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Review Article

Impact of exposure to hazardous substances on occupational disease risk across industries

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ABSTRACT

Occupational exposure to hazardous substances refers to the contact workers have with potentially harmful chemicals, biological agents, or physical hazards in their workplace, leading to various health effects and diseases. This review aimed to evaluate the impact of exposure to hazardous substances on occupational disease risks across various industries. A detailed literature search was conducted using Google Scholar, PubMed, Scopus, and Web of Science, applying Boolean operators to refine search terms. The inclusion criteria for the study were articles published within 15 years, which had specific findings on the direct link between exposure to these occupational hazardous substances and the development of occupational diseases. 10 peer-reviewed articles were used for the study. The findings from the study present major occupational health risks across various industries, ranging from the manufacturing industry, the steel and power industry, the healthcare industry, and other industries analyzed. The highest occupational risks were observed in the steel and power industry, as their experiences at the workplace can lead to severe physical strain, high injury rates, heat stress, electric shocks, and exposure to airborne pollutants. However, the occupation with the least occupational risk from these findings would be the health care industry. While healthcare workers face chemical exposures, respiratory issues, and skin disorders, they generally work in controlled environments with better regulatory oversight and access to protective measures. Therefore, this review emphasizes the need for workplace interventions, occupational safety and health management systems workplace interventions, and stringent regulations to safeguard worker health and prevent disease.

Keywords: Hazardous substances, Industries, Occupational diseases, Occupational exposure, Occupational risks

INTRODUCTION

Given that the financial dividend from working gives the worker access to basic necessities of life, labor has a favorable impact on health. Healthy well-being, job happiness, and eventually increased productivity are all correlated with the aforementioned. Nonetheless, there is a dynamic and reciprocal interaction between the workers and the work environment. Although understanding and implementing occupational health and safety requires a grasp of these work-health relationships, workplace safety is frequently undervalued.[1]

An individual's exposure to risk, injury, or danger at work is known as an occupational hazard; however, occupational diseases are the outcome of these exposures. There is evidence that these

occupational diseases affect a large number of individuals, especially in fast industrializing countries, and hence have an indirect impact on the economy, even if they seem to occur less frequently than other major debilitating diseases. Workers encounter a wide range of risks at work, including chemicals, biological agents, physical factors, and unfavorable ergonomic situations, as many as many forms of labor. These are responsible for a variety of health consequences.[2]

Exposure to hazardous substances in occupational settings has been extensively studied due to its significant impact on worker health and disease risk. Numerous studies have linked various hazardous agents to occupational diseases, highlighting the urgent need for effective preventive measures across industries. A study by Arif and Delclos[3] investigated the association between cleaning-related chemicals and work-related asthma in healthcare professionals (HCPs), identifying strong links between chemical exposure and respiratory disorders. Also, Subramaniam *et al*.[4] examined the effects of cotton dust and endotoxin exposure on textile workers, emphasizing the increased prevalence of illnesses of the respiratory system brought on by indoor air pollutants in low- and middle-income countries. In another study, Awodele *et al*.[5] analyzed paint factory workers in Lagos, Nigeria, and reported that exposure to volatile organic compounds (VOCs) led to both acute and chronic health effects, including skin irritation, respiratory disorders, and neurological symptoms.

Despite these significant findings, gaps still exist regarding a comprehensive synthesis of occupational disease risks across multiple industries. Therefore, this study aims to systematically summarize research from the past 15 years on hazardous substance exposure and its link to occupational disease risk across multiple industries to provide industry-specific and cross-industry recommendations for minimizing hazardous substance exposure and improving worker health outcomes.

METHODS

Search process

A systematic literature search was conducted using four major databases: Google Scholar, PubMed, Scopus, and Web of Science. The study aimed to systematically analyse studies from the past 15 years on the impact of occupational exposure to hazardous substances on occupational disease risks across various industries. The following search terms were used:

- "Occupational exposure to toxic substances AND disease risk"
- "Occupational exposure AND hazardous substances AND cohort study"
- "Workplace chemical exposure AND case-control study"
- "Industrial workers AND toxic substance exposure AND cross-sectional analysis"
- "Occupational exposure AND toxic substances AND disease risk"
- "Workplace chemical exposure OR occupational exposure to heavy metals."

