Background

Mining is a hazardous occupation[1] and has many direct and indirect health risks. Workers working in these mines are exposed to loud noise, vibration, dust, heat, and humidity in mines affecting their ability to work efficiently.[2] The health hazards depend on the type of mineral being mined, related geological formations, the mining techniques employed, and workers’ general health.[3] The common physical damage was reported among the mine workers in the eyes, ears, lungs, skin, and injury could be placed anywhere in the body.[3]

Studies on mine workers underestimate chronic illnesses like silicosis because many develop the disease only after leaving the mining industry. This occurs due to the long latency of illness after exposure to dust.[4,5] A study carried out among former miners in South Africa and India found a heavy burden of silicosis and tuberculosis.[3‑10] Mine workers often need a physician to work without discomfort.[3] A primary care physician in the periphery of mines are heavily involved in the local health care system, they must be aware of mine workers’ health crises. However, it also raises the treatment and management of illness and is consequently associated with higher morbidity patterns among current and ex-mine workers in Karauli district of Rajasthan, India.

Abstract

Background: The mining industry has many hazards to which workers are exposed. Despite that, study on health hazards among mine workers are limited in India. Also, there are negligible studies on ex-miners in India. Thus, the present study tried to explore the current levels of self-reported morbidity among mine workers and ex-mine workers in the Karauli district of Rajasthan, India.

Methods: This study was a comparative cross-sectional study conducted in the Karauli district of Rajasthan, India. A total of 218 mine workers, 137 ex-mine workers, and 203 non-mine workers were interviewed. An interview-led questionnaire recording the presence of self-reported health problems and demographic information was administered. Self-reported symptoms were classified according to the categories defined in the operational definitions.

Results: Ex-mine workers moved away from mining due to respiratory problems (31%), weakness (24%), and TB (20%). Mine workers and ex-miners have significantly increased prevalence of respiratory-related symptoms and injury at the workplace, vision, and oral health problems than the non-mine workers. The adjusted odds of morbidity conditions such as cough up with blood, shortness of breath, and wheezing were significantly higher among ex-miners than current miners.

Conclusion: This study identified respiratory symptoms, injury, vision loss, hearing loss, and poor oral health for both mine and ex-mine workers. The higher self-reported health problems for symptoms like cough up with blood, shortness of breath, and wheezing were found among ex-miners than current mine workers.

Keywords: Former mine workers, operational definition, sandstone, self-reported morbidity, symptoms
medical care costs, impacting economically marginal families.\cite{12} Protective equipment is critical in any occupation where the risks are known and identified.\cite{13} Mining and quarry workers use personal protective equipment (PPEs) to limit hazards and diseases in the quarries.\cite{14} There is minimal use of PPEs among mine workers in India\cite{15,16} and across the world.\cite{14}

Quarrying and crushing are carried out in many parts of India,\cite{17} and there are about 2.5 million workforce in the mining sector in Rajasthan.\cite{18} They do drilling, blasting, crushing large stones into smaller ones, and loading–unloading the vehicles’ slabs.\cite{19} The most common morbidities reported among sandstone mine workers in India were silicosis,\cite{19,20} tuberculosis,\cite{21} dental caries,\cite{22} musculoskeletal disorders,\cite{23} and occupational stress.\cite{24}

While health effects and conditions are reported from mine workers around the world, it is imperative to identify the existing health problems among current mine workers as well as ex-mine workers in India, especially in the less explored district of Karauli in the state of Rajasthan which has 10 percent of state mining leases and 30 percent of state quarry workers.\cite{25} This study aims to evaluate the health of mine and ex-mine workers compared to non-mine workers by measuring levels of self-reported health problems.

**Material and Methods**

**Study design and setting**

A descriptive cross-sectional survey with a comparison group was conducted in the Karauli block of Karauli district [Figure 1] in Rajasthan, India, during May and September 2014 as part of a corresponding author Ph.D. program. Ethical approval for this study was obtained from the Institutional Ethics Committee of the International Institute for Population Sciences, Mumbai, India. The purpose of the study, voluntary participation, duration of the interview, and right to refuse or withdraw from participating from the study was explained to the respondents. Informed consent was obtained from all respondents. Privacy and confidentiality were ensured for each respondent.

