Analysis of the Relationship Between the Use of Personal Protective Equipment and the Occurrence of Workplace Accidents In Palm Oil Factories : Literatur Review

[1]Al-Fata, [2]Dwi Alfindra, [3]Muhajir Ilham, [4]Muhammad Zaky Ramzy

[1,2,3,4]Occupational health and safety, Faculty Of Public Health, University of Teuku Umar, Indonesia
Corresponding author: Al-Fata ; E-mail: fataa9615@gmail.com

Abstract

Due to the use of heavy machinery, hazardous chemicals, and demanding working conditions, palm oil production is one of the most important industries in Indonesia, contributing significantly to the national economy. On the other hand, this industry also carries substantial occupational safety and health risks. If not properly managed, workers in palm oil mills are vulnerable to physical, chemical, and ergonomic hazards that may lead to injuries and even fatal accidents. The use of Personal Protective Equipment (PPE) is one of the key strategies in prevention; however, factors such as discomfort, poor knowledge, negative attitudes, and the lack of a strong safety culture within companies often hinder workers from using it consistently. This study aims to determine the relationship between PPE use and workplace accident incidents in palm oil mills, in order to develop appropriate strategies for improving worker safety. For this purpose, eight relevant national journals were reviewed through Google Scholar using the keywords "PPE use behavior, workplace accidents, palm oil mills." The findings indicate that physical hazards are the most common threats, followed by chemical and ergonomic hazards. Due to low compliance with PPE usage, most studies categorize workers as being at high risk. Elimination, substitution, and engineering controls are still rarely applied to mitigate risks, while administrative measures and PPE implementation are the most commonly adopted strategies. It can be concluded that PPE use behavior has a significant impact on workplace accident rates. Therefore, to reduce the incidence of accidents in the palm oil industry, adequate PPE, continuous training, strict supervision, and a strong safety culture are essential.

Keywords: Usage, Safety, Work accidents

Introduction

According to data from the International Labour Organization (ILO) in 2018, around 2.78 million workers die each year due to work-related accidents and occupational diseases. Of these deaths, 2.4 million (86.3%) are caused by occupational diseases, and more than 380,000 (13.7%) are due to fatal work accidents. In addition, non-fatal work accidents occur nearly a thousand times more frequently, with 374 million workers experiencing injuries each year (ILO, 2018, in Yulfi Okta Juria & Ahmad Husaini, 2023). These statistics indicate that global workplace safety is of great importance, especially in high-risk industries. It also serves as a basis for many literature studies emphasizing prevention as a top priority.

The palm oil industry, which contributes more than 50% of the world's vegetable oil exports, is one of

Indonesia's economic pillars facing many safety issues. Risks such as falling from heights, being crushed by heavy machinery, exposure to pesticides or hot oil, noise, and health-damaging dust are common during production processes that involve heavy machinery, hazardous chemicals, and extreme working environments. Workers in palm oil factories are highly vulnerable to such incidents, which can result in serious injuries or even death, impacting worker productivity and welfare. According to recent research, as written by Yulfi Okta Juria and Ahmad Husaini (2023), these environmental and operational factors have led to an increase in accident rates in the industry.

As explained in various references, the use of Personal Protective Equipment (PPE) is an effective primary prevention strategy. PPE is equipment designed to protect workers from hazards such as radiation, chemicals, biological agents, electricity, mechanical, and physical risks (Danisa Adma Sari, 2022). Nevertheless, factors like lack of knowledge, indifferent attitudes, and poor workplace safety culture often become barriers to the implementation of PPE. Ultimately, this affects worker behavior. Studies indicate that analyzing the relationship between PPE usage behavior and accident rates in palm oil mills is crucial for identifying the sources of problems and creating targeted interventions.

