p-ISSN 2086-6380, e-ISSN 2548-7949

Jurnal Ilmu Kesehatan Masyarakat (JIKM)

HAZARD IDENTIFICATION RISK ASSESSMENT AND RISK CONTROL MEASURES IN MICRO, SMALL, AND MEDIUM ENTERPRISES CUANKI IN KASEMEN DISTRICT, SERANG CITY

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ARTICLE INFO

Article History:

Received : December 18, 2023

Accepted : March 26, 2024

Published: March 27, 2024

DOI:

https://doi.org/10.26553/jikm.2023.14.3.393-407

Available online at

http://ejournal.fkm.unsri.ac.id/index.php/jikm

ABSTRACT

Micro, Small, and Medium Enterprises (MSMEs) Cuanki Bakti Mulia is a company engaged in the food industry that produces cuanki in Indonesia. It is at high risk due to the severity and possibility of accidents causing severe injuries. This study aims to identify hazards, assess risks, and control at MSMEs Cuanki Bakti Mulia, Kasemen District, Serang City. The method used is Hazard Identification Risk Assessment and Control (HIRAC). The object of study is the work of MSMEs Cuanki Bakti Mulia, namely all potentially hazardous activities. Data from the company, interviews, direct surveys of production equipment, and machines in the production process were collected for this study. The results of the study showed that many risks were identified. The process of making and rolling meatball dough, and fried dumpling dough had a high risk rating compared to others. In dough making, ingredients in flour that come into direct touch with the breath might irritate the nasal and mouth mucosa and create respiratory problems. In dough rolling, hands are exposed to vibration for a long time, and noise causes hearing loss. Several protection and prevention measures have been taken, mainly to protect workers from workplace accidents and maintain the hygiene of the food produced. The proposed hazard controls are replacing firewood with gas stoves when frying to make tofu and fried dumplings, setting restrictions on workers' working hours, and ensuring adequate rest by reducing working hours. The company needs to provide and equip with Personal Protective Equipment (PPE).

Keywords: hazards identification, HIRAC, risk assessment, risk control

Introduction

In Indonesia, Micro, Small and Medium Enterprises (MSMEs) are important to the country's economy. MSMEs are businesses owned by individuals or small groups. MSMEs are classified based on total annual turnover, number of workers, and total wealth and assets.[1,2] The total number of MSME players in Indonesia has reached 99% of all business units. Apart from that, MSMEs also contribute significantly to Indonesia's GDP, which is 60.5%, and labor absorption is 96.9% of the total national labor absorption as of October 2022.[3]

According to the International Labor Organization (ILO), there are still many MSMEs who are not aware of and prioritize occupational safety and health (K3) in running their business.[4] K3 is an instrument related to the health, safety, and welfare of the workers involved, the local community, and the surrounding environment. Apart from that, K3 also has a role in ensuring that every worker receives protection and safety for the work they do.[5,6] This is done to minimize the occurrence of work accidents, create an optimal environment, and prevent the emergence of various work-related diseases immediately and in the long term.

In Indonesia, the number of work accidents is very worrying. According to the ILO, Indonesia ranks 52nd out of 53 countries with poor K3 management. The costs the company will incur will be very large if an accident occurs at work.[7] According to the latest estimates by the International Labor Organization (ILO) in 2018, more than 1.8 million work-related deaths occur annually in the Asia and Pacific region. Two-thirds of work-related deaths in the world occur in Asia. 2.78 million workers die every year due to work accidents and occupational diseases.[8]

Work accidents are unplanned, uncontrollable, and unpredictable events that compromise an individual's productivity at work. Based on the studies, there are five categories of elements that contribute to work accidents: raw materials, environment, personnel, tool/machine, material, and method.[9,10] The accident rate for MSME workers is 40% higher than for companies that have more than 1000 workers.[11] Every company always has a risk of accidents, including MSMEs. According to the ILO, most MSMEs still do not consider K3 as a priority and consider implementing K3 as a cost. If even one work accident occurs due to low K3 implementation, this could be a financial disaster for MSMEs.[12] Based on several studies that have been carried out previously, the implementation of occupational health and safety management is very important and must be paid attention to by companies, especially in the aspects of employee training and recruitment, first aid, promotion of K3, and risk control based on the risk control hierarchy.[13] Therefore, the MSME sector needs to implement K3 to build a productive, safe, and healthy business.

