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Review Article

Occupational health and safety hazards in aquaculture

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Abstract: The growing aquaculture industry is expected to have a more pronounced impact on the lives and economies of rural coastal communities worldwide. Both in private production and products, there is a guarantee to provide employment opportunities in the production of aquatic products in a healthy and safe manner. However, this temperature, which is an important preventive measure, has not yet started to be systematically investigated in occupational health and safety (OHS) research. This review, with special emphasis on aquaculture production, presents a detailed outline of the industry from feed production to feed processing, identifying potential OHS hazards at each stage and providing recommendations for current research and actions.

Keywords: Aquaculture, Health, Safety, Hazards

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1. INTRODUCTION

Aquaculture, the farming of aquatic organisms, has evolved into a major commercial activity, accounting for almost half of global food fish production (Subasinghe, 2006). In industrialized nations, the foundation of occupational health and safety legislation revolves around the internal responsibility system. This system distributes responsibility for ensuring safe workplaces among various stakeholders. Workers, for instance, bear responsibility for their own safety and that of others, with rights to be informed about workplace hazards, participate in safety measures, and refuse unsafe work. Employers, managers, and supervisors play a pivotal role in designing workplace environments and implementing OHS protocols necessary for ensuring safety. The internal responsibility system's effectiveness is overseen and supported by external bodies involved in enforcement, compensation, and prevention a framework termed the external responsibility system. Central to this approach is the provision of accurate and timely information on hazards and effective methods for their elimination or mitigation (Moreau & Neis, 2009).

Marine aquaculture is a multifaceted industry with various components. Primary prevention, which involves designing out potential risks, is the most effective approach to safeguarding occupational health and safety (OHS), especially in a rapidly expanding and potentially hazardous industry. Secondary and tertiary prevention measures are also critical. All three levels necessitate active research on hazards, assessments, monitoring of near-misses, injuries, and occupational diseases, alongside considerations of social factors influencing risk, such as education, training, regulatory oversight, interventions, compensation, and reporting. Unfortunately, OHS research in this sector is fragmented and severely limited across all levels, leading to a lack of comprehensive hazard lists at regional, national, or global scales. Here, we present a detailed overview of the industry's structure from feed production to processing, highlight potential OHS hazards associated with each stage, and propose general recommendations for future research and actions within the industry (O'Grady, 2000). Aquaculture involves a wide range of labor-intensive tasks that encompass a complex array of machinery, equipment, chemicals, biological agents, and occasionally challenging physical environments (Erondu & Anyanwu, 2005).

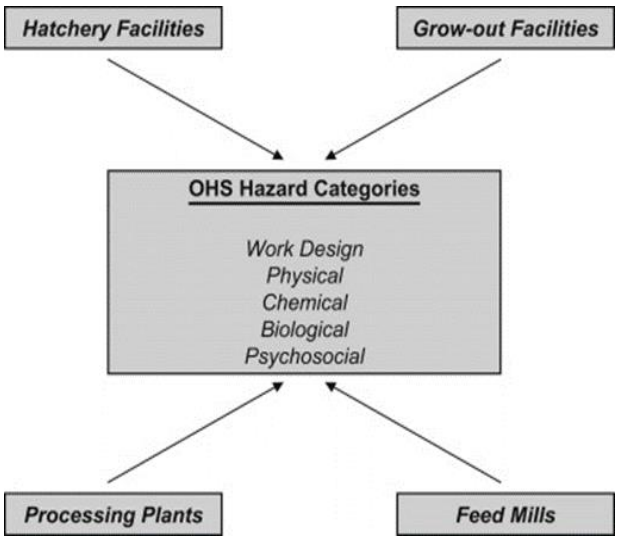

Figure 1. The phases of the aquaculture industry are associated with significant occupational health and safety (OHS) hazard categories. These hazards within each category necessitate identification, evaluation, and management solutions that are applicable across all industry phases (Erondu & Anyanwu, 2005).

While numerous studies have investigated the risk of Work-Related Musculoskeletal Disorders (WMSDs) in seafood processing, few have specifically targeted the aquaculture industry. Research on seafood processing is pertinent because of similarities in work tasks and technologies, despite potential differences in factors like exposure duration, seasonal variations, work pace, repetition rates, and automation levels across these operations. Many processing roles involve repetitive movements, prolonged standing, heavy lifting, and awkward postures in a fast-paced environment. Musculoskeletal disorders affecting the neck, shoulders, back, and limbs, with specific tasks correlating with prevalence and severity, have been well-documented. Soft tissue injury claims are common in seafood processing, potentially exacerbated by under-reporting linked to job insecurity and seasonal employment patterns. Due to gender-based labor divisions, women workers may face higher risks of disorders from repetitive motions, whereas men may be more susceptible to injuries related to heavy lifting (Aasmoe et al., 2008; Chiang et al., 1993; Frost & Andersen, 1999; Hansson et al., 2000; Jeebhay et al., 2004; Leclerc et al., 2004; Nahit et al., 2001; Ólafsdóttir & Rafnsson, 2000). Common physical hazards to occupational health found in most industrial processes include slips, trips, falls from height, workplace transportation hazards, dangerous machinery, electrical hazards, fire safety risks, and exposure to heavy metals. With the exception of heavy metals, these hazards are likely prevalent in various work environments within the aquaculture industry. Physical agents contributing to risk include noise, vibration, heat and cold stress, and lighting. These factors, except perhaps vibration, are also present across different sectors within the broader aquaculture industry (Sarkany, 2011).

