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Improving Resilience of Wingko SMEs through Ergonomic Workstation Design

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Abstract

This community service project aims to improve the resilience of the wingko industry in Magelang, Indonesia, by improving workstations and providing disaster preparedness education. The wingko industry faces challenges related to occupational safety and health due to non-ergonomic working conditions and limited implementation of safety standards. The project consisted of four stages: field assessment, measuring employee work posture using the Rapid Upper Limb Assessment (RULA) and Nordic Musculoskeletal Questionnaire (NMQ), designing a workplace layout involving workers, and organizing the workplace according to occupational health and safety standards. The community service results showed that 68% of workers had a RULA score of 5-6, 21% a score of 4, and 11% a score of 7, indicating the need for investigation and change, while 78% reported complaints of low-grade musculoskeletal disorders (MSDs), with the back and calves being the most affected body parts. Interventions included designing ergonomic workstations, installing safety signs, marking evacuation routes, and providing educational posters on health and safety. Recommendations for regular maintenance, storage space management, and the integration of 5R principles are provided to ensure continuous improvement. This project demonstrates the importance of ergonomic interventions and worker education in enhancing the resilience and sustainability of the local industry.

A. Introduction

Small and medium industries (SMEs) play an important role in Indonesia's economy, especially in providing employment opportunities and driving local economic growth. One rapidly developing sector is the traditional food industry, such as the wingko industry, which can be found in many parts of Central Java, including Magelang. Wingko is a coconut-based food that is baked to achieve its distinctive texture and flavor. Its production process is still largely carried out manually, using relatively simple technology. Despite having promising economic prospects, the wingko industry in Magelang faces various challenges, especially regarding occupational safety and health. Based on various studies related to small-scale food industries, the risk of workplace accidents in this sector tends to be high due to a lack of attention to ergonomic factors, inadequate working environments, and minimal implementation of safety standards (Lukiyanto et al., 2023). Some of the main issues commonly found in the traditional food industry include

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non-ergonomic working positions, excessive heat exposure from ovens or stoves, inadequate ventilation, as well as low usage of personal protective equipment (PPE) (Bonsu et al., 2020).

Studies of SMEs in the food, craft, and textile sectors show that the implementation of "sustainable ergonomics" in Indonesian SMEs remains far below potential (Octavia et al., 2025). However, in specific sectors such as the wingko (traditional coconut-based food) industry, there are still few documented ergonomic interventions (e.g., redesigning work equipment, seating arrangements/table heights, adjusting work postures, ventilation, and PPE) in a systematic manner.

According to data from BPJS Ketenagakerjaan, in 2020 there were 221,740 recorded workplace accident cases, increasing to 234,370 cases in 2021, and reaching 265,334 cases during the January-November 2022 period (BPJS Ketenagakerjaan, 2024). Based on research, among 9,482 workers in 12 regencies in Indonesia, the highest rate of health complaints experienced by workers was musculoskeletal disorders (MSDs) (16%), followed by cardiovascular disorders (8%), neurological disorders (5%), respiratory disorders (3%), and ENT (ear, nose, and throat) disorders (1.5%). The industry that contributed the most to musculoskeletal complaints was the informal sector (Umima & Utami, 2022).

Poor ergonomics at a workstation can increase the risk of MSDs in workers, such as back, neck, and arm pain resulting from uncomfortable sitting or standing positions for prolonged periods (Tanjung et al., 2023). In addition, an unsupportive work environment, such as inadequate lighting and poor air circulation, can cause fatigue and decrease worker productivity. Other risks to be aware of include the potential for accidents due to slippery floors, poorly arranged equipment, and unsafe handling of raw materials (Kenny et al., 2024).

The lack of application of occupational health and safety principles in the wingko industry not only affects the workers but can also impact product quality and production efficiency. According to the World Health Organization, a healthy and safe work environment contributes to increased productivity and improved work quality. Therefore, efforts to improve workstations by prioritizing ergonomic and safety aspects are strategic steps in reducing occupational hazards and enhancing the well-being of workers in the wingko industry.

