Quality of Life and Health Status of Inhabitants in and around Mines in Relation to their Socio-economic Status and Geographic Location of Mines - A Mixed-Methods Approach

Thesis

Submitted to

All India Institute of Medical Sciences, Jodhpur

In partial fulfilment of the requirement for the degree of

DOCTOR OF MEDICINE (MD)

(COMMUNITY MEDICINE)

JULY 2020

AIIMS, JODHPUR **DR. MUKUND GUPTA**

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DEPARTMENT OF COMMUNITY MEDICINE AND FAMILY MEDICINE

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CERTIFICATE

This is to certify that this thesis entitled "Quality of Life and Health Status of Inhabitants in and around Mines in Relation to their Socio-economic Status and Geographic Location of Mines - A Mixed-Methods Approach" is an original work of Dr. Mukund Gupta carried out under our direct supervision and guidance at Department of Community Medicine & Family Medicine, All India Institute of Medical Sciences, Jodhpur.

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DECLARATION

I, hereby declare that the work reported in the thesis entitled "Quality of Life and Health Status of Inhabitants in and around Mines in Relation to their Socio-economic Status and Geographic Location of Mines - A Mixed-Methods Approach" embodies the result of original research work carried out by undersigned in the Department of Community Medicine and Family Medicine, All India Institute of Medical Sciences, Jodhpur.

I further state that no part of the thesis has been submitted either in part or in full for any other degree of All India Institute of Medical Sciences or any other institution/University.

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Dr. Mukund Gupta

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List of abbreviations

COPD	Chronic Obstructive Pulmonary Disease
HRQOL	Health-related quality of life
IARC	International Agency for Research on Cancer
ILO	International Labour Organization
NIHL	Noise-Induced Hearing Loss
NIMH	National Institute of Mental Health
NIOSH	National Institute for Occupational Safety and Health
OSHA	Occupational Safety and Health Administration
PEL	Permissible Exposure Levels
PTB	Pulmonary tuberculosis
TB	Tuberculosis
TWA	Time-weighted average
WHO	World Health Organization

SUMMARY OF THESIS

Background

Rajasthan has its 0.5% geographical area under mining with more than 30,000 mines. The sandstones mine and mineral processing industry is present in 19 out of 33 districts of Rajasthan, employing around 71,000 mine workers (1). Mining is one of the most hazardous occupations. One of the most common causes of impurity in mine air is dust, which is released into the air from operations such as drilling, blasting, shovelling, and tipping (2).

Comparing with normal populations, residents of mining area had lower quality of life scores, which were influenced by chronic disease, job tenure for dust exposure, education and other factors (3). Among the principal health hazards in mines are those related to the poor quality of the air. The most common health hazards are caused due to dust exposure, noise, and vibration (4).

Most studies focus on the miners as an occupational group. Few studies exist regarding non-occupational silicosis developing in the vicinity of the mining regions (5). There is also lack of studies describing quality of life and socio-economic status of inhabitants in and around mines. The present study is being planned to study the quality of life and health status of inhabitants residing in and around the mines in relation to their socio-economic status and geographic location of the mines.

Aim

Aim of the study was to assess the quality of life and health status of inhabitants in and around mines in relation to their socio-economic status and geographic location of mines.

Objectives

1. to assess the quality of life of inhabitants in and around mines,
2. to assess the health status of inhabitants in and around mines,
3. to determine the association of socioeconomic status with quality of life, health status of inhabitants in and around mines,
4. to determine the association of quality of life and health status of inhabitants with distance from the mines through GIS mapping, and

5. to perform a situational analysis in implementation of the Government schemes and policies.

Methodology:

It was a mixed methods study. It had an analytical cross sectional part which was done in inhabitant in and around mines in Jodhpur district. A total of 15 mining zones were selected. The sample size was calculated and fixed to 181 households. All the members within the household were recruited in the study.

The qualitative part included taking up of in-depth interviews and focus group discussion of inhabitants in and around mines and key-informant interviews of stakeholders.

Results:

The majority of families (43.6%) belong to middle socio-economic class as per Modified B.G. Prasad's classification, 2021. Almost half (45.8%) of the adult participants were illiterate. Majority of the adult participants (56.4%) were involved in mining work currently or previously. Among them, 71.0% had been involved in high dust-producing work. About 39.2% of the workers were working for less than 10 years. The median scores of QOL domains were 50 for physical, psychological and social domains, whereas environment had the least score of 38. Among under-5 age group, 25.8% had stunting, 27.5% were underweight and 27.7% had wasting. Anthropometry of 6-10 years age group revealed stunting in 24.3% and underweight in 27.0%. For ages 11-18, stunting was found in 42.1%. Among the adult participants, 12.7% had h/o TB and 17.8% had h/o chronic lung disease, including those affected with silicosis (9.6%). Near about half (53.5%) had anaemia, 16.6% had hearing loss in the worse ear, visual impairment in better eye was present in 27.0%, 34.6% had one or the other musculoskeletal problems. About 58.1% of participants had h/o consumption one or more of substance use. Among the elderly ($\geq$ 60 years), 13.2% had zero ADL score in each of the six domains. Quality of life was significantly associated with distance from mines and per-capita income. Significant association of health status with age, gender and duration of work in mines was reported.

Conclusion:

The current study concluded that the quality of life of inhabitants in and around mines was poor and was affected by distance of households from mines and per-capita income.

The inhabitants had increased prevalence of chronic respiratory, musculoskeletal, and other morbidities. The situational analysis revealed the ground reality of government schemes and policies as well as the issues pertaining to implementation and disbursement.

Chapter 1: INTRODUCTION

India is one of the most prospective nations in terms of the exploration of mineral resources. A 2016 Human Rights report has stated that India's sandstone, granite, marble, and other stone deposits are abundant, allowing for long-term extraction and export (6). This makes the mining industry one of the key industries contributing to the national economy.

Madhya Pradesh state in India has the majority of mines recorded, followed by Gujarat, Karnataka, Odisha, Andhra Pradesh, Chhattisgarh, Tamil Nadu, Rajasthan, Maharashtra, Jharkhand, and Telangana (7). Rajasthan is one of the wealthiest states in terms of minerals in the country and produces about 30 different minerals. More than 85% of the country's potash, wollastonite, lead & zinc and silver resources are in Rajasthan (8). In addition, Rajasthan contributes to over 90% of India's sandstone sector (9). The sandstone mining sector in Rajasthan caters for the provision of construction materials. This requires surface mining which is more labour-intensive and less mechanized. Jodhpur occupies a vital position in the mineral map of Rajasthan. The major sandstone mining areas are in Jodhpur, Bundi, Alwar, Bharatpur, Karauli and Bhilwara districts. Mining and mineral processing are vital employers in 19 Rajasthan's 33 districts. As per the ‘Rajasthan Pneumoconiosis Policy’, Rajasthan is expected to employ over 3 million people directly and indirectly.

Mining has consistently remained one of the most dangerous industries (10). Multiple open pit or open cast mining processes, such as drilling, blasting, loading, transporting, and unloading, generate massive volumes of Particulate Matter (PM) to the external environment (11). Consequently, mine employees' welfare and quality of life are frequently compromised (12). Around 40% of the dust produced by mining activities is made up of coarse aggregates and particles larger than PM10, produced by natural processes like bulldozing, blasting, and driving on dirt roads, which mechanically disturb rock and soil materials (13). Dust within the size range of 0.5 to 3 micron pose maximum risk as these can easily enter the alveoli and causes the most harm (14).

Permissible Exposure Levels (PEL) for respirable dust have been established by federal agencies like Occupational Safety and Health Administration (OSHA) and National Institute for Occupational Safety and Health (NIOSH) to avert negative health impacts

from occupational exposure. OSHA limits a PEL for respiratory dust to 5.0 mg/m3 over an 8-hour TWA (time-weighted average) limit for workplace exposures (15). The permissible level is 0.05mg/m³ for respirable crystalline silica as per National Institute for Occupational Safety and Health (NIOSH) guidelines and Occupational Safety and Health Administration (OSHA) guidelines. The present PEL for free silica, as per Indian standards in mines, is 0.15 mg/m^3 (16).

Non-occupational exposures to respirable dust are hardly ever estimated or evaluated in the surrounding areas of mining activities. Residences close to mines are the leading cause of non-occupational PM exposures. Sandstorms in hilly areas and desert dust in low-lying areas are two natural sources of non-occupational exposure (17). A small amount of farming, building, and dismantling of buildings activities also increase environmental exposure (18). Non-occupational exposure from industrial sites happens when the dust is released from factories. It may be those of crushed quartz, mine and mill sandstones, grind agate, make ceramics, slate pencils or silica flour, and process granite. This affects people in the vicinity of mines or mining-related industries (19).

The majority of diseases caused by occupational dust exposure are incurable, result in permanent disability, and are entirely avoidable with the aid of current technology and control measures. However, due to the lack of workplace dust prevention measures, the disease's late diagnosis, and the scarcity of effective treatments, pneumoconiosis remains a serious global public health concern (14). Labourers in sandstone mines and other types of mines and quarries are susceptible to silicosis (16). Miners may also develop respiratory conditions like chronic obstructive pulmonary disease (COPD). Pneumoconiosis may coexist with these conditions or develop independently (20).

The development of pneumoconiosis generally takes several years. However, following brief intervals of intense exposure, silicosis can develop in rapidly progressing forms. Additionally, there is a rare variation known as mixed-dust pneumoconiosis (21). In low-income and some high-income nations, silicosis and silica dust-associated tuberculosis (TB) continues to rank highly on the priority list for occupational health (22). Workers' risk of contracting tuberculosis rises with prolonged exposure to silica, which also worsens existing pulmonary tuberculosis. Pneumoconiosis (including silicosis, bagassosis, anthracosis, and byssinosis), asbestosis, other chronic lung diseases, musculoskeletal injuries, noise-induced hearing loss, pesticide poisoning, and accidents

are the most common occupational diseases in India (23). Among mine workers, mortality accounting for lung cancer is estimated to be higher (20).

An independent risk factor for musculoskeletal disorders (MSDs) in miners is work-related stress. Inadequate recovery time, heavy manual labour and other strenuous physical work, non-neutral body postures (either dynamic or static) of the wrists, elbows, or shoulders, mechanical pressure concentrations, vibration (both segmental and whole-body), and low temperature all contribute to lower back pain among mining industry workers (24). Fumes, gases, dust, and debris can adversely affect the eyes and are among sandstone mines' widespread chemical and physical hazards (25). Exposure to occupational dust at work may worsen xerophthalmia in miners (26). Crystalline silica, such as quartz or cristobalite, has been identified as potentially carcinogenic to humans by the International Agency for Research on Cancer (IARC). The mining and construction industry workers have a higher risk of developing lung cancer due to higher levels of silica exposure and more extended periods spent in dusty environments (27). It has been proposed that the prevalence of diabetes mellitus and hypertension is higher among mine workers, which may be related to the stress of the working environment (28). There is a higher risk of overdose and death among miners because of the high rate of abuse of drugs and alcohol among them (29).

Mining has detrimental effects on the health and well-being of the population living near mines. The quality-of-life scores of inhabitants of mining areas were also lower than those of the general population, and these scores were affected by factors such as chronic disease, prolonged dust exposure, education, and other variables (3). Mine dust exposure outside the workplace can come from industrial and non-industrial sources (17). When the dust from manufacturing facilities such as those that crush quartz, grind agate, make ceramics, make slate pencils, mine sandstones, mill silica or make granite is released into the environment, it causes non-occupational exposure from industrial sources, which affects residents nearby (18).

WHO defines "*Quality of Life as an individual's perception of their position in life in the context of the culture and value systems in which they live and about their goals, expectations, standards and concerns*." This definition of quality of life places a strong emphasis on subjects' "perceived" quality of life, so it is not anticipated to provide a way to measure any specific symptoms, diseases, or conditions, but rather the impacts of

illnesses and medical interventions on quality of life (18). The WHOQOL-BREF tool "encompasses physical health, psychological health, social relationships as well as environmental health, which helps in producing a quality-of-life profile through assessing the individual's overall perception of quality of life and overall perception of their health" (31). The socioeconomic situation and general standard of living are abysmal due to lower levels of education, lack of access to sanitation facilities and housing, lack of ownership of assets and vehicles, and low per capita income (32,33). Studies on the overall state of Indian miners' health are scarce. Most research has concentrated on the frequency of pneumoconiosis, particularly silicosis. The lack of formal education, drinking, lung disease, having a large family, and engaging in risky behaviour that results in injuries have a direct or indirect impact on the lifespan of miners.

The legislation that governs the mining sector in India is *Mines Act 1952* and *Mines Rules 1955*. The Mines Act is an act to amend and consolidate the law regulating labour and safety in mines. It describes provisions such as drinking water, medical appliances, notification of accidents, certain diseases for miners' health and well-being, hours of work and rest, and extra wages for overtime for miners' benefit (34). The National Programme for Elimination of Silicosis aims to significantly reduce the prevalence of this fatal disease and eliminate it in workplaces by 2030, in accordance with the ILO and WHO's Global Programme for Elimination of Silicosis. Under this programme, preventive strategies are to be employed at all four levels- primordial, primary, secondary and tertiary (35). Pneumoconiosis is a notified disease under *The Factories Act 1948, The Mines Act 1952* and *The Building and Other Construction Workers Act 1996*. It is also notified under the *Rajasthan Epidemics Act 1957*. The mission of the Pneumoconiosis Policy of Rajasthan is prevention and control of this deadly occupational disease, aiming towards elimination and to provide relief and rehabilitation to affected persons. This policy aims to provide three lakhs as one-time assistance to the affected person, two lakhs to the legal nominee in the event of death of the pneumoconiosis victim, rehabilitation pension in case of disability, widow pension to the wife and funeral assistance of ten thousand rupees to the dependents of pneumoconiosis victims.

Chapter 2: AIM AND OBJECTIVES

Aim

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Objectives

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Chapter 3: REVIEW OF LITERATURE

A comprehensive search was conducted using a systematic search strategy in PubMed electronic database to retrieve work already done.

Table 1: Search strategy for review of literature

	Population	**Exposure**	**Outcome**
Inclusion criteria	Inhabitants in and around mines	Proximity to mines	Quality of life Health status Socioeconomic status Activity of daily living
Mesh terms	"Child"[Mesh] "Infant"[Mesh] "Adolescent"[Mesh] "Adult"[Mesh] "Young Adult"[Mesh] "Aged"[Mesh] "Miners" [Mesh]	"Mining"[Mesh] "Dust" [Mesh]	"Quality of Life"[Mesh] "Health Status"[Mesh] "Diabetes Mellitus"[Mesh] "Hypertension"[Mesh] "Pulmonary Disease, Chronic Obstructive"[Mesh] "Heart Diseases"[Mesh] "Cancer" [tiab] "Tuberculosis"[Mesh] "Pneumoconiosis" [Mesh] "Socioeconomic Factors"[Mesh] "Activities of Daily Living"[Mesh]

3.1 Inorganic dust

Natural stone can either be mined or quarried. It includes common stones such as limestone, marble, granite, and slate. The following types of inorganic dust are most frequently encountered in the mining sector in India:

Crystalline silica dust

Crystalline silica dust is generated from cutting, drilling, blasting, sieving, and even transporting silica-containing materials in the mining and quarrying industry. It is comprised of quartz and makes up 90-95% of sand (36).

Coal dust

Coal dust is generated mainly from coal mining activities. Coal is a by-product of decayed matter compressed over long periods (37).

Asbestos dust

Asbestos dust is generated from asbestos, consisting of soft, flexible fibres that are heat resistant. It may be found in large deposits or as contaminants in talc and vermiculite (38).

Metalliferous dust

Mining copper, iron, ore, tin, nickel, gold, silver, and zinc generates metalliferous dust. In addition, this mining releases respirable specks of dust from activities like drilling, extraction, crushing, and processing of minerals (39).

3.1.1 Effect of dust on health

Crystalline silica dust

Silicosis is caused due to exposure by respirable crystalline silica dust. There are three types- chronic, accelerated and acute. Silicosis in itself increases the risk of TB, COPD and kidney disease. The following types of silicosis have been described in the literature (36):

Chronic silicosis results from over-time exposure to low amounts of silica dust. It is the most common form of silicosis.

Accelerated silicosis happens as a result of exposure to a larger amount of silica over a short period. This is usually seen in blasting and drilling operations.

Acute silicosis results from short-term exposure to large amounts of silica dust (40).

Coal dust

Exposure to coal dust causes coal workers pneumoconiosis (black lung disease) (41).

Asbestos dust

Asbestos fibre, when inhaled, settles deeply into the lung, causing fibrosis (asbestosis) which, with time, may cause cancer (mesothelioma). Although no amount of asbestos is safe, the more asbestos exposure, the greater the chance of contracting an asbestos-related disease (42).

Metalliferous dust

Metalliferous mine dust can generate reactive oxygen species in biological tissues. In addition, iron-bearing minerals can cause inflammation in the lung (43).

3.1.2 Effect of dust on the environment

The majority of inhabitants residing in the neighbourhood of mines are likely to be exposed to various kinds of dust and are at risk of developing diseases. In a study done in two villages close to two different industries, one at a distance of 6 km from a slate pencil industrial area and the other 10-15 km away from agate industry, the prevalence of non-occupational silicosis was reported to be 12.6 and 5.8% respectively (5).

The scientific literature regarding the transport of airborne quartz is scarce, despite its toxic effect on the respiratory system. In a study in Central California, airborne quartz emissions were studied near a sand and gravel facility using PM_{10} and $PM_{2.5}$ filters. Samples were collected from four downwind sites at a distance of 22, 62, 259 and 745 meters from the facility and one upwind site at 1495 meters (44).

3.2 Mines

Mining is one of the most hazardous occupations. One of the most common causes of impurity in the air around the mines is dust released from operations such as drilling, blasting, shovelling, and tipping. Pneumoconiosis is caused by inhaling certain types of dust, one of which is mine dust. One of the more severe forms of pneumoconiosis is silicosis, caused by minerals containing abundant free silica, a substance widely encountered in the earth's crust (6).

3.2.1 Types of mines

Surface mining

Process for extraction of ore from the ground by the method of digging. It disturbs the land and causes environmental problems such as erosion and pollution (51).

Underground mining

Mining involves drilling and tunnelling to extract mineral deposits located deep below the surface of the earth (51).

Placer mining

Process of obtaining valuable mineral deposits from river sediments (51).

In-situ mining

Method to recover minerals from ores (51).

3.2.2 Effect of mining on the environment

Air- Surface mines produce dust, mostly from blasting operations. Smelter operations have the potential to pollute the air with heavy metals,

Water- The mining sector impacts underground water through its activity from both surface and underground mines. It may lead to the presence of various trace elements in water reservoirs.

Land- Mining activity impacts land severely.

Health and safety risks arise from the dust, leading to respiratory problems. Problems also arise from exposure to radiation (52).

3.2.3 Mining and India

Around 11 per cent of the global market, the sandstone industry is accounted by India. It ranks third in the production of natural stones (45). There has been a growth of nearly 8% per annum every year for the past 20 years in India’s export of natural stone.

Commercially viable stones are produced in the Indian states of Bihar, Uttar Pradesh, Orrisa, Gujarat, Rajasthan, Madhya Pradesh, Karnataka, Andhra Pradesh, Telangana and Tamil Nadu.

3.2.3.1 Mining and Rajasthan

Rajasthan provides around 18% of the total mineral in India. Rajasthan is only second to Odisha in terms of the geological prospects of mining. The mining sector in Rajasthan provides direct employment to about 8 lakh workers. The mining sector is largely unorganised, with indirect employment of around 22 to 25 lakh persons. It employs low skilled migrant population providing revenue generation for the rural economy and livelihood for the rural workforce of Rajasthan (45). The flooring and cladding of walls make up a large part of Rajasthan's natural stone market.

1.5% of households have their primary earnings directly from mining and quarrying. It is estimated that 184,000 households in Rajasthan earn their primary income from mining and quarrying (46).

3.3 Workers in mining industry

3.3.1 Sociodemographic profile of workers in mining

In primary research by ILO among two clusters of Udaipur-Rajsamand and Kota-Bundi, majority (34%) were from schedule caste, whereas other 30% were from schedule tribes and other backward classes. The "general" category constituted 5%. As per levels of education, most (40%) were illiterate, being significantly higher among women (74%). For others, the education majorly ranged between primary to middle school.

3.3.2 Wages in Mining

Male miners earned an average of INR 395 a day (INR 200-500) whereas female miners earned INR 256 on average per day (INR 200-300). The workers in the natural stone sector do not know about the minimum wage which applies to them, but they report the wage to be too low to cover their basic expenses of electricity, rent or even their children school fees (47). Less than 25% of workers are on a fixed monthly salary, with a majority on a daily wage rate. With such arrangements in the mining sector, the employer's accountability towards the employee is low, making the workers more vulnerable (47).

The floating and seasonal nature of the job among miners doesn't give sustained income or social security to them. The work is physically exhaustive and hazardous, which affects the health of a worker. Usually, symptoms of tuberculosis and silicosis start between the ages of 35 and 40. Medical expenses on these diseases usually result in indebtedness and perpetuation of poverty (46).

3.4 Mining and Quality of Life

Mining not only affects the workers who are actively engaged in mining activities but also effects the health of the population residing in the vicinity of mines. Moreover, comparing with normal populations, residents of mining area had lower quality of life scores. It is influenced by chronic disease, job tenure for dust exposure and education, among other factors (48).

3.4.1 Scales on Quality of life

Table 2: Scales on Quality of life used in previous literature

	WHOQOL- BREF (49)	**36-Item Short Form Survey (SF-36)** (50)	**HRQoL EQ-5D-3L** (51)	**Ferrans and Powers Quality of Life Index** (52)
Parameters	Physical health- Activities of daily living Dependence on medicinal substances and medical aids Energy and fatigue Mobility Pain and discomfort Sleep and rest Work Capacity Psychological- Bodily image and appearance Negative feelings Positive feelings Self-esteem Spirituality / Religion / Personal beliefs	Physical functioning Role limitations due to physical health problems Bodily pain General Health Vitality Social functioning Role limitations due to personal or emotional problems Mental health	Mobility Self-Care Usual activities Pain/Discomfort Anxiety/Depression Cognition	Health and functioning- Health Health care Pain Energy (fatigue) Ability to take care of yourself Control over life Chances of living long Sex life Ability to take care of family Usefulness to others Worries Things for fun Chances for a happy future Social and economic- Friends

	Thinking, learning, memory and concentration Social relationships- Personal relationships Social support Sexual activity Environment- Financial resources Freedom, physical safety and security Health and social care: accessibility and quality Home environment Opportunities for acquiring new information and skills Participation in and opportunities for recreation/leisure activities Physical environment (pollution/noise/traffic/climate)			Emotional support from people Neighbourhood Home Job/not having a job Education Financial needs Psychological/Spiritual- Peace of mind Faith in God Achievement of personal goals Happiness in general Life satisfaction in general Personal appearance Self Family- Family Health Children Family happiness

	Transport			Spouse, lover, partner Emotional support from family
Studies	Souza TP et al (53) Fan LB et al (54) Robledo-Martínez R et al (55)	Li Y et al (56) Cely-Andrade JL et al (57) D'Souza MS et al (58)	Butscher FM et al (59) Becker J et al (60)	D'Souza MS et al (61)

3.4.2 Studies related to mining and Quality of life (Global)

A study conducted among 348 male miners in Rio Grande do Sul, Brazil, by Souza TP et al (2015) (53) measured quality of life by WHO QOL-BREF, where miners aged between 18 and 70 years. Butscher FM et al (2020) (59) conducted a study among 207 people living in artisanal and small-scale gold mining areas where participants with a mean age of 38 years (18-72) majority male (82%). The median duration of working was ten years (1-48). HRQoL EQ-5D-3L was used to assess the quality of life, and 42.5% reported being in perfect health, while 57.5% reported being unwell. In addition, 4.3% of people living in the area were identified with chronic mercury intoxication (59). In another study among small-scale gold miners in Zimbabwe, Becker J (2020) (60) with a similar mean age of 35 years (19-70) with 50% having an income between 100$ and 500$ (7986-39931 INR) with 12% having an income of less than 100$. The average working age in mines is 7.5 years (median of five years). HRQoL EQ-5D-3L scale was used, and 7.7% reported mobility problems, 4.8% in self-care, 7.7% complained of pain/discomfort and 23.1% with anxiety/depression (14). Li Y et al (2019) (56), in a study in 1857, copper-nickel miners in China used SF-36 to measure the quality of life. 42.65% of the miners experience occupational stress, with the detection rate higher for males than females ($p=0.004$). Stressed miners had lower quality of life scores compared to non-stressed miners. This was suggestive that stress could reduce the quality of life of workers ($p < 0.001$) (7).

In a cross-sectional study by Souza TP et al (2015) among 348 male miners in Rio Grande do Sul, Brazil, HRQOL was assessed using the WHOQOL-BREF questionnaire. The workers aged 18 and 70 years have an average monthly income of USD 554 (369-693). There were significant differences between workers with silicosis in those without silicosis in terms of domains WHOQOL-BREF with physical health domain (16.66 ± 2.17 vs 13.92 ± 3.620; $p < 0.001$) and psychological domain (16.15 ± 2.04 vs 14.03 ± 2.670; $p < 0.001$). No difference was observed in the social relationship domain (17.28 ± 2.38 vs 17.18 ± 2.830; $p = 0.736$). The variability of the general health domain was due to dyspnoea, wheezing, FEV1, and pack-years of cigarette smoking. Respiratory symptoms, lung function, pack years of cigarette smoking, years of education, and average monthly income were contributing factors (62).

3.4.3 Studies related to mining and Quality of life in India

A study done by D'Souza MS et al (2013) to determine factors associated with HRQOL among Indian women in mining and agriculture. SF-36 scale was used, where 150 households were selected randomly from each community. It was found that women in the mining community had significantly reduced physical and mental Health and reduced SF36 scores compared with those in the agricultural community with fewer coping strategies in terms of social (69.7% and 80.5%), cognitive (20% and 60.2%), emotional (29% and 53.4%) and behavioural components (26.2% and 31.1%) respectively (58).

A study was conducted among 145 women in a rural mining region of Goa, India, by D'Souza MS et al (2011) to determine reproductive health and HRQOL among women in mining communities. Ferrans and Powers QLI was used as a tool to determine QOL. Reproductive health and quality of life were low among Indian women in mining communities, and most women in the mining community perceive dependence and financial insecurity due to the loss of agricultural fields, poor education and less work participation (61).

3.5 Health status in mining

3.5.1 Health, safety in Mining

Most of the workers in the industry work without any proof of employment. Due to this informal nature of the work, the workers have limited rights and the ability to hold their employers responsible, even in accidents. Due to the lack of accountability, not one case has been registered under the Employers Compensation Act in Rajasthan Court, and not one employer has been penalised in the last 12 years (47).

Workers face significant health and safety risks, notably lung disease and injuries. Other health conditions are linked to exposure to sharp tools, noise and vibrations, heavy machinery, and the risk of stone dust and other harmful substances.

3.5.2 Dust related morbidities

Among the principal health hazards in mines are those related to the poor quality of the air. Non-occupational or environmental silicosis is a global public health concern. Most dust-related diseases cause permanent disability and are invariably incurable. The most

common health hazards are caused due to dust exposure, noise and vibration. Pneumoconiosis and noise-induced hearing loss are notifiable diseases under *Mines Act 1952*.

3.5.2.1 Lung disease and Mining

Free crystalline silica, present in sandstone, quartz, slate, and other building materials, including tiles, bricks, and clay, is commonly associated with incurable lung disease, Silicosis. It is caused due to inhalation of silica dust. Workers breathe the dust generated during cutting, drilling, chipping, blasting, or mining. A report by Marshall, Taylor and Balaton-Chrimes estimates that 56% of mine workers in Rajasthan are affected by silicosis, amounting to well over 10 lakh people (63).

Silicosis is frequently associated with tuberculosis as silicotuberculosis. In addition, Silicotuberculosis and lung cancer are frequent causes of death among silicosis victims.

3.5.2.2 Studies related to lung disease and mining (Global)

In a study among 311 artificial stone workers from the province of Almeria (Spain), all workers were exposed to crystalline silica dust eight hours a day. Cutting was the most common work activity performed among 35.9% of workers with silicosis and 33.6% of workers without silicosis, a study by Requena-Mullor M et al (2021) (64). Chronic respiratory diseases, such as asthma and seasonal allergy, were observed in 43.7% of the workers with silicosis and in 38.9% of those without silicosis. In a study among 193 underground semi-precious stone mineworkers from Rio Grande do Sul, Brazil, by Souza TP et al (2018) (62), the age range was between 18 and 64 years, and the time of working in the mine was 14.7±8.7 years. The length of time working in mining negatively affected lung function. Spirometry showed 13 % with restrictive patterns and 9.3 % of the workers with an obstructive ventilatory patterns. Moyo D et al (2021) (65) did a study among 514 Artisanal and Small-Scale Gold Miners in Zimbabwe. 52 (11.2%) were diagnosed with silicosis (95% CI: 8.6–14.4) with two times the likelihood of having the disease with presence of comorbidities. The prevalence of TB was 4% (95% CI: 2.5–6.4). Cao YM (2011-2016) (66) reported 144 cases diagnosed as silicosis, with the incidence of silicosis at 4.5% and tuberculosis at 5.5% among 3190 excavation workers in Suzhou city, China. Similarly, Ramibiki E et al (2019) (67) 2013 conducted a study among miners in the Karonga, Rumphi, Kasungu and Lilongwe districts of Malawi. It was found that miners performing informal mining were 50% more likely to develop PTB than those in formal

mining (95% CI: 1.10-2.05, P=0.01). A total of 459 (23%) miners had presumptive TB. Among the population, only 120 (26%) sought health care. Hendryx M (2013) (68) conducted a study among 952 adults in rural areas of Kentucky mountaintop coal mining in Kentucky, USA. Current smokers were 208 (38.2%), and Smokeless tobacco use was found in 62 (11.4%) participants. Family cancer history (one or more family members with cancer) was found in 328 (60.3%) participants. Hypertension (14.4%), Asthma (18.2%) and COPD (25.9%) were also found in equally large numbers.

