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An Overview of Human Health Hazards in Indian Mining Industry

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Abstract

The mining sector is well renowned for having extremely dangerous and perilous working conditions. Mine employees and the surrounding community face substantial health risks from non-mechanized, unorganised mining. The current paper evaluates the significance of suitable ergonomics design, organisation, training, and education in the mining sector to control risk and enhance the working environment. The main areas of concern in the Indian mining business are risks to health and safety in the mining industry posed by longer shift lengths, heavier workloads, less task variation, intense physical workloads, and stresses. The physical layout of workstations, occupations, workplaces, the working environment, tools, vehicles, and workload are all factors that contribute to ergonomic problems in Indian mines. However, the Indian government has formed a structured organisation in Dhanbad, Jharkhand, named DGMS. The lack of complete mechanisation, unlawful mining in some portions of the nation, and unorganised mining in distant locations are all blamed for the mine risks present in Indian mines. Production will increase as ore extraction methods become more technologically advanced and occupational health and safety management (OHSM) guidelines are implemented in the Indian mining industry. India's mining industry has a promising future.

Keywords: Human health; Mining; India; Industry; Workplace

Introduction

Numerous ergonomics-related difficulties are currently emerging in the mining industry, primarily as a result of evolving work patterns and a push for increased efficiency. Mining is a long-established profession that has a reputation for being difficult and dangerous [1,2]. The mining industry in India is a major economic activity which contributes significantly to the economy of India. The workers in Indian mines are posed to certain ergonomic hazards associated with a wide range of concerns including the physical design of workstations, workspaces, the working environment, tools, vehicles etc. Moreover, they are also facing certain occupational health hazards [3] which are attributed to poor infrastructure facilities, mining technology is outdated, low inovation capabalities, labour force is highly un-skilled and inexperience, high rate of accidents, lack of training and development progroms in India. The objective of the present study is to visualise the ergonomic hazards in mining industry in India.

Present Status of Indian Mining Industry

("All minerals" excludes data for atomic and minor minerals, natural gas and petroleum (crude) oil. Data in respect of Union Territories is nil/negligible). Historically background and status of Indian mining industry mining and metallurgical activities in India can be traced back for about 6,000 years. However, the first recorded history of mining dates back to 1774 when an English company was granted permission by the East India Company for mining coal in India. Now the Mining industry in India is a major economic activity which contributes significantly to the economy of India. India is endowed with significant mineral resources and 89 minerals are being produced in India. Over 1.1million peoples are employed in Indian mining industry. Over the past three decades, India's mining industry has grown at a pace of 4 to 5 percent annually. All mineral mines in India Data [4] from 2009-2016. Table 1 show a continue decreasing trend of number of mines. Which attributed to reduction in ore grade and lack of deep drilling technology. The mining sector is multi-disciplinary and draws from a variety of crafts and professions. Surface or underground mining is traditionally categorised as either metalliferous or coal mining. The type of resource being mined can also categorise metalliferous mining. Exploration, mine site design and planning, construction, mine operation, decommissioning, and land restoration make up the mining lifecycle.

Table 1: Indian Bureau of Mines, Ministry of Mines.

	All Minerals Mines in India						
States	**2009-10**	**2010-11**	**2011-12**	**2012-13**	**2013-14**	**2014-15**	**2015-16**
AP	456	456	621	774	637	139	135
Himatchal. P	1	1	1	1	1	1	1
Assam	11	11	10	9	6	6	7
Bihar	6	10	6	6	5	1	1
Chhattisgarh	152	167	192	196	173	161	162
Goa	75	79	74	75	86	82	77
Gujarat	446	429	441	487	470	211	225
Haryana	0	0	0	1	1	0	0
HP	26	24	25	20	20	17	17
J&K	11	10	10	8	7	6	10
Jharkhand	299	297	299	293	231	219	211
Karnataka	233	251	207	219	175	160	146
Kerala	30	30	43	55	69	9	8
MP	287	317	417	421	350	289	274
Maharashtra	158	161	158	151	165	138	134
Manipur	0	0	0	0	0	0	0
Meghalaya	9	10	13	14	14	17	16
Odisha	221	192	183	192	179	165	157
Rajasthan	289	308	418	508	552	65	76
Sikkim	0	0	0	0	0	0	0
Tamil Nadu	175	192	305	368	366	234	252
Telangana	-	-	-	-	0	88	83
UP	25	24	25	22	19	6	6
Uttarakhand	34	40	37	34	15	3	3
West Bengal	112	109	124	127	121	100	100
Total No of Mines	3055	3118	3609	3981	3662	2117	2101