B. Methods

This community service project uses a participatory analysis approach involving workers and stakeholders in the wingko industry to identify potential disaster risks and the challenges they face.

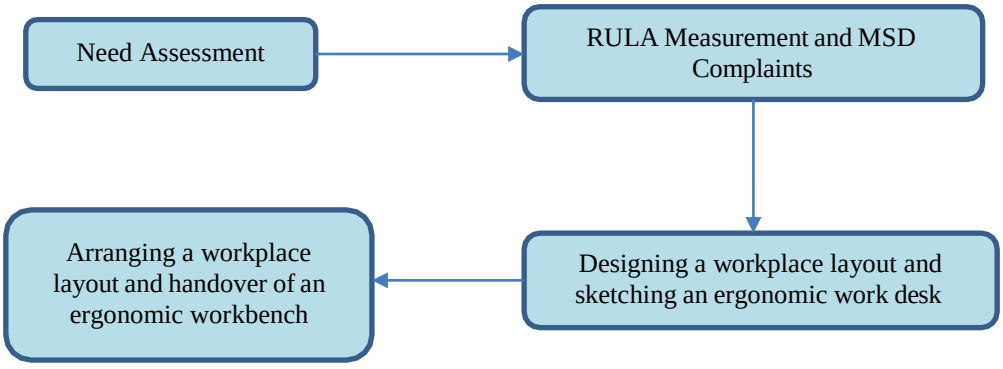

Figure 1. Flowchart of the community service implementation method

The community service activity involved four stages: field assessment, employee posture measurements, workplace layout design involving wingko workers, and workplace layout adjustments in accordance with occupational health and safety standards. The assessment phase began with coordination and obtaining permits from the wingko home industry owner in Magelang Regency. In the second phase, work posture measurements and MSD complaints were conducted on a total of 12 workers. Posture measurements were performed using the RULA (Research and Developmental Disorders) method, and MSD complaints were assessed using the Nordic Musculoskeletal Questionnaire (NMQ). Next, the team designed the workplace

layout and sketched ergonomic work desk designs, involving wingko owners and workers. In the final phase, the community service team adjusted the workplace layout in accordance with OHS standards and handed over the ergonomic work desks to the wingko industry.

Figure 2. Non-ergonomic Workplace and Limited Mobility Space

C. Results and Discussion

Need Assessment

This community service activity was carried out in August 2025, beginning with a need assessment. In this stage, the community service team conducted an analysis of the working conditions at SMEs wingko and identified the main issues at the site. The method used was direct observation of the production flow, from receiving raw materials, processing, baking, cooling, to packaging. In addition, the community service team also conducted brief interviews with the owner and workers to find out the complaints and obstacles frequently encountered in relation to occupational health and safety. The results of the needs assessment revealed the following:

1. The workspace layout is unstructured, causing overlapping movement paths among workers.
2. Work equipment such as desks and chairs are not ergonomically designed to fit workers' anthropometric dimensions.
3. There is no clear separation between the hot zone and the clean zone.
4. Workers frequently perform awkward postures such as bending, overreaching, and manually lifting heavy loads.

