International Journal of Innovation and Industrial Revolution
EISSN: 2637-0972
IJIREV
Volume 7 Issue 23 (December 2025) PP. 337-357
DOI 10.35631/IJIREV.723022

INTERNATIONAL JOURNAL OF INNOVATION AND INDUSTRIAL REVOLUTION (IJIREV)
www.ijirev.com

A SYSTEMATIC LITERATURE REVIEW ON COMBINED EXPOSURE OF NOISE AND VIBRATION AND ITS EFFECT ON WORKER SAFETY

Saina Omar[1*], Irman Abdul Rahman[2], Syazwani Mohd Fadzil[3]

[1] Department of Applied Physics, Faculty of Science and Technology, Universiti Kebangsaan Malaysia, 43600 UKM Bangi, Selangor
Email: sainaomar@gmail.com
[2] Department of Applied Physics, Faculty of Science and Technology, Universiti Kebangsaan Malaysia, 43600 UKM Bangi Selangor
Email: irman@ukm.edu.my
[3] Department of Applied Physics, Faculty of Science and Technology, Universiti Kebangsaan Malaysia, 43600 UKM Bangi Selangor
Email: syazwanimf@ukm.edu.my
[*] Corresponding Author

Article Info:

Article history:
Received date: 30.09.2025
Revised date: 20.10.2025
Accepted date: 30.11.2025
Published date: 17.12.2025

To cite this document:

Omar, S., Abdul Rahman, I., & Fadzil, S. M. (2025). A Systematic Literature Review on Combined Exposure of Noise and Vibration and Its Effect on Worker Safety. *International Journal of Innovation and Industrial Revolution, 7* (23), 337-357.

DOI: 10.35631/IJIREV.723022

Abstract:

Exposure to noise and vibration remains a critical occupational hazard that affects workers across machinery-intensive industries, yet existing findings are dispersed and lack consolidated evaluation. This systematic literature review was undertaken to address this gap by examining how combined or isolated exposure to these physical agents influences health outcomes, safety performance, and risk management practices. The review applied the PRISMA protocol and conducted advanced searches in Web of Science and Scopus using the keyword string "Noise" AND "Vibration" AND "effect" AND "Safety," focusing on peer-reviewed articles published between 2023 and 2025. From an initial pool of 1,149 records, screening and eligibility procedures resulted in 18 primary studies that met all inclusion criteria. The extracted evidence was synthesised into three thematic categories: (1) occupational noise–vibration exposure, health effects, and safety performance; (2) technological approaches, sensor development, and safety-oriented innovation; and (3) modelling, simulation, and noise–vibration mitigation strategies. The results show that workers in industrial, transport, maritime, and small-scale manufacturing sectors commonly experience exposure levels exceeding recommended limits, leading to musculoskeletal strain, sensory fatigue, cognitive disruption, and reduced productivity. Emerging technologies such as advanced sensors, machine-learning-based monitoring tools, structural simulations, and engineered materials demonstrate increasing potential for real-time detection

International Journal of Innovation and Industrial Revolution
EISSN: 2637-0972 IJIREV
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and harm reduction. Overall, the review highlights persistent exposure challenges, uneven control measures, and the need for integrated engineering and organisational strategies. The findings emphasise the importance of systematic evidence synthesis in supporting safer work practices, informing regulatory refinement, and guiding future innovations in noise and vibration management.

Keywords:

Occupational, Noise, Vibration, Exposure, Health, Safety, Mitigation

Introduction

Noise and vibration are among the most common physical hazards encountered in industrial and occupational environments, where they pose substantial risks to workers' health, safety, and operational performance. The prevalence of mechanised processes and heavy machinery in contemporary workplaces intensifies these exposures, highlighting the need for a deeper understanding of their combined effects. Examining the sources of these hazards, their physiological and psychological implications, and the associated mitigation strategies is essential for establishing safer and healthier work conditions.

Industrial equipment such as excavators, tractors, and forging machines represents major contributors to hazardous noise and vibration levels across multiple sectors (Kanu et al. 2025; Liu et al. 2020; Stankov & Stepancev, 2022). Likewise, advancements in construction, agricultural, and manufacturing technologies have led to increased reliance on high-powered machinery, further elevating exposure intensity (Liu et al., 2020; Mohammad-Ghasemi & Khoshmaneshzadeh, 2022; Stankov & Stepancev, 2022). Prolonged exposure to excessive noise remains strongly associated with noise-induced hearing loss, recognised as one of the most prevalent occupational diseases worldwide (Sakthivel et al. 2025). Beyond auditory damage, both noise and vibration have been linked to a range of adverse health outcomes, including reproductive complications in male and female workers, headaches, eyestrain, and increased discomfort proportional to exposure levels (Deboli & Calvo, 2004). These hazards also exert broader physiological and psychological effects, influencing the central and autonomic nervous systems and contributing to stress, sleep disruption, and other systemic health issues (Arquero & Taylor, 2016; Kanu et al. 2025).

To limit these risks, international regulations define maximum permissible exposure levels for both noise and vibration. For instance, directives by the European Parliament establish exposure action values and requirements for risk management to safeguard workers (Krajnak, 2018; Stankov & Stepancev, 2022). Preventive interventions—such as noise-reducing enclosures, vibration-dampening materials, engineering controls, and routine equipment maintenance—are widely recognised as effective measures to reduce exposure (Johnson & Cherniack, 2017; Kanu et al. 2025).

Accurate assessment of these hazards relies on specialised tools, including sound level meters, dosimeters, and vibration meters, which are integral to exposure monitoring and risk evaluation (Liu et al. 2020; Mohammad-Ghasemi & Khoshmaneshzadeh, 2022). In addition, the use of combined exposure indices, such as those based on cumulative noise and hand-arm vibration (HAV) energy doses, provides a structured approach for determining safe exposure limits and selecting appropriate protective measures (Krajnak, 2018). Regular health surveillance—

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EISSN: 2637-0972
Volume 7 Issue 23 (December 2025) PP. 337-357
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encompassing audiometric testing and vestibulological evaluations—further supports early identification and management of work-related health impairments (Arquero & Taylor, 2016; Bovenzi et al. 2006).

Overall, managing the combined impacts of noise and vibration requires a multidimensional approach grounded in regulatory compliance, effective preventive strategies, rigorous exposure monitoring, and consistent health assessment. Strengthening understanding of these hazards and their interactions enables organisations to develop more effective risk-reduction frameworks, ultimately promoting safer and more sustainable working environments.

Literature Review

Occupational noise and vibration are widely recognised as critical workplace hazards that can negatively impact workers' physical and psychological well-being. Numerous studies have demonstrated that prolonged exposure to these hazards can lead to a broad spectrum of health issues, affecting auditory, cardiovascular, musculoskeletal, neurological, and mental functions. Understanding these effects is essential for improving workplace safety and enhancing preventive strategies in industrial settings.