Eligibility criteria

Inclusion criteria

The inclusion and exclusion criteria were established to ensure the selection of important studies. The current research included original research articles (cohort studies, case–control studies, cross-sectional studies, and randomized controlled trials) as well as narrative reviews published within the past 15 years. Studies that empirically assessed workplace exposure to hazardous substances and their connection to occupational diseases were also included.

The selected studies focused on specific hazardous substances commonly found in workplaces, such as heavy metals (lead, mercury, cadmium), chemical solvents (benzene, toluene, formaldehyde), dust and particulates (silica, asbestos), and industrial fumes and gases (carbon monoxide, ammonia, sulfur dioxide). In addition, the studies examined the direct link between exposure to these hazardous substances and the development of occupational diseases, including respiratory diseases, cancer, neurological disorders, and skin diseases.

The industries covered in the included studies focused on occupational settings such as manufacturing, construction, mining, and healthcare. Only peer-reviewed journal articles published between 2010 and 2025 were considered to ensure relevance. In addition, studies were included only if, for ease of access, they were published in English.

Exclusion criteria

Studies such as systematic reviews, meta-analyses, editorials, or theoretical papers without new empirical data were excluded. In addition, general environmental health studies that focus on toxic substances without workplace-specific exposure data were also excluded.

Furthermore, general environmental health studies that focus on toxic substances without workplace-specific exposure data, studies that only measure exposure levels without analyzing health effects or disease incidence, studies that focus on community exposures, studies older than 2010, and non-English studies were all excluded.

Study selection process

The procedure for choosing studies followed a systematic screening approach to ensure that only relevant studies were included**.** Initially, 30 articles were obtained and screened based

on their titles and abstracts, leading to the exclusion of 10 studies due to irrelevance or inaccessible full texts. The remaining 20 articles were shortlisted for full-text review. After a thorough assessment, 10 studies were excluded due to methodological weaknesses or lack of relevance, while 10 studies that satisfied the requirements for inclusion were added to the final review [Figure 1].

Data extraction and qualitative synthesis

A structured table was created to summarize key details from the selected studies, including:

- Authors and year of publication
- Study Type (e.g., observational study, case study, experimental research, narrative reviews, cohort studies)
- Industry Focus
- Hazardous substance exposure
- Occupational disease studied
- Key findings on disease incidence and workers' health
- Recommendations from the study.

Rather than conducting a quantitative data analysis, the findings from these studies were synthesized qualitatively to identify common patterns, industry-specific risks, and key findings on disease incidence and workers' health. The main objective of the study is to provide evidence-based recommendations for industries and policymakers to implement better safety regulations, minimize hazardous exposure, and reduce the incidence of occupational diseases among workers.

Preferred reporting items for systematic reviews and meta-analyses flow diagram

All study selection, screening, and synthesis were conducted independently by the author.

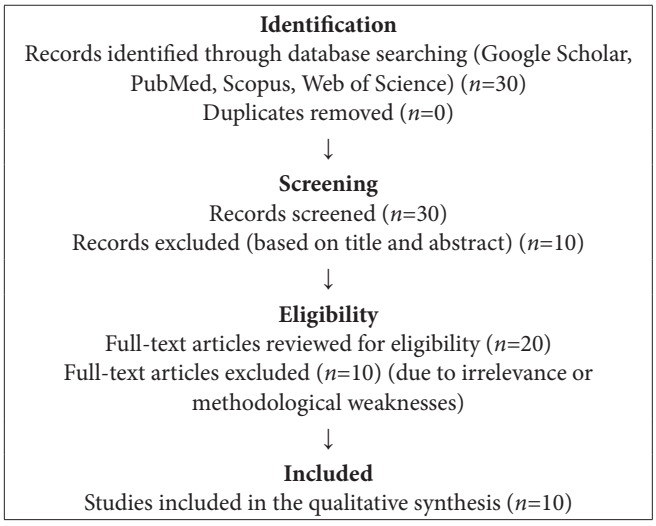

Figure 1: The study selection process based on the preferred reporting items for systematic reviews and meta-analyses guidelines.

