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Ergonomic Hazard Measurement, Evaluation and Controlling in the Pempek Palembang Home Industry Based on SNI 9011:2021

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Abstract:- This study aims to measure, evaluate and control the potential hazards of ergonomics in the Pempek Palembang workplace that have not yet been SNI. Ergonomics hazard phenomenon that occurs is in muscles-skeletal disorders due to work. Injuries or disorders of the skeletal muscle system are caused and exacerbated by work. The data is taken from the measurement of the potential for ergonomic hazards in the workplace of five Pempek Palembang workplaces with a total of 15 workers. Measurement of potential hazards using the Implementation Guidelines for Measurement and Control of Ergonomic Hazards as stated in SNI 9011:2021 and The Minister of Manpower Government Regulations Republic of Indonesia No.5 of 2018 concerning environmental work safety and health. The risk evaluation used was a complaint survey, evaluation of risk factor scores, and anthropometry and workplace design checklists. The results showed that the potential hazards of ergonomics in the workplace include 15% Carpal Tunnel Syndrome, 17% Lower Back Pain, 8.2% Tendonitis, 12% Tenosynovitis, 5.7% De Quertion Syndrome, 10% Reynaud's Syndrome. Thus, it is recommended to carry out a strategy to minimize the risk of ergonomics hazard, namely measuring and controlling posture, tools, and lifting loads, as well as conducting an evaluation and control program with the conditions that must be met are management support, worker involvement, part of HSE (Health, Safety and Environment) and related to performance and remuneration. It does not have a bad impact on workers, and starts from a small scale with SHIP Approach (a systematic, holistic, interdisciplinary,.

Keywords:*-Measurement-Evaluation-Controlling, Ergonomic Hazard Potential, SNI 9011:2021, and Pempek Palembang Home Industry.*

I. INTRODUCTION

Ergonomic hazards refer to potential risks that arise from an inefficient interaction between work tools and humans, often influenced by the behavior of individuals while using the tools. In the context of comprehensive ergonomics, an evaluation can be conducted by examining various aspects such as tasks, work organization, and the work environment. These ergonomic hazards can lead to injuries or disorders within the skeletal muscle system, which are aggravated by work activities. Musculoskeletal disorders (MSDs) (1) specifically involve the skeletal muscles and are typically caused by the prolonged exposure to static loads, resulting in discomfort in the joints, ligaments, and tendons [1]. MSDs manifest as pain, injuries, or abnormalities in the musculoskeletal system, including nerves, tendons, ligaments, muscles, and joints. Furthermore, work-related musculoskeletal disorders (WMSDs) (1) are conditions in which the work environment and work performance significantly contribute to or worsen the disorder. Examples of work-related skeletal muscle disorders include carpal tunnel syndrome (CTS), chronic back pain, tendonitis, tenosynovitis, de Quervain syndrome, and Reynaud's syndrome. Risk assessment, which encompasses evaluating work tasks, existing risk controls, likelihood, severity, and overall risk level, is utilized to assess the level of risk involved [2]. It is important to note that continuing to work while experiencing pain can diminish work productivity and potentially lead to long-term disability and job loss for workers [11]. MSDs can affect workers engaged in physically demanding activities or those working in static and unnatural positions, such as those involved in the production of pempek—a culinary specialty of Palembang, which offers various types. Findings from the observation of 35 workers involved in pempek production revealed that 25 of them experience fatigue [6] [7].

Risk factors associated with musculoskeletal disorders (MSDs) can be categorized into two groups: psychological factors and physical factors. The physical factors consist of occupational risk factors, personal risk factors, and environmental risk factors. Occupational risk factors encompass posture risk, workload, frequency, and duration. Personal risk factors include factors such as job, age, smoking, gender, stress, history of MSDs, and body mass index (BMI). Environmental risk factors include vibration, lighting, noise, cold stress, and heat stress [11] [12]. Job characteristics also contribute to the risk factors, which include work methods, workstation design, physical work environment, psychosocial factors, and work organization. These factors are closely associated with the development

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and exacerbation of work-related skeletal muscle disorders. Static or non-neutral postures, repetitive tasks, excessive force, hard work surfaces or mats, vibration, temperature, lighting, noise, among others, can all contribute to the risk. Research conducted on 9,482 workers across 12 districts and cities in Indonesia revealed that MSDs accounted for the majority of reported disorders (16%), followed by cardiovascular disorders (8%), nervous disorders (5%), respiratory disorders (3%), and ENT disorders (1.5%) [4]. These findings highlight that MSDs are the most prevalent issues faced by workers. Additionally, preliminary studies conducted at the research site indicate that a significant number of workers experience discomfort in the lower back, shoulders, and legs, as well as muscle cramps and pain.

