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Occupational risk analysis in a fish warehouse: a comparative study between GUT matrix and preliminary risk analysis

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Abstract

The occupational hazards to which workers in the fish industry are exposed daily can affect their work performance and compromise their health. This work aimed to compare the analysis of occupational risks raised in a fish warehouse, using the preliminary risk analysis tools and the GUT matrix. Twelve risks were identified, one chemical risk, two biological, three physical, three ergonomic, and three accidents. The risks with a more remarkable power of occurrence and impact are cold, humidity, excessive physical effort, inadequate posture to perform certain tasks, and noise. The assessment of environmental risks through the PRA and GUT matrix is essential for managing health and safety at work in a fish warehouse. With this data, it is possible to develop an action plan to control risks, improve the work environment and guarantee the health and safety of workers.

Keywords: fish; food safety; occupational safety.

Practical Application: This study provides a comparison of occupational risk analysis in a fish warehouse.

1 Introduction

Fish is a highly nutritious food composed of protein, minerals, vitamins, and unsaturated fatty acids, having great importance in world food production (Saeed et al., 2022). Polyunsaturated fatty acids present in fish exert positive effects on the human body (Alkuraieef et al., 2022). In the world, the average annual rate of fish consumption increased by 3.1% between 1961 and 2017, higher than that of all other animal protein sources (meat, dairy), which increased by 2.1% per year (Food and Agriculture Organization of the United Nations, 2020). The coastline of Brazil has 8,500 km and the Exclusive Economic Zone has a vast extension, with an outer limit of 200 nautical miles. Therefore, Brazil has the conditions to become a major producer of fish, even being able to actively enter the global market, replace imports and leverage the national market (Igarashi, 2021; Ximenes, 2021). Thus, the minimum level of safety and health at work is established by regulations and standards that improve working conditions for all workers (World Health Organization, 1995).

According to regulatory standard 1, the level of occupational risk must be indicated for each risk, being characterized by the combination of the severity of possible damages or health problems with the probability of their occurrence, and the company must choose the appropriate risk assessment tools and techniques. In this way, the use of a risk matrix for the assessment of occupational risks is mandatory (Brasil, 2020).

The gravity, urgency, and tendency (GUT) a matrix is a decision tool for prioritizing problems by assigning grades to the aspects of gravity, urgency, and tendency. Regarding gravity, one must consider the intensity and depth of damage that the problem can cause if unacted upon. The urgency analyzes the time for the outbreak of damages or undesirable results if not acting on the problem. The tendency observes the development that the problem will have in the absence of action. Each of these three aspects (G, U, T) are assigned numbers between 1 and 5, with 5 representing the greatest impact and 1 the least. The great benefit of using it is the help it will give the manager to quantitatively assess the problems or risks of the company, making it possible to prioritize corrective and preventive actions (Pinto et al., 2022).

In this context, an important tool used to help detect and prevent potential risks in the work environment is the preliminary risk analysis (PRA). Based on observational analyzes of environmental conditions and activities performed by employees, through its methodology it manages to qualify the risks. In this way, it is possible to identify which parts of the process can operate out of control and unexpectedly, listing the causes, ways of detection, and possible consequences generated for each situation (Jeronimo et al., 2013). There are few studies in this fish sector, using management tools to survey occupational risks. This study is proposed to compare the analysis of occupational risks raised in a fish warehouse, using the PRA tools and the GUT matrix.

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2 Materials and methods

The work was carried out in a fish warehouse, in Santos-SP. The total workday per week is 44 h, from Monday to Friday, from 7:30 am to 4:30 pm and on Saturdays from 8:00 am to 12:00 h. Totaling twenty-six workers. The research was developed in the period from January 2022 to February 2022. In addition, observational analyses and photographic reports were carried out. For the PRA, a spreadsheet was used that, at first, identifies the hazards, causes, and damages textually. Next, the probability of occurrence and the severity (impact) are identified. The scale for probability is high (3), medium (2), low (1). For severity: high (3), medium (2), low (1). The risk level is scored by multiplying the assigned values, respectively the probability and severity of the risk (Benite, 2004). At the same time, the GUT matrix was used as an analysis tool for further comparison (Leite et al., 2018).

Pearson's correlation coefficient (r) was used to determine the relationship between the variables (Aldrich, 1995). Additionally, to measure the reliability of internal consistency and reflect the degree of correlation between the domain variables, Cronbach's alpha (α) indexes were used with a confidence interval of 95% (Cortina, 1993; Silva et al., 2011) using the Jamovi 2.3.0 program.

