Analysis of Occupational Health and Safety Risk Management: Hazard Identification, Risk Assessment, and Risk Control-HIRARC for Workers at Health Quarantine Offices in Makassar, Indonesia

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Abstract: Work hazards and risks are closely related to occupational activities and have the potential to cause injuries and occupational diseases. Every workplace carries the risk of accidents, as reflected in data from Indonesia's Work Accident Insurance Program (JKK BPJS Ketenagakerjaan). The number of workers experiencing fatalities due to occupational accidents and diseases decreased from 4,007 cases in 2019 to 3,410 cases in 2020 but increased again to 6,552 cases in 2021. This study aims to assess occupational health and safety risk management using the Hazard Identification, Risk Assessment, and Risk Control (HIRARC) method among workers at the Makassar Health Quarantine Center. This descriptive study involved a population of 133 workers, with a sample of 57 workers selected using simple random sampling. Data were collected using the HIRARC questionnaire and analyzed using univariate analysis. The results showed that the majority of respondents were aged 40–49 years (57.9%), and 73.7% worked more than 8 hours per day when assigned to night shifts. The HIRARC assessment identified that the most common occupational hazard experienced by workers was ergonomic risk, with complaints of back, waist, and shoulder pain, classified as a moderate risk. In conclusion, ergonomic hazards pose a significant issue among workers, categorized as a moderate risk level. Therefore, it is recommended that the Makassar Health Quarantine Center enhance its occupational health and safety risk management and conduct regular evaluations of workplace hazards and risks.

Keywords: Occupational health and safety, risk management, hazard identification, risk assessment, risk control.

INTRODUCTION

Workplace hazards and risks are intrinsically linked to work activities that can lead to potential injuries and occupational diseases. Every workplace inherently carries the risk of accidents. The level of this risk depends on various factors, including the type of industry, technology, and the effectiveness of risk control measures implemented [1].

Occupational health and safety (OHS) is a critical aspect that must be prioritized and integrated into every work process due to its far-reaching impact. The effective implementation of OHS programs is essential not only in preventing and minimizing work-related accidents and diseases but also in fostering a healthier, more productive work environment. Such initiatives contribute to improved worker well-being and organizational performance [2-3].

According to the International Labour Organization (ILO) in 2019, approximately 337 million workplace accidents occur each year, resulting in an estimated 2.3 million worker fatalities. OHS is therefore not only a concern for workers but also a global business imperative. The ILO's recent estimates show that over 1.8 million deaths due to work-related incidents occur annually in the Asia-Pacific region, with two-thirds of these deaths occurring in Asia. On a global scale, over 2.78 million individuals die every year due to occupational accidents or diseases, and an estimated 374 million non-fatal injuries and illnesses occur annually [4].

In Indonesia, data from the BPJS Employment Work Accident Insurance (JKK) program indicates a significant number of reported work accidents and occupational diseases, which continue to rise each year. The number of workers experiencing work-related accidents and diseases has been steadily increasing, although fatalities from such incidents decreased from 4,007 in 2019 to 3,410 in 2020 before rising again to 6,552 in 2021 [4].

In South Sulawesi, reports from the provincial labor office to the Ministry of Manpower in 2019 highlighted 4 cases of work accidents, mainly caused by contact with sharp or hard objects, resulting in cuts, punctures, and falls from heights [5].

Risk identification conducted at the Makassar Health Quarantine Office in 2022 revealed several areas with potential hazards, including the Environmental Risk Control room, the quarantine control and epidemiological surveillance room, and the health efforts and cross-border areas room. The most significant risks identified were biological hazards, such as the Covid-19 virus, and ergonomic hazards. These

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identified risks underscore the importance of addressing occupational diseases that can be influenced by such factors, including the spread of biological hazards and the physical strain from ergonomic issues.

To effectively manage and mitigate these risks, the Hazard Identification, Risk Assessment, and Risk Control (HIRARC) method is employed. This systematic approach enables the identification, analysis, and control of potential hazards, ensuring a safer and more effective work environment [5].

METHODS

Study Settings and Design

This study employed a descriptive research design to systematically assess workplace risks at the Makassar Health Quarantine Office, using a structured approach to hazard identification, risk assessment, and risk control (HIRARC). The study was conducted across the office's operational areas, including Makassar Sea Port, Sultan Hasanuddin International Airport, and Paotere Sea Port.

