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Occupational Health and Safety Practices Among Coal Mine Workers in Pakistan

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ABSTRACT

Coal mining operations lead to a wide range of health hazards that may cause serious injuries, deaths, and other health problems. The intricate relationship between health-related issues and occupational safety practices among coal mine workers in Pakistan. **Objective:** To identify occupational health issues and safety measures application among coal mine workers in Sindh, Pakistan. **Methods:** Descriptive cross-sectional study was conducted from Oct 2023- Feb 2024 by the department of community medicine and public health Sciences at the surrounding area of Lakhra coal mines, Taluka Manjhand, District Jamshoro, Pakistan. All the currently working individuals in the coal mines for the last six months, age 20 to 60 years and those who gave consent to participate in the study were included. **Results:** Out of 317 coal mine workers, total 36.6% cases had breathing difficulty, 31.9% were suffering from cough, 14.2% of the respondent had musculoskeletal issues, 59.3% had skin problems, 57.4% had eye problems, 9.1% of the cases had hearing problems, 14.0% cases were diabetics, 27.1% were hypertensive and 4.4% of the cases had cardiovascular disease. Only 3.8% of the respondent were trained on the proper use of safety measures by their organizations. **Conclusions:** Coal miners were suffering from numerous occupational health issues with predominance of respiratory illness along eye and skin related issues. No proper protective measures were practiced by the coal miners while no proper health facility, alternate oxygen and drinking water facility available for the coal mine workers.

INTRODUCTION

Occupational health hazards have been considered the main source of potential harm in terms of accidents, injuries, illness, disabilities, and deaths among workers at the workplace due to poor working conditions worldwide [1]. There are various health hazards reported such as physical, chemical, biological and psychological that may affect the workers in their related occupations [2]. According to the International Labor Organization (ILO) approximately 374 million workers suffer every year from non-fatal accidents in comparison, 2.78 million workers die due to occupational accidents and work-related disease worldwide [3]. Coal mining is one of the most hazardous professions because of its dangerous work and the high frequency of accidents. Coal mining operations lead to a wide range of health hazards that may cause serious injuries, deaths, and other health problems. Injuries sustained in the field and prolonged exposure to the coal are the two primary factors that contribute most to morbidity and mortality among coal workers [4]. Every year, thousands of coal mine workers die in accidents and suffer from many other associated factors such as dust inhalation, exposure to toxic chemicals, noise, vibration, and fire [5]. Pakistan has a high rate of coal mining occupation because the nation has abundant coal deposits and a sizable mining sector employing a big share of the labor force. The coal mining industry in the country has become more dangerous due to the lack of advanced technology, equipment safety, and safety knowledge and

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poor working environment [6]. According to the Pakistan Central Mines Labor Federation (2019), coal miners face a range of occupational health and safety hazards, including exposure to coal dust, gas explosions, and cave-ins while on average, over 200 workers lose their lives every year due to explosions related to coal mining throughout the country [7]. Coal workers are exposed to serious risk factors such as dust, vibrations, and high heat load as overloading of the upper extremities when working with heavy tools. Among these risk factors, mine dust contains a crystal form of silica that affects coal miners' health and life [8]. Chemical hazards are harmful to life and health it is the main source of infection in mining caused by dust particles attached to the nasal opening and entering into the breathing system and affect the lungs. The impact of biological hazards due to poor working conditions also causes the health problems such as snakebite, bacterial, viral and fungal disease [5, 8] Psychological hazards are related to long working hours, long-distance traveling, heavy workload, and poor working environment [9]. According to American psychological counsel, the feeling of job insecurity, poor working life, and unrealistic job expectation cause severe stress and anxiety in coal workers. This situation can develop chronic and costly diseases such as diabetes, heart disease, and other psychological disorders [9]. Keeping in view the harmful effects of coal mining and significant dangers they faced without any protective measures.

This study was designed to identify occupational health issues and safety measures application among coal mine workers in Sindh, Pakistan.

