

Occupational Hazards and Potential Health Problems Among Workers in a Small-Scale Bakery Enterprise: A Workplace Assessment Study

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Abstrak

Small-scale food enterprises, including bakeries, contribute significantly to local economic development. However, workers in these settings are frequently exposed to multiple occupational hazards that may increase the risk of work-related injuries and illnesses. This study aimed to identify potential occupational health hazards and related health risks among workers at Allure Patisserie, a home-based bakery located in Taktakan District, Serang City, Banten. A quantitative and qualitative observational study was conducted using direct workplace observation, interviews with the business owner and two workers, and a review of work activities encompassing dough preparation, frying, baking, packaging, and product distribution. Identified hazards were classified into physical, chemical, ergonomic, and psychosocial categories, while potential health effects were evaluated based on established occupational health guidelines and scientific literature. The assessment revealed physical hazards such as the use of sharp cutting tools and exposure to high temperatures and hot oil, posing risks of burns and heat-related illnesses. Chemical hazards included exposure to flour dust, which may contribute to respiratory and allergic conditions such as rhinitis, asthma, and dermatitis. Ergonomic risks were associated with prolonged standing, repetitive tasks, awkward postures, and manual material handling, potentially leading to musculoskeletal disorders. In addition, psychosocial risks related to long working hours, limited workforce, and high job demands may affect workers' mental health and productivity. These findings highlight the need to enhance occupational health awareness, improve work practices, and integrate basic occupational safety and health interventions through primary health care services.

Abstract

Small-scale food enterprises, including bakeries, contribute significantly to local economic development. However, workers in these settings are frequently exposed to multiple occupational hazards that may increase the risk of work-related injuries and illnesses. This study aimed to identify potential occupational health hazards and related health risks among workers at Allure Patisserie, a home-based bakery located in Taktakan District, Serang City, Banten. A quantitative and qualitative observational study was conducted through direct workplace observation, interviews with the business owner and two workers, and a review of work activities, including dough preparation, frying, baking, packaging, and product distribution. Identified hazards were classified into physical, chemical, ergonomic, and psychosocial categories, and potential health effects were evaluated using established occupational health guidelines and scientific literature. The assessment revealed physical hazards, including the use of sharp cutting tools and exposure to high temperatures and hot oil, which pose risks of burns and heat-related illnesses. Chemical hazards included exposure to flour dust, which may contribute to respiratory and allergic conditions such as rhinitis, asthma, and dermatitis. Ergonomic risks were associated with prolonged standing, repetitive tasks, awkward postures, and manual material handling, which can lead to musculoskeletal disorders. In addition, psychosocial risks related to long working hours, limited workforce, and high job demands may affect workers' mental health and productivity. These findings highlight the need to enhance occupational health awareness, improve work practices, and integrate basic occupational safety and health interventions through primary health care services.