Recent research highlights the importance of this component in the plantation and palm oil processing industry. For example, a study conducted by Danisa Adma Sari (2022) in the Relationship between Knowledge and Attitudes with the Use of Personal Protective Equipment for Pesticide Spraying among Oil Palm Farmers at PT. Citra Mulia Perkasa in Lampasio District, Toli-Toli Regency found a strong positive correlation ($r = 0.65$) between workers' positive attitudes towards pesticide risks and the frequency of PPE usage, such as respirator masks and gloves. The results indicate that lack of knowledge contributes to 40% of non-fatal chemical exposure cases, such as skin irritation and respiratory disorders. In fact, consistent use of PPE can prevent these incidents. Referring to these sources, this literature review found variations in understanding PPE behavior at the factory level, where the risks are more diverse. In line with the ILO's recommendations disseminated worldwide, this synthesis provides insights that can be used to develop more comprehensive occupational safety strategies in the palm oil industry.

Methods

This research is a literature review, where the data sources in this study come from literature in the form of national journals that have been published and were obtained from the search engine "Google Scholar." The research data relates to the use of PPE and its relation to workplace accidents in palm oil factories, using the keywords "PPE usage behavior, workplace accidents, palm oil factory," resulting in 20 studies. These data were then further filtered based on the relevance of the title, abstract, and content to this study, resulting in 8 journals. The purpose of this study is to determine the relationship between PPE usage behavior and the occurrence of workplace accidents among palm oil factory workers.

Results

The selected journals were then analyzed from the aspect of hazard identification as shown in (Table 1).

Table 1. Results of Hazard Identification Analysis in the Palm Oil Industry in Indonesia

Paper Identity	chemical	Physical	biological	ergonomic
Edigan et al., (2019)	√	√	-	√
Denisa Adma Sari & Saiful, (2022)	√	√	√	-
Yulfi Okta Juria et al., (2023)	√	√	-	√
Dalimunthe &Farisma (2021)	√	√	-	√
Bastian et al. (2023)	√	√	-	√
Daulay et al. (2016)	√	√	√	-
Sinaga et al. (2024)	√	√	-	√
Muslim et al. (2024)	√	√	-	√

The selected journals were then analyzed from the aspect of risk assessment as shown in (Table 2).

Table 2 Results of Risk Assessment Analysis in the Palm Oil Industry in Indonesia

Paper Identity	Very Higt	High	Medium	Low
Edigan et al., (2019)	√	√	√	-
Denisa Adma Sari & Saiful, (2022)	-	√	√	√
Yulfi Okta Juria et al., (2023)	√	√	√	√
Dalimunthe &Farisma (2021)	-	√	√	-
Bastian et al. (2023)	√	√	-	-
Daulay et al. (2016)	-	√	√	-
Sinaga et al. (2024)	√	√	-	-
Muslim et al. (2024)	√	√	-	-

The selected journals were then analyzed from the aspect of hazard control as shown in (table 03).

Table 3 Results of Hazard Control Analysis in the Palm Oil Industry in Indonesia

Paper identity	Risk control				
	Elimination	subtitution	engineering	Administrative	PPE
Edigan et al., (2019)	-	-	√	√	√
Denisa Adma Sari & Saiful, (2022)	-	-	-	√	√

Yulfi Okta Juria et al., (2023)	-	-	√	-	√
Dalimunthe &Farisma (2021)	-	-	-	√	√
Bastian et al. (2023)	-	-	√	√	√
Daulay et al. (2016)	-	-	-	√	√
Sinaga et al. (2024)	-	-	√	√	√
Muslim et al. (2024)	-	-	-	√	√

Discussion

Hazard identification

The behavior of workers using Personal Protective Equipment (PPE) is an important factor in occupational safety issues in the plantation and palm oil mill industry. Research in Indonesia shows that compliance with PPE usage is crucial to reducing workplace accidents and occupational diseases. This study compares eight relevant studies: Edigan, Sari, & Amalia (2019), Sari, & Saiful (2022), and Juria, Husaini, & Istiawaty (2023), Dalimunthe & Farisma (2021), Bastian et al. (2023), Daulay et al. (2016), Sinaga et al. (2024), and Muslim et al. (2024). All these studies emphasize the relationship between PPE usage behavior and the risk of workplace accidents in the palm oil industry.

