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A Systematic Review of Occupational Health and Safety in Mining Sector in Pakistan

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Abstract The mining sector in Pakistan is regarded as a hazardous occupation due to its dangerous nature and working environment, which frequently results in deadly accidents. This study is aimed to conduct a systematic review of the existing studies on occupational safety and health in the mining sector of Pakistan. For this systematic review, Web of Science, PubMed, Science Direct, Science Hub, and Google Scholar were consulted to search data. Following keywords were used related to occupational health and safety in mining: occupational health and safety (OH&S), mining safety measures, mining health issues, and mining safety culture in Pakistan's mining industry. The result of the meta-analysis shows that OH&S is a major concern in the mining sector. Natural factors, including roof falls, gases and dust, and explosions, as well as human factors such as lack of training, ignorance of safety measures, lack of knowledge, outdated mining methods, and neglect of safety equipment (helmets, goggles, safety gloves, and masks), have led to accidents and casualties. Demographic factors such as age and personal factors like work experience and duration of job are also major causes of mining accidents that lead to fatalities and injuries. The government, stakeholders, and miners themselves have not been able to take serious initiatives to ensure safety. This study concluded that mining conditions are hazardous throughout the country. Workers lives are in danger. Improvements in safety measures not only protect workers lives but also decrease mining accidents, and lead to increased production.

Keywords; Occupational health and safety, mines, mining, Pakistan.

Introduction

Health and safety in the mining sector are considered crucial for the long-term sustainability of mining operations (Jiskani et al., 2019; Silva, et al., 2020). Due to fatalities and bodily injuries, occupational accidents result in significant social and economic issues (Yilmaz & Alp, 2016). Workplace factors like the type of job, posture, bending over while working, and lifting big objects all point to a strong correlation between musculoskeletal problems and miners' health (Arif et al., 2021). Manual labor, uncomfortable postures, and repetitive work are frequently identified as causes of job-related ailments, and intense physical effort has been associated to reduced levels of work capacity (Oliv, 2019). The mining business is acknowledged as having the highest level of occupational hazards among major industrial vocations (Chalgri et al., 2022). Poor working conditions still exist, nevertheless, particularly in poorer nations where basic preventive steps are not taken (Ahmad et al., 2016). However, no steps have been taken to address these problems to the mining industry's long-term development (Silva, et al., 2020). Accident rates are significantly greater in underdeveloped nations than in industrialized nations (Shah et al., 2020). Despite this, they receive little public attention in Asia (China and India), Europe, Africa, and South America (Nowrouzi-Kia et al., 2018).

Pakistan is a developing nation that deals with a number of issues related to workplace safety and health regulations (Ishtiaq et al., 2014). Pakistan, mine-related deaths are a common occurrence (Salim, 2001). The bulk of Pakistani laborers lack formal education and OH&S training. Furthermore, the nation is not familiar with the OH&S training programs (Khokhar et al., 2019). Many miners lose their lives each year as a result of either toxic gas releases or collapsing mines, and mine deaths are quickly becoming more commonplace than accidents due to the extremely hazardous working conditions (Salim, 2001). Mine collapses, gas asphyxia, falling rocks, mine machinery, haulage system failure, gas explosions, and transportation are the most commonly cited causes of mining accidents (Shahani et al., 2020). However, there are safety lapses in this industry that result in worker fatalities (Shahani et al., 2020).

OH&S is a multidisciplinary concept that focuses on promoting the safety, health, and welfare of workers (Amponsah-Tawiah & Mensah, 2016). The mining industry is a hazardous employment. To minimize work-related deaths and boost corporate efficiency, it is necessary to be aware of the elements that have an impact on OSH management (Chen & Zorigt, 2013). Improving worker productivity, as well as OH&S are key industrial concerns, particularly in emerging nations (Shikdar & Sawaqed, 2003). Problems with OH&S have a detrimental impact on workers' productive capability in the sector, resulting in lower production. Workers have a bad attitude about work and a low morale. Workplace accidents are also common (Adeyemo & Smallwood, 2017).

