



# Hazard Identification and Job Safety Analysis for Improving Occupational Health and Safety in Fishing Net Sinking Process in Southern Thailand

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DOI: <https://doi.org/10.30880/ijie.2022.14.04.015>

Received 13 February 2021; Accepted 27 April 2021; Available online 20 June 2022

**Abstract:** The fishing net sinker workers are exposed to numerous workplace hazards that can endanger their health and safety. We utilized a walk-through survey and Job Safety Analysis (JSA) technique to assess each step of the work process, identify potential hazards on each job and suggest the safest approach to fishing net sinker workers in southern Thailand. A JSA is a useful tool for mitigating risk in the workplace. It emphasizes the interaction between workers, tools or equipment, the working environment, and the tasks. The results show that a total of 52 potential hazards occur with varying severity and likelihood, 20% of which are categorized at the highest level. The mesh and lead ball making activities carry an extreme risk rating (RR=12). This work has possible hazards, namely occupational lung and asthma disorders. 40% are categorized at the high-risk level, namely fingers cut by tools (RR=8), and repetitive strain disorder (RR=8). Workers can be more proactive in implementing health and safety measures through appropriate risk control. The result of the paired-sample's t-test showed that the average risk score differs before taking control measures (M= 7.54, SD = 2.62) and after taking control measure (M= 4.31, SD = 1.55) at the 0.0001 level of significance (t = 7.6513, df = 51, n=52, P< 0.0001, 95% confidence interval of this difference 2.39 to 4.07). On an average, risk reduction was about 3.23 point lower after taking control measures. Ensuring that workers use tools and equipment safely and also that they maintain this equipment properly. Thus, it was suggested that the government agencies concerned should carry out regular surveillance and further develop the learning process and solutions to work safety procedures as guidelines to improve their safety, wellbeing, and working conditions. These enhancements will also contribute to the higher efficiency and effectiveness of their work and advance the dynamic interest and participation of the fishing net sinker workers in other areas, including careers for the informal workers of similar work characteristics.

**Keywords:** hazard identification, job safety analysis, occupational health and safety, walk-through survey, fishing net sinker

## 1. Introduction

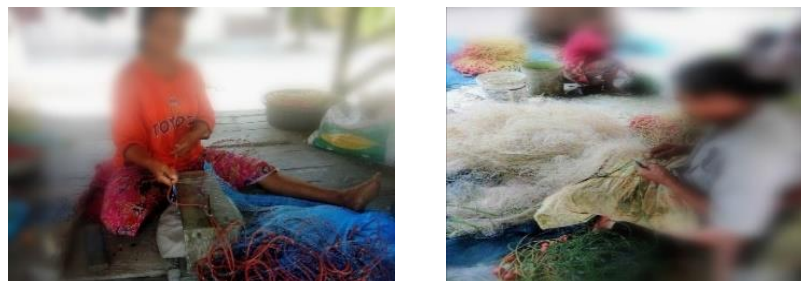
Informal workers play a very important part in the economies of most developing countries worldwide, especially in Thailand. From the community level's economic development policy in Thailand that promotes occupational development in the community, informal workers have seen an increased demand. These workers are employed, but they are insufficiently covered, or not covered at all, by a social security framework. Likewise, many formal workers in the agriculture, production, and service sectors are still out of reach of social security coverage [1]. In the southern region near the coast of the Gulf of Thailand, as the main occupation is fishing, there are many shipyards in the area [2]. A fishing net sinker worker is a professional who is responsible for fixing or making new nets. It is considered a job of an

