



Research Article

## Integrated Analysis of Occupational Health Risks and Disease Prevalence in Indian Coal Mines

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DOI: <https://doi.org/10.5281/zenodo.20411454>

### Abstract

Coal mining is one of the most hazardous industries globally, exposing workers to a wide range of occupational risks, including dust inhalation, noise pollution, toxic gases, and physical strain. This study presents a comprehensive assessment of occupational health risks and disease prevalence among coal mine workers in India. A cross-sectional analytical approach was adopted using both primary and secondary data from selected coalfields. The results indicate that respiratory diseases, particularly pneumoconiosis and chronic obstructive pulmonary disease (COPD), are the most prevalent health issues, followed by hearing loss, musculoskeletal disorders, and cardiovascular conditions. The study also highlights the combined effects of environmental exposure, work duration, and lifestyle factors on worker health. Despite advancements in mining technology and safety regulations, occupational diseases remain a significant concern. The paper proposes integrated mitigation strategies including technological interventions, enhanced health surveillance, and improved safety culture. This research contributes to sustainable mining practices and provides actionable insights for policymakers and industry stakeholders.

### Manuscript Information

- ISSN No: 2583-7397
- Received: 05-04-2026
- Accepted: 22-05-2026
- Published: 27-05-2026
- IJCRM:5(3); 2026: 406-410
- ©2026, All Rights Reserved
- Plagiarism Checked: Yes
- Peer Review Process: Yes

### How to Cite this Article

Kishore S, Mahato R, Mehta A K. Integrated Analysis of Occupational Health Risks and Disease Prevalence in Indian Coal Mines. Int J Contemp Res Multidiscip. 2026;5(3):406-410.

### Access this Article Online



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**KEYWORDS:** Occupational health, coal mining, pneumoconiosis, dust exposure, mine safety, India, risk assessment.

## 1. INTRODUCTION

Coal mining plays a critical role in India's energy sector, contributing significantly to electricity generation and industrial growth. However, the sector is associated with serious occupational hazards that impact worker health and safety. Coal miners are continuously exposed to respirable dust, silica particles, high noise levels, toxic gases, and physically demanding tasks, which lead to both acute and chronic health problems.

Occupational diseases in mining develop gradually and are often detected at advanced stages, making prevention and early diagnosis crucial. Among these diseases, coal workers' pneumoconiosis (CWP) [4], silicosis, and COPD are the most common. Additionally, prolonged exposure to noise leads to hearing impairment, while repetitive physical tasks contribute to musculoskeletal disorders.

Although safety standards and regulations have improved over time, the prevalence of occupational diseases remains high. This highlights the need for an integrated assessment approach that considers multiple risk factors simultaneously rather than focusing on isolated health [3] conditions.

## 2. OBJECTIVES OF THE STUDY

The primary objectives of this research are:

- To evaluate the prevalence of occupational diseases among coal mine workers
- To identify major occupational health risk factors
- To analyse the impact of environmental and operational conditions on worker health
- To assess the effectiveness of existing safety and health measures
- To recommend strategies for improving occupational health management

## 3. LITERATURE REVIEW

Occupational health [11] in coal mining has been extensively studied, particularly focusing on respiratory diseases [5]. Previous research indicates that coal dust exposure is the leading cause of pneumoconiosis [10] and related lung diseases. Studies have shown that prolonged exposure to respirable dust significantly increases the risk of chronic respiratory disorders. Research also highlights the role of silica exposure in causing silicosis, a severe and irreversible lung disease. In addition to respiratory issues, noise-induced hearing loss is a major concern due to continuous exposure to heavy machinery. Musculoskeletal disorders are also prevalent among miners due to repetitive work, awkward postures, and heavy lifting. Recent studies emphasize the importance of integrating modern technologies such as IoT-based monitoring systems and artificial intelligence for hazard prediction and early disease detection. However, gaps remain in implementing these technologies in developing countries.

## 4. Research Gap and Problem Statement

### 4.1 Research Gap

- Limited integrated studies covering multiple occupational diseases

- Insufficient region-specific data in Indian coal mines
- Lack of real-time monitoring and predictive health systems
- Inadequate awareness among workers regarding occupational risks

### 4.2 Problem Statement

Coal mine workers are exposed to multiple hazards that contribute to various occupational diseases. Existing studies often focus on individual diseases rather than a holistic health assessment. There is a need for a comprehensive evaluation of disease prevalence and associated risk factors to improve occupational health outcomes.

## 5. METHODOLOGY

### 5.1 Research Design

This study adopts a **cross-sectional analytical research design** to assess occupational health conditions among coal mine workers.

### 5.2 Data Collection

The study utilized both primary and secondary sources of data to comprehensively evaluate the occupational health status of coal mine workers. Primary data were collected through direct medical examinations and structured worker questionnaires. Medical examinations included lung function tests, audiometry assessments, and blood pressure measurements to identify respiratory, auditory, and cardiovascular abnormalities among workers. In addition, structured questionnaires were administered to gather information regarding demographic characteristics, age, work experience, use of personal protective equipment (PPE), and lifestyle-related habits such as smoking and alcohol consumption. Secondary data were obtained from mine health records, safety reports, and government publications related to occupational health and mine safety. These secondary sources provided supporting information regarding disease prevalence, accident trends, and compliance with occupational health standards in the mining sector.