RESULTS

Overview of included studies

The review analyzed 10 research articles, including cross-sectional studies, narrative reviews, as well as case control research focusing on occupational exposure to hazardous substances and their impact on disease risk across multiple industries. The industries covered include the steel and power industry, the manufacturing industry (paint, rubber, and textile manufacturing industries), and the healthcare industry. The narrative review examined multi-industry analysis encompassing industries such as agriculture, cleaning, cosmetology, printing/lithography. The findings highlighted a wide range of hazardous substances across these industries. Workers in steel and power plants face exposure to chemicals, dust, fumes, heavy metals, silica, noise, and radiation. In manufacturing, paint industry workers are at risk from heavy metals (lead, cadmium, arsenic, chromium), organic solvents, and particulate matter, while rubber industry workers encounter VOCs, rubber dust, and chemical fumes. Textile industry workers are frequently exposed to cotton dust, endotoxins, dyes, solvents, and high noise levels.

In the healthcare sector, asthmagens, carcinogens, ototoxic agents, anesthetic gases and antineoplastic drugs, powdered latex gloves, bleach, cleaners/abrasives, toilet cleaners and detergents, ammonia, glutaraldehyde/ortho-phthalaldehyde, chloramines, and ethylene oxide were the hazardous substances identified.

Beyond these specific industries, the review also examined the exposure risks experienced by workers in cosmetology, cleaning, and printing industries, where substances such as detergents, resins, rubber additives, toxic solvents, and airborne particulates contribute to occupational health risks.

Exposure risks and associated diseases from industry-specific findings

Manufacturing industry

Attarchi *et al*.[6] from their cross-sectional study on the combined effect of cigarette smoking and occupational exposures on lung function, screened workers in the rubber industry, specifically tire manufacturing workers in production units, as they are more exposed to pulmonary health hazards. Their findings highlighted that workers exposed to both occupational hazards and cigarette smoke have significantly worse lung function compared to non-smokers or those with only one exposure; synergistic effects between cigarette smoking and workplace toxins may accelerate lung function decline. The workers also had a higher frequency of respiratory symptoms such as coughing, wheezing, breathlessness, and reduced pulmonary function

tests. These findings further imply that exposure at work alone impacts lung health; however, smoking exacerbates the effects, leading to a higher risk of respiratory disease progression.

Subramaniam *et al*.[4] conducted a narrative review on the textile industry encompassing various processes such as ginning, spinning, weaving, dyeing, and printing. They discovered that exposure to endotoxins and cotton dust causes respiratory problems in a sizable percentage of textile workers. They said that endotoxins and cotton dust exposure have been linked to quantifiable deteriorations in lung function, raising the risk of long-term respiratory conditions. Furthermore, workers exposed to high noise levels in textile factories are at an increased risk of developing hearing loss, and the physical demands of textile work, including repetitive tasks and poor ergonomic conditions, lead to a higher incidence of musculoskeletal disorders among workers.

Research conducted by Awodele *et al*.[5] examined workers in the paint manufacturing industry whose jobs were mixing raw materials and paint production, packaging of manufactured paints, and loading of paints into vehicles for appropriate distribution and marketing. The findings show that a greater proportion of respondents do not utilize these devices. Specifically, 61.5% do not wear goggles, 74.75% do not wear safety boots, 66.75% do not wear dust masks, 61.5% do not wear aprons, and 85.8% do not wear hand gloves. In total, 90% of those surveyed reported having symptoms associated with exposure to hazards, whereas just 10% said they had no symptoms. The most commonly reported health consequence (33.75%) was headache. Other symptoms include itching (5.5%), skin irritation (8.75%), eye discomfort (6.25%), and chronic fatigue (10.5%). The average levels of heavy metals (μg/mL) in urine samples from both paint and non-paint workers. When comparing paint workers to non-paint workers, the results reveal statistically significant ($P < 0.05$) increases in urine concentrations of lead, cadmium, arsenic, and chromium.