**Participants**

The Karauli block was chosen in this study because 80% of the mining operations were in the Karauli block in the district reported by a non-governmental organization working on mining and stone workers. Ten villages were selected using probability proportional to size in the Karauli block to maintain heterogeneity in the sample. A house-to-house inquiry was carried out in each village chosen to approach the workers. The workers were selected at the researcher’s discretion, and others were not involved in the selection process. Workers in the age group above 15 years were included in the study. The workers were generally cooperative, and there were no refusals. The researcher stayed in villages to collect the data to minimize the cost, save time, and experience the respondents’ real-life situations.

**Sample size**

The total sample size for this study was determined based on the proportion of quarry workers in the entire working population in the district. The estimated sample size was 196 mine workers with a P of 0.15,\cite{26} type 1 error at 5%, and “d” is the absolute error of 5%. With the expectation of a 10% attrition rate, the final sample size of quarry workers was 218. To conduct a comparison, a sample of 137 ex-mine workers and 203 non-mine workers were also interviewed.

**Data collection**

A semi-structured interview schedule was used for collecting the information from quarry workers. The author undertook individual face-to-face interviews with respondents in their respective houses using a pre-tested questionnaire prepared by expert consultation and literature reviews. The present study includes sociodemographic variables on age, education, body mass index (BMI), caste, household size, monthly household income, exposure to loud noise, and TB treatment. Further, the family’s health profile was obtained on factors such as the death of a close family member due to illness, relationship with family members, and type of illness. Symptom-based questionnaires were used to capture illness among occupational groups. As it is cost-effective, enabling identification and diagnosis of patients with illness was done in a limited-resource setting.\cite{28}

**Operational definitions and outcome variables**

**Current mine workers** are sandstone mine workers who have at least 3 years of work exposure. **Ex-mine workers** are those who had worked earlier in mines but were currently not working in mines and **non-mine workers or comparison group** are the respondents who have not worked in mines and were living in the same villages. Non-miners were farmers, daily wage earners, carpenters, barbers, and salaried workers.
**Respiratory morbidities** were defined as the presence of cough, wheezing, chest pain, and shortness of breath experienced in the last 3 months and classified in this category. Cough up with blood – if blood was ever seen when coughing. **Hearing impairment** is classified as a symptom of decreased hearing capacity from the past. **Skin disorder** is categorized as a symptom of dryness and skin irritation of the skin. **Injury** is categorized as any injury reported during the work tenure such as a fall from rock, fall from a height, struck, or hit by objects. **Low Vision** issues indicate not being able to see from an arm's length and 20 feet was categorized as low vision. Respondents were asked questions such as how well you could see while reading or threading a needle and whether you have blurred distance vision or trouble seeing objects from a distance – like a road sign or nameplates, etc., Unexplained/unintentional weight loss was defined as unexplained weight loss in the last 3 years. There is no consensus on the definition for the duration of weight loss. Respondents were asked about unintentional weight loss through questions on a change in clothing size/friend or relative corroborating the weight loss/respondent’s estimate of the amount of weight lost. Weight loss is one of the symptoms of silicosis. **Cold** was defined as frequent cold from the last 3 months; among **oral health**, two questions were asked: loss of at least one natural tooth and recurring gum pain since the previous 3 months. Non-specific symptoms included frequent **headaches**, **dizziness**, and **fever** in the last 3 months.

**Statistical analysis**

Data were entered in Epi Info software, and the Statistical Package for Social Sciences (SPSS, version 25) was used for data analysis. Normally distributed continuous variables are expressed in mean (± SD) and categorical variables are presented as numbers (percentages). Qualitative and quantitative differences between two groups were analyzed by χ² test or Fisher’s exact test for categorical parameters and analysis of variance (ANOVA) test for continuous parameters, as appropriate. Logistic regression analysis was carried out to assess the reported symptoms in the exposed mining population after controlling for potential confounders. The statistical significance level was set at P < 0.05.