Participants

The study population comprised all 133 workers at the Makassar Health Quarantine Office. A simple random sampling technique was employed to select 57 workers, ensuring equal representation. The sample size was determined based on purposive sampling technique. Inclusion criteria included active employees of the Makassar Health Quarantine Offices during the study period who were willing to participate and provide informed consent. Employees who were on leave, unavailable during data collection, or had incomplete questionnaire responses were excluded from the study.

Data Collection and Analysis

Data were collected through direct observations and structured interviews using a validated questionnaire designed to assess workplace hazards, risk levels, and existing control measures. The collected data were analyzed using univariate analysis and presented in tabular form with descriptive explanations.

Risk Identification, Assessment, and Control

Workplace risks were identified by evaluating both routine and specific activities performed by personnel. Each task was assessed for potential risks related to occupational diseases (OD) and work-related fatigue (WF). Hazardous activities were identified based on factors such as task complexity, environmental exposure, and ergonomic factors [6-8].

A mathematical scale measurement was used to evaluate the likelihood and severity of each identified risk. Likelihood was rated on a three-point scale: 1 (Least Likely), 2 (Possible), and 3 (Most Likely), while severity was categorized as 1 (Minor Impact), 2 (Moderate Impact), and 3 (Major Impact). The overall risk level was determined using a risk matrix, calculated as:

$$\text{Risk Level} = \text{Likelihood} \times \text{Severity}$$

Based on this calculation, risks were classified into three categories: Low (1-2), indicating minimal risk requiring standard precautions; Medium (3-6), representing moderate risk requiring intervention; and High (>6), denoting severe risk requiring immediate action.

Control measures were implemented according to the assessed risk levels. Low-risk activities, such as ship inspections and laboratory testing, required standard precautions, including the use of personal protective equipment (PPE) like gloves and masks. Medium-risk activities, such as prolonged data entry and monitoring international travelers, necessitated ergonomic interventions, including regular body stretches and ergonomic chair replacements to mitigate musculoskeletal strain. High-risk activities required immediate corrective actions, such as policy revisions and increased health surveillance, to minimize potential hazards.

This structured risk evaluation provided a data-driven approach to workplace hazard identification, ensuring enhanced occupational safety at the Makassar Health Quarantine Offices.

RESULTS

Participant Characteristics

Table **1** shows that, out of 57 respondents, the majority were in the 40-49 age group, with 33 people (57.9%), while the smallest group was the 50-59 age group, with 10 people (17.5%). Regarding gender, the majority of the 57 respondents were female, with 39 people (68.4%). In terms of education level, most respondents had a bachelor's degree (S1), with 39 people (68.4%), and the least had a diploma 4 (D IV),

with 4 people (7.0%). Regarding occupation, all 57 respondents were civil servants (permanent governmental position), with the largest group being 15 people (26.3%) in environmental health staff, and the smallest group being laboratory staff, with 3 people (5.3%).

Table 1: Characteristics Distribution of 57 Participants

Characteristics	n	%
Age (years)		
29-39	14	24.6
40-49	33	57.9
50-59	10	17.5
Sex		
Male	18	31.6
Female	39	68.4
Education		
Diplome III	8	14.0
Diplome IV	4	7.0
Bachelor	39	68.4
Masters	6	10.5
Employment		
Medical doctor	7	12.3
Nurse	9	15.8
Administrative staff	9	15.8
Epidemiology / surveillance staff	14	24.6
Environmental health staff	15	26.3
Laboratory staff	3	5.3
Total	**57**	**100.00**

Length of Services and Daily Work Hours

Table **2** shows the work tenure of the respondents. Out of 57 respondents, 55 people (96.5%) have worked at the Makassar Health Quarantine Center for more than 5 years, and 2 people (3.5%) have worked for 1-5 years. Regarding daily working hours, of the 57 respondents, 42 people (73.7%) work for 16 hours a day when they have a night shift. After a night shift, workers will have the next day off. Meanwhile, 15 people (26.3%) have a daily working hour of 8 hours. Regarding the number of working days per week, out of the 57 respondents, 42 people (73.7%) work 5 days a week with on-call duty on holidays, consisting of doctors, nurses, environmental health workers, and epidemiologists. Meanwhile, 15 people (26.3%) only work 5 days a week.

