Rapid Entire Body Assessment for Work Posture's Analysis of a Pig Farmer in Bali: A Preliminary Study

Ni Made Hari Sugiantini[1], Ni Ketut Guru Prapti[2], Nyoman Agus Jagat Raya[3], I Kadek Saputra[4]

Nursing Study Program
Medical Science Faculty, Udayana University
Denpasar, Bali
prapti.nkg@unud.ac.id
Nursing Study Program
Medical Science Faculty, Udayana University
Denpasar, Bali
Nursing Study Program
Medical Science Faculty, Udayana University
Denpasar, Bali
Nursing Study Program
Medical Science Faculty, Udayana University
Denpasar, Bali

Abstract Traditional pig farmers have a high potential and intensity of exposure to ergonomic hazards. REBA is one of the universal instruments used to assess the ergonomic risks of work postures. This study aimed to analyze the work postures of traditional pig farmer in Bali. This research is a preliminary study with an observational approach. One pig farmer was involved in this study. REBA was used to analyze the subject's work posture, including finding the risk category of the work posture performed. The subject data were analyzed to obtain each group's score. Each initial score obtained by the subject consists of 6 for section A, a value of 5 in section B, and an additional score of 2. The results showed that the pig farmer had a high-risk work posture, with a final score of 10. REBA can potentially analyze the subject's posture in this study comprehensively. Further investigation of work posture among traditional pig farmers is recommended using REBA.

***Index Terms*— Ergonomy, Pig Farmer, Rapid Entire Body Assessment, Work Posture**

I. INTRODUCTION

Pig farming is the most insured livestock sector in Bali. Traditional pig farming in Bali become a thriving industry that still exists with its high productivity. The high meat production and consumption demand cause this sector to grow yearly. The livestock sector in Bali produced 165.3 thousand tons of livestock meat in 2021, dominated by 158.7 tons of pigs [1]. Traditional Balinese culture is still inherent in pig farming, so it utilizes manual handling to care for and produce pork. The conventional feeding system, animal care, and cage hygiene activities are still maintained with traditional techniques. Therefore, a greater physical workload must be incurred due to their tasks.

The high pork production and consumption are principally equal to the farmers' high occupational risk. Environmental hazards are an undeniable phenomenon that must be dealt with, especially for pig farmers who have to move in wet, slippery, and risky environments. Ergonomic hazards, including unergonomic work posture, are potential risks commonly found in pig farmers. Many are habitually unaware of the potential risks as their concentration on tasks. Bending, flexion, rotation, and upper arm elevation are often postures during livestock care activities [2]. Unergonomic work postures become an overlooked phenomenon among traditional workers in general. Therefore, it is important to evaluate workers' postures, including predicting the possible impacts.

Many instruments have been well-developed to assess a worker's posture during activities. Several studies have compared various existing methods, e.g., Rapid Upper Limb Assessment (RULA), Ovako Working Analysis System (OWAS), and Rapid Entire Body Assessment (REBA). REBA is appropriate to analyze work postures from upper to lower body segments. In contrast, RULA has limitations because this instrument is unsuitable for analyzing body postures as a whole, limited to the upper body region. Compared to OWAS, REBA has a more sensitive assessment because it includes body angle analysis. OWAS does not assess the level of flexion formed by measurement of posture angle. With the appropriate considerations, the researcher determined REBA as the research instrument.

REBA is a widely-used instrument that has become one of the ideal standards for evaluating work posture. The validity and reliability of REBA have also been tested in previous research [3]. REBA was used in this study due to its ability to observe unstable postures during work. As is often the case, traditional pig farmers have various activities that require varying work postures. Activities involving all limbs of the pig farmer's body must also be analyzed as a whole so that to analyze the risk of work postures must also be evaluated on all parts of the body. REBA can assess more sensitively and comprehensively than other instruments because it can determine upper to lower body postures. The REBA analysis results can also be used to assess improvement priorities [4]. REBA also considers additional assessments such as coupling, force/load, and activity scores [5].

Based on the phenomenon described, work posture assessment is necessary for traditional pig farmers in Bali due to its high exposure to ergonomic hazards. Several studies explained that occupational injuries are the possible impact of unergonomic work postures. Occupational injuries can significantly decrease workers' productivity. World Health Organization (WHO) states that a reduction in worker productivity will also impact workers' high rate of early retirement [6]. Another possible consequence is a decrease in pig production in Bali. Thus, this study was designed to assess the work posture of traditional pig farmer in Bali using REBA.