**Results**

Table 1 exhibits the profile of mine workers, ex-mine workers, and non-mine workers. The mean age of mine workers, ex-mine workers, and non-mine workers in the comparison group was 41 (± 11), 52 (± 12.3), and 41 (± 15.5) years, respectively. Illiteracy was higher among ex-mine workers (63%), while in mine and non-mine workers, it was 43% and 38%, respectively. The mean BMI was lower in ex-mine (18.5 kg/m²) workers compared to mine workers (19.4 kg/m²) and the comparison group (20.3 kg/m²). More than half (53 percent) of the mine workers and ex-mine workers belonged to scheduled castes. The average

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**Table 1: Profile of current mine workers, ex-mine workers, and non-mine workers**

| Variables          | Categories | Current mine workers n (%) | Ex-mine workers n (%) | Non-mine workers n (%) | Test, P     |
|--------------------|------------|----------------------------|-----------------------|------------------------|-------------|
| Age                | 31-45      | 118 (49.7)                 | 54 (32.9)             | 30 (15.4)              | χ²=38.6, <0.001 |
|                    | 46-60      | 67 (26)                    | 33 (19.7)             | 21 (11.2)              | F=9.01, 0.01 |
|                    | 60+        | 17 (7)                     | 20 (12.2)             | 33 (17.8)              | χ²=9.01, 0.01 |
| Mean (SD)          | 20.3±2.6   | 41.09 (11.0)               | 51.6 (12.3)           | 41.3 (15.5)            | F=32.5, <0.001 |
| Education          | Illiterate | 95 (43.6)                  | 87 (63.5)             | 78 (38.4)              | χ²=33.3, <0.001 |
|                    | Primary    | 53 (24.3)                  | 26 (19.0)             | 34 (16.7)              | χ²=6.04, 0.01 |
|                    | High school and more | 70 (32)                  | 24 (17.5)             | 91 (44.8)              | χ²=24.5, <0.001 |
| BMI                | <18.5      | 83 (38.1)                  | 74 (54.0)             | 72 (35.5)              | χ²=9.01, 0.01 |
|                    | 18.5-25    | 130 (59.6)                 | 58 (42.3)             | 111 (54.7)             | χ²=964.0, <0.001 |
|                    | 25+        | 5 (2.3)                    | 5 (3.6)               | 20 (9.9)               | F=14.0, <0.001 |
| Caste              | SC         | 116 (53.2)                 | 73 (53.3)             | 31 (15.3)              | F=113.2, <0.001 |
|                    | ST         | 23 (10.6)                  | 9 (6.6)               | 14 (6.9)               | χ²=5.7, 0.024 |
|                    | OBC        | 73 (33.5)                  | 48 (35.0)             | 126 (62.1)             | χ²=172.2, <0.001 |
|                    | General    | 6 (2.8)                    | 7 (5.1)               | 32 (15.8)              | FET=113.2, <0.001 |
| Household size     | ≤5         | 86 (39.4)                  | 68 (49.6)             | 109 (53.7)             | χ²=5.7, 0.024 |
|                    | >5         | 132 (60.6)                 | 69 (50.4)             | 94 (46.3)              | χ²=9.01, 0.01 |
| Mean (SD)          | 20.3±2.6   | 19.4 (2.3)                 | 18.5 (3.2)            | 20.3 (3.6)             | F=14.0, <0.001 |
| Monthly income     | <4000      | 113 (51.8)                 | 52 (38.0)             | 57 (28.1)              | χ²=38.6, <0.001 |
|                    | 4000-7000  | 66 (30.3)                  | 43 (31.4)             | 57 (28.1)              | χ²=9.01, 0.01 |
|                    | 7000+      | 39 (17.9)                  | 42 (30.7)             | 89 (43.8)              | F=113.2, <0.001 |
| Exposed to loud noise | No       | 65 (29.8)                  | 78 (56.9)             | 188 (92.6)             | χ²=172.2, <0.001 |
|                    | Yes        | 153 (70.2)                 | 59 (43.1)             | 15 (7.4)               | FET=113.2, <0.001 |
| Treated for TB     | No         | 182 (83.5)                 | 69 (50.4)             | 197 (97.0)             | FET=113.2, <0.001 |
|                    | Yes        | 36 (16.5)                  | 68 (49.6)             | 6 (3.0)                | FET=113.2, <0.001 |
| Total              |            | 418                       | 137                   | 203                    |             |

