DETECTION OF SILICOSIS AMONG STONE MINE WORKERS FROM KARAULI DISTRICT

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REPORT ON

DETECTION OF SILICOSIS AMONG STONE MINE WORKERS FROM KARAULI DISTRICT

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CERTIFICATE

This is to certify that this report on "Detection of Silicosis among Stone Mine Workers from Karauli District" is based on the results and findings of evaluation of medical records including Chest Radiographs and spirometry of stone mine workers from Karauli District of Rajasthan submitted to NIMH by Association for Rural Advancement through Voluntary Action & Local Involvement (ARAVALI), a Rajasthan State Government sponsored NGO. The chest radiographs of workers have been evaluated as per the ILO Classification of Chest radiographs of Pneumoconiosis 2000 and other medical records as per the standard practice.

Date :

Place : Nagpur

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REPORT ON DETECTION OF SILICOSIS AMONG STONE MINE WORKERS FROM KARAULI DISTRICT

1.0 INTRODUCTION

Stone quarrying and crushing are carried out in many parts of India, majority of stone mines are in unorganized and small-scale sector providing employment in rural areas adjacent to the cities in order to meet the demand of growing infrastructure sector. A large number of persons are employed in these unorganized small scale quarrying and crushing units. The reliable data about these workers are not properly maintained and hence details of employment are not available. Working conditions in these stone quarries and crushers are far from satisfactory and do not comply with the health and safety standards. Stone quarrying and crushing activities involve drilling, blasting, crushing the large stones into small pieces and followed by loading of the stone grit in transport vehicles.

In many parts of the country especially in Rajasthan, the large blocks of stones are manually cut and split into stone slabs of various sizes which are used as construction material for roofing and floor layering.

Stone quarrying and crushing operations give rise to large amount of fine dust containing free silica in the range of 20 -70%. Apart from the physical hardship, the workers involved are exposed to air laden with high levels of free silica and inhalation of such siliceous dust for long period is known to cause silicosis and other dust related lung diseases. The exposure to silica dust is known to predispose to tuberculosis, chronic airflow limitation, lung cancer and renal diseases.

Many studies have been conducted in past to determine the prevalence of silicosis amongst the stone quarry workers in the country. Sikand and Pamra (1949) were probably the first to report cases of silicosis in surface workers in India. They recorded that 52.4% of stone cutters and 12.5% of stone breakers suffered from silicosis in stone mines and crushers near Delhi. They also reported higher incidence of tuberculosis among these workers.(1) A Study conducted in 1992-94 by Desert Medicine Research center, Jodhpur, to find out the pattern and predictors of mortality amongst sandstone workers showed that radiological opacities suggestive of silicosis were seen in 9.9% radiographs and radiological signs of pulmonary tuberculosis

were seen in 15.6 % of radiographs. Prevalence of both conditions increased with duration of work. (2)

An environmental and epidemiological survey carried out in stone quarry workers by NIOH Ahmedabad, revealed evidence of silicosis in 22.4% workers. About 32% workers showed radiological evidence of tuberculosis. Majority of the cases of silicosis were detected among workers who had worked for over 10 years. The mean total dust concentrations in two quarries were 3.38 and 3.72 mg/M^3 and respirable dust concentrations in two quarries were 0.80 and 0.85 mg/M^3 respectively. the free silica content in dust was estimated to be about 70%.(3) In a review article "occupational health research in India" it is suggested that the prevalence of silicosis amongst stone quarry workers was 21% and that in stone crusher was 12%.(4)

An environmental and medical survey in sand stone mines located in lalitpur district of Uttar Pradesh revealed that the total and respirable dust concentration during the process of stone cutting were 22.4 mg/m^3 and 1.6 mg/m^3 respectively. Examination of 125 stone cutters showed that the prevalence of silicosis and tuberculosis were 22% and 48% respectively. The average duration of dust exposure for development of silicosis was 12 to 15 years. The total and respirable dust levels after installation of the control device, which operates on the principle of enclosure, were 3.4 mg/ m^3 and 0.8 mg/ m^3 respectively.(5)

