Potential of Work Related Musculoskeletal Disorder in Traditional Salt Farmers

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Abstract. The purpose of this study was to identify work postures and determine the risk of health problems due to the body postures of traditional salt farmers. The sample used in this study was 37 traditional salt farmers from Pundata Baji, Pangkep Regency - Indonesia. The analysis techniques used were the Rapid Upper Limb Assessment (RULA) and Rapid Entire Body Assessment (REBA) methods. The results show that based on the RULA score, there were two work postures that require investigation and change as soon as possible (urgently) (Level 4). As for the REBA score, there was one posture that is included in the very high-risk category, which needs improvement right now. Subjective complaints data show that the most complaints from traditional salt farmers occur in the back area with a percentage of 72.97%. This is caused by the fact that most work postures are carried out in a bent position for a long time.

1. Background

All industries, both formal and informal, are expected to be able to apply occupational safety and health in carrying out their duties so that workers feel comfortable and safe at work, free from work-related diseases, and avoid work accidents [1]. One of the occupational diseases that can appear at any time is musculoskeletal disorders (MSDs) [2, 3]. MSDs are a disease caused by incorrect position or work attitude. MSDs are disorders of normal functioning of muscles, tendons, nerves, blood vessels, bones and ligaments, due to changes in the structure or the musculoskeletal system in a short or long time [4].

The traditional agricultural sector is one type of work that has a high risk for workers [5]. Extreme environmental conditions and the use of technology in managing land that is still quite behind compared to other work determine the level of health and safety of farmers [6]. Activities undertaken by farmers, including preparing land (hoeing), planting, and post-harvest have different levels of risk.

Pundata Baji Village is one of the areas in South Sulawesi - Indonesia where the majority of the population’s livelihoods are as milk fish farmers. But when the dry season arrives and their ponds are drought, some of the fishers turn to traditional salt farmers and make their ponds a place for making salt. Salt farmers in Pundata Baji still use manual methods without machining aids in the process of production and harvest, and post it. As with other traditional farms, in each of these processes, the dominant position of traditional salt farmers is to bend. This position is not very ergonomic because it will lead to complaints, aches, or aches in the back of the body. This study aims to identify work postures and determine the risk of health problems due to the body postures of traditional salt farmers during harvest and post-harvest handling in Pundata Baji.
2. Methodology
This research was conducted on 37 traditional salt farmers in Pundata Baji. Data collection was done through the method of observation on the object under study. The observation method was carried out to obtain data on the work posture of workers by recording or photographing each work posture that occurs when the farmer did his activities. After each work posture was obtained, a portrait was then given a marker and measurements of body segmentation angles. The results of measurements of body segmentation angles were then analyzed using the Rapid Upper Limb Assessment (RULA) and Rapid Entire Body Assessment (REBA) methods to obtain the risk of MSDs in the salt harvest and post harvest processes [7]. In addition to these two methods, this study also used a questionnaire method to map the location and level of complaint of skeletal muscle disorders in traditional salt farmers. The questionnaire used was the Nordic Body Map (NBM) questionnaire [8].

3. Result
After observing the activities carried out by traditional salt farmers in Pundata Baji, especially in harvesting and post-harvest activities, three working postures were observed as presented in Table 1.

| No | Activities                  | Work Postures |
|----|-----------------------------|---------------|
| 1. | Salt harvesting             | 1             |
| 2. | Collecting salt to basket   | 2             |
| 3. | Moving sack of salt         | 3             |

In the Work Posture 1 activity, the farmer did the salt harvesting activity in the area of the salt plots pool with a slouchy working attitude for about one hour to collect salt to the edge of the plots with the workload on the arms holding the chips weighing about three kilograms. Every salt plot pond, there were one to three farmers who harvested with the yield of each salt plot of 150 kg. Figure 1 shows the body segment of a traditional salt farmer when harvesting salt. After being harvested by stacking, the salt is then collected and put in a basket (Figure 2).

