

Systematic Literature Review on Occupational Health and Safety Concerns of Coal Miners in Bermo Region, Coal India Ltd, Jharkhand

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Abstract - Occupational health and safety are all about workers' safety, health and well-being while they work in the organization. The mining sector in India is regarded as a hazardous occupation due to its dangerous nature and working conditions, which frequently result in deadly accidents. The study aimed to systematic literature review of existing studies on occupational health and safety concerns of coal miners in the Bermo region, operated by Coal India Ltd in Jharkhand, India, and how effective have safety measures been in addressing these concerns. The Web of Science, PubMed, Science Direct, Science Hub, and Google Scholar were consulted for this systematic review to search data. The paper went through a wide range of systematic literature reviews from 2010 to 2024 to highlight these issues.

The extensive search was conducted across multiple databases, organisational reports and citation networks. Following PRISMA guidelines, 150 records were initially identified from the database, registers, and other sources. After removing 60 duplicate and irrelevant record, 90 unique studies were screened. Out of these 40 reports were sought for full-text retrieval, and 20 studied were included in the final review.

Despite various development in mining technology, even with new tools and safety protocols, miners still deal with health problems. These include long-lasting respiratory issues like pneumoconiosis, hearing loss from noise, and musculoskeletal disorders.

The analysis highlights recurring themes across the literature, including insufficient safety training, poor ventilation system and lack of personal protective equipment (PPE). The study also highlights how important it is to boost safety measures and training programs by examining these risk factors. This systematic literature review recommends implementing regular and comprehensive checkups, better ventilation systems, and protective equipment (PPE) to mitigate the risks. Despite existing measures implemented by regulatory bodies and Coal India Ltd, significant gaps remain in mitigating occupational hazards. The review suggests the need for more proactive safety

interventions, improved miner education, and stricter enforcement of safety standards.

Keywords - coal mining occupational hazards, occupational health coal miners, Bermo region coal mining, coal miners safety India, respiratory issues coal miners.

INTRODUCTION

Coal mining is a key industry that provides energy and employment opportunities to millions of people around the world. But do not forget that this is also a dangerous profession. There are many health and safety concerns for miners involved in this occupation. Coal mining is a labour-intensive industry and has many health and safety issues. It is an industry full of risks from every side. Some of these dangers are visible, while some are hidden. These risks are dangerous and can cause serious injury or disability to employees. The International Labor Organization and World Health Organization stated that occupational health and safety means ensuring that workers in any occupation have optimal physical, mental and social health. It is about preventing ill health caused by working conditions and protecting workers from health risks. For this reason, it is important to maintain an optimal work environment (Flin et al., 2000). Miller (1996) further states that employee health and safety refer to how work affects workers, and how workers affect their work. Occupational health and safety deals with all aspects of health and safety in workplace and has a strong focus on primary prevention of hazards.

This study mainly focuses on the Bermo region coal mines, which are famous for their coal mining operated by Central Coalfields Limited, a subsidiary of Coal India Limited (CIL). They account for nearly 60% of the country's electricity production. Both the opencast and underground mining have been taken

into consideration for the study mines such as Kargali and Khasmahal in Bermo play a key role in the coal supply.

The objective of the study is to conduct a systematic literature review to understand the occupational health and safety challenges faced by coal miners in the Bermo region, of Jharkhand. It explores the common hazards that miners encounter, such as musculoskeletal disorders, respiratory problems and hearing loss caused by excessive noise. By assessing the effectiveness of current safety practices, this study also aims to offer practical recommendations for regulatory authorities and Coal India Ltd to promote a safer and healthier working environment for the miners.

Coal miners in the Bermo region face numerous physical and psychosocial risks that significantly impact their health and quality of life. Poor air quality, high humidity, and the use of heavy machinery contribute to a range of serious health issues, including respiratory diseases like pneumoconiosis, chronic obstructive pulmonary disease (COPD), and silicosis. Miners are also vulnerable to musculoskeletal disorders and noise-induced hearing loss due to repetitive physical tasks and constant exposure to loud machinery.