In a study conducted by Edigan et al. (2019) at PT Surya Agrolika Reksa in Sei Basau, the researchers found that physical exposure (heat, noise, machinery, and dust) and chemical exposure (boiler smoke, processing materials), as well as ergonomic problems due to improper working postures, are the main hazards in palm oil factories. This indicates that the palm oil factory environment has many risks and requires comprehensive protection.

These results are in line with the research conducted by Sari and Saiful (2022) at PT Citra Mulia Perkasa, Tolitoli Regency, which found that chemical hazards from pesticide use, including paraquat and glyphosate, are the primary threat. Furthermore, there are reports that physical hazards come from spraying equipment and work environment conditions, while biological hazards from pesticide residues have the potential to cause poisoning. According to this study, oil palm plantation workers, especially those who perform spraying, are highly exposed to chemical and biological hazards.

Physical hazards, such as falling, being struck by fruit, and injuries from using harvesting tools, are emphasized by Juria et al. (2023), who investigated palm oil harvesters in Rantau Rasau Village. Additionally, improper body positions while working can lead to more serious ergonomic problems. Therefore, both in factories and on palm oil plantations, workers face numerous safety hazards due to the environment, tools, chemicals, and work practices.

A study by Dalimunthe & Farisma (2021) found that workers in palm oil factories face threats from fiber dust (chemical), which can disrupt the respiratory tract, cause exposure to machinery (physical), and result from non-ergonomic work attitudes. Furthermore, the research findings indicate that although these hazards are already known, workers' compliance with the use of personal protective equipment (PPE) is still low, meaning the risk remains high.

Bastian et al. (2023) found that workers in palm oil factories are exposed to chemical hazards such as boiler vapors

and processing chemicals, physical hazards like high temperatures and falls, machine-related risks, and ergonomic issues due to improper working postures. Additionally, the study emphasizes that workers who do not use personal protective equipment (PPE) have nearly four times higher risk of experiencing accidents compared to compliant workers.

Daulay et al. (2016) research emphasizes hazards in oil palm plantations, where workers are exposed to chemical hazards such as pesticides and fertilizers, prick injuries from oil palm bunches or harvesting tools (physical), and biological hazards such as insect bites. Although the level of compliance with the use of PPE is relatively high due to supervision, the risk cannot be entirely avoided.

Sinaga et al. (2024) found that hazards in palm oil factories include exposure to hazardous chemicals, physical dangers from heat, heavy machinery, and fire, as well as ergonomic hazards related to workers' workload and posture. This study emphasizes that the occupational health and safety culture in palm oil factories is still low and is often viewed as a burden rather than an investment.

Muslim et al. (2024) found that at palm oil factory X, occupational accidents such as being pricked in the eye by a palm thorn, experiencing heat in the production area, or even falling into a boiler are common occurrences. Physical, chemical, and ergonomic hazards were identified. Although workers are aware of the importance of PPE, they do not always use it. This happens because there is no binding policy and the PPE is uncomfortable.

Some illustrations related to physical hazards Based on the eight journals reviewed, physical hazards are the most frequently encountered. Eight journals noted physical hazards (Edigan et al., 2019; Sari & Saiful, 2022; Juria et al., 2023; Dalimunthe & Farisma, 2021; Bastian et al., 2023; Daulay et al., 2016;

Sinaga et al., 2024; Muslim et al., 2024), seven journals reported chemical hazards, five journals reported ergonomic hazards, and two journals reported biological hazards. Therefore, it can be concluded that physical hazards are the most commonly occurring type of hazard among workers in palm oil factories and plantations.

Risk Assessment

According to the research by Edigan et al. (2019), factors such as education, knowledge, and attitude greatly influence compliance with the use of PPE. Workers with low education have a five times higher risk of not using PPE, workers with low knowledge have a six times higher risk, and workers with a negative attitude have nearly a ten times higher risk. This places certain groups of workers in the high-risk category.

