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Occupational Health Vulnerability among Informal Mica Scavengers in Domchanch Block, Koderma District, Jharkhand: Evidence from a Cross-Sectional Study

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Abstract

Mica scavenging continues to serve as an important means of earning livelihood for economically disadvantaged groups living in the areas where mica deposits are found in Domchanch, Koderma, Jharkhand, India. In spite of its economic significance, the occupation exposes the workers to dangerous conditions, which are detrimental to their physical and psychological well-being. The present study aims at investigating the health impacts of mica scavenging on the workers by identifying the frequency of occurrence of chronic lung disorders, physical disorders, and psychological problems. The research design employed for this study was cross-sectional, while primary data was collected through a structured questionnaire from the workers who practice mica scavenging informally.

Based on the findings, it is clear that there is an extremely high prevalence rate of respiratory diseases such as cough, difficulty in breathing and chest pain among the respondents as a consequence of their constant exposure to the dust. In addition to that, the results revealed the presence of a lot of musculoskeletal problems, chronic fatigue, skin irritation and body injuries among the respondents due to heavy physical activities and risky mining practices. Moreover, there are a large number of people who suffered from anxiety, depression, mental stress and occupational burnouts due to their precarious economic condition and hazardous working conditions. The hypothesis suggesting the presence of a significant correlation between mica scavenging and negative health outcomes of physical and psychological nature is proved by the statistical analysis.

The findings clearly show that it is time to take action against these occupational health issues through proper interventions such as conducting health check-ups regularly, providing personal protective equipment, improving safety conditions in workplaces, diversifying livelihoods and implementing strong policies related to informal mining areas.

Keywords: Mica scavenging, Occupational health, Respiratory diseases, Musculoskeletal disorders, Mental health, Informal mining, Jharkhand

1. Introduction

Minerals have traditionally played an important role in economic development through the promotion of industries, employment, and innovation. Of all such minerals, mica is particularly important due to its

outstanding heat resistant quality, electricity insulating property, and flexibility. Mica finds uses in the manufacturing of electrical and electronics items, cosmetic products, paints, plastics, rubber, construction material, and renewable energy technologies. The country has been among the major suppliers of sheet mica in the past decades, with Jharkhand, Bihar, Rajasthan, and Andhra Pradesh having vast deposits of mica in the country. Out of these regions, Jharkhand is among the main suppliers of mica in the country.

In spite of the economic importance of the mineral, decline in the formal mica industry following mine closure, regulations, and other factors has resulted in a fast-growing informal mica mining activity. Thousands of households in the districts of Koderma and Giridih continue to rely on mica mining for survival through collection of mica scraps from abandoned mines and forest areas. The activity is characterized by low income, lack of any legal protection, poor infrastructure, and occupational hazards. Workers, including women and adolescents, frequently engage in physically demanding tasks without protective equipment or access to basic health services.

Occupational health has been established as an important element of sustainable development since healthy employees help in increasing economic productivity and social well-being. But, workers involved in informal mining continue to be one of the most vulnerable occupational groups owing to their continuous exposure to harmful environmental and work hazards. Mica scavenging entails constant exposure to fine mineral dust, repetitive physical labor, excavating of fragile mine debris, lifting heavy loads and working for long periods under extreme climatic conditions. These occupations result in higher chances of suffering from acute and chronic diseases.

Respiratory diseases represent one of the most severe health problems facing mica scavengers. Inhalation of dust from mica and silica leads to constant coughing, difficulty breathing, chest pains, wheezing and decreased lung capacity. Prolonged exposure to such dust may result in respiratory diseases as well as other disorders caused by dust which decrease the quality of life and productivity of workers. Lack of respiratory protection measures and ignorance about health problems arising out of occupation add to these health problems. Simple activities such as digging, bending, carrying heavy mineral loads, walking for miles on uneven terrains, and working in abandoned pits cause back pain, joint problems, muscular weakness, fractures, cuts, skin allergies, and musculoskeletal injuries. All these health problems go unnoticed as a result of the lack of proper medical facilities, inadequate finances, and informal work settings. As a consequence, the workers keep working under poor health conditions which lead to low efficiency and increased vulnerability.