Beyond physical health, mental well-being is a growing concern, as miners often experience high levels of stress, anxiety, and depression, exacerbated by harsh working conditions and limited support. Despite existing safety protocols, accidents remain common due to insufficient training, inadequate ventilation, and a lack of personal protective equipment. Toxic chemical exposure further adds to their health risks.

While initiatives like mobile medical units and health camps organized by Coal India Ltd provide some relief, significant gaps in safety enforcement and emergency preparedness persist. Stronger regulatory measures and proactive safety interventions are urgently needed to protect the health and well-being of miners in the Bermo region.

Coal miners in the Bermo region of Jharkhand face major health challenges due to their working conditions. To address these issues, Coal India Limited has implemented several health projects along with state and federal health initiatives. CIL operates Mobile Medical Units (MMUs) that provide free health screenings, medicines, and testing for

respiratory diseases such as tuberculosis (TB) and pneumonia through its subsidiary Central Coalfields Ltd. In addition, Coal India Limited organizes medical camps focusing on lung disease to help miners and special care can be admitted to the Central Coalfields Ltd (CCL) hospitals and pharmacies serve general occupational health needs. Including the treatment of chronic lung conditions programs such as the Occupational Health Surveillance Program (OHSP) provide early detection and prevention of work-related illnesses. Including regular health examinations chest x-ray and lung function tests with the collaboration between CCL and the National Institute of Occupational Health (NIOH). The TB elimination program under the National Health Mission (NHM) targets miners at high risk of TB. It provides free diagnosis, treatment and awareness programs. The Non-Communicable Disease (NCD) program also screens miners for chronic conditions such as respiratory diseases. High blood pressure and heart disease are prevalent in mining communities.

LITERATURE REVIEW

The previous existing literature on occupational health and safety concerns of miners in the coal industry in India has highlighted various key issues. Several major challenges have been brought to light by the body of research on the occupational health and safety concerns of coal miners in India.

The study on the impact of more work experience has a higher level of hazard recognition and safety compliance and also suggests the importance of training and mentorship programs (Haas et al,2019).

Another study which looks at the global trend of safety in the mining industry discovered that in comparison to the other industries, the coal mining industry has a comparatively poorer safety culture, and that further research is required to create safer regulation and risk reduction techniques (Wen-biao and Xue-sheng (2012).

Moreover, a study of pneumoconiosis in developing nations—including India found that high levels of dust exposure and unfavourable working conditions are to blame for the disease's high incidence and prevalence (Sprundel, 1990).

However, the literature does not provide any empirical support for the hypothesis that safety performance measures and safety culture maturity are related. The

safety culture of coal mines was assessed by using a safety culture maturity framework, and the relationship between cultural maturity and accident rate was investigated (Moreover, a study of pneumoconiosis in developing nations including India found that high levels of dust exposure and unfavourable working circumstances are to blame for the disease's high incidence and prevalence (Sprundel, 1990)

While physical workloads may be lowered with more automation, longer shift durations and less task variation still pose concerns for miners, according to a study on ergonomic issues in the mining industry (Friedman et al., 2019).

The literature does not provide any empirical support for the hypothesis that safety performance measures and safety culture maturity are related. The safety culture maturity of Ghanaian mines was assessed using a safety culture maturity framework, and the relationship between cultural maturity and accident rates was investigated (Maureen Hassall Safety Science, 2019).

This paper focuses on the coal industry and examines the nature and causes of occupational diseases in coal mining in which socioeconomic and technological factors determine the incidence of occupational diseases in workers and uses the Tobit model. The conclusion of this paper was to have the best possible healthcare plan. This work is based on a survey of three coal mines in the state of West Bengal India (Sarkar et al., n.d).

This paper focuses on a health hazard risk assessment methodology for analysing the extent of hazard risk using three important measuring parameters: consequence of exposure, period of exposure and probability of exposure (Chitrasen Samantra, Saurav Datta 2016).