Drawing from various references, observations, socialization, and technical guidance on the measurement, evaluation, and control of potential ergonomic hazards in the workplace, the implementation of SNI 9011:2021 in Palembang City on August 4, 2022 highlighted the continuous need for socialization and technical guidance in addressing potential ergonomic hazards specifically in pempek production sites. SNI 9011:2021 serves as an Indonesian National Standard (SNI) that provides guidelines for measuring and controlling potential ergonomic hazards, derived from the Minister of Manpower Regulation of the Republic of Indonesia No. 5 of 2018 concerning occupational safety and health in the work environment. This standard has been adopted as technical guidance across local governments in Indonesia through collaboration between the Ministry of Manpower and PEI (Employers' Association of Indonesia).

One of the main purposes of implementing SNI 9011:2021 is to effectively assess the risks associated with musculoskeletal disorders (MSDs) and work-related musculoskeletal disorders (WMSDs). It enables a quick evaluation of the exposure to MSDs and WMSDs, particularly focusing on areas such as the back, shoulders/arms, wrists, and neck. Moreover, it aids in identifying risk factors associated with work-related skeletal muscle disorders, including job complaints, risk factor scores, and workplace anthropometry and design [5].

Building upon this background, the current study aims to analyze the risk factors related to work-related skeletal muscle disorders, MSDs, and WMSDs among workers in the home industry of Pempek Palembang. The analysis utilizes the methodology outlined in SNI 9011:2021, which involves measuring and evaluating potential ergonomic hazards in the workplace. Risk assessment will be conducted through complaint surveys, evaluation of risk factor scores, anthropometric checklists, and workplace design evaluations. The research endeavors to determine the percentage of potential ergonomic hazards present in the workplace, including conditions such as carpal tunnel syndrome, lower back pain, tendonitis, tenosynovitis, de Quervain syndrome, and Reynaud's syndrome [3] [5].

II.RESEARCH METHODS

This particular research adopts a descriptive and observational approach to investigate the risk factors associated with work-related skeletal muscle disorders, as well as the occurrence of MSDs and WMSDs among workers in Pempek Palembang home industry settings. The study population consists of 15 workers from One Home Industry Pempek Palembang, who also serve as respondents for the various assessments, including the MSD complaints survey, WMSDs evaluation, risk factor scoring, anthropometric checklist, and workplace design examination. The selection of samples is determined by the number of tasks involved in each stage of the pempek production process. These stages encompass five key processes: 1) mixing raw materials such as wheat flour, rice flour, salt, and hot water to achieve a smooth or doughy consistency, 2) incorporating vegetable oil and eggs, 3) shaping pempek according to preference, 4) boiling the cuko ingredients until they reach boiling point and setting it aside, and 5) frying the pempek until it turns golden yellow and then cutting it into pieces. These individuals serve as the research participants for the measurement, evaluation, and control of potential ergonomic hazards based on SNI 9011:2021.

To mitigate the risks associated with ergonomic hazards, strategies include the measurement and control of posture, tools, and lifting loads, as well as the implementation of evaluation and control programs. These programs should be supported by management, involve employee participation, encompass health, safety, and environmental (HSE) aspects, and address performance and remuneration. The objective is to ensure that workers are not negatively impacted and to initiate the process on a small scale using the SHIP Approach, which stands for a systematic, holistic, interdisciplinary, and participatory approach. The ultimate goal is to establish effective, comfortable, safe, healthy, and efficient (ECSHE) working conditions.

III. RESULTS AND DISCUSSION

The work system observed in the Palembang Pempek home industry has the potential to contribute to work-related skeletal muscle disorders due to the limited understanding of ergonomics, resulting in the absence of measurement, evaluation, and control practices. The level of knowledge and awareness regarding ergonomic work among the 15 respondents from the Pempek Palembang home industry is relatively low. Therefore, it is necessary to adopt a simplified and participatory approach that focuses on ergonomics, aiming to improve the effectiveness, safety, health, and efficiency (ENASE) performance of workers. This can be achieved through workshops involving all workers and owners of the Pempek Palembang home industry, providing them with technical guidance on the implementation of SNI 9011:2021, which addresses the measurement, evaluation, and control of potential ergonomic hazards in the workplace. To ensure comprehensive ergonomics research, three key elements should be considered: problem identification, systemic analysis, and participatory decision-making, with

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the inclusion of appropriate technology. By utilizing this approach, workers and owners of the Pempek Palembang home industry can identify existing workplace issues, determine priorities, and implement interventions to improve their work environments and organizational practices. Evaluation and refinement of these interventions should also be conducted [10][11][12].