A study by Gramin Vikas Vigyan Samiti (GRAVIS), Jodhpur in collaboration with Society for Participatory Research in Asia (PRIA), Delhi in 1994, found that about 10% of mine workers examined suffered from silicosis. Another study conducted in 1996, in sandstone mines in Jodphur, showed that out of the 288 workers examined, 14% were found to be suffering from severe silicosis, and 28% were found to be suffering from silicosis of less severity.(6)

In a survey conducted by Center for Occupational and Environmental Health, New Delhi in Lal-Kuan area of New Delhi to assess health status of resident who had worked in stone crushers and quarries, showed that approximately 39% of the subjects examined were suspected to be suffering from Silicosis, or Silico-tuberculosis while the number of subjects with tuberculosis was 29%.(7)

2.0 SILICOSIS [8]

Silicosis is caused by inhalation of airborne dust of Silicon Dioxide or Silica in the crystalline form also known as quartz. In metal mines, workers are exposed to high concentration of silica dust almost at every stage of mining operation. However, drilling, blasting, loading – unloading of ore, crushing, etc. are some of the dustiest operations and thus, workers in metal mines are at the higher risk of developing silicosis. Occurrence of silicosis is directly related to the degree of exposure to silica dust and higher in the exposure more in the chance of developing silicosis. Silicosis is generally seen in sub-acute and chronic form after exposure to silica dust for many years. However, very heavy exposure to silica dust is known to cause acute silicosis.

2.1 Pathogenesis

The precise pathogenesis of silicosis is not completely understood. The studies suggest that interactions between pulmonary alveolar macrophages and silica particles play a major role in the pathogenesis of silicosis. Surface properties of the silica particles appear to promote macrophage activation. These cells then release chemotactic factors and inflammatory mediators that elicit cellular responses by polymorphonuclear leukocytes, lymphocytes, and additional macrophages. Fibroblast-stimulating factors are also released which promote hyalinization and collagen deposition. The resulting pathologic lesion is the hyaline nodule which contains a central acellular zone with free silica surrounded by whorls of collagen and fibroblasts and an active peripheral zone composed of macrophages, fibroblasts, plasma cells and additional free silica.

The precise properties of the silica particles that evoke pulmonary response are not known. The nature and extent of biologic response is related to the intensity of exposure to silica dust but the surface characteristics of the dust also appear to be important. There is growing evidence that freshly fractured silica may be more toxic than aged silica-containing dusts perhaps because of reactive radical groups on the cleavage planes of the freshly fractured moiety. This may offer a pathogenic explanation for the more frequent observation of cases of advanced disease in sandblasters and rock drillers, in whom exposure to recently fractured silica is particularly intense.

2.2 Clinical Features

Silicosis is a largely asymptomatic disease till the onset of Progressive Massive Fibrosis (PMF). There may be no symptoms even though the radiographic appearances may suggest fairly advanced silicosis. Dyspnoea on exertion is the most frequent and directly related symptom, although it is rarely complained of in the absence of complicating diseases such as tuberculosis or bronchitis. The severity of dyspnoea increases with the progress of disease. Slight unproductive cough may be present at initial stages, however, the quantity of sputum increases later on. The symptoms usually resemble chronic bronchitis. Excessive sputum production is due to bronchial catarrh due to chronic dust exposure and sometimes due to secondary bacterial infection. Chest pain and haemoptysis are invariably due to tuberculosis.

Silicosis can also occur in acute form with heavy exposure to quartz dust over a short period. Acute silicosis develops within few months after inhalation of massive quantities of fresh silica dust. It generally presents as diffuse progressive irregular fibrosis of lower zones with few typical nodular shadows of silicosis. The radiological appearance is almost similar to pulmonary edema. There may also be acute enlargement of hilar lymph nodes. The histological findings are similar to pulmonary alveolar proteinosis. Acute silicosis presents as severe dyspnea and associated weight loss. The diseases is rapidly progressive and death is invariably due to severe hypoxemic ventilatory failure.