Health problems are not limited to physical diseases; they can also have an impact on psychological wellbeing of people. The informal workers who scavenge mica experience prolonged stress due to unstable earnings, high market rates, dangerous conditions of work, debt problems, alienation, and lack of job security. Such factors can lead to anxiety, depression, exhaustion, occupational burnout, and decreased life satisfaction. Mental illnesses are especially alarming since they tend to go undetected and untreated in poor rural areas with low healthcare development and poor awareness of mental disorders.

Occupational exposure and its consequences for health have been well studied through studies done in the mining and extractive industries in the developing world. Most research conducted has found high instances of respiratory conditions, musculoskeletal conditions, workplace injuries, and psychological effects amongst miners operating in hazardous environments. Notably, most studies carried out have focused mostly on formal mining, coal mining, or mining of large minerals. Relatively, not much empirical work has been done on informal mica scavengers even though the occupation is known to be

hazardous and many rural households are increasingly becoming dependent on mica mining for livelihoods.

In the case of Jharkhand, available literature mostly covers issues of child labour, poverty, dependence of livelihood on mica mining, and socio-economic aspects of mica mining. While there are studies that identify occupational hazards, there are no empirical studies that concurrently measure respiratory illness, physical illnesses, and psychological conditions among informal mica scavengers. Also, few empirical studies have applied survey data and statistical hypothesis testing to determine the relationship between occupational exposure and health outcome.

Filling such a gap is especially crucial since the informal mining industry falls beyond the purview of several occupational safety regulations and public health programmes. Absence of empirical evidence makes it difficult for policymakers and development agencies to design effective interventions that would meet the health concerns of mica mining-dependent communities. Identifying the magnitude of the occupational health problems is thus a key step to improve the well-being of miners, increase their productivity, lessen their healthcare burden, and ensure sustainable rural livelihoods.

In view of the above, the current study explores the occupational health effects of mica scavenging in the mica producing areas of Jharkhand. In particular, this study tries to find out whether involvement in mica scavenging is related to higher incidence of chronic respiratory diseases, physical ailments, and mental health problems among workers. Through descriptive and inferential analysis of survey data, the research provides empirical evidence on the multiple aspects of health problems arising from mica scavenging. The results of the research will add to the existing literature on occupational health problems in informal mining industries while providing practical policy implications as well.

2. Review of Literature and Research Gap

2.1 Occupational Health in Informal Mining

One of the areas that have received considerable attention in recent years is occupational health in the realm of labour studies, public health, and environmental science because of the increased awareness about health risks at workplaces among vulnerable groups. As the ILO and WHO note, safe working conditions constitute an essential part of sustainable development and decent work (International Labour Organization [ILO], 2022; World Health Organization [WHO], 2022). At the same time, workers in the informal economy are still subjected to high levels of occupational risks on account of insufficient regulation, access to healthcare facilities, protective equipment, and labour standards enforcement (ILO, 2018; WHO, 2022).

Informal mining is considered one of the most dangerous occupations around the world. In contrast to organised mining operations, informal mining includes manual mining operations, no engineering support, unsafe excavations, and low levels of occupational safety (Hentschel et al., 2002; ILO, 1999). Studies carried out in Asia, Africa, and Latin America show that informal miners are exposed to a number of health risks, such as respiratory diseases, musculoskeletal problems, work-related accidents, and disabilities (Basu et al., 2015; Steckling et al., 2017; World Bank, 2019). Occupational health risks of informal miners are aggravated by the presence of poverty, poor nutrition, and restricted access to preventive healthcare (WHO, 2022).