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INTRODUCTION

Occupational Safety and Health (OSH) is a fundamental right of all workers and represents a legal obligation that must be upheld in every workplace, including the informal sector. However, occupational health issues remain a major concern in small-scale industries, particularly in developing countries such as Indonesia. Informal sector workers often face substantial occupational hazards due to limited regulatory oversight, inadequate safety management systems, and low awareness of workplace risks. As a result, preventive measures for occupational accidents and work-related diseases are frequently insufficient, increasing the risk of injury and adverse health outcomes among workers (Widowati *et al.*, 2024). Given that informal workers constitute approximately 59–60% of Indonesia's total labor force, a large proportion of the working population is potentially exposed to unsafe working conditions, many of which remain undocumented and underreported (Salma, 2025). Micro, small, and medium enterprises (MSMEs) play a crucial role in national economic development, particularly in employment generation and improving community welfare (Ayalu *et al.*, 2023; Alayyannur *et al.*, 2021). Among these, the culinary industry has experienced rapid growth, with small-scale bakeries and patisseries representing a significant segment (Mulyono *et al.*, 2024). These enterprises are often home-based and operate informally, resulting in limited implementation of occupational health and safety (OHS) practices. Consequently, occupational risks in such workplaces are frequently overlooked despite their potential impact on workers' health and productivity (Salsabillah *et al.*, 2023). Workers in bakery workplaces are exposed to a range of specific occupational hazards. Physical hazards include high temperatures from ovens and hot oil, which increase the risk of burns and heat-related illnesses. Mechanical hazards arise from the use of sharp tools during food preparation, leading to potential cuts and injuries (Khazaei *et al.*, 2023). Chemical exposures, particularly flour dust, are associated with respiratory disorders such as rhinitis and asthma, as well as skin conditions like contact dermatitis (Mohammadien *et al.*, 2013). Ergonomic risks are also prominent, including repetitive movements, prolonged standing, awkward postures, and manual handling tasks that contribute to musculoskeletal disorders (Soares *et al.*, 2019). In addition, psychosocial factors such as long working hours, high workload, limited workforce, and seasonal production pressures (e.g., during Ramadan) may negatively affect workers' mental health and overall well-being (Sasaki *et al.*, 2025). Previous studies have highlighted the association between occupational exposures in bakery settings and various health outcomes, including respiratory diseases, musculoskeletal disorders, and workplace injuries. However, most existing research has been conducted in formal or industrial settings, with limited focus on small-scale, home-based bakery enterprises, particularly in low- and middle-income countries. Moreover, there is a lack of integrated assessment that simultaneously examines multiple hazard domains (physical, chemical, ergonomic, and psychosocial) within the context of informal workplaces. Given these gaps, there is a need for comprehensive identification of occupational hazards and potential health problems in small-scale bakery settings. Such evidence is essential to support the development of practical and context-appropriate occupational health interventions. Within the primary health care framework, community health centers play a strategic role in promoting occupational health, identifying workplace risks, and empowering workers and business owners to improve safety practices (Gibb *et al.*, 2016). Therefore, this study aims to systematically identify occupational health and safety hazards and potential work-related health problems among workers in a small-scale bakery. The findings are expected to provide an evidence-based foundation for designing feasible interventions and strengthening the role of primary health care services in protecting the health of informal sector workers.

METHODS

This study using a quantitative and qualitative observational approach of workplace assessment that aims to obtain an overview of the application of the Hazard Identification, Risk Assessment, and Control (HIRAC) method. The HIRAC method is used as the basis for implementing the Occupational Safety and Health Management System (SMK3), which encompasses three main stages: hazard identification, risk assessment, and risk control. Risk assessments are conducted to determine the risk level of each identified hazard and to evaluate the control measures needed to mitigate the impact or

consequences at each stage of the work process, based on the principle of the hierarchy of risk control (Agus Permana *et al.*, 2025). This assessment activity collected the data from owner and two workers. Primary data is obtained through direct inspections of the workplace to identify factors influencing the occurrence of workplace accidents. Aspects assessed include the severity of the accident, the likelihood of an accident occurring (likelihood), the risk level based on the combination of likelihood and severity, and prioritizing risks that require immediate action. Hazard identification is conducted systematically to identify potential hazards at each stage of the work process, which can originate from materials, equipment, or the work systems used. Hazard identification is defined as a systematic effort to recognize the presence of potential hazards in all work activities. Each work stage is analyzed by considering operational conditions, which are classified into normal operating conditions (N), which are daily work carried out according to procedures; abnormal operating conditions (A), which are work performed outside of procedures; and emergency conditions (E), which are situations that are difficult to control and have the potential to pose a high risk (Hakim, 2017). A risk assessment is conducted to calculate the magnitude of the risk and determine whether it is acceptable or requires further control. Risk assessment is conducted by assessing the likelihood of an event occurring (likelihood) and the severity of the impact (severity), in accordance with a qualitative method based on the AS/NZS 4360 standard. Likelihood and severity are each assigned a score between 1 and 5, with likelihood ranging from rare to potentially occurring events, while severity ranges from events with no injury or minor loss to events that could cause death or significant loss. The risk score is obtained by multiplying the likelihood and severity scores, with a risk score ranging from 1 to 25, which is then classified into low, medium, high, and very high risk levels using a risk matrix. The determination of likelihood and severity scores is based on interviews with workers. Risk control is implemented for all identified hazards, taking into account the predetermined risk levels, to determine the most appropriate control priorities. The risk control strategy is developed based on a hierarchy of controls, which includes elimination, substitution, engineering controls, administrative controls, and the use of personal protective equipment (PPE) (Hakim, 2017). This research was conducted at a micro, small, and medium enterprise (MSME) in the culinary sector in Serang City, Banten Province, with data collection scheduled for November 2022. Data were obtained through a field survey, part of the Primary Health Care and Occupational Health System learning module at the Faculty of Medicine, Sultan Ageng Tirtayasa University. The research subjects included all work activities in the production process that have the potential to pose hazards, such as material preparation, processing, and frying. Data collected included the business profile, interview results, direct observations of work processes and production equipment, and work environment conditions. Information was obtained through direct observation and in-depth interviews with one business manager and two workers. Potential hazards obtained from observations and interviews were then analyzed using the HIRAC method to identify hazard sources and determine preventative and control measures that can be implemented to reduce the risk of workplace accidents and work-related health problems. This research was conducted in accordance with the principles of research ethics in accordance with the Declaration of Helsinki and obtained permission from the person in charge of the Primary Health Care and Occupational Health System Module, Faculty of Medicine, Sultan Ageng Tirtayasa University.

