# SAFETY KNOWLEDGE AND ITS IMPACT ON WORKPLACE ACCIDENTS: A SYSTEMATIC LITERATURE REVIEW

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**Article Info:**

**Abstract:**

Safety knowledge is widely recognised as a critical determinant of workplace safety performance; however, empirical evidence on how safety knowledge influences workplace accidents remain fragmented across disciplines, sectors, and methodological approaches. This systematic literature review aims to synthesise empirical evidence on the relationship between safety knowledge and workplace accidents, with particular attention to emerging digital safety analytics, human and organisational factors, and applied occupational safety and health (OSH) practices across specific sectors and populations. Guided by the PRISMA framework, advanced searches were conducted in the Scopus and Web of Science databases for peer-reviewed English-language articles published between 2015 and 2025. Following rigorous screening, eligibility assessment, and quality appraisal, 47 empirical studies were included for qualitative synthesis. Using a PICo-guided thematic analysis, three overarching themes were identified: (1) digital, AI-driven, and knowledge-based safety analytics (safety informatics); (2) human factors, safety climate/culture, and risk perception at individual and organisational levels; and (3) applied OSH practices in specific sectors and vulnerable worker populations. The findings indicate that safety knowledge plays a central mediating role between

safety management practices, safety attitudes, training interventions, and accident outcomes. Technological advancements such as knowledge graphs, machine learning, and predictive safety analytics show growing potential to enhance real-time safety decision-making, while human and organisational factors strongly shape how safety knowledge is perceived and enacted. Sector-specific contexts further influence the effectiveness of safety knowledge transfer, particularly among high-risk and vulnerable worker groups. Overall, this review highlights the need for integrated socio-technical approaches that combine digital safety systems, strong safety culture, and context-sensitive training to reduce workplace accidents and improve occupational safety outcomes.

## Introduction

Occupational safety and health (OSH) is a critical aspect of workplace management, aimed at ensuring the well-being of employees by preventing accidents and injuries. The significance of OSH is underscored by the thousands of deaths and disabilities resulting from workplace accidents each year, which highlight the need for comprehensive safety research and effective safety management systems (Kao et al. 2019; Liu et al. 2020).

### Key Factors Influencing Occupational Safety

Several factors contribute to the effectiveness of OSH initiatives:

**Safety Knowledge**: A fundamental component of OSH, safety knowledge encompasses the understanding of safety protocols and procedures. It is crucial for transforming safety attitudes into safety behaviors, thereby reducing the likelihood of accidents (Kao et al. 2019; Shaidan et al. 2025; Zulkifly et al. 2024). Studies have shown that safety knowledge significantly mediates the relationship between safety management frameworks and the incidence of workplace accidents (Liu et al. 2020; Shaidan et al. 2025).

**Safety Attitudes**: Positive safety attitudes among workers and supervisors play a pivotal role in promoting safe behaviors. When supervisors exhibit positive safety attitudes, it strengthens the relationship between workers' safety knowledge and their safety behaviors (Kao et al. 2019; Zulkifly et al. 2024).

**Safety Training**: Effective safety training programs are essential for enhancing safety knowledge and performance. Engaging training methods are particularly effective in high-risk environments, leading to better safety outcomes (Burke et al. 2011; Shaidan et al. 2025). Regular and comprehensive training helps in maintaining high safety standards and reducing accident rates (Liu et al. 2020; Othman et al. 2017).

**Safety Behavior**: The actual implementation of safety knowledge and attitudes in daily work practices is critical. Safety behavior acts as a mediator between safety knowledge and safety outcomes, indicating that knowledge alone is insufficient without proper behavioral application ( Huang & Yang, 2019; Yu et al. 2021; Zulkifly et al. 2024).

### Challenges and Recommendations

Despite the advancements in OSH, several challenges persist. For instance, the transfer of safety knowledge in dynamic and complex environments like construction sites can be problematic due to frequent changes in personnel and project conditions (Huang & Yang, 2019). Additionally, the perception of risk varies among workers based on individual and demographic factors, which can affect their adherence to safety protocols (García & Montuenga, 2024).

To address these challenges, it is recommended that organizations:
Invest in continuous and engaging safety training programs tailored to the specific risks of the workplace (Burke et al., 2011; Liu et al. 2020) .

Foster a positive safety culture by encouraging both workers and supervisors to prioritize safety attitudes and behaviors (Kao et al. 2019; Zulkifly et al. 2024).

Implement robust safety management frameworks that are regularly reviewed and updated to meet industry standards (S. Liu et al., 2020).

Utilize advanced data analysis techniques to identify patterns and underlying causes of workplace accidents, thereby informing targeted interventions (Sanchez et al. 2014; Sena et al. 2021).
In conclusion, a holistic approach to OSH that integrates safety knowledge, attitudes, training, and behavior is essential for creating a safe and healthy work environment. By addressing the multifaceted nature of workplace safety, organizations can significantly reduce the incidence of accidents and enhance overall employee well-being.

