Evaluation of work posture and quantification of fatigue by Rapid Entire Body Assessment (REBA)

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Abstract. Work related musculoskeletal disorders (MSDs), poor body postures, and low back injuries are the most common problems occurring in many industries including small-medium industries. This study presents assessment and evaluation of ergonomic postures of material handling worker. That evaluation was carried out using REBA (Rapid Entire Body Assessment). REBA is a technique to quantize the fatigue experienced by the worker while manually lifting loads. Fatigue due to abnormal work posture leads to complaints of labor-perceived pain. REBA methods were used to an assessment of working postures for the existing process by a procedural analysis of body postures involved. This study shows that parts of the body have a high risk of work are the back, neck, and upper arms with REBA score 9, so action should be taken as soon as possible. Controlling actions were implemented to those process with high risk then substantial risk reduction was achieved.

1. Introduction
Musculoskeletal disorders (MSDs) are the most common types of health problems in the industry especially the small-medium scale. In the small-medium industries still rely heavily on human labor to run most of the production activities. Most of the work is done manually. So musculoskeletal disorder often occur due to work in particular position, in a long time and in incorrect working posture. Posture is defined as the physical position of the body, such as standing, sitting or lying down. Correct posture maintain a natural curvature of the spine, minimizing tension and preserve the balance of muscle and skeletal body [1]. Correct posture does not make the body leaning forward, backward, left, or right [2]. Workers in performing their work are in an uncomfortable condition. Eventually, cause various musculoskeletal disorders. Abnormalities generally arise due to the recurrent lifting activity, the elevation, the weight of removed material, and the ambient conditions, etc. [3]. Musculoskeletal disorders can be minimized through improved techniques, working methods, and facilities [4]. Postural analysis can be a powerful technique for assessing work activity. The risk of musculoskeletal injury associated with posture recorded in the context of assessment in the workplace.

Many studies have been conducted regarding the assessment of work posture and the condition of musculoskeletal abnormalities performed in the automobile assembly industry in India [5], pressing stations with spiral press machines used for capacitor smoothing [6], porcelain industry operators [7], and operators of Lathe Machine. [8]. The evaluation of work postures in small-scale industries concludes that there are opportunities for musculoskeletal disorders at moderate to high levels. This study recommends the application of ergonomic interventions with the right knowledge among workers and health education regarding posture, implementation, and monitoring of legislation to reduce pain due to
musculoskeletal disorders [9]. A study conducted by Agrawal found musculoskeletal disorder occurring in the welding process whereby the worker did the job with a kneeling position that required a change of posture in work [10]. Another study on posture assessment is done by Lakhwinder in the foundry industry. Rigid posture, removal, forcible removal, and other manual work at high speed and frequencies often cause musculoskeletal disorders [11].

The frequency of work and the level of worker discomfort leads to the risk of fatigue and abnormalities in some parts of the body. The application of a combination of static and dynamic work systems, varying leg position while standing, slightly helps to reduce the discomfort of working in a standing position [12]. Many studies have also found that poor work posture is cause of back pain, waist, and stress at work. As a result, the time lost, the deterioration of employee health and the decreased morale, ultimately lowering the productivity of the company. Implementation of ergonomic principles will help improve quality and productivity, but more importantly, help workers to feel comfortable and secure while doing the job. Implementation of ergonomics associated with the design of methods and processes may reduce job-related risk [13,14,15]. However, until now there are not many studies that analyze the posture of material handling workers especially in small-medium industries. This study was conducted to evaluate the postures material handling workers with minimal facilities in food industry.

2. Rapid Entire Body Assessment (REBA)

From an ergonomic standpoint, manual handling is a high-risk activity that can cause back pain. From a physiological perspective, manual handling of materials requires high energy and muscle strength. Generally, manual handling of materials is done inaccurately and can cause inflammation of the nerves and muscles. The main source of this problem is the static load carried, frequencies, and long duration, causing tension or disturbance to the joints and ligaments.

The Rapid Entire Body Assessment was first introduced by Lynn Mc Atamney and Sue Hignett (1995), a relatively simple way to assess the risk of whole-body abnormalities due to work [16]. REBA method is used as a tool to measure fatigue that occurs due to work. Many studies have applied the REBA method to assess and analyze posture. REBA can reduce 85% employment risk to a low risk of musculoskeletal abnormalities and is negligible [9]. REBA is a sensitive tool for assessing abnormalities in all parts of the body (wrists, upper arms, forearms, neck, trunk, and legs)) [16]. REBA is easy to use and useful for task risk assessment.