In a study by Amandus HE et al (69) among 1073 workers in 31 mines in Pennsylvania, the prevalence of chronic cough, phlegm, wheezing, and dyspnea was estimated in 518 men. A similar study by Ekosse G et al (2005) (70) among 600 residents were living within the Copper mine area in Botswana. About 33% of the individuals complained of persistent chest pains, and 49% complained of persistent, frequent coughing.

3.5.2.3 Studies related to lung disease and mining in Rajasthan

Raghav P et al (2018-2019) (71) conducted a study among 1604 mine workers in the Jodhpur district of Rajasthan. More than three fourth, 1263 (78.7%) of mine workers were male. The mean age of female workers was significantly higher than that of male workers. Widowhood was significantly higher among female workers, whereas the proportion of unmarried was significantly higher among males. The average family size was significantly larger for male workers (4.87 ± 1.93) compared to female workers (4.23 ± 1.98).

In another study in Jodhpur, India, among 174 mine workers in sandstone mines by Rajavel S et al (2017-2019) (72), the mean age of the mine workers was 39.13 ± 11.09 years with three fourth (75.3%) of the workers working for more than ten years in mines. Around 30% had a history of tuberculosis. The prevalence of silicosis was 37.3%, silico-tuberculosis was 7.4%, tuberculosis was 10%, and other respiratory diseases like emphysema and pleural effusion were diagnosed among 4.3% of workers.

3.5.3 Other morbidities in mining

A qualitative study was conducted on the health and safety of mine workers by Pelders J (2014) (39). It included 875 mine workers from three platinum, two gold, one coal, one diamond, and one manganese mine in South Africa. Respiratory diseases were mentioned by all participant groups. Chronic or non-communicable diseases, such as high blood

pressure and diabetes, were reported to be prevalent. Insufficient personal protective equipment (PPE) was also a potential cause of accidents. Fatigue and stress were additional safety risks. A quarter (24%) smoked, 27% drank alcohol more frequently than once a month, and 46% never exercised physically in their leisure time. Around half (51%) rated their quality of life as "good". 29% of the participants reported having at least one disease or disorder. High blood pressure was the most reported condition, followed by hearing loss, diabetes, tuberculosis, and silicosis. Fatigue was present in 16%, and 8% had a history of an accident at work within the last 12 months.

3.5.3.1 Studies related to other morbidities in mining

A study was conducted by Mawaw P M et al (2010) (73) in the Democratic Republic of Congo among 2749 employees in a mining workforce. The overall mean age of the workforce was 37.8 ± 8.9 years. Most study subjects (61.4%) were 40 years of age or less. The overall proportion of diabetics was 11.7%; females were significantly ($p < 0.05$) more affected than males (16% versus 10.2%). The workforce prevalence of hypertension was 18.2% and significantly ($p < 0.05$) higher in males than females. A similar study by Cao YM (66) among 3190 excavation workers in Suzhou city, China, reported Hypertension (37.5%) as the most common complication of silicosis patients, followed by abnormal electrocardiogram (26.3%) and diabetes (28%). In another study in China among 42,122 workers of age $\geq$ 20 years by Yang A M et al (2011-2013) (74), the prevalence of diabetes and prediabetes was found to be 7.5% and 16.8%, respectively. Current and former smokers accounted for 72.6% of male workers.

Prevalence of hearing loss in mining were 24% compared with 16% for all industries combined. This study conducted among 1.9 million workers across all industries (including 9389 in Mining) in the United States by Lawson Sean M (2006-2015) (75).

Kabongo KP and Naidoo S (2016-2017) (76), in a study among 225 female mineworkers in South Africa, stated that 50.22% of participants reported musculoskeletal pain over the last 12 months of working in mines.

Three hundred eleven respondents (28%) had high psychological distress. The most frequently reported stressors were financial stress (62%) and social isolation (60%); among others. This study was conducted among employees at construction and mining sites in Australia by Bowers J et al (2013-2015) (77).

A study was done by Nandi SS et al (2009) (78) among 150 workers in gypsum mines in India. Hypertension (22.6%), diabetes (8.8%), and musculoskeletal morbidity (8%) prevalence were significant in the participants.

3.6 Studies related to distance from mines and Quality of life, health status

Feder et al (2013) conducted a study to assess the quality of life among participants living in the vicinity of wind turbines participants aged 18–79 (606 males, 632 females) residing between 0.25 and 11.22 km from wind turbines. Noise from wind turbines for less than one year was associated with improved scores in the Psychological domain (p=0.0108) in comparison to those who had more than one year of hearing wind turbines. Physical and Environment domains (p=0.0218 and p=0.0372, respectively) had lower scores among participants who reported visual disturbance with wind turbines. Person who perceived personal benefit from wind turbines had higher scores in the Physical domain (p=0.0417) (79).

Kootbodien et al conducted a cross-sectional study in Johannesburg, South Africa, to assess environmental silica dust exposure. Three hundred ten participants in an exposed community residing within 2 km of gold mine tailings and an unexposed population residing more than 10 km from the nearest gold mine tailing were included in the study. Radiologically identified cases of PTB were 14.4% (95% CI 9.2-21.8) in the exposed and 7.5% (95% CI 2.8-18.7) in the unexposed groups. In addition, PTB prevalence was independently associated with previous diagnosis and treatment of PTB (OR = 8.98, 95% CI 1.98-40.34) and exposure to dust in the workplace from sand, construction, and mining industries (OR = 10.2, 95% CI 2.10-50.11) (80).

3.7 Laws, Policies, Schemes in Mining

The Mines Act 1952 calls for requirements for labour and safety and improving working conditions in mines. It defines owners' duty in mining operations, health and safety, encompassing accountability (81).

3.7.1 Institutions governing mining

The *Ministry of Mines of the Government of India, Indian Bureau of Mines, Ministry of Labour and Employment, Directorate General of Mines Safety (DGMS), Ministry of Environment, Forestry and Climate Change (MoEFCC) and Central Pollution Control Board* are a few of the Central Institution bodies regulating mining industries.

The state bodies are the *Department of Mines and Geology, the Rajasthan State Pollution Control Board and the Social Justice and Empowerment Department*. The social justice department is responsible for framing the pneumoconiosis policy and setting up a system to ensure detection, certification and treatment; screening and treatment; and administering the direct monetary benefits to pneumoconiosis victims.

At the district level is the *District Mineral Foundation Trust (DMFT)* with work of distribution of compensation for development and welfare in mining-affected areas. It also contributes to funds for *Rajasthan Pneumoconiosis Policy 2019*.

3.7.2 Social protection in Mining

3.7.2.1 Social protection in Mining in World

Based on a document on the National Programme for Silicosis Department of Labour, South Africa, states preventive measures to prevent silicosis. The policy states control measures like engineering (exhaust ventilation, wet drilling), vacuum cleaning equipment with HEPA filters, and providing appropriate respirators to workers. The policy also talks about providing medical surveillance for workers exposed to silica, having their X-rays read by ILO-certified specialists, and reporting all silicosis and pulmonary tuberculosis cases. Risk assessment and annual reporting are also used to assess trends in silicosis and TB (82).

3.7.2.2 Social protection in Mining in India

The workers in mining industries are entitled to social protection schemes such as the *Unorganised Workers' Social Security Act 2008, The Inter-State Migrant Workmen Act 1979, The Mines Act 1952 and the Employees' Provident Funds and Miscellaneous Provisions Act 1952*.

National Human Rights Commission, India, in a document on NHRC Interventions on Silicosis 2016, has directed that the occupational hazard of silicosis is preventable if the

working conditions are adequately regulated and proper warning and protective equipment are used. Preventive measures suggested include medical examination pre-enrollment and precautionary measures like protective gear and dust control devices. It also states the integration of the silicosis control programme with the TB control programme. Rehabilitative measures include offering an alternative job or a sustenance pension if they cannot work (52).

The stone miners with an income of less than 15,000 INR per month are entitled to Provident Fund, contributed by employers. In addition, employee state insurance provides medical and maternity benefits and compensations in events of injury, disability or death. Mineworkers also have the right to register with the *Rajasthan Building and Other Construction Workers Welfare Fund* to entitle them to additional compensation in events of injury or death.

3.7.2.3 Detection and Certification of Pneumoconiosis victims- Rajasthan Pneumoconiosis Policy

In September 2019, the Rajasthan government framed a policy on pneumoconiosis, including silicosis detection, prevention, control, and rehabilitation. The policy seeks to cover anyone exposed to the threat of dust, irrespective of the nature of their employment.

Based on *Rajasthan Policy on Pneumoconiosis 2019*, rehabilitation assistance of Rs. 3,00,000 as one-time assistance to Pneumoconiosis affected person after certification and Rs. 2,00,000 as assistance on death to the legal heir or nominee in the event of death of the Pneumoconiosis victim is to be provided. There is also a provision for funeral assistance after the death of patients with pneumoconiosis. The policy applies to any worker or person certified suffering from Pneumoconiosis due to exposure to dust in any occupation or from secondary exposure. It also applies to habitants residing in the neighbourhood of mines which are likely to be exposed to dust.

Chapter 4: METHODOLOGY

4.1 Study design

The study design was a mixed methods approach. It had quantitative and qualitative components:

The quantitative part of the study adopted an analytical cross-sectional design.

The study's qualitative part involved in-depth interviews, focus group discussions with inhabitants in and around mines, and key-informant interviews with the stakeholders.

4.2 Study area

The study setting was the residential area in and around the mines of the Jodhpur district in Rajasthan.

4.3 Study populations

Study participants were inhabitants from residential areas of the selected mining zones.

4.4 Sampling

4.4.1 Sample size calculation

4.4.1.1 For the objective of quality of life of individuals:

$$n_q = \frac{Z^2_{1-\propto/2}\, p(1-p) f k}{d^2}$$

(based on the Designing Household Survey Samples: Practical Guidelines by the Department of Statistical Division, UN) (83)

where,

n = sample size in terms of the number of individuals to be selected;

z = level of confidence, i.e., 5%;

p = As no studies are available on the quality of life among inhabitants in and around mines in India, an assumption with the prevalence of 50% having poor quality of life is taken;

f = design effect, assumed to be 2.0, is taken;

k = anticipated rate of non-response = 10%, i.e., k = 1.1;

d = margin of error to be taken (20% relative error) = 0.20 x 0.50 = 0.1 (10.0%).

$$n_q = \frac{(1.96)^2 \times (0.5) \times (0.5) \times 2 \times (1.1)}{(0.1)^2} = 211$$

Since two individuals from each household are taken, number of households = 211/2 = 106.

4.4.1.2 For the objective of the Health Status of individuals

$$n_h = \frac{Z^2_{1-\propto/2}\, p(1-p) f k}{d^2}$$

using the same formula

where,

n = sample size in terms of the number of individuals to be selected;

z = level of confidence, i.e., 5%;

p = estimate of a key indicator to be measured by the survey (prevalence of a disease); here, we take the prevalence of respiratory diseases among mine workers based on a previous study, which is 17% *(based on the study by Dubey K et al., 2017 submitted to NITI Aayog)* (84) ;

f = design effect, assumed to be 2.0, is taken;

k = anticipated rate of non-response = 10%, i.e., k = 1.1;

d = margin of error to be taken (20% relative error) = 0.20 x p = 0.034 (3.4%).

$$n_h = \frac{(1.96)^2 \times (0.17) \times (0.83) \times 2 \times (1.1)}{(0.034)^2} = 1032$$

In Jodhpur, Rajasthan, one household comprises 5.7 individuals on average (85). Since all household members will be assessed for health status, the number of households required to be studied will be 1032/5.7 = **181**.

Considering sample size calculations for both the primary objectives (Quality of Life = 106 and Health status = 181), a higher sample size of 181 households was taken.

4.4.2 Sampling technique

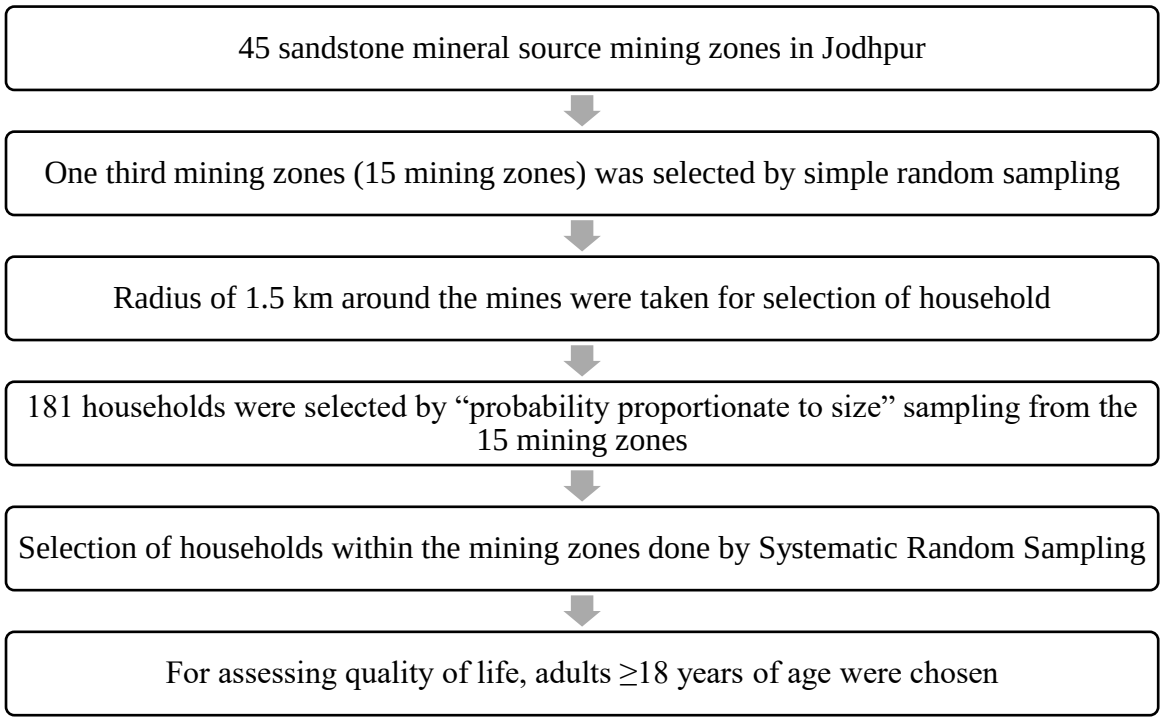

Figure 1 *Flow diagram of selection of mines, households and inhabitants in and around mines*

Lists of all mining zones were checked for in various documents and articles. Mapping and listing of all mining zones in the Jodhpur district were done by the geographic information system (GIS).

Figure 2 *GIS location of the mining zone in Keroo village in Jodhpur district*

Out of all 45 mining zones, 15 were selected by Simple random sampling using Chit Method (Sampling with replacement) (86).

In all the 15 mining zones, the Panchayat committee and field-level health workers asked for the approximate number of households within 1.5 kilometers of each. Households were listed from all 15 mining zones. The number of households in each was selected by probability proportionate to size sampling.

Table 3: List of selected 15 mining zones in Jodhpur district with number of selected households

SN	**Block**	**Area**	**Total no of HHs within 1500 m**	**Total no of selected HHs**
1.	Mandor	Chaukhan	120	18
2.	Mandor	Rohila kalan	20	4
3.	Mandor	Keroo	150	23
4.	Mandor	Barli	30	5
5.	Balesar	Hanwant nagar	5	1
6.	Mandor	Soorsagar	300	47

7.	Shergarh	Khirjan tidna	5	1
8.	Mandor	Thabukra	30	6
9.	Baori	Gangani	100	15
10.	Bhopalgarh	Khangata	150	22
11.	Bhopalgarh	Ratkuriya	100	14
12.	Shergarh	Setrawa	50	7
13.	Balesar	Thadiya	10	2
14.	Baori	Soyla	80	13
15.	Bap	Bari seer	20	3

The households within each mining zone were selected by systematic random sampling with a sampling interval of 6 HHs after rounding down to the nearest whole integer. Selection of HHs was started from the periphery of the mining zone and went outwards with an interval of 6 HHs. If members in households were not available or non-response, the next HHs were selected.

Figure 3 *GIS mapping to find out the distance of HHs from the periphery of the mining zone*

Within the households, all family members were included in assessing health status. However, only adults more than 18 years were recruited to assess the quality of life. Each household has one earning member and one dependent member chosen for WHOQOL BREF Checklist. Among the non-earning member, one was chosen by the Kish method (87). Therefore, if all members were earning, the second recruited member was also earning.

Purposive sampling was undertaken for selection of participant who was information rich, with answers deviant from already known literature were included to discover new areas of approaching the quality of life, health status and situational analysis of government schemes and policies. Deviant cases like participants with c/o morbidities, participants with h/o addiction, participants trying for certification to get rehabilitation assistance, participants receiving incomplete rehabilitation assistance, among others were selected to understand their different perspective from their peers. The participants were continued to recruit until no new themes emerged.

Table 4: Type of methods and participant list for qualitative research

Methods	**Participants**
In-depth interviews	Eight interviews of inhabitants in and around mines
Focus group discussion	Two- one in rural mining zone, other in urban
Key informant interviews	
Field level	Mine owner, E-mitra operator, NGO worker, ASHA, Medical officer
Administrative level	Ex-DTO, Pneumoconiosis board member

Pragmatism with combination of more than one paradigm were used for the purpose of mixed methods research to address the research question.

4.4.3 Integration process for this research

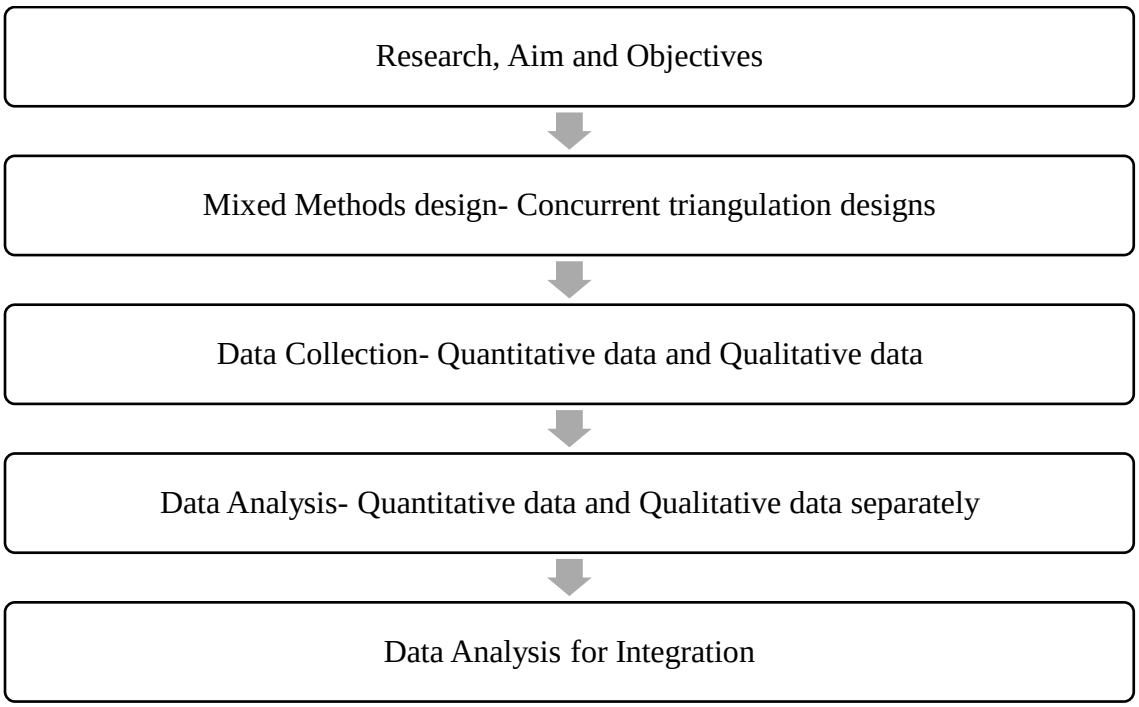

Figure 4 *Integration process for this research*

A concurrent triangulation design (convergent parallel design) was used in this mixed method study with integration at the below-mentioned stages:

a. Formulation of the research protocol,
b. Data collection, where quantitative and qualitative data were collected in a single phase within the same target population (88)
c. Data analysis, by integration of the outcome of quantitative and qualitative parts.

4.5 Study period

The data collection period was from 12 March 2021 to 13 September 2022.

4.6 Study procedures

Ethical clearance was obtained from Institutional Ethics Committee, AIIMS Jodhpur (Annexure- A). In addition, written informed consent was taken from all inhabitants in and around mines who participated in the study.

After ethical clearance for data collection of inhabitants in and around mines following methods were adopted. It includes:

a. Interview by using a semi-structured questionnaire,

b. Clinical assessment and investigations of inhabitants in and around mines,

c. Observations of housing, and

d. In-depth and key-informant interviews and focus group discussions.

4.6.1 Interview by using a semi-structured questionnaire

Different standardized tools were used for data collection. These are as follows:

a. Semi-structured questionnaires (Annexure K) were developed and tested to collect details on socio-demographic status and situational analysis of government schemes and policies.

Figure 5 *Checking of records for availing of government schemes*

b. For the Socioeconomic status assessment, Modified BG Prasad (May 2021) Socio-economic scale (89) was used.

c. WHOQOL-BREF Checklist was used for assessing Quality of life (31).

Figure 6 *Administration of the questionnaire to the participants within household*

d. For all members ≥18 years, a pre-validated tool, Multimorbidity Assessment Questionnaire for Primary Care (MAQ-PC), were used with a close-ended questionnaire of chronic disease condition (90).
e. For persons ≥60 years of age, the Katz Index of Independence in Activities of Daily Living (ADL) was used (91).

4.6.2 Clinical assessment and investigations of inhabitants in and around mines

All the members in the selected households were assessed. The evaluation was based on previous medical illness history and perceived symptoms. Examination of vision was done with the help of a *Snellen chart* and hearing with the help of a *Tuning fork (512 Hz)*. Random capillary blood sugar was measured for all individuals >30 years of age using a glucometer.

Figure 7 *Examination of hearing using a Tuning fork (512 Hz)*

Anthropometry was assessed for children under 18 years of age as per age-appropriate WHO growth charts (92).

4.6.3 Observations of housing

Observation of housing and immediate environment for livelihood assessed using *The Housing Standards In India (Recommended by Environmental and Health Committee 1947)* (93).

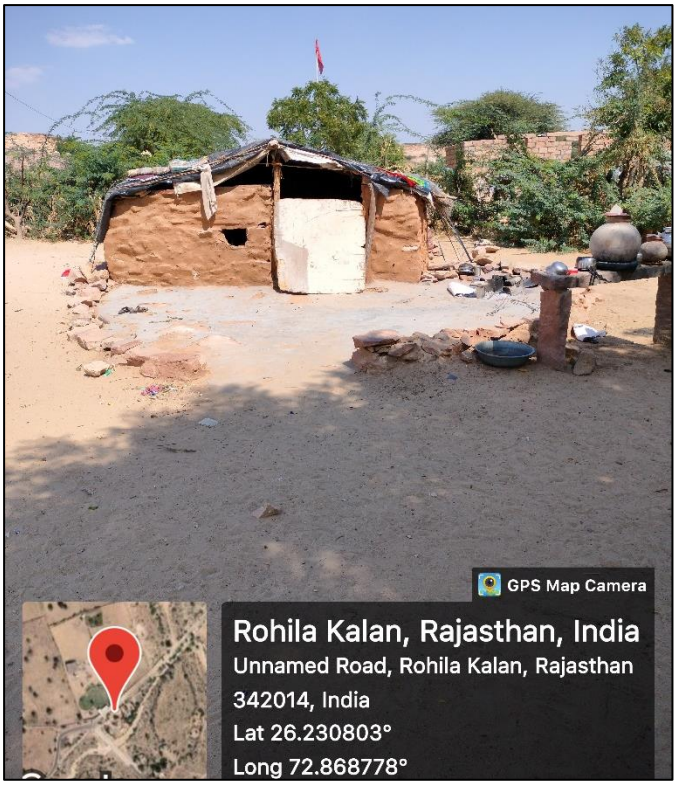

Figure 8 *Observation of housing and immediate environment*

4.6.4 In-depth and key-informant interviews and focus group discussions

Interview guides were prepared for in-depth interviews, key-informant interviews and focus group discussions (Annexure L-N) using the quantitative data collection tools and review of literature.

Grounded theory was the choice of approach which began with data collection and then theories were generated using inductive logic. An iterative process was used for theory generation and the finding were presented as conceptual thematic description and diagrams to demonstrate how the concepts were relating to each other.

Figure 9 *Key informant interview with the medical officer in charge of the Community Health Centre near a mining zone*

4.7 Statistical Analysis

The questionnaires were initially checked for completeness, and data was cleaned for errors and missing values. Next, variables were identified, and suitable coding was done for each. Finally, the corrected data were entered into Microsoft Excel 2016 after preparing a Master-chart.

Data analysis was done using Statistical Package for Social Science (SPSS) software version 23 and R Project for Statistical Computing. For categorical variables, frequency and percentages were used for description, Chi-square test or Fischer's Exact test, as applicable, were used for comparisons. For ordinal variables, medians and interquartile range were used for description, and appropriate non-parametric tests were used for comparisons. For continuous variables, mean and standard deviation were used for description and independent-sample-t-test for comparisons.

For determining association, odds ratios with a 95% confidence interval along with correlation coefficient were used. A p-value of less than 0.05 was considered significant.

4.8 Ethical approval and consent to participate

Ethical approval was obtained from Institutional Ethical Committee, AIIMS Jodhpur, vide their Ethical Clearance Certificate reference no. AIIMS/IEC/2021/3350, dated-12/03/2021. All participants were informed about the purpose of the study. Informed consent was obtained from all the adult participants and guardians in the case of those

under 18. Assent was obtained from those under 18. The participant information sheet was given to all participants. Participants were assured of the complete confidentiality of the information. They were offered the option of withdrawing from the study at any point if they desired. All the data collected were kept confidential.

5.1 Listing of mining zones in Jodhpur district with geolocation tags

There are around 45 mining zones in Jodhpur districts scattered around 5- 200 km from the city.

Table 5: List of all mining zones in Jodhpur district with Geolocation tags

SN	Block	Area	Longitude	Latitude
1	Luni	Jhanwar	72.513591	26.122045
2	Luni	Bujhawar	72.522127	26.134060
3	Luni	Doli	72.592473	26.134908
4	Bilara	Pichiyak	73.412047	26.141221
5	Mandor	Chaukhan	72.545761	26.160157
6	Mandor	Rohila kalan	72.523889	26.162453
7	Mandor	Keroo	72.524764	26.180789
8	Mandor	Barli	72.552772	26.193980
9	Balesar	Hanwant nagar	72.202338	26.202859
10	Bilara	Gujrawas	73.074860	26.203507
11	Mandor	Soorsagar	73.005001	26.311076
12	Balesar	Relan ki dhani	72.291133	26.212530
13	Shergarh	Khirjan tibna	72.240043	26.224310
14	Balesar	Balesar durgawatan	72.275330	26.240023
15	Mandor	Thabukra	73.094321	26.265759
16	Shergarh	Gara	72.214929	26.274718

17	Balesar	Birai	72.411744	26.284885
18	Baori	Gangani	73.115261	26.302019
19	Balesar	Shekhala	72.241283	26.311419
20	Bhopalgarh	Khangata	73.364015	26.314530
21	Bhopalgarh	Ratkuriya	73.341665	26.333235
22	Shergarh	Setrawa	72.160511	26.343629
23	Shergarh	Somesar	72.105818	26.344119
24	Shergarh	Setrawa	72.152610	26.372511
25	Balesar	Dewatoo	72.283878	26.380691
26	Balesar	Chamu	72.340884	26.384355
27	Balesar	Dewaton	72.284595	26.394284
28	Bhopalgarh	Surpura khurd	73.315814	26.420980
29	Osian	Baithwasiya	72.564522	26.442293
30	Bhopalgarh	Rarod	73.290137	26.450428
31	Shergarh	Govindpura	72.044930	26.463911
32	Balesar	Thadiya	72.224150	26.471082
33	Baori	Soyla	73.211370	26.482083
34	Bhopalgarh	Beda ki dhani	73.243355	26.503856
35	Bhopalgarh	Dhandhora	73.243320	26.503940
36	Phalodi	Dhadho	72.073011	26.541488
37	Phalodi	Koloo pabuji	72.194457	26.555299
38	Phalodi	Marwar lohawat	72.351517	26.574009
39	Phalodi	Lohawat	72.242046	26.584537

40	Phalodi	Kheechan	72.241027	27.095636
41	Bap	Bari seer	72.214470	27.284232
42	Bap	Luna	72.424435	27.284800
43	Bap	Meethadiya	72.454135	27.304246
44	Bap	Luna	72.395136	27.305027
45	Bap	Kansingh ki seer	72.344533	27.315381

Mapping and listing of all 45 mining zones in Jodhpur district collected with help of GIS.