![Figure 1. Salt harvesting (Work Posture 1)](image1)

![Figure 2. Collecting salt to basket (Work Posture 2)](image2)
To conduct RULA analysis on Work Posture 1, two assistive tables were used to determine the weight of the forearm, arm, and wrist (Group A) and the neck, back, and leg posture (Group B).

**Table 2. RULA weighting Group A (forearm, arm, and wrist) for Work Posture 1**

| Table A | Wrist | 1 (Neutral) | 2 (0°-15°) | 3 (>15°) | 4 |
|---------|-------|-------------|------------|---------|---|
| Forearm| Arm   | Bended Wrist| Bended Wrist| Bended Wrist| Bended Wrist|
| 1 (20°)| 1     | 1           | 1          | 2       | 2 |
|        | 2     | 2           | 2          | 2       | 3 |
|        | 3     | 3           | 2          | 2       | 3 |
|        | 2 (20°-45°)| 1     | 2          | 2       | 3 |
|        | 2     | 2           | 2          | 3       | 3 |
|        | 3     | 3           | 3          | 3       | 4 |
|        | 3 (45°-90°)| 1     | 2          | 3       | 3 |
|        | 2     | 3           | 3          | 3       | 4 |
|        | 3     | 3           | 4          | 4       | 4 |
|        | 4 (>90°)| 1     | 3          | 4       | 4 |
|        | 2     | 4           | 4          | 4       | 5 |
|        | 3     | 4           | 4          | 4       | 5 |
|        | 4     | 5           | 5          | 5       | 6 |

**Table 3. RULA weighting Group B (neck, back, and foot) for Work Posture 1**

| Table B | Back | 1 (sitting) | 2 (0° - 20°) | 3 (20° - 60°) | 4 (>60°) | 5 | 6 |
|---------|------|-------------|--------------|---------------|---------|---|
| Neck    | Foot | Foot        | Foot         | Foot          | Foot    |   |
| 1 (0°-10°)| 1 | 1          | 3            | 3             | 4       | 5 |
|         | 2 | 2          | 3            | 4             | 5       | 6 |
|         | 3 | 3          | 4            | 5             | 6       | 7 |
|         | 4 | 5          | 5            | 6             | 7       | 8 |
| 2 (10°-20°)| 1 | 1          | 2            | 3             | 4       | 5 |
|         | 2 | 2          | 3            | 4             | 5       | 6 |
|         | 3 | 3          | 4            | 5             | 6       | 7 |
|         | 4 | 5          | 5            | 6             | 7       | 8 |

By means of the same analysis of work risk in Work Posture 1, work risk in Work Posture 2 can be found to be at the same level as work posture 1.

Table 4 shows that Work Posture 1 for farmers who harvest and collect salt had a RULA score of 7 which means that investigation and changes to work posture are needed as soon as possible (urgently).
Table 4. RULA grand total score for Work Posture 1

| Score C | Grand Total Score | Score D = score from table B + Muscle Use Score + Force |
|---------|------------------|--------------------------------------------------------|
|         | 1 2 3 4 5 6 7    | 8 9                                                    |
| 1       | 1 2 3 3 4 5 5    | 5 5                                                    |
| 2       | 2 2 3 4 4 5 5    | 5 5                                                    |
| 3       | 3 3 3 4 4 5 6    | 6 6 6                                                  |
| 4       | 3 3 3 4 5 6 7    | 6 6 6                                                  |
| 5       | 4 4 4 4 5 6 7    | 7 7 7                                                  |
| 6       | 4 4 5 6 6 7 7    | 7 7 7                                                  |
| ?       | 5 5 6 6 7 7 7    | 7 7 7                                                  |
| 8       | 5 5 6 7 7 7 7    | 7 7 7                                                  |
| 9       | 5 5 6 7 7 7 7    | 7 7 7                                                  |

