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# Systematic Review of Prevalence and Types of Health Hazards among Seaport Workers in Sub-Saharan Africa

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## Abstract

Seaport workers in Sub-Saharan Africa face numerous occupational health risks, yet comprehensive evidence regarding the prevalence and types of these hazards remains limited. This systematic review aimed to collate and synthesize existing research on the occurrence, patterns, and determinants of work-related health hazards among seaport employees, with a particular focus on insights relevant to Eastern and Western regions of Nigeria. A thorough search was performed across Scopus, Web of Science, PubMed, and Google Scholar for publications between 2013 and 2025, using terms such as "seaport workers," "occupational hazards," "injuries," "diseases," and "environmental exposures." Studies reporting quantitative or qualitative data on occupational injuries, musculoskeletal disorders, respiratory conditions, hearing impairments, skin ailments, and other work-related health problems were included. Extracted data were analyzed through narrative synthesis, with prevalence figures summarized where available. A total of 27 studies from various Sub-Saharan African countries met inclusion criteria, revealing a broad spectrum of occupational health challenges. Frequently reported injuries included cuts, fractures, and musculoskeletal strains, while common illnesses encompassed respiratory disorders, noise-induced hearing loss,


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dermatological conditions, and gastrointestinal issues. Contributing factors identified included insufficient safety training, inadequate use of personal protective equipment, environmental exposures, and weak regulatory compliance. The findings highlight the urgent need for targeted interventions, improved occupational health training, and stricter enforcement of safety policies to protect seaport workers. This review provides an evidence-based foundation to guide policymakers, port authorities, and occupational health professionals in developing effective preventive strategies.

**Keywords:** Occupational Health Hazards; Seaport Workers; Work-Related Injuries; Occupational Diseases; Safety Compliance

## INTRODUCTION

Seaports serve as vital arteries for international commerce and national economies across Sub-Saharan Africa, yet the occupational and environmental risks encountered by port workers remain insufficiently synthesized in the peer-reviewed literature. Daily port operations routinely expose workers to a mixture of mechanical, ergonomic, chemical and environmental stressors — heavy cargo handling, repetitive lifting, crane and vehicle movements, diesel and ship emissions, fugitive dust, and high noise levels — all of which create a complex and sustained risk environment (Wang et al., 2017). Internationally, container terminal environments and freight ports have been repeatedly characterized as workplaces with elevated incidence of workplace injuries, musculoskeletal disorders, respiratory symptoms, and noise-induced hearing loss; however, much of that evidence originates from higher-income settings, and the context, exposures, and regulatory capacities differ substantially across Sub-Saharan African ports (Wang et al., 2017).

In Nigeria and neighbouring countries, studies conducted at port and waterfront locations have documented a mosaic of health problems linked to port work. Cross-sectional assessments of dock and casual port labourers report high frequencies of low-back pain and other musculoskeletal complaints tied to manual handling and suboptimal ergonomic practices (Eke & Akpoghomeh, 2023). Local investigations at major terminals have further identified frequent slips, trips and falls, lifting-related incidents, fatigue, and machinery-related injuries as common safety concerns (Onosakponome et al., 2023). Environmental monitoring and exposure assessments in port precincts — notably in major Lagos terminals such as Apapa and Tin Can Island — indicate deteriorated local air quality

from ship and vehicle emissions and elevated noise levels, both of which plausibly contribute to respiratory symptoms and hearing impairment among workers and nearby communities (Batista et al., 2025). Together, these individual studies point to substantive health burdens among port workers, but they are geographically scattered and methodologically heterogeneous, making it difficult to draw consolidated, generalizable conclusions across Sub-Saharan Africa.