Tounsadi *et al*.[7] conducted a cross-sectional epidemiological study to evaluate the occupational risks related to otolaryngology, dermatitis, and ophthalmological symptoms among the textile employees in a textile factory. Their findings report that a significant number of workers reported experiencing symptoms related to otolaryngological, dermatological, and ophthalmological health issues, indicating a strong association between chemical exposure and these conditions. The study found a high correlation between the use of toxic chemicals, adverse working conditions, and the prevalence of reported health symptoms. The environmental evaluation verified that workers are exposed on a daily basis to dangerous and toxic chemicals, posing a substantial threat to their health.

Power and steel industries

Dehury and Kumar[8] carried out a cross-sectional study aimed at identifying occupational morbidity and workplace injuries in the power and steel industries. Their findings stated that the majority of workers experienced injuries, musculoskeletal pain, and body pain. From the study population, additional occupational illnesses were found, including heat stroke, itching, fever, electric shock, vision and hearing issues, and respiratory conditions. The study discovered that among workers in the power and steel industries, occupational morbidity was correlated with demographic factors such as household income, occupation, and technical education.

Healthcare/industry

Rai *et al*.[9] conducted a cross-sectional study to determine the frequency of exposures among Bhutanese HCPs to a variety of chemicals used in healthcare settings. According to their findings, the prevalence of exposure to one or more carcinogens, ototoxic agents, and asthmagens was 28.1%, 7.6%, and 98.7%, respectively; the prevalence for anesthetic gases and antineoplastic medications was 2.2% and 6.2%, respectively. The most frequent exposures were to formaldehyde in the carcinogens group, p-xylene among ototoxic agents, latex, and cleaning and disinfecting chemicals in the asthmagens group. Utilizing latex gloves, washing with bleach and chlorhexidine, utilizing formaldehyde as a disinfectant and in the laboratory, and using p-xylene in the laboratory were the situations that led to exposures.

In addition, Supapvanich *et al*.[10] conducted a cross-sectional study to determine the prevalence of dermal and respiratory symptoms associated with latex glove use in nurses in Thailand and evaluate the influence of previously reported occupational risk factors in this population. According to their findings, 18% of the 899 nurses who participated in the study reported health consequences related to latex product use. After controlling for confounding, wearing more than 15 pairs of protective lead gloves per day (odds ratio (OR): 2.10, 95% confidence interval [CI]): [1.32–3.34]), using chlorhexidine (OR: 2.07, 95% CI: [1.22–3.52]), and working as an operating room nurse (OR: 2.46, 95% CI: [1.47–4.12]) were occupational risk factors linked to higher reporting of dermal symptoms. Only working as a labor ward nurse was linked to higher reporting of respiratory symptoms (OR: 3.52, 95% CI: [1.26–9.85]).

Furthermore, Arif and Delclos[3] conducted a cross-sectional study in the healthcare industry, examining professionals routinely exposed to disinfectants and cleaning supplies at their workplace. We looked at the prevalence of occupational asthma (OA), Work-exacerbated asthma (WEA) and work-related asthma symptoms (WRAS), and

none. The relative percentages of WRAS, WEA, and OA were 3.3%, 1.1%, and 0.8%, according to their findings. In general, female HCPs have greater prevalence estimates than male HCPs. For the longest work, exposure to cleaning chemicals and disinfectants/sterilants increased the risks of WRAS and WEA in a dose-dependent way. Both factor 1 (bleach, cleaners/abrasives, toilet cleaners, detergents, and ammonia) and factor 2 (glutaraldehyde/ortho-phthaldehyde, chloramines, and ethylene oxide) had significantly higher risks of WRAS for exposure in any employment. Exposure to bleach, factor 2, and formalin/formaldehyde was found to significantly increase the likelihood of developing WEA. Chloramine exposure was substantially linked to about 5 times the risk of developing OA.