3 Results and discussion

The result of the survey of hazards, situations, damages, and risk assessment are shown in Table 1. Twelve risks were identified, one chemical risk, two biological, three physical, three ergonomic, and three accidents according to regulatory standard 9 (Brasil, 2021a). The risks with a more remarkable power of occurrence and impact are cold, humidity, excessive physical effort, and inadequate posture to perform certain tasks.

The abundant use of ice in the reception and delivery of fish causes workers to be exposed to the cold for long periods. In addition, the melting of this ice favors the constant presence of moisture on the floor and walls. These risks make it possible for the worker to develop respiratory diseases, among others. In addition to causing damage to machines, equipment, and electrical wiring (Grings, 2006). As fish can spoil, post-harvest handling, processing, preservation, packaging, storage and transportation require particular care to maintain its nutritional attributes and avoid waste and losses (Alkuraieef et al., 2022). The use of ice is essential in a warehouse that sells fresh fish to maintain temperature uniformity in the cold chain of the entire process, and thus guarantee the quality of the product (Calanche et al., 2013).

In the reception of raw materials and delivery of the product, workers are subjected to excessive physical effort, which can cause several health problems (Santos & Nascimento, 2015). During the unloading of the same batch of fish, fish with significantly different sizes and weights are received under the same facilities and/or equipment, with this the workers adopt inadequate postures for their handling, which allows the emergence of back problems, pain in the back, tiredness. A band saw machine, equipment that produces high noise is used to remove the

Table 1. Preliminary risk analysis.

Preliminary Risk Analysis					
Hazards Identification			Risk Assessment		
Hazard	Situation	Damage	P	G	Risk (P X G)
Cold	Direct contact with ice used in fish conservation	Changes in the respiratory system	3	2	6
Humidity	Wet floor	Diseases of the skin and respiratory and circulatory systems	3	2	6
Noise	Saw	Psychiatric disorder, deafness	2	2	4
Chemical substances	Incorrect use of cleaning products	skin dermatitis, diseases of the respiratory system	1	2	2
Fungi/molds	Microorganisms due to excess humidity in the environment	Skin injury, diseases of the respiratory system	1	1	1
Toxins	Fish manipulation	Skin lesion	1	2	2
Physical effort	Lifting and carrying weight	Muscle discomfort, repetitive movements	3	2	6
Inappropriate posture	Manipulation of fish of different sizes and weights	Back problems, back pain, tiredness	3	2	6
Extended workday	As it is a perishable raw material	Stress, back problems, irritability, muscle pain, weakness, mental fatigue, ulcers, high blood pressure, tiredness, sleep disturbances, diabetes, nervous disorders	1	2	2
Falls	Na environment with slippery, constantly wet, and/or icy floors	Muscle pain, back pain, fracture	2	2	4
Cutting	Negligence with the knife	Infections	2	2	4
Spines and/or fins on fish	Manipulation of fish	Cuts, infectious and/or inflammatory processes	1	1	1

Adapted from Benite (2004). Criteria for analyzing the PRA Matrix: [3] = P (high), [2] = P (mean), [1] = P (low), [3] = G (high), [2] = G (mean), [1] = G (low), [Risk] = result of multiplying the P x G factors. The risks with a more remarkable power of occurrence and impact are cold.

fish's head, so the worker must wear ear protectors to prevent deafness in the long term. In the world, about 16% of hearing loss is attributed to occupational noise exposure (World Health Organization, 2002).

The risks identified as the presence of toxins on the surface of the fish's body and the presence of fins and/or spines in the fish can cause skin dermatitis and/or infectious processes, and the continuous use of gloves by handlers is recommended as a preventive measure. Chemical substances handled and/or used incorrectly can result in residues on equipment, in addition to providing skin irritation, causing damage to the health of the worker. The high moisture content in the warehouse facilities favors the growth of fungi and/or molds which, in addition to skin dermatitis, in the long term can compromise the respiratory system of workers. The risks of cuts and falls are constant due to the slippery floor, and mainly to errors in the execution of work activities, but they can be mitigated by the correct use of individual protection equipment. Fish is a highly perishable product and has a short shelf life, so even if unforeseen events occur, it is necessary to finish all the processes, which can increase working hours. As a result, it is possible that there is a physical and psychological overload, increased stress, and compromised health and well-being of the worker (Santana et al., 2020).