The study highlights the significance of pre-employment and recurring medical examinations in the mining sector for the prompt identification and suitable management of various health issues among mining employees. The mining sector is multidisciplinary, utilizing a variety of skills and professions. (Kalyani S.)

METHODOLOGY

The systematic literature review aim is to identify and analyse the occupational health and safety concerns

faced by the coal miners in Bermo region, Jharkhand. Focusing on studies published between 2010 and 2024. The review follows the Preferred Reporting items for Systematic Review and Meta- Analysis (PRISMA) guidelines to ensure a comprehensive and unbiased synthesis of the available literature.

RESEARCH DESIGN

The study employs a systematic review approach to collect, evaluate, and synthesize research findings on the advanced occupational health and safety challenges of coal miners in Bermo region. This method was chosen to give a critical analysis of existing knowledge and identify gaps in the literature. A comprehensive search of articles, conference papers, reports and government publications were conducted. This search was performed using the following databases like; Google Scholar, PubMed, Scopus, Science Direct, Web of Science. In addition to database searches, Litmaps, a citation mapping tool, was employed to visualize relationship between studies.

INCLUSION AND EXCLUSION CRITERIA

The inclusion criteria were;

- In this criteria studies published from 2010 to 2024 was gone through.
- Article focused on the occupational health and safety in coal mining, specifically within India.
- Research addressing the key hazards such as respiratory issues, musculoskeletal disorders, and hearing loss.

The exclusion criteria included;

- Studies unrelated to mining industries.
- Paper published before 2010 or outside India.
- Articles lacking empirical data or detailed analysis of coal miner health and safety conditions.

For Screening and selection process initial database searches produced a large number of articles, in which titles and abstracts were reviewed to eliminate the irrelevant studies. The PRISMA flowchart is used to track the selection process to ensure transparency. Meanwhile Litmaps citation mapping is used to identify important studies, their citations, and their influence on subsequent research. Litmaps allows the

