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Analysis of Work Posture in Ismail Ali SMEs Using the NBM, REBA, and OWAS Methods

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ABSTRACT

In Gresik Regency, there are SMEs such as Ismail Ali that sell products such as cement. In lifting and arranging cement, manual material handling is carried out. As a result, workers are at risk of back injury whose activities are not ergonomically appropriate, musculoskeletal disorders can arise. From these activities, the NBM analysis was carried out to determine the source of pain obtained on a Likter scale of 3 in the high risk level, the REBA method by involving the angle of the worker's posture obtained a score of 11 in the very high category, and the OWAS method by examining the effect of the load on the posture obtained a score of 3 in the high category. This research shows that lifting and arranging cement in Ismail Ali SMEs has a high risk of musculoskeletal disorders, seriously affecting health and work productivity. The results of the analysis using the NBM, REBA, and OWAS methods, found that non-ergonomic work positions cause serious injuries if not addressed immediately. Therefore, industries need to implement corrective measures such as scheduled breaks, stretching, improved work postures, worker rotation to reduce the risk of injury, increase efficiency, and prevent human error due to fatigue.

INTRODUCTION

In Gresik Regency, there are many SMEs that sell a variety of products such as Ismail Ali SMEs which sell elemental products for construction including wood, sand, cement, and others. According to Mr. Rifat, the owner of Ismail Ali SME, the most commonly sold products are cement and sand when moving cement is still done manually material handling. Manual labor, especially when lifting and arranging cement, is still done in a bent position at Ismail Ali SME, which puts workers at risk of back injury. When people perform activities that are not ergonomically appropriate, it can lead to various musculoskeletal disorders (MSDs), which can range from mild discomfort to severe illness (Setiawan et al., 2021). As a result, people's ability to complete their work efficiently and effectively decreases. When observed, many activities that workers often perform are during the lifting and setting of cement.

Manual material handling activities involve the use of human labor to lift and transport raw materials and finished goods (Agustin & Darajatun, 2023). The world of work creating a safe work environment is an important role that is very influential about work efficiency and productivity. Ergonomic factors in material handling are often ignored in SMEs, mainly due to limited knowledge and resources to implement safer work standards. Therefore, it is necessary to conduct a more comprehensive ergonomic risk analysis to identify and reduce potential injuries

due to manual labor, so as to avoid the occurrence of musculoskeletal disorders that affect muscles, joints, ligaments, nerves, and other structures that support body movement (Meri et al., 2024).

Based on these complaints, it will be identified with the NBM (Nordic Body Map) questionnaire, REBA, and OWAS methods. By using the Nordic Body Map, it can pinpoint the source of pain and evaluate it (Margaretha, 2022). Due to its standardization and organization, the Nordic Body Map questionnaire is often used to assess worker discomfort (Almahera et al., 2024). The REBA method which focuses on assessing body position and work that requires overall movement, in this process involves matching the angle of the worker's posture (Ardyansyah, 2021) and the OWAS method is an easy way to test the effect of load on a person's posture (Utomo et al., 2021). This approach aims to assess and analyze ergonomic risks in manual material handling activities, especially in lifting and arranging cement, to identify musculoskeletal potential and provide recommendations for improvement.

RESEARCH METHODS

Data Collection

In collecting data when measuring work posture analysis in Ismail Ali SMEs on lifting and arranging cement using tools such as :

1. Kilogram scales by placing a load of cement to determine the load to be lifted by workers.
2. Taking photos using a camera by determining the position of taking the entire posture of the worker.
3. Measuring the angle of the worker's posture of lifting and arranging cement using a digital degree measuring instrument by drawing a line on the photo that has been taken to determine the degree to be analyzed.
4. Giving questionnaires to workers to help analyze the pain caused by lifting and setting cement.