II. METHOD

This research is a preliminary study designed with an observational research approach. The purpose of this study is to describe the work posture of a traditional pig farmer in Bali using REBA observational guidelines. One pig farmer was involved in this study. The study was conducted in December 2022. The study has obtained ethical permission from the Faculty of Medicine, Udayana University. A pre-research consent and information were explained to the subject before data collection.

Data was collected by recording the pig farmer's activities using cameras, tripods, and stopwatch. One image was selected to be assessed based on the video recorded. A stopwatch was used to count repetitive movements. The image criteria set by the researcher is the right shooting angle, clearly showing all body parts in the activity that the subject has done most often.

REBA was used to assess the working posture of a pig farmer in this study. Evidence of the validity and reliability of REBA was presented by McAtamney & Hignett in 2004, stating that REBA worksheets have been valid and used in 14 observations made [7]. The reliability value was obtained in the 62-85% range. In this study, REBA was applied with AutoCAD to calculate the limb angle formed by the subject. There are five risk categories from REBA interpretation, i.e., negligible risk (1), low risk (2-3), moderate risk (4-7), high risk (8-10), and very high risk (11-15).

The REBA component comprises three assessment segments, i.e., Tables A, B, and C. Group A particularly includes neck, legs, and trunk angle analysis. In contrast, Group B contains upper arm, forearm, and wrist angle analysis. Additional adjustments must be considered in determining the score within each region. The two scores in each group are then modified according to the job description, such as force, load, and coupling. The result of the accumulation of all these scores is a C score which is then accumulated with the addition of an activity score to obtain the final REBA score. The assessment flowchart using the REBA method is shown in Figure 1 [8].

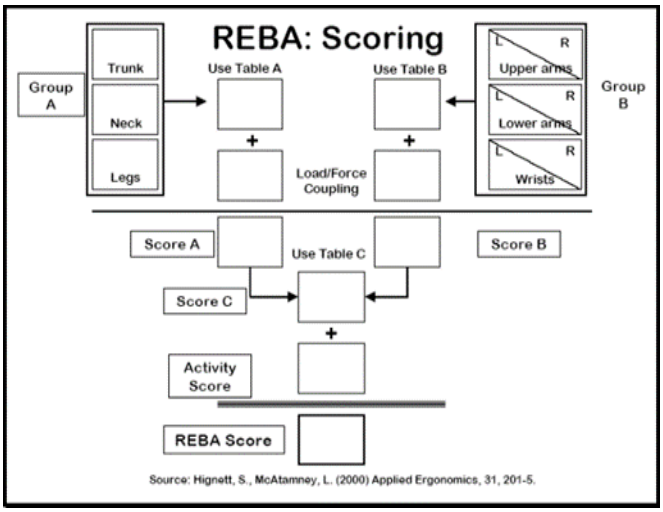

Fig. 1. REBA assessment flow chart (Source: Yuliani, 2020)

III. RESULT

The work posture assessment phase begins with measuring angles at six points of the limbs, i.e., neck, trunk, leg, upper arm, lower arm, and wrist. Body angle measurement using AutoCAD. Angle measurements can be seen in Figure 2.

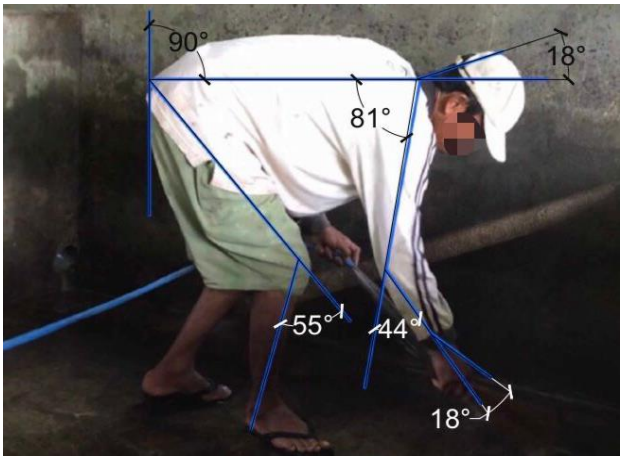

Fig. 2. Working posture and the body angle calculation

The work posture and calculation of the pig farmer's body angle can be seen in Table 2.