## Literature Review

Safety behavior in the workplace is a critical factor in preventing accidents and ensuring a safe working environment. This literature review explores the influence of safety culture, safety knowledge, and safety training on safety behavior across various industries.

### Safety Culture

Safety culture is a significant predictor of safety behavior. It encompasses the values, attitudes, and practices related to safety within an organization. Studies have shown that a strong safety culture positively impacts safety behavior by fostering a shared commitment to safety (Adotey

et al. 2025; Asif et al. 2022; Mahdinia et al. 2022; Sudiarno et al. 2021; Zhang et al. 2021). For instance, in the mining sector in Ghana, safety culture was found to mediate the relationship between occupational health and safety practices (OHSP) and safety behavior (Adotey et al.2025). Similarly, in the aviation industry, safety culture positively influenced pilots' safety behavior, with safety attitude and cognition acting as mediators (Zhang et al. 2021).

### Safety Knowledge

Safety knowledge is another crucial factor influencing safety behavior. It involves understanding safety procedures, recognizing hazards, and knowing how to respond to safety issues. Research indicates that safety knowledge directly impacts safety behavior and can be enhanced through effective safety training programs (Elosta & Alzubi, 2024; Kao et al. 2019; Rasheed et al. 2025; Shaidan et al. 2025; Yu et al. 2021). For example, in the construction industry, safety knowledge was found to mediate the relationship between safety leadership and safety behavior (Elosta & Alzubi, 2024). Additionally, safety knowledge was shown to improve safety compliance among radiology personnel, with safety motivation acting as a mediator (Rasheed et al. 2025).

### Safety Training

Safety training is essential for imparting safety knowledge and shaping safety behavior. Effective training programs can significantly reduce accident rates and improve safety outcomes (Bena et al. 2009; Burke et al. 2011; Estudillo et al. 2025; Love et al. 2022; Sena et al. 2000) . For instance, a study on the construction of the Turin-Novara high-speed railway line found that specific safety training led to a 25% reduction in injury rates (Bena et al. 2009) . Moreover, hands-on and engaging training methods were found to be more effective in enhancing safety perceptions and behaviors (Brahm & Singer, 2013; Love et al. 2022).

### Interplay of Factors

The interplay between safety culture, safety knowledge, and safety training is complex and multifaceted. Safety culture provides the foundation for safety practices, while safety knowledge and training equip employees with the necessary skills and attitudes to perform safely. Studies have shown that these factors often interact to influence safety behavior. For example, in the solid waste management industry, safety knowledge positively influenced safety attitudes and behaviors, which in turn reduced accident occurrences (Zulkifly et al. 2024). Similarly, in the SME manufacturing sector, safety knowledge mediated the relationship between safety attitude, training, and safety behavior (Rasheed et al.2025).

**Figure 1 : Conceptual Map Safety Knowledge and Its Impact on Workplace Accidents**
Source: Generated using Scopus (2025)

In conclusion, safety culture, safety knowledge, and safety training are interrelated factors that significantly influence safety behavior in the workplace. A strong safety culture fosters a commitment to safety, while safety knowledge and training equip employees with the skills and attitudes necessary to perform safely. Future research should continue to explore these relationships and develop strategies to enhance safety behavior across various industries.

## Research Question

Research questions hold a central role in a systematic literature review (SLR), as they establish the foundation, structure, and overall direction of the review process. Clear research questions help define the boundaries of the investigation, supporting decisions on which studies should be included or excluded so that the review remains focused on the intended subject area. Well-constructed questions also support a comprehensive and systematic search strategy, enabling the identification of all relevant evidence while reducing the possibility of selection bias. In addition, research questions assist in organising extracted data, creating a coherent basis for interpreting results and synthesising key findings. Their clarity strengthens the precision of the review and keeps the analysis aligned with specific issues, thereby producing evidence that is meaningful and directly applicable. Research questions further enhance transparency and reproducibility, allowing other scholars to trace the review process, verify outcomes, or expand it to related topics. Consequently, the formulation of research questions is essential for ensuring that an SLR meets its objectives, addresses existing knowledge gaps, evaluates the effectiveness of available evidence, and provides insights into current trends within the field.

According to (Kitchenham & Brereton, 2013), defining the research questions is not only the primary task during the planning stage but also the most critical component of an SLR, as it shapes the entire methodological approach. Since the aim of this review is to identify and evaluate the current state of knowledge, the PICo framework proposed by (Lockwood et al., 2015) was used to guide the construction of the research questions. PICo is a mnemonic tool commonly applied in qualitative evidence synthesis and consists of three core elements:

Population, Interest, and Context. In this study, the PICo structure was derived from the three key dimensions identified through advanced searching of the Scopus database on the topic of safety knowledge and its impact on workplace accidents. These dimensions relate to: (1) digital, ai & knowledge-based safety analytics (safety "informatics) (2) human factors, safety climate/culture & risk perception (people & organisations and (3) applied OSH in specific sectors & populations (contextual risks, training, vulnerable groups). Each dimension was systematically mapped to the Population, Interest, and Context components to ensure a coherent and well-aligned framework for developing focused research questions.