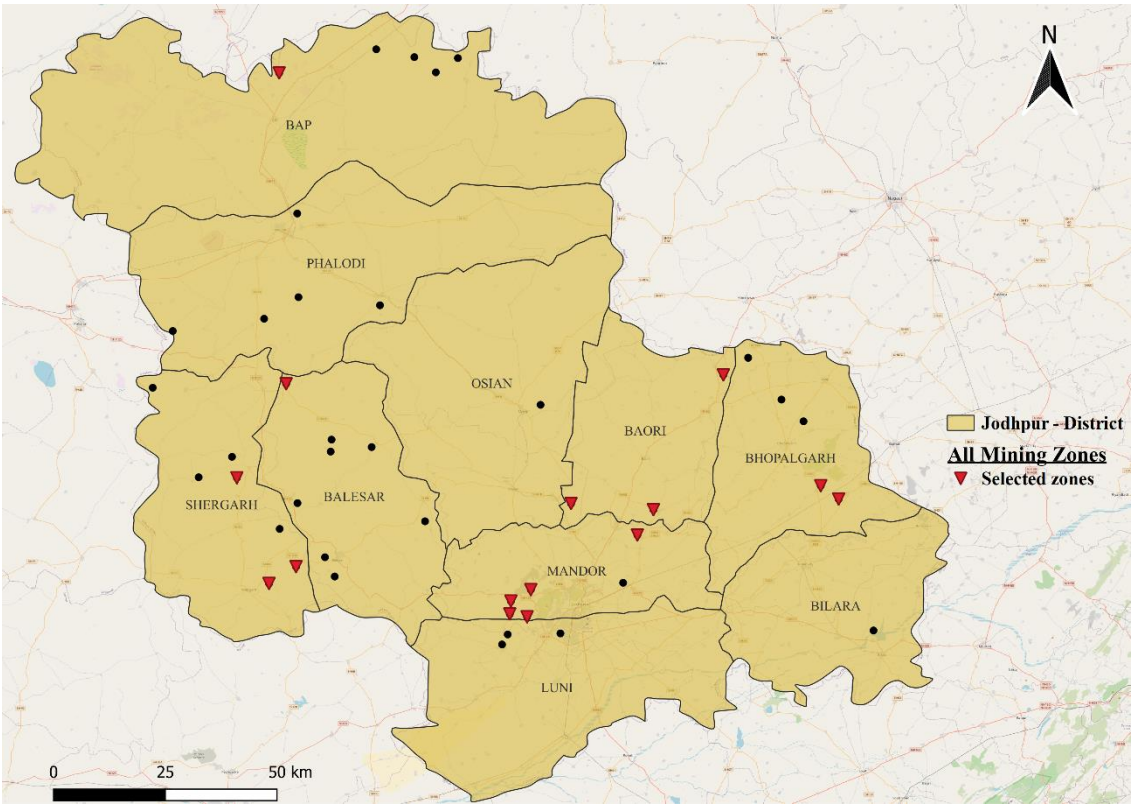

Figure 10 *GIS mapping of all sandstone mineral mining zones in Jodhpur district*

5.2 Sociodemographic characteristics of family and participants

Table 6: Sociodemographic characteristics of family (N = 181)

Characteristic	No of families- n (%)
Residence	
Urban	47 (26.0)
Rural	134 (74.0)
Distance from mines (< 1500 meters)	
Within 250 m	39 (21.5)
251-500 m	67 (37.0)
501-750 m	31 (17.1)
751-1000 m	29 (16.0)
1000-1250 m	8 (4.4)
1251-1500 m	7 (3.9)
Religion	
Hindu	168 (92.8)
Muslim	13 (7.2)
Categories*	
General	7 (3.9)
Other Backward Caste	48 (26.5)
Scheduled Caste	100 (55.2)
Scheduled Tribe	25 (13.8)
Type of family	
Nuclear	95 (52.5)
Joint/3 Generation	86 (47.5)
Average family size Median, IQR	5 (4 - 6)

Characteristic	No of families- n (%)
Per capita income (Rs) Median, IQR	3000 (2194 - 4000)
Socioeconomic status (Modified BG Prasad-May 2021)	
Upper Class (I) ≥ Rs.7863	3 (1.7)
Upper Middle (II) 3931-7862	49 (27.1)
Middle (III) 2359-3930	79 (43.6)
Lower Middle (IV) 1179-2358	43 (23.8)
Lower (V) <1179	7 (3.9)

*Caste categories are per Rajasthan state (94)

Out of 181 families, a majority (74.0%) were chosen from rural areas. As much as 92.8% of households belonged to the Hindu religion, with the majority belonging to the scheduled caste category (55.2%). The majority (43.6%) of households belong to the middle socio-economic class as per Modified B.G. Prasad's classification, 2021. The median per-capita income was Rs.3000 (2194 - 4000).

Table 7: Housing standards of households (N = 181)

Housing Characteristics	No of households - n (%)
Site	
House is elevated from the surroundings	87 (48.1)
Independent access to the street	120 (66.3)
Proper drainage at the site	67 (37.0)
Refuse dumped around the house	84 (46.4)
Safe distance of the house from the traffic	110 (60.8)
Setback	69 (38.1)
Floor	
Cracks	116 (64.1)
Damp	100 (55.2)
Walls	

9 inches brick wall	110 (60.8)
Roof	
Height of the roof below 10 feet	103 (56.9)
Height of the roof 10 feet or above	78 (43.1)
Rooms (Number of living rooms)	
<2	59 (32.6)
≥2	122 (67.4)
Floor area (for 1 person)	
<100 sq.ft.	158 (87.3)
≥100 sq.ft.	23 (12.7)
Windows	
No. of windows in each room	
<2	132 (72.9)
≥2	49 (27.1)
Height of windows above the floor	
≤ 3 feet	104 (57.5)
>3 feet	77 (42.5)
Appropriate lighting	74 (40.9)
Kitchen	
Separate kitchen	83 (45.9)
Separate storage area for food items	37 (20.4)
Latrine and bathroom	
Private bathroom for bathing and washing	71 (39.2)
Water supply in latrine	44 (24.3)
Disposal of waste and garbage	
Disposed-off daily	69 (38.1)
Disposed-off once in 2 days	72 (39.8)
Disposed-off weekly	40 (22.1)

Nearly half of the households had their site of housing elevated from the surroundings, with more than half having independent access to the street and a safe distance of the house from traffic. Only 37.0% had proper drainage at the site, and nearly 46.4% had refuse dumped around the house. Among the households, cracks were present in 64.1%

and dampness in 55.2%. Only about 39.2% had a facility of a private bathroom, and water supply in a latrine was in about 24.3% of households.

Table 8: Socio-demographic characteristics of participants (N = 861)

Socio-demographic characteristics	**No of participants- n (%)**
Age group (years) of all participants (N=861)	
0-9	189 (22.0)
10- 19	163 (18.9)
20-29	110 (12.8)
30-39	133 (15.4)
40-49	98 (11.4)
50- 59	54 (6.3)
60 - 69	83 (9.6)
70 and more	31 (3.6)
Gender of all participants (N=861)	
Male	459 (53.3)
Female	402 (46.7)
Education of those aged 18 and above (N=518)	
No Formal Education	237 (45.8)
Primary Education (Upto class 5)	128 (24.7)
Intermediate (Upto Class 8)	79 (15.3)
High School (Upto Class 10)	47 (9.1)
Class 12 and above	27 (5.2)
Marital status of 18 and above (N=518)	
Unmarried	40 (7.7)
Married	410 (79.2)
Widow, Widower or Separated	68 (13.1)
Widow	47 (5.5)
Widower	19 (2.2)
Separated	2 (0.2)

Out of all participants, the majority (40.9%) were ages 19 or below. Around 45.9% of participants were between the ages of 20 and 59, while only around 13.2% were of ages 60 and above. Among all participants, 459 (53.3%) were males, and 402 (46.7%) were females.

The majority of 410 (79.2%) adult participants were married, while about 13% were widows/widowers or separated. Almost half (45.8%) of the adult participants were illiterate followed by primary class (24.7%). Only about 14.3% of participants had high school education and above.

Table 9: Current occupation of participants aged 16 years or more (N=554)

Occupation	**No of participants- n (%)**
Mine work	247 (44.5)
Shopkeeper	10 (1.8)
Farming	5 (0.9)
Others	26 (4.7)
Not working currently	101 (18.2)
Homemaker	165 (29.7)

*****A person aged 16 – 18 years is allowed to work in mines as per the *Mine (Amendment) Act, 1983* (81), under proper supervision**.**

About 554 participants were older than 16 years, and 247 (44.5%) were employed in mining work. Among them, 7 participants were between the ages of 16 and 18. The other major participants were either not working 101 (18.2%) or homemakers 165 (29.7%). There were no primary income jobs other than mining in the area.

Table 10: Work description of participants ever worked in mines

Work description	**No of participants- n (%)**
Mine work ever	313 (56.4)
Work profile* n=313	
High dust exposure	222 (71.0)
Stone breaking	157 (50.2)
Stone drilling	65 (20.8)
Low dust exposure	122 (38.8)
Stone lifting	42 (13.4)
Clearing soil	50 (15.9)
Driver	21 (7.0)
Blasting	6 (1.9)
Mining supervisor	2 (0.6)
Years of work n=313	
0-10	123 (39.2)
11-20	106 (33.9)
21-30	54 (17.3)
> 30	30 (9.6)
Hours of work/day** n=247	
≤ 8	221 (89.5)
> 8	26 (10.5)

*Mutually exclusive

*Work profile categorised into high-dust producing and low-dust producing based on study by Saranya et al (72)

**8 hours work a day, as per *The Mines Act 1952* (81)

Out of all participants aged 16 years or older, 313 (56.4%) were those who have ever worked in mines. Of them, 222 (71.0%) had been involved in high dust-producing work, including stone breaking and stone drilling. On the other hand, about 122 participants involved in mining work were in low dust-producing work like stone lifting, clearing soil, driving in mining areas and other works.

Of all the workers who have ever worked in mines, 39.2% have worked for less than 10 years while about 26.9% have worked in mines for more than 20 years.

Maximum workers (89.5%) work less than or equal to 8 hours a day, while only 10.5% work more than 8 hours a day.

5.3 Quality of life

5.3.1 Quantitative

Among all the households, the quality of two members ≥18 years was taken. One earning member and one other, preferably non-earning member.

Out of 181 households, each had at least one earning member. Among 53 households, there were no other non-earning adult members; in three households, there were no other adult members. So, QOL was taken for 359 participants.

Table 11: Median scores for Quality of Life domains for adult participants (N = 359)

Domains of Quality of Life	**Median (IQR)**	**Minimum, Maximum**
Physical health	50 (44 - 56)	13, 75
Psychological	50 (44 - 63)	13, 81
Social relationship	50 (31 - 63)	0, 100
Environment	38 (31 - 56)	6, 75

Quality of life was assessed using WHOQOL BREF Checklist, and the scores were transformed to a domain score of 0-100. The scores were divided into four domains: physical health, psychological, social relationship, and environment. The physical health domain had a median score of 50 (44 – 56), the Psychological domain had a median score of 50 (44 – 63), the Social relationship domain had a median score of 50 (31 – 63), whereas Environment domain had a median score of 38 (31 – 56).

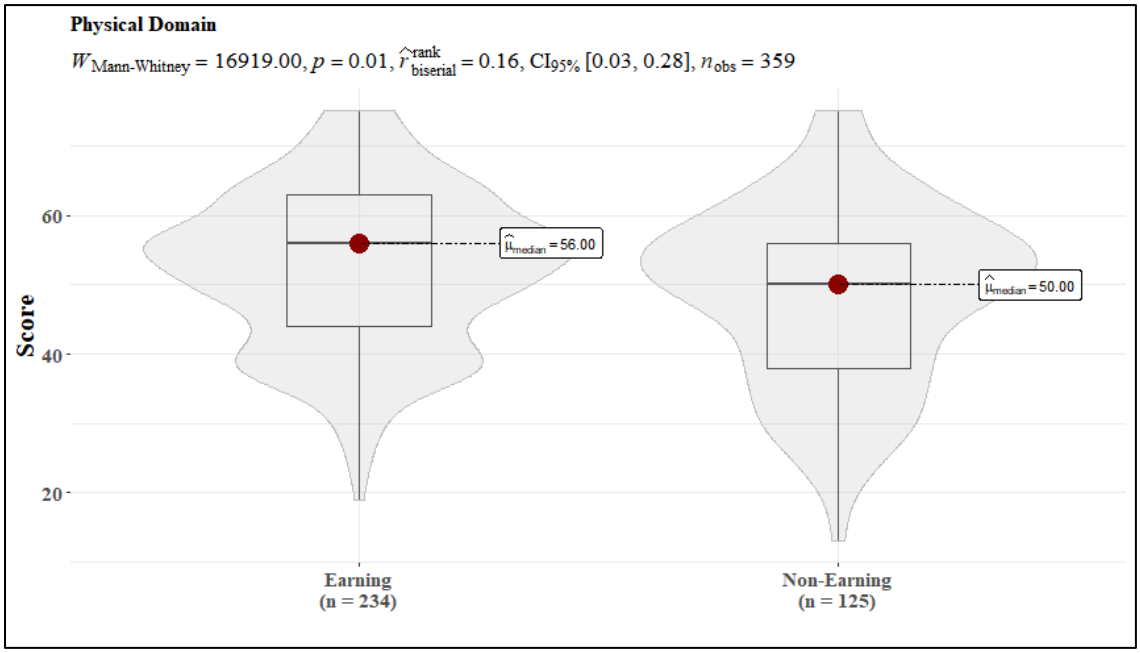

Figure 11 *Violin plots of physical domain Quality of life scores for earning and non-earning participants*

Mann-Whitney test revealed that, across 359 participants where 234 were earning and 125 were non-earning, median score regarding physical QoL domain is lower in case of non-earning member of family and this effect was statistically significant.

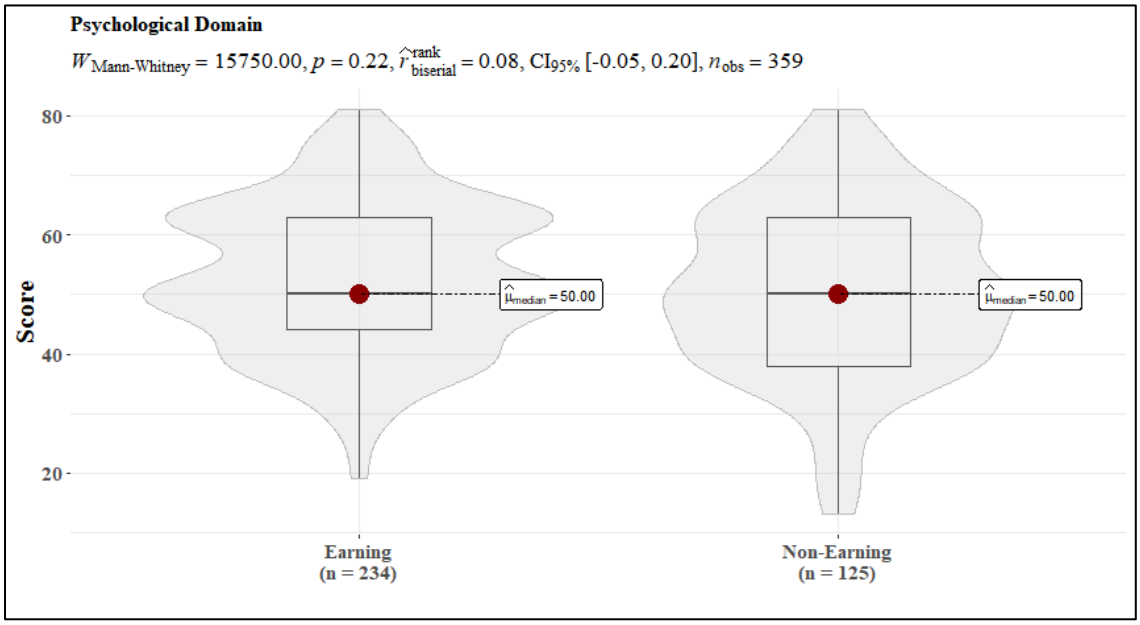

Figure 12 *Violin plots of psychological domain Quality of life scores for earning and non-earning participants*

Mann-Whitney test revealed that, across 359 participants where 234 were earning and 125 were non-earning, median score regarding psychological QoL domain is similar in case of non-earning member of family and this effect was statistically non-significant.

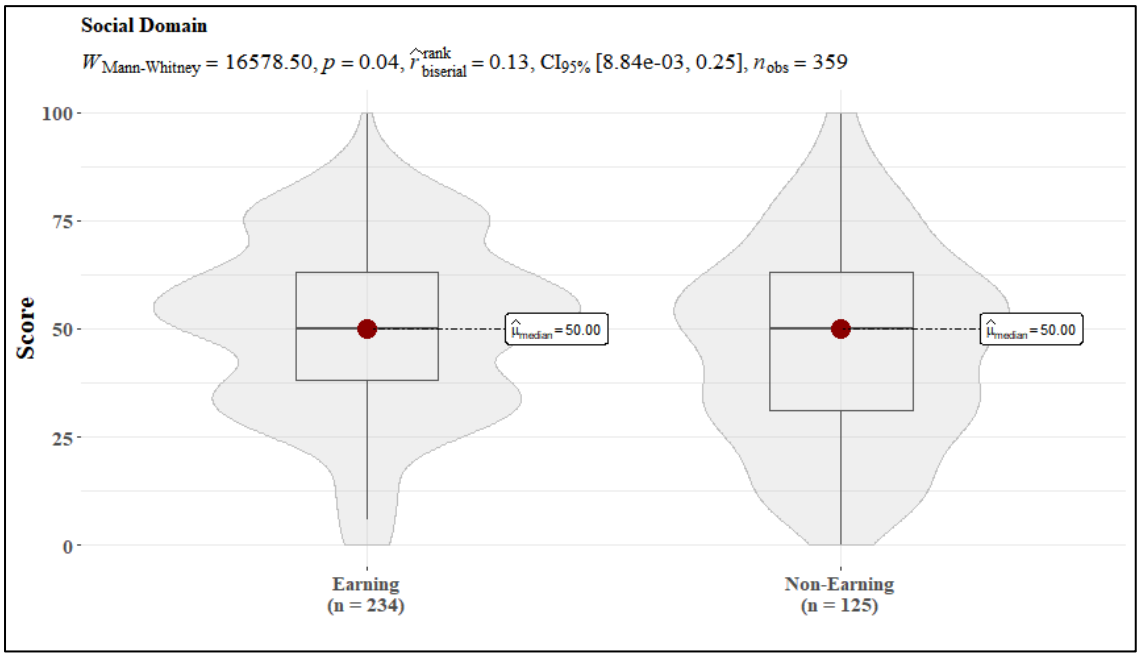

Figure 13 *Violin plots of social domain Quality of life scores for earning and non-earning participants*

Mann-Whitney test revealed that, across 359 participants where 234 were earning and 125 were non-earning, median score regarding social QoL domain is similar in case of non-earning member of family and this effect was statistically significant.

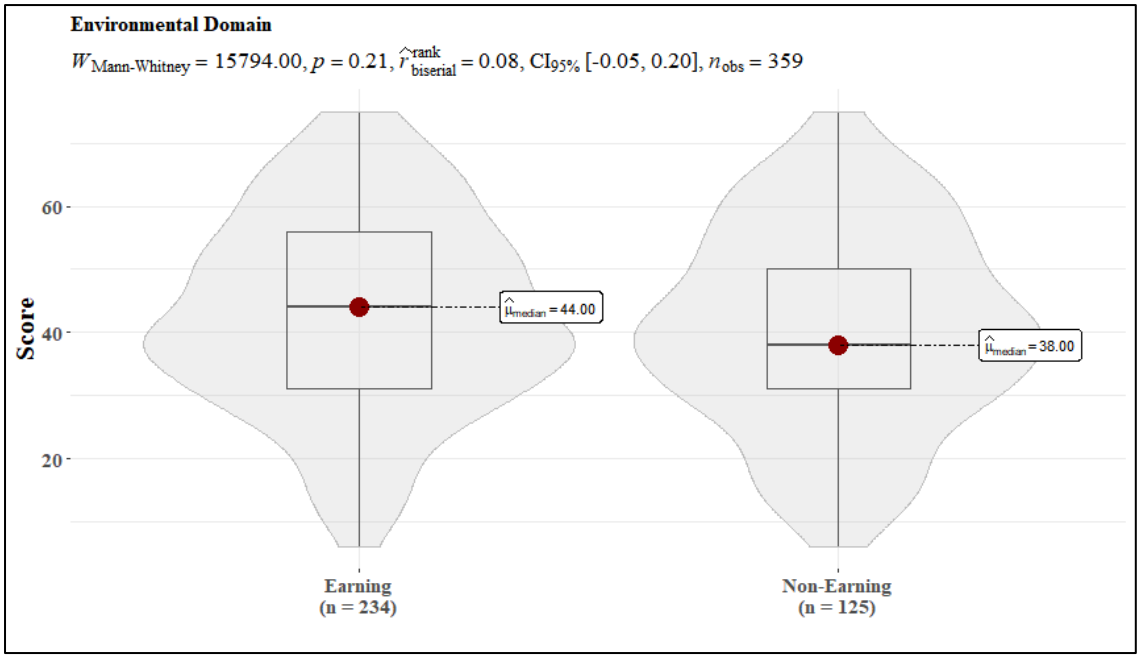

Figure 14 *Violin plots of environmental domain Quality of life scores for earning and non-earning participants*

Mann-Whitney test revealed that, across 359 participants where 234 were earning and 125 were non-earning, median score regarding environmental QoL domain is lower in case of non-earning member of family and this effect was statistically non-significant.

5.3.2 Qualitative

In-depth interviews were taken with 8 participants who were residents in areas in and around mines.

Table 12: Participants selected for In-depth Interviews

No. of participants	**Participant characteristics**
Participant 1	Participant with respiratory distress but without silicosis
Participant 2	Participant with no c/o any morbidity
Participant 3	Participant with h/o addiction and h/o Tuberculosis
Participant 4	Mine worker who is trying to get certified for rehabilitation assistance
Participant 5	Silicosis patient who has received incomplete rehabilitation assistance with h/o Tuberculosis

Participant 6	Participant who is not working and has been rejected for certification for rehabilitation assistance
Participant 7	Participant who is employed in mining and currently suffering from Tuberculosis
Participant 8	Participant with c/o musculoskeletal morbidities but no complaints of any chronic respiratory morbidity

Table 13: Content Analysis grouped under Quality of life pertaining to social barriers

Verbatims	**Codes**	**Subthemes**
"Doctor ne mujhe lockdown ke waqt bahar jaane se mana kiya tha kyuki mujhe pehle se hi saans ki taqleef hai." ***The doctor advised me not to go out during the lockdown as I am already having shortness of breath***.	Restricted mobility during lockdown	Limited social interaction
"Pita aur chacha ki maut ke baad hum khadan ke kaam par lag gaye or akele itne bade parivaar ka kharcha nahi utha paaye. Chachi or baki log ghar chorr kar chale gaye." ***After the death of our father and uncle, we started working in mines as we could not bear the expenses of such a big family alone. Aunt and other people left the house and went away***. *"Ghar par itna koi nahi kamata ki pure parivaar ka kharcha utha paaye jisse aadhe log bahar bade sheher mai ja chuke hai."* ***No one works so much at home that they can afford the expenses of a whole family, so half of the people have moved to the big city.***	Less income, more mouths to feed Migration for income	Family disintegration
"Dada aur pita ki maut ke baad mujhe 14 saal ki umar mai hi khadan mein kaam karna pada." ***After the death of grandfather and father, I had to work in the mine at the age of 14 years.***	Working in mines since childhood	Early age involvement in mine work

"Main pichle 18 saal se khadan mai kaam kar raha hu. Mera chota bhai to 16 ki umar se pehle hi khadan ke kaam mai lag gaya tha" ***I am working in the mine since last 18 years. My younger brother was engaged in the mine work before the age of 16.***		
"Baki gaon ke log bhed bhaw karte kyuki yahan pe sabko bimari hai." ***The people of the rest of the village discriminate because everyone is sick here.***	Taboo due to illness	Discrimination
"Bahari chetra ke log toh humare chetra mein apni betiyon ka Rishta karne se bhi darne lage hai. Kehte hai ki yahan rishta kiya toh humari betiyan 10 saal ke andar hi vidhwa ho jaegi." ***The people of other areas are afraid of marrying their daughters in our area. It is said that if they have a relationship here, their daughters will become widows within ten years.***	Unwilling to marry their daughters into our village	Social exclusion
"Mujhe sarkaar ki taraf se ration mein atta, dal, masala mila tha aur NGO ne chawal aur tel diya tha." ***I got flour, lentils, spices from the governement and NGO provided rice and oil.***	Provision of ration	Social support
"12th tak padhai ki hai, jab pitaji ki maut hui khadan mein kaam karne ki wajah se toh mujhe bhi majburan padhai chorrni padi aur khadan ka kaam shuru karna pada." ***I have studied till 12th, when my father died due to working in mine, I had to leave studies and start working in mine.*** *"1990 mein maine school chor ke pathar ka kaam shuru kia hai."* ***In 1990 I left school to start stone work.***	Left school due to family conditions	Lower education status

Table 14: Content Analysis grouped under Quality of life pertaining to physical problems

"Jodon ka dard kam umar mein hi shuru hogaya hai.. kaam karne ki kshamta kam gayi hai" ***Joint pain has started in early age...ability to work has reduced.*** *"Bhaari pathar uthane padte hai..kamar mein dard to roz ki baat hai"* ***I have to lift heavy rocks, back pain occurs daily.***	Heavy lifting and postural fatigue	Musculoskeletal disorders
"Itni saans ki takleef hai..Bathroom bhi bistar par karna padta hai." ***There is so much shortness of breath.. even "the bathroom" has to be done on the bed.***	Frailty due to illness	Limited ADL
"Jinko ye bimari (silicosis) ho jaati hai, who yeh road pe nahi chal paate hai." ***Those who have this disease (silicosis), are unable to walk on the road (because of dust).***	People with the respiratory illnesses have difficulty in a mining area	Breathlessness and generalised weakness
"Ek ghar mein bahut log hai.. sabko covid hua tha" ***There are many people in the house..everyone had COVID.*** *"Khadan mein kaam karte waqt mask nahi lagaya tha kisi ne..covid to hona hi tha"* ***No one had worn a mask while working in the mine..COVID was bound to happen***	Overcrowding Lack of use of PPE	High risk of COVID infection

"Khaan mein kaam karte waqt toh choti moti chot lagti rehti hai." ***Small injuries keep happening while working in the mines.*** *"Mujhe khan mein kaam karte hue kai baar gambhir chot lagi hai jo aaj tak dard deti hai"* ***I got serious injury several times while working in the mine which still hurts till date.***	Recurrence Decreased QOL, Increased DALY	Risk of accidents and injuries
"Baar baar aspataal jaana padta hai kyuki saans mein dikkat zyaada hogayi hai" ***I have to go to the hospital again and again because breathing problems have become too much.*** *"Khadan ka kaam khatre waala hai..har mahina koi na koi ghayal hota hai"* ***Mine work is dangerous..every month someone or the other gets injured.***	Increase in physical ailments	Frequent medical interventions required
"Peeth mein dard ke karan so nahi paate.." ***I can't sleep because of back pain..***	Musculoskeletal pain	Fatigue and sleep disorders

Table 15: Content Analysis grouped under Quality of life pertaining to psychological issues

"Khaana paani ke liye paisa poora nahi hota.. ghar ke liye saaman kahan se laaye" ***There is not enough money for food and water..from where do we get things for home.*** *"Ghar mein bahut cheezon ki zarurat hai par kisi tarah mushkil se kaam chala rahe hai"* ***There is a need for many things in the house, but we are making it work somehow.***	Cannot afford necessities	Stress due to poor standard of living
"..tension hogayi hai..paise ki kami hai" ***..I am in tension..there is lack of money.***	Stress due to poor income	Anxiety and depression
"Raat mein neend nahi aati..kam kamai hone ki wajah se" ***I can't sleep at night..because of less earnings.***	Unable to sleep peacefully at night	Mental fatigue and sleep disorders
"Khadan ka kaam acha nahi hai..bimari hoti rehti hai..kab kya hojaye pata nahi" ***Mine work is not good..sickness keeps on happening..don't know when what will happen.***	Unsafe work	Uncertainty of health
"Zyaada se zyaada log 60 saal tak Yaha pe rehne wale log ausat 50 saal tak jeete hai..jyada se jyada 60 tak jeete hai." ***Maximum people live here for 60 years, people living here live for an average of 50 years.. maximum live till 60.*** *"Bhai ki maut khadan mai pathar girne e hogayi thi..abhi kam umar ka hi tha"* ***Brother's death happened due to falling of stones in the mine..he was of young age.***	Risk of fatal injury and disease	Decreased life expectancy

"Pathar ka kaam bura nai hai. Magar Silicosis ka koi ilaaj nai hai." ***The stonework is not that bad. But there is no cure for silicosis.***		
"Daru nai piyenge toh raat mein neend nai ati." ***If we don't drink, we can't sleep at night.*** *"Itni thakaan hojaati hai..uske liye nashe ki zarurat hai"* ***We get so tired..we need substance use for that.*** *"Who nasha karte hai yeh soch ke ki sahayta milega. Kyuki who saara din bhari kaam karke pareshan ho jaate hai, bahut bade bade pathar uthane padte hai."* ***They do substance use thinking it will help, because they become stressed after doing heavy work whole day, they have to pick up heavy stones.***	Addiction to relieve stress	Need for substance use
"Bimari failne ka darr zyaada hai..aas paas sab log bimar rehte hai." ***There is more fear of spread of illness Everyone around remains ill.***	Sick people living in close vicinity	Unsafe physical environment

Table 16: Content Analysis grouped under Quality of life pertaining to environmental factors

"Shaam ko poora ilaka dhool mein dhaka hua, kohre jaisa dikhega, dilli ke kohre ki tarah." ***In the evening, the whole area covered in dust, will look like fog, like Delhi's fog.***	Smog in the village	Air pollution
"..dhool mitti bahut hai..khansi hoti rehti hai." ***..there is a lot of dust..cough keeps on happening***.	Impact of dust on respiratory health	Unsafe physical environment
"Aas paas kaafi gandagi hai..hawa mein dhool or khule mein pada hua kachra aam baat hai." ***There is a lot of filth around..dust in the air and garbage lying in the open is common.***	Dirty surroundings	Poor environment
"Kachra fenkne ke liye bahut dur jaana padta hai..Isliye hum ghar ke bahar hi gira dete hai." ***One has to go very far to throw the garbage..That's why we drop it outside the house.***	No facility for clearing out garbage regularly	Open refuse dumping
"Ghar ke paas khadan hone se saara din shor rehta hai.. bahut baar sir dard hojata hai" ***As the houses are situated near the mines, we are exposed to loud noises..many times we experience headache.*** *"Pitaji ke kaan kharab ho chuke hai. 30 saal se khadan mein kaam kar rahe hai."* ***Father's ears are damaged due to working in mines since 30 years.***	Excessive loud noise Impact of noise on health • Headache • Hearing loss	Noise pollution