2.2 Respiratory Health Hazards among Mining Workers

Occupational diseases of the respiratory system are among those occupational diseases of miners that have been studied the most thoroughly. Exposure to mineral dust, silica particles, and suspended

particles has negative consequences on the respiratory system of workers and results in increased probability of occurrence of various types of respiratory diseases (NIOSH, 2019; WHO, 2022). It has already been shown in previous studies that workers engaged in mineral mining were more prone to suffer from chronic cough, difficulty breathing, wheezing, bronchitis, decreased lung capacity, and pneumoconiosis (Leung et al., 2012; Cullinan & Reid, 2013).

The severity of respiratory disease depends on the length of occupational exposure, dust concentration, the usage of protective devices, and ventilation at work (NIOSH, 2019). Workers who engage in informal mining do not have an access to protective devices or medical check-ups, which makes them prone to suffer from chronic respiratory diseases (ILO, 2022). It has been shown that long-term exposure to mineral dust causes chronic respiratory impairment and decrease of labor productivity (Leung et al., 2012).

During the process of mica scavenging, the working environment poses a very dangerous situation since the workers extract, classify and transport mica pieces manually under dusty conditions without proper protective devices. Constant exposure to dust from mica during its extraction and handling significantly increases the probability of experiencing respiratory irritation and developing various pulmonary diseases (Terre des Hommes Netherlands, 2016; Somvanshi et al., 2020).

2.3 Physical Health Issues and Work-Related Injuries

The work in mines involves a lot of physical work that includes digging, lifting, bending, walking and transporting loads on uneven terrain. As a result, musculoskeletal problems have emerged as one of the main occupational health issues faced by mining workers (Punnett & Wegman, 2004).

Several studies have identified high incidences of chronic back pain, neck pain, joint problems, muscle fatigue, bone fracture, cuts, abrasion and repetitive strain injuries among the miners (Basu et al., 2015; Punnett & Wegman, 2004). Such health problems tend to lower the productivity, lead to higher absenteeism and lower earnings in the long run (WHO, 2022). Informal miners are more susceptible to work-related injuries due to insufficient funds and poor access to medical care facilities (ILO, 2018).

Additional research conducted on artisanal and small-scale mining also suggests that lack of proper infrastructural development at the workplace poses high accident risks (Hentschel et al., 2002; World Bank, 2019). Collapsing excavation sites, loose rock formation, sharp mineral fragments, and poor safety mechanisms put workers in danger of suffering both minor and major injuries. The same occupational hazards can be observed in abandoned mica mines where scavengers manually collect leftover mica from loose rocks and abandoned pits (Somvanshi et al., 2020).

2.4 Psychological Well-being in Informal Mining

In addition to physical health, occupational health involves psychological well-being of employees. Recent literature indicates an increasing understanding about the contribution of risky occupations in causing anxiety, depression, emotional exhaustion, stress, and occupational burnout (WHO, 2022; Harvey et al., 2017). Unstable economy, uncertainty about jobs, unpredictable income, exclusion from society, and stressful physical environment constitute some of the main factors contributing to poor mental health in informal workers (ILO, 2018).

Occupations within extractive industries often involve constant mental stress due to riskiness of work conditions, unpredictable payoffs, and uncertainty about living conditions (Harvey et al., 2017). Such stress factors have impacts on emotional well-being as well as on physical health, family harmony, and the quality of people's lives in general. Often, such problems as mental disorders go unnoticed due to

social stigma, lack of awareness, and insufficient access to mental health care in rural areas (WHO, 2022).

Recent studies indicate that informal mining workers experience significantly higher rates of psychological problems compared to workers employed in relatively steady jobs (Steckling et al., 2017). Yet, mental health issues still get comparatively little academic attention in the field of occupational mining studies.

2.5 Mica Scavenging in Jharkhand

Jharkhand is still one of the largest mica-producing states in India with many families making their living through mica harvesting (National Mineral Development Corporation, 2021; Terre des Hommes Netherlands, 2016). With the shutdown of legal mining in the region, informal mica scavenging became a way of earning for poor people living near the abandoned mines (BGR, 2019).