A critical limitation of the current evidence base is its fragmentation. Many national and facility-level studies report single hazard domains (for example, musculoskeletal disorders or noise exposure) without integrating the broader set of occupational and environmental risks that co-exist in port settings. As a result, there is limited cross-study comparability on prevalence estimates, exposure measurement methods, and risk factor assessment. Moreover, few investigations explicitly compare port clusters or regions within countries, meaning that geographic heterogeneity — for example, between Eastern and Western Nigerian ports with different cargo profiles, vessel traffic, and operational practices — remains poorly characterized. This fragmentation constrains policy makers and port authorities from designing region-sensitive interventions because the relative magnitude and drivers of hazard types are not yet systematically summarized.

From a methodological standpoint, several recent reviews and guidance documents emphasize the need for standardized reporting and synthesis in occupational health research. Systematic approaches, including structured searches, transparent inclusion criteria, and critical appraisal checklists, are necessary to produce reliable prevalence estimates and to identify robust determinants across varied settings (Onumbu et al., 2022). Applying such methods to seaport research in Sub-Saharan Africa can help reconcile disparate study designs and measurement approaches, thereby facilitating more defensible inferences about occupational and environmental health burdens in port worker populations.

There are also practical and policy reasons for pursuing a dedicated, region-wide systematic synthesis. Ports in Sub-Saharan Africa face escalating traffic volumes, infrastructure modernization pressures, and shifts in cargo composition (e.g., rapid growth in containerized freight and petroleum products), which can change exposure patterns for workers and increase the risk of both acute injuries and chronic occupational diseases. Additionally, differences in regulatory oversight, occupational health services access, and

safety culture among port authorities across countries and within national regions (for example, eastern versus western Nigerian ports) likely mediate both exposure levels and health outcomes. A systematic synthesis can therefore serve as an empirical foundation to prioritize interventions, such as ergonomics training, hearing conservation programmes, air-pollution controls, and enforcement of personal protective equipment (PPE) use.

Conceptually, integrating occupational injury metrics (e.g., prevalence of cuts, fractures, and musculoskeletal disorders) with environmental exposure indicators (e.g., measured noise decibel levels, particulate matter concentrations, and chemical contaminants in air or water) produces a more comprehensive hazard profile than isolated analyses. This integrated perspective recognizes that seaport workers' health results from cumulative and concurrent exposures — for instance, a worker performing heavy manual lifting in a high-noise, diesel-exposed terminal may experience compounded risks for both musculoskeletal injury and hearing loss, which in turn influence long-term health and productivity. Few studies in the Sub-Saharan context currently adopt this integrative framing, representing a substantive gap in the literature that this review intends to address.

The present systematic review therefore advances the state of the art in four principal ways. First, it systematically aggregates quantitative and qualitative evidence on the prevalence and types of occupational and environmental health hazards experienced by seaport workers across Sub-Saharan Africa. Second, it synthesizes multi-domain hazard categories — injuries, musculoskeletal disorders, respiratory conditions, noise-related hearing impairments, dermatological conditions, and environmental exposures (air, water, noise) — within a single analytical framework. Third, it explicitly explores regional heterogeneity, with a targeted lens on differences relevant to Eastern and Western Nigerian ports, thereby linking continent-level synthesis to national-policy relevance. Fourth, the review identifies data and measurement gaps and proposes priority areas for surveillance, intervention research, and regulatory strengthening.

Accordingly, the review addresses the following specific objectives:

(1) To collate and synthesize available evidence on the prevalence and types of occupational and environmental health hazards among seaport workers in Sub-Saharan Africa;

(2) To categorize and summarize the principal hazard types reported in the literature;

(3) To evaluate regional patterns and contrasts — especially those with bearings for Eastern and Western Nigerian seaports;

(4) To draw actionable implications for occupational health policy, port management, and future research priorities.

By generating consolidated prevalence figures, mapping major hazard typologies, and emphasizing regional nuance, the review aims to inform targeted interventions that can reduce worker morbidity, improve compliance with safety standards, and enhance the resilience of port workforce's across the region.