RESULT AND DISCUSSION

The enterprise, known as Allure Patisserie, specializes in the production of a variety of baked and ready-to-cook food products, including banana bolen, brownies, curry puffs, and frozen snacks. The business was initially established as a form of preparation for the owner's retirement. Supported by the culinary background of one of the owner's children, the enterprise gradually expanded its product line, with banana bolen becoming a key product. Prior to launching sales, the owner participated in a bakery training program, which focused on the preparation of frozen banana products. Since its establishment, the business has experienced rapid growth, particularly through the utilization of online marketplaces. At present, food production activities are carried out by two workers, while procurement of raw materials and product distribution are managed directly by the owner, with occasional assistance from employees or neighboring community members when required. The business operates using personal capital, and demand peaks during the Ramadan period.

The production process at Allure Patisserie is carried out routinely Monday through Saturday, from 8:00 AM to 4:00 PM WIB. Production begins with the preparation stage, which involves preparing all the tools and ingredients that will be used during the process (figure 1). The next stage is the kneading process, where the ingredients are mixed using a mixer until homogeneous, then the dough is folded manually by hand to form two layers. Afterward, the dough is rolled out using a rolling pin to achieve the desired thickness and texture. The rolled dough is then molded using a special bolen mold. The molded dough is then baked in an oven until half cooked. After the initial baking process is complete, the product is removed from the oven to be brushed with egg gloss and sprinkled with cheese as a topping. The product is then baked again in the oven until fully cooked. The final stage of the production process is packaging and distribution, which is carried out using motorcycles for delivery to consumers.



Figure 1. Production Process and The Products.

Table I. Hazard Identification and Risk Assessment.

Work Stage	Potential Hazard	Source of Hazard	Potential Impact	Likelihood (L)	Severity (S)	Risk Score (L×S)	Risk Level
Preparation of tools and materials	Slipping	Wet or cluttered floor	Minor-moderate injury (sprain, fall)	2	2	4	Low
	Manual handling injury	Lifting raw materials	Low back pain, MSDs	3	2	6	Medium
Dough mixing (mixer use)	Fingers caught in machine	Mixer components	Minor-moderate injury	2	3	6	Medium
	Flour dust exposure	Raw materials	Respiratory irritation, allergy	3	2	6	Medium
Manual dough folding	Repetitive movements	Manual work process	Wrist and shoulder fatigue	4	2	8	Medium
Dough rolling	Fingers caught in roller	Rolling equipment	Moderate injury	2	3	6	Medium
	Awkward posture	Inappropriate table height	Lower back pain	4	2	8	Medium
Dough molding	Repetitive hand movement	Manual molding	Hand musculoskeletal disorders	4	2	8	Medium
First baking process	Heat exposure	Oven and hot trays	Burns	3	4	12	High
	High room temperature	Poor ventilation	Heat stress, fatigue	3	3	9	Medium
Egg wash and topping	Biological contamination	Raw eggs	Skin irritation, minor infection	2	2	4	Low
Second baking process	Repeated burn risk	Oven	Moderate-severe injury	3	4	12	High
Packaging	Static posture	Workstation design	Neck and back pain	3	2	6	Medium
Distribution and delivery	Traffic accident	Motorcycle use	Severe injury or fatality	2	5	10	High

Likelihood (L) : 1 (very rarely) – 5 (very often)

Severity (S) : 1 (unscathed) – 5 (fatal)

Risk Level :