METHODS

Descriptive cross-sectional study was conducted by the department of community medicine and public health sciences, Liaquat University of Medical and Health Sciences (LUMHS), Jamshoro, Pakistan at the surrounding area of Lakhra coal mines, Taluka Manjhand, District Jamshoro from October 2023- February 2024. The Lakhra Coal Field is situated in Sindh, Pakistan's District Jamshoro. It is 27 km from Jamshoro to Sehwan along the Indus Highway, which runs parallel to the river's right bank. It is made up of 1309 square kilometers, of which 1206 were designated areas. The study was carried out after getting approval from the ethical review committee of LUMHS, Jamshoro, Pakistan (No. LUMHS/REC/-91) while permission from the senior manager Lakhra coal mine was also taken prior to the study. Moreover, informed consent was also taken from all the miners after explaining them the purpose of the study. All the miners currently working in the selected coal mines for the last six months, age 20 to 60 years and those who gave consent to participate in the study were included. Whereas, miners working outside the selected area, managers, supervisors, women and those not willing to participate were excluded. Non-probability purposive sampling technique was applied for the selection of participants. Whereas, sample size of 317 was obtained using open epi. Online sample size calculator by taking anticipated health hazards among coal miners of 25%, setting confidence interval at 95% confidence level and a margin of error at 5% [9]. Participants were inquired about their general information, about the occupational health issues and the availability of equipment's for their safety measures using a semi-structured written questionnaire regarding occupational health hazards and their safety measures. The questionnaire comprise of three different sections of total 30 questions. Section A includes the demographic and general information of participants, section B comprise of questions about the health related issues while the last section includes questions about the health safety practices, available protective equipment, health facilities, first-aid facilities etc. Health examination of all the participants was also performed by qualified medical doctor and findings were recorded in the pre-designed checklist. The data were entered and analyzed using SPSS version 26. All the qualitative variables were presented as frequency and percentages.

RESULTS

A total of 317 coal miners currently working in the selected coal mines were interviewed. Most 151 (47.6%) of the participants were of age 31-40 years, followed by 91(28.7%) aged 20-30 years, 60 (19.0%) 41-50 years and 15 (4.7%) of age 50 years. Table 1 was presenting the socio-demographic details of study participants. Majority, 282 (89.0%) were married while 35 (11.0%) were single. Based on the working experience, majority of participants had of >6 years whereas, most of them reported that their routine working hours were of 8-12 hours/day (Figure 1).

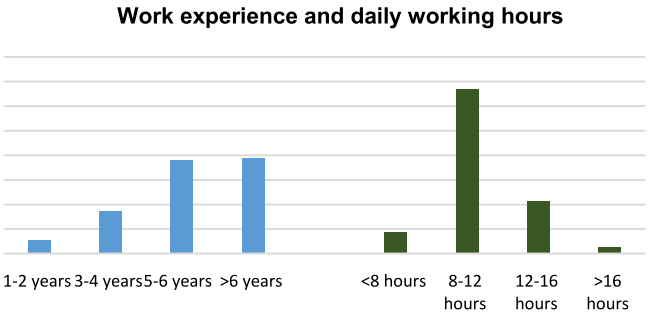

Figure 1: Working Experience and Routine Working Hours of Participants(n=317)

According to the health-related issues, majority of them were suffering from the breathing difficulty, having complaints of cough, had skin and eye related problems. Among the participants, majority of them were hypertensive(Table 1).

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Table 1: Health Related Issues among Respondents (n=317)

Variables	Criteria		Frequency (%)
History Difficulty in Breathing	No		116 (36.6%)
	Yes		201 (63.4%)
Suffering from a Cough	No		101 (31.9%)
	Yes	Cough with Sputum	77 (24.3%)
		Dry Cough	139 (43.8%)
History of the Musculoskeletal Problem	No		202 (63.7%)
	Yes		115 (36.3%)
Any Skin Problems	No		129 (40.7%)
	Yes		188 (59.3%)
Eye Problems	No		135 (42.6%)
	Yes		182 (57.4%)
Hearing Problem	Yes		29 (9.1%)
	No		215 (67.8%)
	Sometimes		73 (23.0%)
Do you have any of the following Existing Diseases?	Cardiovascular		14 (4.4%)
	Diabetic		46 (14.5%)
	Hypertension		86 (27.1%)

According to the availability of safety measures, only very few were trained on the proper use of safety measures by their organizations, while less than one-third were taking proper safety measures during work. Majority of them reported that there was an emergency safety exit plan (Table 2).