Literature on Jharkhand mainly deals with issues such as poverty, dependence on livelihood, use of child labour, educational underdevelopment, gender participation, and chain governance in mica mining (Terre des Hommes Netherlands, 2016; Somvanshi et al., 2020). Several studies have noted socio-economic vulnerability of the miners' families and lack of other employment options leading to dependence on mica scavenging (BGR, 2019).

While all of these studies have recognized dangers associated with the job, not many have focused on health consequences of the occupation through household surveys. Hence, empirical literature on health consequences of adult miners has remained scattered (Somvanshi et al., 2020; Terre des Hommes Netherlands, 2016).

2.6 Research Gap

The review of existing literature reveals several important gaps.

First, while there has been extensive study on occupational health in the context of formal mines, there are very few studies that have studied occupational health of the informal mica scavenging population in Domchanch, Koderma. Occupational health, while important, has had relatively less empirical study in contrast to areas like livelihood dependency, children labor, poverty, environmental degradation, and supply chain challenges.

Second, while past literature focuses on specific aspects of health separately, illnesses affecting respiration, musculoskeletal injuries, work-related injuries, and mental well-being have not been collectively studied under the umbrella of occupational health.

Third, there has been an inadequate number of quantitative empirical studies using household surveys and statistical hypothesis testing to assess the relationship between occupational hazards and multidimensional health issues faced by mica scavengers.

Fourthly, psychological wellbeing is one of the most neglected aspects of research into mica mining. Though cases of economic deprivation and unsafe working conditions have often been cited, there is very little empirical data on cases of anxiety disorders, depression, stress, and occupational burnout among the informal mica miners.

Finally, there is a lack of policy-relevant research that could assist in the development of occupational health programs, preventive health care programs, and alternative livelihood projects for the informal mining communities.

This paper will fill this gap in knowledge by providing empirical insight into the occupational health impacts of mica scavenging through an examination of respiratory diseases, physical illnesses, and psychological impact based on primary data obtained from mica scavengers of Jharkhand.

3. Materials and Methods

3.1 Study Area

This research is based in Domchanch block of Koderma district in Jharkhand, which together form one of the country's most significant belts of mica mining areas. In the past, it has been well-known for its abundant reserves of high-grade mica and has had mining-based occupation for decades. After the end of organized mining activities in the area, a large number of people in the area started engaging themselves in illegal mica scavenging in abandoned mines and forests. The lack of alternate sources of livelihood due to the poor economic conditions of the community makes them more dependent on mica gathering. Thus, it provides a suitable geographical region to investigate the health impacts of informal mica scavenging.

3.2 Research Design

In this study, a descriptive and analytic cross-sectional research design was utilized to examine the health condition of mica scavengers. The quantitative research methodology was used to determine the rate of occurrence of respiratory disease, physical problems, and psychological conditions among the respondents. The primary data collection was done through a survey at one instance using a questionnaire.

3.3 Objectives of the Study

The specific objective addressed in this paper is:

To examine the occupational health impacts of mica scavenging on workers engaged in informal mica collection in Jharkhand.

3.4 Research Hypothesis

The study empirically tests the following hypothesis:

H_1: *Mica scavenging activity results in significantly higher rates of chronic respiratory diseases, physical ailments, and mental health problems such as anxiety, depression, and burnout among mica scavengers.*

3.5 Sampling Procedure and Sample Size

The research was conducted through survey data obtained from the households engaged in mica scavenging in Domchanch. A well-structured sampling approach was applied to select respondents who directly participated in mica collecting as the main or auxiliary source of income. Villages that had more household's dependent on mica were chosen among the study districts, and then appropriate respondents were interviewed through a standard questionnaire. A total sample size of 200 respondents was taken and where selected through purposive sampling.