The risks to be prioritized from the GUT matrix are shown in Table 2. According to the GUT matrix, ergonomic risks are the first that need immediate action, such as excessive physical effort and inadequate posture to perform certain tasks. To minimize the possible damage resulting from these situations, suggested the practice of labor gymnastics, job rotation, for the worker does not perform the same activity for a long period. Furthermore, as suggested the rest breaks are provided in regulatory standard 17 (Brasil, 2021b). In the second position, physical risks (cold and humidity) and two accident risks (falls and cuts) were prioritized. These risks can be mitigated by the correct use of PPE and employee training. In sequence, ergonomic risk (the extended workday) and biological risk (toxins), took the third position. And on the fourth position, the risk of accident due to the presence of spines and/or fins, and also the biological risk due to the presence of fungi and/or molds, and physical risk (noise). Finally, the chemical risk is due to the incorrect use of chemical substances for the cleaning of facilities, equipment, and utensils. Constant training is of paramount importance since there is a significant relationship between theoretical knowledge and workers' attitudes (Agüeria et al., 2018).

The comparative result of the risks described by the PRA and the GUT Matrix are presented in Table 3. Cronbach's α coefficient was calculated for the GUT matrix and PRA domains (12 items). Cronbach's α was 0.79 for the GUT matrix and PRA. Suggesting a strong relationship between the items. Values lower than 0.70 indicate a low correlation between the items and values greater than 0.90 indicate a very strong correlation (Hair et al., 2009).

Excessive physical effort and inadequate posture to perform certain tasks ranked 1st. Falls and cuts in the 2nd position, extended workday, and toxins present on the fish skin, in the 3rd position. Thus, there is a similarity between the first three positions in the two tools. Thus, it is evident that the use of the GUT matrix corroborated the PRA result. The assessment of environmental risks through the GUT matrix is paramount for managing health and safety at work in the industrial (Pinto et al., 2022). Even though it is a tool used by 1 specialist qualified by the company, there are no replicates for filling it out. Therefore, using another tool is a way of working in more detail on the sources of danger and the risks identified. The use of the GUT Matrix and PRA risk analysis tools is just the beginning of the process to improve the functioning of the work protection management system. However, rational organization and effective cooperation between workers and managers of all structural departments are essential (Evtushenko & Siryk, 2015).

The Heatmap of the Pearson correlation coefficient matrix for probability, severity, and the degree of risk, is presented in Figure 1. It is possible to analyze that there is a strong correlation between the two analyzed variables and their product. All two-by-two correlations show r above 0.70, which points to a strong positive correlation. Thus, indicating that the correlation between

Table 2. Prioritization of individualized environmental risks, obtained from the GUT matrix.

	Identified Risks	G	U	T	TT	P
Physical Risk	Cold – direct contact with ice	2	3	2	12	2º
	Humidity - wet floor	2	3	2	12	2º
	Noise – saw	2	2	1	4	4º
Chemical Risk	Chemicals handled incorrectly	1	2	1	2	5º
Biological Risk	Fungi and/or molds	1	2	2	4	4º
	Toxins present on the fish skin	2	2	2	8	3º
Ergonomic Risk	Excessive physical effort	3	3	2	18	1º
	Inappropriate posture for work	3	3	2	18	1º
	Extended workday	2	2	2	8	3º
Accident Risk	Falls	4	3	1	12	2º
	Cutting	4	3	1	12	2º
	Spines and/or fins on fish	2	2	1	4	4º

Adapted from Regulatory Standard 9 (2021) (Brasil, 2021a) and Finelli (2021). Criteria for analyzing the GUT Matrix: [5] = G (extremely serious), U (immediate action), T (worse right away); [4] = G (very serious), U (with some urgency), T (worse in the short time); [3] = G (serious), U (as early as possible), T (worse in the medium time); [2] = G (slightly serious), U (can wait a while), T (worse in the long run); [1] = G (no gravity), U (no rush), T (won't get worse). [TT] = Total: result of multiplying the G x U x T factors. [P] = priority in which actions will be implemented.

Table 3. GUT Matriz and PRA.

Identified risks	GUT	PRA
Cold – direct contact with ice	2º	1º
Humidity - wet floor	2º	1º
Noise – saw	4º	2º
Chemicals handled incorrectly	5º	3º
Fungi and/or molds	4º	4º
Toxins present on the fish skin	3º	3º
Excessive physical effort	1º	1º
Inappropriate posture for work	1º	1º
Extended workday	3º	3º
Falls	2º	2º
Cutting	2º	2º
Spines and/or fins on fish	4º	4º

Comparative of the results of the matrix GUT and PRA.