Exposure to excessive occupational noise has been strongly associated with noise-induced hearing loss (NIHL), which remains one of the most prevalent occupational diseases (Dahlstrom, 2015; Kim, 2010). NIHL typically begins with damage to high-frequency hearing and gradually worsens with continued exposure. Beyond auditory impairment, noise has been linked to hypertension, coronary heart disease, and myocardial infarction (J. Liu et al. 2020; Wang et al. 2021). These cardiovascular effects arise because noise acts as a physiological stressor that stimulates the sympathetic and endocrine systems, leading to increased secretion of stress hormones. Additionally, noise exposure contributes to psychological disturbances, including heightened stress, anxiety, and disruptions in sleep patterns. Noise annoyance is frequently reported among workers and is a recognised indicator of more serious mental health concerns (Alyan et al. 2021; Madvari et al.,2025; Mehrotra et al. 2024).

Occupational vibration exposure, including both hand-transmitted vibration (HTV) and whole-body vibration (WBV), is also associated with multiple adverse health outcomes. HTV contributes to vascular, neurological, and musculoskeletal impairments in the upper limbs, collectively known as Hand-Arm Vibration Syndrome (HAVS) (Bovenzi, 2007; Wasserman, 2003). WBV has been linked to lower back pain and spinal disorders, particularly in workers exposed for long durations (Bovenzi, 2007; Patterson et al., 2021). Long-term vibration exposure can also affect the peripheral nervous system, increasing susceptibility to anxiety and sleep-related problems (Dehghan et al. 2024). In addition, several studies indicate that vibration may affect the female reproductive system, potentially causing menstrual disturbances and increasing pregnancy-related risks (Penkov, 2007).

The mechanisms underlying these health impacts differ between noise and vibration but share common pathways related to physiological stress. Noise functions as an environmental stressor that activates sympathetic and endocrine responses, resulting in cardiovascular strain and heightened stress hormone production (Y. Liu et al. 2021). It also impairs cognitive performance and sleep regulation, further contributing to psychological distress (Alyan et al. 2021; Mucci et al. 2021). Vibration, on the other hand, exerts mechanical forces on tissues and

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EISSN: 2637-0972
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organs, with factors such as frequency and amplitude influencing the severity of musculoskeletal and neurological damage (Patterson et al. 2021).

Control measures for managing occupational noise and vibration exposures are supported by various regulatory guidelines. For noise, requirements such as those set by the Control of Noise at Work Regulations 2005 emphasise engineering controls, administrative strategies, and the use of personal protective equipment (Bradley, 2006; Dawson, 2008). Practices such as noise mapping and regular noise assessments aid in identifying critical exposure areas and guiding mitigation actions (Dawson, 2008; J. Liu et al. 2020). Vibration exposure is governed by frameworks such as the European Directive 2002/44/EC, which outlines procedures for assessment and reduction of vibration-related risks. Employers are encouraged to adopt anti-vibration equipment, select low-vibration tools, and ensure proper maintenance of machinery to minimise exposure (Deboli & Calvo, 2004; Mohr, 2007).

Based on Figure 1, the visual mapping of research themes indicates that worker safety is primarily influenced by three major domains: health risks, the effects of vibration, and the effects of noise. The cluster related to health risks connects directly to physiological indicators such as heart rate, blood pressure, and overall employee health, showing that exposure to noise and vibration can trigger systemic physiological responses. The vibration-related cluster highlights occupational risks and vibration analysis, reflecting the emphasis placed on mechanical stress and its musculoskeletal and neurological consequences. Meanwhile, the noise-related cluster includes environmental noise, noise pollution, and noise-induced hearing loss, demonstrating strong research attention on auditory damage and psychological disturbances. Collectively, Figure 1 shows that noise and vibration hazards are interconnected and contribute to worker safety outcomes through multiple physiological, environmental, and occupational pathways.

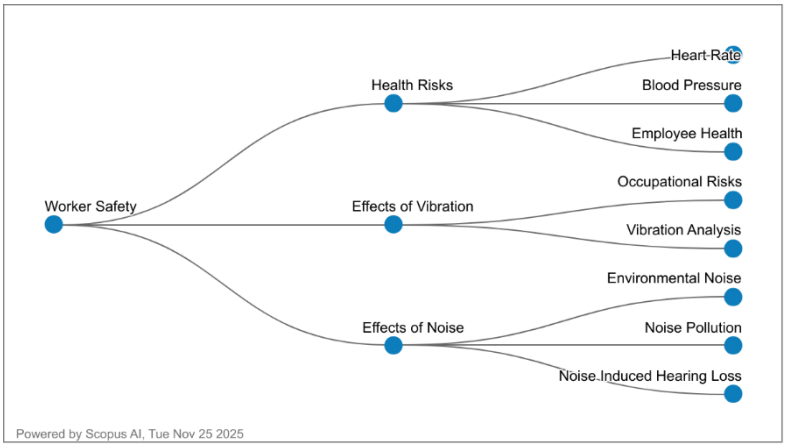

Figure 1 : Conceptual Map Occupational Noise, Vibration, And Worker Safety
Source: Generated using Scopus AI (2025)

Overall, the existing literature demonstrates that occupational noise and vibration pose considerable threats to worker health, contributing to hearing loss, cardiovascular strain, psychological stress, musculoskeletal disorders, and reproductive complications. While regulations and control measures are essential in mitigating these risks, ongoing research remains important to strengthen understanding of exposure interactions and to support the development of more effective workplace interventions.

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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 noise and vibration exposure and its effect on worker safety. These dimensions relate to: (1) occupational noise vibration exposure and associated health and safety outcomes, (2) monitoring technologies, sensor development, and safety-oriented assessment approaches, and (3) modelling, simulation, and mitigation strategies for controlling noise and vibration risks. 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 occupational exposure to noise and vibration affect workers' health outcomes and safety performance across different workplace environments?
RQ2: How are noise and vibration levels monitored, measured, or assessed among workers in machinery-intensive or industrial settings to support safety evaluation and risk management?
RQ3: What mitigation, control, or intervention strategies are implemented in workplaces to reduce the adverse effects of noise and vibration exposure on worker safety?

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Material And Methods

The PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) framework is recognised as a benchmark for conducting systematic literature reviews, as it promotes clarity, completeness, and methodological consistency. According to (Page et al. 2021), adherence to the PRISMA guidelines strengthens the reliability and precision of a review by outlining a structured process for identifying, screening, selecting, and reporting relevant studies. The framework also emphasises the importance of high-quality evidence, including randomised research designs, due to their capacity to reduce bias and enhance the credibility of the findings. In this study, two major scholarly databases Web of Science and Scopus were selected because of their comprehensive coverage, strong indexing standards, and suitability for retrieving multidisciplinary research related to the topic.