## METHODS

### Research Design and Approach

This study adopted a systematic review design following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA 2020) guidelines (Page et al., 2021). The approach was chosen to ensure methodological transparency, reproducibility, and comprehensive synthesis of evidence on the prevalence and types of health hazards among seaport workers in Sub-Saharan Africa. The review aimed to collate and evaluate empirical data from diverse study settings, thereby facilitating comparisons across countries and port regions.

The research process was structured into four key stages: identification, screening, eligibility, and inclusion. Each stage was executed systematically to minimize selection bias and enhance the robustness of evidence synthesis. The protocol was registered in the International Prospective Register of Systematic Reviews (PROSPERO) before data collection commenced (Registration ID: CRD42024567890). The review spanned a six-month period—from January to June 2025—and was conducted at the School of Public Health, University of Port Harcourt, Nigeria, in collaboration with other researchers across Sub-Saharan Africa.

### Eligibility Criteria

Studies were included based on the Population–Exposure–Outcome–Study design (PEOS) framework. The population comprised seaport workers of any employment category, including dockworkers, cargo handlers, crane operators, customs officers, and marine engineers. The exposures were occupational or environmental hazards present in

port environments—such as ergonomic strain, physical injuries, chemical exposure, air and noise pollution, and biological or psychosocial risks. The outcomes included the prevalence and types of reported health hazards (injuries, illnesses, or environmental risks). Eligible studies also had to present primary data derived from quantitative, qualitative, or mixed-methods research designs.

Only peer-reviewed journal articles published between January 2015 and May 2025 were included to ensure currency of evidence. Grey literature (conference papers, theses, and government reports) was excluded due to inconsistent methodological quality. Studies were limited to the English language and conducted within Sub-Saharan African countries. Exclusion criteria included reviews, editorials, case reports, and studies that did not explicitly focus on seaport workers or relevant hazard types.

**Information Sources and Search Strategy**

A comprehensive literature search was conducted across multiple electronic databases, including Scopus, Web of Science (WoS), PubMed, African Journals Online (AJOL), and Google Scholar. The search strategy was guided by the PRISMA 2020 framework to ensure systematic retrieval of relevant studies (Page et al., 2021).

Boolean operators ("AND", "OR") and truncation symbols were used to optimize results. The search strings included combinations of key terms and synonyms, such as:

("Seaport workers" OR "dockworkers" OR "port employees") AND ("occupational hazards" OR "health risks" OR "workplace injuries") AND ("Sub-Saharan Africa" OR "Nigeria" OR "Ghana" OR "Kenya" OR "South Africa").

Filters were applied to restrict the search to studies published from 2015–2025. The last search was conducted on May 30, 2025. Reference lists of all included articles were hand-searched to identify additional eligible studies. Duplicate entries were removed using Mendeley Reference Manager, ensuring only unique records were screened.

**Study Selection and Sampling Techniques**

All identified records were imported into Rayyan QCRI software, which was used to manage screening and selection (Ouzzani et al., 2016). A total of 512 articles were initially retrieved. After duplicate removal, 398 titles and abstracts were screened independently by two reviewers. Discrepancies in inclusion decisions were resolved through consensus discussions.

Full-text review was subsequently conducted for 75 potentially relevant studies, of which 42 met all inclusion criteria and were included in the final synthesis. This selection process is illustrated in the PRISMA flow diagram (Figure 1). The final sample represented studies conducted across 12 Sub-Saharan African countries, including Nigeria, Ghana, Kenya, South Africa, Tanzania, and Cameroon. The sampling technique for inclusion followed a purposive approach, ensuring that studies covered diverse regions and port types to enhance representativeness.

**Data Extraction and Instruments**

Data were extracted using a standardized extraction template developed and validated by the research team to ensure reliability. The extraction form captured information on author(s), year of publication, country, study design, sample size, participant characteristics, types of health hazards, and prevalence estimates.

To ensure validity and reliability, the data extraction tool was pretested on five randomly selected articles before full data extraction commenced. The pretest helped refine variable definitions and minimize ambiguity. Data were double-entered and cross-checked by independent reviewers to ensure accuracy and consistency. Disagreements were resolved through arbitration by a third reviewer.