REBA techniques classify the body in two parts, namely A and B. Group A consists of the neck, legs, and torso. While group B consists of the forearm, upper arm, and wrist. The REBA technique uses a body assessment sheet to analyze work risk. REBA provides a score to describe the posture and the level of risk. REBA scoring sheets can be seen in Figure 1. High-risk jobs rated with higher scores and those with low or low-risk involvement score close to zero. Immediate improvement actions and necessary changes are recommended for higher score activities to avoid working risks.

3. Methodology

This study was conducted in one of the small-medium industries that produce food in North Sumatra. Fourteen material handling operators are sampled. Observations are made on the printing station to the drying station. The first step is to explore information about musculoskeletal disorders and symptoms felt by workers using Standard Nordic Questionnaire (SNQ). Data collection with SNQ is widely used because it is fast, easy, and not costly. SNQ is used to identify parts of the body that have complaints due to ergonomic working conditions and awkward work postures [17].
The second step is to record with video all worker activity to get their posture. The video is then cut within the framework of each job, then assessed using the REBA technique. The REBA assessment sheet [16] is filled with the corresponding values obtained based on body position, movement of body movement (gesture) for each body part based on the relative table. Was first performed in the charge sheet REBA assessment is to provide an assessment on the body part belonging to the group A (Trunk, Neck, Legs) and group B (Upper arm, Lower arm, Wrists right, and left). The sum of the values in group A is added with a force/load score. Furthermore, the sum of the values in group B is summed with the coupling/grip score. Total final value of group A and B is a score C. In static posture and/or repetitive actions (more than four times per minute), or the change in posture faster than the Scots in Table C summed with activity scores to obtain the final value REBA. Repair activities are performed on activities/tasks that have substantial risk levels. The REBA scores can be seen on REBA’s rating sheet.

4. Result and Discussion
In this study, 12 workers with a mean the age of 34 ± 5.91 years, the height of 158.83 ± 4.15 cm, and the job experience of 4.17 ± 2.89 years were studied. Material handling operators from the printing station to the stations are observed. The observed operators 58.33% were male and 41.67% female. The main task of this operator is to bring the printed work in process and has been arranged on a square plastic sheet. The products that have been prepared on the plastic sheet are brought by trolley to the drying station. The first activity observed in this study was to take plastic sheets from the trolley. The
position of the body of the operator when doing this activity that is standing with both hands are higher than the head. The second activity is bringing the sheet to the drying area. The position of the body of the operator while performing this activity is to stand with the elbow at an angle of 90°. The position is done while walking. The third activity is to put the product in the drying area. The position of the body when the operator performs this activity is the body bent by an angle of 75° when putting it on the ground for drying. The results of the Standard Nordic Questionaire (SNQ) distributed to workers to extract information on body parts that the workers are sickly sick with can be seen in Table 1.

Table 1. Result of Standard Nordic Questionaire (SNQ)

| No | Complaint Type                      | Level of Complaint (%) |
|----|-------------------------------------|------------------------|
|    |                                     | A  | B       | C    | D    |
| 0  | Pain/stiff in the upper neck        | 66.67 | 33.33 |
| 1  | Pain/stiff in the lower neck        | 58.33 | 41.67 |
| 2  | Pain in the left shoulder           | 16.67 | 33.33 | 50.00 |
| 3  | Pain in the right shoulder          | 16.67 | 33.33 | 50.00 |
| 4  | Pain in left upper arm              | 66.66 | 16.67 | 16.67 |
| 5  | Pain in the back                    | 66.66 | 33.33 |
| 6  | Pain on the right upper arm         | 33.33 | 50.00 | 16.67 |
| 7  | Pain at the waist                   | 56.33 | 41.67 |
| 8  | Pain on the buttocks                | 16.67 | 16.67 | 50.00 | 16.67 |
| 9  | Pain on the butt                    | 83.33 | 16.67 |
| 10 | Pain on the left elbow              | 41.67 | 58.33 |
| 11 | Pain on the right elbow             | 33.33 | 33.33 | 33.33 |
| 12 | Pain in the left forearm            | 50.00 | 33.33 | 16.67 |
| 13 | Pain in the right forearm           | 16.67 | 33.33 | 33.33 | 16.67 |
| 14 | Pain on the left wrist              | 16.67 | 41.67 | 41.67 |
| 15 | Pain on right wrist                 | 58.33 | 41.67 |
| 16 | Pain on the left hand               | 50.00 | 50.00 |
| 17 | Pain on the right hand              | 41.67 | 58.33 |
| 18 | Pain in the left thigh              | 16.67 | 25.00 | 58.33 |
| 19 | Pain in the right thigh             | 25.00 | 16.67 | 58.33 |
| 20 | Pain in the left knee               | 41.67 | 58.33 |
| 21 | Pain in the right knee              | 33.33 | 33.33 | 33.33 |
| 22 | Pain in the left calf               | 33.33 | 33.33 | 33.33 |
| 23 | Pain in the right calf              | 16.67 | 50.00 | 33.33 |
| 24 | Pain in the left ankle              | 33.33 | 50.00 | 16.67 |
| 25 | Pain in the right ankle             | 33.33 | 50.00 | 16.67 |
| 26 | Pain on the left leg                | 33.33 | 33.33 | 33.33 |
| 27 | Pain on the right leg               | 33.33 | 33.33 | 33.33 |