TABLE II
WORK POSTURE ANALYSIS AND CALCULATION

Remarks	Score
Neck upward 18º	1
Trunk bent 90º	4
One leg raised, bent 55º	3
Load <11 lbs	0
Upper arm towards trunk 81º	3
Lower arm flexion 44º	2
Wrist flexion 18º bent from midline position	2
Well-fitting handle and mid-range grip	0
Trunk bent position held for longer than 60 seconds	1
Repeated twisting of the wrist more than four times per minute	1

After measuring the angle, the angle value is adjusted to REBA based on the observation sheet. REBA score results are shown in Table 3.

TABLE III
CALCULATION OF GROUP A

Table A	Neck											
	1				2				3			
Legs	1	2	3	4	1	2	3	4	1	2	3	4
Trunk 1	1	2	3	4	1	2	3	4	3	3	5	6
Trunk 2	2	3	4	5	3	4	5	6	4	5	6	7
Trunk 3	2	4	5	6	4	5	6	7	5	6	7	8
Trunk 4	3	5	6	7	5	6	7	8	6	7	8	9
Trunk 5	4	6	7	8	6	7	8	9	7	8	9	9

CALCULATION OF GROUP B

Table B	Lower Arm					
	1			2		
Wrist	1	2	3	1	2	3
Upper Arm 1	1	2	2	1	2	3
Upper Arm 2	1	2	3	2	3	4
Upper Arm 3	3	4	5	4	5	5
Upper Arm 4	4	5	5	5	6	7
Upper Arm 5	6	7	8	7	8	8
Upper Arm 6	7	8	8	8	9	9

Based on the calculation of posture A, a total score of 6 was obtained. There was no additional force score in this group. Therefore, the final score of group A was 6. The posture score for group B is 5. The coupling score was 0, as the grip pattern was good.

CALCULATION OF SCORE C

A	Table C											
	B											
	1	2	3	4	5	6	7	8	9	10	11	12
1	1	1	1	2	3	3	4	5	6	7	7	7
2	1	2	2	3	4	4	5	6	6	7	7	8
3	2	3	3	3	4	5	6	7	7	8	8	8
4	3	4	4	4	5	6	7	8	8	9	9	9
5	4	4	4	5	6	7	8	8	9	9	9	9
6	6	6	6	7	8	8	9	9	10	10	10	10
7	7	7	7	8	9	9	9	10	10	11	11	11
8	8	8	8	9	10	10	10	10	10	11	11	11
9	9	9	9	10	10	10	11	11	11	12	12	12
10	10	10	10	11	11	11	11	12	12	12	12	12
11	11	11	11	11	12	12	12	12	12	12	12	12
12	12	12	12	12	12	12	12	12	12	12	12	12

Based on the calculation of REBA values in both groups, a C score of 8 was obtained. Furthermore, there was a static bent position for more than a minute and a repetition of movements more than four times in a minute while the wrist twisted. An activity score of 2 was obtained. The accumulation of C scores and activity scores becomes the final value of REBA, while REBA score = score C + activity score = 8 + 2 = 10. And a final score of 10 was obtained.

IV. DISCUSSION

A traditional pig farmer in this study was shown to have a high-risk work posture. The subject has a high intensity of exposure to ergonomic hazards. A high-risk work posture was obtained based on the REBA analysis in this study. According to REBA guidelines, a score of 10 indicates the need to investigate and start implementing change.

Based on the picture of the subject's posture, it can be identified that the overall work postures formed were bending, flexion of the knees, torso, neck, arm elevation, and wrist rotation. The figure shows that the posture performed is stooped with a torso flexion angle of 90^0 and neck flexion of 18^0. In the lower extremities, knee flexion with a grade of 55^0 was shown, and the legs are supported with the weight spread evenly between the left and right. The upper extremities form an angle of 81^0 between the shoulder and upper arm, the elbow bends at an angle of 44^0, and the wrist is 18^0.