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informal worker, who is at risk at their workplace. The fishing net is made from mesh weaved together. Usually, each fishing mesh consists of four knots and four legs or bars. In sinking the fishing net, it brings the ready-made meshes, strung in a rope and tied with lead balls. This is repeated five times in the fishnet sinking process, and each produces 30 net wholes, using knit to nudge the nets to the lead balls. The lead balls act as a counterbalance weight to the fishing net, while the other side of the net is tied to the buoy. The net's mesh needs changing every 3-4 months because it is torn easily, typically by way of clamping by crabs or cutting by shells. Fishing net sinking can generate an excellent income, but it may cause health hazards. A hazard is a source of danger or harm that can bring about adverse health effects on something or someone. It can occur through the presence of a physical condition, situation or series of events that have the potential for causing harm to people, property or the environment [3, 4]. There are various kinds of occupational hazards exposed by the workers for example, lead dust, repetitive posture, psychological stress. They typically emerge from the following aspects of work and their interaction: tools, materials, and substances used for work activities and how they are performed in the workplace environment, and work design and management [5]. Carrying out this work for long periods of time will put the fishing net sinker worker at risk of exposure to chemical poisoning from a lead (60.60%) and eye fatigue due to continuous and repetitive work [1]. When attachingng the lead balls to the rope, the balls typically collide which causes lead dust to be generated. The lead dust can blow into the air and fall on their clothes and body. The workers also risk ingesting lead into the body by both eating and breathing [6]. The major risk associated with lead is lead poisoning. It impacts the blood system and can cause anemia. Other signs include stomach pain, nausea, hallucinations, coma, tremors, fatigue and a potential rise in the risk of cancer. Lead exposure can also affect the reproductive processes of both men and women [7]. In most cases, the fishing net sinker workers work out of their own home, and there are no correct self-prevention guidelines for them or health and safety education. Moreover, this group of workers face problems from occupational health hazards emerging from substandard working conditions, such as being exposed to poisonous chemicals and unsafe apparatuses and devices, and vulnerability to occupational hazards such as irritation of the ears and eyes [8]. They face problems accessing health and safety services, resulting in a greater change of health problems than the formal workers.

The concern around the fishing net sinker workers in southern Thailand is that their work may have long-term health and environmental impacts upon them and people in their family [9]. Many studies indicated that the fishing net sinker workers are not covered against accidents arising from the tools used for their jobs, or having to adopt an improper working posture, leading to muscle and bone injuries in Fig. 1. Moreover, the fishing net sinkers were not aware of the dangers of lead, and their personal hygiene in the workplace is poor [9, 10]. Many households make fishing nets in their house near the cooking and sleeping areas. The study also indicated that the amount of lead dust in the workplace in Pak Phun Sub-district, where most of them worked in the shipyard, increased by 65 percent. The workers who were to string the lead balls onto the rope in their own homes would increase the chances that every member of their family was exposed to lead [9]. Many studies have suggested that different occupational hazards contribute to causing significant adverse health problems among informal workers, such as accidents and musculoskeletal problems [11,12].

Furthermore, the fishing net sinker workers are characterized by a lack of social security access. Most of them are not aware of the occupational hazards, while some do not even know that it is a dangerous job. When working in this type of job for a long time, it can cause disease or danger to the health of the workers. Therefore, informal workers' safety has always been a significant concern for both practitioners and researchers.



**Fig. 1 - Working characteristics of the fishing net sinker worker**

Particular information on the number of fatalities, illnesses, and injuries in the Thai fishing enterprise is lacking or is limited to anecdotal evidence. There is no adequate system of accident and illness reporting [13]. Based on walk through survey, occupational health and work safety among fishing net sinking process workers in Southern Thailand found that workers were still in need of knowledge and understanding on occupational health and work safety, including inaccessibility to health services provided by the government apart from no protection from labor laws and government sectors, particularly for health issues and work safety. Therefore, workers should be promoted with knowledge for making work improvements with safety and proper working behaviors through the adoption of techniques for work improvement in the workplace. In occupational health and safety systems, informal workers must have a risk management that comprises hazard identification and occupational risk management [14]. The researchers were engaged to analyze the

problems workers face and to propose better occupational solutions. Most importantly, the present study emphasized promoting the workers' learning process and equipping them with proper knowledge and precautions guidelines when being exposed to potential hazards in the workplace. Many workers are injured and killed at the workplace every day [15]. The fishing net sinker workers are commonly women in the families and communities. The hazards existing in this operation cannot be understood by the workers but it is essential for them to know the hazards of the jobs. Therefore researchers selected to carry out job safety analysis. The purpose of the job safety analysis is to encourage the workers' participation through each working process. Then control measures had been given to make the job safer.

A job safety analysis (JSA) is a technique that focuses on job tasks as a way to identify hazards before they occur. A job safety analysis (JSA) is a proactive approach that helps integrate accepted health and safety standards and practices into a specific activity or job process. In a JSA, each essential step of the job analysed to identify potential hazards and to introduce control measures. Once potential hazards have been determined, which creates a connection among the workers concerned, equipment and tools, the working environment, and the tasks involved, suggestions can be made to improve the working conditions [16]. It is an essential element of a risk management system and is done to keep workers safer and keep the workplace running smoothly with less downtime associated with injuries or accidents [17]. Identifying and assessing health hazards may require specialized knowledge. Effective JSA experts need the involvement and cooperation of workers. Workers get involved in discussions around health and safety issues so that they better understand the hazards and risks associated with their work. JSA involved a group of workers and professionals through shared discussion. An advantage of this strategy is that more individuals are included, leading to a greater acceptance of the recommendations.