Mining is perhaps the industry where good worker participation in OH&S is most important. (Nikulin & Nikulina, 2017). Employees generally disobey safety

Standards and engage in risky behavior when they are not monitored, despite the protections and procedures are in place to prevent workplace mishaps (Akdeniz et al., 2018). The rates of occupational injury-related mortality and disability are increasing in emerging countries. As a result, the mining industries of these mineral-rich developing nations are particularly vulnerable to occupational injury-related fatalities and impairments (Amponsah-Tawiah & Mensah, 2016). Occupational dangers are ubiquitous in all jobs, particularly in the mining industry, where workers are frequently subjected to hazardous working circumstances (Cadiz et al., 2016).

The mining industry frequently faces two issues that might result in major safety incidents: hazardous conditions and underestimating safety risks. Accident risk can also be raised by improper health and safety procedures, psychological stress, and unstable employment (Jiskani, Chalgri, et al., 2020). The mining sector plays a vital role in a country's economy (Rajput, 2021) but also poses challenges to maintaining occupational health and safety. Mine workers earn their living by digging their own graves, as hundreds of miners die each year (Ali & Naveed, 2020). Mining is perhaps the industry where good worker participation in OH&S is most important (Nikulin & Nikulina, 2017). Although, research studies have been conducted on the effects of personal characteristics on occupational safety, work-related musculoskeletal disorder/injuries, lack of safety equipment and safety procedures, accidents and injuries in mines, and lack of safety awareness and psychological issues among mine workers. The findings of these studies have not been analyzed through a comprehensive review. To fill this gap in the literature, a comprehensive review is conducted. The purpose of this study was to conduct a systematic review of the existing literature on OH&S in Pakistan's mining industry.

Materials and Methods

A systematic review is a statistical technique that combines the results of different studies on the same topic, i.e., a quantitative, scientific synthesis of research findings. The advantage of this method is that combining the results of previous studies increases the statistical strength and precision of the estimated effects, thus overcoming the problems of small sample sizes and insufficient statistical strength (Tian et al., 2022).

A systematic review was designed and conducted in 2023 based on the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) checklist (Page et al., 2021). The related information and data were searched in the international databases Web of Science, PubMed, Science Direct, Science Hub, and Google Scholar. For the search, following search words were used: (a) associated with mine laborer (miners, mine-workers, miner, mining), (b) related to OH&S (occupational health and safety) in mining, safety measures in mining industry, health issues caused by mining, occupational injuries and fatalities in mining sector, and occupational safety culture in Pakistan's mining industry. EndNote X9 software was used for managing citation and references.

Time frame was the primary criterion for inclusion, and articles published between 2011- 2023 were considered and studies published before 2011 were excluded. The second inclusion requirement was that only articles published in English were included in this study. All studies addressing OH&S of mine workers were included. Articles related to the Pakistan mining sector were included and others excluded. However, articles published in journals on mining and mineral engineering, health, safety and environment, health and safety management, social sciences, and industrial health have also been included.

In the initial stage, using the "search terms" 160 articles were found; however, one hundred and eighteen excluded articles found irrelevant after reading their titles and abstracts. Nine articles were excluded because of time frame. As our study area was limited to Pakistan, 62 articles were not relevant which contained world data. Lastly, 42 articles were included for the analysis

Results and Discussion

Description of the Reviewed Articles

Although 160 studies were retrieved in the initial stage from the international databases. After reading the titles, abstracts, and full texts, 118 (forty-seven were irrelevant, nine were due to the year of publication, and sixty-two were related to other countries) were excluded. Finally, after careful scrutiny, 42 studies were found relevant to the topic and included in this study for analysis.