Multi-industry analysis

Fukai *et al*.[11] conducted a case–control study on various industries to examine whether the number of types of hazardous operations at work experienced through a lifetime is associated with cancer incidence, and additionally examined the combined effects with lifestyle-related factors. Their findings revealed that workers with experience in hazardous operations exhibited a higher incidence of cancers across all sites, notably in the bladder, pancreas, and lung. For all sites, the multivariable-adjusted ORs for cancer incidence were 1 (reference) and 1.16 (95% CI: 1.12–1.21) for one type of hazardous operation, and 1.17 (95% CI: 1.08–1.27) for two or more types, indicating a significant trend (*P* for trend <0.001). There were notable combined associations between hazardous operations and smoking, particularly elevating the risks for lung, pancreatic, and bladder cancers. A significant combined effect was observed between hazardous operations and diabetes, specifically increasing the risk of pancreatic cancer.

Furthermore, Anderson and Meade,[12] from their narrative review on potential health effects associated with dermal exposure to occupational chemicals from different industries such as agriculture, manufacturing, cosmetology, health care, cleaning, painting, mechanics, printing/lithography, and construction found that factors such as extensive hand washing, frequent wet work, hand sanitizer use, exposure to chemical mixtures, or wearing occlusive gloves can change the integrity or function of the skin and play a role in enhancing chemical penetration or sensitization by influencing additional biological responses.

DISCUSSION

The systematic review analyzed 10 studies examining the impact of exposure to hazardous substances on occupational disease risk as presented in Table 1. The industries studied included manufacturing, steel and power industries, healthcare industries, cosmetology, and agricultural industries.

Across the various industries, occupational disease risks vary due to differences in exposure to hazardous substances, job demands, physical and environmental conditions. In the manufacturing industry (rubber and textile sectors, particularly), workers frequently experience respiratory issues due to airborne contaminants such as dust, endotoxins, and toxic chemicals. The effect of these exposures can be on the high side when combined with lifestyle factors like smoking, as seen in the rubber sector, where lung function declines more rapidly among smokers exposed to workplace toxins, according to Attarchi *et al*.[6] In addition, employees in the textile sector commonly report respiratory ailments due to cotton dust exposure, along with significant risks of hearing loss and musculoskeletal disorders resulting from poor ergonomic conditions and high noise levels. According to Tounsadi *et al*., exposures in textile factories further contribute to dermatological, otolaryngological, and ophthalmological health complications.[7]

In the paint manufacturing industry, the findings revealed that heavy metal exposure significantly elevates occupational health risks. Workers in this sector frequently come into contact with hazardous substances such as chromium, arsenic, cadmium, and lead, with chronic exposure leading to systemic toxicity. Despite the evident risks, the study analyzed revealed that a large proportion of workers do not use personal protective equipment, increasing the prevalence of symptoms such as chronic fatigue, headaches, skin irritation, and respiratory distress. According to Awodele *et al.* health outcomes underscore the importance of workplace safety measures and regulatory compliance in mitigating risks.[5]

The steel and power industries present unique hazards, primarily associated with physical strain, environmental stressors, and high-risk machinery. Workers in these industries frequently experience musculoskeletal disorders, body pain, and injuries due to strenuous labor and poor ergonomic conditions. Heat exposure in steel manufacturing further contributes to cases of heat stroke, fever, and exhaustion, while risks such as electric shock and respiratory ailments arise from prolonged exposure to airborne pollutants and hazardous chemicals. Demographic factors such as education level, occupational role, and socioeconomic status also influence susceptibility to workplace-related morbidity (Dehury and Kumar, 2023).[8]

HCPs also experience occupational disease risks arising from regular exposure to asthmagens, carcinogens, and ototoxic agents (Rai *et al*.).[9] Chemicals such as formaldehyde, chlorhexidine, and latex contribute to dermatological and respiratory ailments, with some workers experiencing work-related asthma, exacerbated asthma, and even OA due to prolonged exposure to disinfectants and sterilants. Latex gloves, a common occupational necessity, were also identified

Table 1: A summary of the included studies, highlighting key findings on disease incidence and workers health

