Based on Figure 5, it appears that the worker's neck was flexed, twisted, and tilted, while the torso was in a bent, tilted posture, and twisting can also be seen. Two legs supported the weight, but the knees were bent, and the right leg was twisted.

The working postures formed during the process of placing the fish on the weighing scales were then

used as the basis for measuring the risk of MSD using the REBA method. In comparison, an example of angle measurement for working postures performed by worker 2 is shown in Figure 6.
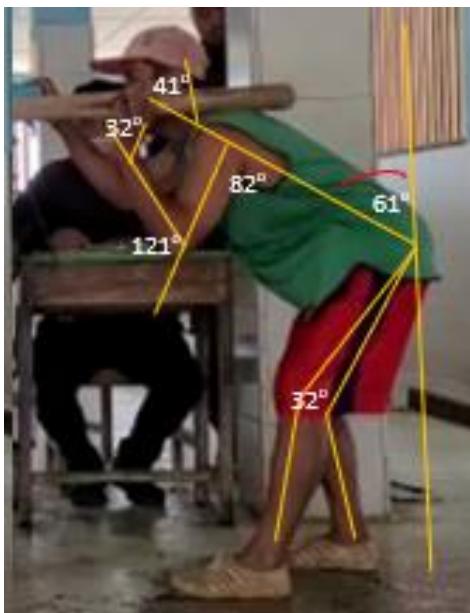
Figure 6. Angle **measurement** of working postures made by worker 2

The working posture of each worker was measured with N=32 to obtain more representative data in describing the angles formed in each body segment analyzed. More descriptive statistics from the angle measurement results of the working posture that have been carried out are presented in Table 2.

Table 2. Descriptive statistics of the body's deviation angle measurement of the working posture of fish-transporting workers

Body Segments	Mean ±SD	
	Worker 1	Worker 2
Neck	32.50±9.83	31.75±5.43
Trunk	45.50±14.12	51.75±7.36
Legs	29.75±3.14	28.75±6.33
Upper arm	93.25±14.48	101.00±12.75
Lower arm	59.25±41.16	47.00±42.98
Wrist position	32.00±4.30	31.00±0.99

Based on the collected data, risk calculation was then performed according to the selanjutnya REBA method [19]. The calculation was assisted using an Excel-based REBA calculator with a calculation mechanism as shown in Figure 7. Figure 7 shows the REBA score calculation process for working posture 4 of worker 1.

In addition to the scores of the body segments (neck, trunk, legs, upper arms, lower arms, wrist position), the REBA score calculation method also considers the load, coupling, and activity conditions. The load, coupling, and activity data of the workers' postures are described in Table 3.
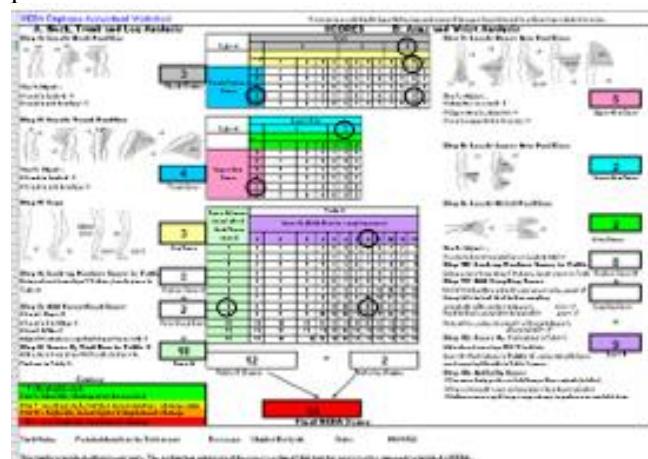

Figure 7. REBA score calculation for working posture 4 of worker 1

Table 3. Load, coupling, and activity scores

Indicator	Score	Description
Load	2	90-100 kg (> 10 kg)
Coupling	2	Hand hold: When holding the pole, the hand could not grip perfectly; the palm was slightly open because the diameter was larger than the worker's handhold. Hand fingers were involved when holding the pole rope because the rope was small.
Activity	2	There are more than four times repetitions of activity in a minute and rapid changes in posture.

The results of the REBA score calculations for both workers are presented in Table 4.

MSD risk level categorization was then performed based on the results of the REBA score calculation. Each REBA score level has implications for whether corrective action is needed and when the action should be taken. The results of the MSD risk level categorization based on the REBA score on the working postures of workers 1 and 2 are presented in Table 5.

B. Discussion

Based on the results of the MSD complaint survey with the NBM questionnaire on fish-transporting

workers, both workers felt uncomfortable in the right and left shoulders with a rating discomfort/pain level of 3, the lower back with a rating level of 5, and the right and left knees with a rating level of 9. This condition is suspected to be caused by simultaneously shouldering the load with a weight on the 90-110 kg container. The load far exceeds the maximum lifting weight standardized by the National Institute for Occupational and Health (NIOSH), which is 23 kg [16]. However, it is known that the risk of back injury increases when lifting, carrying, pushing, and pulling loads if the load is too heavy [20].