Table 1. Description of the reviewed articles

S#	Name of Journal	Number of Articles	Impacts Factor
1	Resources Policy	2	8.222
2	Environmental Technology & Innovation	1	7.758
3	ACS Publications	1	5.780
4	Pakistan Journal of Chest Medicine	1	5.554
5	Journal of Entomology and Zoology Studies	1	5.480
6	International Journal of Environmental Research and Public Health	2	4.614
7	Sustainability	1	3.889
8	The Extractive Industries and Society	1	3.808
9	European Academic Research	1	3.455
10	Journal of Engineering Education	1	3.146
11	Energy sources, part a: Recovery, Utilization, and Environmental Effects	1	2.902
12	Mining of Mineral Deposits	1	2.780
13	Journal of Medical Sciences	2	2.340
14	Journal of Mountain Area Research	1	2.071

15	Social Sciences and Humanities	1	1.900
16	Polish Journal of Environmental Studies	1	1.871
17	American Journal of Analytical Chemistry	1	1.710
18	Engineering, Technology & Applied Science Research	1	1.500
19	Process Safety Progress	1	1.294
20	Journal of Sustainable Mining	1	0.829
21	International Journal of Advanced Biotechnology and Research	1	0.766
22	International Journal of Asian Social Science	1	0.694
23	SYLWAN English Edition	1	0.654
24	Gomal Journal of Medical Sciences	1	0.500
25	international Journal of Economic and Environmental Geology	2	0.187
26	International Journal of Mining and Mineral Engineering	1	0.181
27	Journal of Mining and Environment	2	0.169
28	Journal of the Dow University of Health Sciences	1	0.120
29	Journal of Postgraduate Medical Institute	1	0.112
30	Global Sociological Review	1	0.100
31	Bio Scientific Review	1	NA
32	RADS Journal of Pharmacy and Pharmaceutical Sciences	1	NA
33	Pakistan Journal of Medical Research	1	NA
34	Foundation University Journal of Dentistry	1	NA
35	Iranian Journal of Health, Safety and Environment	1	NA
36	Research Square	1	NA
37	The Journal of Rashid Latif Medical College	1	NA

Province wise Distribution of the Reviewed Articles

Figure 1 shows the frequency of the studies conducted in different provinces of Pakistan about the mining sector. After assessing the full paper, a total of forty-two studies were associated with the topic. The maximum number of studies were conducted in the Punjab province of Pakistan. Forty studies from Pakistan included data collected from male mine workers; only two studies from Gilgit - Baltistan presented data collected from both male and female, and one study also shed light on child labor in the mining sector.

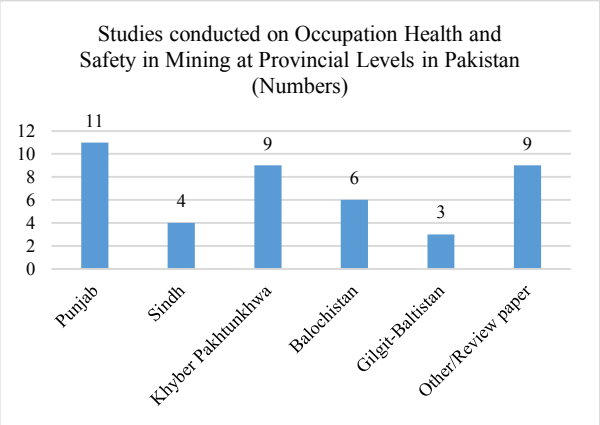

Fig. 1 Frequency of the studies conducted in different provinces of Pakistan.

Occupational Health and Safety in Punjab

Table 2 demonstrates studies conducted on mining in Punjab province identified that the mining environment, as well as miners' living conditions on work sites, all had a substantial influence on tuberculosis prevalence, heat sickness headaches, shortness of breath, nose and eye irritation, throat, sleepiness, TB, and heart disease, and the development of HCV in miners. Congested spaces, age, working hours, unskilled laborers, and experience contribute to body pain and musculoskeletal diseases.