S. No.	Author	Study type	Industry/ occupation	Hazardous substance exposure	Occupational disease studied	Key findings on disease incidence and workers' health
1.	Dehury and Kumar[8]	Cross- sectional study	Steel and power industry workers	Chemical substances, dust and fumes, silica, heat and temperature, hot and heavy metals, noise and vibration, Lasers and radiation as workplace hazardous substances.	Respiratory Illnesses, hearing impairment, musculoskeletal disorders, skin diseases, and visual impairments.	The majority of workers experienced injuries, musculoskeletal pain and body pain. Other occupational diseases like heat stroke, itching, fever, electric shock, eye problem, hearing problems, and respiratory diseases were identified from the study population.
2.	Fukai *et al*.[11]	Case- control study	Multi-industry analysis	Toxic chemicals, Airborne particulates, Radiation, Extreme temperatures	Lung cancer Pancreatic cancer Bladder cancer	Workers with experience in hazardous operations exhibited a higher incidence of cancers across all sites, notably in the lung, pancreas, and bladder. Also, there were notable combined associations between hazardous operations and smoking, particularly elevating the risks for lung, pancreatic, and bladder cancers. Furthermore, a significant combined effect was observed between hazardous operations and diabetes, specifically increasing the risk of pancreatic cancer.
3.	Awodele *et al*.[5]	Cross- sectional study	Paint Factory Workers in Lagos, Nigeria. Workers who were involved in the process of mixing raw materials and paint production, packaging of manufactured paints, and loading of paints into vehicles for appropriate distribution and marketing.	Heavy metals (Lead, cadmium, arsenic, and chromium), Organic solvents (Used in paint formulations), dust, and particulate matter.	Respiratory issues, dermal problems, neurological symptoms	Overall, 90% of the respondents had symptoms relating to hazard exposure, whereas only 10% reported that they were symptoms-free. Headache was the most frequently reported health effect (33.75%). Others include chronic fatigue (10.5%), skin irritation (8.75%), eye irritation (6.25%), and itching (5.5%). The mean heavy metal concentrations (µg/mL) in the urine samples of paint workers and non-paint workers. The results show statistically significant (P<0.05) increases in urine concentrations of lead, cadmium, arsenic, and chromium among paint workers compared to non-paint workers.

(*Contd*...)

Table 1: (*Continued*).

S. No.	Author, year	Study type	Industry/ occupation	Hazardous substance exposure	Occupational disease studied	Key findings on disease incidence and workers' health
4.	Anderson and Meade[12]	Narrative review	Agriculture, manufacturing, cosmetology, health care, cleaning, painting, mechanics, printing/ lithography, and construction.	For cosmetology, Detergents/ surfactants/colors/ fragrances present in shampoos, additives such as preservatives or bio-cides bleaching agents, fragrances or dyes present in other hair product formulations, acrylates used for nail art acrylic products, and nickel sulfate used in the cosmetology equipment. For health care, Biocides, medical gloves containing certain rubber accelerators, and antibacterial hand sanitizers and soaps have also been identified as common sources of allergens. Metals such as nickel, chromium, and cobalt. Epoxy and acrylic resins, rubber additives and chemical intermediates.	Direct skin effects, immune-mediated skin effects, and systemic effects.	Factors such as excessive hand washing, use of hand sanitizers, high frequency of wet work, exposure to chemical mixtures, or wearing occlusive gloves can change the integrity or function of the skin and play a role in enhancing chemical penetration or sensitization by influencing additional biological responses.
5.	Attarchi *et al*.[6]	Cross- sectional study	Rubber industry workers specifically tire manufacturing workers in production units	Airborne particulates, volatile organic compounds, rubber dust, fumes from chemical additives, and gases like sulfur dioxide and nitrogen oxides.	Pulmonary health hazards, lung function impairment, which may be indicative of occupational lung diseases such as chronic obstructive pulmonary disease, occupational asthma, or restrictive lung diseases caused by long-term exposure to airborne toxins and cigarette smoke.	The study likely finds that workers exposed to both occupational hazards and cigarette smoke have significantly worse lung function compared to non-smokers or those with only one exposure. Synergistic effects between cigarette smoking and workplace toxins may accelerate lung function decline. Findings suggest that occupational exposure alone impacts lung health, but smoking exacerbates the effects, leading to a higher risk of respiratory disease progression.