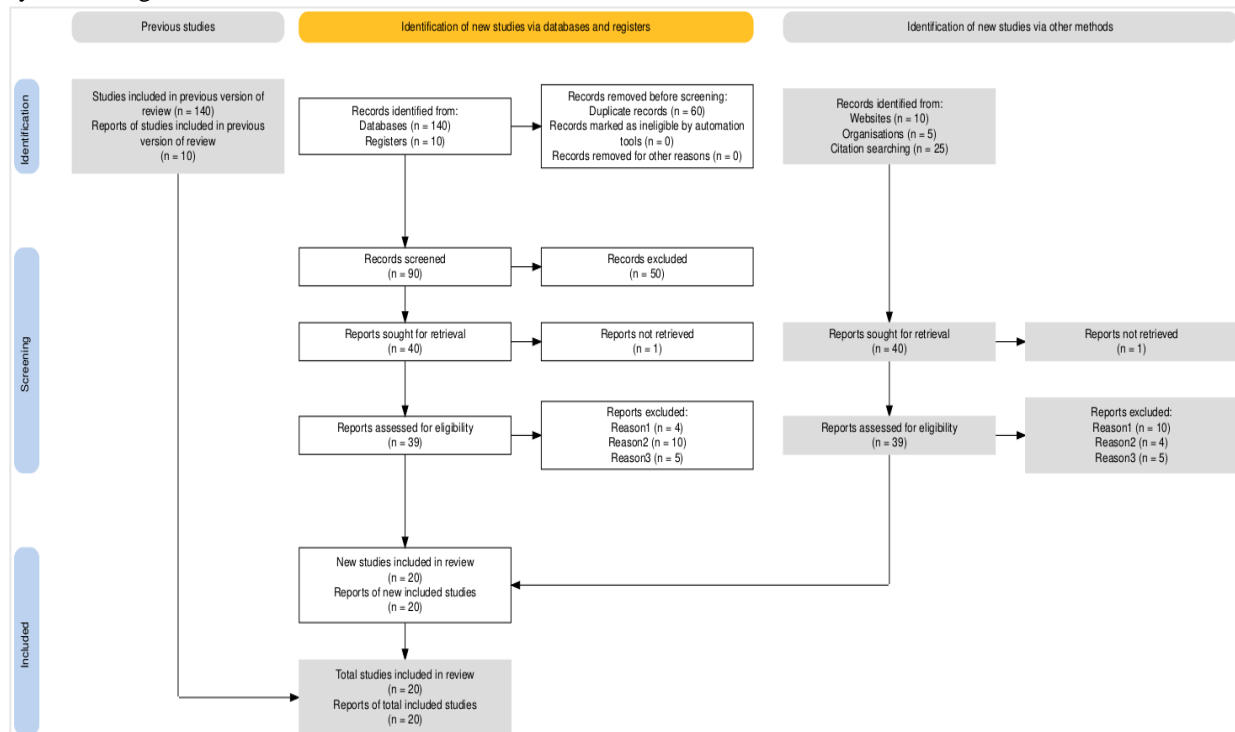
identification of highly cited and original works. Includes relevant study groups that contribute to the main theme of the review. Data were systematically extracted from selected studies using a default form includes, name of study, author, and year of publication, research objectives, methodology and design. Data synthesis involves qualitative analysis. It focuses on identifying recurrent themes and trends across studies. Findings were categorized by type of occupational health and safety challenge (e.g. respiratory problems, musculoskeletal disorders) and compare it to current Coal India Ltd safety regulations. For ensuring the reliability and validity of the findings, Critical Appraisal Skills Programme (CASP) checklist was used. Each study was evaluated on the basis of the quality of the research design, reliability of the data, and its relevance to occupational health and safety challenges in coal mining. In addition, the impact of the studies, as identified by the Litmaps reference figure, was also considered in evaluating the importance of each work. Ethical Considerations this is because the study involved a systematic review of existing literature, therefore, there are no direct ethical concerns regarding human or animal matters. To maintain academic honesty all sources are properly cited and credited and an effort has been made to present an unbiased analysis of the available research. By combining traditional literature search methods for

reference mapping and innovative tools such as litmaps, the method ensures a comprehensive and in-depth examination of occupational health and safety challenges for miners Bermo region.

RESULTS

The systematic literature review focused on occupational health and safety challenges in coal mining, specifically in the Bermo region of Jharkhand, India. This section summarizes the key findings, trends, and gaps identified based on the data obtained from the PRISMA flow diagram and the Litmaps citation map.

For study selection and screening initially, a total of 150 records were identified from various databases. Including corporate reports, academic journal and citation networks and after removing 60 duplicate or irrelevant records, 90 studies were screened for eligibility. Out of the 90 screened studies, 40 reports were searched to retrieve the full text. And after further evaluation, 20 studies were included in the final review. Considering its relevance to the occupational health risks and safety practices of coal miners. PRISMA flow diagram showing the selection process. which followed strict inclusion and exclusion criteria. To ensure that the review captures the most relevant research.



KEY THEMES AND FINDINGS

Occupational health hazards: The majority of reviewed studies found the respiratory diseases like pneumonia, silicosis, musculoskeletal disorders, and hearing loss caused by loud noises as the predominated health issues affecting coal miners in the region. This finding is consistent with several studies, Dauth (2014) and Bhatia (2017), which highlight the toll mining activities that take place on workers.

Risk factors: Several studies have highlighted inadequate ventilation, long working hours poor ergonomics and lack of properly fitting personal protective equipment (PPE). This is a key contributor to health risks. Research by Jones (2012) and Dodoo (2021) highlights the role of organizational failures and outdated infrastructure in exacerbating these threats.