Table 2. Studies on Occupational Health and Safety in Punjab

Punjab Province		
Year	**Findings**	**References**
2022	Heat sickness was common among mine workers. Another finding was that the majority of the workers (whether heat-exposed or not) reported symptoms of heat-related sickness.	(Ijaz et al., 2022)
2022	Workers who operate large vibrating machinery suffer danger. The age and length of time spent working have also had an influence on discomfort.	(Ali et al., 2022)
2021	The study revealed that training workers in the handling of explosives and the safe operation of machinery can reduce the danger. Personal protective equipment, repetitive postures and activities, and hazardous chemical substances are the subjects covered in workplace safety training.	(Janjuhah et al., 2021)
2021	The findings showed that 361 surface mine-related accidents resulted in 377 fatalities over a 15- year period (2004–2018). Unskilled laborers, or mine workers, accounted for 76% of mining deaths.	(Rehman et al., 2021)
2020	High dust concentrations in mines causes respiratory diseases. Experience and working hours were found to be the most significant factors exposing workers to dust.	(Madiha, et al., 2020)
2020	A study showed that body pain is due to working in confined spaces. Worker's age is directly associated with body pain.	(Madiha, et al., 2020)
2020	The study found that mining processes and worker personal factors such as age and experience are shown to be closely related to musculoskeletal diseases.	(Ijaz et al., 2020)
2020	The findings of this study reveal higher oxidative stress among highly exposed coal mine workers (underground workers >surface workers > administrative group > non-exposed group). Working hours have more pronounced adverse effects on workers' health.	(Batool et al., 2020)
2018	Coal dust causes a variety of respiratory illnesses. Exposure to coal dust causes headaches, shortness of breath, nose, and eye irritation, throat, sleepiness, TB, and heart disease.	(Batool et al., 2018)
2017	Workers have a significant risk of TB. The mining environment as well as miners living circumstances at work sites, all had a significant impact on TB prevalence.	(Batool, et al., 2017)
2017	Mine-related occupational variables have a role in the development of HCV among miners. HCV was more prevalent in miners than in the overall population.	(Batool, et al., 2017)

Occupational Health and Safety in Khyber Pakhtunkhwa

Table 3 presents that workers in mines face higher risks of injury and suffer from muscular-skeletal disorders, lung function disorders, hearing loss problems, and respiratory diseases. Gas, dust, roof falls, and fire are regular risks. Lack of knowledge and training in occupational safety and health measures and a lack of safety equipment are the root causes of incidents. Less experienced workers face many more difficulties than experienced workers.

Table 3. Studies on Occupational Health & Safety in Khyber Pakhtunkhwa

Khyber Pakhtunkhwa Province		
Year	**Findings**	**References**
2022	The workers' experience revealed a negative association with injuries compared to workers with less experience. The younger the age (25–35 years), the greater the likelihood of injury.	(Ali & Pal, 2022)
2020	According to the poll, more than half of the workers stated that the presence of gases, dust, and fire is a regular risk. Slides and falls, roof falls, and explosive-related dangers were all ranked higher by more than 60% of workers.	(Sherin et al., 2020)
2020	The findings showed that the majority of accidents occur due to roof falls between 10:00 a.m. and 12:00 p.m. From 1998 to 2019, there were 145 mining events registered, with 69 fatalities, 26 serious injuries, and 130 near misses. The study found that there is one death for every two mines in the Cherat coalfield.	(Shah et al., 2020)
2019	The study showed that 63.67% were diagnosed with pneumoconiosis and 36.32% did not. HRCT, PFTs and chest x-rays result were abnormal in the majority of miners.	(Maula et al., 2019)
2014	According to this study, 61% of miners suffer from muscular-skeletal disorders. Lack of training and knowledge of mine safety measures and not using personnel protective measures were the root causes of the incidents.	(Kibria et al., 2014)
2014	The study found that 77.75% have no knowledge of occupational safety and health measures and are not using proper safety equipment. A study also revealed that coal miners who had completed training faced fewer occupational issues as compared to untrained coal miners.	(Ishtiaq, Jehan, Rehman, Sardar, et al., 2014)
2014	The study found that 60.75% of miners suffer from musculoskeletal health issues. Another finding showed that 28.3% of miners had mining mishaps, whereas 71.7% had no history of mine accidents.	(Ishtiaq, Hussain, et al., 2014)
2014	Findings showed that 50% of coal workers face hearing loss problems. NIHP was common among miners.	(Ishtiaq, Jehan, Rehman, Naeem et al., 2014)
2014	The results revealed that 71% of coal miners experience occupational respiratory health issues due to high concentration of dust.	(Ishtiaq, Nawaz, et al., 2014)

Occupational Health and Safety in Balochistan

Table 4 shows that miners face respiratory, heart, and lung diseases due to the high concentration of dust and gases present in mines. Mine workers in Balochistan are illiterate and lack knowledge about the adverse impacts of dust and gases, which makes the situation more hazardous. Tiny mining structures cause back pain in workers, and the main cause of injuries is a lack of use of safety equipment.