Table 17: Content Analysis grouped under Quality of life pertaining to economical status

"Bimari hone ke pehle kamai theek thi magar ab kamai aadhi ho gai." ***Earning was fine before the disease (silicosis), but now it has reduced to half.*** *"Pehle 15 hazar kama leta tha, abhi 7 hazar hi kamai hoti hai."* ***Earlier I used to earn 15 thousand (per month), now only 7 thousand is earned.***	Impact of disease on income • Reduced work capacity • Increased absenteeism • Increase in medical expenditure	Impoverishment
"Kamane wala ghar mein akela hun. Kai baar udhaar lena padh jaata hai." ***I am the only one working in the house. I have to borrow money so many times.*** *"Abhi mujh par 2.5-3 lakh rupaiye ki udhaari baki hai."* ***Right now I have an outstanding loan of Rs 2.5-3 lakh.***	Taking loans to support family Debts	Financial insecurity
"Kamane wala ghar mein mai akela hun. Ghar kharch toh ram ji chalawe." ***I am the only one working in the house. "Ram ji" (God) will handle the expenses.***	Single earning member	
"Bachpan mein hi pathar ka kaam shuru kar dete hai kyuki arthik stihti kharab rehti hai." ***We start working in mine in childhood, because economic condition is not good.***	Poor family economic condition	

"Kamai hoti hai aur adhi kamai daaru mein chali jaati hai. Daru nai piye toh raat mein neend nai ati." ***Half of the earning is spent in alcohol. If I don't drink alcohol, then I can't sleep in the night.*** *"..jinko silicosis hui, paise mile, unhe nashe ki aisi lat lagi, ki ussi muawje ke paise se nasha kar rahe"* ***..who got silicosis, got money, he got such an addiction, that he is getting intoxicated with the same compensation money.***	Role of addiction in economical status • Income spent on alcohol • Compensation money wasted	Unjustifiable trade-off costs
"Yaha aur koi kaam nahi hai. Charon taraf khan hi khan hai." ***There is no other work. There are mines everywhere***. *"Dusri koi majdoori nahi thi. Abhi bhi dusra koi kaam nahi hai yaha."* ***There was no other labor work. Even now there is no other work here.*** *"Yahan par door door tak bas yahi rojgar hai. Khan chor ke aur koi kaam ka saadhan nai hai."* ***This is the only work available, as farther as we can go. Other than mines, there are no other means of employement.*** *"Ap gaon mein kisi bhi ghar me chale jao..us ghar mein koi na koi ek jan khaan mein kaam karta mil jaega."*	No alternative jobs or source of income	Dependence on mining for livelihood

Go to any house in the village..we will find someone working in a mine.		
"Mujhe 30 saal ki umar mei hi do baar TB ka course lena padh gaya. TB ke samay do saal ghar pe baitha raha." ***I had to take TB treatment twice by the age of 30. I stayed at home for 2 years due to TB.*** *"dam chadne ke karan koi kaam nai hota. Abhi adhi jindagi baaki hai aur koi kamai nai."* ***Due to shortness of breath I can't work. Half my life is left and I have no earnings.***	Reduced working capacity	Increased absenteeism
"Khaan mei kaam karte waqt koi accident ho jae, uske ilaj ke paise koi nai deta." ***If any accident occurs, we are not paid for its treatment.***	No accident compensation	Gaps in social protection coverage
"Agar sarkar se bima mil jae toh shayad humare bachon ko sahayta mil jaegi." ***If government provides (life or term) insurance our children will get help.***	Need for insurance	

Table 18: Content Analysis grouped under Quality of life pertaining to housing conditions

"Dhool ki wajah se ghar ki khidki khol nahi sakte." ***We can't open the window of the house because of the dust.*** *"Kutcha ghar hai..khidki kahan se hogi."* ***It is a "kutcha"house.. where will the window be.***	Inadequate passage for light and air	Poor lighting and ventilation
"Ghar ki halat acchi nahi hai. Itni kamai nahi hoti ki pakka ghar bana sake." ***The condition of the house is not good. There is not enough income to build a "pucca" house.*** *"Ghar ki chatt mausam kharab hone par toot jaati hai."* ***The roof of the house breaks due to bad weather.***	Insufficient money for better housing	Kutcha house
"Ek kamre mein zyada logon ko sona padta hai. Saman rakhne ki jagah nahi hai." ***More people have to sleep in one room. There is no place to keep the things.***	More people live in a small space	Overcrowding
"Shauchalya ki suvidha nahi hai. Sab log khule mein hi jaate hai. Aas paas kaafi ganda rehta hai." ***There is no toilet facility. Everyone goes in the open. The surroundings are very dirty.***	No toilets	Open defaecation
"Paani ki supply nahi hai.. Sarkar ne bahut baar kaha hai paani ki vyavastha karegi.. Par paani door se laana padta hai." ***There is no water supply.. The government has said many times that it will arrange for water.. but water has to be brought from far away.***	No water supply to households	Lack of sanitation and water supply

"Peene ka paani bhi khaara hai. Aas paas paani ki suvidha nahi hai." ***Even the drinking water is salty. There is no water facility nearby.***		
"Kachra daalne ke liye jagah nahi hai.. Gali ke bahar hi sab ek jagah kachra gira dete hai." ***There is no place to dump the garbage.. Everyone drops the garbage at one place outside the street.*** *"Sheher ki tarah ghar ka kachra lene koi nahi aata."* ***No one comes to collect the garbage of the house like the city.***	Open dumping of waste	Improper waste disposal

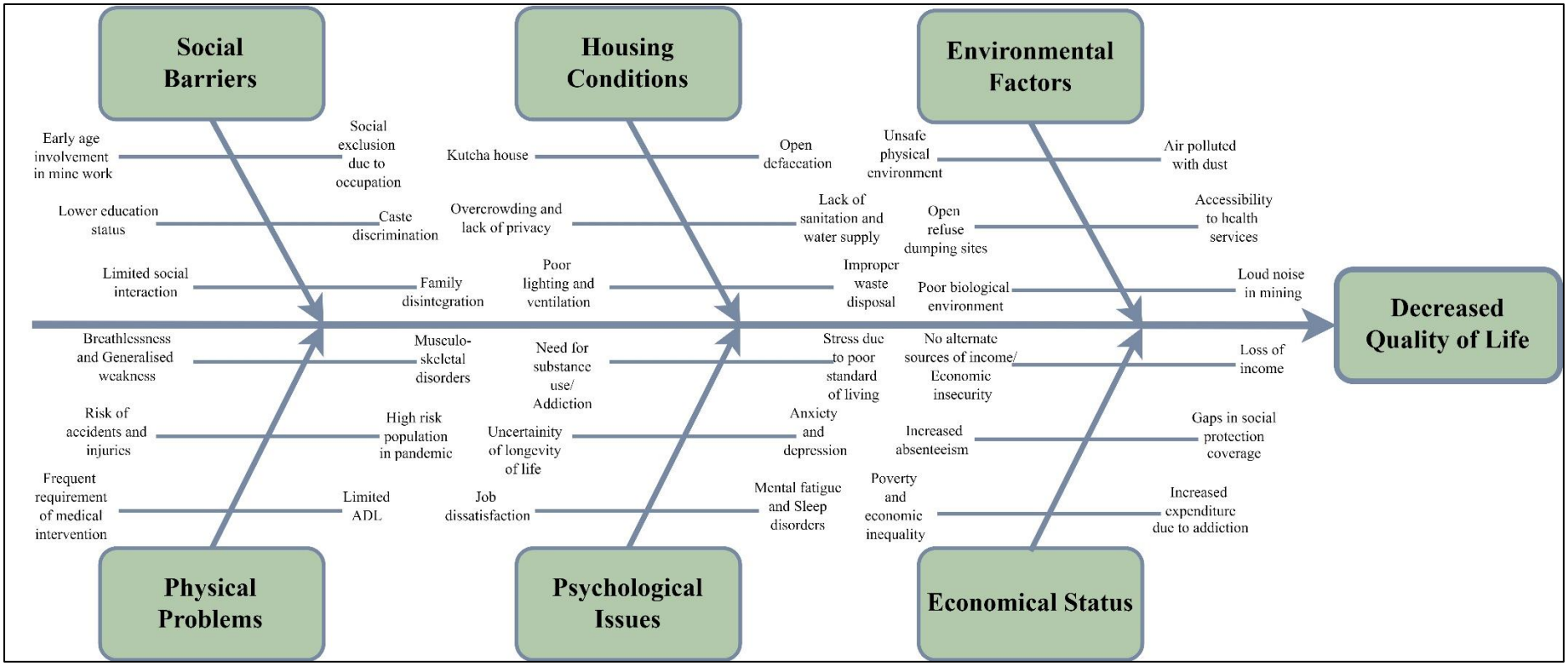

Figure 15 *Fishbone diagram for Root Cause Analysis (Quality of Life)*

5.3.3 Integration of Quantitative and Qualitative Findings

Integration of the outcome of both quantitative and qualitative phases to explain the research question.

Table 19: Analysis by integration of Quantitative and Qualitative part

Parameters	**Quantitative part**	**Qualitative part**
Social	7 participants were between the ages 16 and 18 years who were working in mines	Early age involvement in mine work
	45.8% of adult participants had no formal education	Lower education status
Physical	34.6% of adult participants complained of musculoskeletal problems	Musculoskeletal disorders
	13.5% of adult participants had SNHL	Risk of accidents and injuries
	13.1% of elderly participants had zero ADL scores in each of the six domains	Limited ADL
Psychological	84.5% of adult male participants and 40.7% of adult female participants had h/o substance use	Need for substance use
Environment	46.4% of households surveyed had refuse dumped around the house	Open refuse dumping
Housing	Appropriate lighting was present only in 40.0% of the households	Poor lighting and ventilation
	Only 39.2% of HHs had private bathroom facility Only 24.3% of HHs had a water supply in latrine	Lack of sanitation and water supply

5.4 Health Status

5.4.1 Health Status of Children

Table 20: Assessment of the nutritional status of children ≤ 5 years as per WHO growth chart (N=101)

Parameters	**No of children – n (%)**
Height for age (Z-score)	
Normal	75 (74.3)
Moderate stunting (between -2 to -3 SD)	21 (20.8)
Severe stunting (below -3 SD)	5 (5.0)
Weight for age (Z-score)	
Normal	75 (74.3)
Moderate Underweight (between -2 to -3 SD)	19 (18.8)
Severe underweight (below -3 SD)	7 (6.9)
Weight for height (Z-score)	
Normal	73 (72.3)
Moderate wasting (between -2 to -3 SD)	20 (19.8)
Severe wasting (below -3 SD)	8 (7.9)

*As per WHO Growth Chart

Among 101 children under or equal to 5 years of age, 25.8% had stunting, among which 5.0% had severe stunting as per height for age on the WHO growth chart.

Likewise, as per weight for age, 25.7% were underweight, among which about 6.9% had severe underweight.

Charting for weight for height in the WHO growth chart for less than or equal to 5 years of age revealed wasting in 27.7%, with severe wasting in about 8%.

Table 21: Assessment of the nutritional status of children between 6-10 years as per WHO growth chart (N=111)

Parameters	**No of children- n (%)**
Height for age (Z-score)	
Normal	84 (75.7)
Moderate stunting (between -2 to -3 SD)	24 (21.6)
Severe stunting (below -3 SD)	3 (2.7)
Weight for age (Z-score)	
Normal	81 (73.0)
Moderate underweight (between -2 to -3 SD)	23 (20.7)
Severe underweight (below -3 SD)	7 (6.3)

*As per WHO Growth Chart

Charting for height for age and weight for age in the WHO growth chart for ages 6 to 10 years showed stunting in 24.3% and underweight in 27%.

Table 22: Assessment of the nutritional status of children between 11-18 years as per WHO growth (N=131)

Parameters	**No of children - n (%)**
Height for age (Z-score)	
Normal	75 (56.4)
Moderate stunting (between -2 to -3)	39 (29.3)
Severe stunting (below -3)	17 (12.8)

*As per WHO Growth Chart

Using WHO growth charts for calculating height for age, stunting was found among 42.1% of the ages between 11 and under 18.

5.4.2 Health Status of Adult participants

5.4.2.1 Quantitative

Table 23: Health service utilisation assessment of adult participants (N=518)

Parameters*	**No of participants – n (%)**
Admission to hospital in last year n(%)	49 (9.5)
At least one visit to the outpatient department in the last year n(%)	199 (38.4)
No of visits to outpatient department in last year Median (IQR)	3 (2-4)
Daily medications n (%)	177 (34.2)
No of daily medications Median (IQR)	2 (1-3)

*Not mutually exclusive

Out of 199 participants who reported at least one visit to the outpatient department in the last year, 35 visited OPD for chronic respiratory conditions, 34 for NCD, 24 for fever, 22 for musculoskeletal problems and 11, 9 for injury and TB, respectively.

Table 24: Respiratory conditions (ever) of adult participants as reported by participants (N=518)

Respiratory conditions	**No of participants – n (%)**
T.B.*[#]	66 (12.7)
Once	48 (9.2)
More than once	18 (3.5)
Silico-tuberculosis*	25 (4.8)
Chronic Lung Disease*	92 (17.8)
Silicosis*[#]	50 (9.6)
COPD	33 (6.5)
Asthma	9 (1.7)
COVID-19*	41 (7.9)
mMRC (Modified Medical Research Council) Dyspnea Scale	
1=after strenuous exercise	307 (59.3)
2=after moderate exercise or walking up slope or stairs	128 (24.7)
3= plain surfaces 500 meters or 8-10 minutes	68 (13.1)
4=normal activity	11 (2.1)
5=even at rest	4 (0.8)

*Not mutually exclusive

[#]TB and Silicosis include cases of silico-tuberculosis

Out of 518 adult participants, 66 (12.7%) had tuberculosis. Among them, 48 (9.2%) received treatment once and 18 (3.5%) had taken treatment more than once.

Among 518 adult participants, 92 (17.8%) had h/o chronic lung disease, with silicosis (9.6%), COPD (6.5%) and asthma (1.7%). In addition, 4 participants with COPD had h/o TB, while one other with COPD had h/o silico-tuberculosis and COVID-19 infection.

Among 518 adult participants, 41 (7.9%) tested positive for COVID-19. Out of 41 participants with h/o COVID-19 infection, 5 had h/o TB; 3 with Silicosis, COPD; and one with silico-tuberculosis and asthma.

Table 25: Other morbidity profile (ever) of adult participants (N=518)

Conditions	**No of participants - n (%)**
Anaemia (g/dl)	278 (53.6)
Anaemia (g/dl) in Females (N=253)	201 (79.4)
Mild (F=11-11.9)	18 (7.1)
Moderate (F=8-10.9)	163 (64.4)
Severe (F <8)	20 (7.9)
Anaemia (g/dl) in Males (N=265)	77 (27.7)
Mild (M=11-12.9)	30 (11.3)
Moderate (M=8-10.9)	35 (13.2)
Severe (M <8)	12 (4.5)
Deafness (in the worse ear)	
No deafness	432 (83.4)
Conductive deafness (CD)	16 (3.1)
Sensory neural hearing loss (SNHL)	70 (13.5)
Visual impairment (in the better eye)	
No visual impairment (6/6-6/18)	378 (73)
Moderate visual impairment (6/18-6/60)	100 (19.3)
Severe visual impairment (6/60-3/60)	29 (5.6)
Blindness (worse than 3/60)	11 (2.1)
Cataract (in any eye)	58 (11.2)
Hypertension (N=518)	
Known case	124 (23.9)
Newly identified during the study	45 (8.7)
No hypertension	349 (67.4)
Diabetes (more than 30 yrs) (N=362)	
Known case	38 (10.4)
Newly identified during the study	23 (6.3)
No diabetes	301 (83.1)
h/o vascular disease	
Angina/Heart attack	21 (4.1)
Stroke	12 (2.3)

Cancer (breast cancer, stomach cancer, oral cancer, lung cancer)	9 (1.7)
Chronic kidney disease	6 (1.2)
Musculoskeletal problems	179 (34.6)
Pain/stiffness in joints	92 (17.7)
Chronic back pain	166 (32.0)
Acid peptic disease	178 (34.4)
Others	5 (1.0)

*Not mutually exclusive

Anaemia was present in 278 (53.6%) participants, with anaemia in 79.4% of females and in 27.7% of males.

On examination with a tuning fork for assessment of hearing in the worse ear, conductive deafness was found in 16 (3.1%) participants and sensory neural hearing loss in 70 (13.5%) participants.

On examination of visual acuity by Snellen chart in the better eye, moderate visual impairment (6/18-6/60) was found in 100 (19.3%), severe visual impairment (6/60-3/60) in 29 (5.6%) and blindness (worse than 3/60) in 11 (2.1%). In addition, among all the 518 adult participants, cataract in one eye was found in 58 (11.2%) participants.

Out of 518 adult participants, 124 (23.9%) had been diagnosed with hypertension, and another 45 (8.8%) had uncontrolled blood pressure with systolic blood pressure >140 and/or diastolic blood pressure >90.

Out of 362 participants more than the age of 30 years, 38 (10.4%) had been diagnosed with diabetes, and another 23 (6.3%) had a random blood sugar level of >200 mg/dl.

Among types of cancer, 4 were breast cancer, 1 case of stomach cancer and 2 each of oral and lung cancer.

Others include 3 participants with h/o epilepsy and 2 malaria cases.

Table 26: Gender wise distribution of substance use in adults (N=518)

Type of substance use	**Male (N=265) - n (%)**	**Female (N=253) - n (%)**
Substance use*	224 (84.5)	103 (40.7)
Smoking (bidi)	52 (19.6)	2 (0.8)
Chewing tobacco	112 (42.2)	97 (38.3)
Alcohol	50 (18.9)	0 (0.0)
Opium	10 (3.8)	4 (1.6)

*Not mutually exclusive. Some participants consumed more than one substance.

Among the adult participants, 327 (63.1%) participants were consuming one or more of tobacco, alcohol, and tobacco products. Among the adult males, 224 (84.5%) had h/o substance use, while among adult females, 103 (40.7%) had h/o substance use.

The majority had a h/o chewing tobacco, with 42.2% adult males and 38.4% adult females. Among adult males, chewing tobacco was followed by smoking (19.6%) and alcohol consumption (18.9%).

Table 27: Activities of Daily Living (ADL) of participants ≥60 years (N=114)

Activities of Daily Living	**No of participants – n (%)**	
	Dependent (0)	**Independent (1)**
Bathing	24 (21.1)	90 (78.9)
Dressing	24 (21.1)	90 (78.9)
Toileting	20 (17.5)	94 (82.5)
Ambulation	22 (19.3)	92 (80.7)
Continence	18 (15.8)	96 (84.2)
Feeding	15 (13.2)	99 (86.8)

Fifteen elderly participants had ADL scores of zero in each of the six domains.

Activities of Daily Living were checked for all 114 participants ≥60 years of age. Among them, most dependents had problems or needed help with bathing (21.1%) and dressing (21.1%). Among all participants, 15 scored zero in each domain as they were bid-ridden.

5.4.2.2 Qualitative

Table 28: Content Analysis grouped under health status pertaining to musculoskeletal and injuries

Verbatims	**Codes**	**Subthemes**
"Bhaari pathar uthane padte hai..kamar mein dard to roz ki baat hai" ***We have to pick up heavy stones... back pain is a daily thing***	Heavy manual work	Back pain
"Itni thakaan hojaati hai..uske liye nashe ki zarurat hai" ***There is so much fatigue..substance use is needed for that.*** *"Zyada kaam se kamzori aajati hai, daru nahi pienge to josh kaise aayega"* ***Excess work causes weakness. If we don't have alcohol, how will energy come.***	Excess work causing • Fatigue • Weakness	Substance use to relieve bodily exhaustion
"Roz ek jaisa kaam karte hai..kamar aur kandhe thak gaye hai" ***Every day we do same work ..back and shoulders are tired.*** *"25 saal se pathar uthane ka kaam kar raha hun..jodon mai roz dard rehta hai"* ***I have been lifting stones for 25 years, joints pain everyday.***	Repetitive work	Postural fatigue
"Khaan mein kaam karte waqt toh choti moti chot lagti rehti hai." ***While working in mines, small injuries are bound to happen.*** *"Mujhe khan mein kaam karte hue kai baar gambhir chot lagi hai jo aaj tak dard deti hai."* ***I have been injured so many times while working in the mine, that pains till date.***	Prone to accidents	Injury

"..yeh sab nishan mere janm se thodi hai, khaan mein kaam karne se hue hai." ***..all these scars are not from my birth, they are due to working in mines.*** *"Ab itni chot lagti rehti hai ki who uspe dhyaan nahi jaata."* ***Now this much injury happens, we don't bother about them.***		
"..chota chota pathar ucchal kar lag jaata hai. Kabhi agar ankh mein chale jaye toh ankh se andhe ho jaate hai." ***..we get hit by small stones, if they go in the eye, we go blind.*** *"..powder daalne se ankh kharab ho gai.."* ***..eye got damaged due to powder.***	Hazardous work • Debris • Powder chemicals	Visual impairment

Table 29: Content Analysis grouped under health status pertaining to respiratory problems

"Pehle mai 7-8 km chal leta tha. Ab 1-2km mein hi saans phul jaati hai." ***Before I could walk up to 7-8 km. Now breath gets heavy (breathlessness) within 1-2 km.*** *"Lambi doori tak paidal nahi chal sakte. Beech mein rukna hi padta hai."* ***I can't walk for a long distance. I have to stop in between (to catch breath).***	Decreased functional ability	Shortness of breath
"Mere pita ko to pehle se Saans ki bimari thi, mujhe bhi hai.. khadan ki dhool se wo aur zyaada hogayi hai" ***My father had breathing problems, now I do too. Mine dust has increased the problem.*** *"Asthma bachpan se hai..garibi ki wajah se khadan mein kaam karta hu.. bahut dikkat hoti hai"* ***Asthma is there from childhood, I work in mine due to poverty..there is a lot of problem.*** *"Jab mai khadan mein kaam karta tha, tab saans ki taqleef se kaam nahi ho pata tha, davai aur bufara lena padta tha. Ab thand ke mausam mein bhi saans ki taqleef ho jaati hai."* ***When I used to work in mine, I couldn't work due to breathing problem, had to take medicine and 'bufara'. Now in winters also I suffer from breathing problem.*** *"Bachon ko allergy hota hai dust se."*	Breathing problems aggravated by dust	Susceptibility to chronic respiratory diseases

Children get allergies from dust.		
"Maine 2 baar TB ki davai li hai." ***I have taken TB treatment twice.***	Recurrent TB infection	Tuberculosis
"Mines mein jitne bhi kaam karte hai, lag bhag sabhi ko TB ho chuka hai." ***Almost all who are working in mines, have suffered from TB.***	Increased prevalence in mining community	
"Ek ghar mein 8 log rehte h..TB ki bimari failti hai baar baar" ***There are 8 people living in the house..TB spreads everytime.***	High infectivity due to overcrowding	
"Aas paas bahut logon ko TB hogaya tha..is wajah se humare ghar ke buzurgo ko bhi hogaya" ***Nearby many people had TB, because of that elderly in our house also got the disease.***	High prevalence in community	
"Pehle 6 mahine course lia phir dobara jach karaya toh doctor sahab ne dobara course start kar diya." ***I did the course for 6 months then got tested again..doctor started the treatment course again.***	TB relapse after completed treatment	
"2 baar course kar chuka hu davai ka..ab nahi karna chahta..kamzori aati hai" ***I have taken the medicine course two times.. Now I don't want to, it causes weakness.*** *"Zyaada dava nahi leni chahiye umar kam hojati hai..shareer kamzor hojata hai"* ***We should not take more medicines..life span reduces..body becomes weak.***	Non-compliance to TB treatment	

Table 30: Content Analysis grouped under health status pertaining to substance use

"Majdoori karke itna thak jaate hai aur daaru pee ke so jaate hai." ***We get tired from doing labour and we consume alcohol and sleep.***	Physical tiredness	Alcohol use
"Daru nai piyenge toh raat mein neend nai ati." ***If we don't drink alcohol, we can't sleep at night.***	Sleeplessness	
"Nasha nahi karne wale silicosis mareej ki halat bahut kharab hoti hai.." ***Silicosis patient who does not do substance use gets into very bad condition.***	Beliefs regarding substance use	Alcohol use
"Yaha ke logon ki manyata hai ki daaru peene se fefda poora saaf ho jaega". ***People here believe that drinking alcohol will clean out the lungs.***		
"10-12 saal ki umar se, jabse khan mein jana shuru kia hai, tabse daru shuru ki thi. Khan mein baaki majdoor bhi peete the toh hum bhi 10 rupaiye mein jitna ata, who pee lete." ***I started drinking since the age of 10-12 years when I started working in mines. Other mine workers also drank, so I also started drinking (alcohol) whatever we got in 10 rupees.***	• Early age of initiation of work • Easily available from peers at work • Common norm at work	Early age of initiation of alcohol

Table 31: Content Analysis grouped under health status pertaining to healthcare costs

"Jab bhi choti moti chot ke liye haspatal jana hota hai..Poore din ki hazri chali jaati usi mein." ***Whenever we have to go to the hospital for small injury..whole day attendance is lost in that.***	Loss of daily wage	Indirect costs
"Aane jaane ka kharch lagta hai,.us din ki hajri bhi gawani padti hai lagbhag 500-600 rupaiye." ***We have to face travel expense and attendance is also lost, about 500-600 rupees are spent.***	Travel expense	
"Jach maine karwai thi private haspatal mein..wahi par 20 hazar kharch ho gae." ***I had gone to private hospital for investigations..there I spent 20,000 rupees.*** *"X-ray private se karana padta hai jo bahar hospital ke lab mai hota hai"* ***X-ray has to be done from private that is done in the lab outside the hospital.***	Investigations	Out of pocket expenditure
"4000 mein ghar kaise chale..utne ki toh dawai aa jati hai." ***In 4000 rupees, how can we run a house, this much is spent on medicine.*** *"Bimari ke baad jyada kharch toh dawai goli ka bhada hai."* ***After the disease, expense is more on the medicine.***	Medications	
"4 mahine ke liye mai bahut mehenge private aspataal mai daakhil tha, tab mujhe rishtedaaron se paise lene pade the." ***For 4 months I was admitted in a very costly private hospital, I had to take loan from relatives.***	Loan to cover expenses	Catastrophic expenditure

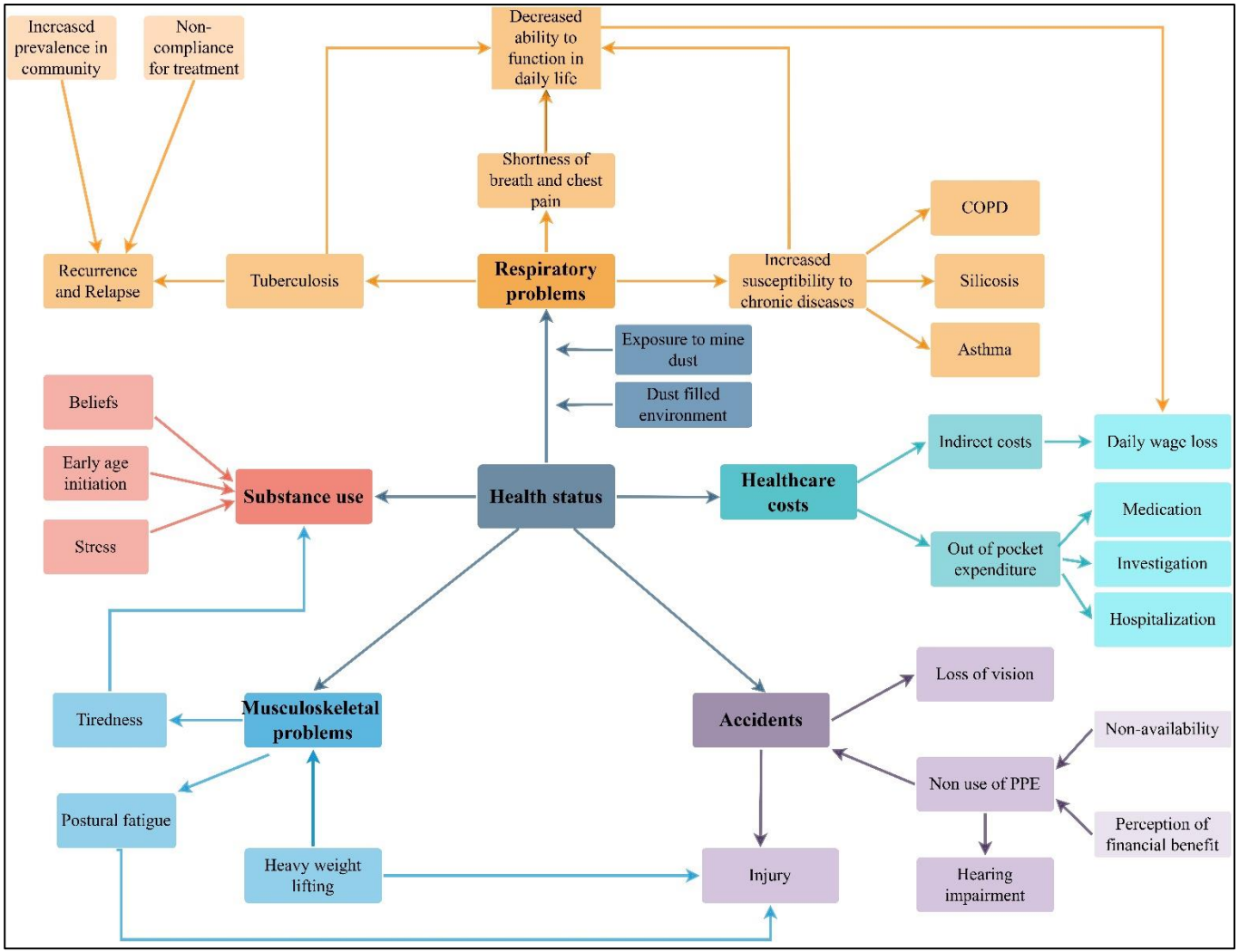

Figure 16 *Thematic Framework (Health Status)*

5.4.3 Integration of Quantitative and Qualitative Findings

Integration of the outcome of both quantitative and qualitative phases to explain the research question.