The PRISMA model is divided into four principal phases: identification, screening, eligibility, and data abstraction. The identification phase involves systematically searching the selected databases to capture all potentially relevant publications. The screening phase consists of applying predefined criteria to remove studies that do not align with the review's objectives. During the eligibility phase, the remaining articles undergo detailed evaluation to ensure alignment with the inclusion requirements. The final phase, data abstraction, involves extracting, organising, and synthesising information from the accepted studies to support meaningful interpretation and robust conclusions. This structured workflow enhances the methodological integrity of the review and ensures that the resulting evidence is dependable, comprehensive, and suitable for informing subsequent research and practical applications.

Identification

In this study, essential steps of the systematic review process were employed to collect a significant amount of relevant literature. The process started with the selection of keywords, followed by identifying related terms using dictionaries, thesauri, encyclopedias, and previous research. All relevant terms were identified, and search strings were formulated for the Web of Science and Scopus databases as shown in Table 1.

Table 1 Search Strategy and Keyword Strings

Scopus	TITLE-ABS-KEY ("Noise" AND "Vibration" AND "effect" AND "Safety") AND (LIMIT-TO (PUBYEAR , 2023) OR LIMIT-TO (PUBYEAR , 2024) OR LIMIT-TO (PUBYEAR , 2025)) AND (LIMIT-TO (SUBJAREA , "ENVI") OR LIMIT-TO (SUBJAREA , "SOCI")) AND (LIMIT-TO (DOCTYPE , "ar")) AND (LIMIT-TO (LANGUAGE , "English")) Date of Access: November 2025
Web Of science	"Noise" AND "Vibration" AND "effect" AND "Safety" (Topic) and Review Article (Document Types) and 2025 or 2024 or 2023 (Publication Years) Date of Access: November 2025

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Screening

Potentially pertinent research items are assessed in the screening step to make sure they support the predetermined research question or questions. During this stage, choosing research topics is frequently done using Scopus and web of science. At this point, duplicate documents are eliminated. After 1149 publications were initially discarded, 24 papers were left for additional analysis in accordance with particular inclusion and exclusion standards refer to Table 2. The literature was the first criterion because it is the primary source of useful advice. This includes book series, book reviews, meta-syntheses, meta-analyses, conference proceedings, and chapters that were not included in the most recent study. Only English-language publications from 2023 to 2025 were included in the review. Due to duplication, four publications in total were rejected.

Table 2 Screening Criteria For Study Selection

Criterion	Inclusion	Exclusion
Language	English	Non-English
Time line	2023 – 2025	< 2022
Literature type	Journal (Article)	Conference, Book, Review
Publication Stage	Final	In Press
Subject	Environmental Sciences Social Sciences Public environmental Occupational Health	In Press

Eligibility

In the third step, known as the eligibility phase, 24 articles were prepared for review. During this stage, the titles and key content of all articles were carefully examined to ensure they met the inclusion criteria and aligned with the current research objectives. Consequently, 2 article were excluded as they did not qualify as due to the out of due to the out of field, title not significant, abstract not related on the objective of the study, no full text access founded on empirical evidence. As a result, a total of 18 articles remain for the upcoming review.

Data Abstraction and Analysis

An integrative analysis was used as one of the assessment strategies in this study to examine and synthesise a variety of research designs quantitative methods. The goal of the competent study was to identify relevant topics and subtopics. The stage of data collection was the first step in the development of the theme. Table 3 shows how the authors meticulously analysed a compilation of 18 publications for assertions or material relevant to the topics of the current study. The authors then evaluated the current significant studies related to occupational safety and machinery hazards in plantation works. The methodology used in all studies, as well as the research results, are being investigated. Next, the author collaborated with other co-authors to develop themes based on the evidence in this study's context. A log was kept throughout the data analysis process to record any analyses, viewpoints, riddles, or other thoughts relevant to the data interpretation. Finally, the authors compared the results to see if there were any inconsistencies in the theme design process. It is worth noting that, if there are any disagreements between the concepts, the authors.

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Table 3 Details of Primary Studies Included in the Review

No	Authors	Title	Year	Journal Title	Scopus	Web Of science
1	Ni et al.(2025)	Research on a vortex-induced vibration monitoring sensor technology based on triboelectric nanogenerator	2025	Energy	/	
2	Jin et al. (2025)	Numerical studies of ballastless track-embankment vibrations considering track irregularities	2025	Transportation Geotechnics	/	
3	Rahman et al. (2025)	Recent developments in mitigating clogging in permeable pavements: a state-of-the-art review	2025	Innovative Infrastructure Solutions	/	
4	Falola et al. (2024)	Occupational hazards in sawmill industry and its effect on sawmill output in Nigeria	2024	Safety In Extreme Environments	/	
5	Kafu and Mlaba (2024)	Assessing the Impact of Quarrying as an Environmental Ethic Crisis: A Case Study of Limestone Mining in a Rural Community	2024	International Journal Of Environmental Research And Public Health	/	
6	Pu et al. (2024)	Development of comprehensive healthier process plants based on inherent safety concept	2024	Process Safety And Environmental Protection	/	/

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7	Rutkowski and Korzeb (2024)	Noise and Vibration Recorded on Selected New Generation DP Class Shuttle Tankers Operated in the Arctic Offshore Sector	2024	Transnav	/	/
8	Jibiri et al. (2024)	Evaluation and implication of noise and vibration levels to the operators and proxy population around selected block molding industries in Ibadan, Nigeria	2024	International Journal Of Occupational Safety And Health	/	
9	Arsal et al. (2024)	Occupational Risks of Podologists: A Combined Assessment of VOCs, Vibration, Noise Levels and Health Complaints	2024	International Journal Of Environmental Health Research	/	/
10	Wei et al.(2023)	Effects of Air Vent Size and Location Design on Air Supply Efficiency in Flood Discharge Tunnel Operations	2023	Journal Of Hydraulic Engineering	/	
11	Yang et al. (2023)	Highly sensitive and ratiometric detection of nitrite in food based on upconversion-carbon dots nanosensor	2023	Analytica Chimica Acta	/	
12	Zhao et al.(2023)	Vertical-Longitudinal Coupling Effect Investigation and	2023	Sustainability (Switzerland)	/	