Table 4. Studies on Occupational Health and Safety in Balochistan

Balochistan Province		
Year	**Findings**	**References**
2022	The study found that the tiny structure of the coal seam creates illnesses, and workers staying over their scheduled hours increase the frequency of sickness.	(Ayaz et al., 2022)
2021	Lower back discomfort was reported by 87.8% of respondents. In addition, they were diagnosed with a respiratory disease from exposure to hazardous gases during mining. 68.9% of the overall study group had been trapped within a mine at least once throughout their mining careers.	(Arif et al., 2021)
2019	This study compared the lung function results of coal miners, carpenters, and stone quarry workers. Coal miners had worse lung function than other working groups.	(Ahmed et al., 2019)
2017	The study discloses that only 3% of workers in Mach coal fields use goggles; the other 99.7% do not. Injuries occur due to a lack of body protection equipment.	(Asif & Saeed, 2017)
2013	As a result of the high concentration of coal dust and gases, workers suffer from respiratory disorders and heart issues. Sleepiness, shortness of breath, lung issues, and headaches were common among miners.	(Azad et al., 2013a)
2013	Miners in Balochistan are illiterate, not aware of the negative impacts of gases, and exposed to respiratory diseases.	(Azad et al., 2013b)

Occupational Health and Safety in Sindh

Table 5 illustrates some information about studies conducted in Sindh province on mining. The majority of workers were not sufficiently knowledgeable about occupational safety and health. Mining site conditions are not supportive, and almost all workers are suffering from musculo-skeleton disorder and body pain. Roof falls are the primary cause of accidents, and the presence of toxic gases are responsible for many diseases from which workers suffer.

Occupational Health and Safety in Gilgit-Baltistan

Table 6 shows the mining conditions in Gilgit-Baltistan. People in the twenty-first century confront obstacles such as inadequate education, safety, and technological advancement. Inadequate safety precautions are raising a number of concerns. Workers in gold mining (both male and female) are exposed to high concentrations of mercury.

Table 5. Studies on occupational health and safety in Sindh province

Sindh Province		
Year	**Findings**	**References**
2022	86% were unfamiliar with OSH, and the majority of workers reported that mining sites are not suitable for working. Back pain was reported by 88%, shoulder discomfort (76%), and leg pain (67%).	(Sahito et al., 2022)
2022	Almost all body parts of miners suffer from pain. 54% of sufferers experienced knee pain, 44% claimed foot disorders, 38% reported wrist disorders, 36% had shoulder pain, 16% had neck pain, 10% had elbow discomfort, and 2% had hip pain.	(Chalgri et al., 2022)
2021	The findings revealed that the concentration of hazardous elements (Pb) was found to be greater in workers. Stomach problems, renal disorders, osteoporosis, impaired immunological function, delayed sexual maturation, and hypogonadism in males are a result of high amounts of exposure to metals.	(Afridi et al., 2021)
2017	Most of the accidents occur due to roof falls and poisonous gases. The working condition is poor; workers are still using ancient methods and are not aware of the use of safety equipment.	(Panhwar et al., 2017)

Table 6. Studies on Occupational Health & Safety in Gilgit-Baltistan

Gilgit- Baltistan Province		
Year	**Findings**	**References**
2020	The study's findings showed that in the twenty-first century, miners have a lack of education, a lack of safety precautions, a lag in technical innovation in mineral mining, and tiresome physical work.	(Zeeshan, 2020)
2019	A variety of issues are occurring as a result of these unscientific mining processes and a lack of safety tools.	(Alam et al., 2019)
2016	Hg in any form exceeded the WHO and USEPA-permitted limits. Female urine, hair, and nails contain more Hg than male hair and nails.	(Riaz et al., 2016)