Table 2: Distribution of Length of Service, Work Hours, and Number of Working Days

Variables	n	%
Length of service		
> 5 years	55	96.5
1-5 years	2	3.5
< 1 years	0	0
Working hours		
8 hours	15	26.3
>8 hours	42	73.7
Number of working days		
5 working days and on-call duty on holidays	42	73.7
5 working days without on-call duty	15	26.3
Total	**57**	**100.0**

Risk Identification, Risk Assessment, and Risk Control

Table **3** presents the results of risk identification, risk assessment, and risk control for 10 work activities at the Makassar Health Quarantine Center. Among these, two tasks including data entry and monitoring of international travelers were classified as medium-risk, each with a risk score of 6. These activities are considered repetitive and monotonous, which can lead to musculoskeletal discomfort such as back, waist, and shoulder pain. Risk control measures for these tasks include incorporating stretching exercises during work breaks and replacing chairs with ergonomic ones to mitigate potential injuries.

Office Space Checklist

Table **4** shows the office space checklist for the Makassar Health Quarantine Center, Makassar Sea Port. There is no fire extinguisher available in the health effort and cross-border areas, administrative office, quarantine control and epidemiological surveillance room, environmental risk control room, or laboratory. Fire extinguishers are only available in the corridor, but they are in poor condition. Aside from this, all other equipment is in good condition.

Table **5** presents the office space checklist for the Makassar Health Quarantine Center at Sultan Hasanuddin International Airport. The checklist reveals that fire extinguishers are not available in several rooms, including the Health Effort and Cross-Border Areas, administrative office, Quarantine Control and

Table 3: Results of Risk Identification, Risk Assessment, and Risk Control Assessments

Risk Identification			Risk Assessment			Risk Control
Activity	**Risk**	**OD and WF**	**Likelihood**	**Severity**	**Risk**	**Actions**
Vaccination	Never	Never	1	1	1 (Low)	Using PPE such as gloves and masks
Examination of ship crew on the ship	Never	Never	1	1	1 (Low)	Using PPE such as gloves and masks
Examination of sailors	Never	Never	1	1	1 (Low)	Using PPE such as gloves and masks
Ship inspection	Never	Never	1	1	1 (Low)	Using PPE such as gloves and masks
Ship sanitation inspection	Never	Never	1	1	1 (Low)	Using PPE such as gloves and masks
Environmental sanitation inspection around the office	Never	Never	1	1	1 (Low)	Using PPE such as gloves and masks
Conducting laboratory tests	Never	Never	1	1	1 (Low)	Using PPE such as gloves and masks
Monitoring of international traveler	Never	Never	3	2	6 (Medium)	Performing body stretches during work breaks; Replacing the chair with an ergonomic one
Passenger inspection	Never	Never	1	1	1 (Low)	Using PPE such as gloves and masks
Data entry	Sitting for too long	Ergonomics: Low back pain, and shoulder pain	3	2	6 (Medium)	Performing body stretches during work breaks; Replacing the chair with an ergonomic one

Note: OD, Occupational Diseases; WF, Work-Related Fatigue; PPE, Personal Protective Equipment.

Table 4: Office Space Checklist of the Makassar Health Quarantine Center at the Makassar Seaport

Checklist	Room/unit				
	Cross-border health unit	**Administrative affairs unit**	**Quarantine control and epidemiological surveillance unit**	**Environmental Risk Control unit**	**Laboratory unit**
The floor is clean and not slippery	Yes	Yes	Yes	Yes	Yes
Enough lighting and is in good condition	Yes	Yes	Yes	Yes	Yes
The corridor is safe and unobstructed for walk	Yes	Yes	Yes	Yes	Yes
Ventilation is adequate and well-maintained	Yes	Yes	Yes	Yes	Yes
All electrical equipment is in good condition and safe	Yes	Yes	Yes	Yes	Yes
Fire extinguishers are available and in good condition	No	No	No	No	No
All equipment in the office is in good condition	Yes	Yes	Yes	Yes	Yes

Epidemiological Surveillance Room, Environmental Risk Control Room, Laboratory, and Disease Control and Prevention Substance Room. Fire extinguishers are only located in the corridor, but they are in poor condition. Despite this, all other equipment and facilities are in good condition.