This study's main objective was to identify existing potential hazards in each of the work processes, focus on assessing the key health and safety risks, and establish and implement control measures to improve their workplace conditions. This study pointed to the creation of primary prevention strategies and the agencies concerned to solve the workers and their families' occupational health and safety problems. We expect this study to shape future interventions for informal workers by providing a model for the health, safety, and wellbeing of workers.

## 2. Methodology

### 2.1 Research Design and Participant

This study type was quasi-experimental design, one group pre-test, and post-test without control group design. It was carried out to examine the work processes and used an interview questionnaire among fishing net sinker workers. Total population of 70 fishing net sinker workers were invited to participate in the study. The sample group consisted of 34 workers who were voluntarily to join the study. The selection criteria for the participants were having at least five years of work experience as a fishing net sinker, continuing work throughout the research session, and a willingness to participate in the experimental study.

The dismissal criteria would be applied to those who could not participate in the research throughout the session or requested to leave the experimental study for any reason. After that, to prepare a meeting with the community, the researchers invited and gathered the fishing net sinker workers to plan the research activities, setting each session's date and time. The meeting objectives were to discuss the activities such as hazard identification, job safety analysis, and risk control measures, including group discussion on work improvements and action plan creation.

### 2.2 Research Instrument and Data Collection

**Phase 1:** Questionnaire Survey. Information was obtained from the participants through interviews by researchers regarding their current and past activities. The questionnaires consisted of 3 parts. For part I, Demographics data and workplace characteristics, Part II, Knowledge about work safety procedures with choices consisting of 13 correct or incorrect questions on source of hazard, routes of workplace exposure, and health effect and prevention. Part III, Behaviour prevention against work hazards and personal hygiene with the rating scale of 9 items, a total of 36 points by classifying behaviors that should be improved (9-20 points) fair (21-28 points) and Good (29-36 points), A total of 36 items. This subscale has well-established validity (IOC=0.987) based on three expert panels and reliability (Cronbach's alpha 0.727)

**Phase 2:** An intervention based on Job Safety Analysis.

The researchers conducted a walk-through survey at Nakhon Si Thammarat province. The purpose of the walk-through survey was to learn more about the fishing net sinker process and observe work practices and determine whether there are any unsafe aspects of operations. A walk-through survey (WTS) was done by physically walking through the workplace and noting the hazards. WTS is the first step in evaluating and identifying equipment and processes. Professional walk-through surveys are an essential part of working in an occupational setting, giving a picture of the working conditions relatively quickly [11]. A comprehensive preparatory study consists of an examination of fishing net sinker workers' processes, and identification of hazardous agents. During the walk-through survey of 1 month, the researchers were able to obtain preliminary information about hazards. After that, the researchers utilized a job safety analysis technique to identify hazards on each task before it occurred and developed a process to prevent the workers

from finishing the net sinker process. The job safety analysis (JSA) is a method to minimize the risk well before conducting the job by assessing the risk with all the expert's input. In practice, hazard identification of a workplace is usually performed by an expert occupational health and safety practitioner to identify, and assess the severity of the risk, and recommend the exact control measure. OSHA 3071 approves conducting JSA with four basic steps as follows: 1) Select the job to be analyzed, 2) break the job down into specific tasks, 3) identify potential hazards and risks present in each task, 4) determine preventive control measures to overcome these hazards, creating work safety standard documents and training on safe work behaviors and observation [18,19]. Ideally, after you identify uncontrolled hazards, you will take steps to eliminate or reduce them to an acceptable risk level.

The risk rating matrix can be identified as one of the most common risk analysis methods [20, 21]. The likelihood is based on the observation performed to collect data on individual hazard occurs. At the same time, the severity of those hazards was determined based on illness or injury to health, property damage, and environmental damage of hazard exposure by each of the participating workers as described (Table 1, 2). The hazard exposure and severity of the hazard were ranked based on the rating suggested in the guideline [22].