Review of Studies at National Level in Pakistan

Table 7 shows studies reveal that almost all miners had pain in their bodies (upper and lower back issues, knees, thighs, elbows, neck, shoulders, and hand pain) as a result of job circumstances. Furthermore, natural factors like mine collapse, rock falls, gas explosions, and mine blasting have the greatest per-accident fatality rate. Human error, a lack of suitable machinery, personal protective equipment, lack of safety training, heavy workloads, a violation of regulation, and haulage-related dangers have also been highlighted as the leading causes of accidents. It was discovered that the accident rate in Pakistani coal mines is higher than in China and India.

Table 7. Review of studies carried out at national level in Pakistan

Pakistan: National level		
Year	**Findings**	**References**
2022	Risk elements: Hours of working shift, no. of repetitions /minute, loading and unloading, dumping, tumbling and blasting operations, coal cutting.	(Arooj et al., 2022)
2021	Human error, a lack of suitable machinery, personal protective equipment, environmental risks, a lack of safety training, and a violation regulation, rock falls, haulage, and explosive-related dangers have been highlighted as the leading causes of accidents	(Sherin et al., 2021)
2021	It was discovered that the accident rate in Pakistan coal mines is high than China and India.	(Shahani et al., 2021)
2020	According to this study, Roof falls and gas suffocation were the major causes of all accidents. The number of incidents varied from 2006 to 2019, but was particularly high in 2019.	(Shahani et al., 2020)
2020	71.3% of subjects reported bodily issues. Participants did not use appropriate tools; lack of safety equipment and safety procedures; and there was a lack of training. Only 7.4% said they had training.	(Jiskani, Chalgri, et al., 2020)
2020	Upper and lower back issues, knees, thighs, elbows, neck, shoulders, and hand pain were common; almost all miners had pain in their bodies and rose as a result of job demands.	(Jiskani, Silva, et al., 2020)
2020	Pakistan has an unacceptably high average yearly increase in deaths per million tons of coal output (108.86%) when compared to India (-0.46%) and China (-23.81%). Furthermore, mine collapse, gas explosions, and mine blasting have the greatest per-accident fatality rate.	(Shahani et al., 2020)
2019	This study showed that between 2012 and 2016, 92 workers died in surface accidents, 85 perished in roof collapse occurrences, and 54 died in side falls. There were 455 accidents between 2012 and 2016. More than 76% of them were fatalities, while more than 23% were non-fatal.	(Jiskani et al., 2019)
2015	The primary cause of these injuries is hazardous practices with heavy workloads. Roof collapses accounted for 21% of all fatal incidents in Baluchistan coal mines in 2010. Workers are being impacted by mercury leaks from gold mines.	(Batool, 2015)

Thematic Analysis of the Research Studies

The findings in Table 8 show themes on which research studies were conducted. The main theme was the impacts of personal factors such as age, experience, and working hours on occupational safety which was covered by thirteen studies. Similarly, twelve research studies explore work-related musculoskeletal disorders like shoulder and neck pain, upper and lower limb pain, and foot and toe injuries that mine workers suffer during mining. Lack of safety training and procedures, and lack of equipment during mineral exploration were identified by eleven studies. Ten studies were conducted on deaths that occurred as a result of mining. Furthermore, eight research studies focused on respiratory diseases from which mine workers suffer due to high concentration of dust**,** and seven studies focused on accidents that occur as a result of rock falls and mine collapses during mining, due to which injuries occur. Lung diseases, such as pneumoconiosis,

were identified by six studies. Some research studies were conducted on the themes of lack of ergonomic awareness and ear problems, psychological issues, infectious diseases including tuberculosis and HCV, back pain issues, gas explosions, and skin infections, respectively.