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		System Optimization for a Suspension-In-Wheel-Motor System in Electric Vehicle Applications				
13	Cheng and Dong, (2024)	Flexible curved multi-functional sensors for air flow and vibration signal measurement of train bogie	2024	Measurement Science And Technology		/
14	Li et al. (2025)	Resilient ultrafine fiber sponges with thermal bridge structures for high-temperature traffic noise reduction	2025	Journal Of Colloid And Interface Science		/
15	Huang et al.(2024)	The Noise Exposure of Urban Rail Transit Drivers: Hazard Classification, Assessment, and Mitigation Strategies	2024	Applied Sciences-Basel		/
16	Nagy et al.(2024)	Machine learning-based soft-sensor development for road quality classification	2024	Journal Of Vibration And Control		/
17	Yan et al. (2025)	Network Monitoring Method for Scraper Posture of Mine Scraper Conveyor via Frictional Piezoelectric Effect and Triangular Constrained Filtering	2025	Ieee-Asme Transactions On Mechatronics		/

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18	Kumar et al.(2025)	Analysis of a nonlinear aeroelastic system with parametric uncertainties under dynamic stall condition	2025	International Journal Of Non-Linear Mechanics		/

Quality of Appraisal

According to the guidelines outlined by (Kitchenham & Brereton, 2013), once the primary studies have been identified and selected, their methodological quality must be evaluated to determine the robustness of the evidence they provide. Primary studies refer to original research articles or documents included in the review after the screening process, and they represent the core sources of data used to address the research questions. In this study, the quality of each primary study was assessed using the framework proposed by(Abouzahra et al. 2020), which comprises six quality assessment criteria. Each criterion was evaluated using a three-level scoring system: "Yes" (Y) scored as 1 when the criterion was fully satisfied, "Partly" (P) scored as 0.5 when the criterion was only partially met, and "No" (N) scored as 0 when the criterion was not addressed. This scoring approach enabled a systematic and consistent comparison of the methodological strength of all included studies.

Table 4 presents the quality assessment (QA) procedure applied to evaluate each study based on predefined criteria. Three experts reviewed every study independently, scoring each criterion as "Yes" (Y), "Partly" (P), or "No" (N). The individual assessments were then combined to produce a total score for each study. To qualify for inclusion in the subsequent stage of the review, a study needed to achieve a total score of more than 3.0 across all three experts. This threshold ensures that only studies demonstrating an acceptable level of quality are carried forward in the analysis.

This figure 2 illustrates the PRISMA flow diagram used to record the identification, screening, eligibility evaluation, and final inclusion of studies in this systematic literature review. It summarises how records were retrieved, filtered, and selected according to predefined criteria. As a result, a total of 18 articles remain for the upcoming review. The overall study selection process based on the PRISMA protocol is summarised in Figure 2.

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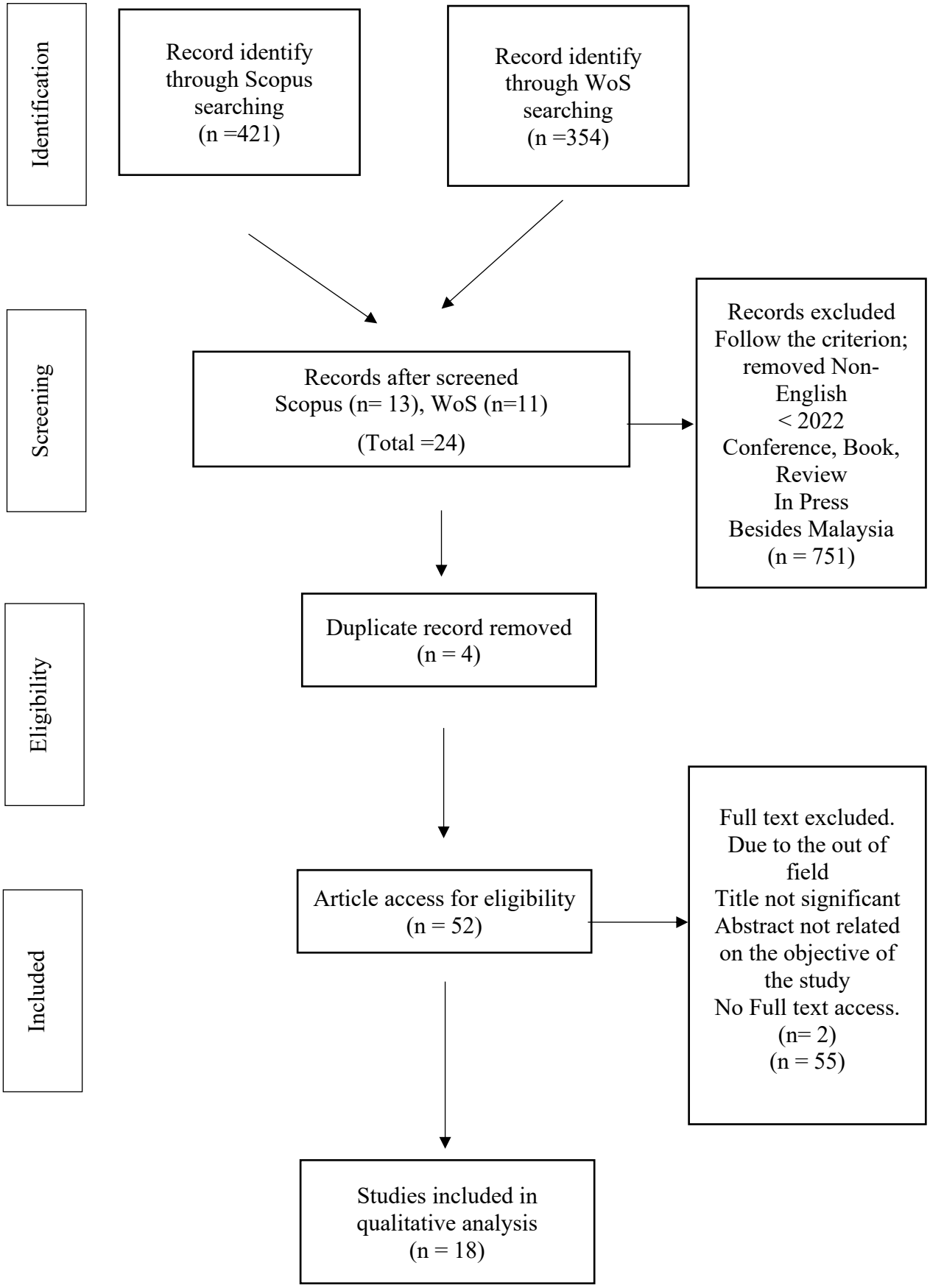

Figure 2 PRISMA Flow Diagram for Study Selection

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Result and Finding

Based on the six predefined quality assessment criteria, the reviewed studies collectively demonstrate an overall satisfactory standard of methodological quality. Most papers clearly stated their research purpose (QA1) and provided a relevant contribution to the understanding of noise and vibration exposure and worker safety (QA2). These two criteria consistently achieved strong ratings, indicating that the majority of studies were grounded in clear objectives and addressed meaningful occupational safety issues. In addition, most papers presented adequately described research methodologies (QA3), reflecting structured procedures that were aligned with their respective study aims.