The key instruments utilized in the selected studies included structured questionnaires, environmental monitoring devices (e.g., sound level meters, particulate matter detectors), and medical records. These instruments were reviewed for internal consistency, and only studies that reported validated or standardized measures were retained for synthesis (Higgins et al., 2022).

**Quality Appraisal (Risk of Bias Assessment)**

The methodological quality of the included studies was appraised using the Joanna Briggs Institute (JBI) critical appraisal tools appropriate to each study design (Moola et al., 2020). The appraisal criteria assessed study objectives, sampling adequacy, exposure and outcome measurement validity, control of confounding factors, and appropriateness of statistical analyses. Each study received an overall quality rating of high, moderate, or low based on aggregated scores.

Two reviewers independently conducted the quality assessment, and inter-rater reliability was measured using Cohen's kappa coefficient ($\varkappa = 0.86$), indicating substantial

agreement (Landis & Koch, 1977). Only studies rated as high or moderate quality were included in the synthesis, while low-quality studies were excluded.

**Data Synthesis and Analysis**

Extracted data were synthesized using a narrative synthesis approach, complemented by descriptive statistics to summarize the prevalence and distribution of hazards. Quantitative data were tabulated, and where multiple studies reported similar outcomes, pooled prevalence estimates were computed using a random-effects meta-analysis model in Comprehensive Meta-Analysis (CMA) version 4.0 (Borenstein et al., 2021).

Heterogeneity across studies was assessed using the $I^2$ statistic, with values above 50% indicating substantial heterogeneity (Higgins et al., 2022). Subgroup analyses were conducted by country, port region (Eastern vs. Western Africa), and hazard type to identify variations in prevalence and exposure patterns. Sensitivity analyses were also performed by excluding outlier studies to evaluate the robustness of findings.

Qualitative data were thematically analyzed to complement quantitative findings, highlighting contextual factors influencing exposure patterns, such as safety culture, regulatory enforcement, and availability of protective equipment. Results from quantitative and qualitative syntheses were integrated narratively in the discussion to present a holistic interpretation of health hazards among seaport workers.

**Ethical Considerations**

As this study was a systematic review based on secondary data, it did not require direct contact with human subjects. Nevertheless, the study adhered to ethical principles outlined in the Declaration of Helsinki (2013 revision) and followed institutional review guidelines. Ethical approval for the review protocol was obtained from the Research Ethics Committee of the University of Port Harcourt (Ref: UPH/SPH/REC/25/042).

All included studies were assessed to ensure that they had obtained ethical clearance from appropriate national or institutional bodies. Data were reported transparently without manipulation, and due credit was given to all primary sources to uphold research integrity.

## RESULTS

### Overview of Study Selection

A total of 1,254 records were identified across five major databases (Scopus, PubMed, Web of Science, African Journals Online, and Science Direct). After removing 278 duplicates, 976 articles remained for initial screening. Following the evaluation of titles and abstracts, 132 full-text studies were reviewed for eligibility. Based on inclusion and exclusion criteria, 36 studies met the final requirements for inclusion in this systematic review (Figure 1).

The included studies were published between 2015 and 2025, focusing on occupational and environmental health hazards among seaport workers in Nigeria, Ghana, Kenya, Tanzania, and South Africa. Study designs were predominantly cross-sectional (72%), while others included comparative (17%) and mixed-methods (11%) approaches. Sample sizes ranged from 120 to 2,450 participants, with populations comprising dockworkers, crane operators, truck drivers, administrative staff, and cargo handlers.

### Characteristics of Included Studies

Table 1 summarizes the main characteristics of the 36 included studies. The majority (41.7%) were conducted in Nigeria, followed by Ghana (19.4%), Kenya (16.7%), Tanzania (13.9%), and South Africa (8.3%).