Applying the PICo framework allowed each research question to be formulated with precision, ensuring clear alignment between the population under study, the phenomena of interest, and the occupational contexts in which noise and vibration hazards occur. This structured approach supports targeted literature identification, enhances conceptual clarity, and strengthens the analytical foundation for synthesising evidence on worker exposure and safety risks. Based on this framework, the following research questions were developed:

**RQ1:** How does the integration of digital, AI-driven, and knowledge-based safety analytics influence workplace accident rates and safety outcomes among employees in industrial environments?

**RQ2:** What is the relationship between workers safety knowledge, organisational safety climate/risk perception, and the incidence of workplace accidents across different organisational contexts?

**RQ3**: How do occupational safety training interventions and applied OSH practices affect workplace accident rates among employees in specific high-risk sectors and vulnerable worker populations?

## Material And Methods

The PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) framework is widely regarded as a gold standard for systematic literature reviews due to its emphasis on transparency, methodological rigor, and comprehensive reporting. As noted by (Page et al. (2021), compliance with PRISMA guidelines enhances the trustworthiness and accuracy of a review by providing a clear and systematic approach to the identification, screening, selection, and documentation of relevant studies. The framework further highlights the value of robust evidence sources, particularly studies employing randomized designs, as these approaches help minimize bias and improve the validity of research outcomes. In the present study, the Web of Science and Scopus databases were selected because of their extensive academic coverage, rigorous indexing practices, and relevance for accessing multidisciplinary literature related to the research focus.

The PRISMA framework consists of four sequential stages: identification, screening, eligibility assessment, and data extraction. During the identification stage, comprehensive search strategies are applied across the selected databases to capture all potentially relevant publications. The screening stage involves filtering studies based on predefined inclusion and exclusion criteria to eliminate those that fall outside the scope of the review. In the eligibility stage, the remaining articles are examined in greater detail to confirm their suitability for inclusion. The final stage, data extraction, focuses on systematically collecting, organizing, and synthesizing information from the selected studies to enable meaningful analysis and interpretation. This stepwise process strengthens the methodological soundness of the review

and ensures that the resulting evidence base is reliable, thorough, and capable of supporting future research and practical decision-making.

## *Identification*

This study applied the key stages of a systematic review to ensure the comprehensive collection of relevant scholarly literature. The review process began with the careful selection of core keywords, after which related terms were identified through the use of dictionaries, thesauri, encyclopedias, and prior studies. These terms were then refined and combined to develop effective search strings tailored to the Web of Science and Scopus databases, as presented in Table 1.

**Table 1: Search Strategy and Keyword Strings**

| | |
|---|---|
| **Scopus** | TITLE-ABS-KEY ( "safety" AND "knowledge" AND "ACCIDENTS" ) AND ( LIMIT-TO ( PUBYEAR , 2015 ) OR LIMIT-TO ( PUBYEAR , 2016 ) OR LIMIT-TO ( PUBYEAR , 2017 ) OR LIMIT-TO ( PUBYEAR , 2018 ) OR LIMIT-TO ( PUBYEAR , 2019 ) OR LIMIT-TO ( PUBYEAR , 2020 ) OR LIMIT-TO ( PUBYEAR , 2021 ) OR LIMIT-TO ( PUBYEAR , 2022 ) OR LIMIT-TO ( PUBYEAR , 2023 ) OR LIMIT-TO ( PUBYEAR , 2024 ) OR LIMIT-TO ( PUBYEAR , 2025 ) OR LIMIT-TO ( PUBYEAR , 2026 ) ) AND ( LIMIT-TO ( DOCTYPE , "ar" ) OR LIMIT-TO ( DOCTYPE , "cp" ) ) AND ( LIMIT-TO ( LANGUAGE , "English" ) ) <br> Date of Access: December 2025 |
| **Web Of science** | "safety" AND "knowledge" AND "Accidents" (Topic) and Review Article (Document Types) and 2026 or 2025 or 2024 or 2022 or 2023 or 2021 or 2019 or 2017 or 2015 or 2016 or 2018 or 2020 (Publication Years) and English (Languages) <br> Date of Access: December 2025 |

## *Screening*

During the screening phase, potentially relevant studies were evaluated to ensure their alignment with the predefined research question(s). This stage primarily involved sourcing and filtering publications retrieved from the Scopus and Web of Science databases. Duplicate records were identified and removed at this point. Following the initial screening, 6,260 records were excluded, leaving 134 articles for further examination based on the specified inclusion and exclusion criteria outlined in Table 2.