In general, work accidents are caused by two factors, namely human actions that do not meet work safety (unsafe acts) and unsafe environmental conditions (unsafe conditions). One of the K3 management systems that applies globally or internationally is OHSAS 18001:2007. Usually known as Hazard Identification Risk Assessment and Control (HIRAC).[14] HIRAC is a process of

identifying hazards that can occur in routine or non-routine activities within a company and then carrying out a risk assessment of these hazards. The risk assessment results help create a hazard control program so that the company can minimize the level of risk that may occur to prevent work accidents.[15] The researchers used the HIRAC method because the level of work accidents and various threats to occupational safety and health (K3) is still quite high in the MSME industrial sector. Work safety is intended to prevent, reduce, protect, and even eliminate the risk of work accidents (zero accidents) in the workforce by preventing work accidents that occur during activities. Therefore, every company that is at risk of work accidents can identify hazards, one of which is the HIRAC method.

Based on several previous studies in MSMEs, work accidents occur due to: a lack of understanding of the importance of K3 in carrying out work, not using safety equipment, and the absence of a first aid kit for accidents (P3K) at laundry MSMEs,[16] Garment MSME workers do not use Personal Protective Equipment (PPE),[17] have not implemented occupational health and safety management in MSMEs in Lanting, Kebumen, Central Java.[18] However, there has been no research on MSMEs Cuanki. MSMEs Cuanki Bakti Mulia is located in Serang City's Kasemen District. MSMEs Cuanki Bakti Mulia is a food-related MSME that has cooperative capital that is self-financed. MSMEs Cuanki Bakti Mulia has 100 trading partners spread across Cilegon, Serang city, and the district, several problems occur, one of the problems is that several times the production does not meet the order target, the number of defective products is quite large, another problem is poor employee discipline and work accidents experienced employees several times in a certain period. Therefore, it is very important to identify hazards, assess risks, and control at MSMEs Cuanki Bakti Mulia, Kasemen District, Serang City.

Methods

The type of study used is quantitative research with a descriptive approach to obtain information on the application of the Hazard Identification Risk Assessment and Control (HIRAC) method. The HIRAC method is the basis of the Occupational Health and Safety Management System.[15] Hazard identification, risk assessment, and control are the three phases of risk analysis that make use of the HIRAC technique.[15,19] To evaluate risk control measures to lessen the impact or consequences of hazards arising from each stage of work through the hierarchy of control, a risk assessment was conducted to ascertain the level of risk.[20]

Primary data was obtained by inspecting the workplace: factors influencing work-related accidents; severity of an accident; probability of an accident (likelihood); level of risk in terms of likelihood and severity; and prioritization of risks to be addressed. Hazard identification was carried out to find out the potential hazards that exist at each stage of work. The source of the

hazard can come from materials, tools, or systems. The data was then analyzed using the HIRAC method. The phases of the HIRAC method are explained in detail below.

Hazard identification is a systematic effort to identify the existence of dangers in organizational activities.[21,22] Every workplace that carries out risk identification from each event and then weighs the conditions in determining the risk is as follows: Normal operating conditions (N): Daily work and according to procedures, Abnormal operating conditions (A): Work outside the procedure, Emergency condition (E): A situation that is difficult to control.[23]

Risk assessment is an effort to calculate the magnitude of risk and determine whether the risk is acceptable. Risk assessment is used to determine the level of risk in terms of the possibility of occurrence (likelihood), shown in Table 1 and Table 2 shows the severity that can be caused (severity).[24,25]

Table 1. The likelihood level scale on the AS/NZS 4360: 2004 standard

Level	Criteria	Description
1	Rarely	Rarely happened
2	Sometimes	Rarely happening
3	Can occur	It can happen every once in a while
4	Often occur	Often occur
5	It almost certainly will happen	It can happen at any time

Source:[24,25] **.**

In qualitative methods according to the AS/NZS 4360 standard, the possibility or likelihood is given a range between a risk that rarely occurs to a risk that can occur at any time. For severity, it is categorized between events that do not cause injury or only a slight loss, the most severe if it can cause a fatal event (death) or significant damage to the company.[24]

Table 2.The severity level scale on the AS/NZS 4360: 2004 standard

Level	Criteria	Description
1	Insignificant	No injury and/or no disease caused and/or no effect on the environment, small financial loss
2	Minor	Minor injury and/or illness with mild symptoms and/or small effect on the environment, small financial loss
3	Moderate	Moderate injury and/or chronic illness requires medical treatment and/or moderate effect on the environment, sizeable financial loss
4	Mayor	Serious injury and/or chronic illness require medical treatment and/or serious and long-term environmental damage, big loss, production disruption
5	Catastrophic	Fatal and/or chronic diseases require serious medical treatment and/or very serious and long-term environmental damage, huge losses and very broad impacts, cessation of all activities

Source: [24,25]**.**

Risk matrix where probability and severity ratings are given a value of 1-5. Thus, the risk value can be obtained by switching between probability and severity, namely between 1-25. Risk rating is a value that indicates the risk is at low (blue), medium (green), high (yellow), or very high

levels (red), as shown in Table 3.[25] Determining the likelihood and severity values based on the AS/NZS 4360 standard for each hazard risk is carried out by interviewing workers.