Processes 1 and 2 in the work system of the Palembang Pempek industry are non-ergonomic, specifically the mixing process of raw materials such as wheat flour, rice flour, and salt, followed by pouring hot water and kneading until smooth. These tasks require an ergonomic intervention study due to the non-physiological work attitude, which involves sitting on a chair that lacks anthropometric support. The manual bending required for forming pempek results in significant muscle energy expenditure. The Nordic Body Map (NBM) indicates a high risk of musculoskeletal pain and complaints in the wrists, arms, and back, with approximately 50% of workers experiencing such issues. Additionally, the NBM classifies the fatigue level as high (45–62), the physical workload as heavy (125–145 dpm), and the CVL category as rather heavy (60–78%). Work organization lacks appropriate work breaks and fails to provide additional nutrition. The designated break time is from 12:00 to 13:00 WIB for Isoma. The work environment is characterized by high temperatures (38–40 oC), humidity, poor ventilation, and inadequate air circulation. To address these concerns, it is recommended to redesign the work system, potentially incorporating a more ergonomic solution such as a pempek-shaped printer [9].

The non-ergonomic work system can be observed in processes 3 and 5, namely the process of forming pempek according to taste and the process of frying the pempek until it reaches a golden yellow color, followed by cutting it into pieces. These tasks involve a non-physiological work attitude, such as sitting on a chair that lacks anthropometric support and constantly looking down. Manual bending during the formation of pempek requires significant muscle energy, leading to musculoskeletal pain and complaints in the wrists, arms, and back, affecting approximately 50% of the workers. The Nordic Body Map (NBM) assessment reveals a high risk level (42–50) for these issues, along with a classification of high fatigue (45–62), heavy physical workload (125–145 dpm), and a rather heavy CVL category (60–78%). In terms of work organization, there is a lack of scheduled work breaks and inadequate provision of additional nutrition. The designated break time is from 12:00 to 13:00 WIB for Isoma. The work environment is characterized by a hot workspace (40–45 oC), high humidity, dim lighting, and the presence of all processes in a single room, resulting in poor ventilation and suboptimal air circulation. To address these concerns, it is recommended to redesign the working system, potentially incorporating a more ergonomic solution such as a pempek-shaped printer, as well as improving the lighting conditions [9].

The implementation of SNI 9011:2021 aims to address potential ergonomic hazards associated with work and reduce the risk factors for work-related skeletal muscle disorders. This involves evaluating various aspects, including anthropometric data checksheets, workplace design checklists, and complaint checklists derived from the Nordic Body Map (NBM). The evaluation of potential ergonomic hazards involves a comprehensive assessment, incorporating a complaint survey, risk factor score evaluation, anthropometric checklist, and workplace design analysis.

Based on the NBM assessment, the prevalence of musculoskeletal disorder (MSD) symptoms is as follows: 45% for low back pain, 25% for wrists, 15% for ankles, and 15% for shoulders. The results further indicate the presence of potential ergonomic hazards in the workplace. Specifically, there is a 15% occurrence of carpal tunnel syndrome, 17% for lower back pain, 8.2% for tendonitis, 12% for tenosynovitis, 5.7% for de Quervain's syndrome, and 10% for Reynaud's syndrome. By conducting these evaluations and assessments, the aim is to identify and address the potential ergonomic hazards, ultimately improving the working conditions and reducing the risk of work-related skeletal muscle disorders.

The strategy to minimize the risk of work-related skeletal muscle disorders is based on SNI 9011:2021, which provides guidelines for measuring and evaluating potential ergonomic hazards in the workplace. This strategy aligns with the Minister of Manpower Regulation number 5 of 2018, which focuses on occupational safety and health in the work environment. According to Article 23 of this regulation, the strategy involves defining ergonomic hazards and measuring factors such as posture, position, work method, workplace layout, equipment, and lifting loads. The control measures outlined in the strategy aim to improve posture and work methods. Appendix 6 of the regulation provides further details on anthropometry, workplace design, production and office floors, lifting tables, and safe force limits according to the NIOSH Recommended Weight Limit (RWL). By following these guidelines and implementing appropriate measurement and control practices, the aim is to reduce the occurrence of ergonomic hazards and promote a safer and healthier work environment. [3][5][7].