- 1) 1–5 = Low;
- 2) 6–8 = Moderate;
- 3) 9–12 = High;
- 4) ≥ 15 = Very High

During the dough-forming stage, workers use knives and cutting tools to cut or shape the dough. This activity carries a significant risk of workplace accidents. Using knives carries the risk of cuts to the hands or fingers, both to oneself and to others in the work area. The risk of injury also increases if the knife used is not sharp enough, as workers must exert greater force when cutting, potentially causing sprains or muscle strains. Knife-related injuries generally occur under certain conditions, including when the knife is dull, when the knife is not stored safely while the worker is handling other objects, or when the knife is pulled back toward the body during use. The risk also increases when workers reflexively try to catch a falling knife, and when workers experience fatigue due to lack of rest or prolonged repetitive work. This fatigue factor can reduce concentration and increase the likelihood of workplace accidents. Frying and baking processes involve exposure to high ambient temperatures, often accompanied by increased relative humidity. These conditions can cause physical fatigue and increase the risk of heat exhaustion in bakery workers. Heat exhaustion occurs due to prolonged exposure to heat combined with sustained physical activity, overburdening the body's ability to regulate temperature. Symptoms can include extreme fatigue, dizziness, excessive sweating, and decreased concentration. If left untreated, heat exhaustion can progress to heatstroke, a potentially life-threatening medical emergency. In addition to the health risks associated with heat, frying also poses a risk of workplace accidents such as burns. Workers are at risk of burns if they slip, trip, or fall while handling, cleaning, or working around a fryer containing hot oil. Hot oil splashes can also cause burns to the skin of the face and eyes. The most common causes of these injuries include poor workplace hygiene practices, such as floors slippery from oil or water that are not promptly cleaned, increasing the risk of slipping and falling onto hot surfaces. Furthermore, placing frozen food directly into hot oil can cause oil splashes that are dangerous to nearby workers. During dough preparation, workers are exposed to flour dust, especially those responsible for mixing and shaping the dough. Long-term exposure to flour dust is known to be associated with various health problems, particularly respiratory disorders and allergies. Exposure to flour dust can cause asthma, both intermittent and persistent, conjunctivitis, allergic rhinitis, and contact dermatitis. Studies show that the risk of rhinitis increases with flour dust exposure exceeding 1 mg/m³, while an increased risk of asthma is reported with exposure exceeding 3 mg/m³. This risk is even greater if adequate ventilation or personal protective equipment such as masks are not available. Ergonomic risks are found in several work stages, particularly when preparing dough with heavy lifting, and when shaping dough, which requires workers to stand for long periods, work in a bent position, and perform repetitive movements. High physical workloads, repetitive work cycles, and unergonomic work postures can lead to musculoskeletal disorders. These disorders can affect the joints, muscles, bones, and soft tissues, commonly characterized by back pain, shoulder pain, wrist pain, and muscle fatigue. If this condition continues without adequate control, it can reduce work capacity and worker productivity. Relatively long working hours (7:00 AM–4:00 PM WIB) with a limited number of workers, namely only two, have the potential to pose psychosocial risks. Psychosocial factors arise from the interaction between job demands, management systems, and work environment conditions, which can negatively impact workers' mental health and well-being. These disorders include excessive workload, uncertainty about task allocation, lack of job variety, and monotonous work cycles, which can ultimately impact productivity. Furthermore, disruptions in social interaction and communication between workers, such as social or physical isolation, less harmonious work relationships, and lack of social support, can also exacerbate workers' psychosocial well-being. This plant survey identified various potential occupational safety and health (OHS) hazards for workers in small-scale bakery businesses, including physical, chemical, ergonomic, and psychosocial hazards. The results indicate that despite the relatively small scale and home-based nature of the businesses, the complexity of the work processes and the limitations of the OHS

