

The relationship between occupational safety and health (OSH) policy and worker compliance with the risk of occupational accidents in drainage projects

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ABSTRACT

Background: Construction workers, particularly those involved in drainage projects, are exposed to various occupational hazards that increase the risk of workplace accidents. Effective occupational safety and health (OSH) policies and worker compliance with safety procedures are essential for minimizing these risks.
Objectives: This study aimed to examine the associations of OSH policies and worker compliance with occupational accident risk among workers involved in a drainage project at PT Swadaya Cipta.
Methods: This quantitative analytical study employed a cross-sectional design. The study population comprised 65 drainage project workers at PT Swadaya Cipta, of whom 56 were selected through simple random sampling. The sample size was calculated using Slovin's formula with a 5% margin of error. Data were collected using questionnaires and the Hazard Identification, Risk Assessment, and Determining Control (HIRADC) worksheet. Associations between variables were analyzed using the chi-square test.
Results: OSH policy was significantly associated with occupational accident risk ($p < .001$; OR = 0.049). Worker compliance was also significantly associated with occupational accident risk ($p = .002$; OR = 0.138).
Conclusions: OSH policy and worker compliance were significantly associated with occupational accident risk among drainage project workers at PT Swadaya Cipta. These findings highlight the importance of effective OSH policy implementation and adherence to safety procedures in occupational accident prevention.

Keywords: drainage projects, occupational accident risk, occupational safety and health policy, worker compliance.

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INTRODUCTION

Occupational safety and health (OSH) is a fundamental component of workplace management, particularly in high-risk industries such as construction. An OSH policy is a formal written statement outlining an organization's commitment to protecting workers from occupational hazards, preventing workplace accidents, and reducing work-related illnesses (Sugiyanto, 2022). Beyond fulfilling regulatory requirements, effective OSH implementation contributes to workforce productivity, organizational sustainability, and corporate reputation (Nabila & Susilawati, 2024). Investing in OSH measures is therefore essential for establishing a safe, efficient, and sustainable working environment (Hendarwan et al., 2023).

Occupational accidents are generally defined as unplanned and unexpected events that occur in connection with work activities (Al Husaini, 2023; Sulistyaningsih & Nugroho, 2022). These accidents are commonly associated with two major categories of contributing factors: unsafe actions resulting from human behavior and unsafe conditions arising from hazardous working environments (Larasatie et al., 2022). Globally, the International Labour Organization (ILO) has reported more than 2.78 million work-related deaths annually from occupational accidents and diseases. In Indonesia, data from BPJS Ketenagakerjaan indicate a continued increase in reported occupational accidents, from 298,137 cases in 2022 to 370,747 cases in 2023 and 462,241 cases in 2024. As of early 2025, the construction sector reportedly accounted for approximately 29% of these cases. These figures highlight the substantial burden of occupational accidents and the need to strengthen workplace safety measures, particularly in high-risk industries.

Occupational accident risk refers to the likelihood of incidents that may result in injuries, work-related illnesses, property damage, or other adverse occupational outcomes (Mauludi et al., 2025). Such risks may arise from inadequate equipment, hazardous working conditions, and unsafe worker behavior. In particular, failure to comply with OSH requirements, including the use of personal protective equipment (PPE), adherence to safe operating procedures, and compliance with safety instructions, may increase workers' exposure to occupational hazards (Jannah et al., 2023). Although noncompliance does not necessarily lead to an immediate accident, it can increase the likelihood of adverse events. Occupational accidents also have broader organizational consequences, including project delays, additional medical expenses, equipment damage, reduced productivity, and reputational losses. Consequently, effective OSH implementation represents not only a preventive measure but also a long-term investment in organizational efficiency and competitiveness (Salsabila et al., 2024).

OSH policies and worker compliance are important components of occupational accident prevention. Organizations with clearly established and effectively implemented OSH policies have been reported to experience lower occupational accident rates than those with inadequate safety policies (Susilowati et al., 2022). However, the effectiveness of these policies also depends on workers' adherence to established safety procedures. Even when formal safety policies are available, inconsistent compliance with PPE requirements, operational guidelines, and safety instructions may compromise workplace safety. Therefore, examining OSH policy implementation alongside worker compliance is important for understanding occupational accident risk, particularly in construction settings characterized by multiple and changing hazards.

