

ASSESSING MUSCULOSKELETAL DISORDERS (MSDs) OF WORKERS OF FIRED CLAY BRICKS INDUSTRY

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Abstract. Ergonomics is important for sustainable development in many fields, including architecture, health, product design, safety, and workplace design. Ergonomic assessments are essential in the workplace to prevent musculoskeletal disorders (MSDs). Currently, Indonesia has a standardized ergonomic assessment, SNI 9011:2021. This assessment standard is widely used to evaluate human posture. This study aims to evaluate the position of a traditional brick-maker in which the posture identification system is based on the SNI 9011:2021. This study employed a cross-sectional design with a sample of workers in conventional brick manufacturing. The primary findings of this study were visual ergonomic assessment for posture identification, identification of ergonomic assessment categories with high risk in brick manufacturing, and the prevalence of nagging pain among workers in the brick moulding and drying process. To reduce occupational ergonomic risk, particularly for brick-making workers, ergonomic intervention is required in the form of additional work aids such as chairs. This has been shown to reduce the evaluation score based on SNI 9011: 2021, thereby reducing the occurrence of musculoskeletal disorders.

Keywords : Ergonomic, Musculoskeletal disorder, SNI 9011:2021, brick industry,

1. INTRODUCTION

Ergonomics is important in many fields, including product design, architecture, health and safety, and workplace design [1,2]. Ergonomic assessment is a significant component in preventing musculoskeletal disorders (MSDs). Musculoskeletal disorders (MSDs) have been a major health concern that is frequently caused or exacerbated by workplace factors such as repetitive motion, stress, and awkward postures [3-5]. These disorders are associated with decreased productivity, sick leave, and chronic work disability [6,7]. MSDs can lead to pain and impaired function in the musculoskeletal system, particularly in the upper extremities and neck [8,9]. Recognizing the underlying causes and risk factors of MSDs is imperative for effective treatment and prevention. An ergonomic assessment is widely used to examine the human joint skeleton and identify postures that help prevent MSDs. Many ergonomic assessments are currently taking place in a variety of sectors. One of the industries that receives a lot of complaints about MSDs is industrial manufacturing.

Personal factors and ergonomics have long been important considerations in the industrial sector. In the manufacturing industry, it will affect the working productivity in which the manufacturing sector will rely heavily on output, product quality, and innovation [10]. This manufacturing sector requires efficient use of human resources to achieve high productivity [11].

Musculoskeletal disorders (MSDs) represent a significant health problem, often caused or exacerbated by work-related factors such as repetitive movements, stresses, and clumsy postures [12,13]. These impairments can

lead to decreased productivity, sickness absence, and chronic work disability [12]. Dental professionals are particularly vulnerable to MSDs due to the suboptimal ergonomics of the work environment [14]. The impact of MSDs on the musculoskeletal system can be resulting in pain and impaired function, especially in the upper extremities and neck [13]. Thus, understanding the causes and risk factors of MSDs is essential for effective intervention and prevention.

Human resources are a critical component of a manufacturing industry's production activities. To increase productivity and quality, consider the environment, workspace, and operator conditions. This will have a significant impact on the operator's physical conditions they also require adequate rest time to work, which increases labour productivity [10,15].

Various work environment factors are likely to contribute to the development of MSDs in the brick making process. Certain body sites such as the neck, upper extremities, and back have a high increased risk of MSDs [16] These impairments are associated with risk factors in the work environment including lifting, material handling, repetitive work postures, and awkward work postures. Excessive repetitive and prolonged exposure to static loads can lead to complaints of damage to joints, ligaments and tendons. Workers who perform repetitive activities in one cycle are very vulnerable to MSDs [17].

Brick-making is one example of a physically demanding activity. Workers in the brick-making of small and medium enterprise (UMKM) continue to engage in manual activity. This industry continues to be supported by a large number of workers as well as the use of traditional equipment in the burning and drying processes. The brick production process continues to use traditional tools, such as a manual printing process that is done in a sitting position for 7 hours. This can lead to the occurrence of MSDs.

