

Study of the performance of small industry and household pottery craft workers based on ergonomic principles

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Abstract

Musculoskeletal complaints in pottery workers occur due to the use of work tools that are not ergonomic. Work tools that are not ergonomic cause unnatural work postures such as squatting, bending over, out of reach, etc. Overcoming this requires measuring workers' body dimensions or anthropometric data. Using anthropometric data in tool design requires worker measurement data to be calculated using percentiles according to the tool to be designed or redesigned. Applying worker anthropometric data provides work tool designs that suit workers' needs so that they are comfortable when used. This has the impact of no longer causing musculoskeletal complaints, often referred to as ergonomic work tools. Applying ergonomics principles in small industries and households is necessary so that workers can carry out their work effectively, comfortably, safely, healthily, and efficiently. This is so that workers can increase their productivity while maintaining their health.

Keywords: Worker performance; Small industry; Household; Pottery; Ergonomics

1. Introduction

Currently, the work is carried out traditionally using simple tools or machines, such as effortless machines to high technology-based machines, and is done repeatedly. This condition has the impact of a job being less exciting and monotonous. Especially for work that is done manually, it requires heavy physical demands and pressure. This increases the occurrence of complaints and complaints among workers. Conditions like this cause pain in the back and waist, tension in the neck; wrist, arm, and leg pain, eye fatigue, and other complaints. To overcome this, ergonomics is used to solve every problem that arises in the workplace, especially in small industries and households, as discussed in this article.

Ergonomics is a multidisciplinary field. Ergonomics can be found in various non-technical fields such as health, medicine, and social sciences such as psychology. However, the area of ergonomics is very closely related to the field of engineering. It can be classified as a part of engineering closely related to humans as workers. Ergonomics and human factors are scientific disciplines that simultaneously optimize human well-being and overall system performance in different work contexts [1]. According to the IEA, ergonomics (or human factors) is a scientific discipline concerned with understanding interactions between humans and other elements of a system and a profession that applies theories, principles, data, and methods to design and optimize human well-being and overall system performance [2]. Ergonomics is the science of harmonizing workers with tools and workstations to make work practical, comfortable, safe, healthy, and efficient. Applying ergonomics principles in small industries and households is necessary so that

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workers can carry out their work effectively, comfortably, safely, healthily, and efficiently. This is so that workers can increase their productivity while maintaining their health. This article focuses on pottery crafts, one of the small industries in the Lombok area, namely in Banyumulek village.

The artisans in Banyumulek village use materials found around them to produce pottery. These ingredients include clay, water, and natural dyes using tamarind seeds [3]. Pottery is used as a livelihood for some people in Banyumulek and as a tourist attraction. The process of making pottery is still straightforward, using manual equipment. Apart from that, the workers' working posture is not ergonomic due to the simple work tools. Simple equipment and worker work postures are shown in Figure 1.



Figure 1 Simple tools and working postures in making pottery, a) clay, b) tools for mixing clay, c) firing pottery and d), e), f) forming process [4]

The work posture, as in Figure 1, is the impact of a straightforward work tool. Working posture is unnatural and does not comply with ergonomic principles. This can cause musculoskeletal complaints in workers. Increased levels of musculoskeletal complaints, including fatigue and the risk of muscle injury due to unnatural work postures, result in additional workload, decreased productivity, and other health costs [5, 6, 7, 8]. For pottery production to continue to be sustainable, participation from the workers themselves is necessary in terms of the tools used. This method uses ergonomic principles related to humans as the center of work to reduce occupational health and safety risks [9, 10]. The principle of fitting the task to the man in ergonomics is that work must be adapted to human abilities and limitations to increase the results achieved [11]. Manual work will result in complaints among workers such as back and waist pain, neck tension, wrist, arm and leg pain, eye fatigue, and many others. The presence of various complaints, both physical and psychological, will undoubtedly reduce work performance, which will ultimately reduce work productivity [12]. Based on recommendations from the Occupational Safety and Health Administration (OSHA), ergonomic measures are used to prevent sources of disease in two ways, namely (1) technical engineering, such as the design of workstations and work tools; (2) management engineering, such as criteria and work organization. This reduces musculoskeletal disorders. Exposure to risk factors for musculoskeletal disorders increases the risk of work injury [13]. To overcome musculoskeletal disorders, ergonomic work tools are needed, namely, work tools designed based on ergonomic principles.

Small industries and households need work tools to run a business by some people to make the production process more accessible. Artisans need work tools that are easy to operate, safe, comfortable, and effective. To increase productivity, the work tools must maintain workers' quality of life. This article aims to provide information about the importance of ergonomics applications in carrying out work. By applying ergonomic principles to work tools used in

production, workers can work effectively, comfortably, safely, healthily, and efficiently. Ergonomics can increase productivity, operate safely, and maintain health.

2. Material and methods

This article provides information about models of work tools that are effective and suitable for small businesses in pottery production. This article is based on observations made by pottery artisans in Banyumulek village, Lombok. From the results of the words, the work tools used and the work posture of the pottery artisans were obtained. In addition, musculoskeletal complaints were measured in workers using the Nordic Body Maps (NBM) questionnaire. From these data, the author conducted a study regarding work tools suitable for use by pottery artisans based on several research results.