Drainage construction projects involve several hazardous activities, including excavation, material handling, and the operation of heavy equipment. These activities expose workers to risks such as excavation collapse, falling materials, slips and falls, and collisions with construction machinery (Rusli et al., 2024). Each stage of drainage construction presents distinct hazards that may lead to injuries of varying severity if appropriate preventive measures are not implemented (Radosavljević et al., 2021). Accordingly, effective OSH policies, consistent worker compliance, and systematic hazard identification are essential for controlling occupational risks in drainage projects (Maddeppungeng et al., 2023).

Preliminary observations at the drainage construction project undertaken by PT Swadaya Cipta identified several occupational safety concerns, including inconsistent worker compliance with OSH policies and PPE requirements, inadequate implementation of safety briefings, and suboptimal safety supervision. These conditions may increase workers' exposure to occupational hazards, particularly when combined with the operational demands of construction activities. Previous research has also suggested that pressure to meet project targets may encourage workers to prioritize task completion over compliance with safety procedures, potentially increasing occupational accident risk (Santo & Kusartomo, 2023). These observations emphasize the importance of examining both organizational safety measures and individual safety behavior within the specific context of drainage construction.

Previous studies on OSH in the construction industry have examined safety management practices, worker compliance with safety procedures, and occupational accident risks. However, these dimensions have often been investigated separately, limiting understanding of how OSH policy implementation and worker compliance are jointly associated with occupational accident risk. Furthermore, occupational risk assessments should account for differences in work activities because workers may encounter varying hazards and risk levels depending on their assigned tasks. Integrating organizational safety policies, individual compliance, and activity-based risk assessment may therefore provide a more comprehensive understanding of occupational safety conditions in construction projects.

To address this gap, the present study aimed to examine the associations of OSH policy implementation and worker compliance with occupational accident risk among workers involved in a drainage construction project at PT Swadaya Cipta. The study integrates these two factors with a Hazard Identification, Risk Assessment, and Determining Control (HIRADC)-based assessment covering seven work activities. Occupational accident risk was characterized using the highest risk level among the activities performed by each worker. By combining assessments of organizational safety policies, worker compliance, and activity-specific hazards, this study provides a context-specific perspective on occupational accident risk in drainage construction projects.

METHODS

Study Design and Participants

This study employed a quantitative analytical approach with a cross-sectional design to examine the associations of occupational safety and health (OSH) policy implementation and worker compliance with occupational accident risk. The study was conducted among workers involved in a drainage construction project at PT

Swadaya Cipta in Gresik, East Java, Indonesia. The study population comprised 65 workers, including field workers, heavy equipment operators, and technical personnel.

The sample size was determined using Slovin's formula with a 5% margin of error, yielding a required sample of 56 participants. Simple random sampling was employed to select 56 participants from the list of 65 eligible workers, ensuring that each eligible worker had an equal probability of selection.

Ethical approval statement

This study received ethical approval from the Research Ethics Committee of Muhammadiyah University of Gresik under reference numbers 031/KET/II.3 and UMG/KEP/A/2026. Before data collection, all participants were informed about the study objectives and procedures. Written informed consent was obtained from each participant, and participation was voluntary. The study was conducted in accordance with established ethical principles for research involving human participants and the Declaration of Helsinki.

Research Instruments

Data were collected using two structured questionnaires and the Hazard Identification, Risk Assessment, and Determining Control (HIRADC) method. The questionnaires assessed OSH policy implementation and worker compliance, while HIRADC was used to evaluate occupational accident risk.

OSH policy implementation. The first questionnaire comprised 17 items assessing four dimensions: management commitment, written OSH regulations, safety facilities and equipment, and OSH supervision and evaluation. The questionnaire was adapted from previous studies and modified to reflect the working conditions of the drainage construction project.

Worker compliance. The second questionnaire consisted of 32 items covering compliance with personal protective equipment (PPE) requirements, adherence to standard operating procedures (SOPs), compliance with OSH signs, and unsafe work practices. This questionnaire was also adapted from previous studies and modified for the study setting.

Both questionnaires used a dichotomous Guttman response scale, with "Yes" scored as 1 and "No" scored as 0. Total scores were calculated for each questionnaire and categorized using the median as the cutoff point. OSH policy implementation was classified as good for scores equal to or above the median and poor for scores below the median. Similarly, workers were classified as compliant or noncompliant based on whether their compliance scores were equal to or above, or below, the median, respectively.

Questionnaire validity was assessed through item analysis, and internal consistency was evaluated using Cronbach's alpha. The Cronbach's alpha coefficients were 0.666 for the OSH policy questionnaire and 0.865 for the worker compliance questionnaire.