The working system that has been in place for generations to maintain this commitment presents a challenge in improving work postures that can lead to MSDs. Some of them perform in the brick industry. Work posture in a sitting position during the brick-making process is one of the risks of MSDs. Consequently, the company owner's intervention is required in order to consider humans as the primary driver of improvement while maintaining the value of the work culture that workers have long maintained.

Several studies on MSDs have been carried out. A large percentage of workers who have worked for 4.5 years or have reached the age of 30 experience health and physical deterioration as a consequence of their workload. However, once workers become accustomed to their working conditions, they no longer perceive these complaints [18]. Workers' main complaints after work concern the waist, neck, and certain parts of the spine [19,20].

Risk assessment is an advantageous instrument for investigating unfavorable workplace exposures and prioritizing workplace changes. Health and safety legislation in Sweden and Europe requires periodic risk assessments to prevent exposure to potentially hazardous work environments [21,22]. SNI 9011: 2021 is one of the risk assessments that has become a standard in Indonesia. It is a standard for identifying ergonomic hazards. SNI 9011: 2021 measures the stages of preparation, implementation, and evaluation of ergonomic measurements in the workplace. The findings of this study can be used to identify potential health issues caused by ergonomic hazards in the workplace [23]. Thus, the purpose of this study is to identify MSD disorders in brick-making workers using SNI 9011: 2021, which was issued by the Indonesian government.

2. METHODS

This research design was cross-sectional involving 47 participants from the Yogyakarta geographic region. Respondent participation was based on consent and a protocol approved by Ahmad Dahlan University's ethics committee on October 25, 2023 (number 012310241). The selection of respondents was carried out randomly from the existing population. Assessment of MSDs and ergonomic symptoms refers to SNI 9011-2021, which addresses the assessment and evaluation of ergonomic risks in the workplace. Appendix D: SNI 9011-2021 contains an ergonomic hazard questionnaire for analysing and evaluating the level of ergonomic risk. The study looked at exposure duration, manual handling, and upper and lower body posture. Table 1 displays the total score based on the ergonomic risk level evaluation results.

Table 1. Risk Level Interpretation.

Score	Interpretation
≤ 2	Safe workplace
3-6	Need further Assessment
≥ 7	Dangerous

3. RESULTS AND DISCUSSION

3.1 Characteristic Respondent

The characteristics of research respondents are required to determine the distribution of respondents. Age measurements on the KTP are based on the date of birth, while gender is a phenotypic trait indicated by secondary gender characteristics. Body weight and height measurements were taken during the study. The research included 47 participants with an average age of 55 ± 5.18 years. In this study's age variable, there were 40 people over 50 (85.1%) and 7 people under 50 (14.9). Male workers totalled 29 (61.7%), while female workers totalled 18 (38.3%). Further details, the characteristics of the respondents are shown in Table 2.

Table 2. The Characteristic of Respondent

Parameters	Mean \pm SD
Age (Years)	55 ± 5.18
Height (cm)	153.47 ± 7.61
Weight (Kg)	57.27 ± 8.95
BMI (Kg/m ²)	24.37 ± 3.48
Work Experience (Years)	12.40 ± 4.67

3.2. Gender

In the study, 47 people took part in brick making. In this study, 61.7% were men and 38.3% were women. According to the study's findings, female respondents reported experiencing more MSD symptoms in the previous year while working on brick making. Some studies have also found that women are more likely to develop MSD symptoms when engaging in repetitive activities [24,25].

3.2. Working Periods

The working period in the brick industry is a considerable length of time, it can be seen in Table 2 that the average working period of the workers is 12.4 years. According to research [17], there is a relationship between length of service and MSDs, especially work involving muscle strength.