Hazards Faced by Mine Workers

There are numerous risks that the mining sector must deal with, some of which are listed here.

Physical Hazards

Vulnery injury remains a significant problem and ranges from the trivial to the fatal [3,4]. Common causes of fatal injuries include rock falls, fires, explosions, accidents involving mobile equipment, falls from considerable heights, trapping, and electrocution. Catastrophic harm is more seldom caused by flooding in underground workings, wet-fill discharge from collapsing bulkheads, and air blast from block caving failure. The systematic use of risk management strategies has helped to significantly reduce injury frequency rates in industrialised countries. To get to rates that the larger population can tolerate, though, more improvement is needed. Mining involves a lot of noise. It is produced through ore processing, drilling, blasting, cutting, material handling, ventilation, and crushing and conveying. In mining, noise control has proven challenging, and noise-induced hearing loss is still a widespread problem [5,6]. In tropical regions and deep underground mines, where temperatures of virgin rock and air rise with depth primarily because of the geothermal gradient and air column auto-compression, heat and humidity are experienced [7]. Fatal heat and heat exhaustion Miliaria rubra, colloquially problem in deep underground mining [7 -13]. Physical risks present in underground mining include whole-

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body vibration, hand-arm vibration, radon daughter exposure, solar UV exposure, infrared exposure, electromagnetic field, and barometric pressure.

Chemical hazards

Substances, combinations, and materials that are hazardous at work might be categorised in several ways. The risk of silicosis was greatest during dry drilling in the latter part of the nineteenth century because of crystalline silica, which has long been a significant mining hazard [14]. The major health risks associated with coal dust in mining include "black lung" and chronic obstructive pulmonary disease in coal workers [15-32]. In affluent countries, dust suppression, ventilation, and respiratory protection have now largely eliminated the concerns [33,34]. Asbestos-related disorders are a legacy of asbestos mining and processing that are still present today. There is a danger of lung cancer associated with the commercial extraction of arsenic from metal ores, which has occurred during the smelting of copper [35-38]. Lung cancer and nasal sinus cancer risk have been linked to exposure to nickel compounds in some nickel refineries [39-42]. Health risks are present with other metal ores, such as those of lead, cadmium, manganese, platinum, and cobalt [43-48]. When air concentrations are higher during metallurgical processing than they are during ore mining, the dangers are typically at their highest. Explosions caused by coal dust and methane gas in underground coal mines continue to be a severe problem that needs careful monitoring and management [49]. In some underground coal mines, carbon dioxide and hydrogen sulphide gas are also issues. In some gold mining operations, particularly in underdeveloped countries, mercury is still utilised to extract gold by the creation of mercury vapour during amalgam preparation, retorting, or melting [50].

Biological hazards

Organic chemicals known as biological hazards are a threat to both human and other living things' health. It consists of harmful bacteria, viruses, poisons (derived from biological sources), spores, fungi, and bioactive compounds. Biological disease vectors and transmitters can also be thought of as biological dangers. In some isolated mining settings, there is a high danger of contracting tropical diseases like malaria and dengue fever. Leptospirosis and ankylostomiasis were frequent in mines, but in the developed world, rat eradication and improved sanitation have effectively minimised these risks [51]. On mine sites, cooling towers are a typical sight. To find large numbers of other heterotrophic microbes or Legionella contamination, routine microbiological testing of the water is required.