The primary eligibility criterion focused on scholarly literature, as it represents the main source of reliable and actionable evidence. Publications such as book series, book reviews, meta-syntheses, meta-analyses, conference proceedings, and book chapters that were not relevant to the most recent scope of the study were excluded. Additionally, only articles published in English between 2015 and 2025 were considered. As a result of the deduplication process, a total of four records were removed.

**Table 2: Screening Criteria for Study Selection**

| Criterion | Inclusion | Exclusion |
|---|---|---|
| **Language** | English | Non-English |
| **Time line** | 2015 – 2025 | < 2015 |
| **Literature type** | Journal (Article) | Conference, Book, Review |
| **Publication Stage** | Final | In Press |
| **Subject** | Environmental Sciences Social Sciences Public environmental Occupational Health | In Press |

*Eligibility*

The third stage of the review process, referred to as the eligibility phase, involved a detailed evaluation of 40 shortlisted articles. At this stage, article titles and core content were thoroughly reviewed to confirm compliance with the inclusion criteria and relevance to the study's objectives. As a result of this assessment, 122 articles were excluded for several reasons, including lack of relevance to the research field, non-informative titles, abstracts that did not address the study objectives, absence of full-text availability, or insufficient empirical evidence. Following this filtering process, 28 articles were retained for inclusion in the final review.

*Data Abstraction and Analysis*

This study employed an integrative analysis approach as one of its evaluation methods to examine and synthesize evidence derived from studies using quantitative research designs. The primary objective of this approach was to identify key themes and subthemes relevant to the research focus. Data collection represented the initial stage in the thematic development process. As presented in Table 3, the authors conducted a detailed review of 28 selected publications, extracting statements and information pertinent to the study objectives.

Subsequently, the authors critically assessed the most relevant literature addressing occupational safety and machinery-related hazards within plantation work settings. Attention was given to both the methodologies applied across the studies and their reported findings. The lead author then worked collaboratively with the co-authors to develop thematic categories grounded in the accumulated evidence and aligned with the context of the study. Throughout the analysis, a systematic log was maintained to document analytical decisions, interpretations, emerging questions, and reflections related to data interpretation. In the final stage, the authors cross-checked the developed themes to identify and resolve any inconsistencies in the thematic framework. Where differences in interpretation arose, these were addressed through discussion until consensus was achieved.

**Table 3: Details of Primary Studies Included in the Review**

| No | Authors | Title | Year | Journal Title | Scopus | Web Of Science |
|----|---------|-------|------|---------------|--------|----------------|
| 1 | Pětvaldský et al. (2025) | A Comparative Analysis of OSH Training: Evaluating Traditional Methods Versus Interactive and Virtual Reality Approaches in the Context of Sustainability | 2025 | Sustainability (Switzerland) | / | |
| 2 | Zhao et al. (2022) | Architecture and Application of Mine Ventilation System Safety Knowledge Graph Based on Neo4j | 2025 | Sustainability (Switzerland) | / | |
| 3 | Bafail & Alamoudi (2024) | Investigation and Analysis of Interrelationships Among Safety Managerial Aspects Affecting Safety Climate Using Decision-Making Trial and Evaluation Laboratory Approach | 2024 | Sustainability (Switzerland) | / | |
| 4 | Wong et al. (2018) | Agricultural Health and Safety: Evaluating Farmers' Knowledge, Attitude, and Safety Behavior in Northern Thailand | 2024 | Safety and Health at Work | / | |
| 5 | Qiu et al. (2024) | Why do Workers Generate Biased Risk Perceptions? An Analysis of Anchoring Effects and Influential Factors in Workers' Assessment of Unsafe Behavior | 2024 | Safety and Health at Work | / | |
| 6 | Fan et al.(2024) | Research on the Prediction of Sustainable Safety Production in Building Construction Based on Text Data | 2024 | Sustainability (Switzerland) | / | |
| 7 | Ahsan et al. (2024) | A Safety Model for Preventing Nosocomial Infections in Stroke Patients | 2024 | Open Public Health Journal | / | |
| 8 | Tanaporn et al. (2024) | Factors Predicting Safe Motorcyclist Riding | 2024 | Open Public Health Journal | / | |