Management support and employee involvement play crucial roles in the evaluation and control program for work-related skeletal muscle disorders. Management support is integrated into the Safety and Health Management System (SMK3) and is characterized by its positive impact on workers, systematic approach, comprehensive coverage, and recognition of benefits in terms of productivity and quality. It is important for management to consistently communicate the significance of worker safety and health, delegate responsibilities to managers, supervisors, and employees, allocate sufficient resources to the ergonomics process, incorporate safety and health considerations into production processes and improvements, and ensure compliance with the Occupational Safety and Health (OSH) Act's non-retaliation policy for workers reporting work-related injuries and illnesses.

To foster employee involvement, a system should be developed that allows employees to actively participate in the design of work, equipment, and procedures, report workplace

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hazards without fear of reprisal, and receive training. Additionally, an employee complaint or suggestion procedure should be established, providing a safe platform for employees to raise ergonomic concerns. It is important to encourage employee feedback on the workplace, form employee groups to identify problems and analyze tasks, and seek recommendations for solutions. Furthermore, it is essential to ensure that no employee faces retaliation for exercising their rights under OSHA law, which includes reporting potential hazards, symptoms, or work-related injuries. By actively involving employees and creating an environment where their voices are heard, organizations can effectively address ergonomic issues and promote a culture of safety and well-being.

Controlling the risk of work-related skeletal muscle disorders requires a systematic and holistic approach that includes the active participation of workers and the utilization of cost-effective technology. The control hierarchy provides a framework for addressing the risks, beginning with the least effective measures and progressing towards the most effective ones. The recommended sequence is as follows: firstly, protecting the worker through the use of personal protective equipment (PPE); secondly, implementing changes in work practices through administrative controls; thirdly, isolating individuals from the hazard by employing engineering controls; fourthly, replacing the hazard with safer alternatives through substitution; and finally, eliminating the hazard altogether [8].

The application of ergonomics and occupational safety and health (OSH) often faces obstacles due to several key factors. Firstly, the implementation of K3 and ergonomics, which aim to create a healthy, safe, comfortable, and efficient work environment while enhancing productivity, may struggle to demonstrate immediate monetary benefits in the eyes of company management. Consequently, ergonomics and K3 programs may receive low priority within companies. Secondly, the programs implemented tend to focus more on reactive measures rather than proactive and promotional initiatives, thereby being perceived as mere expenses. Additionally, factors such as limited knowledge about ergonomics and K3 among both management and employees, insufficient funding, lack of supervision, and inconsistent enforcement of government sanctions contribute to the challenges.

To address these issues, there is a need to prioritize the pursuit of K3 and ergonomics in a manner that showcases tangible benefits not only for the workforce but also for the company's bottom line. This entails emphasizing the financial advantages associated with these initiatives in the language understood by businesses. Furthermore, it is crucial to strengthen supervision and enhance the enforcement of sanctions by the government. By doing so, the application of K3 and ergonomics can yield profitable outcomes that are not only beneficial to the workforce but also immediately visible and valued by companies.

IV. CONCLUSIONS AND SUGGESTIONS

➢ *Conclusion*

The research findings emphasize the importance of implementing SNI 9011:2021 to effectively address and control potential ergonomic hazards in the workplace, thereby minimizing the risk factors associated with work-related skeletal muscle disorders. The evaluation process, which incorporated an anthropometric data checksheet, a workplace design checklist sheet, and a complaints checklist developed from the NBM checklist sheet, allowed for a comprehensive assessment of these hazards. Based on the evaluation, the prevalence of musculoskeletal disorder (MSD) symptoms was identified, with 45% reporting low back pain, 25% experiencing wrist pain, 15% encountering ankle pain, and 15% having shoulder discomfort. Furthermore, the study revealed specific hazards related to ergonomics in the workplace, such as a 15% incidence of carpal tunnel syndrome, 17% occurrence of lower back pain, 8.2% prevalence of tendonitis, 12% manifestation of tenosynovitis, 5.7% manifestation of de Quertion syndrome, and 10% occurrence of Reynaud's syndrome.

➢ *Suggestions*

Strategies aimed at reducing the risk of work-related skeletal muscle disorders, as outlined in SNI 9011:2021, require the active involvement of both management and employees, with a focus on overcoming obstacles in their implementation. This can be achieved through several measures: firstly, demonstrating tangible outcomes by creating an ENASE-compliant workplace and showcasing the financial advantages it brings to the company; secondly, ensuring that company management gives due priority to ergonomics and OSH programs; and thirdly, implementing comprehensive programs that not only address curative measures but also encompass preventive and promotive actions, thus emphasizing their beneficial nature. Additionally, providing intensive technical guidance on the implementation of SNI and K3 to both management and employees, along with strict government supervision and the application of sanctions, are crucial components to successfully eliminate these obstacles and promote a safer working environment.

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ISSN No:-2456-2165

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