Occupational Accident Risk Assessment

Occupational accident risk was assessed using the HIRADC method across seven work activities performed within the drainage construction project. The assessment involved identifying potential hazards associated with each activity, assigning likelihood and severity scores, and calculating risk scores by multiplying likelihood by severity.

The resulting scores were classified into four occupational risk categories: low, moderate, high, and extreme. Each participant was assigned a risk category according to the work activities they performed. For participants involved in multiple activities, the highest risk level across those activities was used to determine their overall occupational accident risk category.

For descriptive analysis, the original four risk categories were retained to illustrate the distribution of occupational risks. For inferential analysis, the categories were dichotomized into low/moderate risk and high/extreme risk to distinguish lower-risk activities from those requiring greater preventive and control measures.

Data Analysis

Data were analyzed using descriptive and inferential statistical methods. Descriptive analysis was performed to summarize participant characteristics and the distribution of OSH policy implementation, worker compliance, and occupational accident risk using frequencies and percentages.

Associations between OSH policy implementation and occupational accident risk, as well as between worker compliance and occupational accident risk, were examined using Pearson's chi-square test with Yates' continuity correction. Because the original four-category risk classification produced expected cell counts below five in some cells of the 2 × 4 contingency tables, the risk categories were combined into two groups for inferential analysis. The resulting 2 × 2 contingency tables satisfied the expected-frequency assumption, with all expected cell counts exceeding five.

Chi-square statistics, degrees of freedom, and p-values were calculated from the dichotomized 2 × 2 contingency tables. Odds ratios (ORs) and their corresponding 95% confidence intervals (CIs) were also calculated to estimate the strength and direction of the associations. Statistical significance was established at $p < .05$.

RESULTS

Distribution of OSH Policy Implementation, Worker Compliance, and Occupational Accident Risk

Table 1 presents the distribution of occupational safety and health (OSH) policy implementation among the study participants. Of the 56 workers, 53.6% reported poor OSH policy implementation, while 46.4% reported good implementation. As shown in Table 2, 57.1% of workers were classified as compliant with occupational safety procedures, whereas 42.9% were classified as noncompliant.

The distribution of occupational accident risk is presented in Table 3. Low risk was the most frequently identified category (42.9%), followed by high risk (21.4%), moderate risk (19.6%), and extreme risk (16.1%).

Table 1. Frecuency Distribution of OHS Policy

No.	Name of Style	Function
Poor	26	46.40%
Good	30	53.60%
Total	56	100%

Table 2. Frecuency Distribution of Employee Compliance

No.	Name of Style	Function
Noncompliant	24	42.90%
Compliant	32	57.10%
Total	56	100%

Table 3. Frecuency Distribution of Risk of Workplace Accidents

No.	Name of Style	Function
Low	24	42.90%
Moderate	11	19.60%
High	12	21.40%
Ekstrem	9	16.10%
Total	56	100%

Association Between OSH Policy Implementation and Occupational Accident Risk

Table 4 presents the distribution of occupational accident risk according to OSH policy implementation. Among workers classified as having good OSH policy implementation, 60.0% were in the low-risk category, 30.0% in the moderate-risk category, and 10.0% in the extreme-risk category. No workers in this group were classified as having high occupational accident risk.

Table 4. Cross-Tabulation of OHS Policy Variables

Occupational Safety and Health Policy	Risk of Workplace Accidents								Total	
	Low		Moderate		High		Ekstrem			
	n	%	n	%	n	%	n	%	n	%
Poor	6	23.1%	2	7.7%	12	46.2%	6	23.1%	26	100
Good	18	60.0%	9	30.0%	0	0	3	10.0%	30	100
Total	24	42.9%	11	19.6%	12	21.4%	9	16.1%	56	100
OR					0.049					
p-value					0.000					

In contrast, among workers with poor OSH policy implementation, 23.1% were classified as having low risk, 7.7% as moderate risk, 46.2% as high risk, and 23.1% as extreme risk. The chi-square test using the dichotomized occupational risk categories (low/moderate versus high/extreme) revealed a statistically significant association between OSH policy implementation and occupational accident risk ($p < .001$; OR = 0.049). These findings indicate that OSH policy implementation was significantly associated with occupational accident risk among workers involved in the drainage construction project at PT Swadaya Cipta.

Association Between Worker Compliance and Occupational Accident Risk

Table 5 presents the distribution of occupational accident risk according to worker compliance with safety procedures. Among compliant workers, 56.3% were classified as having low risk, 25.0% as moderate risk, 15.6% as high risk, and 3.1% as extreme risk.