Psychosocial hazards

Stress, aggression, and other workplace stresses are examples of psychosocial risks. In general, work is good for people's mental health and general wellbeing. It gives them direction, a sense of purpose, and an identity. It also offers possibilities for people to grow and use their social skills to create relationships with others and feel better about themselves. Although it has been challenging to address drug and alcohol addiction in the mining industry, most significant mining operations now have rules and procedures in place.

Ergonomic hazards

Ergonomics is the study of how to design a workspace, the tools used there, and the actual working environment for comfort, effectiveness, safety, and productivity. An environmental physical feature that endangers the musculoskeletal system is known as an ergonomic hazard. Themes including repetitive motion, manual handling, the workplace/jobs, task design, unpleasant workstation height, and inadequate body placement are examples of ergonomic hazards. Despite the growing mechanisation of mining, there is still a sizable amount of physical handling. The majority of occupational diseases in the mining industry still fall under the category of cumulative trauma illnesses, which frequently cause long-term disability [3]. Underground, during ground support, especially while pipelines and electrical cables are suspended, overhead work is prevalent. This may lead to or worsen shoulder issues. Broken ground is common and can injure the knees and ankles.

A wide range of difficulties, including the physical layout of the workstation, the work area, the working environment, equipment, vehicles, computer programmes, and plant, might be connected to ergonomic problems. Additionally, it may involve cognitive functions related to stress, workload, decision-making, and skillful performance (Table 2).

Table 2: Different musculoskeletal problems, symptoms, causes, disease.

Body Parts Affected	Symptoms	Possible Causes	Workers Affected	Disease Name
Thumbs	Pain at the base of the thumbs	Twisting and gripping	Butchers, Housekeepers, Packers, Seamstresses, Cutters,	De Quatrain's Disease
Fingers	Difficulty moving finger; snapping and jerking movements	Repeatedly using, the index fingers	Meatpackers, Poultry workers, Carpenters, Electronic, assemblers	Trigger finger
Shoulders	Pain, Stiffness	Working with the hands above the head	Power press, operators, Welders, Painters, Assembly line workers	Rotator cuff tendinitis

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Hands, Wrists	Pain, Swelling	Repetitive or forceful hand and wrist motions	Core making, Poultry processing, Meatpacking	Tenosynovitis
Fingers, Hands	Numbness, tingling; ashen skin; loss of feeling and control	Exposure to vibration	Chainsaw, Pneumatic hammer, and gasoline-powered tool operators	Raynaud's syndrome (white finger)
Fingers, Wrists	Tingling, Numbness, severe pain; loss of strength, sensation in the thumbs, index, or middle or half of the ring fingers	Repetitive and forceful manual tasks without time to recover	Meat and poultry and garment workers, Upholsterers, assemblers, VDT operators, Cashiers	Carpal tunnel syndrome
Back	Low back pain, Shooting pain or numbness in the upper legs	Whole body vibration	Truck and bus drivers, tractor and subway operators; warehouse workers; Nurses aides; grocery Cashiers; baggage handlers	Back disability

Parameters of Ergonomic Hazards

The tools of ergonomic hazards of different basis which is main factors.

Environment

Acts and their accompanying Rules, which have been developed for the mitigation of pollution and general environmental concerns of India, are primarily responsible for managing the environmental issues of the mining sector. The shared goals of these rules include halting additional environmental and ecosystem damage brought on by minging and adopting appropriate steps for environmental conservation. The main source of ergonomic risks can be found in several central as well as statistical rules and regulations. Prior to establishing or operating any industry or processes that could potentially pollute the environment (required under the Air (Prevention and Control of Pollution) Act 1974), the relevant state pollution control board must grant its approval. These are the two main environmental permits needed in connection with mining operations. Additionally, approval is needed as per the "Hazardous Waste" (Management and Handling) Rules of 1989. The applicable state pollution control body must grant such consent. According to the Environmental Protection Act of 1986, including the provisions of the Environmental Impact Assessment Notification of 2006, environmental permission from the ministry of environment and forest is required.