**Table 1 - Probability of likelihood levels**

Probability Values (P)	Levels of Probability	Frequency
1	Unlikely	The event that is unlikely (occurs for more than ten years)
2	Possible	The event that may occur (occurs 1-10 years)
3	Likely	The event that may occur frequently (occurs once or twice per year)
4	Almost certain	Recurring event (occurs more than twice per year)

**Table 2 - The severity of consequences levels**

Severity values (S)	Levels of severity	Consequences
1	Minor	Minimal bruises, wounds, the injury needs first aid treatment, and no days lost injury
2	Medium	Cause disability but not permanent injury
3	High	Lost time or restricted activity
4	Extreme	Multiple loss time accident, permanent disability or fatality

The risk was calculated by multiplying the probability of occurrence and severity of the hazard, and a risk matrix table was used to classify the calculated risk score. Based on Table 3, the green box (RR = 1-2) shows the low risk level, the yellow box (RR 3-6) shows the medium risk level, the orange box (8-9) shows the high risk level and the red box (RR12-16) shows the extreme risk level.

**Table 3 - Risk rating matrix**

Probability \ Severity	Levels of risk	1 - Unlikely	2 - Possible	3 - Likely	4 – Almost Certain
1- Insignificant	1	Low (1)	Low (2)	Moderate (3)	Moderate (4)
2 - Minor	2	Low (2)	Moderate (4)	Moderate (6)	High
3 - Moderate	3	Moderate (3)	Moderate (6)	High (9)	Extreme (12)
4 - Major	4	Moderate (4)	High (8)	Extreme (12)	Extreme (16)

**Phase 3: Implementation Strategy.** A typical implementation strategy aimed to provide guidelines to encourage the sharing of good routine practices. The implementation composed of the following activities;

1) The first activity was to equip the fishing net sinker workers with knowledge about work safety procedures, utilizing training and media, diagrams, videos, pictures, sheets, brochures, and video clips, which could increase the experimental group's awareness level [23]. Occupational health training was provided all workers at the fishing net sinker workers for 3 hours at a time. When pointing out the risks to their health, they seemed to realize the problems and concerns about their families' safety. There were lectures on lead poisoning, the quantity of lead contamination in fishing net and shipyard-related working procedures, lead-exposure prevention methods, how to protect themselves from risk in the workplace, and surveillance by using knowledge boards with questions and 30 minutes of discussion. Therefore, there was a process of creating safety in the workplace procedures focusing on safe work practices together so that the fishing net sinker workers could recognize and understand the guidelines. They would be able to practice them properly and avoid the dangers that were a threat to them and their work. This technique could help them understand their work process well. For the researchers, this would facilitate the analysis of work-related hazards more accurately and systematically to identify and analyze hazards or risk factors. The emphasis of the hazard analysis would be given to the relationship between the workers, tools used in their job and the environment that might affect the workers, damage to equipment, machinery, environment conditions, and danger from chemical substances and lead dust to seek the tendency of hazards in each work procedure. As a result, the study would provide scientific information to be concluded as solutions to work procedure problems. It would ensure that the fishing net sinker workers would practice these solutions regularly and work safely [19]. Finally, there would be a process of creating workplace safety procedures focusing on good practice together so that the fishing net sinker workers could recognize and understand the guidelines.

2) The second activity was to participate in discussing workplace safety procedures in which the researchers got involved in helping the participants analyze the topic being discussed. After that, workplace safety measures were concluded and put into practice to change their working behaviors. This session took about 60 minutes. It allowed both researchers and participants to interact and exchange ideas, starting to prepare mutual understanding and shared intention to solve their occupational problems. Then, they were informed of the objectives and the analysis procedures to obtain information on work safety procedures and relevant practical measures. Next, the participants were divided into small groups of 4-5 people. A research assistant was assigned to each group to help explain guidelines and concerns about group activities. Once the discussion started, the research assistants and researchers would help the participants in job safety analysis by analyzing the health problems or hazards in each work procedure and the cause of the work procedure's issues.

3) The overall conclusion of the activity was made. The fishing net sinker workers were asked to view the analyzed workplace safety procedures discussed and the workplace safety procedures set again. All additional suggestions and activities to perfect the outcomes were welcome. It was to ensure that the workplace safety procedures and safety measures were beneficial and practical for them. Every fishing net sinker worker was encouraged to put these guidelines into practice to improve their workplace safety procedures.

4) Implementation of the improvements: After the section set out meeting the job safety analysis of the fishing net processes, six months after the intervention was completed, the village public health volunteers and the researchers were committed to following up the results practiced by the fishing net sinker workers. Meanwhile, they were given advice and adjustments to suit their safest working conditions while applying the new workplace safety procedures. Also, there was a public relations professional to promote the guidelines and encourage them from time to time via the village broadcast system.