The selected respondents comprised adult mica scavengers belonging to various ages, education, occupation, and household. The selected respondents were a good representation of the occupations of informal mica scavengers in the study area.

3.6 Data Collection

The primary data were collected through personal interviews utilizing a pre-tested questionnaire. The main objective of the questionnaire was to collect the data on demographic characteristics, occupational exposure, dependence on occupation, working conditions, respiratory symptoms, physical ailments, psychological well-being, access to healthcare services, and occupational health practices. The health-related part of the questionnaire had the following measures to measure:

- Respiratory health (cough, difficulty breathing, chest pain, wheezing, and others symptoms)
- Physical health (musculoskeletal pain, tiredness, injuries, dermatitis, and other physical symptoms)

- Psychological health (stress, anxiety, depression, exhaustion, and burnout) Categorical and Likert-type scales were used for recording answers.

3.7 Variables Included in the Analysis

Dependent Variable

Health status of mica scavengers in terms of occupational health, which was defined by three dimensions:

- Respiratory illnesses
- Physical ailments
- Psychological health problems

Independent Variable

- Mica scavenging and occupational exposure

Control Variables

In order to better interpret the results of the research, some socio-economic variables were taken into account, such as:

- Age
- Gender
- Education
- Size of family/household
- Occupational experience
- Daily working hours
- Income
- Duration of engagement in mica scavenging3.8 Statistical Analysis

The data collected was then coded, classified, and analyzed using suitable software for statistical analysis. Frequencies, percentage, mean and standard deviation were computed to provide a description of the respondents' demographics and occupation.

In order to test the hypothesized relationship, inferential statistics appropriate to the kind of variable was used to establish the degree of association between occupational exposure through mica scavenging and respiratory diseases, physical illnesses and psychological issues. Statistical significance was determined at the common 5% significance level ($p < 0.05$).

3.9 Ethical Issues

Respondents were allowed to participate voluntarily. They were briefed on the study's objectives, and their verbal informed consent was secured before the data was collected. Confidentiality and anonymity were ensured in the whole process of the research. Personal identification data were not included in the dataset for analysis, and the data collected was intended for academic research purposes only.

3.10 Scope of the Study

This paper analyzes the hypothesized relationship about the occupational health effects of mica scavenging. Therefore, the scope of the analysis is limited to respiratory diseases, physical illnesses and psychological problems experienced by the respondents.

4. Results and Discussion

4.1 Occupational Health Status of Mica Scavengers

Exposure to hazards in the workplace is one of the most important factors influencing the health status of miners working informally. In order to examine the first research question, the respondents were

asked how often do they experience various physical and psychological health problems in the course of their participation in mica scavenging.

4.1.1 Physical Health Consequences

According to the analysis, physical morbidity is quite common for miners engaged in mica scavenging. Eye diseases proved to be the most common health problem with 91.5% (n = 183) of participants admitting that they experienced eye irritation or other issues of similar kind. Constant exposure to mica dust, particles in the air, and work under the sun without protective glasses is likely to cause these disorders.

The second most common health problem experienced by the participants was back pain affecting 91.0% (n = 182) of respondents. Repetitive bending, squatting, carrying heavy mineral loads, and moving over irregular ground are physically strenuous activities. 90.5% (n=181) of the participants mentioned persistent cough and other respiratory conditions as their health complaints due to the harmful influence of inhalation of fine mica dust throughout extraction, collecting, and transportation processes.

Similarly, skin diseases, irritations, and allergies experienced by 89.5% (n=179) of respondents can be related to continuous contact with mineral particles and poor sanitary conditions in the workplace. Frequent illness suffered by 88.5% (n=177) of respondents is a result of occupational exposures, malnutrition, and lack of medical care affecting the overall health condition of mica scavengers.

Workplace injuries were reported by 85.5% (n=171) of respondents. These injuries were caused by unstable abandoned mines, sharp rocks and minerals, manual extraction process, and lack of occupational safety measures such as protective equipment and safe working practices.