Nordic Body Map (NBM)

The Nordic Body Map questionnaire is a specific type of ergonomic checklist. Pain problems can be found and evaluated with the help of the Nordic Body Map (Lady et al., 2023). The most widely used tool for measuring employee pain is the Nordic Body Map questionnaire, which stands out for its standardization and organization (Bankar, 2021).

Rapid Entire Body Assessment (REBA)

REBA (Rapid Entire Body Assessment) was introduced by Hignett and McAtamney who are ergonomists from Notingham University. REBA focuses on assessing body position and work that requires full-body movement (Wachid et al., 2024). The results of this analysis are organized into decision categories that identify the type of corrective action required. This process usually involves matching the angles of the worker's posture with the weights listed in the available tables, as part of the assessment procedure. As such, the assessment can help determine better work postures and a reduction in the risk of injuries and strains. In this way, areas that require special attention to reduce the risk of injury or strain to workers can be identified (Mauludi, 2023).

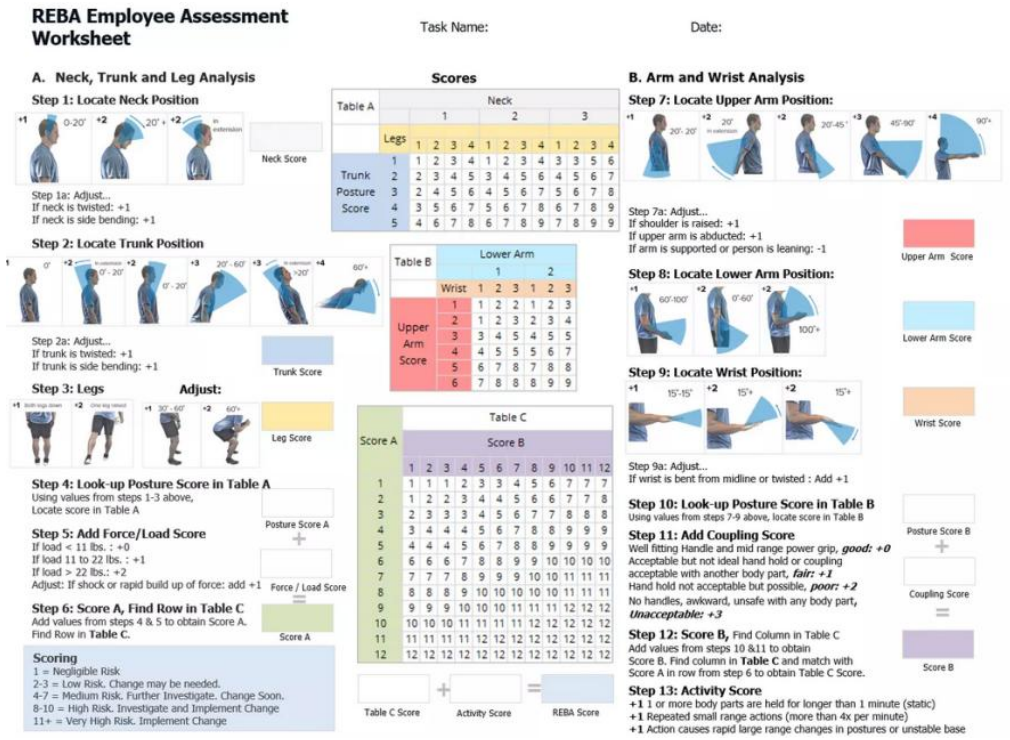

Figure 1. Rapid Entire Body Assessment
(Source : Mauludi, 2023)

Ovaka Work Analysis System (OWAS)

OWAS is a technique for measuring the body that relies on the following measurement principles: the entire task is broken down into increasingly smaller time intervals (in seconds or minutes), and then a number of different work postures and activities are sampled from each cycle (Fatimah et al., 2024). Then, measurements are taken from each sample. Encouraging people to work in a pleasant and safe way is the main idea behind posture monitoring (Iqbal et al., 2021). Postures and workloads are classified into different work phases using this strategy. We classify the postures after we examine them and assign values to them. To protect the human body from potential hazards in the workplace, OWAS seeks to identify these hazards. To classify the postures against the body parts that have been observed for evaluation and study, as follows (Senny et al., 2021) :