Table 32: Analysis of health status by integration of Quantitative and Qualitative part

Parameters	**Quantitative part**	**Qualitative part**
Musculoskeletal and Injuries	34.6% of the above 18 participants had h/o musculoskeletal problems	Musculoskeletal
Respiratory	17.8% of adult participants had h/o chronic lung disease (ever)	Increased susceptibility to chronic respiratory diseases
	12.7% of adult participants had h/o T.B.	Tuberculosis
Substance use	84.5% of adult male participants and 40.7% of adult female participants had h/o substance use	Substance use to rid tiredness Relieves stress in silicosis patients

5.5 Association of Quality of life

5.5.1 Association of Quality of life with Distance from the mines

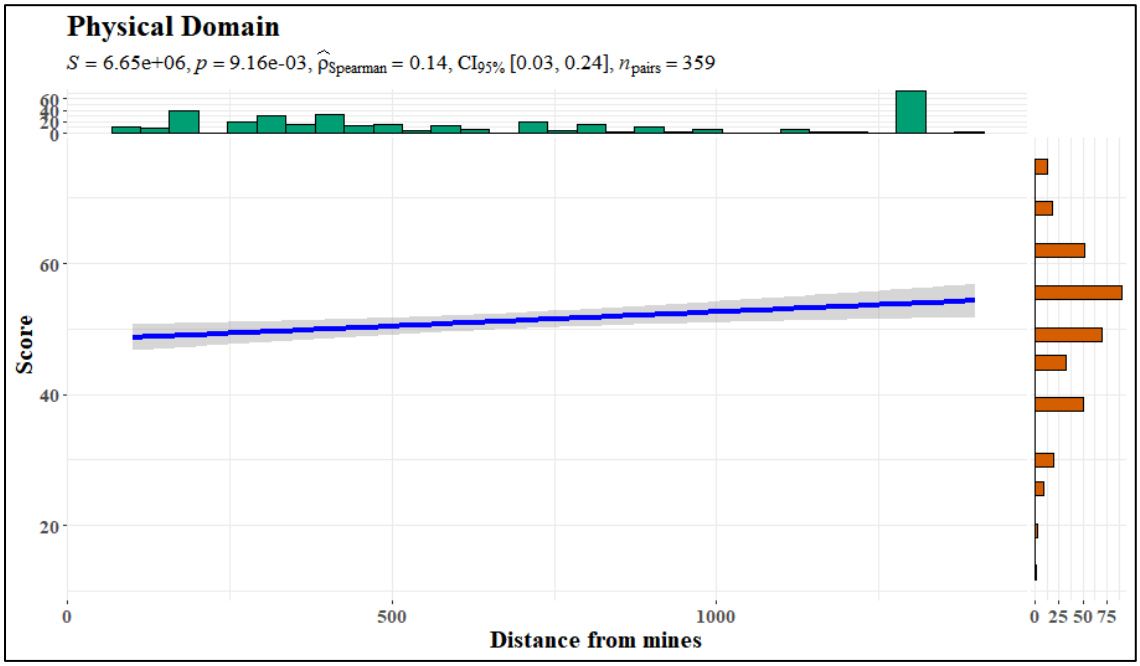

Figure 17 *Correlation plot with histogram between Physical domain of Quality of life and distance from mines*

Spearman's correlation test revealed that, across quality of life score for physical domain of participants in 181 HHs, was positively correlated with distance of HHs from the mines, with statistically significant effect.

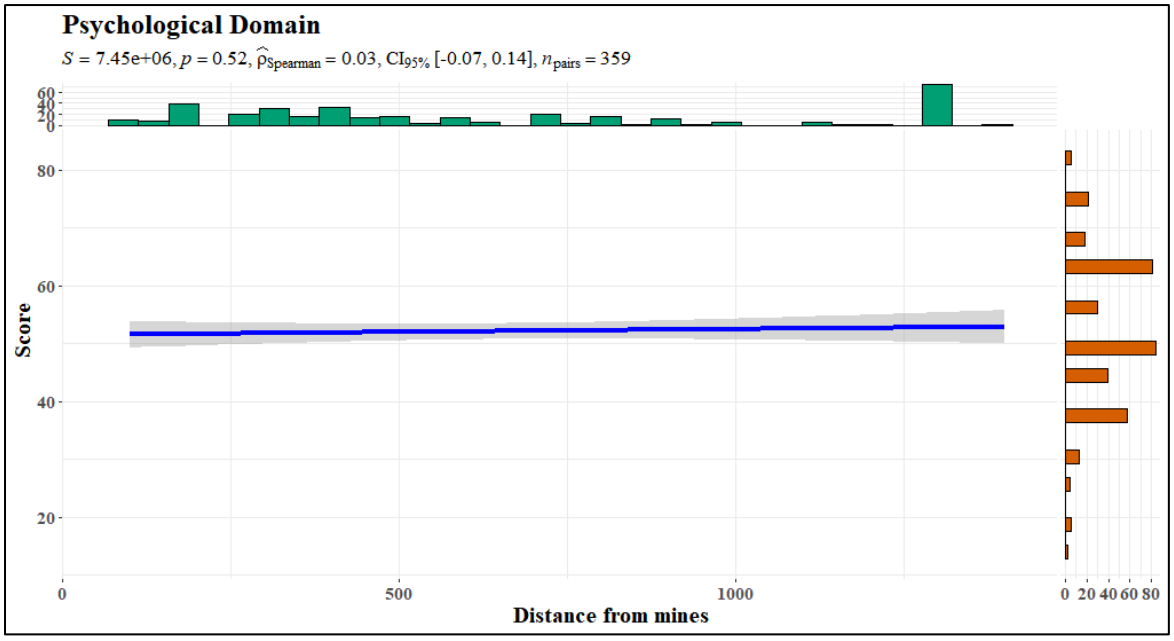

Figure 18 *Correlation plot with histogram between psychological domain of Quality of life and distance from mines*

Spearman's correlation test revealed that, across quality of life score for psychological domain of participants in 181 HHs, was positively correlated with distance of HHs from the mines, but this effect was not statistically significant.

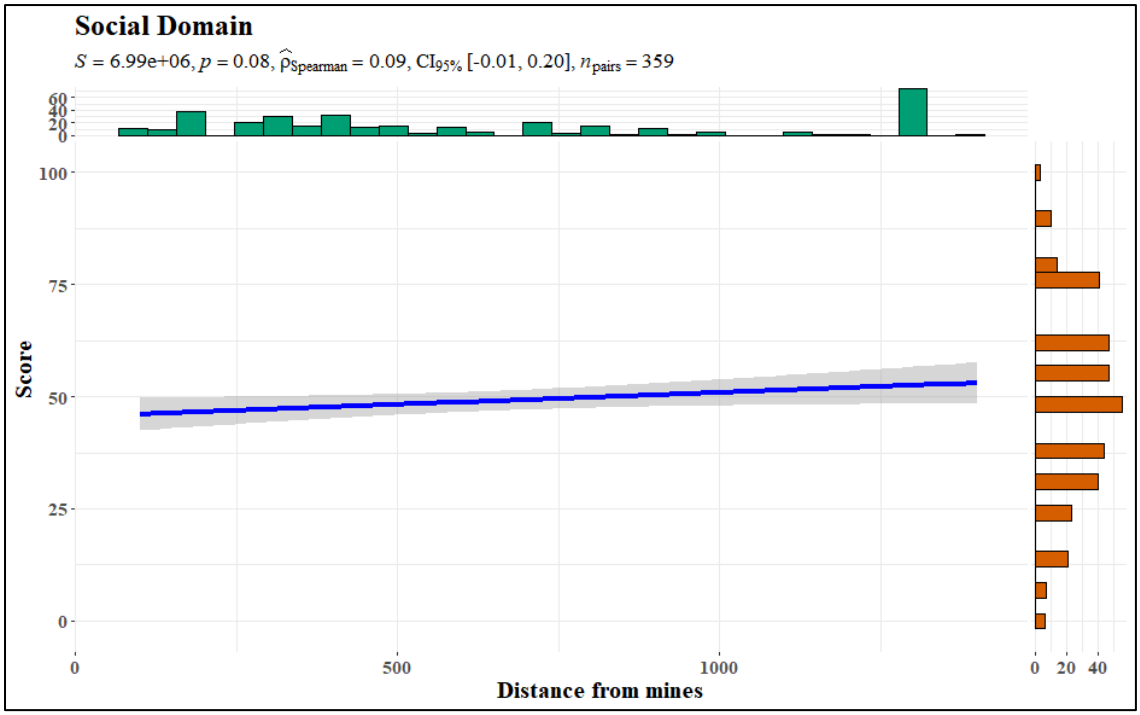

Figure 19 *Correlation plot with histogram between social domain of Quality of life and distance from mines*

Spearman's correlation test revealed that, across quality of life score for social domain of participants in 181 HHs, was positively correlated with distance of HHs from the mines, but this effect was not statistically significant.

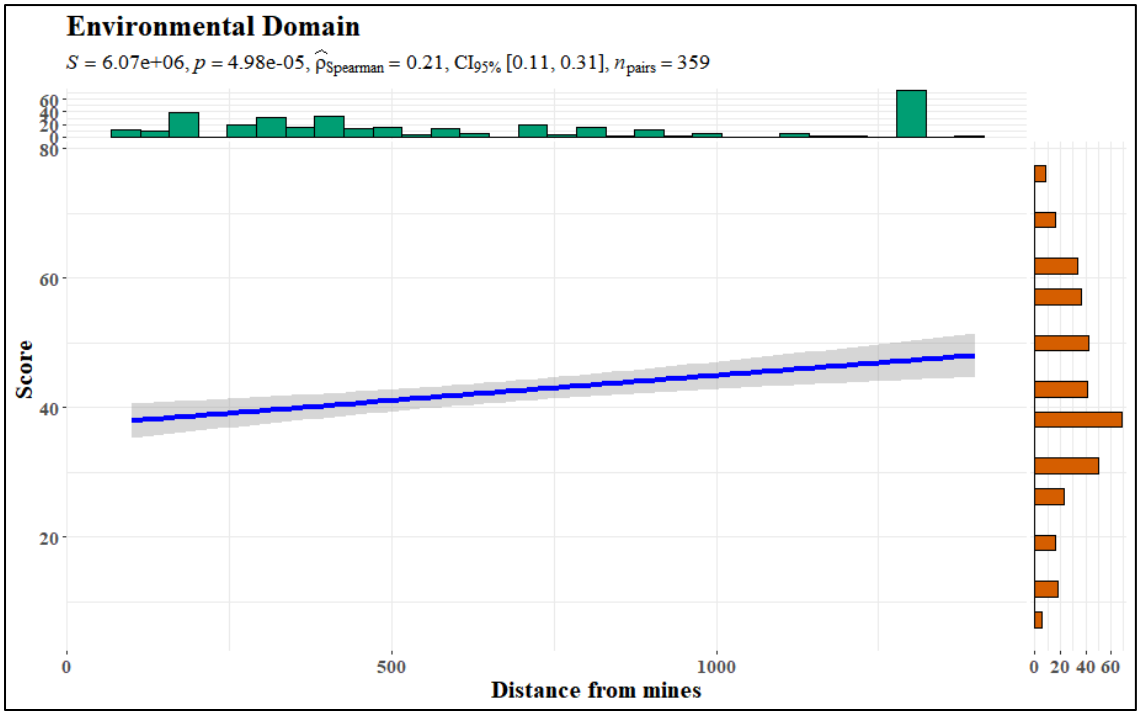

Figure 20 *Correlation plot with histogram between environmental domain of Quality of life and distance from mines*

Spearman's correlation test revealed that, across quality of life score for environmental domain of participants in 181 HHs, was positively correlated with distance of HHs from the mines, with statistically significant effect.

5.5.2 Association of Quality of life with Per-capita Income

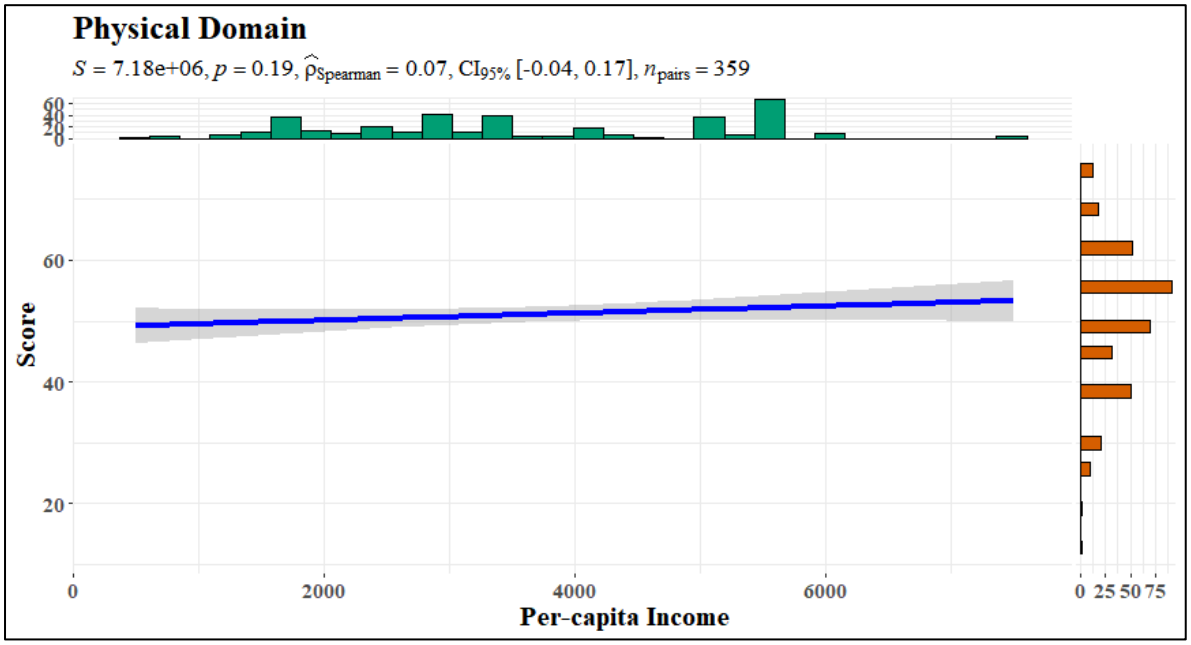

Figure 21 *Correlation plot with histogram between physical domain of Quality of life and per-capita income*

Spearman's correlation test revealed that, across quality of life score for physical domain of participants in 181 HHs, was positively correlated with per capita income, but this effect was not statistically significant.

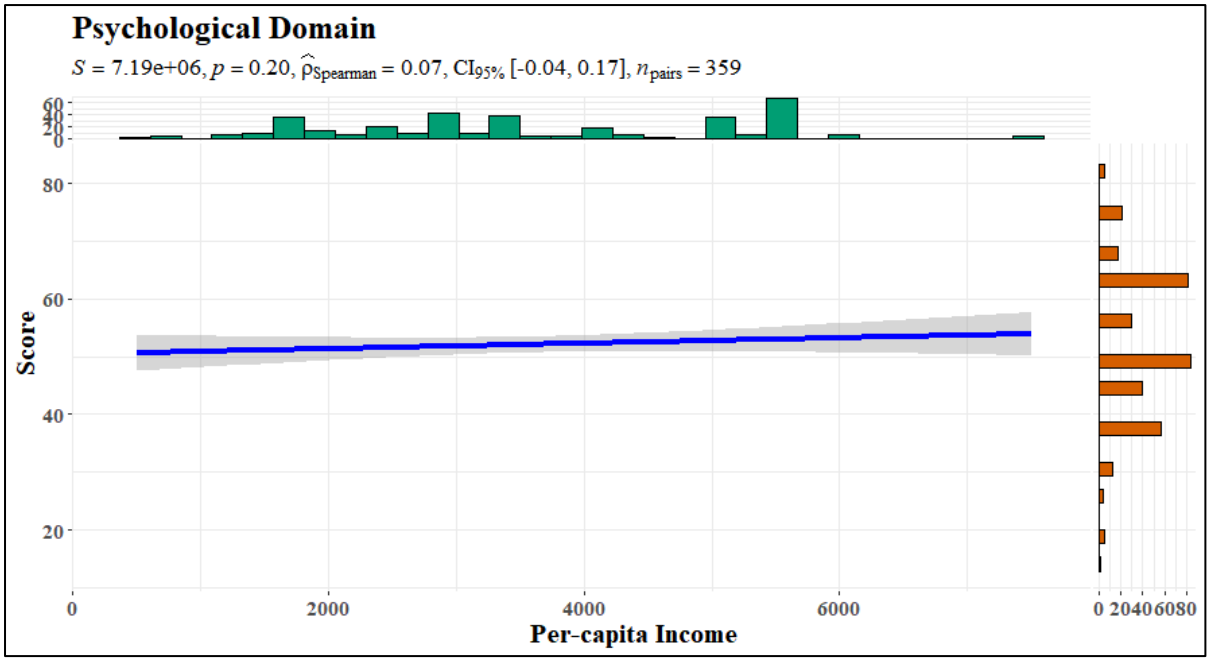

Figure 22 *Correlation plot with histogram between psychological domain of Quality of life and per-capita income*

Spearman's correlation test revealed that, across quality of life score for psychological domain of participants in 181 HHs, was positively correlated with per capita income, but this effect was not statistically significant.

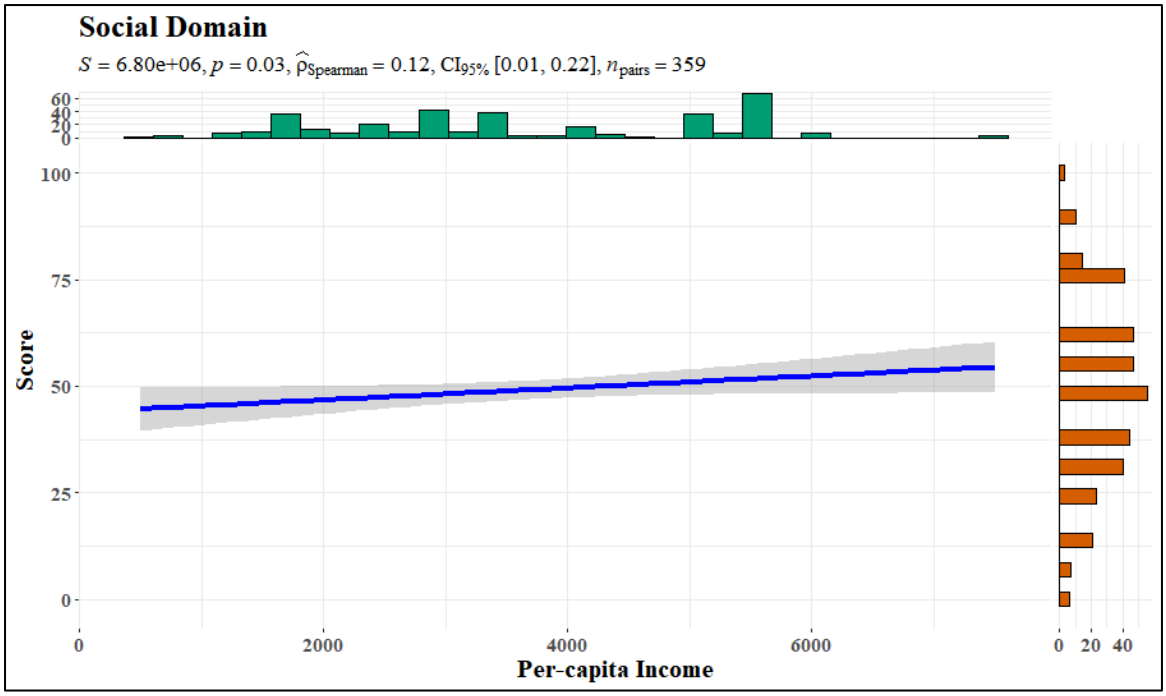

Figure 23 *Correlation plot with histogram between social domain of Quality of life and per-capita income*

Spearman's correlation test revealed that, across quality of life score for social domain of participants in 181 HHs, was positively correlated with per capita income, with statistically significant effect.

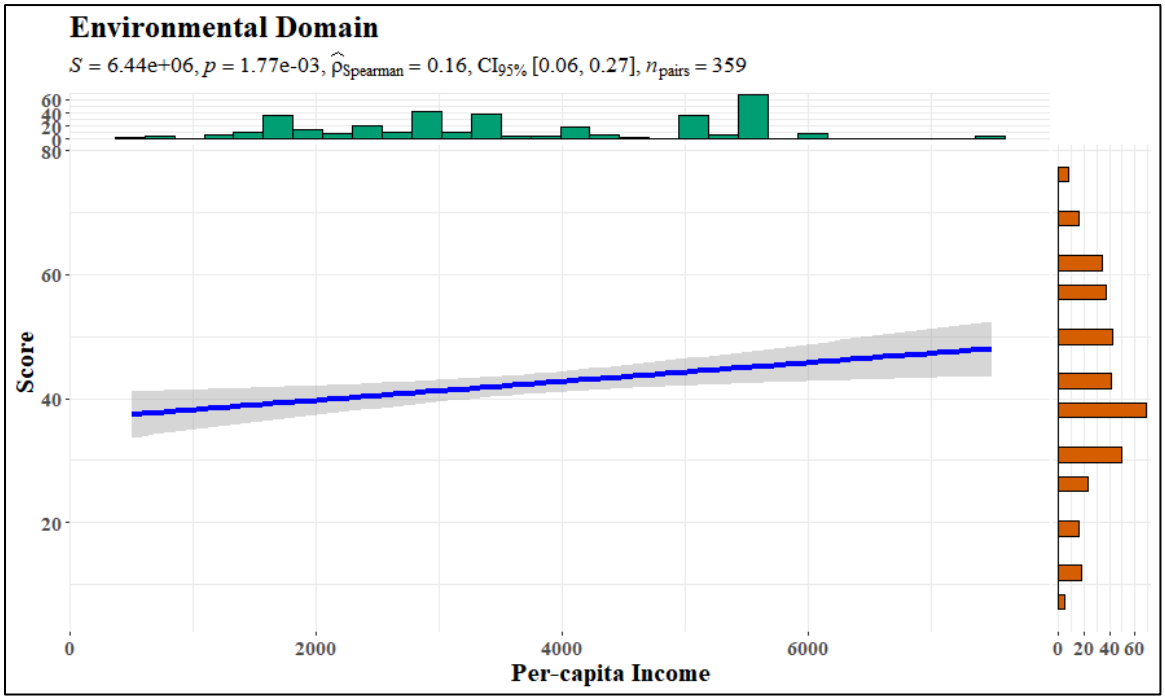

Figure 24 *Correlation plot with histogram between environmental domain of Quality of life and per-capita income*

Spearman's correlation test revealed that, across quality of life score for environmental domain of participants in 181 HHs, was positively correlated with per capita income, with statistically significant effect.

5.6 Association between Health Status with distance from mines, socioeconomic status and other sociodemographic characteristics

5.6.1 Association with silicosis

Table 33: Association with Silicosis on univariate analysis

Variables	Silicosis - n (%)		Odds ratio	P value
	Yes	No	(95 % CI)	
Age Group				
Elderly	9 (10.0)	81 (90.0)	1.05 (0.49 - 2.24)	0.902
Adult	41 (9.6)	387 (90.4)	1 (Ref)	
Gender				
Male	47 (17.7)	218 (82.2)	17.97 (5.51 - 58.53)	<0.0001
Female	3 (1.18)	250 (98.8)	1 (Ref)	
Religion**				
Muslim	4 (10.5)	34 (89.5)	1.11 (0.37 - 3.26)	0.777
Hindu	46 (9.6)	434 (90.4)	1 (Ref)	
Caste				
SC-ST	37 (10.2)	326 (89.8)	1.24 (0.64 - 2.40)	0.524
OBC-Gen	13 (8.4)	142 (91.6)	1 (Ref)	
Type of family				
Nuclear	23 (10.8)	190 (89.2)	1.25 (0.69 - 2.23)	0.461
Joint-Three Generation	27 (8.9)	278 (91.1)	1 (Ref)	
Socio-economic status**				
Upper/Middle	46 (9.8)	424 (90.2)	1.19 (0.41 - 3.47)	1.000
Lower	4 (8.3)	44 (91.7)	1 (Ref)	
Mine work				
Ever worked	49 (16.0)	257 (84.0)	40.23(5.50 - 293.77)	<0.0001
Never worked	1 (0.5)	211 (99.5)	1 (Ref)	
Dust exposure in mines				
High dust producing	40 (19.8)	162 (80.2)	2.60 (1.21 - 5.60)	0.012

Low dust producing	9 (8.7)	95 (91.3)	1 (Ref)	
No of years in mines				
More than 20	28 (33.3)	56 (66.7)	14.00 (4.68 - 41.88)	<0.001
11-20	17 (16.0)	89 (84.0)	5.34 (1.74 - 16.46)	
Less than 10	4 (3.4)	112 (96.6)	1 (Ref)	
Distance from mines (in meters)				
Within 250	10 (10.2)	88 (89.8)	1.03 (0.43 - 2.46)	0.989
251-500	14 (9.7)	130 (90.3)	0.97 (0.44 - 2.16)	
501-1000	13 (9.0)	132 (91.0)	0.89 (0.39 - 2.00)	
1000-1500	13 (9.9)	118 (90.1)	1 (Ref)	

p-value is calculated using Chi-square

**Fischer Exact

A significant association was found between h/o silicosis and gender, with odds in males about 18 times that of females. A significant association is found with h/o silicosis and type of work (ever worked and never worked in mines), dust exposure in mines and no of years in mines. The odds of ever working in mines in reference to never working is 40 times. The odds of high dust-producing work compared to low dust-producing work is 2.6 times. Odds compared to work duration of fewer than ten years compared to 11-20 years and more than 20 years is 5.3 and 14 times, respectively.

There is no significant association of h/o silicosis with distance from mines and socioeconomic status upon univariate analysis.

Table 34: Association of Silicosis with distance from mine after adjusting for potential confounding factors upon multivariable logistic regression analysis (N = 518)

Variables	**Odds ratio (95 % CI)**	**P value**
Male gender (vs female)	6.33 (1.21 – 33.06)	0.029
Age (in years)	1.11 (1.04 – 1.18)	0.001
High mining dust exposure (vs. low dust exposure)	1.16 (0.40 – 3.40)	0.780
Years worked in mines	0.997 (0.925 – 1.075)	0.946
Distance from mines	1.00 (0.999 – 1.001)	0.740
Model parameters: - 2 log likelihood ratio = 137.023, Nagelkerke R square = 0.27, Hosmer & Lemeshow Chi-square = 7.80, df = 8, p value = 0.453		

Further, multivariable logistic regression analysis was conducted taking presence of silicosis as dependent variable. Age, years worked in mines and distance from mines were taken as continuous variables. No significant association was found between silicosis and distance from mines even using multivariable approach after adjusting for all other variables such as age, gender, years worked in mines and extent of dust exposure in mining. Gender is a confounder. Years worked in mines also was not significant probably because age was a confounding factor i.e., older individuals were more likely to have worked in the mines for a longer period.

5.6.2 Association with chronic respiratory morbidities other than silicosis

Table 35: Association with chronic respiratory morbidities other than silicosis on univariate analysis

Variables	Chronic respiratory morbidities other than silicosis- n (%)		Odds ratio (95 % CI)	P value
	Yes	No		
Age Group				
Elderly	27 (30.0)	63 (70.0)	11.80 (5.95 - 23.40)	<0.0001
Adult	15 (3.5)	413 (96.5)	1 (Ref)	
Gender				
Male	25 (9.4)	240 (90.6)	1.47 (0.76 - 2.74)	0.258
Female	17 (6.7)	236 (93.3)	1 (Ref)	
Religion**				
Hindu	39 (8.1)	441 (91.9)	1.03 (0.30 - 3.51)	1
Muslim	3 (7.9)	35 (92.1)	1 (Ref)	
Caste				
OBC-Gen	13 (8.4)	142 (91.6)	1.05 (0.53 - 2.09)	0.879
SC-ST	29 (8.0)	334 (92.0)	1 (Ref)	
Type of family				
Joint-Three Generation	34 (11.1)	271 (88.9)	3.21 (1.46 - 7.09)	0.002
Nuclear	8 (3.8)	205 (96.2)	1 (Ref)	
Socio-economic status**				
Lower	5 (10.4)	43 (89.6)	1.36 (0.50 - 3.64)	0.575
Upper/ Middle	37 (7.9)	433 (92.1)	1 (Ref)	
Mine work				
Ever worked	22 (7.2)	284 (92.8)	0.74 (0.395 - 1.400)	0.357
Never worked	20 (9.4)	192 (90.6)	1 (Ref)	
Type of Work in mines				
High dust producing	17 (8.4)	185 (91.6)	1.82 (0.65 - 5.08)	0.247

Low dust producing	5 (4.8)	99 (95.2)	1 (Ref)	
Dust exposure in mines				
More than 20	14 (16.7)	70 (83.3)	23.0 (2.96 - 178.73)	<0.0001
11-20	7 (6.6)	99 (93.4)	8.13 (0.98 - 67.23)	
Less than 10	1 (0.9)	115 (99.1)	1 (Ref)	
Distance from mines (in meters)				
Within 250	6 (6.1)	92 (93.9)	0.65 (0.23 - 1.79)	0.826
251-500	11 (7.6)	133 (92.4)	0.82 (0.35 - 1.92)	
501-1000	13 (9.0)	132 (91.0)	0.98 (0.43 - 2.22)	
1000-1500	12 (9.2)	119 (90.8)	1 (Ref)	

p-value is calculated using Chi-square

**Fischer Exact

A significant association is found between h/o Chronic respiratory morbidities other than silicosis and age group, with the odds in the elderly being 11.8 times that of adults. Association is also found with the type of family, with joint and three-generation families having odds of 3.2 times that of a nuclear family. Association is also found with the duration of work in mines. Keeping reference as a duration less than ten years, odds in 11-20 years and over 20 years are 8.1 times and 23 times, respectively.