Table **6** shows the office space checklist for the Makassar Health Quarantine Center at Paotere Port. The checklist indicates that there are no fire extinguishers available in the office spaces. However, all other equipment and facilities are in good condition.

DISCUSSIONS

The majority of the respondents in this study were aged between 40 and 49 years, comprising 57.9% (33 individuals) of the total, while the smallest group was

Table 5: Office Space Checklist of the Makassar Health Quarantine Center at Sultan Hasanuddin International Airport

Checklist	Room/unit					
	Cross-border health unit	Administrative affairs unit	Quarantine control and epidemiological surveillance unit	Environmental Risk Control unit	Laboratory unit	Disease control and prevention unit
The floor is clean and not slippery	Yes	Yes	Yes	Yes	Yes	Yes
Enough lighting and is in good condition	Yes	Yes	Yes	Yes	Yes	Yes
The corridor is safe and unobstructed for walk	Yes	Yes	Yes	Yes	Yes	Yes
Ventilation is adequate and well-maintained	Yes	Yes	Yes	Yes	Yes	Yes
All electrical equipment is in good condition and safe	Yes	Yes	Yes	Yes	Yes	Yes
Fire extinguishers are available and in good condition	Yes	Yes	Yes	Yes	Yes	Yes
All equipment in the office is in good condition	No	No	No	No	No	No

Table 6: Office Space Checklist of the Makassar Health Quarantine Center at Paotere Seaport

Checklist	Condition
The floor is clean and not slippery	Yes
Enough lighting and is in good condition	Yes
The corridor is safe and unobstructed for walk	Yes
Ventilation is adequate and well-maintained	Yes
All electrical equipment is in good condition and safe	Yes
Fire extinguishers are available and in good condition	No
All equipment in the office is in good condition	Yes

aged 50-59 years, with only 17.5% (10 individuals). Among the 57 respondents, most were female, making up 68.4% (39 individuals). In terms of education, the majority held a Bachelor's degree (S1), with 68.4% (39 individuals), while only 7.0% (4 individuals) had a D4 degree. All respondents were civil servants (Aparatur Sipil Negara, ASN), working in various health-related professions such as doctors, nurses, environmental health officers, epidemiologists, and laboratory staff.

Regarding work experience, a significant portion of respondents (96.5%, or 55 individuals) had worked at the Balai Besar Kekarantinaan Kesehatan Makassar for over 5 years, while 3.5% (2 individuals) had worked there for 1-5 years. The working hours for the respondents varied, with 73.7% (42 individuals) working 16-hour shifts on days with night shifts, with the next day off. The remaining 26.3% (15 individuals) worked 8-hour shifts. The shift system consisted of morning shifts (07:30–16:00) and night shifts (16:00–07:30), primarily applied at the Makassar Port and Sultan Hasanuddin International Airport, while the Paotere Port had standard 07:30–16:00 shifts. The workers involved in morning and night shifts were primarily from the divisions of Cross-Border Health Efforts, Quarantine Control Room, and Environmental Risk Control Room, performing tasks such as vessel inspections and document input. In terms of weekly work hours, 73.7% (42 individuals) worked 5 days a week, with additional on-call duties during holidays. This group consisted mainly of doctors, nurses, environmental health officers, and epidemiologists. The remaining 26.3% (15 individuals) worked 5 days a week without on-call duties and were primarily

laboratory staff, administrative personnel, and employees at the Paotere Port.

The study also explored the potential risks in various work activities at Balai Besar Kekarantinaan Kesehatan Makassar. For example, during vaccination activities conducted by doctors and nurses, the primary risk identified was the possibility of needle-stick injuries, although this was reported as a rare occurrence and not deemed a significant risk. Similarly, while inspecting ship crew on vessels, the risk of disease transmission through physical contact or airborne particles was minimized through the use of PPE such as masks and gloves. This precaution also applies to the examination of passengers and sailors, where the risk of transmission was similarly reduced. In environmental health inspections on ships, the primary risk involved slipping on wet surfaces, especially in ship kitchens. However, no incidents of accidents or disease transmission were reported, as staff always used appropriate PPE.