| | | | | | |
|---|---|---|---|---|---|
| | | Behaviors among Thai Undergraduates | | | |
| 9 | Bui et al. (2024) | Biosafety knowledge and perception among medical laboratory students: a cross-sectional study at a medical university in Vietnam | 2024 | International Journal of Occupational Safety and Health | / |
| 10 | Strauss et al.(2023) | Exploration And Description Of Certified And Non-Certified Rock Climbers' Attitudes, Perceived Social Pressures And Control Over Certification | 2023 | South African Journal for Research in Sport, Physical Education and Recreation | / |
| 11 | Hao et al. (2023) | Emergency Decision Making for Electric Power Personal Accidents Based on Ontology and Case-Based Reasoning | 2023 | Sustainability (Switzerland) | / |
| 12 | Yuan et al. (2023) | Architecture and Application of Traffic Safety Management Knowledge Graph Based on Neo4j | 2023 | Sustainability (Switzerland) | / |
| 13 | Machfudiyanto et al. (2023) | Applying Association Rule Mining to Explore Unsafe Behaviors in the Indonesian Construction Industry | 2023 | Sustainability (Switzerland) | / |
| 14 | Liu et al. (2023) | Research on the Construction of Safety Information Ontology Knowledge Base and Accident Reasoning for Complex Hazardous Production Systems-Taking Methanol Production Process as an Example | 2023 | Sustainability (Switzerland) | / |
| 15 | Sanchez-Pi et al. (2014) | Occupational safety and health in construction: a review of applications and trends | 2017 | Industrial Health | / |
| 16 | Zara et al. (2023) | Influence of communication determinants on safety commitment in a high-risk workplace: a systematic | 2023 | Frontiers In Public Health | / |

| | | | | | |
|---|---|---|---|---|---|
| | | literature review of four communication dimensions | | | |
| 17 | Gomez-Bull et al. (2023) | Risk perception in the construction industry: A literature review and future research directions | 2023 | Work-A Journal Of Prevention Assessment & Rehabilitation | / |
| 18 | Cavalcanti et al. (2023) | Construction accident prevention: A systematic review of machine learning approaches | 2023 | Work-A Journal Of Prevention Assessment & Rehabilitation | / |
| 19 | Duarte et al. (2021) | Occupational Accidents Related to Heavy Machinery: A Systematic Review | 2021 | Safety | / |
| 20 | Hanvold et al.(2019) | Occupational Safety and Health Among Young Workers in the Nordic Countries: A Systematic Literature Review | 2019 | Safety And Health At Work | / |
| 21 | Wen et al. (2024) | Research status and trends of enterprise safety culture: a knowledge graph analysis based on CiteSpace | 2024 | Frontiers In Public Health | / |
| 22 | Bowdler et al.(2023) | Effective Components of Behavioural Interventions Aiming to Reduce Injury within the Workplace: A Systematic Review | 2023 | Safety | / |
| 23 | Meng & Chan (2021) | Current States and Future Trends in Safety Research of Construction Personnel: A Quantitative Analysis Based on Social Network Approach | 2021 | International Journal Of Environmental Research And Public Health | / |
| 24 | Ensslin et al. (2023) | Bibliometric and systemic review of the state of the art of occupational risk management in the construction industry | 2023 | International Journal Of Occupational Safety And Ergonomics | / |
| 25 | Nilsson (2016) | Interventions to reduce injuries among older workers in agriculture: A review of evaluated intervention projects | 2016 | Work-A Journal Of Prevention Assessment & Rehabilitation | / |

| 26 | Pocock et al.(2018) | Occupational, physical, sexual and mental health and violence among migrant and trafficked commercial fishers and seafarers from the Greater Mekong Subregion (GMS): systematic review | 2018 | Global Health Research And Policy | / |
| 27 | Kyung et al.(2023) | Underreporting of workers' injuries or illnesses and contributing factors: a systematic review | 2023 | Bmc Public Health | / |
| 28 | Kazi et al.(2019) | Injury among the immigrant population in Canada: exploring the research landscape through a systematic scoping review | 2019 | International Health | / |

### *Quality of Appraisal*

In line with the methodological guidance provided by Kitchenham & Brereton (2013), the methodological rigor of the selected primary studies was systematically evaluated after the study selection phase. Primary studies are defined as original research articles or source documents retained following the screening process, serving as the principal evidence base for addressing the research questions. In the present study, the quality of each included article was assessed using the quality assessment framework developed by Abouzahra et al. (2020), which consists of six distinct evaluation criteria. Each criterion was rated using a three-point scale: "Yes" (Y) awarded a score of 1 when fully satisfied, "Partly" (P) assigned a score of 0.5 when partially fulfilled, and "No" (N) given a score of 0 when not addressed. This scoring scheme facilitated a structured and comparable evaluation of methodological quality across all studies. Table 4 outlines the quality assessment (QA) process applied to the included studies based on the predefined criteria. Three subject-matter experts independently reviewed each study and assigned ratings of "Yes" (Y), "Partly" (P), or "No" (N) for every criterion. The individual scores were subsequently aggregated to generate an overall quality score for each study. Only studies achieving a cumulative score exceeding 3.0 across the three reviewers were retained for the subsequent phase of the review, ensuring that the analysis was based on studies meeting an acceptable standard of methodological quality.