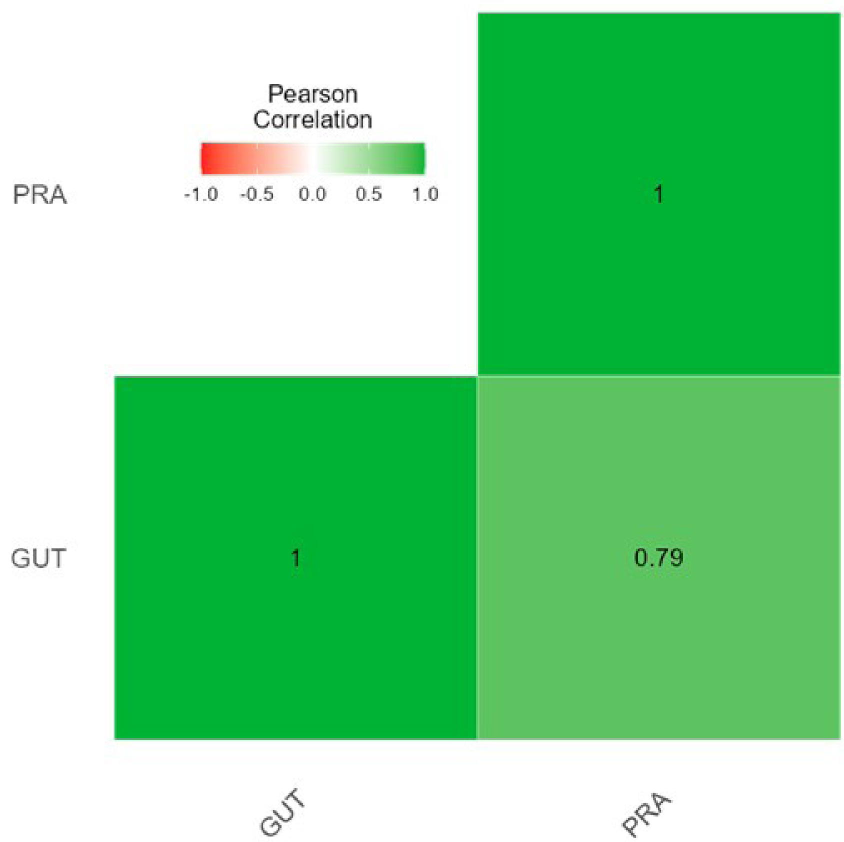

Figure 1. Heatmap of Pearson correlation coefficient matrix.

the two matrices is due more to the result of multiplying the factors (0.79 or 79%) than to random variables in the process (0.21 or 21%). Additionally, one matrix complements the other when classifying, categorizing, ranking, and multiplying the factors.

The results of the photographic report at the fish warehouse are shown in Figure 2. Physical, ergonomic, and accident risks can be seen in all images. Workers must understand and recognize the organization's commitment to occupational safety since the involvement of all is essential both for the execution and maintenance of safe work practices and for the incidence of work-related injuries (Hu et al., 2022). Thus, in the industrial space, the awareness and engagement of employees in safety prove the link between the execution of work and occupational safety.

It can be seen, then, that the environmental risks are generated mainly through materials and utensils, obsolete or maintenance-free equipment, lack of ergonomic study of the workstations,

Figure 2. The photographic report of the risks in the work environment. Images from the photographic report, refer to the different risks identified. Physical and ergonomic risk (a), ergonomic risk (b), accident risk (c), physical risk (d), (e) and (f), physical and accident risk (g), accident risk (h), ergonomic risk (i).

lack of standard operating procedures, and their due training and low-skilled management with a conformist profile within the scope of work safety (Pinto et al., 2022).

Overall, food safety must be integrated with worker safety. Therefore, a work environment with a reduced risk of accidents and a preventive culture disseminated by all stakeholders favors everyone and reduces the labor liabilities for the company. The risks are part of the activity related to the manipulation of fish and food in general. Therefore, adequate environmental comfort (thermal, light, and acoustic) and the correct use of personal protective equipment can mitigate many risks observed in this work.

4 Conclusions

Based on the data extracted from this study, workers in the fish warehouse perform their activities with numerous sources of hazards. As a result, they are subject to the five main risk groups. However, the ergonomic and physical risks were highlighted in both management tools.

The assessment of environmental risks through the PRA and GUT matrix is essential for managing health and safety at work in a fish warehouse. With this data, it is possible to develop an action plan to control risks, improve the work environment and guarantee the health and safety of workers. The awareness of employees, adequate training, and the partnership between the occupational safety team and the food safety team is the way to achieve better results.

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