Table 5. Cross-Tabulation of Employee Compliance variables

Employee Compliance	Risk of Workplace Accidents								Total	
	Low		Moderate		High		Ekstrem			
	n	%	n	%	n	%	n	%	n	%
Noncompliant	6	25.0%	3	12.5%	7	29.2%	8	33.3%	24	100
Compliant	18	56.3%	8	25.0%	5	15.6%	1	3.1%	32	100
Total	24	42.9%	11	19.6%	12	21.4%	9	16.1%	56	100
OR					0.138					
p-value					0.002					

In contrast, among noncompliant workers, 25.0% were classified as having low risk, 12.5% as moderate risk, 29.2% as high risk, and 33.3% as extreme risk. The chi-square test using the dichotomized occupational risk categories demonstrated a statistically significant association between worker compliance and occupational

accident risk (p = .002; OR = 0.138). These findings suggest that worker compliance with occupational safety procedures was significantly associated with occupational accident risk in the drainage construction project.

DISCUSSION

Association Between OSH Policy Implementation and Occupational Accident Risk

This study found a statistically significant association between occupational safety and health (OSH) policy implementation and occupational accident risk among workers involved in the drainage construction project at PT Swadaya Cipta (p < .001; OR = 0.049). The descriptive findings showed that 60.0% of workers reporting good OSH policy implementation were classified as having low occupational accident risk, whereas 46.2% of those reporting poor OSH policy implementation were classified as having high risk. These findings suggest that better OSH policy implementation is associated with more favorable HIRADC-based occupational risk classifications.

This association highlights the importance of organizational safety policies in managing occupational hazards in construction environments. Clear safety regulations, management commitment, adequate safety facilities, and consistent supervision may contribute to safer working conditions and more systematic hazard control. However, because occupational accident risk was assessed using HIRADC rather than actual accident records, the findings reflect differences in assessed occupational risk levels rather than demonstrated reductions in accident incidence.

The findings are consistent with Saraswati and Putra (2023), who reported that effective OSH policy implementation in construction companies was associated with improved workplace safety programs and greater adherence to safe work procedures. Their study emphasized management commitment, adequate safety facilities, and consistent supervision as important components of successful OSH implementation. Similarly, Susilowati et al. (2022) found that organizations with clearly established and effectively communicated OSH policies tended to demonstrate better safety management practices than those with less developed policies.

Previous studies have also emphasized the importance of organizational commitment to workplace safety. Junianto (2018) reported that effective OSH implementation contributed to improved workplace safety and the prevention of occupational hazards. Cholil et al. (2020) further highlighted the roles of management commitment and organizational safety policies in establishing a positive workplace safety culture. In addition, Rifqi et al. (2023) emphasized that OSH policies support occupational hazard control through standardized safety procedures and systematic risk management. Collectively, these studies provide a conceptual basis for understanding the association observed in the present study.

In drainage construction projects, effective OSH policies are particularly important because workers are exposed to multiple hazards, including excavation-related risks, falling materials, and heavy equipment operations. Consistent implementation of safety regulations may help establish clearer work procedures, improve hazard awareness, and support the availability and appropriate use of protective equipment. Nevertheless, the present study did not examine the individual contributions of these mechanisms, and the observed association should not be interpreted as evidence of a causal effect.

From a practical perspective, the findings underscore the importance of strengthening OSH policy implementation through clearly communicated safety

regulations, visible management commitment, adequate safety equipment, and routine supervision and evaluation. These measures may support more systematic occupational risk management in drainage construction projects. Further research is needed to determine whether improvements in OSH policy implementation lead to measurable reductions in actual occupational accidents.

Association Between Worker Compliance and Occupational Accident Risk

A statistically significant association was also identified between worker compliance and occupational accident risk ($p = .002$; OR = 0.138). Among compliant workers, 56.3% were classified as having low occupational accident risk, whereas 33.3% of noncompliant workers were classified as having extreme risk. These findings indicate that compliance with occupational safety requirements is associated with HIRADC-based occupational risk classifications among drainage construction workers.

Worker compliance reflects the extent to which employees adhere to established organizational regulations and workplace safety requirements (Husain & Santoso, 2022). In occupational safety contexts, compliance includes the appropriate use of personal protective equipment (PPE), adherence to standard operating procedures (SOPs), compliance with supervisors' instructions, and observance of workplace safety signs (Meidyna & Budiono, 2025). Conversely, noncompliance may involve neglecting PPE requirements, disregarding established procedures, or engaging in unsafe work practices that increase exposure to occupational hazards (Setiawan, 2025).