Figure 2 presents the PRISMA flow diagram illustrating the stages of study identification, screening, eligibility assessment, and final inclusion in this systematic literature review. The diagram summarizes the process through which records were retrieved, screened, excluded, and ultimately selected in accordance with the predefined criteria. Following this process, 28 articles were deemed eligible and included in the final review. The complete study selection workflow guided by the PRISMA framework is depicted in Figure 2.
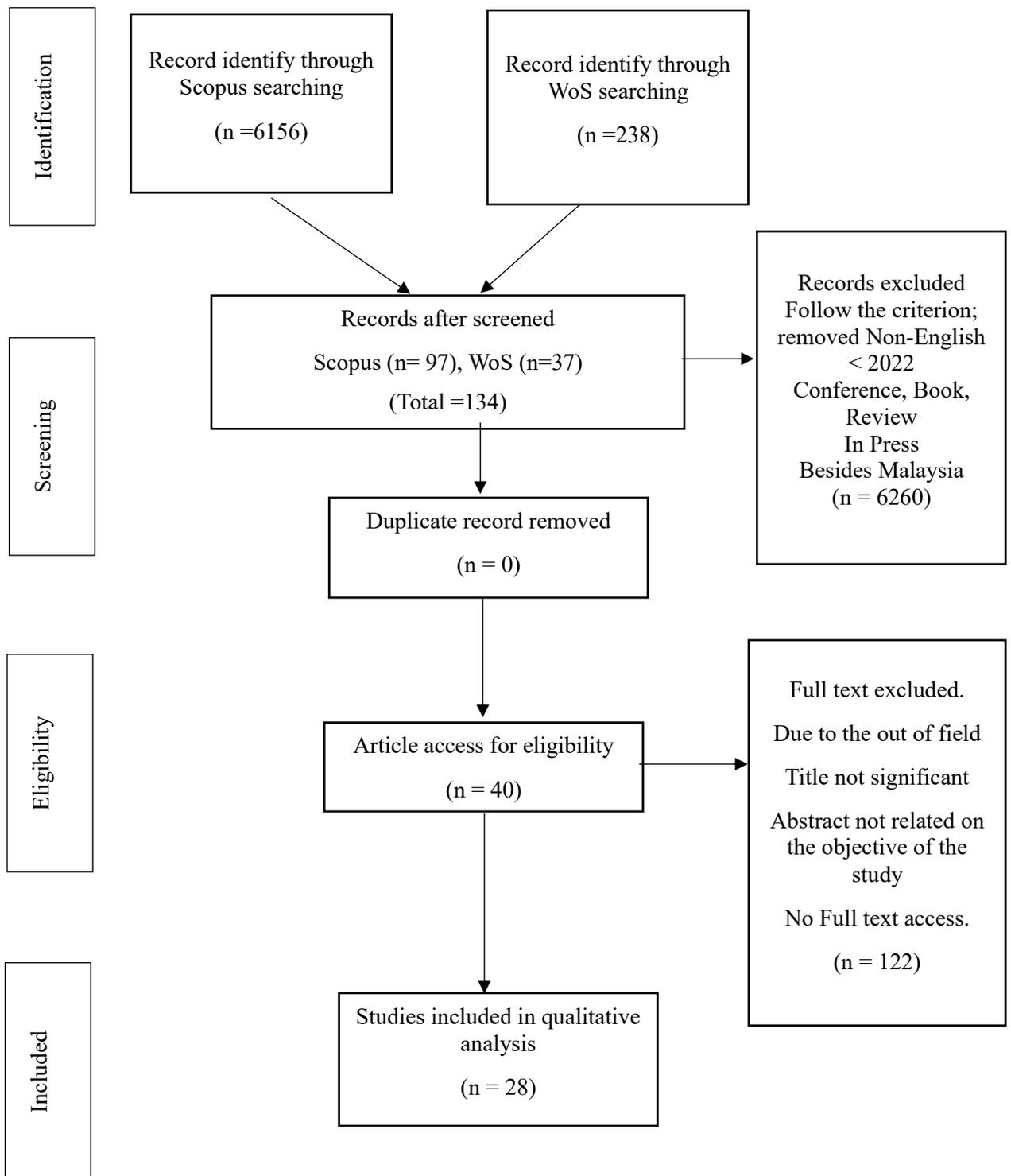
**Identification**

Record identify through Scopus searching

(n =6156)

Record identify through WoS searching

(n =238)

**Screening**

Records after screened

Scopus (n= 97), WoS (n=37)

(Total =134)

Records excluded
Follow the criterion;
removed Non-English
< 2022
Conference, Book,
Review
In Press
Besides Malaysia
(n = 6260)

Duplicate record removed

(n = 0)

**Eligibility**

Article access for eligibility

(n = 40)

Full text excluded.

Due to the out of field

Title not significant

Abstract not related on the objective of the study

No Full text access.