(*Contd*...)

Table 1: (*Continued*).

S. No.	Author, year	Study type	Industry/ occupation	Hazardous substance exposure	Occupational disease studied	Key findings on disease incidence and workers' health
6.	Tounsadi *et al*.[7]	Cross- sectional epidemiological study.	Textile manufacturing industries	Workers in the textile industry are exposed to numerous hazardous chemicals, such as dyes, solvents, and finishing agents. The study identified several toxic substances present in the workplace, including heavy metals and aromatic compounds, which are known to pose significant health risks upon prolonged exposure.	Otolaryngological symptoms, Dermatological symptoms, Ophthalmological symptoms.	A significant number of workers reported experiencing symptoms related to otolaryngological, dermatological, and ophthalmological health issues, indicating a strong association between chemical exposure and these conditions. The study found a high correlation between the use of toxic chemicals, adverse working conditions, and the prevalence of the reported health symptoms. The environmental assessment confirmed that workers are daily exposed to dangerous and toxic chemicals, posing a substantial threat to their health.
7.	Subramaniam *et al*.[4]	Narrative review	Textile Industry encompassing various processes such as ginning, spinning, weaving, dyeing, and printing.	Cotton dust, endotoxin, chemicals, noise, and musculoskeletal disorders causes several health-related hazards to textile workers	Respiratory disorders. Other aspects that influence human comfort and health during working hours like occupational noise, musculoskeletal disorders, and eyesight problems.	A significant proportion of textile workers experience respiratory symptoms due to exposure to cotton dust and endotoxins. Studies have reported a higher prevalence of byssinosis and other respiratory conditions among these workers. Exposure to cotton dust and endotoxins has been associated with measurable declines in lung function, increasing the risk of chronic respiratory diseases. Workers exposed to high noise levels in textile factories are at an increased risk of developing hearing loss. The physical demands of textile work, including repetitive tasks and poor ergonomic conditions, lead to a higher incidence of musculoskeletal disorders among workers.

(*Contd...*)

Table 1: (*Continued*).

S. No.	Author, year	Study type	Industry/ occupation	Hazardous substance exposure	Occupational disease studied	Key findings on disease incidence and workers' health
8.	Rai *et al*.[9]	Cross- sectional study	Healthcare workers/ industry	Asthmagens, carcinogens, ototoxic agents, anesthetic gases, and antineoplastic drugs.	Respiratory conditions like asthma, potential carcinogenic effects, and hearing impairments due to ototoxic exposures.	The prevalence of exposure to one or more asthmagens, carcinogen, and ototoxic agents was 98.7%, 28.1%, and 7.6%, respectively; and was 6.2% for anesthetic gases and 2.2% for antineoplastic drugs.
9.	Supapvanich *et al*.[10]	Cross- sectional study	Healthcare industry/ nurses	Powdered latex gloves	Dermal symptoms and respiratory Symptoms.	The study revealed that 18% of the nurses reported health effects attributed to the use of latex products. After adjusting for confounding factors, the following occupational risk factors were significantly associated with increased reporting of dermal symptoms: • Wearing more than 15 pairs of PLGs per day was associated with a higher incidence of dermal symptoms (Odds ratio: 2.10; 95% C: 1.32–3.34). • Exposure to chlorhexidine was linked to an increased risk of skin-related issues (OR: 2.07; 95% CI: 1.22–3.52). • Nurses working in operating theaters had a higher likelihood of reporting dermal symptoms (OR: 2.46; 95% CI: 1.47–4.12).
10	Arif and Delclos[3]	Cross- sectional study	Healthcare industry, examining professionals routinely exposed to cleaning agents and disinfectants in their work environment. This includes roles such as physicians, nurses, respiratory therapists, occupational therapists, and nurse aides.	Bleach, cleaners/ abrasives, toilet cleaners and detergents, ammonia, lugtaraldehyde/ ortho-phthalaldehyde, chloramines, ethylene oxide, formalin/ formaldehyde	Work-related asthma symptoms, Work-exacerbated asthma, Occupational asthma	The study reported the following prevalence rates among the surveyed healthcare professionals: • WRAS: 3.3% • WEA: 1.1% • OA: 0.8% Notably, these prevalence rates were higher among female healthcare professionals. The analysis revealed a dose-dependent relationship between exposure to cleaning agents and the likelihood of developing WRAS and WEA.