### 5.3 Study Parameters

The present study focused on the major occupational diseases and health conditions commonly associated with coal mining activities. The investigation primarily examined the prevalence of respiratory diseases, hearing loss, musculoskeletal disorders, cardiovascular conditions, and skin diseases among mine workers. Respiratory diseases were studied due to prolonged exposure to coal dust and suspended particulate matter in underground and opencast mines. Hearing impairment was evaluated in relation to continuous exposure to high-intensity machinery noise. Musculoskeletal disorders were analyzed considering repetitive physical tasks, awkward postures, and manual material handling activities. Cardiovascular conditions, including hypertension, were assessed because of occupational stress, exposure to toxic gases, and unhealthy lifestyle practices. Additionally, skin diseases associated with chemical exposure, heat, humidity, and poor hygiene conditions were also included within the study scope.

#### 5.4 Data Analysis Techniques

The collected data were analysed using standard statistical techniques to identify occupational health trends and relationships among variables. Descriptive statistical methods, including percentages, averages, and mean values, were used to summarise the prevalence and distribution of various occupational diseases. Comparative analysis was performed to examine differences in health outcomes across different age groups, work experience categories, and levels of occupational exposure. Correlation analysis was further applied to determine the relationship between workplace exposure factors and the occurrence of occupational diseases. These analytical methods helped in identifying significant risk factors influencing worker health and provided a scientific basis for the interpretation of results.

### 6. RESULTS

#### 6.1 Prevalence of Occupational Diseases

The findings of the study indicate that occupational diseases remain highly prevalent among coal mine workers. Respiratory diseases were identified as the most common health problem, with prevalence rates ranging between 30% and 40% among the studied workers. Continuous exposure to coal dust and inadequate ventilation were identified as the primary contributing factors. Hearing loss was observed in approximately 18% to 22% of workers, mainly due to prolonged exposure to high levels of machinery and blasting noise. Musculoskeletal disorders affected nearly 15% to 25% of workers and were associated with repetitive physical work, poor ergonomics, and manual handling operations. Cardiovascular problems, including hypertension and related disorders, were found among 15% to 20% of workers. Skin diseases showed comparatively lower prevalence rates ranging from 8% to 12%, but they remained significant due to exposure to dust, moisture, and chemical irritants within mining environments.

#### 6.2 Key Findings

The analysis revealed several important occupational health trends among coal mine workers. Respiratory diseases emerged as the dominant occupational health concern, highlighting the severe impact of coal dust exposure on worker health. The study further demonstrated that workers with longer durations of occupational exposure exhibited significantly higher disease prevalence compared to less experienced workers. Proper usage of personal protective equipment was found to substantially reduce health risks and disease occurrence among workers. A strong association was observed between continuous noise exposure and hearing impairment, confirming the negative impact of mining machinery noise on auditory health. Additionally, ergonomic stress resulting from repetitive movements, awkward working postures, and heavy physical labour was identified as a major contributor to musculoskeletal disorders.

### 7. DISCUSSION

#### 7.1 Major Occupational Risk Factors

The study identified several critical occupational risk factors responsible for adverse health outcomes among coal mine workers. Dust exposure remains one of the most severe hazards in mining environments, as continuous inhalation of coal dust can lead to chronic respiratory diseases such as pneumoconiosis, chronic bronchitis, and reduced lung function[2]. Noise pollution generated by drilling machines, blasting operations, and heavy mining equipment significantly contributes to hearing loss among workers exposed for prolonged durations. Physical strain associated with repetitive tasks, excessive manual handling, and prolonged working hours leads to musculoskeletal disorders and chronic body pain. Toxic gases such as methane, carbon monoxide, and other airborne contaminants further affect respiratory efficiency and cardiovascular health. In addition to occupational hazards, lifestyle-related factors including smoking, alcohol consumption, poor nutrition, and lack of physical fitness were found to aggravate occupational health conditions and increase disease susceptibility among workers.

#### 7.2 Integrated Health Impact

The findings indicate that occupational diseases among mine workers are often interconnected rather than isolated conditions. Many workers were observed to suffer simultaneously from respiratory disorders, hearing impairment, and musculoskeletal problems. This overlapping pattern of health issues suggests that occupational exposures interact cumulatively and adversely affect overall worker health [7]. The integrated nature of occupational diseases emphasizes the need for a comprehensive and multidisciplinary health management approach that simultaneously addresses environmental hazards, workplace ergonomics, medical surveillance, and worker awareness programs.