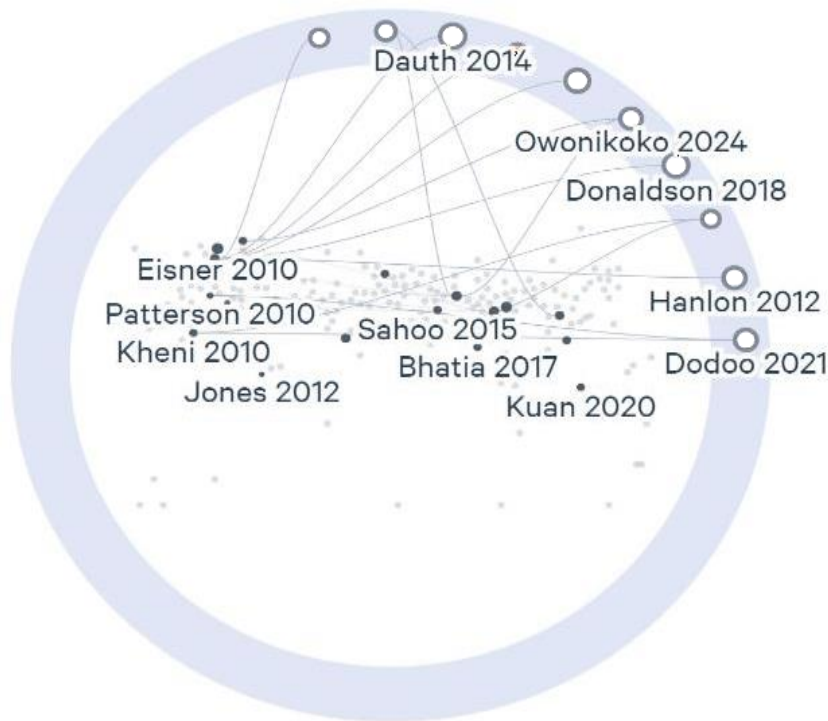
Safety practices and regulatory gaps: Studies by Eisner (2010) and Kheni (2010) addressed the existence of safety regulations. Instead, it pointed to poor enforcement and outdated protocols that have not kept

up with modern technology and evolving industry practices. They still maintain it. Security audits are seen as periodic. And non-compliance with safety measures remains a recurring issue. This results in workplace accidents and chronic diseases.

Effectiveness of existing safety measures: Research indicates that although Coal India Limited has implemented various safety interventions. These includes training programs and awareness initiatives. But the effectiveness of such measures is limited by a lack of consistent enforcement. Miners' awareness and allocation of resources studies such as Paterson (2010) and Owonikoko (2024) indicate that training programs are often generic and not tailored to the specific needs or challenges faced by miners in the Bermo region.

Emerging technologies: Several studies, such as Kuan (2020) and Dodu (2021), explore the potential of emerging technologies such as real-time monitoring, Automatic threat detection and wearable sensors. However, the overall adoption of these technologies is still low. This is especially true in the Bermo region, where traditional mining and old equipment still dominate.

 Litmaps



This reference map is used as a visual representation of the academic overview for systematic reviews of “Occupational Health and Safety Challenges for Coal Miners” helps identify influential studies that shape the understanding, citation formats and provide context for knowledge. It can also be used to guide discussions about past and recent research results. This figure depicts a citation network created through Litmaps, a tool for tracking academic literature and citations over time. It shows the relationship between important academic papers and how they reference each other within the scope of your research topic.

DISCUSSION

A systematic review of the advanced occupational health and safety (OHS) challenges faced by coal miners in Jharkhand's Bermo region revealed several key findings from the 2010 to 2024 research period. This discussion synthesizes key perspectives from the reviewed literature. The impact of these will be assessed.

Prevalence of health hazards in coal mining Most of the reviewed studies focused on musculoskeletal disorders (MSD), respiratory problems, and noise-induced hearing loss (NIHL) as a major occupational health concern among coal miners. Preliminary research, such as Kheni (2010) and Hanlon (2012), specifically on pneumonia. Among miners who are exposed to high levels of coal dust and record a significant burden of respiratory diseases such as chronic obstructive pulmonary disease (COPD), this finding is further supported by Sahu (2015) who emphasizes welding. There is a direct link between inadequate dust control measures and the severity of lung disease.