While these strengths are evident, the assessment also highlights several areas requiring improvement. Variation appears in the clarity of concept definitions (QA4), where some studies provided only partial explanations of noise–vibration constructs or key occupational safety terms. This limited the depth of interpretation and sometimes reduced conceptual accuracy. A more pronounced gap was observed in the comparison with existing literature (QA5), as many studies offered minimal integration with previous findings, resulting in weaker analytical framing. The discussion of limitations (QA6) was also inconsistent across studies; several papers omitted or briefly mentioned methodological constraints, reducing transparency regarding the scope and applicability of their results.

Despite these variations, the overall scores confirm that all studies met the minimum threshold required for inclusion in the review. Several papers demonstrated high levels of methodological rigour, with clear descriptions of concepts, structured methodologies, comparative discussion, and acknowledgment of study limitations. Conversely, studies with lower scores generally lacked conceptual clarity, provided limited comparative analysis, and did not explicitly state their limitations. Nevertheless, these papers still offered relevant insights into noise and vibration exposure and were retained for their contribution to the overall evidence base.

Overall, the quality assessment indicates that although the methodological depth varies, the selected studies collectively provide credible, relevant, and sufficiently structured evidence for understanding noise–vibration exposure and its implications for worker safety. The findings confirm a solid foundation for synthesising broader patterns, evaluating safety impacts, and supporting the thematic analysis of occupational noise and vibration risks across machinery-intensive environments.

The overall quality assessment of the 18 selected studies shows a mixed but generally acceptable level of methodological strength. Most of the papers clearly stated their research purpose, demonstrated relevance to noise–vibration exposure and worker safety, and described their methodologies adequately. These three criteria (QA1, QA2, QA3) were consistently strong across all studies.

Variation was observed in the clarity of conceptual definitions (QA4)**.** Several studies only partially defined key variables such as vibration exposure, noise thresholds, health symptoms, or machine–environment interactions. This inconsistency limits the precision of interpretation and reduces conceptual robustness in some articles.

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More notable weaknesses appeared in QA5 (comparison with existing studies) and QA6 (discussion of limitations)**.** Many papers did not sufficiently compare their findings to previous research, and more than half failed to explicitly mention methodological or contextual limitations. This reduces transparency and makes it difficult to assess the scope, constraints, or generalisability of their findings.

The highest-performing studies achieved 92%**,** indicating very strong alignment with all six quality criteria. These articles demonstrated clear objectives, well-defined concepts, structured methodologies, meaningful comparison with existing literature, and explicit reporting of limitations—reflecting a high level of academic rigour.

The lowest-performing studies scored 50%, mainly due to a lack of comparative analysis, insufficient conceptual explanation, and the absence of a limitations section. Despite these shortcomings, these studies still met the minimum inclusion threshold because they clearly stated their research purpose and relevance to noise–vibration exposure.

Overall, most studies achieved moderate to high total marks, confirming that the selected dataset provides credible, relevant, and useful evidence for understanding the effects of combined noise and vibration exposure on worker safety. However, improvements are still required in enhancing conceptual definitions, situating findings within broader literature, and reporting study limitations more transparently.

Table 4 Quality Scoring of Primary Studies Related to Noise and Vibration

PS	QA1	QA2	QA3	QA4	QA5	QA6	Total	Percentage
PS1	Y	Y	Y	P	N	P	3.5	58%
PS2	Y	Y	Y	P	N	N	3.0	50%
PS3	Y	Y	Y	Y	P	P	4.5	75%
PS4	Y	Y	Y	Y	P	P	4.5	75%
PS5	Y	Y	Y	Y	Y	P	5.5	92%
PS6	Y	Y	Y	Y	P	P	4.5	75%
PS7	Y	Y	Y	Y	P	P	4.5	75%
PS8	Y	Y	Y	Y	P	N	4.0	67%
PS9	Y	Y	Y	P	N	P	3.5	58%
PS10	Y	Y	Y	Y	P	N	4.0	67%
PS11	Y	Y	Y	Y	Y	P	5.5	92%
PS12	Y	Y	Y	Y	P	N	4.0	67%
PS13	Y	Y	Y	Y	P	P	4.5	75%
PS14	Y	Y	Y	P	N	N	3.0	50%
PS15	Y	Y	Y	P	N	N	3.0	50%
PS16	Y	Y	Y	P	N	P	3.5	58%
PS17	Y	Y	Y	Y	P	P	4.5	75%
PS18	Y	Y	Y	Y	P	N	4.0	67%

The development of the themes was refined progressively to ensure clarity and alignment with the overall objective of examining exposure to noise and vibration and their effects on worker safety. The process of selecting, reviewing, and validating the themes was carried out by three experts with relevant backgrounds in occupational health, noise and vibration assessment, and

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workplace safety management. These experts evaluated the suitability and accuracy of each subtheme to ensure that the thematic structure accurately represented the patterns, risks, and safety implications identified across the selected studies. The expert validation process was essential in establishing domain validity, particularly in confirming that each subtheme meaningfully captured issues related to noise exposure, vibration intensity, and their combined impacts on worker health and safety.

During this phase, the researchers also compared emerging interpretations to address discrepancies that arose during theme construction. Any inconsistencies were resolved through collaborative discussion to reach a shared understanding of how the findings should be grouped and represented. The finalised themes were subsequently refined based on expert feedback to strengthen their coherence and ensure consistency with the central focus of the review. These refinements ensured that the final thematic structure accurately reflected the key concerns surrounding noise and vibration exposure, including health outcomes, risk factors, and the broader implications for worker safety across diverse occupational settings.

Occupational Noise Vibration Exposure, Health Effects, and Safety Performance

The selected studies show that workers in machinery-intensive sectors remain highly exposed to combined noise and vibration, often at levels that exceed recommended standards and contribute to both acute and chronic health complaints. In Nigerian sawmills, Falola et al. (2024) identified environmental pollution, noise, vibration, dust and faulty machinery as among the most severe occupational hazards, all of which were strongly associated with reduced sawmill output and work-related health problems.

A similar pattern of multi-hazard exposure emerged in block-moulding industries in Ibadan, where (Jibiri et al. 2024) reported mean noise levels above occupational limits at operating points and hand–arm vibration values that exceeded vibration standards, indicating a high likelihood of adverse health effects among machine operators. In a different service-sector context, (Arsal Yildirim et al. 2024) showed that podologists working with grinding tools experienced simultaneous exposure to volatile organic compounds (VOCs), noise and hand–arm vibration, with musculoskeletal pain, ocular irritation, skin problems and respiratory complaints all being positively associated with measured exposure levels. Collectively, these findings suggest that combined physical agents, rather than noise or vibration in isolation, are driving a substantial proportion of the health burden in machinery-based occupations.