No association is found between distance from mines and socioeconomic status.

5.6.3 Association with chronic morbidities other than chronic respiratory

Table 36: Association with chronic morbidities other than chronic respiratory on univariate analysis

Variables	Chronic morbidities other than chronic respiratory – n (%)		Odds ratio (95 % CI)	P value
	Yes	No		
Age Group**				
Elderly	90 (100.0)	0 (0.0)	undefined	<0.0001
Adult	320 (74.8)	108 (25.2)	1 (Ref)	
Gender				
Female	223 (88.1)	30 (11.9)	3.10 (1.95 - 4.93)	<0.0001
Male	187 (70.6)	78 (29.4)	1 (Ref)	
Religion**				
Muslim	33 (86.8)	5 (13.2)	1.80 (0.69 - 4.73)	0.225
Hindu	377 (78.5)	103 (21.5)	1 (Ref)	
Caste				
OBC-Gen	124 (80.0)	31 (20.0)	1.07 (0.67 - 1.72)	0.756
SC-ST	286 (78.8)	77 (21.2)	1 (Ref)	
Type of family				
Joint-Three Generation	250 (82.0)	55 (18.0)	1.50 (0.98 - 2.31)	0.059
Nuclear	160 (75.1)	53 (24.9)	1 (Ref)	
Socio-economic status				
Upper/Middle	373 (79.4)	97 (20.6)	1.14 (0.56 - 2.32)	0.711
Lower	37 (77.1)	11 (22.9)	1 (Ref)	
Mine work				
Never worked	171 (80.7)	41 (19.3)	1.17 (0.75 - 1.81)	0.480
Ever worked	239 (78.1)	67 (21.9)	1 (Ref)	
Type of work in mines				
High dust producing	158 (78.2)	44 (21.8)	1.02 (0.58 - 1.80)	0.947
Low dust producing	81 (77.9)	23 (22.1)	1 (Ref)	

Dust exposure in mines **				
More than 20	84 (100.0)	0 (0.0)	undefined	<0.0001
11-20	82 (77.4)	24 (22.6)	2.01 (1.11 - 3.63)	
Less than 10	73 (62.9)	43 (37.1)	1 (Ref)	
Distance from mines (in meters)				
Within 250	78 (79.6)	20 (20.4)	0.83 (0.42 - 1.62)	0.711
251-500	111 (77.1)	33 (22.9)	0.72 (0.39 - 1.23)	
501-1000	113 (77.9)	32 (22.1)	0.75 (0.41 - 1.37)	
1000-1500	108 (82.4)	23 (17.6)	1 (Ref)	

p-value is calculated using Chi-square

**Fischer Exact

Comparing h/o chronic morbidities other than chronic respiratory, a significant association is found with age group and gender. Higher odds are found in the elderly compared to adults, and females have 3.1 times greater odds than males.

A significant association is also found with the number of years of work in mines, with higher odds being those working for more than ten years with those working less than ten years.

No association is found between distance from mines and socioeconomic status.

5.7 Situational analysis of government schemes and policies

5.7.1 Quantitative

Table 37: Social schemes registered in households

Social schemes registered	**No of families - n (%)**
Bhamasha yojana/Jan aadhar yojana (N=181)	174 (96.1)
Chiranjeevi yojana (N=181)	130 (71.8)
Silicosis (N=50)	
Received compensation	44 (88.0)
Receiving silicosis pension	43 (86.0)
Death due to silicosis (N=40)	
Compensation after death*	31 (77.5)

*31 (77.5%) had received funeral benefits along with the compensation received after the death

Most of households 174 (96.1%) had availed *Bhamasha yojana*. Rest 3.9% had not registered for the scheme as they were non-residents of Rajasthan state.

None of the mine workers had been given the provision of *Provident Fund* by their employers. None of the mine workers were registered or had the knowledge of *Building & Other Construction Workers' Welfare* (BOCWW) Fund. None of the workforce in the mining areas were registered in the *eSHRAM* portal, which is the National Database of Unorganised Workers (95).

Table 38: Secondary data from Pneumoconiosis portal

Status	**No of cases**
Net Registered*	149850
Net Disbursed	18315 (12.2)
Net Rejected Cases	115046 (76.8)
Net Pending cases	16489 (11.0)
Net Pending for Appointment for Screening at CHC/PHC	4 (0.2×10^{-2})
Net Pending for Screening at CHC/PHC	8153 (5.4)
Net Pending for Appointment for Screening at Medical Board	157 (0.1)
Net Pending for Screening at Medical Board	3805 (2.5)
Cases pending for certificate generation	146 (0.1)

*As on 2022.02.05 (YYYY.MM.DD)

Out of 149850 registered cases, around 12.2% has received the disbursement money with about 76.8% rejections. Among 11.0% pending cases, largest number of cases are pending at CHC/PHC level (5.4%) and medical board level (2.5%), with least pendency at certificate generation level (0.1%) (96).

5.7.2 Qualitative

Almost all the participants were aware of the compensations provided by the government for being diagnosed with silicosis. Many were getting monthly pensions, and few had already received the silicosis compensation amount of Rs.3 lakhs. However, most of them complained about the delay in diagnosing the disease and the allocation of money.

Two focus group discussions were conducted. First focus group discussion had 6 participants; all were residents of the villages around the mines and was conducted in one of the rural mining zones.

Table 39: Participants selected for Focus Group Discussion 1

No. of participants	**Participant characteristics**
Participant 1	Current mine worker with respiratory distress not diagnosed as silicosis,
Participant 2	Participant with h/o of working in mining who is currently unemployed with B/L below knee amputation due to a smoking history,
Participant 3	Elderly female homemaker with h/o working in mines,
Participant 4	Current mine worker with no respiratory distress,
Participant 5	Anganwadi helper,
Participant 6	Previous mine worker diagnosed with silicosis and has received compensation.

The second FGD was conducted in an urban mining zone with 6 participants who were residents of areas around the mines.

Table 40: Participants selected for Focus Group Discussion 2

No. of participants	**Participant characteristics**
Participant 1	Participant who is continuing to work in mines despite his c/o breathlessness as there is no other source of income,
Participant 2	E-mitra operator,
Participant 3	Currently unemployed participant with h/o working in mines. Participant has been diagnosed with silicosis and is getting rehabilitation pension, which is irregular and has received rehabilitation assistance,
Participant 4	Participant with family h/o death due to silicosis,
Participant 5	Truck driver in a mining area,
Participant 6	Mine worker with no current morbidities.

Table 41: Situational Analysis grouped under SWOT pertaining to strength of government schemes and policies

Verbatims	**Codes**	**Subthemes**
In-depth interviews and Focussed group discussions		
"Pehle ek lakh dete the ab 3 lakh de rahe hai aur marne ke baad do laakh de rahe hai. Uske alawa mareej ko palanhar yojana ke antargat palan poshan aur padhai ke liye prati baccha 1000 rupaiya mahina milta hai, who bhi agar who school jata hai toh." ***Used to give one lakh, now giving 3 lakhs and after death, giving two lakhs. Apart from this, the patient gets Rs 1000 per month per child for upbringing and education under the Palanhar Yojana, whosoever goes to school.***	• Silicosis compensation, • Silicosis pension, • Palanhar, • Widow pension	Knowledge about government schemes and policies
"Har mahine 1500 rupaye milte hai." ***1500 rupees are received every month.***	Monthly pension	Timely in receipt of monetary benefit
"Lockdown ke waqt 1500 rupaye ki pension aur sarkaar ke diye huye 2 lakh rupaye se hi kharcha nikala hai." ***At the time of lockdown, the pension of Rs 1500 and Rs 2 lakh given by the government were used for expenses.***	Monetary in receipt during lockdown	Source of income
"Silicosis bimari hone ke baad mujhe sarkaar se 2 lakh rupaye mile."	Silicosis Compensation	

After being diagnosed with silicosis, I received Rs 2 lakh from the government.		In receipt of government schemes and policies
"..aur viklang suvidha mili hai joki 700 rupaiya mahina hai." ***..and disability benefit is available which is Rs.700 per month.***	Disability pension	
"Pension milta hai 1500 rupaiya, joki vidhwa pension hai." ***The pension received is Rs 1500, which is a widow pension.***	Widow pension	
"Pehle inke paas kutcha makaan tha, ab sarkari sahayta se unhone yeh pakka makaan bana lia." ***Earlier they had kutcha house, now with the help of the government, they built a pucca house.***	Pucca house	
"..koi toh admi sahi kaam ke liye lagata hai, jaise koi dukaan laga leta hai, koi kheti ke liye tractor leta hai.." ***..some people use it for right work, like some people set up a shop, some people buy tractors for farming..***	Utilisation of rehabilitation assistance money	Vocational rehabilitation
"Message hindi aur english dono mein ata hai." ***The message (informing the date and place of screening facility) is available in both Hindi and English.***	Information message is bilingual	Ease in registration
"Pehle mujhe ration nahi milta tha par silicosis hone ke baad milna shuru ho gaya." ***Earlier I did not get ration but after getting silicosis, I started getting ration.***	Commodity	Food security after silicosis certification
Key informant interview		

"..bahut saari cheejein online hai, yeh E-mitra se seedha rasta koi nahi hai. (DTO)" ***..there are so many things online, no other direct way than E-Mitra. (DTO)***	Online registration	Ease of registration
"Detection toh humare yaha ho raha hai X-ray basis par..certification who kar rahe hai board par. (Medical Officer)" ***Detection is being done here on the basis of Xray but..certification is done by them at the level of Board. (Medical Officer)*** *"Jinko detection jaruri nahi hai who log bhi ate hai phir aap aasani se unko separate kar sakte hai, board ke saamne jo unnecessary burden hai usko kam kar sakte hai. (Medical Officer)"* ***Those who do not need detection, we can easily separate them, we can reduce the unnecessary burden on the Board. (medical officer)***	• Detection at peripheries • Certification at level of board	Levels of check before certification
"..sab icchuk hai aur jaan na chah rahe aur apply kar rahe hai, pehle itna nahi tha. (Medical Officer)" ***..everyone is interested to know and they are applying more, earlier it was not so much. (medical officer)*** *"Jab se monetary benefit ayi hai, kafi log jagruk hue hai..jyada ko benefit mila hua hota hai aur kai log prakriya mein hote hai. (Medical Officer)"* ***Ever since monetary benefits have come, many people have become aware..many have got benefits and many are in the process. (medical officer)***	Increase in number of applications Increased awareness	Increased detection of cases

"Pehle sirf shehro mein hi centre the..phir unhe bifurcate kiya aur periphery mein bahut saare centres diye. (Medical Officer)" ***First the centres were in cities only.. then they were bifurcated and centers were provided in the periphery. (medical officer)***	Decreased dependence on urban centres Provision of centres at peripheries	Ease of examination
"..bahut saare log unnecessary apply kar rahe, jinko plain x-ray se hi..reject kar sakte hai. (Medical officer)" ***..many people are applying unnecessarily, who can be rejected only by plain X-ray. (medical officer)***	First level of rejection at CHC	Decreased burden for detection at Pneumoconiosis board
"Agar kisi silicosis mareej ke paise aa gae toh uska ghar ka gujara ho jaega aur usko khaane peene aur dawai ke liye paise mil jaenge. (ASHA)" ***If a silicosis patient gets money (assistance), then his household will be able to survive and he will get money for food, drink and medicine. (ASHA)***	• Household expense, • Expense of food and medicines	Use of assistance money for livelihood
"Rejection, jo genuine hai who toh reject honge hi."(Board member) ***Genuine rejections will definitely be rejected. (board member)***	Genuine rejections	Competence of system

Table 42: Situational Analysis grouped under SWOT pertaining to weakness of government schemes and policies

Verbatims	**Codes**	**Subthemes**
In-depth interviews and Focus group discussions		
"Mere pita bhi khadan mein hi kaam karte the aur unhe bhi saans ki bimari thi. Par kabhi unki silicosis ki jaanch nahi huyi kyuki humein iski jaankari nahi thi..Unko guzre huye 11 saal hogaye." ***My father also worked in the mines and had respiratory problems. But he was never tested for silicosis because there was no information..He passed away 11 years ago.***	Lack of information	Lack of knowledge • Disease • Diagnosis • Govt. schemes
"Mujhe itna nahi pata. Main utna padha likha nahi hun. Kya scheme hai kya nahi, mujhe nahi pata." ***I don't know that much I am not educated. I don't know what are the schemes.***	Lack of education	
"Mujhe laga ki TB hai, isliye silicosis wali jach nai karai." ***I thought it was TB, so did not get tested for silicosis.***	Thought it was TB	Delay in registration
"Koi bhi haspatal jao, waha poora din nikal jata hai..poore din ke hajari chali jaati." ***Go to any hospital, your full day is spent there..wage for the day is lost.***	Afraid of losing daily wage	
"Mujhe padna nahi ata..toh message kab ata hai, malum nahi chalta." ***I don't know how to read..I don't know when the message (for date and name of health facility for screening) is received.***	Unable to read SMS of screening date and place	Problems in registration

"..ek baar reject hone ke baad 6 mahine baad taka ap avedan nahi kara sakte silicosis jach ke liye." ***..once rejected, you cannot apply for silicosis test for 6 months.***	"Lock period" after rejection	Problems in re-registration
"Maine silicosis wali jaanch karwayi thi, par abhi tak report nahi aayi." ***I had got the test done for silicosis, but the report has not come yet.***	Delay in Test Results	Delay in detection
"..toh uska na koi message ata hai, na koi reply, ki apka paas hua ya fail. Matlab reject ho toh bhi ek reply ana chahie ki reject ho gaya." ***..no message is recieved if it has passed or rejected. Even if it is rejected, a reply should come that it has been rejected.***	No information after rejection	Problem in detection
"Xray jo karai who humare paas nai. Toh jab reject hua toh hum kisi aur doctor se pooch bhi nahi sakte." ***We do not have the X-ray, so when it was rejected, we couldn't go to another doctor to ask.***	No means of cross verifying diagnosis	Problem in diagnosis
"..kai admi byaj par 50,000 udhar lete hai.." ***..some people have borrowed 50,000 rupees (bribe to get their certificate cleared to receive assistance money) on interest..***	Paying off	Problem in certification
"Silicosis hone ke baad 1500 pension ata hai, jo ki 12 mahine mein 3-4 mahine hi ate hai. Jo paise nai aye, woh phir nai ate." ***After getting silicosis, 1500 rupees pension comes only for 3-4 months in 12 months. The money that was not recieved, never comes again.***	Irregularity of in receipt of pension	Untimely annuity

"Mere certificate ban ne ke baad do baar pension aye hai; 6 mahine mein do baar." ***I got pension twice after getting my certificate; twice in 6 months.***		
"2016 mein certificate bana toh ek lakh hi aye sirf. Palanhar ke paise bhi nai aa rahe." ***The certificate was made in 2016, only 1 lakh rupees were received. Palanhar's money is also not coming.***	Palanhar	Non receipt of provision for sustenance of family
"Silicosis ho gai thi aur paisa atak gaya..humko ek se dusri jagah chakkar lagwate the. Log aise mein himmat har jaate hai." ***Had silicosis and the money got stuck..we were made to go from one place to another. People lose hope in that.*** (from a resident whose father had silicosis, received the pneumoconiosis certificate but the money got stuck due to wrong entry of bank account number by E-mitra operator) *"Pitaji ka jab paisa release hua tab bank khaata record mismatch hone se wapis chala gaya. Phir jab tak pitaji jeevit rahe tab tak paisa nahi aya, unke marne ke 6 mahine baad aya."* ***When father's money was released, the money went back due to mismatch of bank account records. Then money did not come till father was alive, it came after 6 months of his death.***	Confusion after stuck payments	Lack of clarity

"Jodhpur mein haspatal ane jane ka kharch isi mein lag jaega. Baki toh teen lakh mein kuch nahi hoga." ***The expenses of traveling to the hospital in Jodhpur will be consumed in this. Rest, nothing will happen in three lakhs.*** *"Dikkat yahi hai ki kahi jana hai toh paisa lagta hai, tel bharana padta hai, aur us din ki hazri jaati hai."* ***The problem is that if you want to go somewhere, you have to pay money, you have to pay for the petrol, and attendance is lost on that day.***	• Transportation cost • Loss of daily wage	Entire assistance money/income used up in healthcare costs
"..kitne hi paise toh bimari mein nikal jaate hai." ***..so much money is spent on the disease (treatment).*** *"..abhi toh karj lekar ilaaj karwana padta hai."* ***..now we have to get treatment done by taking a loan.*** *"Bimari ke baad jyada kharcha toh dawa goli hai. 8000 ki kamai mein 2000-3000 toh dawai ka kharch hai."* ***After illness, more expense is of medicines. Out of the earned 8000 rupees, 2000-3000 is the cost of medicines.***	• Expense on treatment • Loan taken for treatment • Catastrophic expenditure	
"Khud hi kharch laga kar ilaaj karana padta hai, koi usme paise se sahayta nahi milti." ***We have to spend our own expenses for the treatment, we do not get any financial help.***	Lack of financial support for healthcare costs	

"Gram sevak form bharne ke 5000 rupaiya mangta hai..humare pas itne rupaiye ho toh hum khud hi banwa lete." ***Gram sevak asks for 5000 rupees to fill the form (for funds to build toilet)..if we had that kind of money, we would have made (toilets) by ourselves.***	Corruption	Inducement to build toilets
"School ke liye copy aur kapde bahar se lene padte hai.." ***We have to take copy and clothes from outside for school.***	Self-expenditure on clothes, copies for school	Non provision of clothes, copies in school services
"Ration mein sirf gehu milta hai, usko chor ke ek tinka nahi milta." ***Only wheat is available in the ration, no other benefit.*** *"Sirf gehu milta hai 5 kilo prati vyakti bas."* ***Only wheat is given, 5 kg per person only.***	Only wheat is provided	Insufficient ration
"..samanya vidhwa ko milne wala hi pension milta hai." *.. general widow pension is the only pension received.*	Widow pension like those of other widows	No distinctive widow pension
Key informant interview		
"Logo ko bas yahi pata hai ki certificate milne pe 3 lakh milte hai. Uske baad unhe yeh nahi pata hota ki woh 1500 ka pension kaise start karae. Palanhar yojana ka logo ko idea nahi hai.. (E-MITRA)"	No knowledge of pneumoconiosis rehabilitation pension and pension for	Lack of knowledge

People only know that they will get 3 lakhs on getting the certificate. After that they do not know how to start the pension of Rs 1500. People have no idea about Palanhar Yojana.. (e-mitra) *"Silicosis policy ya pension ka toh pata nahi. Bas yeh pata hai ki 3 lakh milte hai. (MINE OWNER)"* ***Don't know about silicosis policy or pension. Just know that 3 lakhs are given. (mine owner)***	provision for sustenance of family	
"..doctors yaha pe occupation hi nahi samajh rahe toh yeh nahi pata tha ki occupational disease kya hai aur communicable disease kya hai. Yeh burden of detection of occupational disease to turant aa gaya tha communicable disease hospital ke upar..(NGO)" ***..doctors are not aware of occupations here, so they did not know what is an occupational disease and what is a communicable disease. This burden of occupational disease detection immediately fell on the communicable disease hospital..(NGO)*** *"..kuch ka toh X-ray mein ekdum clear dikhai de raha hai phir bolte hai ki nahi hai silicosis. (DTO)"* ***..some of it is clearly visible in X-ray and then they say that it is not silicosis. (DTO)*** *"Unko yeh toh pata chal gaya tha ki TB aur silicosis mein farak kya hai lekin silicosis bimari notifiable hai who bhi nahi pata tha. Aaj ki tareekh mein bhi evident hai. Toh yeh saari cheeje jo delay hui na wo basically lack of knowledge ke karaan hai. (NGO)"*	Lack of orientation of doctors	• Misdiagnosis of silicosis • Not notifying silicosis cases

They had come to know that what is the difference between TB and silicosis, but no one knew that silicosis is a notifiable disease. It is evident even today. So all these things which got delayed are because of those who basically lack knowledge. (Non government organization)		
"..yeh policy kisi ke upar tabhi lagu hota hai jab who confirm hota hai..(NGO)" ***..this policy is applicable only on those who are confirmed ..(NGO)***	Out of pocket expenditure	Policy has no role in decreasing OOPE
"..woh agar kisi ke paas paise nahi hota, aur koi bolta hai ki hume humari hajri nahi khoni. (ASHA)" ***..that if someone does not have money, or someone says that we should not lose our attendance. (ASHA)***	Wage loss for the day at each step of registration	Delay in Registration
"Portal mein agar ek baar jo reject ho jae who dobara apply nahi kar pata. (E-MITRA)" ***If once rejected in the portal, he is not able to apply again. (e-mitra)***	"Locked" from portal after rejection	Problem in re-registration
"Portal khud se hi us worker ko uske ghar ke address ke paas wale CHC mein screening ke liye bulata tha..iss karan se kai log nahi jaa paate the. (E-MITRA)" ***The portal automatically selects the CHC near workers' home address for screening facility. Due to this many people are not able to go. (e-mitra)*** *(*Workers are not given the option to choose the screening facility. This becomes a problem when their work place address is different from their permanent residence.)	Problem in selection of screening facility	Problem in screening

"Spirometry toh nahi hoti hai..(Medical officer)" ***Spirometry is not done..(medical officer)***	Unavailability of spirometer	Lack of equipment
"..bahut saare cases hai jinka paisa release hota hai jaipur se lekin jodhpur nahi ata..jisne data (bank account number) fill kia usne ek zero kam feed kar dia. (NGO)" ***..there are many cases whose money (rehabilitation assistance) is released from Jaipur (capital city of the state) but does not reach Jodhpur (current district in study)..those who filled the data (bank account number) wrote one zero less. (Non government organization)***	Incorrect filling of bank account number	Nonreceipt of rehabilitation assistance
"Yeh silicosis patient ki vidhwa ko sirf 500 hi pension..unhe 1500 nahi milte. (E-MITRA)" ***The silicosis patient's widow gets only 500 rupees pension..she doesn't get 1500 rupees. (e-mitra)***	Not receiving actual widow pension benefit	Incorrect disbursement
"..jo policy kar rahi hai who kewal detect karne ka paisa batt rahi hai. (NGO)" ***..the policy is only giving money for detection. (Non government organization)***	Centred around disbursement	Role of policy only for disbursement
"..yeh funds sirf rehabilitation ke liye hai, it has nothing to do with prevention, nothing to do with reduction. (NGO)" ***..this fund is only for rehabilitation, it has nothing to do with the provision, there is nothing in the reduction. (Non government organization)***	Fund only for rehabilitative assistance	
"..poore hodh lagi hui hai ki pendency zero karne mein..kitne log expose hai jinko nahi hona chahie, uske prati who yeh 1% bhi kaam nahi kar rahe. (NGO)"	No work on prevention	

..everyone is busy in making the pendency zero.. How many people are exposed who should not have been exposed, they are not doing even 1% work towards that. (Non government organization)		

Table 43: Situational Analysis grouped under SWOT pertaining to opportunities of government schemes and policies

Verbatims	**Codes**	**Subthemes**
In-depth interviews and Focus group discussions		
"Sarkar se nivedan rahega ki hume koi dusra kaam de jisse ki hum khaan se chutkara pa sake. Dusra koi rojgar de." ***It is a request to the government to give us some other work so that we can get out of the minework, provide some other employment.*** *"Sarkar koi factory laga de jaise ata ki chakki laga de ya thaliya banana ya silai kendra ya sarkari school ki dress banana ka kaam ya handicraft adi."* ***The government should set up a factory like setting up a flour mill or plate-making or sewing center or government school dress making or handicraft etc.***	Factories should be set up in mining areas • flourmill, • clothes, • handicrafts, • manufacturing	Alternative work option in mining areas
Key informant interview		
"Worker ki primary screening karne unke kaam par jana chahie aur har saal ya 6 mahine mein unka medical checkup..(Board Member)" ***For worker's primary screening, one should go to their workplace and their medical checkup should be done every year or every 6 months. (board member)***	Prework screening and routine checkup	Provision of periodic check-up

"In worker ko timely aware kar paaye jo occupational hazard hai..unko bata dia jae ki yeh precaution rakhe. (Medical officer)" ***These workers should be timely made aware about occupational hazards..they should be told about keeping precaution (medical officer)*** *"Mareej ko sahayta raashi dena ek had theek hai lekin bimari ko jadd se khatam kiya jaye toh badiya hai, uska upaay sirf prevention hi hai. (Board member)"* ***It is okay to give financial assistance to the patients, but if the disease is eradicated from the root, then it is better, its solution is only prevention. (board member)***	• Awareness on occupational hazards • Personal protection from occupational hazards	Focus on preventive measures
"TB ke saare patient ka bi-directional mein janch kara do. (NGO)" ***Get all TB patients tested in bi-directional manner. (Non government organization)*** *"..anyatha silicosis rahega aur kamjor lungs ghoomte phirenge aur TB hota rahega toh TB control kabhi nahi hoga..(NGO)"* ***..or else silicosis will remain and weak lungs will be there and if TB continues then TB control will never happen..(Non government organization)*** *"Jo bhi patient silicosis ka aa raha hai OPD mein, uska TB ka screening ho hi raha hai."* ***Whenever a patient of silicosis is coming to the OPD, he is being screened for TB also.***	Screening for TB in patients with occupational history	Bidirectional screening
"Peripheral mein humare centres bhadae gae hai, who silicosis detection ke centre hai. (MEDICAL OFFICER)" ***Peripheral centres are increased in number, they are centres for silicosis detection. (medical officer)***	Peripheral centres for silicosis detection	Increase in no of peripheral health facility

"..they need different type of occupational therapy. (Medical officer)" ***..they need different types of occupational therapy. (medical officer)*** *"Samanya exercise se unko bahut benefit mil sakta hai.. (Medical officer)"* ***They can get a lot of benefit from moderate exercise. (medical officer)***	Occupational therapy for Pneumoconiosis patients	Pulmonary rehabilitation
"Yeh jo log hai yeh bahut gareeb hai, yeh log sharirik, samajik, arthik roop se bahut hi kamjor hote hai aur unke pas itne samadhan nahi hai..un logo tak itna mobilisation aur itni lambi prakriya..is prakriya mein aur sudhar kiya ja sakta hai. (Medical officer)" ***These people are very poor, these people are very weak physically, socially, economically and they do not have so many solutions.. So much mobilization and lengthy process... The process has to be further improved. (medical officer)***	Opportunity to de-marginalise mining community	Scope of improvement in process
"Option daal sakte hai ..yadi aap anpad hai aur sunna chahte hai is bhasha ko dabae..(NGO)" ***An option should be put...if you are illiterate and want to listen then choose this language ..(Non government organization)*** (Illiterates are unable to read the SMS with time and place of appointment of screening facility resulting in pendency)	Voice messages for illiterate	Reduction in pendency of registration
"..gaon ke kai log koi carpenter ya koi hath se kareegar hota hai, kapda banaya, kisi ne dhoti banaya, kisi ne dari banai..aise bahut saare kaam ho sakte hai. (DTO)" ***..the people of the village are some carpenters or some hand artisans, make cloth, some make dhoti, some make carpet..many such works can be done. (DTO)***	Villagers are skilled in different works	Alternative work option in mining areas

Table 44: Situational Analysis grouped under SWOT pertaining to threats of implementation of government schemes and policies

Verbatims	**Codes**	**Subthemes**
In-depth interviews and Focus group discussions		
"Jinka course chal raha, unke paise nai aye aur jinhone kabhi sir dard ki goli bhi nai li, unka paas ho gaya." ***Who are getting treatment, they didn't get money and those who never even took headache pills, their money passed (received rehabilitation assistance money after silicosis certification).*** *"Jiske pas paisa hai who paisa deke paas kara deta hai. Jinke pas nahi, who chakkar kat ta rehta hai."* **The one who has money, he gives money and gets his certificate passed. Those who don't have it, they keep on making rounds.**	Getting silicosis certification done through bribery	Distrust in compensation disbursement
"Emitra wala form bharne ke 10,000 mangta hai. Aur form pass karane ke baad 40,000 aur. Itna paisa kahan se laaunga?" ***E-mitra operator asks for 10,000 for filling the form. And 40,000 more after passing the form. From where will I get so much money?*** *"Emitra wala certificate pass karane ka paisa mangta hai"* ***E-mitra operator asks for money to pass the certificate.***	Bribery	Problems in registration

"..jinko silicosis hui, paise mile, unhe nashe ki aisi lat lagi, ki ussi muawje ke paise se nasha kar rahe" ***..who got silicosis, got money, they got such an addiction, that they are doing 'nasha' with the same compensation money.*** *"Sarkar paisa isi liye de rahi hai ki aap koi saral kaam kar lo ya dukaan laga lo..log aamtor pe ya toh motorcycle le leta hai ya makaan banwa leta hai, koi aish karne mein kharch kar deta hai, koi daaru mein uda deta hai."* ***Government is giving money to do other work or set up a shop..people spend on motorcycle or build a house, some spend money on luxury, some spend money on alcohol.***	Money spent on addiction	Misuse of rehabilitation assistance
Key informant interview		
"Workers ko aisa lagta hai ki agar mask nahi pehne toh 3 lakh milenge. (MINE OWNER)" ***The workers feel that if they do not wear masks, they will get 3 lakhs (rehabilitation assistance money after silicosis certification). (mine owner)*** *"Silicosis ko who yeh nahi samajhte ki yeh bimari lailaj hai aur uske karan ek dardnak maut hona wala hai, who jaante hai ki silicosis hoga toh 3 lakh milega, sarkar paise degi..this is the level of awareness. (NGO)"* ***They do not understand that silicosis is incurable and it will lead to a painful death, they know that if there is silicosis, they will get 3 lakhs, the government will give money..this is the level of awareness. (Non government organization)***	Lack of awareness	Undermining severity of disease