management system place workers at high risk of occupational accidents and work-related health problems, both acute and chronic (Zachar *et al.*, 2025). The most prominent physical hazard in this study was the use of knives and cutting tools during the dough-forming stage. The risk of injuries such as cuts and wounds increases when knives are blunt, not stored safely, or used repeatedly while fatigued. This finding aligns with previous research indicating that occupational accidents in the informal food sector are often influenced by a lack of standard operating procedures (SOPs) and adequate OHS training, leading workers to rely solely on work experience (Haruyama *et al.*, 2014). Furthermore, frying and baking processes involve exposure to high temperatures and hot oil, which are categorized as high-risk in the HIRAC assessment. Prolonged heat exposure, especially in work spaces with limited ventilation, can lead to heat exhaustion. This condition occurs when the body's thermoregulatory mechanisms are unable to compensate for exposure to environmental heat and continuous physical activity. If left untreated, heat exhaustion can progress to heatstroke, a serious and potentially life-threatening emergency. In addition to health problems, the risk of workplace accidents such as burns from hot oil splashes or direct contact with oven surfaces is also quite high, especially if floor hygiene and personal protective equipment are not optimal (Spector *et al.*, 2019). The chemical hazards identified in this study were primarily related to exposure to flour dust during the dough-making and shaping stages. Workers directly involved in this process had higher exposure levels than workers at other stages. Exposure to flour dust has been linked to various health problems, such as allergic rhinitis, asthma, conjunctivitis, and contact dermatitis. The risk of respiratory problems increases with the duration and intensity of exposure, especially in work environments with inadequate ventilation and without the use of personal protective equipment. These findings confirm that exposure to flour dust remains a relevant health issue even in small-scale bakeries (Stobnicka *et al.*, 2015). Ergonomic risks were found in almost all work stages, particularly when lifting dough, standing for long periods, working in a bent-over position, and performing repetitive movements while shaping dough. The combination of non-ergonomic work postures, physical workloads, and repetitive work cycles can lead to musculoskeletal disorders, such as low back pain, shoulder pain, and wrist pain. These findings align with previous research showing that musculoskeletal disorders are one of the most common health problems among informal sector workers and MSMEs, and have the potential to reduce workers' productivity and quality of life if not taken preventive measures (Lee *et al.*, 2021). Most of the risk controls implemented at each work stage in small-scale bakeries are still non-standardized and heavily dependent on worker experience. This situation means that existing controls are not fully capable of optimally reducing occupational safety and health risks. Control recommendations are compiled based on a risk control hierarchy, with an emphasis on simple and realistic administrative and technical controls for implementation in MSMEs. Administrative controls include the development and implementation of work SOPs, rest schedules, job rotations, and safety training. Meanwhile, technical controls focus on improving ergonomics, modifying work tools, installing machine guards, and improving ventilation. The use of personal protective equipment (PPE) is recommended as an additional control, especially at work stages with high heat exposure and mechanical risks (table 2). Overall, the implementation of the recommended controls is expected to reduce the risk of workplace accidents and occupational health problems, while simultaneously improving worker safety and productivity in MSME bakeries.

Table II. Risk Control and Recommended Control.

Work Stage	Existing Control	Recommended Control (Hierarchy of Control)
Preparation of tools and materials	None standardized	Administrative: housekeeping SOP, floor maintenance
	Worker experience	Administrative: training on safe lifting techniques
Dough mixing (mixer use)	Manual supervision	Engineering: machine guarding
	Natural ventilation	Administrative + PPE: mask use
Manual dough folding	Unscheduled breaks	Administrative: scheduled rest breaks
Dough rolling	Worker experience	Engineering: tool modification
	None	Engineering: ergonomic workstation adjustment
Dough molding	None	Administrative: job rotation
First baking process	Cloth gloves	PPE: heat-resistant gloves
	Natural ventilation	Engineering: improved ventilation
Egg wash and topping	Hand washing	Administrative: food hygiene SOP
Second baking process	Worker experience	PPE + Administrative: baking SOP
Packaging	None	Engineering: ergonomic table design
Distribution and delivery	Standard helmet	Administrative + PPE: delivery SOP, safety gear

CONCLUSION

This plant survey demonstrates that workers in small-scale bakeries are exposed to multiple occupational hazards, with the most significant risks identified in activities involving sharp tools, high temperatures and hot oil, flour dust exposure, repetitive movements, and non-ergonomic work postures. Using the HIRAC method, several work processes were classified as moderate to high risk, indicating a substantial potential for workplace injuries and work-related health problems. Importantly, existing risk control measures were found to be largely informal and inconsistent, relying heavily on worker experience rather than structured safety practices. These findings highlight a critical gap in occupational safety management within informal bakery settings. To address this, practical and feasible interventions should be prioritized, including the development of simple standard operating procedures, improvement of workplace ergonomics (e.g., workstations and posture), implementation of regular rest breaks and job rotation, enhancement of ventilation to reduce flour dust exposure, and consistent use of appropriate personal protective equipment. In addition, targeted occupational health education and training for workers and business owners are essential to improve hazard awareness and safe work practices. Strengthening occupational safety and health in small-scale bakeries requires not only workplace-level interventions but also support from primary health care services, particularly community health centers, to facilitate hazard identification, health promotion, and preventive programs. Overall, this study underscores the need for systematic and context-appropriate approaches to improve workplace safety in the informal sector, with the ultimate goal of reducing occupational risks, protecting workers' health, and enhancing productivity.

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