Aquaculture operations often involve the use of various potentially hazardous machines. Workers handling knives or operating processing, grading, or feed

manufacturing equipment can suffer injuries such as cuts, sprains, broken bones, amputations, and, in extreme cases, death from entrapment or crushing. Proper training is essential for those using or maintaining this machinery and working near conveyor belts. Machines with moving parts must be equipped with appropriate guards and accessible emergency stop buttons. Lockout/tagout procedures are necessary during maintenance to ensure safety (Moreau & Neis, 2009).

Excessive noise exposure is a significant yet often overlooked physical hazard in the aquaculture industry. Historically, many industries have documented cases of occupationally-induced hearing loss. In aquaculture, potential sources of excessive noise include feed blowers, motorized vehicles, and machinery in fish processing plants and feed mills. Implementing auditory safety measures, such as using hearing protection, is crucial to prevent both short-term and long-term hearing issues, as well as associated mental fatigue in certain roles (Palmer et al., 2002).

Chemical agents play multiple roles in aquaculture, including disinfection, anesthesia, pest control, freezing, cleaning, disease control, and preservation. Regulations governing the use of these chemicals are stringent due to concerns about food safety and environmental impact. Comprehensive health and safety information is readily available for most compounds, ensuring proper handling and adherence to regulatory standards (Burridge, 2003).

Biological hazards are prevalent in the aquaculture industry, much like in traditional fishing. These hazards include handling animals with sharp teeth or spines, as well as exposure to sharp bones and shell fragments, which can lead to bites, cuts, puncture wounds, infections, allergic reactions, and disease. Occupational allergies and asthma can result from exposure to aerosolized proteins, while contact with aquatic organisms has been linked to bacterial and parasitic diseases (Durborow, 1999). Fish feed comprises various ingredients, including plant and animal proteins, oils, grains, seeds, vitamins, minerals, and additives. Inhalation of dry aerosols from animal feeds can adversely affect feed mill workers, leading to conditions such as occupational asthma, chronic bronchitis, organic dust toxic syndrome, and extrinsic allergic alveolitis (Baser et al., 2003).

Pressurized work environments characterized by high demand, low control, employment uncertainty, and shift work have been linked to work-related stress and associated psychological and physiological symptoms, impacting quality of life. While there is limited analysis of psychosocial hazards specific to employment in the aquaculture industry, it shares stress factors with similar occupations in fisheries, sea-based work, and agriculture. For example, remote grow-out operations common in aquaculture often necessitate extended periods away from employees' families and homes, similar to challenges faced in other marine occupations (Carter, 2005; Gregoire, 2002; Israel et al., 1996).

2. CONCLUSION

Aquaculture is rapidly expanding worldwide, operating in dynamic and complex environments often located in rural and remote areas. Despite limited research on occupational health and safety (OHS) in aquaculture, various phases of the industry highlight numerous potentially serious occupational hazards. Additionally, secondary factors may exacerbate risks and hinder effective reporting and regulation. In many countries, the internal responsibility system mandates employers to inform workers about potential OHS hazards and to minimize risks of injury and disease associated with those hazards. Workers have rights including the right to be informed about OHS risks, participate in improving OHS through joint occupational health and safety committees (JOHSC), and refuse unsafe work. Contemporary compensation agencies often bear prevention responsibilities, and in some cases, share inspection duties with governmental bodies.

Systematic identification of hazards, along with education, training, and prevention measures, are crucial for ensuring safety in the aquaculture industry. Research should systematically document hazards, assess risks, develop appropriate prevention strategies, and evaluate their effectiveness. Establishing ergonomic guidelines in aquaculture processing plants would enhance workplace safety. Employers must ensure forklift operators receive proper training and operate in a safe environment. Measures such as improving visibility with larger open spaces and angled mirrors to eliminate blind spots, reducing the use of diesel and propane forklifts in enclosed areas, maintaining forklifts well, and installing ventilation systems to prevent diesel fume re-entrainment are essential for minimizing chemical risks.

Managing biological hazards involves minimizing animal handling, providing training in safe handling practices, designing appropriate work environments, and ensuring proper enclosure and ventilation to mitigate exposure to aerosolized proteins. Effective use of personal protective equipment is crucial when other measures are insufficient. Activities like grinding, mixing, forming, and bagging in feed manufacturing can expose workers to organic aerosols in poorly ventilated settings. Implementing efficient ventilation systems that enclose aerosolizing processes and using appropriate personal protective breathing devices as needed can reduce respiratory health risks. Psychosocial factors unique to the aquaculture industry should also be studied further to address potential challenges related to employment conditions and worker well-being.

Authors' Contributions

MRT: Manuscript design, Draft checking, Writing, Draft checking, Reading, Editing and Approved the final manuscript.

MK: Draft checking, Writing, Draft checking, Reading, Editing, and Approved the final manuscript.

Conflict of Interest

The authors declare that there is no conflict of interest.

Statement on the Welfare of Animals

Ethical Approval: For this type of study, formal consent is not required.

Data Availability

The datasets generated during and/or analysed during the current study are available from the corresponding author on reasonable request.

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