Note: Normally distributed continuous variables are expressed in mean±SD, Categorical variables are presented as number (percentage). Qualitative and quantitative differences between two groups were analyzed by χ² test or Fisher’s exact test for categorical parameters and ANOVA test for continuous parameters, as appropriate.
family size of the respondent was around six for all three groups. The monthly income of more than half of the mine workers was less than four thousand. In contrast, these percentages among the ex-mine workers and the comparison group were 38% and 28%, respectively. Most of the mine workers (70%) reported being exposed to loud noise, followed by ex-mine workers (43%) and the comparison group (7%). Half of the ex-mine workers reported being treated for TB compared to mine (17%) and non-mine workers (3%).

The health profile of family members of the respondents is given in Table 2. More than half of the mine workers (53%) and ex-mine workers (57%) reported the death of family members due to sickness. Furthermore, most of the deceased were fathers of mine workers (87%), ex-mine workers (84.5%), and non-mine workers (65%). The main reason for the death of a family member was due to respiratory-related causes (either TB, asthma, or silicosis) reported by mine workers (90.4%) and ex-mine workers (88.6%). The non-mine workers reported less death (64%) due to respiratory-related causes.

The prevalence of self-reported signs and symptoms among mine workers, ex-mine workers, and non-mine workers is shown in Table 3. Mine workers and ex-miners have a higher prevalence of most signs and symptoms as compared with the comparison group. Table 4 shows the binary logistic regression analysis to measure the adjusted odds ratio (AOR) of association between mine workers, ex-mine workers, and reference groups with self-reported signs and symptoms, controlling for potential confounders. The table has two models, 1 and 2. In model 1, reference category was a comparison group or non-mine workers, while in model 2, the reference category was mine workers. In model 1, the odds of most illnesses among mine and ex-mine workers were significantly elevated with the comparison group, controlling for potential confounders. However, in model 2, ex-mine workers have significantly increased odds of coughing up with blood (AOR = 5.41), shortness of breath (AOR = 2.37), and wheezing (AOR = 3.04) compared with current mine workers.

Figure 2 shows the reasons reported by ex-mine workers for leaving the mining activity. Significant reasons were respiratory problems (31%) followed by weakness (24%) and TB (20%).

Discussion

The present study shows the family member of mine workers (current and ex), especially the father who died through

### Table 2: Health profile of mine workers, ex-mine workers, and non-mine workers household

| Variables                                      | Current mine workers n (%) | Ex-mine workers n (%) | Non-mine workers n (%) | Test, P |
|------------------------------------------------|----------------------------|-----------------------|------------------------|---------|
| Any HH member (closed relation) died due to Illness |                             |                       |                        |         |
| Yes                                           | 115 (52.8)                 | 78 (56.9)             | 52 (25.6)              | NA      |
| No                                            | 103 (47.2)                 | 59 (43.1)             | 151 (74.4)             | $\chi^2$=43.9, <0.001 |
| If yes, relation with HH member*               |                            |                       |                        |         |
| Father                                        | 102 (87.2)                 | 71 (84.5)             | 34 (65.4)              | NA      |
| Mother                                        | 8 (6.8)                    | 3 (3.6)               | 11 (21.2)              |         |
| Brother                                       | 4 (3.4)                    | 5 (6.0)               | 1 (1.9)                |         |
| Son                                           | 2 (1.7)                    | 0 (0.0)               | 3 (5.8)                |         |
| Wife                                          | 1 (0.9)                    | 5 (6.0)               | 3 (5.8)                |         |
| Reported Illness*                             |                            |                       |                        |         |
| Respiratory related                           | 104 (90.4)                 | 70 (88.6)             | 34 (64.1)              | NA      |
| Other                                         | 11 (9.56)                  | 9 (11.4)              | 19 (35.8)              |         |