Table 2: Availability of Safety Measures According to Respondents (n=317)

Variables	Criteria	Frequency (%)
Does your Organization Provide you with Trainings on the Proper use of Safety Measures?	No	12 (3.8%)
	Yes	283 (89.2%)
	Don't know	22 (7.0%)
Are you taking Proper Safety Measures During Work?	Yes	38 (12.0%)
	No	262 (82.6%)
	Don't know	17 (5.4%)
	Helmet with Cap Torch	241 (76.0%)
What types of Equipment's for Safety Measures do you use at work?	Helmet with Cap Torch Safety Mask and Shoes	17 (5.3%)
	Safety Mask and Eye Goggles	06 (2.0%)
	Safety Gloves Only	12 (3.8%)
	Safety Mask Only	24 (7.6%)
	Safety Mask Only	17 (5.3%)
Is there any Emergency Safety exit Plan?	No	250 (79.0%)
	Yes	67 (21.0%)
Are there any Alternate Oxygen Facility in Mines?	No	210 (66.3%)
	Yes	73 (23.0%)
	Don't know	34 (10.7%)

Surprisingly, over two-third of participants reported that there were no health facilities provided by the company, while a very small number of participants reported that company providing them first aid facility within the coal mines' premises only. Regarding medical cost for any health related issue, over half of them reported that they themselves bear the treatment costs. Over two-third of participants reported that there were no safe drinking water facilities in the mine and they were not frequently washing their hands with soaps (Table 3).

Table 3: Evaluation of Health Care Status According to Respondents (n=317)

Variables	Criteria	Frequency (%)
Is there any Health Facility Provided by the Company?	Yes	85 (26.8%)
	No	232 (73.2%)
Is there Availability of medical Staff?	Yes	85 (26.8%)
	No	232 (73.2%)
Does the Company Provide you first Aid Facility within the Coal Mines' Premises?	No	283 (89.3%)
	Yes	34 (10.7%)
Does the company provide you periodic checkup?	No	303 (95.6%)
	Yes	14 (4.4%)
Who bears the Cost of Treatment?	Coal Worker	179 (56.5%)
	Company	138 (43.5%)
What is the Monthly Cost of Treatment if Paid by Coal Workers?	>4000	26 (8.2%)
	1000-2000	113 (35.6%)
	2000-3000	167 (52.7%)
	3000-4000	11 (3.5%)
Is there a Safe Drinking Water Facility in the Mine?	No	310 (97.8%)
	Yes	7 (2.2%)
Do you Frequently Wash your Hands with Soap?	No	240 (75.7%)
	Yes	77 (24.3%)

DISCUSSION

Coal mining is a dangerous occupation that exposes workers to various occupational health hazards. Coal mine workers were at risk of developing a range of health conditions due to exposure to dust, noise, and chemicals. Prolonged exposure to coal dust can lead to a range of respiratory diseases [10]. Current study has been done to evaluate the occupational health hazards among coal mine workers and its associated factors. In this study 36.6% cases had breathing difficulty, 31.9% were suffering from cough, 14.2% of the cases had musculoskeletal issues, 59.3% cases had skin problems, 57.4% had eye problems, 9.1% of the cases had hearing problems, 14.0% cases were diabetics, 27.15 were hypertensive and 4.4% of the cases had cardiovascular disease. Consistently Panhwar S *et al.*, reported that the health problems in the coal mine workers were a result of being exposed to these gases [11]. In the line of this series Ayaaba E *et al.*, also reported that "prevalence of asthma, pneumonia, bronchitis and emphysema were respectively 47.55%, 14.29%, 9.69% and 5.10%, while coughing was the most cited respiratory symptom (35.4%) [12]. High exposure to SO2 by populations living near power plants, led to them commonly suffering from suffocation, wheezing, coughing, and reductions of lung" function. In the current study, among the participating miners, 63.4% reported to have