OWAS basic posture is set using a four-digit code that starts from the back and moves sequentially, a 3-digit arm code, a 7-digit leg code, and a 3-digit weight code that is raised when manual material handling is performed (Anshari & Yuamita, 2022).

a. Back Position Code Digits

Code digit 1 : Straight Back; the axis line of the worker's body is parallel to the axis line of the legs and hips.
Digit code 2 : Bent Back; the body is in a flexion position this method does not explicitly mention the flexion angle, but can be considered for inclinations > 20°.
Digit code 3 : Back Twisting; body twisting lateral inclination of > 20°.
Digit code 4 : Twisting back; body with simultaneous flexion and rotation or tilt.

b. Arm Position Code Digits

Code digit 1 : Both Arms Down; both arms of the worker below shoulder height.
Code digit 2 : One Arm Down and One Above; the worker's one arm is down and the other is raised above shoulder height.
Code digit 3 : Both Arms Above Shoulder Height; both of the worker's arms are above shoulder height.

c. Leg Position Code Digits

Digit Code 1 : Sitting Position; workers perform work in a sitting position.
Digit Code 2 : Standing; with both legs straight with body weight balanced between both legs.
Digit Code 3 : Standing; others bend with body weight with one leg straight and feet balanced between the two feet.
Digit Code 4 : Standing or Squatting; with both legs slightly bent and weight balanced between both feet. Although this method does not explicitly mention the angle at which the thigh angle or >150° occurs.
Digit Code 5 : Standing or Squatting; with both legs bent and weight balanced between both legs.
Digit Code 6 : Kneeling; the worker rests one or both knees on the floor.
Digit Code 7 : Walking; the worker is in a walking position when doing work.

d. Load and Strength Code Digits

Digit Code 1 : <10kg.
Digit Code 2 : 10 to 20kg.
Digit Code 3 : >20kg.

RESULTS AND DISCUSSION

This research was conducted at Ismail Ali SME located in Gresik district. The data used is descriptive quantitative which is carried out by observation of the posture of workers while working at Ismail Ali SME. This study utilizes three posture analyses, namely NBM to identify complaints in certain body parts due to work postures, REBA for assessment of workers' postures involving matching the angles of the worker's body, and OWAS to evaluate work attitudes.

Posture of workers at work in Ismail Ali SME during lifting and arrangement of cement in figure 2.

Lifting Cemen Arrangement Cemen

Figure 2. Worker Posture
(Source : SME Ismail Ali)

Based on figure 2, workers when lifting and arrangement of cement, the body position is bent, the legs are bent, and the load lifted is 50 kg. Cement lifters are prone to fatigue and limb injuries. Interviews with cement removal workers have revealed measurements, worker

complaints, and discomfort. Interviews with workers revealed that lifting and arranging cement causes soreness in various parts of the body, including the neck, waist, knees, legs and arms. The feeling of muscle fatigue in the neck, waist, knees, legs, and arms, due to the manual lifting process can result in the risk of MSDs musculoskeletal disorders.

From these results, an NBM questionnaire will be administered to measure complaints on body parts due to posture, REBA for assessment of workers' posture which involves matching the angle of the worker's body, and OWAS to evaluate work attitudes.

