JUKEKE Jurnal Kesehatan dan Kedokteran
JUKEKE Vol 5 No. 1 | February 2026 | ISSN: 2829-0437 (print), ISSN: 2829-050X (online), Page. 192-201

Occupational Safety Risk Analysis in Printing Area using JSA

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Article History
Received : January 06, 2026
Accepted : January 14, 2026
Published : January 15, 2026
Available Online: January 15, 2026

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Cite This Article:
Sumaningrum, N. D., & Mely Purnadianti. (2025). Occupational Safety Risk Analysis in Printing Area using JSA. Jurnal Kesehatan Dan Kedokteran, 5(1), 192–201.

DOI:
https://doi.org/10.56127/jukeke.v5i1.2466

Abstract: Printing workplaces involve diverse operational activities that may pose occupational safety and health (OSH) risks to workers. **Objective:** This study aims to identify potential hazards and assess occupational risk levels in a printing facility using the Job Safety Analysis (JSA) method, considering that printing, cutting, ink handling, and manual material handling activities may lead to work-related injuries and health disorders. **Methodology:** A descriptive observational approach was employed. Data were collected through direct workplace observations, interviews with workers and supervisors, and a review of work process documentation. The JSA procedure involved breaking down work activities into sequential steps, identifying hazards at each stage, and determining risk levels along with appropriate control measures. **Findings:** The results revealed exposure to mechanical, chemical, physical, and ergonomic hazards. Mechanical hazards were predominantly associated with printing and cutting machine operations, posing risks of hand injuries and crushing incidents. Chemical hazards were identified during ink handling activities, with potential health effects from skin contact and inhalation exposure. Ergonomic hazards were mainly observed during manual material handling tasks, increasing the risk of musculoskeletal disorders. Several identified hazards were classified as medium to high risk, indicating the need for prioritized preventive actions. **Implications:** The findings highlight the importance of implementing integrated OSH control measures, including engineering controls, administrative actions, consistent use of personal protective equipment, and the strengthening of workplace safety culture to reduce occupational risks in printing environments. **Originality/Value:** This study provides a systematic, task-based hazard mapping of core printing processes using JSA, offering practical guidance for prioritizing risk control strategies in printing operations with medium to high risk levels.

Keywords: Occupational Safety, Printing Area, Job Safety Analysis

INTRODUCTION

Occupational Safety and Health (OSH) is a fundamental component of industrial operations aimed at preventing workplace accidents and occupational diseases, particularly in work settings that involve multiple hazard sources. In Indonesia, the urgency of proactive OSH management is reflected in national accident insurance indicators, where reported fatalities due to occupational accidents and diseases decreased from 4,007 cases

in 2019 to 3,410 in 2020, but increased again to 6,552 cases in 2021 (Pawenrusi et al., 2025). Evidence from operational workplaces also shows that ergonomic problems remain prominent; workers in a health quarantine office in Makassar frequently reported back, waist, and shoulder pain, which was classified as a moderate risk (Pawenrusi et al., 2025). These realities indicate that OSH risks persist across sectors and reinforce the importance of structured prevention systems to protect workers and sustain organizational performance (ILO, 2022).

The literature emphasizes that OSH risk management is a formal process that begins with hazard identification, proceeds to risk analysis and evaluation, and ends with control actions to eliminate hazards or reduce residual risks that cannot be eliminated. This orientation supports a shift from reactive safety metrics toward proactive prevention based on risk management principles and management-system approaches (ILO, 2022). From an industrial hygiene perspective, exposure and risk assessment are central to occupational health programs because organized characterization of chemical, physical, biological, and ergonomic exposures help prioritize controls, target training and surveillance, and strengthen program evaluation. Task-level methods such as Job Safety Analysis (JSA) are also recommended to identify hazards at each step of a work process and translate them into practical preventive measures (OSHA, 2021). However, many workplaces still rely on general procedures and experience-based practices, while hazards tied to specific job steps are not consistently documented, rated, and linked to an explicit hierarchy of controls creating gaps between policy expectations and implementation quality (Hasle et al., 2021; Lingard et al., 2021).

Therefore, this study aims to analyze occupational safety and health risks in a printing area using the Job Safety Analysis method by breaking selected work activities into sequential steps, identifying hazards at each step, assessing risk levels to determine priorities, and proposing feasible control measures based on the hierarchy of controls. This approach is expected to generate a clearer task-based risk profile and actionable recommendations that can strengthen hazard control implementation in printing operations, where machinery, chemical agents such as inks and solvents, and manual material handling frequently coexist (Manuele, 2022; Tarwaka, 2021).