This article presents several work tools designed based on the principles of ergonomic applications. Ergonomics has several terms and definitions related to the understanding of ergonomics, such as human factors, human engineering, human factors psychology, applied ergonomics, and industrial engineering/ergonomics. Of the many terms, those that are often used are human factors and ergonomics. Understanding human factors is usually associated with problematic work psychology (mental workloads and cognitive issues), while ergonomics is related to physical work. Human engineering, often called ergonomics, is defined as designing man-machine interfaces so workers, machines, or other products can function more effectively and efficiently as an integrated human-machine system [14]. Ergonomics principles are carried out through anthropometric data and a worker participation approach. This is an effort to reduce the occurrence of musculoskeletal complaints in workers. A participatory approach has advantages such as profitable procurement of work tools, a lighter physical workload, and the most effective way to redesign manual tasks [9, 15]. Work tools that are not ergonomic have an impact on unnatural working posture. As a solution, this is done by measuring the anthropometric data of workers who use work tools for production processes, especially on a small scale. Anthropometric problems are related to the design of workstations, work facilities, and product design so that measurements are appropriate and suitable for the dimensions of the human body parts that will be them. This is done to achieve pleasant, comfortable, safe, and healthy conditions for humans and to create efficient working conditions with effective results to fulfill ergonomic requirements [16]. The method in this report uses the results of observations in Banyumulek small industries, research, and news. A study was conducted regarding ergonomic interventions based on anthropometric data to design work tools to reduce workers' musculoskeletal complaints in the small-scale pottery production process. Anthropometric databases can help create appropriate workplaces and equipment, reducing disruptions and accidents [17].

3. Results and discussion

The results of the subject's observations in the tiny pottery industry in Banyumulek village showed that the work tools used were still simple. This has an impact on unnatural working postures, as shown in Figure 2.



Figure 2 Condition of Banyumulek pottery craftsmen, a) workers' working posture, b) work aids



Figure 3 One example of musculoskeletal complaints experienced by workers

Workers in making pottery use straightforward tools. The tools used have an impact on the working posture of the worker, namely, the worker is in a squatting position. This kind of working posture based on ergonomic principles is wrong and unnatural. Bad and unusual work postures increase the risk of injury to the musculoskeletal area [18]. Working postures, as in Figure 2a, give rise to musculoskeletal complaints, as shown in Figure 3. Based on the results of measurements of five samples of workers using the Nordic Body Maps (NBM) questionnaire, it was found that the average level of musculoskeletal complaints was 64.2. This indicates that musculoskeletal complaints occur with moderate risk. Musculoskeletal complaints with a mean score of 64.2 indicate that corrective action is needed on work tools. Several models of work tools that are suitable for traditional pottery workers are presented below



Figure 4 Design of table and chairs for pottery workers [19]

The redesign of the pottery maker's work facilities, as presented in Figure 4, was carried out by Hanafi et al. through a design in the form of a table and chair equipped with a backrest [19]. In this design, the seat height can be adjusted, and the backrest can be adjusted back and forth according to the worker's needs. The redesign of the pottery maker's work tools through changes made to work tables and chairs was carried out by Yusuf, as shown in Figure 5. As carried out in Figure 5, the redesign of the work tools reduced the pain that occurred in workers. In addition, productivity increased by 44.5%.

As in Figure 5, the design model is still relevant to be applied to pottery workers in small industries because it is easy and affordable. Apart from that, the work tools today are still straightforward, like those in Banyumulek. Applying ergonomic principles to design work tools can make workers' working posture more natural and comfortable. This condition will prevent workers from experiencing musculoskeletal complaints, which impact productivity. Unergonomic postures cause musculoskeletal complaints, which have the effect of reducing productivity [21].

The application of ergonomics to work tools has an impact on a more natural working posture. This aims to avoid musculoskeletal complaints in workers. Olowogbon et al. explained that poor working posture due to poor agricultural manual lifting and handling causes musculoskeletal disorders (MSDs). This disorder has symptoms including pain in the lower and upper back, shoulders, ankles, knees, elbows, neck, wrists, and hands [22]. MSDs can be reduced by training workers in ergonomics, performing multi-person tasks, encouraging breaks, and alternating work postures [23]. Training workers in ergonomics is necessary because ergonomics achieves harmony between humans or workers and workstations and tools. This is by the International Ergonomics Association, which states that ergonomics is a scientific discipline that deals with human interaction and other elements of a system and a profession that applies theory, principles, data, and methods to design and optimize human welfare and overall system results [2]. Work tools designed with ergonomic principles provide a practical, comfortable, safe, healthy, and efficient way of working and do not cause new problems after the device is applied in production. Increase productivity and quality of life for workers.



Figure 5 Redesign of pottery-making work tools a) old tools, b) redesigned tools [20]

4. Conclusion

Based on observations made on pottery workers in Banyumulek village, unnatural working postures were found. This is due to the use of straightforward work tools—the work tools used cause musculoskeletal complaints in workers. From the results of a review of several studies and literature, it was found that ergonomic interventions to design or redesign a work tool based on worker anthropometric data were able to reduce musculoskeletal complaints and fatigue. To minimize risks in physical work and increase productivity, it is essential to carry out an ergonomic assessment. The results of the ergonomic assessment after using the new tools as a result of ergonomic intervention show that work posture becomes natural, reduced musculoskeletal complaints and fatigue, and increased comfort and productivity.

Compliance with ethical standards

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Disclosure of conflict of interest

The authors declare no conflict of interest.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study. Subjects were willing to participate in research entitled "Study of the performance of small industry and household pottery craft workers based on ergonomic principles" and were willing to have their musculoskeletal complaints measured.

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