**Phases 4:** Evaluation of the activities. All kinds of data collection were carried out before and after developing occupational health and safety guidelines for six months each.

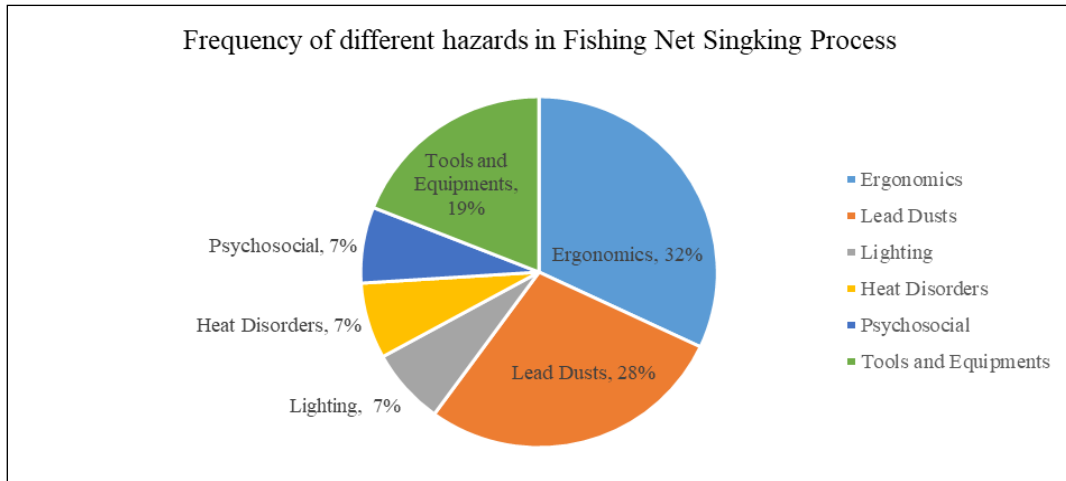
## 2.3 Data Analysis

Data was analyzed statistically using descriptive statistical methods to describe the study population using frequencies, mean, and percentage relevant categorical variables—calculating the mean of a set of values in a sample used for an observational study. The paired t-test is a type of hypothesis testing used when two sets of data are being observed. An inferential statistic was used to determine the independent factors associated with safety knowledge.

## 3. Result and Discussion

### 3.1 Demographic Characteristics and Occupational Hazards of fishing net sinker workers

The Results of the demographics analysis of the fishing net sinker workers based on the personal data of 34 fishing net sinker workers, most of them were female (92.18%), aged 41-60 years old (41.18%), and married (73.53%). Their education level was elementary school (67.65%). Each household had about 3-4 members (41.18%). The monthly income was lower than 5,000 baht (64.71%), and the average monthly payment was 5,001-10,000 baht (47.06%). Most of them worked in their household area (94.12%), whereas their average work experience was around 19 years, with the average working time 7 hours per day, six days per week. In 34 workers' home, 52 hazards were identified and their analysis was performed shown in Fig. 2.



**Fig. 2 - Frequency of different hazards in a fishing net sinker process**

### 3.2 Job Safety Analysis Before and After Control Measures in Fishing Net Sinking Process

The hazards found in different types of the fishing net sinker process. Job safety analysis was performed through a participatory process of the sample group at the beginning of the study. Control measures and safe procedures were implemented in 6 months. After that, the JSA was performed again to observe altered risk. JSA is a participatory tool with which workers can take action on their own to identify and remedy safety and health problems and find practical solutions. The goal is to prevent and reduce fatal accidents, injuries and occupational diseases. Using job safety analysis to tackle their daily safety and health problems allows workers, especially small - medium-sized enterprises, to make their workplaces safe and healthy. The fishing net sinking process has five main activities listed in the JSA Form. Additional video recordings were used in order to analyze the hazards exposed to workers while performing their tasks. The control measures for the fishing net sinking process' potential hazards are analyzed based on engineering controls, administrative controls, and personal protective equipment [3]. In practice, if the hazard cannot be eliminated entirely, It is probably that the control measures implemented will be a composite of all the three components that were subsequently released. Apart from that, all of these risk from the highest, medium, and the lowest risk category have resulted in their current risk control and the reduction of risk after taking appropriate control measures are shown in Table 4.