In the office environment, health officers were at risk of exposure to chemicals from pest control agents, but the use of PPE mitigated this risk. Additionally, the inspection of ship documents and laboratory testing posed no significant risks due to the lack of direct contact or the use of hazardous chemicals. One notable risk, however, was related to ergonomics, particularly for workers involved in surveillance of international travelers and data entry. These tasks, often repetitive or requiring prolonged sitting, could result in musculoskeletal disorders such as back and shoulder pain. However, this risk can be managed by implementing preventive measures like stretching exercises and ergonomic office chairs.

Risk assessments showed that most activities, such as vaccination, ship's crew inspections, ship sanitation checks, environmental inspections around the office, ship inspections, and laboratory tests, had a very low likelihood of risk (score of 1). These activities were deemed to have minimal severity, with impacts such as mild injuries or small financial losses. As a result, the risk level for these activities was classified as low. Conversely, the activities related to monitoring international travelers and data entry were deemed to have a moderate risk level, with a likelihood score of 3 and a severity score of 2. This suggests that while the risk is relatively low, it could lead to mild injuries or require medical attention.

To mitigate these risks, PPE use (masks and gloves) was emphasized for most activities, while for data entry and traveler monitoring, ergonomic adjustments were recommended, such as incorporating stretching exercises and using ergonomic chairs to prevent musculoskeletal issues. The overall risk assessment revealed that 8 out of 10 activities were categorized as having a low-risk level (score of 1), including vaccination, ship crew inspections, ship sanitation checks, environmental inspections, ship inspections, and laboratory tests. On the other hand, 2 activities related to data entry and monitoring international travelers were classified as moderate-risk (score of 6), primarily due to their repetitive nature and prolonged sitting, which could lead to musculoskeletal issues.

This study's findings align with previous research. For instance, Irwanda *et al*. (2022) found that ergonomic risks, such as poor sitting posture and monotonous tasks, significantly impacted office workers, with 83.33% reporting musculoskeletal issues [10]. Similarly, Tasha and Widiawan (2022) highlighted the potential risks associated with poorly designed office chairs that could lead to back pain [11]. The results also correlate with findings from Marhan *et al*. (2023), who observed that 69.7% of office workers in Malaysia experienced severe discomfort in their neck, shoulders, and lower back due to repetitive tasks and prolonged sitting [12].

Overall, ergonomic hazards, particularly related to prolonged sitting and repetitive motions, were the most common risks reported by workers at Balai Besar Kekarantinaan Kesehatan Makassar. These findings emphasize the need for improved ergonomic interventions in the workplace to prevent musculoskeletal disorders and enhance worker comfort and productivity.

The study also highlighted the importance of proper equipment maintenance. For instance, fire extinguishers in the office corridors were found to be in poor condition, which could pose a risk in case of emergencies. According to PERMENAKER RI No.04/MEN/1980, fire extinguishers should be easily visible, accessible, and well-maintained, with proper placement and signage [13]. The office fire extinguishers at Balai Besar Kekarantinaan Kesehatan Makassar were found to meet some of these criteria, but maintenance issues must be addressed to ensure readiness in case of an emergency.

In conclusion, while the overall risk in the workplace is low, attention should be given to ergonomic improvements and ensuring proper maintenance of

safety equipment to further reduce the potential for work-related injuries and health issues.

CONCLUSION

Based on the research conducted at the Makassar Health Quarantine Office regarding occupational health and safety risk management using the Hazard Identification, Risk Assessment, and Risk Control (HIRARC) method, it can be concluded that: First, the risk identification results show that the high-risk work activities at the Makassar Health Quarantine Office are data input and monitoring of international travelers. Second, in the risk assessment, there are activities with a risk score of 1, categorized as low risk, which include activities such as vaccination, examination of passengers and sailors on ships, sanitation inspection of ships, office surroundings inspection, ship inspection, and laboratory test examination. Third, ergonomic hazard risks with a score of 6 fall into the moderate hazard category, related to data input activities and monitoring of international travel. Fourth, the checklist results show that there is a fire extinguisher in poor condition, while the flooring, adequate lighting, ventilation, electrical equipment, and office tools are all in good or usable condition. Fifth, for risk control, low hazard risks are managed through the use of personal protective equipment (PPE) such as masks and gloves, while for moderate hazard risks, control is implemented by stretching during work breaks and using ergonomic chairs.

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