Given the characteristics of printing processes, it is expected that mechanical hazards related to moving machine parts and sharp cutting components, chemical exposure during ink and solvent handling, physical hazards such as noise, and ergonomic risks associated

with repetitive work and manual lifting will emerge as dominant risk groups (Manuele, 2022; Tarwaka, 2021). Consistent with evidence that ergonomic complaints can represent a moderate risk issue in real workplaces (Pawenrusi et al., 2025), manual material handling and awkward postures in printing tasks are expected to contribute substantially to musculoskeletal risk. It is also anticipated that PPE availability alone may not ensure adequate protection if training, supervision, and enforcement are insufficient; thus, stronger engineering and administrative controls are likely required to reduce residual risks (Hasle et al., 2021; OSHA, 2021).

RESEARCH METHOD

The unit of analysis in this study was the work activities and job steps performed in the printing area, along with the potential hazards that may arise at each step of the work sequence. The focus was placed on routine printing-related tasks that involve interaction between workers, tools/equipment, materials, and the work environment, so that hazards could be identified at the task level in a structured manner.

This study employed a descriptive observational field investigation to document actual workplace conditions without manipulating any variables. This design was selected because the objective was to capture hazards and work practices as they naturally occur in the printing area, making it suitable for occupational safety and health investigations where the emphasis is on direct, real-world documentation of unsafe conditions and behaviors (Widodo & Prasetyo, 2023).

Data were obtained from primary sources collected in the workplace and supporting documents relevant to work procedures and safety practices. Primary sources included information from workers and supervisors as key informants regarding work routines, perceived hazards, and existing controls. Supporting documentation (where available) was used to complement field observations and provide context for current safety practices (Hummah et al., 2025).

Primary data were collected through direct observation, interviews with workers and supervisors, and review of related documentation. Observations were conducted in situ to record job sequences, equipment use, work posture, and existing control practices. Interviews were used to clarify work steps, confirm hazards that may not be visible during observation, and verify how controls (e.g., PPE and procedures) are applied in practice.

These combined techniques are commonly used in occupational health research to obtain comprehensive descriptions of workplace hazards and practices (Hummah et al., 2025).

Data analysis followed the Job Safety Analysis (JSA) procedure by breaking selected work activities into detailed job steps, identifying potential hazards at each step, and then formulating appropriate risk control measures. Identified hazards were organized and classified into major categories such as mechanical, chemical, physical, and ergonomic hazards to support clearer risk interpretation and intervention planning. The final output was a structured description of hazards and recommended controls aligned with the identified issues in each work step (Oktiasari & Apsari, 2025).

RESULT AND DISCUSSION

Based on direct field observations, several primary work activities were identified in the printing area, including the operation of printing machines, paper cutting processes, ink handling, and manual material handling tasks. Each of these activities was associated with distinct potential hazards that could contribute to occupational accidents or adverse health effects. The outcomes of the Job Safety Analysis are summarized in Table 1,2

Table 1. Job Safety Analysis in Printing

Job Activity	Work Step	Potential Hazard	Existing Control	Identified Issue	Recommended Control
Printing machine operation	Printing process	Noise exposure	Ear protection available	PPE rarely used	Safety supervision, safety signage
Paper cutting	Cutting operation	Sharp blades	Gloves available	Inconsistent PPE use	Safety training, enforcement
Ink handling	Ink filling and cleaning	Chemical exposure	Masks and gloves available	Workers not accustomed to PPE	SOP implementation, supervision
Manual material handling	Lifting paper bundles	Heavy load	None	Improper lifting	Ergonomic training

An example of making a table can be seen in Table 1 and Table 2. If the contents of the table come from a particular source, write down the reference with the number.