2.3 Chest Radiography

Chest radiography is the most important tool for the diagnosis of silicosis. There is direct relationship between degree of exposure to dust and severity of radiographic changes. In the initial stage, there is „reticulation" of lung fields due to thickening of peri-vascular and inter-communicating lymphatics. However, the radiographic diagnosis of silicosis can only be made after appearance of nodules particularly in upper and middle zones of lungs. The silicotic nodules initially are 2-5 mm in diameter, homogenous in density and usually bilaterally symmetrical. The nodules increase in number and size to “r” type and eventually cover most parts of the lungs.

Silicotic opacities tend to increase even after cessation of exposure to silica dust and sometimes calcification is seen in small nodules. There may also be Kerley B Lines at bases and thickening of inter- lobar fissure and pleura. Eggshell calcification of

hilar lymph nodes when present is almost pathognomonic of silicosis. At later stage, the silicotic nodules frequently unite and conglomerate to form large shadows of Progressive Massive Fibrosis (PMF). These shadows initially have a multi-nodular appearance but later on consolidate into contracted dense fibrotic masses often surrounded by bullae. The cavitation of shadows may occur with or without tuberculosis infection. There is invariably extensive pulmonary fibrosis close to the PMF lesions.

2.4 Lung Function Tests

Simple silicosis is rarely associated with lung function abnormalities except at the advance stage. However, there may be mixed type of lung function abnormalities due to exposure to dust. In cases of acute silicosis, restrictive type of lung function abnormalities may be seen. In late stages of progressive massive fibrosis there will always be severe mixed type of lung function abnormalities.

2.5 Complications of Silicosis

Pulmonary tuberculosis is the most frequent and an important complication of silicosis, presumably due to reactivation of previously existing quiescent lesions. There may also be infection due to atypical mycobacteria. The other complication of silicosis include pneumothorax associated with combination of fibrosis and bullae, increased frequency of scleroderma and tendency for renal failure. Recent studies have suggested that the silica dust may be carcinogenic and there may be increased incidence of lung cancer among silicotics. There is also some evidence to suggest that silica dust exposure may increase the incidence of ischemic heart diseases.

2.6 Prognosis

The prognosis in silicosis depends on the degree of exposure and the rate of development of silicosis. Acute silicosis invariably carries very poor prognosis and majority of the patient die within few months. Silicosis occurring at late stage is less debilitating till the onset of progressive massive fibrosis. Development of progressive massive fibrosis at any stage invariably carries poor prognosis.

3.0 MINING ACTIVITY IN KARAULI

3.1 Geography of Karauli

Karauli is one of the southern Eastern district of state of Rajasthan bordering Madhya Pradesh and is primarily a hilly area under Aravali hills. The geological formation is pre Cumbrian metamorphic rocks which is rich is limestone, sandstone, slica sand, etc. The area is specially famous for pink coloured construction stone used for carving and other decorative material. Livelihood of the rural population of this district is mainly dependent on agriculture, animal rearing, and mining. The sandstone famously called Karauli stone is mined here mostly in unorganized sector. 15 to 20 % of population is dependent on mining for there livelihood. Due to the poverty the nutritional status of the population is below average.

The information regarding the type of mineral, number of mines and average number of workers employed is given below in Table -1.

Table - 1

Sr. No	Name of Minerals	No. of Mine Leases	No. of Mines Worker
1	Silica sand	30	390
2	White Clay	05	240
3	Sand Stone	167	15000
4	Hand mill stone	05	10
5	Machinery Stone	100	600

The number of stone mines in Karauli area is approximately 1500-2000 with daily average employment of 5-20 workers. The mines are seasonal and operated by small entrepreneurs. Invariably whole family is involved in working of the mine and wages are based on amount of stone extracted. It is not uncommon to have persons employed in mines from childhood.

3.2 Method of Mining

Karauli stone occurs in form of layers (patti) at the depth of few feet. The working in mines is wholly manual with no mechanisation. After removal of overburden, the stone slabs are manually cut in blocks of stone by making holes with chisels and hammers (Fig-1). The block of stone so separated is then split into layer of various

thicknesses depending on natural layers. The split stone layers (patti) are sold as such or cut in small square slabs depending on nature of stone and requirement. The stone patti and slabs are loaded into trucks and transported to market. Karauli stone patti is basically used for making roof of houses and floors.