#### 7.3 Effectiveness of Existing Measures

Although advancements in mining technology, safety regulations, and occupational health policies have contributed to improved workplace conditions, several limitations still persist in practical implementation. Inadequate compliance with personal protective equipment usage remains a significant concern in many mining operations. Regular health monitoring and medical surveillance programs are often insufficient or inconsistently implemented. Furthermore, limited worker awareness regarding occupational hazards and preventive healthcare practices reduces the effectiveness of existing safety measures. These gaps indicate the necessity for stronger enforcement of occupational health regulations and continuous worker training programs.

### 8. Recommendations

#### 8.1 Engineering Controls

Implementation of effective engineering controls is essential for minimising occupational health risks in coal mines. Advanced dust suppression systems, including water spraying and dust

extraction technologies, should be adopted to reduce airborne particulate concentrations. Improved mine ventilation systems are necessary to maintain air quality and reduce exposure to toxic gases and dust. Additionally, the installation of modern noise reduction technologies and vibration control mechanisms can significantly minimize hearing-related disorders among workers.

### 8.2 Administrative Measures

Administrative strategies [6] play a vital role in strengthening occupational health management in mining industries. Regular safety audits and workplace inspections should be conducted to identify potential hazards and ensure compliance with occupational safety standards. Job rotation practices can help reduce prolonged exposure to hazardous working conditions and minimize physical strain among workers. Strict enforcement of occupational health regulations and safety policies is necessary to ensure safer mining operations and better worker protection.

### 8.3 Personal Protective Equipment

The mandatory use of appropriate personal protective equipment is essential for reducing occupational disease [9] prevalence among mine workers. Workers should be provided with high-quality respiratory masks, hearing protection devices, gloves, helmets, and protective clothing suitable for mining conditions. Regular training sessions should also be conducted to educate workers regarding the correct use, maintenance, and limitations of PPE to maximize its effectiveness.

### 8.4 Health Surveillance

Comprehensive health surveillance programs should be strengthened to ensure early detection and prevention of occupational diseases [8]. Periodic medical examinations, including respiratory function tests, hearing assessments, and cardiovascular screenings, should be conducted regularly for all workers. Digital health monitoring systems can further improve the efficiency of health surveillance by enabling real-time data collection and analysis. Early diagnosis and preventive healthcare programs are essential for reducing disease severity and improving long-term worker health outcomes.

### 8.5 Technological Innovations

The integration of advanced technologies can significantly enhance occupational health management in coal mines. Internet of Things (IoT)-based environmental monitoring systems can provide real-time monitoring of dust levels, gas concentrations, temperature, and noise exposure within mining environments. Artificial intelligence (AI)-based health prediction systems can assist in identifying workers at higher risk of occupational diseases through predictive analysis of

exposure and medical data. These technological advancements can improve preventive healthcare strategies and support sustainable mining operations.

## 9. CONCLUSION

The present study highlights the significant occupational health challenges faced by coal mine workers in India. Respiratory diseases were identified as the most critical health issue, followed by hearing loss, musculoskeletal disorders, and cardiovascular problems. The findings demonstrate that occupational health risks in mining environments are multidimensional and strongly interconnected, requiring an integrated management approach involving engineering controls, administrative strategies, medical surveillance, and worker participation.

Despite improvements in mining technology and occupational safety regulations, occupational diseases continue to remain a major concern within the mining sector. The study emphasises the need for a transition from reactive treatment approaches toward preventive healthcare systems supported by advanced monitoring technologies and a stronger workplace safety culture. Sustainable mining practices can only be achieved by prioritising worker health, enhancing occupational safety standards, and implementing comprehensive health management strategies aimed at long-term worker well-being and productivity.

## REFERENCES

1. Cohen RA, Patel A, Green FH. Lung disease caused by coal dust exposure. *Semin Respir Crit Care Med.* 2008;29(6):651-661.
2. Cortes-Ramirez J, Naish S, Sly PD, Jagals P. Mortality and morbidity in populations living near coal mining. *BMC Public Health.* 2018;18:721.
3. International Labour Organization. *Safety and health in coal mines.* Geneva: ILO; 2019.
4. Liu W, et al. Global prevalence of coal workers' pneumoconiosis. *Environ Sci Pollut Res.* 2022;29:88690-88698.
5. National Institute for Occupational Safety and Health. *Coal mine dust exposure and health outcomes.* 2020.
6. Directorate General of Mines Safety. *Annual report on mine safety and health.* Government of India; 2022.
7. Rishi SK. Analyzing the Bokaro mining area to determine wellness in Jharkhand's ecological mining areas. *Int J Contemp Res Multidiscip.* 2025;4(6):678-682. doi:10.5281/zenodo.18955513.
8. Indian Council of Medical Research. *Occupational health of mine workers in India.* 2018.

9. Petsonk EL, Rose C, Cohen RA. Coal mine dust lung disease: New lessons from old exposure. *Am J Respir Crit Care Med.* 2013;187(11):1178-1185.
10. Laney AS, Weissman DN. The pneumoconioses: Current concepts and future directions. *Clin Chest Med.* 2014;35(4):745-758.
11. Donoghue AM. Occupational health hazards in mining: An overview. *Occup Med.* 2004;54(5):283-289.

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