OR: Odds ratio, CI: Confidence interval, WRAS: Work-related asthma symptoms, WEA: Work-exacerbated asthma, OA: Occupational asthma.

from the research as a significant source of dermal symptoms, particularly among nurses who use them frequently.

Across multiple industries, workers exposed to hazardous substances face a heightened risk of developing long-term health complications, including cancer. A case-control study by Fukai *et al*.[11] on multi-industry exposure found that individuals involved in hazardous operations have a significantly higher incidence of cancer, particularly in the lungs, pancreas, and bladder. This association becomes more pronounced when combined with smoking, amplifying the carcinogenic effects of workplace toxins. Diabetes, another prevalent condition, also appears to exacerbate the risk of pancreatic cancer when coupled with occupational exposures. Furthermore, chemical exposures across different industries, including agriculture, cosmetology, healthcare, and construction, contribute to dermatological disorders. Excessive hand washing, frequent sanitizer use, exposure to combinations of chemicals, and the occlusive effects of gloves alter skin integrity, facilitating the penetration of harmful substances and increasing the likelihood of sensitization and other adverse biological responses.[12]

The highest occupational hazards were noted in the steel and power industry, as their experiences at the workplace can lead to severe physical strain, high injury rates, heat stress, electric shocks, and exposure to airborne pollutants. The combination of musculoskeletal pain, respiratory diseases, heat stroke, and frequent workplace injuries makes this industry one of the riskiest. Fatal risks such as electric shock and extreme heat exposure further increase the danger level. However, the occupation with the least occupational risk from these findings would be the health care industry. While healthcare workers face chemical exposures, respiratory issues, and skin disorders, they generally work in controlled environments with better regulatory oversight and access to protective measures. The prevalence of OA, dermatitis, and chemical-related ailments is significant, but life-threatening risks like severe injuries or toxic metal exposure are less common compared to heavy industries.

The recommendations from research on the steel and power industries emphasize the need for a comprehensive safety management strategy to prevent workplace injuries and reduce industrial accidents. In the rubber industry, Attarchi *et al*.[6] suggested workplace interventions such as improved ventilation, the application of safety gear, and smoking cessation programs to mitigate health risks. Similarly, Tounsadi *et al*.[7] highligted the importance of stringent safety measures, regular health monitoring, and the adoption of safer chemical alternatives to protect textile industry workers. In the healthcare sector, Arif and Delclos[3] emphasize the need for protective measures and reduced exposure to specific cleaning-related chemicals to lower the prevalence of asthma and its symptoms in medical personnel.

CONCLUSION

This systematic review highlights that significant Hazardous material exposure at work is linked to health concerns across various industries. The findings revealed that workers in industries such as manufacturing, steel, and power industries face the highest occupational disease hazards brought on by exposure to airborne pollutants, toxic chemicals, extreme heat, and physical hazards. While healthcare workers also encounter chemical and biological exposures, their risks are reduced by regulatory oversight and protective measures. Despite advancements in occupational health policies, these exposure-related diseases from hazardous substances remain a major concern. The persistence of respiratory disorders, neurological impairments, skin conditions, and cancers emphasizes the urgent need for stricter workplace interventions, improved safety protocols, and effective occupational health management systems. Employers must prioritize hazard control measures, including engineering controls, equipment for personal protection, and regular health monitoring, to reduce disease incidence. Policymakers should also strengthen regulatory frameworks, enforcing safety standards and promoting worker education to help minimize occupational disease risks and ensure long-term worker health and well-being. Finally, workers should ensure to adhere strictly to all safety protocols to mitigate their exposure to these risks, which in turn leads to diseases.

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