Table 3. Matrix of risk assessment on AS/NZS 4360: 2004 standard

Likelihood	Severity				
	Insignificant (1)	Minor (2)	Moderate (3)	Major (4)	Catastrophic (5)
Rare (1)	L	L	M	H	H
Unlikely (2)	L	L	M	H	VH
Possible (3)	L	M	H	VH	VH
Likely (4)	L	M	H	VH	VH
Almost Certain (5)	M	H	VH	VH	VH

Source:[25]

Risk control is carried out for all hazards found in the hazard identification process and considering the risk ranking to find priorities and ways of controlling them. Furthermore, in determining controls, this study considers the control hierarchy starting from elimination, substitution, engineering controls, administrative controls, and PPE controls.[20,26]

This study took place at MSMEs Cuanki Bakti Mulia, Kasemen District, Serang City, and data was collected from November 1 to November 7, 2022. This data is the result of plant survey field activities which are part of the activities of the Primary and Occupational Health Care System Module, Faculty of Medicine, Untirta.

The object of study works at MSMEs Cuanki Bakti Mulia, Kasemen District, Serang City, namely all forms of activities (work of making tofu, meatballs, and fried dumplings) that are potentially dangerous. The information gathered included company data, data from interviews, information from direct surveys of production equipment, and information about equipment utilized in the production process. The source of information in this study was obtained from direct observations and interviews with one worker leader, and six workers

The potential hazards that may arise from the results of surveys and interviews were identified, and these data were then analyzed using the HIRAC method to help companies prevent and reduce the potential for workplace accidents in the work process by locating the source of the danger. Risk assessment and risk control were then implemented to further reduce exposure to the hazards present in each type of work.

This study was carried out following the guidelines of the Declaration of Helsinki and received permission from the Chair of the Primary and Occupational Health Care System Module, Faculty of Medicine, Untirta (No: ND- 10/UN2.F1.D1.2/SPKP dan Okupasi/PDP.01/2022).

Results

On the implementation of HIRAC in production activities at MSMEs Cuanki Bakti Mulia, Kasemen District, Serang City. 3 types of work are the focus of the research analysis, namely the

work of making tofu, meatballs, and fried dumplings. Researchers identify which aspects of work have the potential to cause work hazards and accidents originating from the workplace, work equipment, machines, and materials related to activity processes and conditions to avoid unsafe actions and eliminate unsafe conditions. A risk assessment was carried out on all potential dangers that exist in MSMEs Cuanki Bakti Mulia. The following are the results of the risk assessment which can be seen in Table 4 :

Table 4. Hazard Identification and Risk Assessment

Process of Making Tofu							
No	Processes	Hazard	Risk	Condition N/A/E	Likelihood	Severity	Risk Rating
1	Refining process	unergonomic body position	Low back pain and neck pain	N	4	2	M
2	Soybean coagulation process	Vinegar on skin	Irritant contact dermatitis	A	4	1	L
3	Frying with firewood	Direct contact with combustion fumes	Respiratory problems and eye irritation	N	4	2	M
4	Frying with oil	Splashed with hot oil	Blistered skin	A	4	1	L
5	Making tofu	Prolonged standing position	Soreness and tingling	N	3	1	L
Process of Making Meatball							
No	Processes	Hazard	Risk	Condition N/A/E	Likelihood	Severity	Risk Rating
1	Making dough	Flour that comes into direct contact with breathing	Respiratory disorders	N	4	3	H
2	Dough rolling process	Hands are exposed to vibrations for quite a long time	Hand-arm vibration syndrome	N	1	5	H
		Noise that causes hearing loss	Hearing loss to sensorineural deafness	N	1	5	H
3	Thickening and clumping	Direct contact with large amounts of Sodium tripolyphosphate	Mild skin irritation	A	4	1	L

4	The process of making meatballs	Standing for a long time causes blood to pool in the lower extremities	Chronic varicose veins and rheumatic diseases	N	1	4	H
		Long working hours with a heavy workload	Worker fatigue	A	4	1	L
Process of Making Fried Dumplings							
No	Processes	Hazard	Risk	Condition N/A/E	Likelihood	Severity	Risk Rating
1	Making dough	Flour that comes into direct contact with breathing	Respiratory disorders, irritation of the nasal and oral mucosa	N	4	3	H
2	Frying with oil	Splashed with hot oil	Blisters or vesicles on the upper extremities	A	5	1	M
3	Frying with firewood	Inhalation of burning smoke	Respiratory disorders	N	4	2	M

There are numerous risks were identified, 5 activities were obtained with a blue risk rating, 4 activities with a green risk rating, and 5 activities with a yellow risk rating. In the process of making tofu with 5 activities, there are 2 activities with a moderate risk rating, namely, the refining process with the danger of unergonomic body position, and another frying with firewood with the danger. Table 4 also shows the working environment conditions, there are five abnormal conditions, nine normal conditions, and no emergency conditions.