Kuesioner Nordic Body Map (NBM)

The most widely used tool for measuring employee pain is the Nordic Body Map questionnaire. This questionnaire is carried out by distributing it to workers in Ismail Ali SMEs such as table 1 as follows :

Table 1. Kuesioner Nordic Body Map

	Skeletal Muscle	Scoring				NBM
		1	2	3	4	
1	Nape	v				
2	Left Shoulder			v		
3	Right Shoulder				v	
4	Left Upper Arm				v	
5	Back				v	
6	Right Upper Arm				v	
7	Waist				v	
8	Hips				v	
9	Butt	v				
10	Left Elbow		v			
11	Right Elbow		v			
12	Left Forearm			v		
13	Right Forearm			v		
14	Left Wrist			v		
15	Right Wrist			v		
16	Left Hand			v		
17	Right Hand			v		
18	Left Thigh			v		
19	Right Thigh			v		
20	Left Knee		v			
21	Right Knee		v			
22	Left Calf			v		
23	Right Calf			v		
24	Left Ankle		v			
25	Right Ankle		v			
26	Left Foot		v			
27	Right Foot		v			
	Total Score		75			

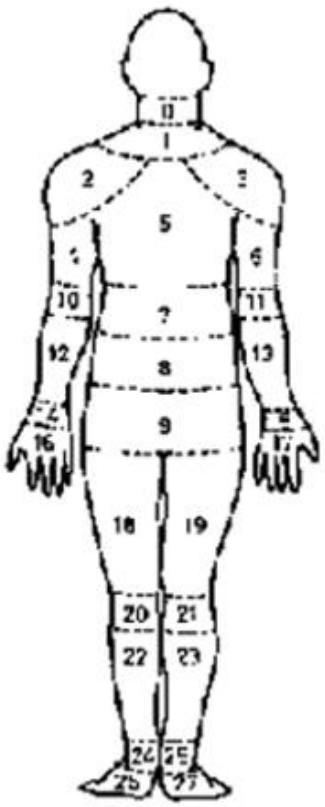

Table 1 shows the results of the Nordic Body Map questionnaire, which is obtained by calculating the score of each respondent and then determining which area has the highest score. The worker lifting cement has a score of 75. The worker lifting and arranging cement has a fairly high risk, namely complaints of very sore left shoulder score 4, right shoulder score 4, left upper arm score 4, back score 4, left upper arm score 4, back score 4, right upper arm score 4, waist score 4, and hip score 4.

Rapid Entire Body Assessment (REBA)

REBA focuses on assessing body positions and jobs that require full-body movement. The results of this analysis are organized into decision categories that identify the type of corrective action required. This process usually involves matching the angles of the worker's

posture with the weights listed in the available tables, as part of the assessment procedure. As shown in figure 2, the process of lifting and setting cement will be scored in table 2.

Table 2. REBA Score Determination

Posture	Score	Description	Final Score
Lifting Cemen			
Score A			
Neck	2, neck bent sideways +1	147°	3
Trunk	4	64° forward	4
Legs	1	10° both feet down	1
Score B			
Upper arm	4	119°	4
Lower arm	2	164°	2
Wrist	2	171°	2
Total Score C	Score A (8) and Score B (9)	10 + Activity Score (Work Posture Change/Shift) +1	11
Arrangement Cemen			
Score A			
Neck	2, neck bent to the side +1	161°	3
Trunk	3, back bent to the side +1	30°	4
Legs	1	3° both feet down	1
Score B			
Upper arm	3	45°	3
Lower arm	2	169°	2
Wrist	2	168°	2
Total Score C	Score A (8) and Score B (8)	10 + Activity Score (Work Posture Change/Shift) +1	11

Based on table 2, it has been obtained from lifting cement with the results of Score A obtained with a score of 6, coupled with the weight of the load received of > 22 lbs (+2) so the total Score A is 8. In Score B obtained with a score of 6, coupled with no grip, awkward, insecure with any part of the body is not acceptable (+3) so the total Score B is 9. The values of Scores A and B are included in Score C, which results in a score of 10. The next step is to add an activity score that takes into account the frequency of movement, because the movement causes a rapid change or shift in posture from the initial position (+1) will be added to Score C, resulting in a final total score of 11.

The cement arrangement with the results of Score A obtained with a score of 6, coupled with the weight of the load received of > 22 lbs (+2) so the total Score A is 8. In Score B obtained with the results of a score of 5, coupled with no grip, awkward, insecure with any part of the body is not acceptable (+3) so the total Score B is 8. The values of Scores A and B are included in Score C, which results in a score of 10. The next step is to add an activity score that takes into account the frequency of movement, because the movement causes a rapid change or shift in posture from the initial position (+1) will be added to Score C, resulting in a final total score of 11.