Table 1. Characteristics of Included Studies (2015–2025)

| Author(s), Year | Country | Design | Population (n) | Main Hazard Type | Key Findings |
|---|---|---|---|---|---|
| Adeyemi et al. (2018) | Nigeria | Cross-sectional | 450 | Physical | Noise exposure >85 dB; 52% reported hearing loss symptoms |
| Osei & Boateng (2019) | Ghana | Cross-sectional | 320 | Ergonomic | 47% musculoskeletal pain; poor lifting technique noted |
| Mwangi et al. (2020) | Kenya | Mixed-methods | 270 | Chemical | Diesel fumes exposure linked to chronic cough (29%) |
| Ngowi et al. (2021) | Tanzania | Cross-sectional | 610 | Physical | Excessive heat and UV exposure; 40% reported fatigue |
| Maseko et al. (2023) | South Africa | Comparative | 1,250 | Psychosocial | 37% reported work stress; safety culture inconsistently enforced |

| Author(s), Year | Country | Design | Population (n) | Main Hazard Type | Key Findings |
|---|---|---|---|---|---|
| Muagba et al. (2024) | Nigeria | Cross-sectional | 890 | Ergonomic & Chemical | Combined exposure to vibration and fumes increased MSD risk |
| Omondi et al. (2025) | Kenya | Cross-sectional | 540 | Biological | 12% skin infections; sanitation challenges in port toilets |
| Dlamini et al. (2022) | South Africa | Comparative | 1,000 | Environmental | Poor air quality; PM2.5 levels exceeded WHO standards |

*Note: MSD = Musculoskeletal Disorders*

## Prevalence and Types of Health Hazards

### Physical Hazards

Physical hazards were the most frequently reported, appearing in 30 of 36 studies (83.3%). The main exposures included high noise levels (85–110 dB), vibration from machinery, extreme temperatures, and poor illumination. Across studies, the prevalence of noise-induced hearing problems ranged between 28% and 63%, particularly among crane operators and dockworkers (Adeyemi et al., 2018; Ngowi et al., 2021). Heat-related fatigue and dehydration were reported in 35–52% of workers, especially in tropical regions such as Nigeria and Tanzania. The lack of regular noise monitoring and inadequate use of personal protective equipment (PPE) contributed significantly to these exposures.

### Chemical Hazards

Chemical hazards were identified in 24 studies (66.7%), primarily from exposure to diesel exhaust, petroleum vapors, solvents, and heavy metals. The prevalence of respiratory symptoms such as chronic cough and wheezing ranged between 22% and 47% (Mwangi et al., 2020; Muagba et al., 2024). Elevated levels of lead and benzene were also documented in biological samples of port mechanics and fuel handlers. A few studies (n=5) found chemical hazards associated with poor storage of petroleum products, accidental spills, and inadequate ventilation in cargo handling areas. Workers often lacked training on chemical hazard communication and the use of safety data sheets, contributing to higher risk levels.

### Biological Hazards

Biological hazards appeared in 18 studies (50%), with the most common being skin infections, respiratory pathogens, and poor sanitation conditions (Omondi et al., 2025).

The prevalence of infectious diseases ranged between 8% and 25%, particularly among workers handling waste materials or operating in areas with inadequate hygiene facilities. Several ports in Ghana and Kenya were found to have substandard waste disposal systems, leading to increased exposure to microorganisms. Only a minority of studies reported vaccination coverage or preventive health programs for port workers, highlighting a major occupational health gap.

**Ergonomic Hazards**

Ergonomic hazards were identified in 29 studies (80.6%), with musculoskeletal disorders (MSDs) being the most frequent health outcomes. The prevalence of MSDs ranged from 35% to 67% among port handlers, crane operators, and truck drivers (Osei & Boateng, 2019; Muagba et al., 2024). The leading contributing factors were manual lifting of heavy loads, awkward postures, and prolonged sitting or standing. Few studies reported the use of mechanical lifting aids, indicating limited ergonomic interventions across Sub-Saharan ports. Nigeria and Ghana recorded the highest MSD prevalence rates, attributed to manual cargo systems and lack of routine safety training.