**Table 4 - Job safety analysis before and after control measures in fishing net sinking process**

Job Steps	Identified Hazard and Risk	Effects	Risk Analysis and Evaluation			Control Measures and Recommended Safe Procedures	Risk Analysis and Evaluation		
			P	S	RR		P	S	RR
1. Taking ropes and lead balls out of sacks	- Knife/Scissors cutting hands or fingers - Knit prick to hand - Rope cut	- Finger and hand injuries - Cut, laceration or wound - abrasions	4	2	8	- To place the sack firmly before cutting the sewed - Use a sharp blade; a dull knife indicates that when cutting, a worker has to exert more force, raising the risk of an injury - Position hands away from the blade while cutting - Quality of knife/scissors	2	2	4
2. Measuring the wood distance for fishing net sinking, using nail at its end and using it to measure the length of rope about 20 cm.	- Hammer hitting thumb, fingers, or hand	- Broken bones - Fractures - Bruises	3	2	6	- To nail with a gentle force first that the nails are stuck to the fishing net. After that, remove the hand from the nail to prevent hitting it with the hammer - Do not use fabricated tools	2	3	6

Job Steps	Identified Hazard and Risk	Effects	Risk Analysis and Evaluation			Control Measures and Recommended Safe Procedures	Risk Analysis and Evaluation		
			P	S	RR		P	S	RR
3. Stringing the lead balls into the rope to serve as a counterbalance weight to the fishing net	- Dust from the lead balls	- Occupational lung, skin, and eye disorders - Anaemia and impaired brain - Nervous system functions	4	3	12	- Wash hands thoroughly after work - Use the appropriate PPE such as face masks and aprons to prevent dust from sticking to work clothes - To dress appropriately - Ensure proper housekeeping	2	3	6
	- Hammer hitting the hand	- Broken bones - Fractures - Bruises	3	2	6	- Training the workers regarding safety measures - Do not use fabricated tools	2	2	4
	- Repetitive work, awkward posture while sitting at the fishing net for a long time	- Discomfort and body aches - Pain in the neck, shoulders, or back	4	2	8	- To change the seating position frequently and correctly - Change the layout for easy access to equipment - Avoid repetitive and monotonous work	2	2	4
4. Using knit to nudge the meshes to the lead balls	- Knife cut from arranging the lead balls - Rope cut	- Finger and hand injuries - Lacerations from exposed nails	4	2	8	- Check to see that replaceable parts such as blades are secured - Utilize the proper tools for the job at hand.	2	2	4
	- Dust from lead balls	- Asthma - Occupational lung, skin and eye disorders - Anaemia and impaired brain functions - Impaired nervous system functions - Breathing problems or related effects	4	3	12	- Wear PPE that protects from contacting hazards such as face masks and aprons - Change clothes after finishing work - Separate the workplace from the home - Clean your workplace after every operation by using a soaked cloth to wipe - Provide local exhaust ventilation in the workplace	2	3	6
5. Using knit to nudge the meshes to the buoys and repeat the net sinking procedures on the other side of the net as in steps 2-5	- Repeated operation causes "Trigger Finger"	- Pain in the neck, waist, shoulders, or back - Tendon and ligament injury - Musculo-skeletal pain	4	2	8	- Take a break between operations - Change the seating position frequently and correctly - Change the layout for easier access to equipment - Procedure follow up	2	2	4

Job Steps	Identified Hazard and Risk	Effects	Risk Analysis and Evaluation			Control Measures and Recommended Safe Procedures	Risk Analysis and Evaluation		
			P	S	RR		P	S	RR
			5. Using knit to nudge the meshes to the buoys and repeat the net sinking procedures on the other side of the net as in steps 2-5 (Con't)	- Light	- Sore or irritated eyes - Trouble focusing - Eye fatigue		3	2	6
	- Heat	- Heatstroke - Body dehydration and fainting - Lack of concentration	2	3	6	- Advise drinking 1 cup of water every 30 min - Advise wearing loose-fitting cotton clothes	2	2	4
	- Urgent on demand work	- Work stress and caused occupational accident and injury	3	2	6	- Flexibility and adaptability will serve you well. - Prioritize and set achievable deadlines	2	2	4