Beyond individual workplaces, several studies highlight how noise and vibration exposure is embedded in wider industrial and environmental systems. In a rural limestone-mining community, (Kafu-Quvane & Mlaba, 2024) documented community concerns about land degradation, vibration, air and water pollution, linking quarry operations not only to direct worker risk but also to broader environmental and ethical dilemmas around quality of life and corporate responsibility. At sea, (Rutkowski & Korzeb, 2024) examined noise and vibration levels on DP-class shuttle tankers operating in the Arctic offshore sector, emphasising that measured values could exceed normative limits and pose risks to seafarers' health while simultaneously impacting marine ecosystems. In urban transport systems, (Huang et al. 2024) reported that equivalent continuous sound pressure levels in rail-transit driver cabs averaged around 87 dB, with substantial fluctuation and distinct noise patterns linked to mechanical systems, wheel–rail interaction, aerodynamic effects and braking operations. These examples illustrate that noise–vibration exposure is often tied to the way infrastructure and production

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systems are designed and operated, with implications that extend beyond the immediate worksite.

Several contributions also underline how organisational readiness, risk management and inherent safety thinking shape the way noise and vibration hazards are controlled. (Pu et al. 2024) proposed a Process Plant Healthiness Metric grounded in inherent occupational health, explicitly incorporating noise, vibration and ergonomic factors within a fuzzy, multi-criteria framework for assessing plant design alternatives. Their results showed that systematically redesigning process plants based on this framework markedly reduced overall "unhealthiness" scores, suggesting that noise and vibration can be tackled proactively at the design stage rather than reactively through personal protective equipment alone. In the transport domain, (Nagy et al. 2024) developed a low-cost, vehicle-mounted multi-sensor system to classify road quality via vibration measurements, motivated in part by the recognition that poor road surfaces contribute to harmful vehicle vibrations affecting both structural integrity and occupant comfort. Together, these studies point to a gradual shift from narrowly monitoring exposure towards integrating noise–vibration risks into broader occupational health, reliability and infrastructure-management strategies.

Taken as a whole, the empirical evidence indicates that noise and vibration remain pervasive, cross-cutting hazards in sectors ranging from forestry and small-scale manufacturing to maritime transport, mining and urban rail operations. Sawmill workers, block-moulding operators, podologists, quarry workers, seafarers and rail-transit drivers all experience overlapping patterns of exposure, with reported outcomes including pain, fatigue, sensory irritation, respiratory symptoms and reduced productivity. At the same time, weaknesses in control measures—such as limited use of personal protective equipment, inadequate separation between industrial and residential zones, and insufficient integration of noise–vibration criteria into plant and system design—mean that many of these risks remain structurally embedded in work processes. The reviewed studies therefore converge on the need for more comprehensive risk-control mechanisms that combine accurate exposure assessment, inherent-safety-oriented design, and stronger organisational commitment to managing noise and vibration as core determinants of worker health and safety performance.

Technological Approaches, Sensor Development, and Safety-Oriented Innovation

Across the reviewed literature, technological advances emerge as a key driver in improving how noise and vibration are detected, monitored, and controlled in machinery-intensive settings. Several studies focus on new sensing technologies capable of capturing complex signals in demanding environments. Ni et al. (2025) introduced a vortex-induced vibration sensor using a triboelectric nanogenerator, offering high sensitivity for oscillations that conventional systems often miss. Likewise, Cheng and Dong (2024) developed flexible curved multifunctional sensors for measuring airflow and structural vibration on train bogies, showing the potential of integrated sensing platforms for improving diagnostic accuracy in transportation systems. These innovations reflect an ongoing shift toward multimodal, energy-efficient sensors that can be embedded directly into mechanical components.

Beyond hardware, data-driven approaches are increasingly used to interpret vibration behaviour in real time. Nagy et al. (2024) proposed a low-cost vehicle-mounted setup using accelerometers and gyroscopes to classify road conditions from vibration signatures, demonstrating how machine-learning methods can support maintenance and road safety. Yan

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et al. (2025) combined piezoelectric energy harvesting with advanced filtering algorithms to track scraper conveyor posture in mining operations, achieving stable monitoring under challenging underground conditions. Together, these studies underline the value of pairing physical sensors with computational tools to analyse complex noise–vibration patterns.

Additional research explores environmental optimisation and fluid–structure interactions. Wei et al. (2023) assessed how air-vent geometry affects air-supply effectiveness in tunnels, noting implications for noise generation and operational safety. Yang et al. (2023) designed an upconversion nanosensor for nitrite detection in food—an application outside traditional mechanical systems but indicative of broader trends toward high-precision sensing technologies.

Overall, these findings point to a continued move toward smart, adaptive, and integrated technologies that improve early hazard detection, strengthen real-time risk evaluation, and support proactive decision-making. Whether through advanced sensors, machine-learning frameworks, energy-harvesting mechanisms, or airflow optimisation, technological innovation is shown to enhance noise–vibration management across a range of industrial environments.

Modelling, Simulation, and Noise–Vibration Mitigation Strategies

Studies within this theme demonstrate the growing use of modelling and simulation to analyse noise–vibration behaviour, predict system responses, and support safer machinery design. Numerical modelling of transport infrastructure remains prominent, with Jin et al. (2025) showing how irregularities in ballastless track–embankment systems influence vibration responses and structural risk, reinforcing the value of computational prediction. In the automotive sector, Zhao et al. (2023) examined vertical–longitudinal coupling in suspension-in-wheel motor systems for electric vehicles, demonstrating that dynamic optimisation can minimise vibration and improve stability. Similarly, Kumar et al. (2025) used nonlinear aeroelastic simulations to identify stall-flutter risks associated with airflow fluctuations and structural load uncertainties.

Material-based mitigation strategies also feature strongly. Li et al. (2025) introduced thermal-bridge ultrafine fibre sponges capable of reducing high-temperature traffic noise while maintaining mechanical durability under cyclic loading. Rahman et al. (2025), in a related review, highlighted that vibration-based cleaning techniques can support long-term permeable pavement performance and indirectly reduce noise from surface degradation.

Another stream of research focuses on system-wide optimisation for safer operations. Pu et al. (2024) proposed a fuzzy, multi-criteria healthiness metric for process plants that integrates noise, vibration, and ergonomic factors, illustrating how simulation-driven evaluations can inform inherently safer design.

Collectively, these modelling- and mitigation-focused studies show that effective noise–vibration control requires multilevel strategies spanning structural engineering, advanced materials, computational modelling, and system-safety frameworks. They also underscore the importance of simulation-led design for future noise–vibration management, particularly in complex industrial and transportation systems where dynamic loads are difficult to assess through empirical methods alone.