Fig-1: Stone cutting in mine

The majority of mines employ less than 20 persons and do not use power or explosives; hence they are not covered by definition of mine under the Mines act, 1952. The mine owners as well as mine workers are ignorant of health and safety requirements and due to general lack of education, awareness about safety appliances and occurrence of diseases due to work conditions is minimal. Though, some medical practitioners are aware of the respiratory diseases occurring among workers, they are mostly treated as case of pulmonary tuberculosis. It is not uncommon that cases of respiratory disease are repeatedly treated with anti tubercular drugs without much response.

3.3 Family livelihood Resource Programme

ARAVALI (Association for Rural Advancement through Voluntary Action & Local Involvement) is a non-government organization initiated by the Government of Rajasthan. Since 1997 ARAVALI is engaged in building organizational and programme capacities of NGOs in the State of Rajasthan. The main objective of ARAVALI is establishing Family Livelihood Resource centres (FLRCs) is an innovative approach of ARAVALI to dynamically and systematically analyse livelihood issues of the identified families as well as build tools and skills amongst functionaries to address the emerging challenges with the aim of enabling the most vulnerable to come out of the poverty trap through sustainable measures. The objective of the FLRC is to develop and deliver a customised package of livelihood resources and support services, for sustainable income generation and enterprise promotion, of the poorest and the most vulnerable households in its area. Dang Vikas Sansthan (DVS), Karauli based voluntary organization, is one of the ARAVALI"s field host organization for FLRC since 2008. DVS identified the poorest

and the most vulnerable families affected by mining based livelihood in six gram panchayats of Karauli block.

4.0 STATUTORY REQUIREMENTS UNDER MINES ACT, 1952 AND RECOMMENDATIONS OF CONFERENCES ON SAFETY IN MINES

The Mines act, 1952 and Mines Rules, 1955 provide the statutory requirements for medical examination of workers and detection of notified diseases. The Conferences on Safety in Mines have further recommended detailed medical examination and classification of chest radiographs as per ILO classification. The important provisions are listed below.

4.1 Mines Act, 1952 [10]

Section 25 Notice of Diseases

Mine management is required to submit notice of occurrence of notified diseases under section 25 of Mines Act, 1952.

The said section requires that:-

1. Where any person employed in a mine contracts any disease notified by Central Government as a disease connected with mining operations, the owner, agent or manager of the mine, shall send notice thereof to the Chief Inspector.

2. If any medical practitioner attends on a person who is or has been employed in a mine and who is or is believed by the medical practitioner to be suffering from any disease notified under sub-section (1), the medical practitioner shall send a report in writing to the Chief Inspector stating

    a) the name and address of the patient.
    b) the disease from which the patient is or is believed to be suffering.
    c) The name and address of the mine in which the patient is or was last employed.

Following diseases have been notified as the diseases connected with mining operations for the purpose of sub-section (1) of Section 25 of the Mines Act, 1952:-

- Silicosis
- Pneumoconiosis
- Manganese Poisoning - Nervous type
- Asbestosis
- Cancer of lung or the stomach or the pleura and peritoneum (i.e.mesothelioma)

The Central Govt. vide notification S.O.399 (E) dated 21/2/2011 has further notified following diseases connected with the mines operation.[11]

- Noise Induced Hearing Loss
- Contact dermatitis caused by direct contact with chemicals
- Pathological manifestations due to Radium or Radioactive substances

4.2 Mines Rules, 1955 [12]

Rule 29 B: Initial and Periodical Medical Examination

The Rule provides for;

(a) Initial medical examination of every person to be employed in the mine.

(b) Periodical medical examination, once every five years of persons employed in the mines.

(c) In case of the persons engaged in the process of mining or milling of asbestos, periodical medical examination shall be done at least once in every twelve months and every such examination shall include all the tests except the X-ray examination, which shall be carried out once in every three years.