(n = 122)

**Included**

Studies included in qualitative analysis

(n = 28)

**Figure 2: PRISMA Flow Diagram for Study Selection**

**Result and Finding**

Following study selection, a quality appraisal was conducted to evaluate the methodological rigor of the included studies. The detailed quality scoring outcomes are summarised in Table 4, which reports criterion-level ratings, total quality scores, and corresponding percentages. Studies that met the predefined quality threshold were included in the final synthesis.

Following the eligibility screening process, a total of 28 studies published between 2016 and 2025 were subjected to methodological quality appraisal. These studies comprised empirical investigations, systematic reviews, scoping reviews, and bibliometric analyses across a range of occupational safety and health contexts, including construction, agriculture, healthcare, transportation, and vulnerable worker populations (Table 3).

Quality assessment was conducted using six predefined criteria (QA1–QA6), with each criterion rated as *Yes* (1), *Partly* (0.5), or *No* (0). The resulting total quality scores ranged from 3.0 to 5.5, corresponding to percentage scores between 50% and 92%, as presented in Table 4. Overall, the findings indicate that the methodological quality of the included studies was moderate to high. Of the 28 studies, 22 achieved total scores of 4.0 or above (≥67%), reflecting satisfactory methodological rigor. Among these, two studies (PS4 and PS22) attained the highest quality scores (5.5; 92%), demonstrating strong performance across all assessed criteria. An additional sixteen studies (57%) scored 4.5 or higher (≥75%), indicating robust study design, clarity of objectives, and appropriate analytical approaches.

A smaller subset of studies (six studies) obtained total scores of 3.5 (approximately 58%), while three studies recorded the minimum acceptable score of 3.0 (50%). These lower-scoring studies typically exhibited partial fulfilment of several criteria, particularly in relation to methodological transparency or analytical depth. Nevertheless, all included studies met the predefined quality threshold and were therefore retained for qualitative synthesis. Across the six quality criteria, QA2 (clarity of objectives) and QA6 (relevance to occupational safety and health) demonstrated the highest levels of compliance, with the majority of studies receiving full scores. In contrast, QA1 and QA3, which relate to methodological detail and rigor, showed more variability, with several studies receiving partial or no scores for these criteria. This pattern suggests heterogeneity in study designs and reporting quality across the reviewed literature.

In summary, the quality appraisal confirms that the evidence base underpinning this systematic literature review is methodologically sound and suitable for thematic synthesis. The variation in quality scores highlights differences in research design and reporting practices but does not undermine the overall reliability of the included studies.

**Table 4: Quality Scoring of Primary Studies Related to Safety Knowledge and Its Impact on Workplace Accidents**

| PS | QA1 | QA2 | QA3 | QA4 | QA5 | QA6 | Total | Percentage |
|---|---|---|---|---|---|---|---|---|
| PS1 | P | Y | Y | P | N | P | 3.5 | 58% |
| PS2 | P | Y | Y | P | P | Y | 4.5 | 75% |
| PS3 | P | N | N | P | N | Y | 3.0 | 50% |
| PS4 | P | Y | Y | Y | Y | Y | 5.5 | 92% |

| | | | | | | | | |
|------|---|---|---|---|---|---|-----|-----|
| PS5 | N | Y | P | P | Y | Y | 4.0 | 67% |
| PS6 | P | Y | N | Y | Y | Y | 4.5 | 75% |
| PS7 | P | P | P | Y | Y | P | 4.0 | 67% |
| PS8 | N | P | Y | P | P | Y | 3.5 | 58% |
| PS9 | N | Y | Y | Y | P | Y | 4.5 | 75% |
| PS10 | Y | Y | P | P | P | Y | 4.5 | 75% |
| PS11 | N | N | Y | P | Y | Y | 3.5 | 58% |
| PS12 | P | N | P | P | Y | N | 4.5 | 75% |
| PS13 | P | P | Y | P | Y | Y | 4.5 | 75% |
| PS14 | Y | P | P | N | Y | Y | 4.0 | 67% |
| PS15 | P | P | N | N | Y | Y | 3.0 | 50% |
| PS16 | Y | N | P | Y | Y | Y | 4.5 | 75% |
| PS17 | Y | P | Y | P | Y | P | 4.5 | 75% |
| PS18 | N | Y | N | Y | Y | P | 3.5 | 58% |
| PS19 | P | Y | Y | P | Y | Y | 5.0 | 83% |
| PS20 | Y | P | P | Y | Y | P | 4.5 | 75% |
| PS21 | P | Y | Y | P | N | P | 3.5 | 58% |
| PS22 | P | Y | Y | Y | Y | Y | 5.5 | 92% |
| PS23 | P | Y | N | Y | Y | Y | 4.0 | 67% |
| PS24 | N | P | Y | P | P | Y | 3.5 | 58% |
| PS25 | P | P | P | Y | Y | Y | 4.5 | 75% |
| PS26 | P | N | N | P | N | Y | 3.0 | 50% |
| PS27 | P | P | P | Y | Y | P | 4.0 | 67% |
| PS28 | N | Y | N | Y | Y | P | 3.5 | 57% |