Table 4. REBA scores

	Worker 1	Worker 2
Neck	3	3
Trunk	4	5
Legs	3	3
Load	2	2
Upper arm	5	4
Lower arm	2	2
Wrist position	2	2
Coupling	2	2
Score A	10	11
Score B	9	8
Score C	12	12
Activity	2	2
REBA Total Score	**14**	**14**

Table 5. REBA scores and risk category

	REBA Score	Risk Category
Worker 1	14	Very High
Worker 2	14	Very High

As observed from the level of discomfort assessment experienced by the workers from the survey results with the NBM questionnaire, it appears that worker 2 gave a higher score. This assessment fact is possibly caused by the age demography of worker 2, in which worker 2 was 50 years old. As workers age, their physical and mental abilities tend to decline; therefore, accidents and illnesses in workers increase with age [21]. There is a correlation between age and MSD complaints, in which someone over 35 years of age has the potential to experience a high level of MSD [23].

Data collection for REBA analysis through measuring the angles of the two workers' postures are shown in Figure 5 and Figure 6. The score of each body segment of fish-transporting workers produces a total REBA score for workers 1 and 2 of 14, and the average REBA score from 32 measurements taken is 14.00 for both workers. Both workers have a very

high risk of injury, and their working postures must be fixed immediately.

Based on field observations, it is estimated that the risk factors for this condition are: a hunched posture with a side bending, a bent leg posture, a neck in an extension with a side bending position, an upper arm posture that causes raised shoulders or in a position far from the torso (abduction), the wrist in an extension position with a posture deviation angle greater than 15 degrees. The greater the deviation of the posture from the ideal posture, the more awkward the work position experienced will increase the risk of MSDs. [24]. Working conditions with awkward postures will trigger the emergence of MSD complaints. In a previous study, Vanissa stated that there is a correlation between work posture and MSD complaints felt by workers [25]. There is a significant indirect influence between workload and MSD complaints through work posture variables [26].

In addition to the risk factors of awkward working postures, in the fish transporting work activities on Sadeng Beach, a very heavy lifting load of 100 kg was lifted by the two workers. Musculoskeletal disorders are associated with work involving heavy loads [27]. The lifting was done manually with improper tools, causing pressure on the workers' body parts, making it difficult for them to hold the weight, and resulting in awkward working postures. Moreover, manual lifting loads increases the risk of MSD [28].

Facts on the observation ground revealed that workers experienced pain on both sides of the shoulders and the lower back. The shoulders were sore because this segment was used to support the carrying tools, experiencing pressure. Meanwhile, the lower back was sore because of the bent posture when moving and placing fish on the weighing scales. A bent posture with a minimum flexion deviation of 60 degrees potentially causes an increased risk of Low Back Pain (LBP) [29]. The hefty amount of loads also exacerbated the flexion posture of the bodies of fish-transporting workers in Sadeng Beach.

Workers transported fish to the weighing scales by walking while carrying a load of 90-110 kg of fish. This was possible to be the cause of the emergence of complaints of pain in the workers' knees. Heavy burden on the knees is closely related to increased knee pain [30].

Based on the survey results, both workers experienced discomfort in different body segments. Worker 1 complained of discomfort on the left and the right shoulders, as well as the lower back. Worker 2 had complaints on both left and right knees. The occurrence of shoulder and lower back pain

complaints in Worker 1 is possibly caused by his height, which was much taller than Worker 2. For information, Worker 1 had a height of 170 cm, and Worker 2 had a height of 153 cm. The difference in the dimensions of the height of workers, which reaches 17 cm, affects the load distribution, causing imbalanced load distribution for both workers. In addition, Worker 1, who is much taller, must adjust his posture to the height of Worker 2. This fact causes Worker 1 to be in a hunched posture and experience side bending. The long duration and high repetition rate of work activities then exacerbated the awkward posture. Work factors that imply MSD include work posture, workload, work duration, and repetition. [31]. Apart from work position, there is a strong relationship between age and length of service of the workers with MSD complaints [23]. MSD complaints by fish-transporting workers in Sadeng Beach were revealed from the NBM questionnaire survey results, in which Worker 1 complained pain in the lower back of the body (LBP). An unergonomic working posture when doing work will be at risk of occupational diseases and work accidents. One of the complaints due to work is low back pain (LBP), which is pain felt in the lower back of the body [32].

Each risk factor considered in the REBA calculation contributes to the very high level of risk in the fish-transporting activities. The measurement results revealed that all analyzed postures are remarked as very high in the risk category and must be immediately corrected.

V. CONCLUSIONS

Based on the experiment, the conclusion is as follows. Fish transporting activities in fish auction at Sadeng Beach were remarked as very high risk with a REBA score of 14. Risk factors of working postures of fish transporting workers in fish auction at Sadeng Beach include awkward working postures experiencing bent and twisting, a heavy load of weight (>100kg), and a high repetition of working activity.Analysis related to MMH activities during fish transporting activities in the fish auction at Sadeng Beach is necessary, especially in terms of transport safety analysis and working biomechanics analysis.

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