Tabel 2. Table Risk Rating

Work Activity	Hazard Type	Potential Hazard	Possible Impact	Likelihood (1–5)	Severity (1–5)	Risk Level	Risk Category	Existing Controls	Recommended Controls
Printing machine operation	Mechanical	Moving rollers and gears	Hand injury, finger crushing	3	4	12	High	Machine guard available	Improve machine guarding, routine inspection, operator training
Cutting machine operation	Mechanical	Sharp blades	Cuts, amputations	3	5	15	High	Emergency stop	Install interlock system, strict SOP enforcement
Ink preparation	Chemical	Ink and solvent exposure	Skin irritation, respiratory problems	3	3	9	Medium	PPE available	Improve ventilation, mandatory PPE use, chemical safety training
Material handling	Ergonomic	Manual lifting of paper stacks	Musculoskeletal disorders	4	3	12	High	No lifting aid	Provide trolleys, ergonomic training
Printing room environment	Physical	Noise exposure	Hearing fatigue	2	3	6	Medium	None	Noise monitoring, ear protection

Table 1 and 2 Show The results of this research indicate that printing activities involve a diverse range of occupational safety and health hazards, including mechanical, chemical, physical, and ergonomic risks that occur throughout various stages of the work process. This diversity of hazards is closely related to the characteristics of printing operations, which rely heavily on machinery, chemical materials, and manual handling tasks.

Mechanical hazards were identified as one of the most prominent risks, especially during the operation of printing and cutting equipment. Exposure to moving machine components such as rotating rollers and sharp blades increases the likelihood of hand injuries and crushing accidents when engineering safeguards and administrative controls are not consistently applied. Similar patterns have been reported in recent studies within the manufacturing and printing sectors, where machinery-related hazards continue to be a major source of occupational injuries due to inadequate machine guarding and weak adherence to standard operating procedures (OSHA, 2023). This condition suggests that

mechanical risks remain a persistent challenge in printing workplaces, even in the presence of formal safety regulations.

Chemical risks were mainly linked to activities involving the handling and preparation of printing inks and solvents. These substances contain chemical agents that may adversely affect workers' health through skin contact or inhalation exposure (Truelove et al., 2021). Although personal protective equipment was provided, irregular use limited its protective effectiveness. This observation is in line with recent occupational health studies emphasizing that the mere provision of PPE does not ensure adequate protection. Instead, consistent PPE use is largely shaped by factors such as workers' awareness of hazards, the quality of safety training, and the level of supervision and enforcement in the workplace (Kim & Park, 2023). The inconsistency observed in PPE usage indicates weaknesses in safety communication and organizational safety culture, which may compromise chemical hazard management.

Ergonomic risks were also evident, particularly during manual material handling tasks such as lifting and transporting paper materials. Repetitive activities, awkward working postures, and improper lifting methods can substantially increase the risk of developing work-related musculoskeletal disorders (A.I.H.A, 2026; OSHA, 2023). This finding supports previous research identifying manual handling as a dominant contributor to musculoskeletal injuries across industrial work environments (da Costa & Vieira, 2010). The lack of mechanical handling aids and ergonomic training in the workplace may further intensify these risks, highlighting the importance of targeted ergonomic interventions.

The implementation of Job Safety Analysis in this study proved to be a valuable method for systematically identifying workplace hazards and establishing risk control priorities. By decomposing work activities into sequential steps, JSA facilitates a thorough evaluation of hazards associated with each task (Widodo & Prasetyo, 2023). This approach supports proactive risk prevention and aligns with modern occupational safety frameworks that emphasize hazard identification and the application of control hierarchies (OSHA, 2021). The findings demonstrate that JSA is a practical and flexible tool for enhancing safety performance, particularly in small- to medium-scale industrial settings such as printing facilities.

In summary, the study highlights that reducing occupational risks in printing operations requires a comprehensive and integrated safety management strategy. Engineering controls, including enhanced machine guarding and ergonomic equipment,

should be reinforced by administrative actions such as regular safety training, active supervision, and strict enforcement of operating procedures. Furthermore, fostering a strong safety culture is essential to promote consistent compliance with PPE use and safe working behaviors. Without the implementation of these combined measures, workplace hazards are likely to persist and continue posing significant threats to workers' health and safety.

This study concludes that occupational safety and health risks in printing workplaces are multidimensional and interrelated, encompassing mechanical, chemical, physical, and ergonomic hazards that arise throughout daily work activities. The presence of these diverse hazards reflects the operational characteristics of printing processes, which rely heavily on machinery, chemical materials, and manual labor, as commonly reported in industrial safety studies (OSHA, 2021). Without comprehensive risk management, such conditions may increase the likelihood of occupational injuries and work-related health problems.