Table 5. REBA weighting Group A (neck, back, and foot)

| Table A | Back |
|---------|------|
|         | 1 2 3 | 4 | 5 |
| Foot    |       |   |   |
| Neck = 1| 1 1 2 | 2 | 3 | 4 |
|         | 2 2 3 | 4 | 5 | 6 |
|         | 3 3 4 | 5 | 6 | 7 |
|         | 4 4 5 | 6 | 7 | 8 |
| Neck = 2| 1 1 3 | 4 | 5 | 6 |
|         | 2 2 4 | 5 | 6 | 7 |
|         | 3 3 5 | 6 | 7 | 8 |
|         | 4 4 6 | 7 | 8 | 9 |
| Neck = 3| 1 3 4 | 5 | 6 | 7 |
|         | 2 3 5 | 6 | 7 | 8 |
|         | 3 5 6 | 7 | 8 | 9 |
|         | 4 6 7 | 8 | 9 | 9 |

Figure 3 shows the Work Posture 3 where farmers underwent activities with a bent work attitude on the edge of the salt mound pond area to lift the sacks of salt to the vehicle that will transport the sacks of salt to the storage shed. Each sack of salt weighs bout 50 kg. To analyze work risk in this work posture, two REBA assist tables (tables 5 and 6) were used to produce a RULA grand score table (table 7). Table 8 shows the occupational risk categories of the REBA method. From this table, it is revealed that work risks in Work Posture 3 are in the very high risk level category and require urgent work method changes.
**Figure 3.** Moving sack of salt

### Table 6. REBA weighting Group B (wrist, upper arm, arm)

| Table B | Upper Arm |
|---------|-----------|
| Pergelangan |  | 1 | 2 | 3 | 4 | 5 | 6 |
| Arm = 1 | 1 | 1 | 1 | 3 | 4 | 6 | 7 |
| 2 | 2 | 2 | 4 | 5 | 7 | 8 |
| 3 | 2 | 3 | 5 | 5 | 8 | 8 |
| Pergelangan |  | 1 | 2 | 4 | 5 | 7 | 8 |
| Arm = 2 | 2 | 2 | 3 | 5 | 6 | 8 | 9 |
| 3 | 3 | 4 | 6 | 7 | 8 | 9 |

### Table 7. RULA grand total score for Work Posture 3

| Skor A | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|--------|---|---|---|---|---|---|---|---|---|----|----|----|
| 1 | 1 | 1 | 2 | 3 | 4 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 2 | 1 | 2 | 3 | 4 | 4 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 3 | 1 | 2 | 3 | 4 | 4 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 4 | 2 | 3 | 3 | 4 | 5 | 7 | 8 | 9 | 10 | 11 | 12 |
| 5 | 3 | 4 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 10 | 11 | 12 |
| 6 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 10 | 11 | 12 | 12 |
| 7 | 4 | 5 | 6 | 7 | 8 | 9 | 9 | 10 | 10 | 11 | 11 | 12 |
| 8 | 5 | 6 | 7 | 8 | 8 | 9 | 9 | 10 | 10 | 11 | 11 | 12 |
| 9 | 6 | 6 | 7 | 8 | 9 | 10 | 10 | 10 | 11 | 11 | 12 | 12 |
| 10 | 7 | 7 | 8 | 9 | 9 | 10 | 10 | 11 | 11 | 11 | 12 | 12 |
| 11 | 7 | 7 | 8 | 9 | 9 | 10 | 11 | 11 | 11 | 12 | 12 | 12 |
| 12 | 7 | 8 | 8 | 9 | 9 | 10 | 11 | 11 | 11 | 12 | 12 | 12 |

### Table 8. Work risk category of REBA’s method

| REBA Score | Risk Level   | Actions            |
|------------|--------------|--------------------|
| 1          | -            | -                  |
| 2-3        | Low          | Maybe needed       |
| 4-7        | Medium       | Needed             |
| 8-10       | High         | Needed immediately |
| 11-15      | Very High    | Needed now         |
Next, Table 9 shows the recapitulation results of subjective complaints caught through the NBM questionnaire felt by 37 farmers.