Yellow markers are assigned to the neck score row at value 1 and the legs score row at values 3 and 4 in the trunk

column to obtain score A. Then, the meeting point between the three scores is obtained at value 6, then becomes the final score for section A. In section B, yellow markers are assigned at the value of 2 in the lower arm score, 2 in the wrist score row, and 3 in the upper arm column. The meeting point of the three scores in group B is obtained at value 5. Later, the A score and B score were converted to table c, and a value of 8 was obtained as a C score

A good grip pattern was shown, accompanied by repetitive twisting movements on the right wrist. The researcher observed that the posture was maintained statically for more than one minute, and there were repetitive movements more than four times a minute, so there was an increase in the activity score obtained by 2 points. A score of 10 was obtained from the accumulation of score C with activity scores.

Work posture is defined as a group of positions of the worker's limbs while doing their tasks [9]. In the term of ergonomics, work posture is an aspect that should be considered. In the livestock industry, work postures can be influenced by the environment and the farmer's activity [10]. Several studies stated that torso bending was the most common posture among workers in the livestock sector. The bent position will lead to a static load on the spinal nerve pads. Previous research states bending posture tends to become a predisposing factor for any complaints in the lower back [11].

Work-Related Musculoskeletal Disorders (WRMSDs) may be the most common impact that affects pig farmers due to their unergonomic work postures. Several studies have been conducted to determine the association between unergonomic work postures to the incidence of occupational diseases, one of which is WRMSDs [12]. The International Labor Organization (ILO) notes that the number of WRMSDs has increased among workers [13]. The 2018 Basic Health Research in Indonesia stated that 9% of injuries were caused by occupational risk [14]. The highest prevalence of WRMSDs in Indonesia occurred in fishermen, farmers, and laborers, with a percentage reaching 31.2% [15]. This phenomenon proves that the high risk of work postures is a possible cause of WRMSDs.

REBA has been well used to analyze the work posture of the subjects in this study. Based on the findings in this study, researchers also observed REBA's ability to determine follow-up work posture scores obtained by subjects. There are clear qualifications for determining group A and B scores, and the additional scores for repetitive and static movements are also considered. The use of REBA in the livestock sector is also described in several studies [16]. In this study result, REBA suggested investigating and implementing more ergonomic work posture changes in subjects.

In this study, the implementation of work posture changes in traditional pig farmers should be considered, as this problem is often associated with WRMSDs. Changes in work posture habits need to be made in conventional pig farmers. According to a previous study, ergonomically correct standing postures consist head and shoulders upright, arms relaxed on either side of the body, and feet shoulder-width apart [17].

Further investigation is necessary to design a new, more effective posture in order to reduce or eliminate the risk of WRMSDs experienced by farmers. A more ergonomic posture can be formed by minimizing the knee flexion angle so that both feet stand in perfect alignment. Reducing trunk flexion angle may be done by adding a proper broom handle used when cleaning the cage. After implementing a new posture and further investigation is carried out, it is necessary to review the new REBA score obtained by the worker [16].

Changes are needed to prevent the risk of injuries occurring to pig farmers. Creating a safe neutral position in the workplace can prevent the occurrence of work-related musculoskeletal complaints. Modifying more ergonomic work equipment for traditional pig farmers is necessary. In addition, safety support equipment also needs to be provided. Changes that can be made include: using comfortable and safe footwear, anti-slip boots can be feasible, modifications to work equipment by adding broom handles that are adapted to the farmers' standing posture can be useful in reducing the hunched position.

Periodic stretching may be needed to prevent musculoskeletal injury due to constant muscle contraction during work. Health education are necessary to be provided among pig farmers to improve their occupational health and safety. Health information and training on periodic muscle stretching will effectively be used to prevent work-related musculoskeletal complaints. Periodic stretching can reduce the risk of neck pain and spine complaints which are often in a static position during work [18]. Therefore, further research and innovation of posture changes are recommended.

V. CONCLUSION

The pig farmer in this study had a high-risk work posture with a score of 10. WRMSDS seems to be a predictable impact if there is no change and improvement in the pig farmers' work posture. Researchers have also found that REBA has good potential to serve as a work posture analysis method for pig farmers. From the result of this study, further research may be needed to examine the work posture of pig farmers more extensively, including the real impact of high-risk work posture and its association with WRMSDs. On the other hand, health professionals are also expected to provide education and information to pig farmers to implement better postures in future activities.

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