Workplace

Inspections of the workplace are a crucial component of a successful health and safety management system and aid in preventing work-related illness and injury. Inspections detect and disclose potential dangers that could be eliminated or avoided by carefully analysing the workplace. A thorough workplace audit will examine the setting, the tools, and the working procedures. Equipment also refers to supplies and tools. The way employees engage with relevant elements while performing a task or operation is referred to as the work process. Due to the nature of the work being done, certain areas in a workplace may require extra care, especially if data or observation indicates that stress, wear, impact, vibration, heat, corrosion, chemical reaction, or misuse may be taking place. Remember that any examination should cover the complete work area, including parking lots, building access, rest areas, storage, and amenities. Management must be notified immediately of anything that constitutes an immediate risk during a workplace health and safety examination. Work may need to cease until the threat is under control depending on the amount of risk.

Design and safety

Asbestos, hazardous chemicals and lead are just a few of the jobs that those running company or undertakings are required to monitor the health of their personnel for. The following important laws relating to labour welfare and safety must be followed by employers. The Mines Act of 1952, which specifies requirements for the welfare and safety of mine workers. The mining Rules of 1955 established provisions for workers' health and sanitation in mines. By taking dangers into account as early as possible in the planning and design process, which includes design of plant, structures, substances, as well as the work itself, safety in design strives to prevent accidents and disease. In order to completely remove or significantly reduce the risks of injury throughout the life of a product being designed, safe design refers to the early integration of hazard detection and risk assessment techniques. It includes all forms of design, such as the layout and configuration of buildings, hardware, systems, and other pieces of equipment.

Tools and equipment

If not operated appropriately, machinery and other working equipment might be deadly. Anyone employing equipment at work must receive adequate training in how to use it and maintain their familiarity with it. Here are some more tips to keep staff members secure when utilising equipment.

Safety Solution (Prevention) of Ergonomic Hazards in Indian Mining Industry

Different preventative measures are used in the mining sector in India to address the issue of dangers.

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Risk and Safety management

Mine owners, who are also employers, are required to have systems in place to make sure that the hazards at each of their mines are evaluated, including fire and explosion risks, mobile equipment accidents, height-related risks, entrapment due to in-rushes, etc. This entails conducting risk assessments with the goal of determining the steps required to comply with legal standards for health and safety as well as to assure the workers' safety. Risk assessment is crucial for determining their relative importance, prioritising prevention and control measures, and determining whether current control measures are adequate. The primary goal of safety and risk management is to identify dangers and take into account the protective measures already in place for their prevention and mitigation. Determine how to minimise the chance of an event occurring as a result of a certain hazard and possible solutions. Review the risk assessment on a regular basis or whenever you believe that a situational change will have a substantial impact on the risk to which individuals are exposed.

Training for public awareness

Such coal mining enterprises can be prevented in part by safety education and training. A crucial part of any organization's health and safety management system is its training programme, which educates young people about the dangers associated with various aspects of the mining industry in order to manage and lower the likelihood of accidents and injuries. Mine owners can achieve regulatory compliance as employers by participating in safety orientation and training, which demonstrates diligence. In addition to lowering the risk of occupational safety exposure for miners, it helps to create a culture of safety within the working environment.

Organizations

The organization's findings regarding ergonomic risks show a strong and favourable relationship between management and various safety competencies for workers in the Indian mining industry.

Work environment

Working conditions in mines can be challenging because of how quickly they can deteriorate and alter as the mining sector develops. Health and safety have been a top priority for miners since mining became industrialised in the late nineteenth century. These miners may be at risk for a variety of health issues, such as physical, ergonomic, and psychological issues.

Conclusion

In this study, the relationship and effects of ergonomic risks on the Indian mining sector are being investigated. The study looks at organisational commitment in its various forms, as well as occupational health and safety. According to the study's findings, there is a strong correlation between affective, normative, and continuous commitment and various safety management strategies.

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