Composite physical health score was calculated as between 3 and 17, with mean value being equal to 9.90 (SD=2.76), and median value equals 10. This set of statistics suggests that there is no isolated incidence of illness among the population sample but there is a consistently high level of physical morbidity. Low standard deviation means that poor physical health condition is common for all respondents regardless of their individual characteristics.

4.1.2 Mental Health Outcomes

The findings further reveal that psychological distress is widespread among mica scavengers. The most frequently reported symptom was a lack of enthusiasm, experienced by 95.5% (n = 191) of respondents, indicating reduced emotional well-being and diminished motivation. Feelings of anxiety or nervousness were reported by 94.5% (n = 189) of respondents, reflecting the psychological strain associated with hazardous working conditions, financial insecurity, and uncertainty regarding future livelihoods.

Additionally, results show that psychological stress is common among mica scavengers. The most common symptoms were the absence of enthusiasm among 95.5% (n=191) respondents, which implies poor emotional well-being and demotivation. Anxiety and nervousness were common among 94.5% (n=189) of respondents, pointing at psychological stress due to the dangers related to work, insecurity about their financial situation and worries about the future livelihood.

Significantly, 94.0% (n=188) of respondents felt that their life has no sense, implying the presence of depressive symptoms among the population studied. Moreover, 93.0% (n=186) were conscious about their heartbeat due to the stress, whereas 92.5% (n=185) were unable to relax. Overall, the results imply the fact that psychological stress is integral for the experience of workers involved in informal mica scavenging.

The mean value of composite mental health score is equal to 10.53 (SD=1.93), median is 11, and the range is between 5 and 15. High value of mean and low dispersion of data demonstrate the fact that psychological stress is not an isolated problem of a particular group of people.

Table 1: Prevalence of Reported Health Problems among Mica Scavengers

Health Indicator	N	%
Eye problems	183	91.5
Back pain	182	91.0
Respiratory symptoms	181	90.5
Skin disorders	179	89.5
Frequent illness	177	88.5
Work injuries	171	85.5

Note. *n* = Number of respondents reporting the health problem at least sometimes (Never excluded); *N* = 200.

4.1.3 Discussion

The study results offer substantial evidence that informal mica mining poses serious occupational health dangers for both physical and psychological health. High rates of the development of respiratory disorders, musculoskeletal disorders, eyesight problems, skin disorders, and occupational injuries show a long history of exposure to dangerous occupational environments due to air dust, manual labor, unsafe mining methods, and lack of occupational safety precautions.

Mental health indicators are no less alarming. High rates of anxiety, emotional exhaustion, hopelessness, and chronic stress demonstrate that occupational health of informal mica scavengers does not limit to physical diseases only. Economic instability, income uncertainty, unsafe working environment, and lack of social security systems seem to play an important role in the development of psychological health disorders. The presence of physical illnesses and mental health disorders together can lead to lower work capability, increased healthcare demands, and poverty cycle. This is corroborated by past research into occupational health among informal miners, which has found increased incidence of respiratory illness, musculoskeletal disorder, occupational injuries, and occupational stress due to their exposure to the hazardous working conditions of mining industry. This pattern has also been established in studies done on artisanal and small-scale mining wherein occupational safety, hard labor, and lack of access to health care services act together as risk factors for negative health effects. The current study further builds up on this evidence base through an exploration of the multidimensional occupational health problem faced by mica scavengers in Jharkhand including physical as well as mental health.

4.1.4 Hypothesis Testing

The hypothesis that mica scavenging leads to increased cases of chronic respiratory diseases, physical illnesses, and mental health issues among miners is corroborated by the descriptive analysis. Over 85% of respondents suffered from each of the physical health problems, and over 92% of them were suffering from the signs of psychological distress. In addition, the overall physical and mental health scores are indicative of poor health.