This score on lifting and setting cement reflects a very high risk level and changes should be made to the posture to reduce the potential for injury or strain to the worker.

Ovaka Work Analysis System (OWAS)

A technique for measuring the body that relies on the following measurement principles: The entire task is broken down into increasingly smaller time intervals (in seconds or minutes), and then a number of different work postures and activities are sampled from each cycle. Then, measurements are taken from each sample. The back, leg, arm movement scores as well as the lifted load scores are shown in table 3 as follows :

Table 3. Ovaka Result Analysis System

Work Activities	Lifting Cemen	Arrangement Cemen
Code	4-1-2-3	4-1-2-3
Category	3	3

The categorization of the risk level of the owas method is shown in table 3. A score of 3 is given to workers when lifting and arranging cement, this score will be used to determine the risk level of the owas method.

Analysis NBM, REBA, and OWAS Methods

At the analysis stage of the NBM, REBA, and OWAS which have classified the risk categories in the cement lifting work posture, as well as the subjective classification of the level of musculoskeletal risk based on the total score obtained. The explanation is in table 4 below :

Table 4. NBM, REBA, and OWAS Analysis Results

Activity	NBM	REBA	OWAS	Description
Cement Lifting and Arrangement	75	11	3	**NBM** : scale 3 (71-90) which is classified as high, meaning that immediate corrective action is needed. **REBA** : score of 11+ which is classified as very high, this attitude is dangerous for the musculoskeletal system because the work posture is very tense in the future, changes must be made. **OWAS** : high-risk level 3, a position with very harmful effects on the musculoskeletal system, and corrective action should be taken as soon as possible.

The results of the analysis in table 4 show that cement lifting and arrangement workers are in the high risk category for musculoskeletal disorders. In addition, immediate remedial action is required. With corrective action, workers can avoid the risk of muscle and joint injuries, chronic pain, potential permanent disability, etc. There are corrective actions for workers by providing a 1-hour break that is done twice, stretching to keep muscles, bones, and joints strong, using correct posture when sitting and standing, and rotating workers. That way it can avoid muscle, bone, and joint injuries due to non-ergonomic work positions, avoid human errors due to fatigue that can cause work accidents, prevent extreme fatigue due to monotonous or repetitive tasks, and avoid high absenteeism due to work injuries so that operations continue to run smoothly.

CONCLUSION

Based on the results of the data recapitulation of the NBM (Nordic Body Map) questionnaire, workers lifting and arranging cement in Ismail Ali SMEs where there is a level of likter with a scale of 3 with a total score of 75 (71-90), entering into a high risk level must require immediate action. In the REBA (Rapid Entire Body Assessment) method identified that cement lifting workers have a risk level with a score of 11 + into a very high risk level position with very dangerous effects on the musculoskeletal system, and corrective action must be taken as soon as possible. The OWAS (Ovaka Work Analysis System) method identified that cement lifting workers have a risk level with a score of 3, falling into the high category, the effect on the musculoskeletal system is a position with a very dangerous effect on the musculoskeletal system, and corrective action is needed as soon as possible.

This study shows that cement lifting and setting workers at Ismail Ali SME have a high risk of musculoskeletal disorders, which can have a serious impact on health and work productivity. Based on the results of analysis using the NBM, REBA, and OWAS methods, it was found that unergonomic work positions can cause serious injuries if not addressed immediately. Therefore, industries need to implement corrective measures such as scheduled breaks, stretching, improved work postures, worker rotation to reduce the risk of injury, increase

efficiency, and prevent human error due to fatigue. Further research can compare ergonomic risks in various industrial sectors to determine the pattern of musculoskeletal disorders and the best solutions that can be widely applied.

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