## Digital, AI & Knowledge-Based Safety Analytics (Safety "Informatics")

Several studies demonstrate an increasing adoption of digital and AI-driven approaches to operationalise safety knowledge for accident prevention. Knowledge graph and ontology-based systems were frequently applied to structure complex safety information and support decision-making in high-risk industries. For example, Zhou et al. (2019) and Yuan et al. (2023) developed based safety knowledge graphs for mine ventilation and traffic safety management, respectively, showing that these systems enabled efficient querying of accident patterns and relationships between hazards, controls, and outcomes. Similarly, Liu et al. (2021) constructed a safety ontology and accident reasoning model for hazardous chemical production, demonstrating improved identification of accident causation pathways.

Machine learning and text-mining techniques were also prominent. Fan et al. (2024) applied text data and XGBoost modelling to predict construction safety risks, achieving high predictive accuracy and identifying safety knowledge–related factors as critical determinants of accident severity. Reviews by Cavalcanti et al. (2023) and Meng & Chan (2021) further confirm that predictive safety analytics increasingly rely on accident narratives, inspection reports, and unstructured text to generate proactive safety insights. Collectively, these findings indicate that digital safety analytics enhance the accessibility, integration, and practical use of safety knowledge, shifting accident prevention from reactive analysis to proactive risk prediction.

**Human Factors, Safety Climate/Culture & Risk Perception (People & Organisations)**

Across the reviewed literature, safety knowledge was consistently identified as a key mediating factor linking organisational practices to safety outcomes. Bafail & Alamoudi (2024) demonstrated that safety managerial aspects—particularly leadership competence and rule enforcement—strongly influence safety climate, which in turn affects accident prevention. Similarly, Kao et al. (2019) showed that safety knowledge mediates the relationship between safety attitudes and safety behaviour, with supervisory attitudes strengthening this pathway.

Risk perception emerged as a critical determinant of how safety knowledge is enacted. Qiu et al. (2024) found that cognitive anchoring effects significantly distorted workers' risk perception, leading to either underestimation or overestimation of unsafe behaviour risks. Workers with lower safety knowledge and weaker cognitive engagement were more susceptible to biased risk perception, increasing unsafe behaviour. These findings align with broader reviews by Gomez-Bull et al.(2023) and (García-Mainar & Montuenga, 2024)which identified safety behaviour and risk perception as central mechanisms linking knowledge to accident outcomes.

In addition, organisational safety culture and communication were shown to shape the effectiveness of safety knowledge. Zara et al. (2023) highlighted that safety communication climate and communication satisfaction significantly influence safety commitment in high-risk workplaces, reinforcing the role of organisational context in translating safety knowledge into safe practices.

**Applied OSH in Specific Sectors & Populations (Contextual Risks, Training, Vulnerable Groups)**

The impact of safety knowledge varied across occupational sectors and worker populations. In agriculture, Wong et al.(2018) found that farmers with higher safety knowledge and training exposure demonstrated significantly safer behaviours, while lower education levels were associated with increased accident risk. Similarly, Nilsson, (2016) reported that injury-prevention interventions among older agricultural workers were often less effective due to limited engagement and contextual barriers.

In healthcare and laboratory settings, safety knowledge was strongly associated with compliance and accident prevention. Ahsan et al. (2024) showed that safety management practices positively influenced safety knowledge and motivation, leading to improved infection prevention among nurses. Bui et al.(2024) reported that biosafety knowledge among medical laboratory students was significantly influenced by academic level and training exposure, with implications for laboratory accident prevention.

Studies focusing on vulnerable populations highlighted persistent gaps. Hanvold et al. (2019) identified young workers as particularly vulnerable due to limited experience and safety knowledge, while Pocock et al. (2018) and Kazi et al.(2019) documented heightened injury risks among migrant and immigrant workers linked to inadequate safety knowledge, precarious employment, and underreporting. In transportation contexts, Tanaporn et al.(2024) demonstrated that safety knowledge, perceived behavioural control, and training significantly predicted safe riding behaviours among motorcyclist students.

Overall, these findings indicate that safety knowledge is most effective when embedded within sector-specific OSH practices and tailored to the needs of vulnerable worker groups.

**Conclusion**

Across all three themes, the reviewed studies consistently show that safety knowledge plays a central but context-dependent role in workplace accident prevention. Digital safety analytics enhance the generation and application of safety knowledge Zhao et al.(2022) and Fan et al. (2024) organisational culture and risk perception shape its behavioural translation Kao et al. (2019) and Qiu et al.(2024), and sector-specific conditions determine its practical effectiveness Wong et al.(2018) and Ahsan et al.(2024). The evidence supports an integrated socio-technical approach combining technological systems, organisational support, and context-sensitive training to reduce workplace accidents.

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