In the process of making meatballs with 4 activities, there are 4 processes with a high-risk rating, namely, making dough with hazardous flour that comes into direct contact with breathing, dough rolling process with hazardous hands are exposed to vibrations for quite a long time and noise, the process of making meatballs with hazard standing for a long time. In the process of making fried dumplings with 3 activities, there is 1 process with a high-risk rating, namely, making dough with dangerous flour that comes into direct contact with breathing.

Prevention or control of hazards to avoid unsafe actions and eliminate unsafe conditions. The MSMEs Cuanki Bakti Mulia has carried out quite good risk control. Several protective and preventive measures have been carried out at the MSMEs Cuanki Bakti Mulia, which are mainly carried out to protect workers from the dangers of work accidents and maintain the hygiene of the food produced. These efforts are as follows: Tofu Making Process: in the tofu-making process, workers wear boots to prevent the risk of slipping due to the wet and slippery floor surface.

Workers also wear head coverings in the form of hats to prevent contamination of food due to hair falling on product ingredients. Workers also wash their hands before and after work to prevent the transmission of bacteria and viruses.

Meatball-Making Process: in the meatball-making process, workers use ear plugs, namely ear muffs, especially for workers who operate meatball dough rolling machines, while several other workers who work around the machine use ear plugs. Workers tasked with forming the meatball dough also use plastic gloves to maintain food hygiene. These meatball-making workers also wash their hands before and after work to prevent the transmission of bacteria and viruses. Making dry siomays: when making dry siomays, workers wear masks when making siomays to prevent inhalation of flour particles in the air. This is mainly done by workers whose job is to coat the siomay skins with tapioca flour. Workers here also wash their hands before and after work to prevent the transmission of bacteria and viruses.

Discussion

Based on the results of hazard identification and risk assessment in Table 4, the process of making dough in making meatballs and making fried dumplings has a severity score of 3 and likelihood of 4, therefore it includes a high-risk rating, this was also found in the other study.[27] The company must take this seriously, making dough has a high-risk rating because the flour that comes into direct contact with breathing will cause respiratory disorders and irritation of the nasal and oral mucosa.[28,29] Therefore, in K3, this must be the company's attention, because flour exposure causes pulmonary function parameters to decrease, interstitial lung disease, and an increased risk of respiratory symptoms.[30,31]

The most effective way to reduce the risk of exposure to flour dust is to eliminate the source of exposure.[32] If that's not possible, there are other risk controls to use. Eliminating the hazard by substituting a safer process or material, where possible. It is the most effective control to consider that generates less flour dust be used. For engineering control, a flour dust extraction system, and ventilation be improved, and a HEPA vacuum be used for cleaning.[33]

The refining process in making tofu carries the danger of unergonomic body positions, this was also discovered in the other study.[34] Unergonomic body position can cause lower back pain and neck pain,[35] and another one is frying with firewood with the danger of direct contact with combustion fumes, which can cause respiratory problems and eye irritation.[36,37]

The dough rolling process with hazardous hands are exposed to vibrations for quite a long time and noise can cause hand-arm vibration syndrome,[38]and hearing loss to sensorineural deafness.[39] The process of making meatballs with hazardous standing for a long time causes blood to pool in the lower extremities can cause chronic varicose veins and rheumatic diseases.[40]

Recommendations for improving occupational health and safety efforts for workers in this report are based on five risk control hierarchies, namely elimination, substitution, design, administration, and personal protective equipment (PPE) are as follows in table 5:

Table 5. Risk Control

Risk Control Hierarchy	Tofu Making Recommendation	Making Meatballs Recommendation	Making Fried Dumplings Recommendation
Elimination	-	-	-
Substitution	provide enough chairs so that workers do not stand for too long., and replace firewood with a gas stove when frying	substituting a safer process or material, and providing enough chairs so that workers do not stand for too long	replace firewood with a gas stove when frying
Engineering controls	a flour dust extraction system be installed, ventilation be improved, a HEPA vacuum be used for cleaning	a flour dust extraction system be installed, ventilation be improved, a HEPA vacuum be used for cleaning, and the meat grinder machine to reduce the intensity of the noise produced	a flour dust extraction system be installed, ventilation be improved, a HEPA vacuum be used for cleaning
Administrative controls	provide work process training, ensure adequate rest by reducing working hours, and regulate the limitation of workers' working hours	provide work process training, ensure adequate rest by reducing working hours, regulate the limitation of workers' working hours, and post instructions signs, and warning labels to increase awareness of hazards in workplace areas such as meat mills.	provide work process training, ensure adequate rest by reducing working hours, regulate the limitation of workers' working hours, and post instructions, signs, and warning labels to increase awareness of hazards in workplace areas such as meat mills.
PPE	mask to reduce the risk of respiratory problems due to inhalation of wood-burning smoke, gloves to protect hands from danger or maintain the hygiene of production materials, especially so that hot oil does not come into contact with the skin directly, apron to protect the body, especially from hot oil during frying activities, hair cap so that food products are not contaminated by workers' hair during the work process.	mask to reduce the risk of respiratory problems due to inhalation of wood-burning smoke, gloves to protect hands from danger or maintain the hygiene of production materials, earplugs to reduce the risk of permanent hearing loss due to the noise of meat-grinding diesel engines, hair cap so that food products are not contaminated by workers' hair during the work process	mask to reduce the risk of respiratory problems due to inhalation of wood-burning smoke, gloves to protect hands from danger or maintain the hygiene of production materials, especially so that hot oil does not come into contact with the skin directly, apron to protect the body, especially from hot oil during frying activities, hair cap so that food products are not contaminated by workers' hair during the work process

To protect workers, harmful behavior must be eliminated at its source. Nevertheless, the labor appears challenging because the primary sources of possible risk stem from the materials and equipment used in the preparation of meatballs, tofu, and fried dumplings. Eliminating the risk factors is the most effective way to control ergonomic hazards.[41]

So, the first recommendation is substitution by providing enough chairs so that workers do not stand for too long to make tofu, meatballs, and fried dumplings, substituting a safer process or material, replacing firewood with a gas stove when frying for making tofu, and fried dumplings. Extended periods of standing at work have been linked to several potentially dangerous health consequences, including exhaustion, cardiovascular issues, lower back and leg pain, and discomfort-related health effects.[42] Using firewood for cooking lowers respiratory health.[36] Companies must thus make it easier for people to convert to using cleaner fuels when making tofu and fried dumplings.

Engineering controls can be carried out by installing a flour dust extraction system, improving ventilation, using a HEPA vacuum cleaner for cleaning, and modifying the meat grinder machine to reduce the intensity of the noise produced. Administrative controls with provide work process training, ensure adequate rest by reducing working hours, and add workers so that working hours do not exceed the regulations are for for making tofu, meatballs, and fried dumplings. Post instructions, signs, and warning labels to increase awareness of hazards in workplace areas such as meat mills for making meatballs. Thus, administrative actions that support increasing the company's positive safety culture and reducing accidents are very important.[43]

Companies need to provide and equip PPE to be used by workers.[44,45] Appropriate PPE for this job includes; a mask, gloves, apron, earplugs, hair cap. The strength of this study is the hirac method, with this method apart from identifying hazards, it can also assess risks and provide recommendations for risk control. These recommendations will be very useful in preventing and reducing accidents in the workplace. The limitation of this study is that it does not carry out a hazard analysis of the equipment, machines used, and risk calculations on the financial side which have an impact on the company in determining the risk rating. For future researchers, it is necessary to study potential hazards by applying other methods that focus more on equipment and machines such as the Failure Mode and Effect Analysis method and analysis of risk calculations on the financial side which have an impact on companies in determining risk ratings because it is not only workers who are protected but company assets also need to be protected.

Conclusion

Hazard identification and analysis is the first step in preventing occupational illnesses in employees and preserving a secure work environment. All MSMEs who engage in the activities of Tofu Making, Meatball Making, and Fried Dumplings must routinely conduct HIRAC studies. This

assists in accomplishing two objectives: first, it allows for the identification of critical and high-risk hazards that require immediate attention; second, it enables the early implementation of control measures, which lowers risk to the lowest feasible level.

Acknowledgment

This study was carried out thanks to the primary and occupational health care system module, Faculty of Medicine, Sultan Agung Tirtayasa University. We would also like to thank the Kasemen Community Health Center, Serang City, and the MSMEs Cuanki Bakti Mulia.

Funding

This study does not accept any unique grants from local funding organizations.

Conflict of Interest

According to the author, there is no interest.

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