*Multiple response

### Table 3: Prevalence of self-reported signs and symptoms among Mine workers, ex-mine workers and non-mine workers

| Signs and symptoms                  | Current mine workers n (%) | Ex-mine workers n (%) | Non-mine workers n (%) | P* |
|-------------------------------------|----------------------------|-----------------------|------------------------|----|
| Chronic cough                       | 145 (66.5)                 | 102 (74.5)            | 44 (21.7)              | <0.001 |
| Cough up with blood                 | 20 (9.2)                   | 30 (21.9)             | 6 (3.0)                | <0.001 |
| Cold                                | 42 (19.3)                  | 42 (30.7)             | 7 (3.4)                | <0.001 |
| Headache                            | 36 (16.5)                  | 27 (19.7)             | 17 (8.4)               | 0.007 |
| Dizziness                           | 19 (8.7)                   | 13 (9.5)              | 3 (1.5)                | 0.001 |
| Fever                               | 60 (27.5)                  | 45 (32.8)             | 11 (5.4)               | <0.001 |
| Chest pain                          | 143 (65.6)                 | 95 (69.3)             | 28 (13.8)              | <0.001 |
| Shortness of breath                 | 118 (54.1)                 | 102 (74.5)            | 30 (14.8)              | <0.001 |
| Wheezing                            | 67 (30.7)                  | 73 (53.3)             | 16 (7.9)               | <0.001 |
| Weight loss                         | 33 (15.1)                  | 20 (14.6)             | 7 (3.4)                | <0.001 |
| Suffer injury at workplace          | 139 (63.8)                 | 83 (60.6)             | 52 (25.6)              | <0.001 |
| Hearing loss                        | 99 (45.4)                  | 70 (51.1)             | 13 (6.4)               | <0.001 |
| Problem in seeing 20 meters far     | 94 (43.1)                  | 80 (58.4)             | 31 (15.3)              | <0.001 |
| Problem in seeing arm's length distance | 96 (44.0)                 | 68 (49.6)             | 37 (18.2)              | <0.001 |
| Lost any of natural teeth           | 59 (27.1)                  | 54 (39.4)             | 29 (14.3)              | <0.001 |
| Gum pain in your mouth              | 76 (34.9)                  | 57 (41.6)             | 28 (13.8)              | <0.001 |
| Skin problem                        | 63 (28.9)                  | 29 (21.2)             | 29 (14.3)              | 0.001  |

*Chi square test
illnesses. This may be due to the fact that the fathers may be formerly working in mines. Mine workers start their job from an early age of 10 years as a helping hand to their family members, father, or elder brother. This could lead to the symptom of common cold, cough, chest pain, and shortness of breath after 10–15 years of service. The clinical signs and progression of silicosis disease are identical to tuberculosis.

Most were treated for TB by doctors in Karauli and given doses of directly observed treatment, short-course (DOTS).

In the present study, issues such as chronic cough, cough up with blood, cold, dizziness, fever, chest pain, shortness of breath, wheezing, weight loss, an injury at the workplace, hearing loss, problem in seeing from a distance of 20 m, problems in seeing at arm’s distance, loss of any of natural teeth, and pain in gums were higher among mine workers and ex-mine workers compared to the comparison group.

However, the study could not find any statistically significant odds of skin diseases among mine workers and ex-mine workers. Further, in the present study, the adjusted odds of cough up with blood, shortness of breath, and wheezing were significantly higher among ex-miners than current mine workers.