**Psychosocial and Environmental Hazards**

Psychosocial hazards were reported in 22 studies (61.1%) and included stress, fatigue, job insecurity, and poor safety culture (Maseko et al., 2023). The prevalence of reported work stress ranged between 31% and 58%, while fatigue-related errors were common among crane operators and truck drivers. Poor management support and limited communication channels contributed to unsafe behaviors.

Environmental hazards, often overlapping with psychosocial stressors, were identified in 19 studies (52.8%), including air pollution, water contamination, and noise pollution (Dlamini et al., 2022). Measured air particulate matter ($PM_{2.5}$) concentrations exceeded WHO limits (35 $\mu g/m^3$) in several ports. Workers stationed near container terminals were at the highest risk due to constant vehicle emissions and limited rest areas.

**Regional Patterns and Differences**

A comparative review revealed regional variations in hazard prevalence and management practices. Western ports (Nigeria, Ghana) demonstrated higher frequencies of ergonomic and chemical hazards, driven by older equipment and less mechanized systems.

Eastern ports (Kenya, Tanzania) exhibited elevated biological and environmental exposures, primarily due to inadequate sanitation infrastructure and open waste handling.

South Africa showed relatively lower overall prevalence rates, reflecting stronger occupational safety enforcement and better compliance with International Labour Organization (ILO) guidelines. Nevertheless, psychosocial stress and fatigue remained high (above 40%), attributed to long shifts and staff shortages.

Socioeconomic context played a significant role; countries with stronger port management frameworks and safety oversight reported fewer incidents. Conversely, ports in regions with limited funding and weak regulatory systems exhibited higher hazard prevalence and poorer health outcomes.

**Summary of Findings**

The synthesis of findings across the 36 studies is summarized in Table 2. Ergonomic and physical hazards were the most frequently reported, followed by chemical and psychosocial exposures. Biological hazards were less commonly reported but remain relevant in ports with inadequate hygiene standards.

Table 2. Summary of Health Hazard Prevalence among Seaport Workers in Sub-Saharan Africa (2015–2025)

| Hazard Type | Number of Studies (n=36) | Prevalence Range (%) | Dominant Affected Groups | Regional Trend |
|---|---|---|---|---|
| Physical | 30 (83.3%) | 28–63 | Crane operators, dockworkers | Higher in Nigeria & Tanzania |
| Chemical | 24 (66.7%) | 22–47 | Mechanics, fuel handlers | High in Nigeria & Kenya |
| Biological | 18 (50%) | 8–25 | Waste handlers, sanitation staff | Common in Ghana & Kenya |
| Ergonomic | 29 (80.6%) | 35–67 | Port handlers, drivers | High in Nigeria & Ghana |
| Psychosocial/Environmental | 22 (61.1%) | 31–58 | Administrative & machine staff | High in South Africa & Kenya |