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Conclusion

This systematic literature review examined existing research on occupational noise and vibration exposure and its effects on worker safety across various industries. Using predefined inclusion criteria, the review identified studies that addressed exposure measurements, health outcomes, risk patterns, and preventive strategies. The synthesis highlights that noise and vibration—whether in isolation or combined—remain widespread hazards linked to hearing impairment, neuromuscular dysfunction, increased stress, and reduced alertness. Evidence shows growing emphasis on dose–response relationships and distinctions between whole-body and hand–arm vibration, supported by methodologies ranging from field assessments to epidemiological analyses.

A key contribution of this review is the integration of fragmented findings into a coherent framework explaining how chronic exposure interacts with biomechanical strain, fatigue, and task complexity to influence safety outcomes. The results underscore the need for improved engineering controls, equipment design, operational procedures, and worker training, while offering insights for policymakers refining exposure limits and regulatory enforcement. Despite limitations related to database scope and language filters, the review identifies directions for future research, including advanced monitoring technologies, predictive models, and sector-specific intervention studies. Overall, the review reinforces the importance of systematic evidence synthesis in guiding comprehensive, evidence-based strategies to protect workers from the long-term consequences of noise and vibration exposure.

Acknowledgement

The author would like to acknowledgement and extended appreciation to the the Universiti Kebangsaan Malaysia, Department of Applied Physics, Faculty of Science and Technology for their continuous support and encouragement of this project.

Funding Statement

There is no funding to support this study

Conflicts of Interest

The authors declare that they have no conflicts of interest to report regarding the present study

References

Abouzahra, A., Sabraoui, A., & Afdel, K. (2020). Model composition in Model Driven Engineering: A systematic literature review. *Information and Software Technology*, *125*(May), 106316. https://doi.org/10.1016/j.infsof.2020.106316

Alyan, E., Saad, N. M., Kamel, N., Yusoff, M. Z., Zakariya, M. A., Rahman, M. A., Guillet, C., & Merienne, F. (2021). Frontal electroencephalogram alpha asymmetry during mental stress related to workplace noise. *Sensors*, *21*(6), 1 – 12. https://doi.org/10.3390/s21061968

Arsal Yildirim, S., Pekey, B., Aydin, L., Peker Karatoprak, A., Kolayli, F., Argun Baris, S., Er, D. K., Yazici Ozcelik, E., & Yapsakli, K. (2024). Occupational Risks of Podologists: A Combined Assessment of VOCs, Vibration, Noise Levels and Health Complaints. *International Journal Of Environmental Health Research*, *34*(6), 2529–2543. https://doi.org/10.1080/09603123.2023.2256684

International Journal of Innovation and Industrial Revolution
IJIREV
EISSN: 2637-0972
Volume 7 Issue 23 (December 2025) PP. 337-357
DOI 10.35631/IJIREV.723022
Bovenzi, M. (2007). Criteria for case definitions for upper limb and lower back disorders caused by mechanical vibration. *Medicina Del Lavoro*, *98*(2), 98 – 110.

Bradley, R. (2006). Measuring up to noise. *Plant Engineer (London)*, *50*(4), 16 – 17.

Cheng, X., & Dong, W. (2024). Flexible curved multi-functional sensors for air flow and vibration signal measurement of train bogie. *Measurement Science And Technology*, *35*(12). https://doi.org/10.1088/1361-6501/ad7628

Dahlstrom, D. L. (2015). Occupational Noise. In *Hamilton and Hardy's Industrial Toxicology: Sixth Edition*. wiley. https://doi.org/10.1002/9781118834015.ch104

Dawson, J. (2008). Keep it down. *Engineering*, *249*(4), 71 – 72.

Deboli, R., & Calvo, A. (2004). Vibration aspects. *Resource: Engineering and Technology for Sustainable World*, *11*(7), 5 – 6.

Dehghan, S. F., Golbabaei, F., Mohammadi, H., Esmaeil Hadjar, F. H., & Yamini, A. (2024). Study of Anxiety Levels and Sleep Quality in Workers Exposed to Whole Body Vibration: A Case Study in a Foundry Industry. *Journal of Military Medicine*, *26*(1), 2165 – 2178. https://doi.org/10.30491/JMM.2024.1006568.1109

Huang, L., Sun, Z., Yu, C., Zhang, Y., & Yan, B. (2024). The Noise Exposure of Urban Rail Transit Drivers: Hazard Classification, Assessment, and Mitigation Strategies. *Applied Sciences-Basel*, *14*(16). https://doi.org/10.3390/app14167388

Jibiri, N. N., Selemon, D., & Akomolafe, I. R. (2024). Evaluation and implication of noise and vibration levels to the operators and proxy population around selected block molding industries in Ibadan, Nigeria. *International Journal of Occupational Safety and Health*, *14*(3), 335–344. https://doi.org/10.3126/ijosh.v14i3.52897

Jin, Z., Zhang, W., Li, Y., & Geng, X. Y. (2025). Numerical studies of ballastless track-embankment vibrations considering track irregularities. *Transportation Geotechnics*, *51*. https://doi.org/10.1016/j.trgeo.2025.101536

Kafu-Quvane, B., & Mlaba, S. (2024). Assessing the Impact of Quarrying as an Environmental Ethic Crisis: A Case Study of Limestone Mining in a Rural Community. *International Journal of Environmental Research and Public Health*, *21*(4). https://doi.org/10.3390/ijerph21040458

Kim, K. S. (2010). Occupational hearing loss in Korea. In *Journal of Korean Medical Science* (Vol. 25, Issue SUPPL.1). https://doi.org/10.3346/jkms.2010.25.S.S62

Kitchenham, B., & Brereton, P. (2013). A systematic review of systematic review process research in software engineering. *Information and Software Technology*, *55*(12), 2049–2075. https://doi.org/https://doi-org.eresourcesptsl.ukm.remotexs.co/10.1016/j.infsof.2013.07.010

Kumar, S., Tripathi, D., Venkatramani, J., & Gupta, A. (2025). Analysis of a nonlinear aeroelastic system with parametric uncertainties under dynamic stall condition. *International Journal Of Non-Linear Mechanics*, *175*. https://doi.org/10.1016/j.ijnonlinmec.2025.105116

Li, Y., Zong, D., Sun, Y., Pang, S., Liao, Y., & Liu, Y. (2025). Resilient ultrafine fiber sponges with thermal bridge structures for high-temperature traffic noise reduction. *Journal Of Colloid And Interface Science*, *693*. https://doi.org/10.1016/j.jcis.2025.137634

Liu, J., Zhu, B., Xia, Q., Ji, X., Pan, L., Bao, Y., Lin, Y., & Zhang, R. (2020). The effects of occupational noise exposure on the cardiovascular system: a review. *Journal of Public Health and Emergency*, *4*. https://doi.org/10.21037/jphe.2020.03.07