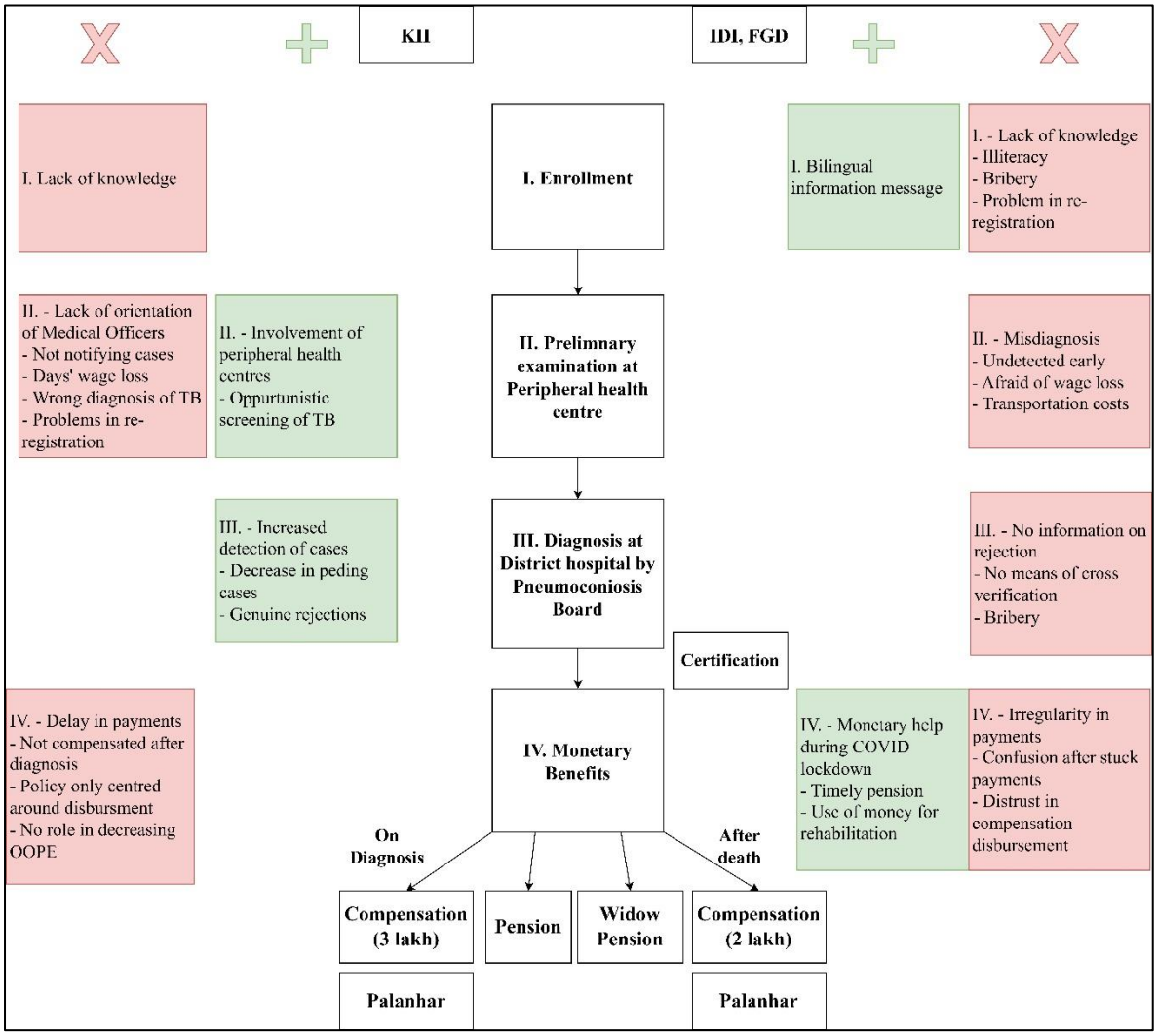

Figure 25 *Thematic flow diagram of steps of Pneumoconiosis policy and its strength and weakness*

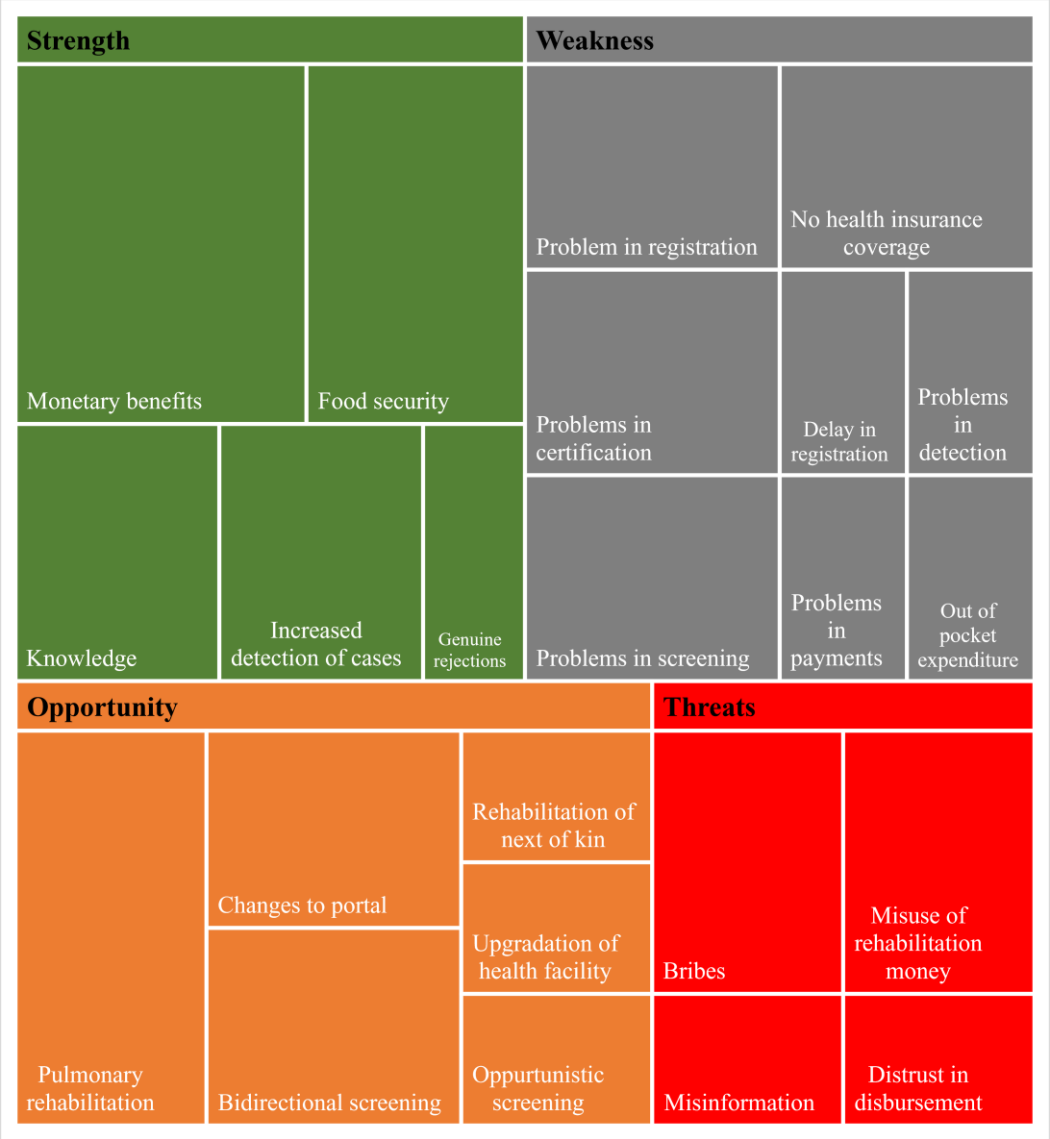

Figure 26 *SWOT Analysis of government schemes and policies*

5.7.3 Integration of Quantitative and Qualitative Findings of Situational analysis

Integration of the outcome of both quantitative and qualitative phases to explain the research question.

Table 45: Integration of Quantitative and Qualitative findings of Situational analysis of government schemes and policies

Parameters	**Quantitative part**	**Qualitative part**
Pneumoconiosis Policy (compensation)	Net registration	Delay in registration Process needs to be simpler Bribe for registration Problem in re-registration Reduce wait duration for reregistration
	Net pending for screening at CHC/PHC (5.4%)	Problem in selection of screening facility
	Net pending for screening at medical board (2.5%)	
	Net disbursed (12.2%)	Delay in payments Non-verification of bank account number Not compensated after diagnosed silicosis Distrust in compensation disbursement
	Net rejected (76.8%)	Misdiagnosis of silicosis No means of cross verifying diagnosis
Pneumoconiosis Policy (pension)	Receiving pension (86.0%)	Irregularity in pension

Pneumoconiosis Policy (compensation after death)	Received compensation after death (77.5%)	
Other schemes and policies	Chiranjeevi yojana (71.8%)	Loan taken for treatment Catastrophic expenditure on healthcare

Chapter 6: DISCUSSION

The current study was carried out in 45 sandstone mineral source mining zones in district Jodhpur, Rajasthan. The aim of the study was to assess the quality of life and health status of inhabitants in and around mines in relation to their socio-economic status and geographic location of mines.

6.1 Households

Household characteristics

The majority of the participants included in the study were residing in rural area. Most of the households followed Hindu religion, with greater part of population belonging to scheduled caste category, followed by other backward castes and scheduled tribes. This finding is similar to the primary research conducted by the ILO among two clusters of Udaipur-Rajsamand and Kota-Bundi districts in Rajasthan, wherein majority were from schedule caste, whereas others were from schedule tribes and other backward classes (97). The average family size in the present study ranged from 4-6 members per family (median= 5). Similar to this, in a study by Raghav P et al (2020) the average family size was reported to be 4.87 ± 1.93 members (98).

In the present study, majority of the households belonged to middle socio-economic class as per Modified B.G. Prasad's classification, 2021. The median per-capita income was Rs. 3000 per month (IQR 2194 – 4000). However, another study conducted by **Y**adav AK et al (2018) indicated a greater average income of about Rs 395 a day (IQR 200-500), which was equivalent to around Rs 11,000 per month (47). It is evident that mine workers usually have less per capita income and that affects their ability to handle health expenditure, leading to poorer health status.

Housing criteria

The current study reported that majority lived in kutcha houses, with poor ventilation and lighting. Independent kitchen and latrines were found in very few houses. In another study carried out by Patra HS et al (2015) the living conditions of the people in and around mines was found to be poor, with majority living in Kutcha houses (32). A study

done in South Africa by Pelders et al (2018) has reported high proportions of informal accommodation - a lack of access to water, sanitation, and electricity; and poor roads in the mining areas (99). Poor living conditions are a consequence of lower socioeconomic status and migratory habits of the mine workers.

6.2 Participant characteristics

Sociodemographic characteristics

The mean age of adult participants in our study was found to be 42±16 years, among whom majority were of male gender. This is similar to other studies in mining area conducted in India, by Rajavel S et al (2017-19) reporting mean age 39.13 ± 11.09 years (100) and Abbas I (2016) reporting workers' mean age of 49.89±7.2 years (101). A study by Butscher FM et al **(**2020**)** among small-scale gold miners showed participants' mean age as 38 years (18-72), majority of them were also male (59). Literacy rate reported in the present study was low, with almost half of the adult participants being illiterate, followed by participants educated up to primary class. This finding is at par with the research carried out by ILO in Udaipur-Rajsamand and Kota-Bundi district clusters in Rajasthan (97). This can be explained by early age involvement in mine work, leading to lower status of education.

Occupational characteristics

The larger part of population (44.5%) residing around the mines in this study worked as mine workers and only a small number of participants worked as shopkeepers and farmers. This was mainly because no other major income job was present other than mining in the area in the present study. Majority of the mine workers in this study had work history of 10 years or less. These findings are consistent to the study by Butscher FM et al **(**2020**)** where median duration of working was 10 years (59), and by Becker J (2020) where average years of working in mines was reported to be 7.5 years (60). The results might be similar because after 10 years or so, mine workers get afflicted by chronic lung diseases due to dust exposure and musculoskeletal disorders and have to leave mines work.

6.3 Quality of life

Quality of life in the current study was assessed using WHOQOL BREF Checklist. Physical health domain, psychological domain and social domain showed a median score of 50 whereas environmental domain showed a low median score of 38 in the current study. Workers in our findings reported facing social exclusion and discrimination post-illness. As stated by one of the inhabitants of the mining area during the In-depth interview:

"Bahari chetra ke log toh humare chetra mein apni betiyon ka Rishta karne se bhi darne lage hai. Kehte hai ki yahan rishta kiya toh humari betiyan 10 saal ke andar hi vidhwa ho jaegi."

Limited social interaction, poor physical health, temporary dwellings and economic insecurity was found to trigger stress and anxiety in the present study. Significant substance use among mine workers included in the study was noted, mostly consumed for stress and fatigue alleviation. Environmental pollution was another factor for lower physical and mental health status, as stated by the participants of the study, contributing to lowest score for Environmental domain. One of the truck driver working in mines reported in the Focus group discussion:

"Shaam ko poora ilaka dhool mein dhaka hua, kohre jaisa dikhega, dilli ke kohre ki tarah."

The same checklist was used by another study by Souza TP et al (2015) in Brazil**,** which also showed lower scores of all 4 domains (53). Another study by Butscher FM et al **(**2020**)** used HRQoL EQ-5D-3L to assess quality of life and majority reported as "being unwell"(59). Similarly another study conducted by Li Y et al (2019) in China using SF-36 showed lower quality of life scores among miners (56). In 2013, D'Souza MS et al reported reduced Physical Health, Mental Health and SF36 scores in women involved in mining (58). A qualitative study by Pelders J (2019) stated that greater occupational fatigue causes indebtedness, less sleep, increased alcohol use, poor self-reported health and higher stress (102). Consistently, D'Souza et al (2013) also proved increased susceptibility to illness/diseases due to changes in the quality of air and water, degradation of soil, mining accidents (103).

6.4 Health status

Clinical findings of participants

The current study findings of anaemia among more than half of participants is consistent with another study conducted on miner's health by Dhatrak et al (2017) (104). Numerous factors such as the lack of education, poor exposure to information and undernutrition might be the causes of anaemia prevalence.

Noise-induced hearing loss (NIHL) is one of the common occupational health hazards of mining operations, mostly in workers involved in drilling and blasting. Findings related to hearing loss among miners have been reported by the National Institute of Miners' Health (NIMH), Nagpur through various studies in mines where noise NIHL was found to be present in about 13% of the employees (105). This is comparable to the findings of current study where NIHL was seen in 16% mining population.

Visual impairment in mine workers might be due to foreign body injury and occupational dust exposure as found by us. About 19% mine workers in the present study reported moderate visual impairment. The loss of vision was attributed to dust filled environment and non-use of protective goggles. This is quite high prevalence in comparison to visual impairment (5%) found in mine workers by Koffuor et al (2012) in stone miners in Ghana, Africa. This difference in prevalence of visual impairment in our findings is most probably due to differences in use of protective eye wear and type of work in mines.

According to the morbidity trends shown in studies by Nandi SS et al (2009) (78) and Ahmad A (2015) (106), miners are often more likely to experience cardiovascular and musculoskeletal problems. Additionally, Ghahramani N (2010) reported that tubulointerstitial disease, chronic kidney disease, and end-stage renal disease have all been linked to silica dust exposure (107). Research work by Nandi SS et al (2009) (78)**,** Rodriguez-Fernandez et al (2015) (108) and Mawaw P M et al (2017) (109) have shown elevated risks of obesity, diabetes mellitus and hypertension, which are the first signs of the growing burden of NCDs. Hypertension and diabetes were found to be prevalent in the present study; however, a few cases were newly diagnosed during the course of the study. Along with this, non-communicable diseases like stroke, heart attacks, cancers and chronic kidney disease were also reported.

Mine workers interviewed in the current study complained of heavy lifting work for long durations, leading to weakness and accidents as found during in-depth interviews.

Musculoskeletal disorders (MSDs) are now the primary contributor to early retirement and absenteeism among mine workers, as well as a significant risk factor for work - related disability, as per research conducted by Li et al (2021) (110). High prevalence of lower back pain was reported by Bandyopadhyay et al (2012) in coalminers in eastern India (111). This finding is consistent with the current study, reporting higher prevalence of chronic back pain. A systematic review by Rabei H et al (2021) on MSDs in mine workers around the world reported highest prevalence of MSDs related to back, among other MSDs (112). This can be due to issues such as excessive manual labour, repetitive bending and turning, awkward postures and prolonged standing at work, which is common in almost all mines. PPE usage in our findings was minimal, mainly due to discomfort and non-availability, making the workers prone to injury and accidents.

Although there were no significant findings related to oral and lung cancers in our study, crystalline silica has been identified by the International Agency for Research on Cancer (IARC) as being potentially carcinogenic to humans (27). Isolated instances of naturally occurring asbestos (NOA) exposure and non-occupational neighbourhood exposure that resulted in pleural plaques and malignant mesothelioma have also been documented (113).

Prevalence of respiratory morbidities

There has been enough evidence of association of chronic lung disease such as silicosis, COPD and asthma with crystalline silica exposure. A report by Marshall, Taylor and Balaton-Chrimes estimates more than half of the mine workers in Rajasthan to be affected by silicosis, a number mounting to well over 10 lakh people (6). Increased susceptibility to chronic respiratory morbidities and infectious diseases like TB and COVID-19 was reported in the present study. The majority of the participants in this study were suffering from silicosis, followed by COPD and asthma. Misdiagnosis of silicosis as TB was also reported in some cases. A corresponding study in Jodhpur by Rajavel S et al (2019), reported a similar prevalence of silicosis and other respiratory morbidities (100).

A prospective study by Farazi et al (2015) among 2000 mine workers found that the risk of developing pulmonary tuberculosis is closely associated with the severity of silicosis (114). In the current study, Tuberculosis and Silico-tuberculosis were found to be prevalent, along with reports of recurrence and/or relapse of TB. Non-compliance of TB patients towards treatment was also one of the factors for prevailing TB infection. This is parallel to another study in Jodhpur by Rajavel S et al (2019), which also reported

similar findings of tuberculosis and silico-tuberculosis in the participants (100). Pulmonary TB prevalence has been linked with exposure to dust in the workplace from sand, construction, and/or mining industries by Kootbodien et al (2019) (115). Despite the vast efforts made for control and eradication of this disease, TB control programs have not been very successful in communities with high exposure to silica, and TB-related morbidity and mortality are increasing in such areas.

Addiction habits

Substance use is commonly found in mining population, majorly due to easy availability at a younger age. Substance use can also be seen as a part of beliefs and traditions because it has been prevalent among generations of mine workers. One of the beliefs as stated by an elderly participant during In-depth interview:

"Yaha ke logon ki manyata hai ki daaru peene se fefda poora saaf ho jaega".

Workers in our study reported taking up substance use to cope up with fatigue and stress. More than half the mine workers are reported to be affected by substance use in the study by Sahoo SK (2020), among iron ore miners in eastern India (116). Similar proportions of mine workers can be seen consuming alcohol and tobacco products in our study. Due to tobacco use and widespread smoking habits, mine workers' oral health is generally in poor condition and it predisposes to oral and lung cancer. In our findings, only 0.7% of the participants were ever diagnosed with oral and lung cancers, which may be linked to tobacco use.

Healthcare costs

Mine workers in the present study reported to have endured heavy healthcare costs due to their susceptibility to chronic morbidities. Out of pocket expenditure on medications, investigations and hospitalization usually exceed their average earnings. Indirect costs like loss of daily wage due to sickness, also contributed to their economic burden. Most of the participants with history of working in mines reported similar complaints, one such was:

"Jab bhi choti moti chot ke liye haspatal jana hota hai..Poore din ki hazri chali jaati usi mein."

A study by Sahoo PK (2020) has reported that majority of the mines do not bear the cost of worker's health problems and this causes huge out-of-pocket expenditure of the workers on their healthcare (116).

6.5 Association of Quality of Life

Association of Quality of life with Distance from the mines

In the current study, Physical and environmental domains were found to be significantly associated with distance of households from mines, indicating inferior physical health and poorer environmental conditions in participants who lived closer to mining area.

Quality of life in the vicinity (0.25 - 11.2 km) of wind turbines was assessed by Feder et al (2013) (117). Lower scores on both the Physical and Environment domains ($p = 0.0218$ and $p = 0.0372$, respectively), were observed among participants reporting high visual annoyance toward wind turbines. However, lower exposure to hearing wind turbines was associated with improved scores on the Psychological domain ($p = 0.0108$).

Association of Quality of life with Per-capita Income

In the present study, Social and Environmental domains were found to be significantly associated with per-capita income, depicting better social relationships and superior environmental conditions of participants who lived farther from mines.

Likewise, Patra HS et al (2015) associated low per capita income with relatively poorer quality of life in mine workers (32), by reporting 'very poor' scores of quality of life in villages with lowest monthly income as compared to the villages with better earning. Effect on Environmental domain (housing, assets, water and sanitation, entertainment sources, health expenditure) was found to be similar to our findings. In another study by Li et al (2019), high occupational stress levels were associated with lower income status of the mine workers, leading to poorer quality of life (56), affecting the Psychological domain.

6.6 Association of Health Status

Association of Silicosis and other chronic lung disease

It is evident in our results that silicosis is predominantly diagnosed in men. This gender predisposition is likely a reflection of the fact that men are more likely to be engaged in occupations with high likelihood of respirable silica particle exposure such as mining,

sandblasting, quarrying or foundry work as suggested by previous studies (100,118). Exposed elderly persons had a significantly higher prevalence of chronic respiratory symptoms and diseases (asthma, chronic bronchitis, emphysema) than those who were unexposed, as reported by Nkosi et al (2015) (119). Likewise, our findings suggested that the odds of having chronic lung diseases, other than silicosis, were higher in the elderly population.

The mine workers in the present study, who were employed in the industry for >20 years, were found to have the maximum odds of having history of silicosis and other chronic lung diseases. Similarly, another study in Jodhpur by Rajavel et al (2020) (100) and Cohen et al (2009) (120) reported that chronic silica exposure is associated with silicosis, chronic bronchitis, emphysema, accelerated decrements in lung function, and premature mortality.

It is proven that occupational exposure to silica dust is the major etiology behind silicosis (121–124), correspondingly supported by our results. However, studies have been carried out explaining silicosis due to non-occupational exposure also (17,19,125–127). One case of silicosis was found in our study who never worked in mines, pointing to non-occupational exposure as the etiology of silicosis.

Sample selection criteria was based on health status findings (respiratory morbidities) of the participants. Therefore, only areas within 1.5 km were selected, as it was found that dust can travel up to this distance (44). This sample size and selection strategy therefore could have been underpowered to determine the association of participants' health status with distance from the mines, especially beyond 1.5 kilometers. It could be confounded by factors like common work profile (mining/mining related) and similar socioeconomic status of inhabitants in and around mines. For this, multivariable analysis was also performed.

However, Bhagia et al (2009) found prevalence of non-occupational silicosis in two villages within 10-15 km to two different industries- slate pencil and agate (19), suggesting association between silicosis and distance from industries. Herrera et al (2016) (128), Hendryx M (2008) (129) and Nayak T (2018) (130) reported that proximity to mining areas is statistically significant to and has positive impact on aggravating the respiratory illness. The results of our study may differ due to migratory habits of mine workers, who often move after developing chronic lung disease, or due to silicosis-related deaths. Also, Salvi et al (2009) significantly associated poor socioeconomic status (as a risk factor) with COPD, after adjustment for smoking status, occupational

exposures, and ethnic origin (131). This result is in contrast with our finding of no significant association between chronic morbidities and socioeconomic status, most probably due to negligible differences in the per capita income of the population living around mines.

Association of chronic morbidities other than chronic respiratory morbidities

Significant association of chronic morbidities (other than respiratory) with elder age group and gender (females) was reported in our study. This is consistent with the results of the study by Talukdar B (2017) which proved that the incidence of multimorbidity is positively associated with age (132).

Higher number of years of work in mines were found to be positively correlated with higher prevalence of musculoskeletal disorders in the present study. Similar result is also evident from a study by Emkani et al (2016), where longer work experience was associated with higher prevalence of MSDs (133).

Our study did not find any significant association of chronic morbidities with distance from mines and socioeconomic status. On the other hand, Hendryx M (2008) reported that residential proximity to heavy coal production was associated with poorer health status and with higher risk for cardiopulmonary disease, chronic lung disease, hypertension, and kidney disease (129). Bird et al (2015) stated that household income was strongly and independently associated with type 2 diabetes prevalence, its associated conditions of high blood pressure and being overweight or obese (134). Grotto et al (2008) also indicated that low SES is associated with higher blood pressure (135).

6.7 Situational analysis of government schemes and policies

Mine work is regarded as one of the most hazardous occupations, therefore, the workers in mining industries are entitled to social protection schemes provided by the government such as *Unorganised Workers' Social Security Act 2008*, *The Inter-State Migrant Workmen Act 1979, The Mines Act 1952 and the Employees' Provident Funds and Miscellaneous Provisions Act 1952*. The *National Human Rights Commission of India* (NHRC) has highlighted that silicosis is preventable if exposure to silica dust is controlled by regulating the working conditions and installing proper warnings, along

with usage of protective equipment. Once a worker or any other person is afflicted by silicosis, it becomes a constitutional obligation on part of the State to take appropriate short-term and long-term measures from the point of view of providing medical facilities and rehabilitation of the victims (136).

It should be obligatory to medically examine all the enrolled workers before employment. Respiratory disorders in the workers should be ruled out by chest radiography and pulmonary function test. Implementation of precautionary measures including the protective gears for the workers of silicosis-prone industries should be made mandatory by the concerned authorities. Dust control devices should be installed to reduce the dust generation at the workplace. The use of wet drilling and dust extractors must be enforced by respective regulatory authorities.

The *Silicosis Control Programme* should be integrated with the existing *National Tuberculosis Elimination Programme* (NTEP). The District Tuberculosis Officer must collect and maintain accurate information and documentation on number of workplaces and workers at risk from silica exposure. The National /State Social Security Board set up under The Unorganized Worker's Social Security Act, 2008 should recommend welfare schemes to be formulated for the welfare of the unorganized workers who are at the risk of contracting silicosis as well as those already affected and their families.

The treatment cost of the silica affected person including permanent, temporary or contractual worker should be borne by the employer. The district administration should ensure its implementation and treatment. The silicosis victims should be rehabilitated by offering an alternative job or a sustenance pension if they cannot work. NGOs should be involved in monitoring and implementation of the programmes initiated for the benefit of silica exposed workers.

The current study identified various challenges in the process of proper implementation of the Pneumoconiosis Policy among silicosis patients. One of the challenges established was that some of the beneficiaries who are entitled under this policy lacked awareness about early detection of the disease (silicosis) and/or schemes and policies of the government. The reasons behind this lack of knowledge are that there were no provisions for regular health check-ups of the mining population for detection of the illness, and since they are mostly uneducated, dissemination of information among them is tedious. However, the information that is provided via SMS is bilingual in nature, which proves quite helpful for those who can read.

The mining industry is an unorganized sector, and the unregistered mines and gaps in the line listing all mine workers often pose major challenges in the early detection of cases. Another barrier commonly reported was misdiagnosis of silicosis, causing delays in early detection, registration, and therefore, proper disbursement of benefits. The availability of confirmatory diagnostic tests such as spirometry, which is considered the gold standard test, poses another challenge. Monetary constraints and fear of losing daily wages make the mine workers forestall their impending preliminary examination at peripheral health centers. Nevertheless, involvement of peripheral health centres does help in the timely detection of silicosis and also provides a platform for opportunistic screening of TB. As stated by Medical officer in-charge of a CHC near a mining zone during one of the Key informant interviews:

"Jo bhi patient silicosis ka aa raha hai OPD mein, uska TB ka screening ho hi raha hai."

Confirmation of diagnosis and rejection of non-silicosis cases at the level of the peripheral health centre helps to reduce the burden on the Pneumoconiosis Board, making it responsible only for positive cases. Although the persons who got rejected complained that they do not have access to their medical reports/X-rays, thereby, preventing them from getting cross-verification done. This might be due to a lack of trust in the physician and the Pneumoconiosis board, mostly due to complaints of other people about misdiagnosis and delays in receiving benefits.

Another complaint regarding the practice of getting certification done through bribery was mentioned by some participants. However, without any evidence this reason cannot be considered, and further probing is required. Disbursement of monetary benefit after completion of certification in the form of Compensation, after diagnosis and after death, Silicosis Pension, Widow Pension, and Palanhar, not only helps in the rehabilitation of the affected and his next of kin, but also proved helpful during the pandemic when they had lost their regular source of income. One of the mine workers who was unemployed during the pandemic (COVID-19) stated:

"Lockdown ke waqt 1500 rupaye ki pension aur sarkaar ke diye huye 2 lakh rupaye se hi kharcha nikala hai."

Knowledge about provision of benefits has motivated the vulnerable population to visit health centers for regular check-ups. However, a major drawback of being aware of receiving benefits was reported to have led some workers to stop using PPE, so that they

develop silicosis and receive the money. Quoting from one of the Key informant interviews, conducted with a mine owner:

"Workers ko aisa lagta hai ki agar mask nahi pehne toh 3 lakh milenge."

Also, it was reported that the compensation money provided primarily for rehabilitation, was used for buying assets or spent on substance use. Another problem discussed was irregularity in pension and delayed payment of compensation money, that could be attributed to stuck payments and incorrect filling of bank account numbers.