The study by Sari and Saiful (2022) also showed a similar trend. The results indicated a significant relationship between the use of PPE by pesticide sprayers and knowledge ($p=0.009$) and attitude ($p=0.024$). Workers with extensive knowledge were more likely to comply, whereas workers with limited knowledge often neglected PPE because it was uncomfortable or not fully available.

Juria et al. (2023) confirmed this pattern by finding that half of the respondents continued to exhibit poor behavior when PPE was used. The statistical test results showed a significant relationship between PPE usage and knowledge ($p=0.002$) and attitude ($p=0.037$). Interestingly, this study also found that although most employees have good knowledge and attitudes, there are still barriers in the form of unpleasant perceptions regarding the comfort of using PPE. This indicates that knowledge is not the only factor determining the risk of workplace accidents; perception and daily work habits also play a role.

A study by Dalimunthe & Farisma (2021) indicates that the likelihood of accidents falls within the high to medium category. This is due to the fact that some workers still often neglect personal protective equipment (PPE) when working in areas filled with fiber dust and machinery. As a result, they are at risk of respiratory problems and workplace accidents.

According to research by Bastian et al. (2023), workers who do not use PPE are 3.9 times more likely to experience accidents than workers with non-ergonomic postures. As a result, this study categorizes workers as highly vulnerable.

According to research conducted by Daulay et al. (2016), hazards such as pesticide poisoning and physical injuries still exist, even though workers are quite compliant with the use of PPE due to supervision. Therefore, the likelihood of occupational accidents is categorized from high to moderate.

Sinaga et al. (2024) place worker risk at high to very high levels. This is due to chemical, physical, and ergonomic hazards that are not yet fully controlled, as well as a lack of OHS culture in the workplace.

Muslim et al. (2024) found that the risk of workplace accidents falls into the high to very high category. This is reinforced by numerous fatal cases, such as workers falling into palm oil boilers, which are caused by workers' lack of compliance with personal protective equipment despite being aware of the importance of self-protection.

Of the eight journals analyzed, the most frequently found risk category was high risk. Two journals reported very high risk (Edigan et al., 2019; Bastian et al., 2023), four journals reported high risk (Sari & Saiful, 2022; Juria et al., 2023; Daulay et al., 2016; Sinaga et al., 2024), and two journals reported moderate-high risk (Dalimunthe & Farisma, 2021; Muslim et al., 2024). There are not many reports indicating a low risk. Therefore, most oil palm employees fall into the category vulnerable to workplace accidents.

Risk control

In terms of control, all three studies tend to emphasize the use of PPE and administrative strategies. In Edigan et al. (2019), they emphasized that to improve worker compliance, factory management must conduct occupational health and safety training, continuous outreach, and intensive supervision.

According to research by Sari and Saiful (2022), it is important for companies to provide sufficient personal protective equipment (PPE). Without complete availability and strict supervision, workers tend to neglect the use of PPE even though they are aware of the dangers of pesticides.

Conversely, Juria et al. (2023) stated that more persuasive methods, such as continuous training and repeated socialization, are necessary. This is important because some workers do not want to use personal protective equipment (PPE) as they feel uncomfortable using it while working. In other words, companies not only need to provide PPE but also must be able to encourage workers to consistently use it.

According to research conducted by Dalimunthe & Farisma (2021), even though the company has provided PPE and OHS socialization, employee compliance remains low. Therefore, the control approach used has not been fully successful.

Bastian et al. (2023) study shows that PPE such as helmets, gloves, masks, and protective shoes are used to prevent posture-related injuries. Employee compliance levels remain a major barrier to effective control.

According to research conducted by Daulay et al. (2016), strict supervision can increase workers' compliance with the use of PPE up to 100%. This indicates that the supervision component is crucial for the success of hazard control

strategies.

Sinaga et al. (2024) showed that the implementation of the OHS Management System (PP 50/2012), which serves as an administrative basis for hazard control, is very important. This study also indicates that efforts to eliminate and substitute hazards are still very rarely carried out.