In this fishing net sinking process, the identification of hazards, and observation at the workplace, and face to face interviews with 34 workers who are an expert in the specific area [17, 23], were identified and evaluated using job safety analysis. The mesh making with lead ball activities has the highest risk rating (RR=12). Lead fishing-net sinkers are often identified as scrap metal and/or treated in the shape of a small tube or lead sheeting ring [24]. Lead in this form is much more easily absorbed. The adverse health effects caused by lead exposure have long been suspected. Lead-induced encephalopathy and changes in behaviour [2, 25, 26]. The high-risk category (RR=8) is from the taking rope and lead balls out of sacks activities and using knit to nudge the meshes to the lead ball, for example, contact with hand tools. Cuts and abrasions can also injure workers: in using knives (to repair nets) and cables; contact with fittings projecting from the structure [27]. Injuries in several accidents arose from individuals striking their hands—these hazards arising due to either poor configuration or equipment limitation. During knitting to nudge the meshes, the worker used the knit to nudge the buoys' meshes. The posture of the meshes is forwarding bending and laterally twisted. During this activity, the risk increases depending on the knitting and may increase the risk of developing musculoskeletal complaints, including lower back, neck, and leg pain. The knitting activity rating falls in the medium-risk category (RR=8), due to the likelihood of adopting a bending posture during the knitting process and constant repetition of this bending daily which can cause MSD. The workers may feel discomfort and body aches. Some workers suffer from repetitive strain from awkward lifting. Based on the result, job safety analysis is designed to help achieve the vision of the informal worker's health and safety in the workplace. A JSA is the first step to protecting workers against occupational hazards, and controlling a safe workplace involves defining and analyzing hazards. In many cases, a JSA will be performed first to find and address the higher level hazards [18]. All hazards that have been assessed should be dealt with by prioritizing in one or more of the following; engineering controls, administrative controls, and personal protective equipment [17, 28]. To provide an approach implies until the hazard is diminished correctly, the use of one hazard control method over another higher up in the hierarchy of control may be appropriate. Based on these findings, it is recognized that there are many high-risk occupational health and safety tasks. Therefore, the workers need a variety of control measures to avoid potential hazards [29] such as washing their hands with a detergent before drinking water or having lunch, cleaning of the workplace regularly to reduce the risk of dust from the lead balls, to train in health and safety, to ensure that workers use personal protective equipment, taking a shower after work, changing clothes at home, and washing clothes separately from the family wash [9, 25, 30]. In addition, workers must also be capable of comprehending the JSA and operating within it as well. It is essential to minimize as much ambiguity as possible when it comes to communicating hazards.

### 3.3 Statistical analysis of risk reduction after control measures

In 34 workers' home, 52 hazards were identified and their analysis was performed shown in Fig. 2. Statistical analysis was performed using the Graph Pad's website [31]. A value of  $P < 0.05$  was considered significant [Table 5]. The results of the paired-samples t-test show that the average risk score differs before taking control measures ( $M = 7.54, SD = 2.62$ ) after taking control measure ( $M = 4.31, SD = 1.55$ ) at the 0.0001 level of significance ( $t = 7.6513, df = 51, n = 52, P < 0.0001, 95\%$  confidence interval of this difference 2.39 to 4.07). On an average, the risk reduction was about 3.23 point lower after taking control measures.



**Table 5 - Statistical analysis of risk reduction after control measures**

	Number of hazards	Mean	Standard deviation	Standard error mean
Before Control Measures	52	7.54	2.62	0.36
After Control Measures	52	4.31	1.55	0.21
Difference	52	3.23		0.42

\*95% confidence interval for the mean difference.

### 3.4 Evaluation of Activities; Safety knowledge and Behaviours

Previous interviews with occupational health training revealed that many workers in the fishing net sinker process had lacked knowledge and / or understand the risk of contact with the net sinker. Very few people know about this, but knowledge is wrong. After occupational health training, many workers (91.18-100%) understand the risk and protection against it. The researchers describe the implementation of the risk evaluation phase after workers have been learning the process for six months. The advantage of using this approach and the accuracy of the outcomes of the risk evaluation are also discussed. The worker's average scores on work safety knowledge were at a high level (Mean = 11.79, SD = 0.98), higher than the pre-learning process (Mean = 9.50, SD = 2.09). Their knowledge scores on work safety procedures before and after the activities were significantly different at p-value <0.001. However, the differences in work safety scores before and after were significantly different at p-value <0.05. Overall, the fishing net sinker workers at first were less cautious about workplace safety procedures and lacked proper knowledge of health risks when dealing with lead for a long time. After the intervention activities to increase their awareness and equip them with knowledge about workplace safety, the integrated method can reduce the risk and create a necessary recommendation to improve their workplace [16] as described (Table 6,7).

**Table 6 - Statistical analysis of knowledge risk reduction after control measures**

Knowledge	Mean	Standard deviation	t	Df	p-value
Before control measures	9.50	2.09	-6.171	33	0.000*
After control measures	11.79	0.98			

\*95% confidence interval for the mean difference. The two-tailed P <0.001. By conventional criteria, this is considered to be extremely statistically significant.