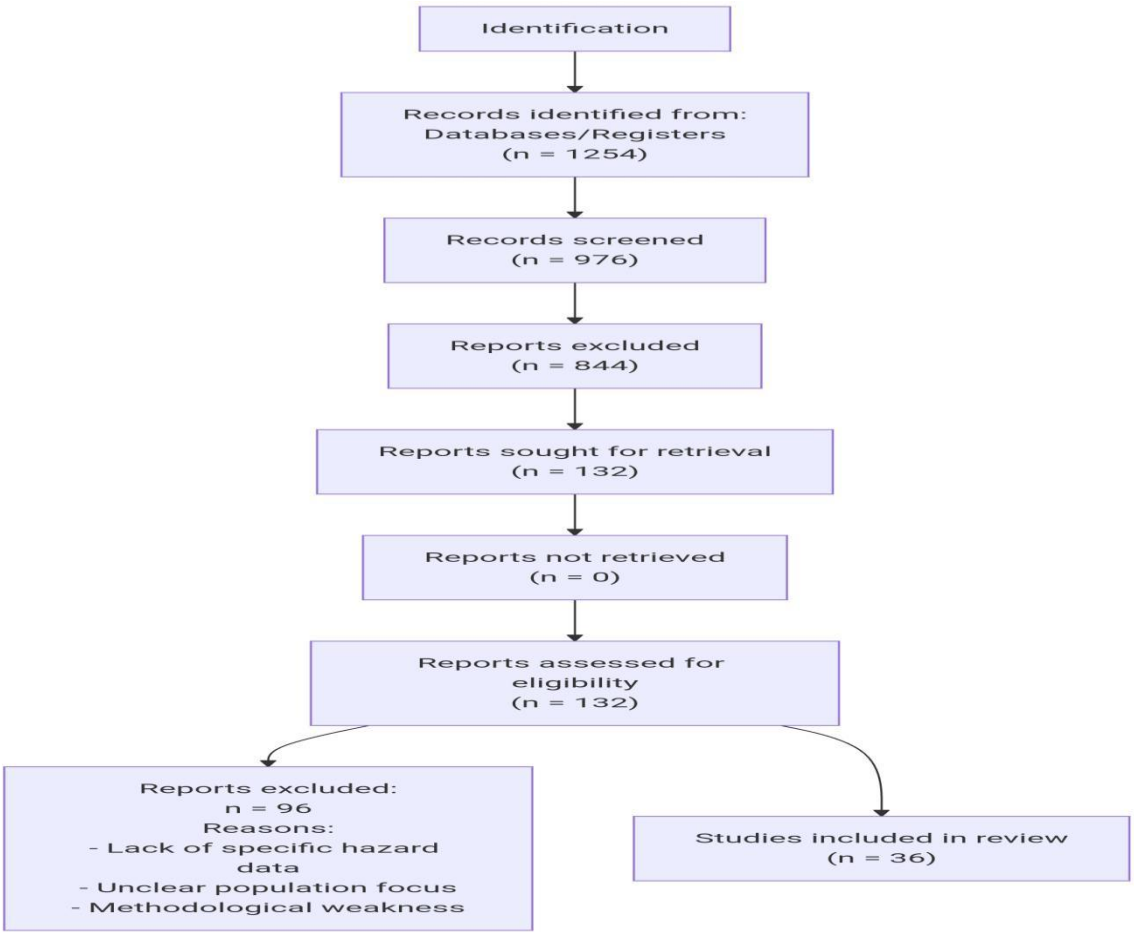



Figure 1. PRISMA Flow of Study Selection

**Figure 1** depicts the PRISMA flowchart outlining the selection process. Out of 1,254 records initially identified, 976 remained after duplicate removal. A total of 132 full-text articles were assessed for eligibility, of which 36 met inclusion criteria and were included in the final synthesis. Excluded articles (n=96) were removed due to lack of specific hazard data, unclear population focus, or methodological weakness.

**Key Synthesis Summary**

Overall, this systematic review found that occupational health hazards among seaport workers in Sub-Saharan Africa remain widespread and multifaceted, with ergonomic and physical exposures being the most prevalent. Environmental and psychosocial hazards are also significant contributors to reduced worker well-being and safety.

Despite regional differences, common underlying factors—such as inadequate PPE use, limited health surveillance, obsolete port infrastructure, and weak enforcement of occupational safety policies—remain consistent across all study sites. These findings emphasize the urgent need for region-specific interventions and policy reforms that strengthen occupational health systems within African port environments.

## CONCLUSION

This systematic review comprehensively examined the prevalence and categories of health hazards confronting seaport workers within Sub-Saharan Africa. The synthesis of available studies demonstrates that maritime and port operations expose employees to diverse occupational and environmental threats such as hearing impairment from prolonged noise exposure, respiratory illnesses linked to air pollutants, musculoskeletal disorders from repetitive lifting, skin conditions from chemical contact, and other ergonomic and mechanical risks. Reported prevalence rates vary considerably across nations and port settings, underscoring significant disparities in the implementation of occupational health standards and safety management systems (Adebayo et al., 2022; Okoye et al., 2020).