3.3. Ergonomic Risk Assessment

The assessment of potential ergonomic risks in brick-making based on SNI 9011-2021 identifies two assessment categories that are high risk and warrant further investigation. According to the results of the musculoskeletal disorders analysis, the hazard level score ranged from 7 to 26, with a total of 47 respondents. In the assessment of MSD symptoms in the process of printing and drying bricks, it was discovered that 6.4% of the sample never felt annoying pain caused by the work of printing and drying bricks, while the remaining 93.6% experienced undesirable pain as a side effect of the work of printing and drying bricks. Of the total respondents, 44 workers experienced pain (93.6%) and the remaining 3 workers did not suffer from pain (6.4%). The number of hours spent at work by the respondents was 32 people doing their work for more than 5 hours (68.1%), while the remaining 15 people worked for less than 5 hours (31.9). Most of the respondents, namely 42 people, use their right hand as the dominant hand (89.4%) while the remaining 3 respondents use their left hand as the dominant hand (6.4%) and there are also right and left hand dominant workers, as many as 2 respondents (4.2%). A total of 44 respondents have worked for more than 5 years (93.6%) and 3 respondents have worked for less than 5 years (6.4%).



Figure 1. Work posture of brick worker

Workers in the brick sector experience MSDs complaints as a result of repetitive activities during the brick moulding process, which put pressure on the muscles due to the continuous workload. Furthermore, it is the result of working postures while sitting during the moulding process. Symptoms of MSDs based on SNI 9011-2021 revealed that as many as 6.4% of the sample never experienced annoying pain caused by the work of printing and drying bricks, while the remaining 93.6% experienced annoying pain as a result of the work. Of the 6% of the workers who did not experience pain, two had not worked for more than ten years, and one had worked for more than ten years but could use both hands well without dominant left or right hands making the worker's job easier. Figure 2 illustrates the results of pain complaints.

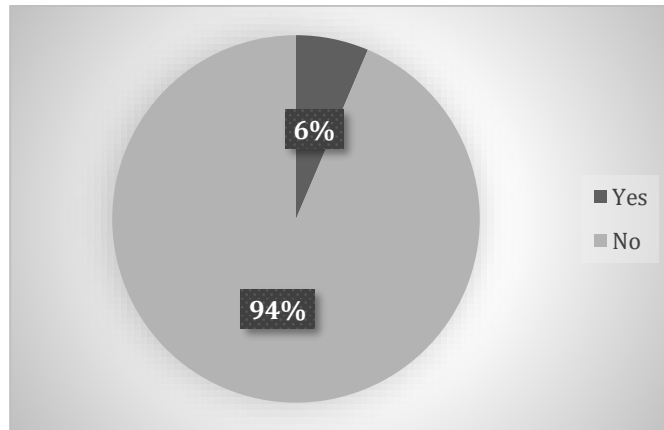


Figure 2. The chart of pain complaint

Static postures put more strain on muscles and tendons, resulting in fatigue or exhaustion [26,27]. The hazard score in the gotrak assessment work posture ranges from a maximum of 26 to a minimum of 7, with a tolerance value of less than 7 indicating safety.



Figure 3. Photo of workers after using suggested improvements



Figure 4. Picture of worker mannequin after suggested improvements

The suggested improvement to the type of folding chair has a significant impact on the hazard factor score assessment. Whenever this improvement suggestion is implemented, all overall ratings for the hazard factors will change. For instance, the respondent's hazard factor score began with a value of 8, which is classified as hazardous, but after implementing the improvement suggestion in the form of a folding chair, the score changed from 8 to 6. Based on the results of the SNI 9011-2021 assessment, it is demonstrated that the improvement suggestion in the form of a folding chair can reduce the hazard factor score.

4. CONCLUSION

The results of the MSD assessment using SNI 9011-2021 show that most traditional brick-makers have MSDs symptoms with varying degrees of risk. As many as 93.6% of workers complain of lower back pain, which is caused by their position, specifically crouching. The average age of brick workers is more than 50 years. The advice assigned to reduce MSDs complaints is to provide a small chair to sit in while making bricks. The score obtained before using a small chair was 8, and the score obtained after using a chair as a seat was 6. This illustrates how suggestions for improvement, such as using a chair or sitting aid, can reduce the score value of MSDs complaints based on SNI 9011 2021.

Therefore, it is recommended that brick-making workers require ergonomic intervention in the form of additional work aids such as chairs to reduce work ergonomic risks. This has been proven to reduce evaluation scores based on SNI 9011:2021 thereby reducing the occurrence of musculoskeletal disorders.

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