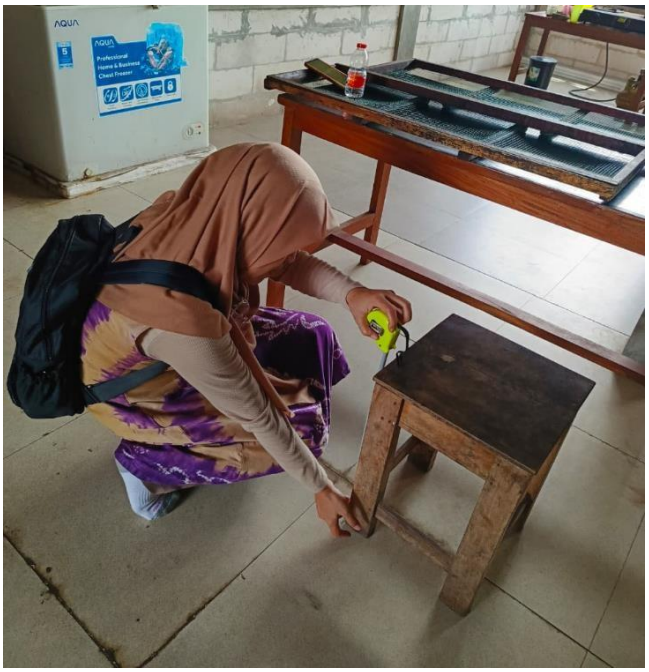

Figure 3. Work Chair Measurement

Work Posture Data Collection (RULA) and MSDs Complaints

Based on the results of the needs assessment, it was found that work equipment such as tables and chairs did not match the workers' anthropometry. This resulted in discomfort and awkward postures among the workers (Khademi et al., 2025). An awkward working position that is left unchecked for too long can cause occupational diseases such as MSDs (Arturo Realyvásquez-Vargas et al., 2020).

Results of RULA Measurements

At this stage, the community service team conducted work posture assessments on all workers. Based on the RULA measurements, the results are as follows:

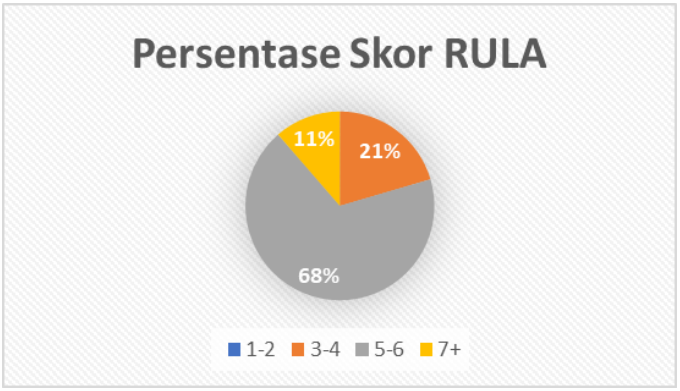

Figure 4. Percentage of RULA Score

The results of observational analysis using the RULA method show that the majority of respondents (68%) obtained scores of 5–6. This is because the workers in this category are those involved in baking and packaging. The main risk factors identified in the packaging activities of wingko workers stem from a combination of working posture, the nature of the tasks, and the working environment conditions. The workers perform their tasks sitting on the floor with low work tables, causing their bodies to lean forward and their necks to bend down during the wrapping and arranging of products. This position results in prolonged static load on the back, neck, and shoulder muscles.

In addition, the movement of the hands is performed repeatedly for quite a long duration. Sitting cross-legged without support can also potentially cause discomfort and restrict blood circulation. Meanwhile, in the grilling process, workers carry out their tasks while standing for an extended period of time (Jo et al., 2021). In addition, the stove's position, which is level with the waist, causes workers to tend to work with their necks slightly bent downward in a static posture. Furthermore, wrist movements during the grilling process are also performed repeatedly over a relatively long duration. The combination of these factors, especially the bent posture and repetitive movements, contributes to a RULA score of 5-6, indicating the need for further investigation and implementation of changes in the near future to reduce the risk of musculoskeletal disorders (Shin & Park, 2017).

A total of 2 respondents (21%) had a RULA score of 4, which falls into the category of requiring further investigation and possibly needing improvement. Respondents in this category were those who worked in the molding, weighing, and baking processes. In the molding and weighing process, activities were carried out while sitting without back support, at a low worktable that caused the arms and body to bend forward. The risk factors identified stemmed from a bent posture that maintained a static load on the back and neck muscles, combined with repetitive arm movements while taking, weighing, and transferring the dough to trays. These activities were repeated throughout long working hours, increasing the risk of muscle strain, especially in the shoulders, upper back, and wrists (Mishra et al., 2019).