Thus, Hypothesis H_1 is proved (refer 4.1.1, 4.1.2), revealing that informal mica scavenging is linked with significant occupational health risks. The results clearly indicate the necessity of development of comprehensive occupational health policies, involving medical check-ups, provision of personal

protective equipment, awareness of health care issues, mental health assistance and alternative livelihood options for better quality of life of mica-dependent people.

5. Conclusion

This paper analyzed the occupational health effects of informal mica scavenging among the workers in the mica-producing areas of Jharkhand, India. The research revealed a clear pattern of adverse effects on both physical and psychological health of the workers engaged in mica scavenging. Most of the respondents experienced problems with their breathing, musculoskeletal system, eyes, skin, frequent illness, work accidents and injuries. Also, the high physical health score suggests that occupational morbidity is common rather than occasional among workers.

Another serious problem is related to psychological health of respondents involved in mica scavenging. High levels of anxiety, emotional exhaustion, feelings of hopelessness, stress reactions, difficulties relaxing show that the burden of mica scavenging affects not only physical health but also psychological state of workers. The combination of physical illnesses and mental disorders is evidence of multidimensionality of occupational vulnerability among informal mica workers. Harsh work conditions, long-term exposure to dust from minerals, difficult physical labour, unpredictable incomes, and inadequate healthcare lead to poor general condition of workers and decreased quality of their lives.

This research clearly demonstrates that there is a connection between scavenging of mica and prevalence of chronic respiratory diseases, physical illnesses, and mental disorders among workers. Thus, it can be concluded that occupation health is an important, yet often overlooked aspect of informal mining occupations. Solving the mentioned health-related problems requires recognizing the needs of miners who work informally in the framework of occupational health policies and rural development programs.

In addition to providing empirical knowledge, the study reveals the necessity of combining such aspects as occupational health, social security, and livelihood development in the policies aimed at informal mining areas. Improvement of workers' health is crucial not only for better lives of people but also for sustainable livelihoods and rural development.

6. Policy Implications

Implications of the results from this study have far-reaching consequences on the decision-making process and service delivery of policymakers, health practitioners, and development agencies in mining-affected regions.

To begin with, there is need for occupational health screening programmes that will enable early detection of respiratory ailments, musculoskeletal complications, skin ailments, and psychosomatic illnesses in the mica mining villages. Mobile health centres or community-based healthcare services will go a long way in making health services available to mining communities in remote areas.

Secondly, provision of appropriate personal protective gear including dust masks, protective gloves, protective foot wear and protective goggles should be made available to miners. Health awareness campaigns should also be organized to create awareness among workers on occupational risks, workplace hygiene, first aid services, and preventive health measures.

Thirdly, there is need for strengthening of occupational safety policies of the government relating to informal mining processes through collaborative efforts between government agencies, civil society organisations and public health agencies. Even if complete formalization of the sector might not be easy,

health and safety measures can considerably decrease workplace accidents and ill-health problems. Also, mental health must be integrated into the occupational health programme in mining areas.
Lastly, policy measures in the long run need to focus on livelihood diversification by building skills and vocational training, self-employment options, and promoting rural entrepreneurship. It is necessary to decrease reliance on the hazardous activity of mica mining for improving occupational health outcomes and overall well-being of the families.

7. Limitations of the Study

While the study provides useful empirical information, there are some limitations to the research. It used a cross-sectional design; hence, there is no way to conclusively establish causal relations between occupational exposure and health outcomes. Information about the health condition of individuals was mostly gathered from self-reports of participants and can be biased.
Moreover, the study was limited to only certain regions of mica mines in the state of Jharkhand. Clinical examination of the health status of miners and assessment of biomedical markers was out of the scope of the research, hence, there were no clinical diagnoses of health problems during the study.
Further research might consider using longitudinal study designs, incorporating health examinations, and comparing health status of informal mica miners with that of people living outside mines.

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