| No | Location          | Frequency | Presentation |
|----|-------------------|-----------|--------------|
| 1  | Tailbone          | 0         | 0.00 %       |
| 2  | Buttocks          | 20        | 54.05 %      |
| 3  | Back              | 27        | 72.97 %      |
| 4  | Neck              | 19        | 51.35 %      |
| 5  | Head              | 2         | 5.41 %       |
| 6  | Shoulder          | 0         | 0.00 %       |
| 7  | Hip               | 4         | 10.81 %      |
| 8  | Forearm           | 23        | 62.16 %      |
| 9  | Elbow             | 0         | 0.00 %       |
| 10 | Arm               | 10        | 27.03 %      |
| 11 | Wrist             | 14        | 37.84 %      |
| 12 | Palm              | 0         | 0.00 %       |
| 13 | Thigh (back)      | 0         | 0.00 %       |
| 14 | Knee              | 0         | 0.00 %       |
| 15 | Calf              | 13        | 35.14 %      |
| 16 | Ankle             | 0         | 0.00 %       |
| 17 | Foot              | 0         | 0.00 %       |
| 18 | Chest (upper part)| 0         | 0.00 %       |
| 19 | Chest (lower part)| 0         | 0.00 %       |
| 20 | Stomach           | 0         | 0.00 %       |
| 21 | Thigh (front)     | 0         | 0.00 %       |

Based on the complaint data obtained using the NBP questionnaire, it is seen that traditional salt farmers had the biggest complaint on their back with a percentage of 72.97%. This was caused by the fact that most work postures were carried out in a bent position for a long time so that the burden was more felt on the back. The next biggest complaint was in the upper arm as much as 62.16% due to the position in using aids and lifting position which was still wrong and carried out repeatedly, resulting in pain in the upper arm. There were also complaints as much as 54.05% in the buttocks caused by the weight of the burden lifted and the harvest process was carried out in a bent position repeatedly within 1-2 hours. Complaints on farmers’ necks also had a high percentage (51.35%) caused by the position of the neck which forms a slightly raised angle in quite a long time.

Table 10 provides work posture recommendations for traditional salt farmers which can avoid working risks from work posture errors during harvest and post-harvest salt.
Table 10. Recommendations for improving work posture

| No | Activity/Posture | Initial Work Posture | Recommended Work Posture | Recommended Posture Image |
|----|------------------|----------------------|--------------------------|---------------------------|
| 1  | Activities were carried out with the back position slightly bent and the neck forming an angle with the head slightly raised. | The activity of collecting salt should be done in a standing body position. Back does not form a normal angle and neck position so that there is no fatigue in the back. | RULA Score : 7 | RULA Score : 4 |
| 2  | The activity of putting salt into the basket was done with the position of the legs bent and the back forming a very large angle, and the position of the arms that form a large angle. | The activity of putting salt into the basket should be done by bending the knees and squatting, keeping the back and neck straight so that the angles of the arms formed are also not too large and the body position is more stable. | RULA Score : 7 | RULA Score : 4 |
| 3  | Activity The activity of lifting salt was carried out with the back bent, the foot slightly bent so that it supports a weight of > 10 kg and the neck forms an angle. | Activities when you want to lift salt should be done in a squat position, so as to keep your back straight so that the weight of the load is spread evenly on the body. | REBA Score : 11 | REBA Score : 3 |

4. Conclusion
Based on observations and data processing that had been carried out on 37 salt farmers in Pundata Baji, it is concluded that there were three working postures in the traditional salt harvest process. Based on the RULA scoring, there were 2 postures (work posture collecting harvested salt and work posture putting salt into the basket) which fall in level 4 category, namely work posture that requires investigation and changes were needed as soon as possible (urgent). Meanwhile, based on REBA scoring, there was one posture that is included in the category of very high risk that requires improvement now. Based on the complaint data obtained using the NBP questionnaire, it is seen that traditional salt farmers had the biggest complaint on the back (72.97%) followed by the upper arm area (62.16%), buttocks (54.05%) and on the farmer's neck (51.35%).
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