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breathlessness while 43.8% were with dry cough and 24.3% with productive cough. Occupational health hazards among coal mine workers were a significant concern due to the potential impact on the health and well-being of these workers. There were several justifications for the concern regarding occupational health hazards among coal mine workers. Firstly, coal mine workers were exposed to high levels of coal dust, which can lead to the development of respiratory diseases such as pneumoconiosis, silicosis, and chronic bronchitis. These conditions can have long-term health consequences and can significantly reduce a worker's quality of life. Workers in underground coal mines were at varying risk of experiencing this kind of discomfort depending on their personal characteristics and work-related circumstances. Along with these respiratory, skin and eye related issues, many (36.3%) coal mine workers in this study reported to suffering from musculoskeletal problems. These findings were consistent with other Pakistani studies by Sarikaya S *et al.,* and Sahito WS *et al.,* that also reported high prevalence of musculoskeletal problems and body pain complaints reported by their study participant coal miners [13, 14]. Jeripotula SK *et al.,* and Yong X *et al.,* also reported the high incidences of musculoskeletal injuries and related issues among the coal mine workers in their study along with their related factors [15, 16]. It has been reported and documented that among the miners, coal miners suffer from different illnesses (such as respiratory conditions, gastrointestinal issues, headaches, musculoskeletal injuries, and bodily discomfort) that raises the cost of treatment among these workers [17]. Along with these Methane and carbon monoxide were two environmental factors that poses a significant health problem among these workers that further increase the health costs associated with coal mining [18]. In the present study, workers reported the high cost of health related issues among these workers. Additionally, only 43.5% workers reported that the cost of their health issues borne by company while 10.7% said company providing them first aid facility within the coal mines' premises. Furthermore, availability and applicability of safety measures in this study was found poor and only 3.85% of participants were trained on the proper use of safety measures by their organizations. Astoundingly, over two-third of participants (78.9%) don't even know about the safety exit plan in case of any sort emergency while 66.3% reported that they don't have any alternate emergency oxygen facility in their mines. Yang L *et al.,* reported that the safety difficulties in mining activities and the influence of IoT were found and grouped into three primary factors [19]. They further reported that these elements were general safety problems, environmental considerations, and mines information technology. Lately, mechanization and automation have been introduced into coal mines, which has led to increases in safety as well as productivity and cost savings. Tactlessly, human factors such as a lack of sufficient competence, lack of experience, perception error, and risky behaviors were the major causes of coal mining injuries [20]. Moreover, a lack of a thorough emergency rescue plan was another contributing factor. Unfortunately, these has been observed among the workers in this study which may result in some serious accident and cause fatal injuries. Most of the workers in this study reported that there was no safe drinking water facility available within the mine. The lack of safe drinking water facility in the coal mines is a critical issue that needs urgent attention. It can lead to serious health problems, such as dehydration and waterborne diseases, which can affect the productivity and well-being of workers [17]. The provision of safe drinking water should be a priority for mine owners and management to ensure the health and safety of workers. Due to time constraints and limited resources, only one coal mine of the province included. Moreover, limited access to the working sites and inclusion of more workers were the main constraints of the study.

CONCLUSIONS

The study concludes that coal miners were suffering from numerous occupational health issues with predominance of respiratory illness along eye and skin related issues. No proper protective measures were practiced by the coal miners while no proper health facility, alternate oxygen and drinking water facility available for the coal mine workers. It was recommended to conduct a study including large number of mines will give more insight of the challenges. Government and other stakeholders should focus such issues and policy-makers need to organize events and seminars for improving education and access to resources for workers from low socioeconomic backgrounds, improving safety regulations and enforcement, and ensuring that employers prioritize the safety and health of their workers, regardless of their level of education or socioeconomic status. By doing so, we can help protect the health and safety of workers in hazardous industries like coal mining, and ensure that they were able to work in safe and healthy environments.

Authors Contribution

Conceptualization: AAT
Methodology: TFM
Formal analysis: KNA, TFM, RS
Writing, review and editing: AAT, MIS, TFM, MUH

All authors have read and agreed to the published version of the manuscript

Conflicts of Interest

All the authors declare no conflict of interest.

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