Mechanical hazards represent a major source of risk, particularly in activities involving printing and cutting machines. Frequent worker interaction with moving machine components exposes operators to potential injuries when engineering safeguards and safe work procedures are not consistently applied. Although safety standards and technical guidelines are widely available, the continued occurrence of mechanical risks indicates that implementation gaps remain a critical challenge in industrial environments (Occupational Safety and Health Administration (OSHA, 2023). This finding emphasizes the importance of strengthening preventive measures beyond regulatory compliance.

Chemical exposure risks were mainly associated with ink handling and preparation processes. Even when personal protective equipment is provided, inconsistent use reduces its effectiveness in protecting workers from harmful substances. This highlights that technical controls alone are insufficient if not supported by adequate training, supervision, and effective safety communication (Hasle et al., 2021). Previous studies have shown that PPE compliance is strongly influenced by organizational safety culture and workers' risk perception rather than PPE availability alone (Kim & Park, 2023). Improving workers' awareness and reinforcing organizational commitment to safety are therefore essential to ensure effective chemical hazard control.

Ergonomic risks were also identified as a significant concern, particularly during manual material handling activities. Repetitive movements, improper lifting techniques,

and sustained physical strain increase the potential for musculoskeletal disorders, which remain among the most common occupational health problems in industrial sectors (A.I.H.A, 2026; OSHA, 2023). The absence of ergonomic aids and structured ergonomic programs further amplifies these risks. Addressing ergonomic hazards requires not only physical interventions but also education and behavioral changes to promote safer work practices (da Costa & Vieira, 2010).

The application of Job Safety Analysis in this study proved to be a valuable tool for identifying hazards systematically and establishing priorities for risk control. By analyzing work activities step by step, JSA facilitates a clearer understanding of how hazards emerge and how they can be prevented (Hasle et al., 2021; Professionals, 2026). This approach supports proactive safety management and aligns with contemporary occupational safety frameworks that emphasize hazard identification and control hierarchy implementation (OSHA, 2021). JSA is particularly suitable for small- to medium-scale industries, where access to advanced risk assessment tools may be limited.

Overall, the findings indicate that effective risk reduction in printing operations requires an integrated safety management strategy. Engineering controls should be complemented by administrative measures, such as standard operating procedures, regular training, and consistent supervision. Equally important is the development of a positive safety culture that encourages safe behavior and continuous compliance with safety practices, as emphasized in recent occupational safety research (Kim & Park, 2023). When these elements are implemented collectively, the likelihood of occupational accidents and health problems can be substantially reduced.

In conclusion, this study demonstrates that Job Safety Analysis can serve as a practical and effective framework for improving occupational safety and health in printing environments. The insights generated from this research may support management and policymakers in designing targeted interventions to enhance workplace safety. Future studies are recommended to expand the scope of analysis by involving multiple workplaces and incorporating quantitative exposure measurements to further strengthen the evidence base for occupational risk management in the printing industry.

CONCLUSION

Referring to the Job Safety Analysis (JSA) results summarized in the analysis table, it can be concluded that work activities in the printing area are characterized by varying levels of occupational safety and health (OSH) risks, ranging from low to high. Activities such as

machine operation, equipment cleaning, and manual material handling were classified as having medium to high risk levels, while other routine tasks were generally categorized as low to medium risk. The primary hazards identified include entanglement with moving machine components, exposure to chemical agents such as printing inks and cleaning solvents, ergonomic stress caused by repetitive movements and awkward postures, as well as physical hazards including excessive noise and heat.

Based on the JSA evaluation, the majority of hazards with medium and high risk levels can be effectively reduced through the application of appropriate control measures. The JSA table highlights the importance of engineering controls, such as the installation of machine guards and adequate ventilation systems, as well as administrative controls, including the implementation of standard operating procedures (SOP), job rotation, and clear safety signage. In addition, the use of personal protective equipment (PPE) such as gloves, masks, hearing protection, and safety footwear was identified as a key measure to lower residual risk levels, particularly for high-risk activities.

Nevertheless, the JSA findings indicate that despite PPE availability, worker compliance in using PPE remains insufficient. As a result, several activities continue to present medium residual risk levels, suggesting gaps in safety awareness, supervision, and enforcement.

Therefore, to further reduce risk levels from medium and high to low, it is essential to strengthen occupational safety management by improving worker safety training, increasing supervision during high-risk tasks, and enforcing safety regulations more consistently. The sustained implementation of control measures recommended in the JSA, supported by strong management commitment, is expected to significantly reduce the likelihood of workplace accidents and occupational health issues in the printing area

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