The study found the respiratory disease to be a common health risk among mine workers, of which primary symptoms are

| Outcome variables                        | Model 1 | Model 2 | Reference: Non-mine workers | Reference: Current mine workers |
|-----------------------------------------|---------|---------|-----------------------------|-------------------------------|
| Chronic Cough                           | 3.595 (2.001-6.456)* | 5.89 (3.263-10.645)* | 1.640 (0.933-2.880) | 0.28 (0.155-0.500)* |
| Cough up with blood                     | 2.37 (0.770-7.326) | 5.41 (1.923-15.27)* | 2.28 (1.073-4.849)* | 0.42 (0.136-1.299)* |
| Cold                                    | 4.96 (1.934-12.708)* | 8.83 (3.550-21.979)* | 1.78 (0.996-3.186) | 1.78 (0.996-3.186) |
| Headache                                | 1.59 (0.722-3.517) | 1.99 (0.905-4.362) | 1.247 (0.661-2.352) | 0.63 (0.284-1.385) |
| Dizziness                               | 6.74 (1.615-28.132)* | 6.08 (1.442-25.669)* | 0.90 (0.368-2.216) | 0.15 (0.036-0.619)* |
| Fever                                   | 5.09 (2.253-11.530)* | 4.28 (1.935-9.472)* | 0.840 (0.478-1.478) | 0.19 (0.087-0.444)* |
| Chest pain                              | 6.40 (3.429-11.959)* | 7.039 (3.808-13.010)* | 1.10 (0.636-1.901) | 0.16 (0.084-0.292)* |
| Shortness of breath                     | 4.01 (2.090-7.708)* | 9.51 (4.962-18.231)* | 2.37 (1.325-4.239)* | 0.25 (0.130-0.479)* |
| Wheezing                                | 2.32 (1.098-4.893)* | 7.05 (3.460-14.382)* | 3.04 (1.741-5.321)* | 0.43 (0.204-0.911)* |
| Weight loss                             | 4.84 (1.714-13.692)* | 3.935 (1.397-11.081)* | 0.81 (0.379-1.739) | 0.21 (0.073-0.583)* |
| Suffer injury at workplace              | 2.15 (1.247-3.707)* | 2.394 (1.388-4.131)* | 1.11 (0.668-1.857) | 0.46 (0.270-0.802)* |
| Hearing loss                            | 3.61 (1.589-8.222)* | 5.58 (2.535-12.310)* | 1.54 (0.843-2.833) | 0.28 (0.122-0.629)* |
| Problem in seeing 20 meters far         | 3.43 (1.753-6.713)* | 4.73 (2.472-9.068)* | 1.38 (0.809-2.356) | 0.29 (0.149-0.571)* |
| Problem in seeing arm’s length distance | 2.47 (1.321-4.642)* | 2.03 (1.110-3.718)* | 0.82 (0.481-1.399) | 0.40 (0.215-0.757)* |
| Lost any of natural teeth               | 2.42 (1.192-4.938)* | 2.27 (1.147-4.500)* | 0.93 (0.531-1.650) | 0.412 (0.203-0.839)* |
| Gum pain in your mouth                  | 2.63 (1.375-5.032)* | 2.72 (1.448-5.107)* | 1.03 (0.612-1.747) | 0.380 (0.199-0.727)* |
| Skin problem                            | 1.38 (0.713-2.683) | 1.25 (0.636-2.464) | 0.90 (0.510-1.607) | 0.723 (0.373-1.403) |

The model is controlled for age, education, BMI, caste, household size, monthly income, exposed to loud noise, substance use. *Significant relation, bivariate logistic regression was performed.

![Figure 2: Reasons reported by ex-miners for leaving mine industry (n=137)](image-url)
breathlessness, chest pain, wheeze, and cough[32] and associated with duration of exposure.[33] This was similar to findings of studies on Nigeria,[34,35] Zambia,[36] and Pakistan.[37]

The present study showed the higher odds of unexpected weight loss among mine workers and ex-mine workers. The reason for such findings could be improper food habits or lack of nutritional food required for quarry work or heavy physical work. Weight loss is one of the symptoms of silicosis and TB.[38] So, unexpected weight loss could also be a symptom of the early stages of silicosis, which usually go unnoticed. However, this is just a possible explanation which is needed to be further explored with clinical examination.