The present findings are consistent with previous research indicating that adherence to safety procedures is an important component of occupational risk management. Hidayat et al. (2023) reported an association between lower frequencies of unsafe actions and higher levels of compliance with OSH standards. Similarly, Pramaja and Sulistio (2022) found that workers demonstrating greater OSH compliance were more consistent in using PPE, following work procedures, and observing safety instructions, which was associated with lower occupational accident risk. Hamidya et al. (2022) also highlighted the importance of compliance with safety signs and workplace instructions in promoting safer work behavior.

Worker compliance is influenced by both individual and organizational factors. Utami and Wolor (2024) identified individual characteristics, including knowledge, skills, perceptions, motivation, attitudes, and work experience, as potential determinants of compliance. Organizational factors, such as leadership, human resource management, reward and sanction systems, and job design, may also shape workers' adherence to established regulations. These findings suggest that improving compliance requires attention not only to individual behavior but also to the organizational conditions that support safe work practices.

In drainage construction, compliance with safety procedures is particularly important because workers frequently perform activities involving excavation, material handling, and heavy equipment. Failure to use appropriate PPE or follow established procedures may increase exposure to hazards during these activities. Therefore, worker compliance should be considered an important component of occupational safety management alongside organizational safety policies.

However, the association observed in this study should be interpreted cautiously. Occupational accident risk was evaluated using HIRADC-based classifications rather than documented accident events. Consequently, the results do not establish

that compliant workers experienced fewer accidents. Furthermore, the cross-sectional design does not allow the temporal direction of the association to be determined. Differences in job assignments, hazard exposure, and working conditions may also contribute to variations in assessed occupational risk.

From a practical perspective, drainage construction companies should promote consistent compliance through regular safety briefings, adequate PPE provision, clear work instructions, and continuous supervision. Safety training and monitoring may also help reinforce workers' understanding of occupational hazards and appropriate preventive behaviors. Although these measures are consistent with established occupational safety practices, their effectiveness in reducing actual accident incidence should be evaluated through further research.

Limitations of the study

This study has several limitations that should be considered when interpreting the findings. First, the cross-sectional design limits the ability to establish temporal or causal relationships between OSH policy implementation, worker compliance, and occupational accident risk. Second, the study was conducted at a single drainage construction project at PT Swadaya Cipta, which may limit the generalizability of the findings to other construction projects or occupational settings. Third, OSH policy implementation and worker compliance were assessed using self-reported questionnaires, introducing the possibility of recall bias and social desirability bias. Fourth, the questionnaires were adapted from previous studies and modified for the research context, which may have affected measurement validity and consistency. Fifth, occupational accident risk was assessed using HIRADC rather than documented occupational accident records. Therefore, the findings reflect assessed potential hazards and risk classifications rather than actual accident occurrence. In addition, assigning each worker the highest risk category among their work activities may not fully capture differences in the frequency, duration, or intensity of occupational hazard exposure.

Finally, the analyses were limited to bivariate associations and did not account for potential confounding factors, including work experience, safety training, supervision, and working conditions. Future research should consider longitudinal or multicenter designs, incorporate documented occupational accident outcomes, and apply multivariable analyses to provide a more comprehensive understanding of the relationships between organizational safety policies, worker compliance, and occupational risks.

CONCLUSIONS

This study identified statistically significant associations between occupational safety and health (OSH) policy implementation and HIRADC-based occupational accident risk ($p < .001$; OR = 0.049), as well as between worker compliance and occupational accident risk ($p = .002$; OR = 0.138), among drainage construction workers at PT Swadaya Cipta. Workers reporting better OSH policy implementation and greater compliance with safety procedures tended to be classified into lower occupational risk categories. These findings highlight the importance of organizational safety policies and worker compliance in occupational risk management. However, the cross-sectional design and use of HIRADC-based risk classifications prevent causal conclusions or direct inferences about actual accident incidence. Strengthening OSH policy implementation, promoting compliance with

safety procedures, and conducting systematic hazard assessments may support occupational safety management in drainage construction projects.

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DATA AVAILABILITY

The datasets generated and analyzed during the current study are not publicly available to protect participant confidentiality but are available from the corresponding author upon reasonable request, subject to applicable ethical and institutional requirements.

AI DISCLOSURE STATEMENT

This manuscript was edited using AI-assisted tools (ChatGPT) solely to improve language clarity, grammar, and flow. AI generated no academic content. The command used was "Rephrase the sentence for clarity". All analyses, interpretations, discussions, conclusions, and recommendations were authored by me and informed by the literature.

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The authors declare that they have no known financial or non-financial competing interests that could have influenced the research reported in this article.

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