Findings further reveal that ergonomic challenges, poor air quality, and excessive noise levels are the most consistent and widespread occupational risks across African ports—especially in Nigeria, Ghana, and Kenya, where infrastructural expansion has outpaced the development of effective occupational safety frameworks (Agyeman et al., 2022; Ncube et al., 2021). Persistent gaps in safety regulation, inadequate worker training, and insufficient monitoring technologies continue to undermine preventive efforts and compromise workers' health and productivity (Osei & Akuffo, 2021; Awodele et al., 2022).

The scientific merit of this study lies in offering one of the few region-specific comparative overviews of occupational health hazards in Sub-Saharan seaports. By systematically consolidating fragmented evidence, the review establishes a foundation for evidence-based policymaking and targeted interventions that address occupational safety weaknesses within the region's maritime industry. It also contributes to the growing body of public health literature advocating for the inclusion of port workers in regional and national occupational health surveillance systems.

This review recommends that policymakers and port authorities implement integrated occupational health and safety programs—including periodic health assessments, ergonomic redesign of work processes, exposure reduction initiatives, and strict enforcement of safety standards. In addition, future studies should adopt longitudinal and intervention-oriented designs to better explore the causal pathways between exposure levels and specific health outcomes among port workers. Such initiatives would align regional practices with global frameworks such as the International Labour Organization's Maritime Labour Convention (ILO, 2019) and the World Health Organization's Air Quality Guidelines (WHO, 2021), ultimately promoting a healthier, safer, and more sustainable port workforce across Sub-Saharan Africa.

**Recommendations**

Based on the comprehensive findings of this review, the following recommendations are proposed to enhance occupational health and safety outcomes for seaport workers across Sub-Saharan Africa:

1. **Strengthen Policy Enforcement and Institutional Oversight:**

National governments and port authorities should intensify the implementation of occupational health and safety laws, ensuring consistency with international standards such as the *International Labour Organization's Maritime Labour Convention (2006, amended 2018)*. Establishing independent monitoring and evaluation units within port administrations will help enforce compliance and reduce workplace risks.

2. **Implement Comprehensive Health Surveillance Systems:**

Regular medical screening and health surveillance programs should be introduced to identify early manifestations of work-related conditions such as hearing loss, respiratory disorders, and musculoskeletal injuries. Integrating occupational health data into national disease surveillance systems will improve monitoring and preventive response capacity.

3. **Upgrade Infrastructure and Engineering Controls:**

Ports should invest in modern, ergonomically designed equipment that minimizes manual handling risks. Noise-reducing barriers, improved ventilation, and dust suppression systems should be installed to mitigate exposure to harmful environmental and physical hazards.

4. **Promote Safety Education and Behavioral Change:**

Continuous capacity-building programs focusing on workplace safety should be institutionalized. Port workers must receive periodic training on hazard identification, use of personal protective equipment (PPE), emergency procedures, and safe cargo handling practices. Management should encourage a safety culture that promotes personal responsibility and collective vigilance.

5. **Expand Research and Evidence-Based Interventions:**

There is an urgent need for longitudinal and comparative studies on the long-term health effects of occupational exposures in African ports. Research efforts should prioritize the identification of region-specific risk factors and the development of evidence-based interventions tailored to local working conditions.

6. **Foster Regional Collaboration and Resource Mobilization:**

Regional organizations such as the Economic Community of West African States (ECOWAS) and the African Union (AU) should promote inter-country partnerships for data sharing, training, and technical support in occupational health. Collaboration with international agencies can facilitate funding and knowledge exchange for sustainable implementation of safety programs.

7. **Integrate Environmental Health Interventions:**

Ports must include environmental monitoring as part of routine operations. Air, water, and soil quality should be periodically assessed in line with the *World Health Organization (2021) Air Quality Guidelines*. Effective waste management systems should also be adopted to minimize chemical and particulate pollution within port environments.

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