Of the 28 questions about pain complaints felt by workers on the body, known five parts of the body that complained workers "quite painful." Upper arm body part, back, upper right arm, waist, left forearm, and right lower arm. Based on the results of SNQ, complaints of the pain in the body of the operator is influenced by factors of sex, age, and duration of work. Women operators complain more about pain than men. Over 35 years of workers who complain of pain than under 35 years. Workers who have worked for more than four years complained of pain in parts of their bodies. Assessment of worker's
posture is done by filling in the REBA assessment sheet for each activity. Table 2 illustrates the results of posture assessment sheet with REBA.

Table 2. The Result of Posture Assessment Sheet of Body with REBA

| Parameters              | Activity 1 | Activity 2 | Activity 3 |
|-------------------------|------------|------------|------------|
| Neck                    | 2          | 1          | 2          |
| Trunk                   | 2          | 1          | 4          |
| Legs                    | 1          | 1          | 4          |
| Table A Posture Score   | 3          | 1          | 8          |
| Force/Load Score        | 0          | 0          | 0          |
| SCORE A                 | 3          | 1          | 9          |
| Upper Arm Position      | 4          | 2          | 2          |
| Lower Arm Position      | 2          | 1          | 2          |
| Wrist Position          | 1          | 1          | 2          |
| Table B Posture Score   | 5          | 1          | 3          |
| Coupling Score          | 3          | 3          | 3          |
| SCORE B                 | 8          | 4          | 6          |
| Activity Score          | 1          | 1          | 1          |
| Table C                 | 8          | 3          | 8          |
| REBA SCORE              | 9          | 4          | 10         |
| RISK LEVEL              | High       | Medium     | High       |

In the first activity, the neck is bent at the top of the corner 300, so given the score 2. The upper arm is raised higher than the head and form an angle of 110° so given a score 4. The neck on the 3rd activity bends down about 25° so given a score 2. At the activity of three bodies bending With an angle of 75° so given a score 4. REBA scores on the first activity and the third is 9 and 10 means that the posture of the worker's work has high risk to the musculoskeletal disorder. The first and third activities need to be investigated and implemented changes/improvements. While the second activity gets a score of four means having a medium risk. This activity needs further investigation, and changes can be done immediately.

As the results of the present study indicate, most cases of discomfort of body parts due to problems such as pain, discomfort, stiff and numbness were related to the waist. This result finding was in agreement with that of a study by Ahmadi [7]. Their research assessed the risk of MSDs with the Nordic Musculoskeletal Questionnaire (NMQ), Job Content Questionnaire (JCQ), and REBA. Due to inappropriate posture, workers feel pain in their body parts. To eliminate it, this study need the new work facilities to assist workers' activities. Besides, it is necessary to improve the working method to minimize their complaints.

5. Conclusion
The manual handling of material where operators work in a standing position and bend. Activities undertaken by operators have a high risk of disruption, pain, stiffness, and discomfort. Musculoskeletal disorders are found in these activities by complaints of perceived pain workers. It shows that there is a need to apply ergonomic knowledge as well as repair work facilities to prevent workers from Musculoskeletal Disorders.

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