The Pneumoconiosis policy plays no role in compensation for out-of-pocket expenditure for those who got rejected during screening. It primarily focuses on disbursement of monetary compensation to silicosis affected victims, rather than focusing on prevention also. Quoting from one of the Key informant interviews, conducted with an NGO member:

"..yeh funds sirf rehabilitation ke liye hai, it has nothing to do with prevention, nothing to do with reduction"

Hence, a comprehensive policy is required to address the issues related to workers at risk of exposure to occupational dust, ranging from primary to tertiary prevention, irrespective of nature of employment, be it mining, building or other construction work.

Chapter 7: LIMITATIONS

The limitations of the present study are as follows:

- The WHO-QOL BREF tool could only be administered to adults. So, quality of life was calculated only for adults.
- Spirometry, which is considered gold standard, could not be performed due to COVID-19, instead respiratory morbidity assessment was done based on recall/history of the participants.

Chapter 8: CONCLUSION

The present study concluded that the population living in and around mines, majorly, belongs to middle socioeconomic class as per Modified B.G. Prasad classification, 2021.

Based on the results of the study, the quality of life of inhabitants in and around mines was affected by distance of households from mines and per-capita income of the households. Average to below-average scores of physical, psychological, social and environmental domains were reported, indicating poor quality of life.

Health status of the adult population varied with the years of work experience in mines, depicting prevalence of chronic respiratory and other morbidities. Health status assessment of the population under 18 years of age revealed presence of malnutrition.

The situational analysis of government schemes and policies revealed participants' adequate knowledge of the benefits provided and complaints regarding delays/problems at various stages from registration to disbursement of monetary benefits. Key informant interviews disclosed that, apart from monetary rehabilitation, the government should focus on upgradation of CHCs near the mining zones, capacity building of medical officers and better prevention measures for dust and noise control, along with rehabilitation of the affected.

Chapter 9: RECOMMENDATIONS

The recommendations from the present study are as follows:

Service recommendation

- It is recommended to have a policy of not having a residential area within a certain minimum distance from the periphery of mining zones.
- Screening of health status of inhabitant in and around mines should be done at regular intervals to aid in early diagnosis and prompt treatment.
- The government should provide opportunities for alternate sources of income in the vicinity of mining zones.
- The complaints of inducement in the present study should be explored by the concerned government agencies.

Policy recommendation

- Process from registration till disbursement of rehabilitation money should be simpler.
- The entitlements provided by the government should reach the beneficiaries without delay and should focus on prevention of the disease/conditions and rehabilitation of those already affected.

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ANNEXURES

Annexure 'A': Ethical Clearance Certificate

अखिल भारतीय आयुर्विज्ञान संस्थान, जोधपुर
All India Institute of Medical Sciences, Jodhpur
संस्थागत नैतिकता समिति
Institutional Ethics Committee

No. AIIMS/IEC/2021/ 3515 **Date: 12/03/2021**

ETHICAL CLEARANCE CERTIFICATE

Certificate Reference Number: **AIIMS/IEC/2021/3350**

Project title: **"Quality of life and health status of inhabitants in and around mines in relation to their socio-economic status and geographic location of mines- A mixed-methods approach"**

Nature of Project:	**Research Project Submitted for Expedited Review**
Submitted as:	**M.D. Dissertation**
Student Name:	**Dr. Mukund Gupta**
Guide:	**Prof. Pankaja Raghav**
Co-Guide:	**Dr. Suman Saurabh**

Institutional Ethics Committee after thorough consideration accorded its approval on above project.

The investigator may therefore commence the research from the date of this certificate, using the reference number indicated above.

Please note that the AIIMS IEC must be informed immediately of:

- Any material change in the conditions or undertakings mentioned in the document.
- Any material breaches of ethical undertakings or events that impact upon the ethical conduct of the research.

The Principal Investigator must report to the AIIMS IEC in the prescribed format, where applicable, bi-annually, and at the end of the project, in respect of ethical compliance.

AIIMS IEC retains the right to withdraw or amend this if:

- Any unethical principle or practices are revealed or suspected
- Relevant information has been withheld or misrepresented

AIIMS IEC shall have an access to any information or data at any time during the course or after completion of the project.

Please Note that this approval will be rectified whenever it is possible to hold a meeting in person of the Institutional Ethics Committee. It is possible that the PI may be asked to give more clarifications or the Institutional Ethics Committee may withhold the project. The Institutional Ethics Committee is adopting this procedure due to COVID-19 (Corona Virus) situation.

If the Institutional Ethics Committee does not get back to you, this means your project has been cleared by the IEC.

On behalf of Ethics Committee, I wish you success in your research.

Dr. Praveen Sharma
Member Secretary

Member Secretary
Institutional Ethics Committee
AIIMS,Jodhpur

Basni Phase-2, Jodhpur, Rajasthan-342005; **Website:** www.aiimsjodhpur.edu.in; **Phone:** 0291-2740741 Extn. 3109
E-mail : ethicscommittee@aiimsjodhpur.edu.in; ethicscommitteeaiimsjdh@gmail.com

Annexure 'B': Award of ICMR Financial Support for the MD thesis

ICMR
INDIAN COUNCIL OF MEDICAL RESEARCH
Serving the nation since 1911

भारतीय आयुर्विज्ञान अनुसंधान परिषद
स्वास्थ्य अनुसंधान विभाग, स्वास्थ्य और परिवार कल्याण मंत्रालय, भारत सरकार

Indian Council of Medical Research
Department of Health Research, Ministry of Health and Family Welfare, Government of India

No.3/2/June-2021/PG-Thesis-HRD (25) **Date:** 28/09/2021

MD21JUN-0177
Dr. Mukund Gupta,
Department of Community Medicine and Family Medicine,
All India Institute of Medical Sciences,
Basni, Jodhpur, Rajasthan-342005

Subject: Award of ICMR Financial Support for the MD/MS/DM/MCh/DNB/DrNB/MDS thesis for the June, 2021 batch- reg.

Dear Dr. Mukund Gupta,

This is in reference to your application seeking financial assistance from the ICMR for MD/MS/DM/MCh/DNB/DrNB/MDS thesis entitled **"Quality of life and health status of inhabitants in and around mines in relation to their socio-economic status and geographic location of mines- A mixed-method approach."**

I am glad to inform you that, based on the recommendation of Expert Committee, the Director General, ICMR has approved your application for the financial support of **Rs. 50,000/- (Fifty thousand only)** for the thesis as stated above, which will be disbursed in two/three installments. Initial amount of **Rs. 30,000/-** will be released after receipt of the Undertaking as per the guidelines and remaining amount of **Rs. 20,000/-** on receipt of the electronic copy and summary of work done of your thesis duly approved by the University/Institute along with one publication in an indexed Journal. Mandatory requirement to avail this opportunity is to provide us with an Undertaking duly forwarded through the Guide, to the undersigned, enabling us to release the grant.

The amount will be released after submission of the UNDERTAKING, GUIDE DETAILS as well as the MANDATE FORM (available on ICMR website) along with a photocopy of a Cancelled Cheque (Please ignore, if already submitted) LATEST BY 15th October, 2021 for receiving e-payment for purpose of verification of the concerned bank account where money is to be remitted.

Yours faithfully

(Bal Murti Sah)
Administrative Officer-HRD
For Director General

Copy to:
1. Guide: Prof. Pankaja Raghav, Professor, Department of Community Medicine and Family Medicine, All India Institute of Medical Sciences, Basni, Jodhpur, Rajasthan-342005

वी. रामलिंगस्वामी भवन, पोस्ट बॉक्स नं. 4911,
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V. Ramalingaswami Bhawan, P.O. Box No. 4911
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+91-11-26589336 / 26588707
Fax: +91-11-26588662 | icmr.nic.in

Annexure 'C': Participant information sheet (English)

ALL INDIA INSTITUTE OF MEDICAL SCIENCES, JODHPUR

DEPARTMENT OF COMMUNITY MEDICINE AND FAMILY MEDICINE

Participant Information Sheet

Title- Quality of Life and Health Status of Inhabitants in and around Mines in Relation to their Socio-economic Status and Geographic Location of Mines - A Mixed-Methods Approach.

I have been explained in my own understanding language by the principal investigator that they are doing this study to estimate the quality of life and health status of inhabitants in and around mines in relation to their socioeconomic status & geographic location of mines. For this he will be asking questions, which will be related to quality of life, health status, socioeconomic status. He will also look into the records maintained by you for the study. He will also be doing clinical examination and investigation of random blood sugar, hemoglobin. I will invite some of you for participation in In-depth interview and focus group discussions if you consent. I will audio-record the interview process if you consent.

This study will not provide you any monetary benefit. However, your participation will provide essential inputs for better cancer prevention services to community. You can refuse to answer any question and can withdraw yourself from study at any time. It will not affect you negatively in any way.

The data obtained will be used for the purpose of the study only. All your records will be kept confidential.

For further details or any other query, you may contact to following person:

Dr. Mukund Gupta	Prof. Pankaja Raghav
Mobile no- 7980810584	Mobile no- 8003996904

Annexure 'D': Participant information sheet (Hindi)

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Annexure 'E': Informed consent form (English)

ALL INDIA INSTITUTE OF MEDICAL SCIENCES, JODHPUR

DEPARTMENT OF COMMUNITY MEDICINE AND FAMILY MEDICINE

Informed Consent Form

Title of Thesis/Dissertation: Quality of Life and Health Status of Inhabitants in and around Mines in Relation to their Socio-economic Status and Geographic Location of Mines - A Mixed-Methods Approach.

Name of PG Student: Dr. Mukund Gupta **Tel. No.:** 7980810584

Participant Identification No.: _____

I,_____S/o or D/o_____

R/o_____, give my full, free, voluntary consent to be a part of the study "Quality of Life and Health Status of Inhabitants in and around Mines in Relation to their Socio-economic Status and Geographic Location of Mines - A Mixed-Method Approach", the procedure and nature of which has been explained to me in my own language to my full satisfaction. I confirm that I have had the opportunity to ask questions.

I understand that my participation is voluntary and am aware of my right to opt out of the study at any time without giving any reason.

I understand that the information collected about me and any of my medical records may be looked at by responsible individual from AIIMS, Jodhpur or from regulatory authorities. I give permission for these individuals to have access to my records.

Date: _____ _____

Place: _____ Signature/Left thumb impression

This to certify that the above consent has been obtained in my presence.

Date: _____ _____

Place: _____ Signature of PG Student

1. Witness 1

_____

Signature

Name: _____

Address: _____

2. Witness 2

_____

Signature

Name: _____

Address: _____

Annexure 'F': Informed consent form (Hindi)

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Annexure 'G': Informed consent form – Guardian (English)

ALL INDIA INSTITUTE OF MEDICAL SCIENCES, JODHPUR

DEPARTMENT OF COMMUNITY MEDICINE AND FAMILY MEDICINE

Informed Consent Form – Guardian

Title of Thesis/Dissertation: Quality of Life and Health Status of Inhabitants in and around Mines in Relation to their Socio-economic Status and Geographic Location of Mines - A Mixed-Methods Approach.

Name of PG Student: Dr. Mukund Gupta **Tel. No.:** 7980810584

Participant Identification No.: _____

I,_____S/o or D/o_____

R/o_____, give my full, free, voluntary consent for my ward _____, to be a part of the study "Quality of Life and Health Status of Inhabitants in and around Mines in Relation to their Socio-economic Status and Geographic Location of Mines - A Mixed-Methods Approach.", the procedure and nature of which has been explained to me in my own language to my full satisfaction.

I confirm that I have had the opportunity to ask questions.

I understand that participation is voluntary, and I am aware of my right to opt out of the study at any time without giving any reason.

I understand that the information collected and any of medical records may be looked at by responsible individual from AIIMS, Jodhpur or from regulatory authorities. I give permission for these individuals to have access to records.

Date: _____ _____

Place: _____ Signature/Left thumb impression

This to certify that the above consent has been obtained in my presence.

Date: _____ _____

Place: _____ Signature of PG Student

1. Witness 1

   _____

   Signature

   Name: _____

   Address: _____

2. Witness 2

   _____

   Signature

   Name: _____

   Address: _____

Annexure 'H': Informed consent form – Guardian (Hindi)

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Annexure 'I': Informed assent form (English)

ALL INDIA INSTITUTE OF MEDICAL SCIENCES, JODHPUR

DEPARTMENT OF COMMUNITY MEDICINE AND FAMILY MEDICINE

Informed Assent Form

Title of Thesis/Dissertation: **Quality of Life and Health Status of Inhabitants in and around Mines in Relation to their Socio-economic Status and Geographic Location of Mines - A Mixed-Methods Approach.**

Name of PG Student: Dr. Mukund Gupta **Tel. No.:** 7980810584

Patient/Volunteer Identification No.: _____

I,_____S/o or D/o_____

R/o_____, give my full, free, voluntary assent to be a part of the study "Quality of Life and Health Status of Inhabitants in and around Mines in Relation to their Socio-economic Status and Geographic Location of Mines - A Mixed-Methods Approach.", the procedure and nature of which has been explained to me in my own language to my full satisfaction. I confirm that I have had the opportunity to ask questions.

I understand that my participation is voluntary and am aware of my right to opt out of the study at any time without giving any reason.

I understand that the information collected about me and any of my medical records may be looked at by responsible individual from AIIMS, Jodhpur or from regulatory authorities. I give permission for these individuals to have access to my records.

Date: _____ _____

Place: _____ Signature/Left thumb impression

This to certify that the above assent has been obtained in my presence.

Date: _____ _____

Place: _____ Signature of PG Student

1. Witness 1

_____

Signature

Name: _____

Address: _____

2. Witness 2

_____

Signature

Name: _____

Address: _____

Annexure 'J': Informed assent form (Hindi)

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Annexure 'K': Semi-structured questionnaire

FAMILY DETAILS

FAMILY NO.	
DISTANCE FROM NEAREST MINES (<1500 meter)	
1=URBAN, 2=RURAL	
BLOCK NAME	
AREA NAME	
RELIGION	
CASTE	
FAMILY INCOME	
FAMILY TOTAL EXPENDITURE (1 month)	
EXPENDITURE IN FOOD	
EXPENDITURE IN HEALTHCARE (1 month)	
NO OF FAMILY MEMBER (take only nuclear or 3 gen family)	
NO OF EARNING MEMBER	
EARNING MEMBER WORKING IN MINES	
NO OF CHILDREN <18	
NO OF ADULTS	
NO OF ELDERLY	
BHAMASHA CARD (1=YES, 2=NO)	
CHIRANJIVI (1=YES, 2=NO)	
SILICOSIS REHAB (1=1 lakh, 3=3 lakh)	
SILICOSIS PENSION (1=YES, 2=NO)	
PALANHAR (1=YES, 2=NO)	
WIDOW PENSION (1=YES, 2=NO)	
ANY FAMILY MEMBER DIED DUE TO SILICOSIS	
HAVE YOU RECEIVED COMPENSATION OF 2 LAKHS AFTER DEATH (1=YES, 2=NO)	

CHILD 1 (<5 YRS)	
AGE	
SEX	
HEIGHT	
MUAC	
WEIGHT	
H/O ASTHMA	
CHILD 2 (<5 YRS)	
AGE	
SEX	
HEIGHT	
MUAC	
WEIGHT	
H/O ASTHMA	
CHILD 3 (6-18 YRS)	
AGE	
SEX	
HEIGHT	
WEIGHT	
H/O ASTHMA	
CHILD 4 (6-18 YRS)	
AGE	
SEX	
HEIGHT	
WEIGHT	
H/O ASTHMA	

SITE (1=yes, 2=no)	
House is elevated from the surroundings	
Independent access to the street	
Proper drainage	
Refuse dumped around the house	
Safe distance of the house from the traffic	
SETBACK (1=yes, 2=no)	
Presence of setback around house	
FLOOR (1=yes, 2=no)	
Free from cracks	
Damp proof	
WALLS (1=yes, 2=no)	
9 inch thick	
Roof (1=yes, 2=no)	
Height of roof 10 feet or more	
ROOMS	
No of rooms	
Floor area per person	
WINDOWS	
No of windows in each room	
Height of windows above floor >3 feet	
Appropriate lighting	
KITCHEN	
Separate	
Separate storage area for food	
LATRINE	
Private	
Water supply	
WASTE DISPOSAL	
1.Daily, 2.once in two days, 3.weekly	

EARNING MEMBER

NAME		
MOB NO		
AGE		
SEX (1=male, 2=female)		
SYSTOLIC BP		
DIASTOLIC BP		
CATARACT (1=yes, 2=no)		
SNELLEN (WITH SPECS)	R	L
SNELLEN (WITHOUT SPECS)		
TUNING FORK 256 HZ (1=CD, 2=SNHL)	R	L
FBS		
RBS		
PALOR (1=YES, 2=NO)		
HEMOGLOBIN (check only if palor present)		
MARITAL (1=married, 2=unmarried, 3=widow, 4-separated)		
HIGHEST EDUCATION (1=uneducated, 2=upto class 5, 3=upto class 8, 4=upto class 10, 5=upto class 12, 6=graduate)		
OCCUPATION (1=mine worker, 2=construction worker, 3=shopkeeper, 4=farming, 5=others)		
IF MINE WORKER, TYPE OF WORK (1=cutting, 2=drilling, 3=lifting, 4=cleaning, 5=driver, 6=blasting, 7=others)		
NO OF YEARS IN MINE		
NO OF HOURS A DAY YOU WORK		
BREATHLESSNESS (1=after strenuous exercise, 2=after mod exercise or walking up slope or stairs, 3= plain surface 500 meters or 8-10 minutes, 4=normal activity, 5=even at rest)		
ADMITTED IN HOSPITAL IN LAST 1 YEAR (1=yes, 2=no)		
DID YOU VISIT OPD IN 1 YEAR (1=yes, 2=no)		

If yes, for what	
DO YOU TAKE MEDICATIONS DAILY (1=yes, 2=no)	
If yes, for what	
NO OF MEDICATIONS TAKEN DAILY	

DO YOU SUFFER FROM THESE CONDITIONS	
DIABETES (1=yes, 2=no)	
HYPERTENSION (1=yes, 2=no)	
CHRONIC LUNG DISEASE (1=yes, 2=no)	
IF CLD (1=asthma, 2=silicosis, 3=copd)	
TUBERCULOSIS (1=yes, 2=no)	
TAKEN TREATMENT FOR TB (1=yes, 2=no)	
IF SILICOSIS THEN RECEIVED COMPENSATION (1=1 lakh, 3= 3lakh)	
IF SILICOSIS THEN RECEIVING PENSION (1=yes, 2=no)	
COVID IN PAST (1=yes, 2=no)	
ANGINA/HEART ATTACK (1=yes, 2=no)	
PAIN IN CHEST WHILE WALKING (1=yes, 2=no)	
STROKE (1=yes, 2=no)	
DIFFICULTY IN VISION (1=yes, 2=no)	
CANCER (1=yes, 2=no)	
If yes, which cancer	
LONG TERM KIDNEY DISEASE (1=yes, 2=no)	
MALARIA (1=yes, 2=no)	
PAIN/STIFFNES IN JOINT (1=yes, 2=no)	
CHRONIC BACK PAIN (1=yes, 2=no)	
ADDICTION (1=yes, 2=no)	
1=alcohol, 2=bidi, cigarette, 3=tobacco, 4=gutka, 5= afeem	

TICK APPROPRIATE COLUMN					
	Very	dissatisfied	Neither nor	satisfied	Very
3. To what extent do you feel that physical pain prevents you from doing what you need to do?					
4. How much do you need any medical treatment to function in your daily life?					
5. How much do you enjoy life?					
6. To what extent do you feel your life to be meaningful?					
7. How well are you able to concentrate?					
8. How safe do you feel in your daily life?					
9. How healthy is your physical environment?					
10. Do you have enough energy for everyday life?					
11. Are you able to accept your bodily appearance?					
12. Have you enough money to meet your needs?					
13. How available to you is the information that you need in your day-to-day life?					
14. To what extent do you have the opportunity for leisure activities?					
15. How well are you able to get around?					
16. How satisfied are you with your sleep?					
17. How satisfied are you with your ability to perform your daily living activities?					
18. How satisfied are you with your capacity for work?					
19. How satisfied are you with yourself?					
20. How satisfied are you with your personal relationships?					
21. How satisfied are you with your sex life?					
22. How satisfied are you with the support you get from your friends					
23. How satisfied are you with the conditions of your living place?					
24. How satisfied are you with your access to health services?					
25. How satisfied are you with your transport?					
26. How often do you have negative feelings such as blue mood, despair, anxiety, depression?					

ELDERLY 1 (GRANDFATHER)

NAME		
AGE		
SEX (1=male, 2=female)		
SYSTOLIC BP		
DIASTOLIC BP		
CATARACT (1=yes, 2=no)		
SNELLEN (WITH SPECS)	R	L
SNELLEN (WITHOUT SPECS)		
TUNING FORK 256 HZ (1=CD, 2=SNHL)	R	L
FBS		
RBS		
PALOR (1=YES, 2=NO)		
HEMOGLOBIN (check only if palor present)		
MARITAL (1=married, 2=unmarried, 3=widow, 4-separated)		
HIGHEST EDUCATION (1=uneducated, 2=upto class 5, 3=upto class 8, 4=upto class 10, 5=upto class 12, 6=graduate)		
OCCUPATION (1=mine worker, 2=construction worker, 3=shopkeeper, 4=farming, 5=others, 6=unemployed, 7=homemaker)		
IF MINE WORKER, TYPE OF WORK (1=cutting, 2=drilling, 3=lifting, 4=cleaning, 5=driver, 6=blasting, 7=others)		
NO OF YEARS IN MINE		
NO OF HOURS A DAY YOU WORK		
BREATHLESSNESS (1=after strenuous exercise, 2=after mod exercise or walking up slope or stairs, 3= plain surface 500 meters or 8-10 minutes, 4=normal activity, 5=even at rest)		
ADMITTED IN HOSPITAL IN LAST 1 YEAR (1=yes, 2=no)		
DID YOU VISIT OPD IN 1 YEAR (1=yes, 2=no)		
If yes, for what		
NO OF TIMES VISITED OPD IN 1 YEAR		
DO YOU TAKE MEDICATIONS DAILY (1=yes, 2=no)		
If yes, for what		

NO OF MEDICATIONS TAKEN DAILY	

DO YOU SUFFER FROM THESE CONDITIONS	
DIABETES (1=yes, 2=no)	
HYPERTENSION (1=yes, 2=no)	
CHRONIC LUNG DISEASE (1=yes, 2=no)	
IF CLD (1=asthma, 2=silicosis, 3=copd)	
TUBERCULOSIS (1=yes, 2=no)	
TAKEN TREATMENT FOR TB (1=yes, 2=no)	
IF SILICOSIS THEN RECEIVED COMPENSATION (1=1 lakh, 3= 3lakh)	
IF SILICOSIS THEN RECEIVING PENSION (1=yes, 2=no)	
COVID IN PAST (1=yes, 2=no)	
ANGINA/HEART ATTACK (1=yes, 2=no)	
PAIN IN CHEST WHILE WALKING (1=yes, 2=no)	
STROKE (1=yes, 2=no)	
DIFFICULTY IN VISION (1=yes, 2=no)	
CANCER (1=yes, 2=no)	
If yes, which cancer	
LONG TERM KIDNEY DISEASE (1=yes, 2=no)	
MALARIA (1=yes, 2=no)	
PAIN/STIFFNES IN JOINT (1=yes, 2=no)	
CHRONIC BACK PAIN (1=yes, 2=no)	
ADDICTION (1=yes, 2=no)	
1=alcohol, 2=bidi, cigarette, 3=tobacco, 4=gutka, 5= afeem	

ADL FOR ELDERLY		
	1= Independent	0= Dependent (supervision/assistance)
BATHING		
DRESSING		
TOILETTING		
AMBULATION		
CONTINENCE		
FEEDING		

Annexure 'L': Interview guide of in-depth interviews

IN-DEPTH INTERVIEW GUIDE

a. QUALITY OF LIFE

1. What are the difficulties/challenges you face by working in the mines?
2. How do you address the difficulties with your social environment/physical health/psychological health/environment?
3. What do you think/do to improve your life?
4. What are the other occupations than mining that you know of/could do, which could give you a better life?
5. What support do you expect from the government/NGOs/employers to make your lives better?

b. HEALTH STATUS

a. Health care Facilities

1. Challenges in assessing healthcare from HCF

What are the health care facilities in your area-

Which healthcare facility do you prefer and why?

What were the problems you faced in seeking healthcare?

What are the services offered in the health care facility in your area-

What other essential services do you expect in your healthcare facility?

How far is the health care facility from your residence-

How do you go to the healthcare facility?

How much do you spend on your visit to HCF?

b. Health status of family members

2. What illnesses is present among family members?
3. Any history of hospitalization of family members

c. Health status

4. What health issues restrict your capacity to work?

Any musculoskeletal pain

Any injuries suffered during work

Any respiratory distress at work

5. Do you suffer from any chronic illness?

What medications do you take daily?

Any history of hospitalization

d. Addiction

6. What is the substance you use and what substance you started using after starting working in mines

How much do you spend on your addiction habits

c. SE STATUS

1. How is your economic condition

Sources of income

Savings-perspective

Loans taken, interest on loan

2. Socioeconomic condition pre and post illness
3. Social support from government and other agencies (NGO)

Occupational benefit

Maternity benefit

Compensation for accidents

Health Insurance

Life Insurance

4. What other job options you have if not for mining

d. SITUATIONAL ANALYSIS

1. What are the government schemes you know which will be beneficial to you and your family?
2. Self-reported reason for patient delays
3. Knowledge about the rehabilitative efforts from the government and delays associated with them
4. Effectiveness of rehabilitation provision
5. Reason for the delay in detection, diagnosis, certification, and disbursement of compensation money of silicosis
6. What are the schemes/services being provided to you by government. What problems do you face in getting them
7. What all services do you expect to receive from government authorities

Annexure 'M': Interview guide of key informant interview

INTERVIEW GUIDE (Medical Officers, ASHA, NGO)

1. What can you tell me about the burden of Silicosis in your community?
   Number of silicosis patients presenting to the OPD
   What are their chief complaints?
   Do they present early or late?
2. What can you tell me about the Pneumoconiosis policy
3. What are the recent advancements in the policy
4. Is there any change in number or Time of visits by people with Silicosis pre policy and now?
5. What problems do you think are present in implementation of Pneumoconiosis policy
6. Reason for the delay in detection, diagnosis, and rehabilitation of silicosis
7. What else do you think can be done in improving the system of detection and certification?

INTERVIEW GUIDE (Administrators- Board Member, DTO)

1. What do you know about the Pneumoconiosis policy of Rajasthan
2. What is the role of policy in decreasing Out of Pocket expenditure?
3. Effectiveness of rehabilitation provision
4. Is there any delay in payments?
5. What are the reasons for the delay in detection, diagnosis, and rehabilitation of silicosis
6. What work is being done to facilitate proper notification of silicosis cases
7. What are the problems/challenges/barriers in implementation of the policy
   Funds
   Bribes
8. What are the recent changes to the policy
9. How do you plan to increase the efficiency and effectiveness of the policy?
10. Any plan to introduce Health Insurance for miners/construction workers (unorganized sector)?
    Cover expense related to accidents while working in mines
    Health insurance to cover medical expense (respiratory, musculoskeletal) acquired while working in mining industry
    Any plan to organize the mining sector (Include mine workers under cover of ESI)
11. Any plan to use digital systems for better detection, certification of cases?
    Change in Portal
    Installations of digital Xray's at PHC/CHC near mining zones
12. Any plan to open a separate department to look after welfare of silicosis victims?
13. Any plan to introduce premedical and yearly checkup for mine workers
14. Plan to introduce incentives for silicosis diagnosis to increase reporting of cases
15. Plan to introduce bi-directional screening for silicosis and tuberculosis among mine workers
    Linking TB with Silicosis
16. Plan to rehabilitate silicosis victim or next of kin by provide alternative job/skill training

Annexure 'N': Interview guide of focus group discussion

FOCUSSED GROUP DISCUSSION

1. Social support from government and other agencies (NGO)
   Occupational benefit
   Maternity benefit
   Compensation for accidents
   Health Insurance
   Life Insurance
2. What are the government schemes known, beneficial to you and your family
   Name and components of the schemes
      Mining related- Silicosis compensation, silicosis pension
      Others- Palanhar, Widow, Ration, MCH services, Anganwadi services
   What problems do you face in getting them
3. Problems in registration
   Self-reported reason for patient delays
   Problems in re-registration
4. Ease of/fallacy in process of acquiring certificate
   Jan adhar
   Reasons for delay in certification
5. Approx time for screening to money in hand
   Time for each steps
   Reasons for delay in disbursement of compensation money of silicosis
   Frequency of pension received monthly
6. What else do you think can be done in improving the system of detection and certification?

APPENDIX

Appendix i: List of caste in the state of Rajasthan

JOGI	OBC
RAJPUT	GENERAL
BHIL	ST
MEGHWAL	SC
MALI	OBC
GARG	GENERAL
BELDAR	SC
RAWAL	SC
VAISHNAV	GENERAL
ODD	OBC
NAYK	ST

Appendix ii- Transcripts of in-depth interviews

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IDI 5 (Silicosis patient, incomplete compensation with h/o TB)

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IDI 6 (Reject for silicosis certification)

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IDI 7 (Taking TB treatment, currently not working)

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I- [illegible]

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R-[illegible]

I-[illegible]

R- [illegible] 4000 [illegible]

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R- [illegible], [illegible], [illegible]

I- [illegible]?

R- [illegible] 350-400 [illegible] 5000-6000 [illegible] 2000-3000 [illegible]

I- [illegible]

R- [illegible]

I- [illegible]

R- [illegible]

I- [illegible]?

R- [illegible]

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R- [illegible] 50 [illegible]

I- [illegible]?

R- [illegible]

[illegible] 4000-5000 [illegible]

R- [illegible] 10 [illegible] 12 [illegible] 600-700 [illegible]

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IDI 8 (No complain of respiratory morbidity)

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Appendix iii- Transcripts of key-informant interviews

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KII (ASHA working in residential area around mines)

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Appendix iv- Transcripts of focus group discussion

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