Recent studies, such as Bhatia (2017) and Dodu (2021), have expanded their focus to include new health concerns, such as mental health issues, that were previously underrepresented in the literature. These studies indicate a broader awareness of the psychosocial impacts of coal mining. These include anxiety, depression, and post-traumatic stress disorder (PTSD), mining accidents or safety violations.

Effectiveness of safety measures and regulations Several studies evaluate the effectiveness of existing security measures and regulatory frameworks.

Donaldson (2018) provides a critical analysis of safety regulations in Indian coal mines. Identify gaps in enforcement of safety regulations and limited availability of personal protective equipment (PPE), studies indicate inconsistent use at ground level. This is despite the mandatory security guidelines proposed by the Director General of Mine Safety (DGMS) it continues to happen. Owonikoko (2024) one of the latest studies. It features technological innovations such as real-time air quality monitoring and automatic safety monitoring. To provide a guideline for solving long-term occupational risk problems.

Training and awareness gaps Lack of adequate safety training and awareness has emerged as a significant risk factor in many studies. Sahn (2015) and Bhatia (2017) identified lack of continuous training programs as a major problem. This is especially true for contract workers and unskilled workers who are most at risk from workplace hazards. This training gap is closely tied to the frequent accidents and injuries reported in the field. This is because miners often lack the knowledge and skills required to work safely in hazardous environments. Dodoo (2021) reinforces this observation by advocating for improved training programs tailored to the specific needs of coal miners. It includes demonstration of practical safety procedures. It may help improve miners' ability to respond effectively to workplace hazards.

The role of personal protective equipment (PPE) The role of PPE in reducing occupational hazards has been widely discussed in the literature, however, findings show a disconnect between policy and practice. While several studies including Douth (2014) and Donaldson (2018) highlight the importance of PPE in protecting miners from respiratory disease and physical injury. They also identified significant challenges in using poor quality PPE. Lack of proper fit and resistance to wearing protective equipment due to discomfort was frequently cited in the reviewed literature. Bhatia (2017) also highlights financial constraints that prevent small- and medium-sized mining operations from acquiring high-quality safety equipment. This is especially relevant in Bermo, where resource constraints make the challenge for miners to obtain appropriate protection more severe.

Knowledge gaps and future research directions

Although the literature covers a wide range of important health and safety issues, but there are still some gaps. First, there is a need for more local education. It focuses on the unique challenges faced by coal miners in the Bermo region of the state of Jharkhand most research, including Kenny (2010) and Sahoo (2015), has been conducted in broader contexts, such as nationwide studies or mining environments in general. This limits its applicability to Bermo's unique economic and social situation. More research is needed on the long-term effects of exposure to modern mining technologies and materials, although Owonikoko (2024) discusses technological interventions. But there has been little investigation into the potential health risks of new machines and materials.

CONCLUSION

This systematic literature review highlights the complex, multifaceted nature of occupational health and safety challenges for coal miners in the Bermo region. While great progress has been made in understanding and managing these risks, The effectiveness of current safety measures is limited by inconsistent implementation. Insufficient training and financial constraints A combination of technological innovations Regulatory enforcement and comprehensive employee education is essential to ensuring safety and good health. Working environment for future coal miners. The findings of this review have important implications for regulators. coal mining company and policymakers Coal India Limited and DGMS should invest in modern security infrastructure. Adopt new technology and introduce stricter safety regulations. To address the gaps that still exist in safety practices, ongoing training programs should also be prioritized. Quality control for PPE and mental health interventions to ensure the well-being of coal miners.

To sum it all up, there's a need for continued attention and improvement when it comes to occupational health and safety for coal miners in Bermo. By focusing on the main risk factors found in this study, we can work towards reducing accidents while making sure miners are healthier overall. The insights gained from this research should push us toward positive changes working hard for safer and healthier conditions for our coal miners.

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