Meanwhile, 1 other respondent (11%) obtained a score of 7, indicating that an investigation must be conducted immediately and corrective actions need to be implemented as soon as possible. This respondent with the RULA score is a worker involved in the process of steaming wingko. This is due to the fact that the worker stands in front of a large steamer with their upper arms raised high to reach the dough, while the body is slightly bent forward. This condition causes the shoulder, back, and neck muscles to work repetitively for an extended period. The process of mixing the heavy and sticky dough adds extra strain to the arms and lower back, especially because the movements are performed repeatedly and require significant strength (Hosseini et al., 2025).

The results of the observational analysis using the RULA method show that the majority of respondents (68%) scored 5–6, which falls into the category requiring investigation and immediate corrective action. A total of 21% of respondents scored 4, which indicates the need for further investigation and possible corrective action. Meanwhile, the remaining 11% of respondents scored above 7, indicating that an immediate investigation must be conducted and corrective action should be implemented without delay.

Results of MSD's Complaint Analysis

The next step, the community service team measured MSD complaints among workers using the Nordic Musculoskeletal Questionnaire. The results of the MSD complaint measurements among wingko workers are as follows:

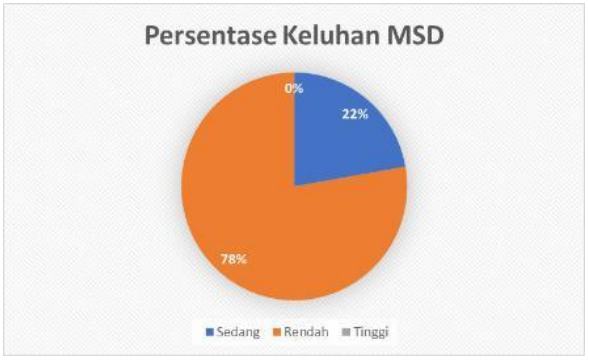

Figure 5. Percentage of MSD's Complaints

The analysis results of the NMQ show that the majority of respondents (78%) experience low-level MSD complaints. Meanwhile, 22% of the respondents fall into the moderate-level MSD complaint category, and no respondents reported high-level complaints. The body parts most frequently experiencing high

levels of pain are the back, right calf, and left calf, each with a percentage of 22%. This condition is influenced by the lack of back support while working, causing workers to frequently bend over because the wingko is positioned lower than their height. As for calf complaints, these generally arise from work activities that require workers to stand for long periods, such as during the baking and steaming processes, as well as from high mobility while working (Coenen et al., 2018). Workers in the packaging section also often sit cross-legged, causing their legs to bear the weight of their bodies, which leads to discomfort (Jung et al., 2020).

Design or Layout Creation of the Workplace

The unplanned layout of the workplace has made it non-ergonomic and resulted in very limited working space. At this stage, the community service team creates a workplace layout according to the workflow of the wingko-making process. The location for preparing the main raw materials is separated from other processes. The work layout is arranged in sequence from dough weighing and molding, baking, cooling, to packaging.