Muslim et al. (2024) found that the main factors causing low worker compliance levels are the absence of standard operating procedures (SOPs) and binding policies. The comfort of personal protective equipment (PPE) also significantly influences compliance. As a result, the current control approach is dominated by administrative measures and the use of PPE.

Research results indicate that out of the eight journals, the administration and use of PPE are the most common hazard control methods. No efforts were found to eliminate or substitute, and engineering controls are rarely discussed. Therefore, the palm oil sector still relies on PPE and administrative approaches as a last resort to protect workers.

Conclusion

The results of the literature review indicate that there is a strong relationship between the behavior of PPE usage and the level of workplace accidents occurring in the palm oil industry. Physical hazards are the most common, followed by chemical and ergonomic hazards. The main factors influencing worker compliance are their knowledge, attitudes, and perceptions of PPE. Due to low compliance with PPE usage, the majority of workers fall into the high-risk category. Administrative control methods and PPE usage are the most commonly employed, while elimination, substitution, and engineering methods are not yet optimal. Therefore, to significantly reduce accident rates, companies must be committed to providing adequate PPE, continuous training, strict supervision, and a better workplace safety culture.

Acknowledgment

Thank you to all parties involved in the preparation of this scientific article, and thank you to all the teams who helped to search for literature in the discussion of the article review.

References

Bastian, A., Arif, M., & Mardiono, H. (2023). Hubungan pengetahuan APD, perilaku penggunaan APD, dan ergonomi dengan kejadian kecelakaan kerja pada pekerja di pabrik kelapa sawit di Rokan Hulu Riau. Jurnal Keselamatan dan Kesehatan Kerja, 12(2), 55–64.

Dalimunthe, R., & Farisma, N. (2021). Hubungan sikap dengan penggunaan APD pada pekerja pemisahan fiber kelapa sawit di PT. Supra Matra. Jurnal Kesehatan Lingkungan, 5(1), 77–84.

Daulay, S., Hutabarat, R., & Siregar, H. (2016). Penerapan penggunaan alat pelindung diri (APD) sebagai upaya perlindungan terhadap tenaga kerja di perkebunan PT. Aek Tarum-Sampoerna Agro, Tbk. Mesuji Raya, Ogan Komeling Ilir Sumatra Selatan. Jurnal Ilmu Kesehatan Masyarakat, 7(1), 22–30.

Edigan, A., Sari, D. A., & Amalia, R. (2019). Hubungan antara perilaku keselamatan kerja terhadap penggunaan alat pelindung diri (APD) pada karyawan PT Surya Agrolika Reska Di Sei. Basau. Jurnal Kesehatan Masyarakat PREPOTIF, 5(1), 335–339.

International Labour Organization (ILO). (2018). Safety and health at the heart of the future of work: Building on 100 years of experience. Geneva: ILO.

Juria, Y. O., Husaini, A., & Istiawaty, R. (2023). Hubungan Tingkat pengetahuan dan sikap dengan pemakaian alat pelindung diri (APD) pada pemanen kelapa sawit Di Desa Rantau Rasau. Jurnal Kesehatan

Masyarakat PREPOTIF, 5(1), 335–339.

Muslim, F. O., Aulia, A., Nengcy, S., & Efendi, M. (2024). Analisis kesadaran pekerja dalam penggunaan alat pelindung diri di pabrik sawit X. Menara Ilmu: Jurnal Penelitian dan Kajian Ilmiah, 18(2), 48–54.

Sari, D. A., & Saiful. (2022). Hubungan pengetahuan dan sikap dengan pemakaian alat pelindung diri penyemprotan pestisida pada petani kelapa sawit PT. Citra Mulia Perkasa Di Kecamatan Lampasio Kabupaten Toli-Toli. Jurnal Kesehatan Masyarakat PREPOTIF, 5(1), 335–339.

Sinaga, R., Simanjuntak, A., & Sembiring, J. (2024). Analisis penerapan K3 di pabrik perkebunan sawit. Jurnal Kesehatan Kerja Indonesia, 15(1), 33–41.