Within the mining industry, noise exposure is one of the risks that cause hearing loss. During the mine operation, the quarry workers used a drill machine, which had a noise level of more than 90 dBA which is the maximum permissible limit.[39] The present study found higher odds of self-reported hearing loss among mine workers and ex-mine workers. Research findings in Tanzania[40] and India[41] also show the risks of hearing loss among mine workers.

Poor vision in either near or far viewing is a major risk among mine workers in the present study. This problem has been also found in Ghana mine workers[42] as well as by studies on Indian mine workers.[43] The major hazards against which eye protection is needed at the workplace are projectiles, chemicals (splashes and fumes), radiation (especially visible light, ultraviolet (UV), and infrared), and heat.[44] Common projectiles in the mining industry include pieces of screwdriver blades, drill bits, grinding wheel, metal debris, rock, steel rod, and dust.[3]

Adjusted odds of self-reported skin problems were not found significant in the present study but were found as significant risks among mine workers in South Africa[45] and Pakistan.[46]

In the present study, adjusted odds of injury at the workplace were higher among mine workers and ex-mine workers compared to the comparison group. Risks of injury in the mining occupation were found to be significantly higher in the Province of Katanga, Democratic Republic of Congo (DRC)[44] and Ghana.[46] The basic causes of high injury rate among mine workers are unsafe behavior and insufficient mine design, unanticipated geological conditions, inadequately maintained equipment, inadequate supervision, or a combination of these factors.[46]

The present study also revealed that 16.5% of mine workers and 49% of ex-mine workers were treated for TB. Tuberculosis or TB, which is the clinical complication of silicosis called as silico-tuberculosis, is still a significant public health concern in low- and middle-income countries. Silica-exposed mine workers with or without silicosis are at increased risk for tuberculosis. The risk of a patient with silicosis developing tuberculosis is higher (2.8 to 39 times) than a healthy individual.[47]

Ex-miners generally have a greater risk of mortality than working miners and the general population, and this ill-health contributed to exit from mining.[48] The reasons to move away from mining reported by the ex-mine workers are respiratory (31%), weakness (24%), TB (20%), injury (12%), silicosis (5%), and low vision (4%). These illnesses were prevalent among people employed in the mining sector.[8]

The present study is also relevant to the practice of primary care physicians. A previous study reported that mine workers were aware of the mining hazards.[46] Thus, primary care physicians at the local level play an essential role in educating the workers about the symptoms of the disease to look for and the importance of early diagnosis and educating them about safety at work, food hygiene, and promoting a healthy lifestyle. Silicosis is an irreversible, progressive, incurable disease, but it is preventable if intervention is done quickly. Hence, attempts must be made towards primary and secondary prevention.[46] Our study has some limitations, including the non-use of scientific instruments (like audiometry, spirometry, etc.) and not doing clinical examination to evaluate workers’ health problems. This work was a part of the author's Ph.D., and there were resource and budget constraints. The sample size for ex-mine workers was not representative. The respondents may have overestimated the symptoms and the mining-related health problems in this study. However, we attempted to address this issue by using operational definitions.

**Conclusion**

This study found that mine workers and ex-mine workers have poor health conditions due to mining only. Some symptoms like cough with blood, shortness of breath, and wheezing were higher among ex-miners than current mine workers. Globally, evidence has already identified mining as a hazardous profession. The mine workers suffer severe medical conditions due to mining operations, which worsens when mining is done informally. Based on this study’s findings, efforts to reduce the disease burden among the ex-mine workers should address the above-identified risk factors. Further research is needed among ex-mine workers with an adequate sample size to identify ways to decrease the health risks by reducing hazards at work and increasing safety measures used by mine workers in the Karauli district in Rajasthan.

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**Conflicts of interest**

There are no conflicts of interest.

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