Liu, Y., Shu, L., Huo, Z., Tsang, K. F., & Hancke, G. P. (2021). Collaborative Industrial Internet of Things for Noise Mapping: Prospects and Research Opportunities. *IEEE Industrial Electronics Magazine*, *15*(2), 52 – 64. https://doi.org/10.1109/MIE.2020.3040162

International Journal of Innovation and Industrial Revolution
IJIREV
EISSN: 2637-0972
Volume 7 Issue 23 (December 2025) PP. 337-357
DOI 10.35631/IJIREV.723022

Lockwood, C., Munn, Z., & Porritt, K. (2015). Qualitative research synthesis: Methodological guidance for systematic reviewers utilizing meta-aggregation. *International Journal of Evidence-Based Healthcare*, *13*(3), 179–187. https://doi.org/10.1097/XEB.0000000000000062

Madvari, R. F., Bidel, H., Ghajari, H., Jegari, Z., Babaee, F., & Abbasi, M. (2025). Studying the Effect of Noise Annoyance on the Anxiety of Workers in a Corrugated Packaging Manufacturing Company: A Case Study. *Journal of Health and Safety at Work*, *15*(3), 558 – 573.

Mehrotra, A., Shukla, S. P., Shukla, A. K., Manar, M. K., Singh, S. K., & Mehrotra, M. (2024). A Comprehensive Review of Auditory and Non-Auditory Effects of Noise on Human Health. *Noise and Health*, *26*(121), 59 – 69. https://doi.org/10.4103/nah.nah_124_23

Mohr, D. (2007). The noise and vibration occupational health and safety ordinance in practice; [Die Lärm- und Vibrations-Arbeitsschutz-Verordnung in der Praxis]. *VDI Berichte*, *2002*, 3 – 28.

Mucci, N., Traversini, V., Lulli, L. G., Vimercati, L., Rapisarda, V., Galea, R. P., De Sio, S., & Arcangeli, G. (2021). Neurobehavioral alterations in occupational noise exposure: A systematic review. *Sustainability (Switzerland)*, *13*(21). https://doi.org/10.3390/su132112224

Nagy, R., Kummer, A., Abonyi, J., & Szalai, I. (2024). Machine learning-based soft-sensor development for road quality classification. *Journal Of Vibration And Control*, *30*(11–12), 2672–2684. https://doi.org/10.1177/10775463231183307

Ni, W., Jiang, J., Huang, H., Tian, G., & Ma, Y. (2025). Research on a vortex-induced vibration monitoring sensor technology based on triboelectric nanogenerator. *Energy*, *325*. https://doi.org/10.1016/j.energy.2025.136121

Page, M. J., McKenzie, J. E., Bossuyt, P., Boutron, I., Hoffmann, T. C., Mulrow, C. D., Shamseer, L., Tetzlaff, J. M., Akl, E., Brennan, S. E., Chou, R., Glanville, J., Grimshaw, J. M., Hróbjartsson, A., Lalu, M. M., Li, T., Loder, E. W., Mayo-Wilson, E., McDonald, S., … Moher, D. (2021). The prisma 2020 statement: An updated guideline for reporting systematic reviews. *Medicina Fluminensis*, *57*(4), 444–465. https://doi.org/10.21860/medflum2021_264903

Patterson, F., Miralami, R., Tansey, K. E., Prabhu, R. K., & Priddy, L. B. (2021). Deleterious effects of whole-body vibration on the spine: A review of in vivo, ex vivo, and in vitro models. *Animal Models and Experimental Medicine*, *4*(2), 77 – 86. https://doi.org/10.1002/ame2.12163

Penkov, A. (2007). Influence of occupational vibration on the female reproductive system and function. *Akusherstvo i Ginekologiia*, *46*(3), 44 – 48.

Pu, W., Raman, A. A. A., Hamid, M. D., Gao, X., & Buthiyappan, A. (2024). Development of comprehensive healthier process plants based on inherent safety concept. *Process Safety and Environmental Protection*, *184*, 804–822. https://doi.org/10.1016/j.psep.2024.02.017

Rahman, T., Tajudin, A. N., Wulaningtyas, A. H., Andika, N., Irawan, M. Z., & Widyatmoko, I. (2025). Recent developments in mitigating clogging in permeable pavements: a state-of-the-art review. *Innovative Infrastructure Solutions*, *10*(3). https://doi.org/10.1007/s41062-025-01882-6

Rutkowski, G., & Korzeb, J. (2024). Noise and Vibration Recorded on Selected New Generation DP Class Shuttle Tankers Operated in the Arctic Offshore Sector. *TransNav*, *18*(1), 57–64. https://doi.org/10.12716/1001.18.01.04

International Journal of Innovation and Industrial Revolution
IJIREV
EISSN: 2637-0972
Volume 7 Issue 23 (December 2025) PP. 337-357
DOI 10.35631/IJIREV.723022
Wang, D., Dai, X., & Chen, W. (2021). Study on the association between occupational noise exposure and cardiovascular diseases. *Chinese Journal of Industrial Hygiene and Occupational Diseases*, *39*(7), 555 – 557. https://doi.org/10.3760/cma.j.cn121094-20200917-00533

Wasserman, D. E. (2003). Occupational vibrations: Are you at risk? *Journal of the Mine Ventilation Society of South Africa*, *56*(2).

Wei, W., Gong, J., Deng, J., & Xu, W. (2023). Effects of Air Vent Size and Location Design on Air Supply Efficiency in Flood Discharge Tunnel Operations. *Journal of Hydraulic Engineering*, *149*(12). https://doi.org/10.1061/JHEND8.HYENG-13305

Yan, X., Zhou, G., Zhou, P., Wang, W., Han, L., & He, Z. (2025). Network Monitoring Method for Scraper Posture of Mine Scraper Conveyor via Frictional Piezoelectric Effect and Triangular Constrained Filtering. *IEEE-ASME Transactions On Mechatronics*. https://doi.org/10.1109/TMECH.2025.3548447

Yang, Y., Wei, S., Wang, J., Li, J., Tang, J., Aaron, A. A., Cai, Q., Wang, N., & Li, Z. (2023). Highly sensitive and ratiometric detection of nitrite in food based on upconversion-carbon dots nanosensor. *Analytica Chimica Acta*, *1263*. https://doi.org/10.1016/j.aca.2023.341245

Zhao, Z., Zhang, L., Wu, J., Gu, L., & Li, S. (2023). Vertical-Longitudinal Coupling Effect Investigation and System Optimization for a Suspension-In-Wheel-Motor System in Electric Vehicle Applications. *Sustainability (Switzerland)*, *15*(5). https://doi.org/10.3390/su15054168