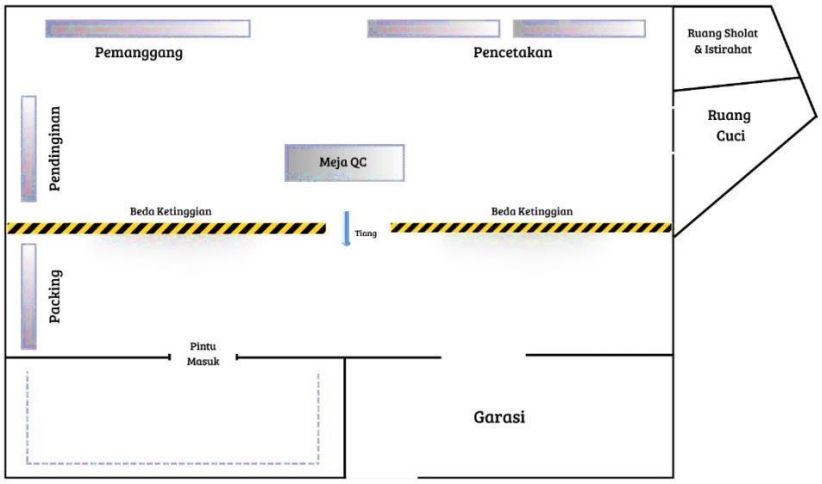

Figure 6. Workstation design

The workplace layout is arranged to maximize the available space while taking into account the comfort and safety of workers. Installing safety signs to indicate floor level differences and marking evacuation routes are among the interventions implemented to enhance worker safety. In addition, the community service team also created various posters about dehydration awareness, heat warnings, the importance of the 5Rs, and the need for simple stretching exercises during work breaks to raise awareness about the importance of maintaining workers' health (Abad, 2018; Bortolini et al., 2023).

Designing an Ergonomic Work Desk for Wingko Packaging

The creation of ergonomic work desks is one of the objectives of this community service activity. The community service team created work desks for packaging because the results of the need assessment indicated that workers in the packaging department were still using very traditional and makeshift work desks. Non-ergonomic work desks force workers to maintain awkward postures while working. The packaging work desk we designed is as follows:

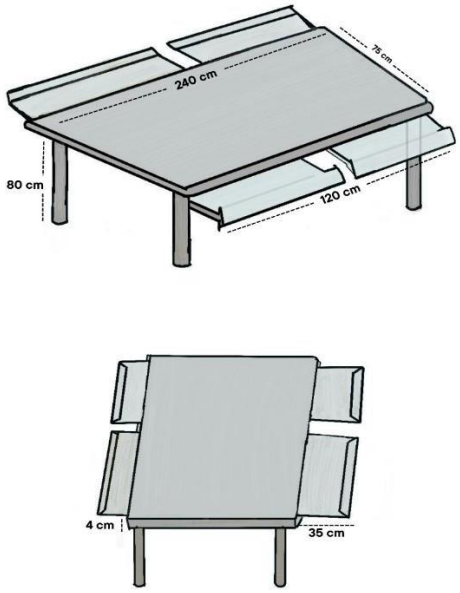

Figure 7. Packaging Work Desk Design

Workplace Layout Arrangement

The layout arrangement of the workplace was carried out after the desks were completed. The arrangement took place on October 6, 2025. In addition to reorganizing the workstations, the community service team from the Occupational Safety and Health Bachelor's Program also supported the wingko industry by providing educational posters about the dangers of dehydration and the importance of stretching during work breaks, installing safety lines to indicate differences in floor levels, and putting up evacuation route signs.

Figure 8. Installation of Evacuation Route and Handover of Ergonomic Work Desk

Figure 9. Group Photo with the Owner of the Wingko Small Business

D. Conclusion

Our recommendations include several strategic steps to improve occupational safety and health (OHS) in the wingko industry. First, regular maintenance and evaluation of ergonomic workplace layout and equipment is crucial. These evaluations should be conducted regularly (for example, every 6 months) to ensure that the workplace continues to meet production needs while maintaining worker comfort and health. Second, improved storage space management is highly recommended. The addition of vertical shelves or dedicated cabinets for storing equipment, packaging boxes, and raw materials will help maintain a tidy workspace and reduce the risk of accidents due to trips or falls. Third, implementing the 5S principle (Ringkas, Tidy, Clean, Maintain, and Diligent) will support a more organized and sustainable work culture, which can reduce potential workplace hazards. By implementing these 5S principles, MSMEs can maintain continuous improvement in their OHS practices.

Overall, this community service activity significantly contributes to increasing disaster awareness and preparedness, while simultaneously improving occupational safety and health standards in the wingko industry in Magelang. Implementing these recommendations will not only improve worker welfare but also support the operational sustainability of MSMEs in the region, making them better prepared to face future OHS challenges and disasters.

E. Acknowledgment

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