**Table 7 - Statistical analysis of behaviours risk reduction after control measures**

Behaviors	Mean	Standard deviation	t	Df	p-value
Before control measures	25.41	7.16	-3.126	33	0.004*
After control measures	11.79	0.98			

\*95% confidence interval for the mean difference. The two-tailed P <0.001. By conventional criteria, this is considered to be extremely statistically significant.

The study revealed a statistically significant difference in knowledge scores before and after the implementation, p-value <0.001. This was because the learning process enhanced their knowledge about their job safety analysis and safety standard operating procedures when dealing with workplace hazards. The lecture technique used to educate the workers could help them understand the content more easily than to study independently. When the researcher is a self-lecturer, the workers would gain the correct knowledge and ask questions immediately. This made it easier for them to understand the content. The related documents distributed to them in the learning process were beneficial as they could go over them again on their own when at home. The activity increased their implicit knowledge about the issues and exposed their explicit knowledge to benefit others and work. Workers' involvement is positively related to safety procedures and participation [23]. They were more confident in performing their tasks at work and could recognize useful knowledge better in practice. They would be able to practice them properly and avoid the dangers that were a threat to their work. This technique could help them understand their work process well. For instance, the workers understood how to improve certain areas that can significantly reduce the spread of lead, resulting in the increased experience from the learning process. Therefore, it was very necessary that the government agencies or the leaders of the group had to be motivated, encouraging the fishing net sinker workers to have good work hygiene and safe work procedures [32]. There should be work analysis activities provided periodically or at least once a year to encourage and evaluate their work performance. Involving workers in the process of hazard identification is also essential. Workers have a unique understanding of their work, and for identifying hazards, this expertise is invaluable. Workers' participation would help reduce oversights,

ensure a quality assessment, and get all employees to "buy-in" on the solutions [19]. Regarding the behaviours on work safety, it was found that the fishing net sinker had an average score before and after the intervention with a statistically significant difference  $p$  – value = 0.004. This indicated the increase in their knowledge and work performance as behaviours were closely related to intention, determined action, or practice, leading to behavioural improvement. When considering each item's results, it was convincing that the fishing net sinker workers were committed to handwashing habits before eating, preparing food and cooking, and washing their hands after work. Hand washing is essential personal hygiene that helps to prevent various diseases. The campaigns appearing in many media outlets could increase their awareness of learning health information to develop them to apply good practice.

#### 4. Conclusion

This study ultimately concludes that apart from the nature of the fishing net process, occupational hazards in the workplace contribute significantly to the likelihood of occupational accident and the prevention of these occupational hazards will help protect workers from harm. The highest rating (RR=12) was found in the mesh making with lead ball activities. The results of this study before applying the JSA technique revealed a high level in fishing net sinker workers after control measures showed that all activities had medium and low-risk levels. Moreover, during the last six months, preventive measures include remedial efforts to reduce respiratory tract and working posture. The fingers and hands were the most affected areas of the body, using a mask, gloves regularly and following the safety procedure after job safety analysis. This was a practical way to control health and safety hazards in the workplace. The participatory learning techniques used in our participatory approach included using job safety analysis for the understanding process, demonstrate how positive workplace health and safety outcomes can sustain productivity and the workers increased their ability to improve their work condition. This study can help prevent and reduce worker risk exposure in the workplace. Particularly the government concerned should get involved and carry out this intervention to guide its efforts to work with informal workers to promote a culture where health and safety are at the center of the workplace. The government needs to emphasize addressing safe working activities and applying these workplace safety procedures to the fishing net sinker workers in other areas and encourage them to prevent workplace injuries, illness, and fatalities. Throughout Thailand, Intervention in the current and future studies will help informal workers. The researchers will use the recent study's findings to support future work to assist other informal worker groups.

#### Ethical Considerations

The research has been recognized and endorsed by the Ethics Committee of Human Research. Walailak University No.59/022WU-EC-AH-4-020-59. All procedures performed in studies involving human participants were in accordance with the ethical standards. The participants were informed about the study, and the purpose of the study was explained to them clearly in the Thai language. The consent of each participant was sought through an information note attached to the questionnaire.

#### Acknowledgement

Funding for this project was through the National Research Council of Thailand. The authors would like to forward our deepest gratitude to the village public health volunteers, study participants, and data collectors who participated in the study for their genuine dedication and effort shown during the data collection.

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