Table 8. Thematic analysis of the studies (multiples options)

S. No.	Themes	Number of studies
1.	Effects of personal characteristics on occupational safety	13
2.	Work-related musculoskeletal disorders/injuries	12
3.	Lack of safety equipment and safety procedures	11
4.	Deaths	10
5.	Respiratory diseases	8
6.	Accidents/injuries	7
7.	Lung diseases	6
8.	Lack of ergonomics awareness	3
9.	Ear problems	3
10.	Psychological issues	3
11.	Tuberculosis	3
12.	Upper and lower back issues	2
13.	Gas explosion	1
14.	HCV	1
15.	Skin infections	1
	Total	

The primary contribution of this study is to review the existing literature on occupational health and safety in the mining industry of Pakistan. According to this study, workers who have spent their entire lives in this field suffer from a number of difficulties. Working conditions have a great impact not only on their physical health but also adversely affect their psychological health. Table 8 shows accidents and fatalities that occur due to the insufficiency of safety measures during mining. The findings of this study highlight that safety equipment and knowledge have a significant impact on mine workers' health.

Mining has a terrible accident and sickness record when compared to other economic sectors such as manufacturing, construction, and rail, earning it the reputation of being the most dangerous industrial sector (Hermanus, 2007). Mining workers face many difficulties and suffer from injuries, illnesses (McDermott, 1997) and musculoskeletal disorders such as neck pain and lower and upper back pain (Tawiah et al., 2015). Miners are suffering from respiratory diseases like pneumoconiosis and silicosis due to dust and gases. Mining areas are the pits of contagious diseases like TB (Nelson, 2013) and mines are hotspots of HIV disease (Batool et al., 2017). Mine workers are not getting any proper ergonomic training and education regarding occupational health and safety, which leads to disabilities and fatalities (Asif et al., 2017). They are not only damaging their physical health but also causing psychological disorders and stress (Tynan et al., 2016).

Workplace accidents occur on a daily basis as a result of a lack of preventive measures (Yilmaz & Alp, 2016). Previous research found sixteen key causes of mining accidents. (1) human error, (2) risky conduct,

(3) harmful activity, (4) lack of safety training, (5) lack of safety education, (6) new employee, (7) inadequate supervisory leadership, (8) insufficient organizational resources (9) mechanical failure (10) geological component (11) hazardous work environment (12) lack of a safety culture (13) poor safety records (14) lack of rules and regulations (16) and inadequate safety management (Ismail et al., 2021). In general, Pakistan's legal and regulatory framework governing mineral development is based on out-of-date legislative advice that does not contain modern mineral development technologies (Ashraf & Cawood, 2019).

Mine deaths are quickly becoming more commonplace than accidents due to the extremely hazardous working conditions (Salim, 2001). Workplace accidents occur regularly due to lack of preventive measures (Yilmaz & Alp, 2016). The primary issues that mine workers face include dangerous and unhealthy working conditions, low pay, and no social security benefits (Ali & Naveed, 2020). Even though miners' health and safety have improved throughout time, mining remains one of the most dangerous jobs (Sammarco, 1999).

Conclusion

The results of this meta-analysis revealed that occupational safety and health in the mining sector are determined by a variety of elements. Worker's health and safety is compromised due to lack of compliance to safety procedures during mining. The implementation of safety measures leads to a safe working environment for miners as well as improve their performance. The majority of workers are not trained and have limited knowledge about occupational safety and health. The impact of natural factors (gases and dust) can be minimized by using the safety equipment. The only way to reduce mining accidents is to enhance safety standards and implement a proper monitoring system.

It is concluded that Pakistani policymakers, mines and mineral development departments, and mining lease holders should ensure occupational health and safety in the mining sector. These include raising awareness on safe work practices, improving working conditions, implementing safety protocols and security standards, arranging medical examinations, providing access to modern equipment, dust control measures, and proper ventilation systems. Training workers on proper lifting, posture, and monitoring their health and wellbeing status, as well as increasing rest time and reducing working hours, can also contribute to achieving occupational health and safety (OH&S) in the mining sector.

Declarations

Ethical Approval: This study involves no ethical issues.

Authors Contribution: MB and SP both designed, wrote and reviewed the article.

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