(d) The periodical medical examination or the x-ray examination or both, shall be conducted at more frequent intervals if the examining authority deems it necessary to confirm a suspected case of a dust related disease.

The routine initial or periodical medical examination should include -

General physical examination,
A full size postero-anterior chest radiograph,
Lung Function Tests (Spirometry)

Central Government has notified;

Initial medical examination of every person seeking employment in mines and periodical medical examination once in five years of the following categories:-

(i) persons employed below ground in a mine:
(ii) persons employed in open cast workings of manganese mine or an asbestos mine:
(iii) persons engaged in operation of draglines, shovels, dozers, scrapers, dumpers, power drills, boring machines, locomotives winding engines, air compressors and other machinery installed or deployed on the surface or in the open cast workings in a mine:
(iv) persons engaged in crushing, grinding, dressing, processing, screening, or sieving of minerals, ores or stone or in any operation incidental thereto in a mine**.**

I. Rule 29C

The medical examinations to be conducted by a medical officer appointed by the mine.

II. Rule 29D

The rule describes the procedure to be followed for conduct of medical examination including notice of medical examination to the examinee in Form - M

III. Rule 29E

The rule describes the action required to be taken in case a person fails to submit himself for medical examination.

IV. Rule 29F

Initial and periodical medical examination of persons to be conducted in accordance with standards laid down in Form - P or Form - P I.

V. Rule 29G (1)

All medical examination records along with job details depicting occupational dust exposure profile of the person shall be retained till the person is in employment and ten years thereafter.

VI. Rule 29H

Every candidate for medical examination to handover three passport size photographs at the time of medical examination.

VII. Rule 29I

No woman shall, without her consent, be medically examined by a male medical practitioner except in presence of another woman

VIII.

IX. Rule 29J

Where a person is declared medically unfit on medical examination, he may file an appeal with the manager for medical re-examination by Appellate Medical Board.

X. Rule 29K

The Appellate Medical Board shall consist of

a. Inspector of Mines (Medical), Member Secretary
b. One Physician
c. One Radiologist

XI. Rule 29L

The Appellate Medical Board shall examine a person in accordance with standard laid down in Form – P or PI and issue certificate in Form – S.

XII. Rule 29M

Medically unfit person not to be employed in mines.

XIII. Rule 29N

If as a result of any medical examination a person is found to have any disease notified under section 25 of Mines Act, the provisions of Workman Compensation Act shall become applicable.

XIV. Rule 29O

The full cost of every medical examination under the rules shall be borne by the owner of the mine.

Rule 29P

Every mine shall submit an annual return about number of medical examinations conducted by it in form T.

4.3 Recommendations of VIIth, VIIIth and IXth Conferences on Safety in Mines

Important recommendations of VIIth, VIIIth and IXth National Conferences on Safety in Mines on Occupational Health Services and Medical Surveillance.

(i) There is a need for creation of Occupational Health Services in each mining company working mechanized mines.

(ii) Occupational Health Services shall have sufficient technical personnel with specialized training and experience in Occupational Medicine, Industrial Hygiene, Ergonomics, Occupational Health Nursing, etc. They should keep themselves up-to-date with progress in the scientific and technical knowledge necessary to perform their duties. Occupational Health Services should, in addition, have necessary administrative personnel, equipment and appliances for carrying out the assigned functions.

(iii) (i) Management of every mechanised mine should, in consultation with experts of the Occupational Health Services, prepare a scheme for:

- (a) Identification of operations and activities where factors hazardous to health of persons at work exist or may arise during the course of work.
- (b) Monitoring the levels or values of different factors which may affect health of persons.
- (c) Specifying the various control measures necessary for keeping the levels / values within the permissible limits.
- (d) Health surveillance.
- (e) Health education.
- (f) First – aid training.

(iv) There should be at least one medical officer properly trained in Occupational Health in each area who should also be associated with Periodical Medical Examinations.

(v) At least one medical officer engaged in medical examinations should be trained in use of ILO Classification of Radiographs for Pneumoconiosis.

(vi) Adequate facilities for X-rays and Lung Function Tests should be provided at each medical examination centre.

(vii) Health surveillance record shall be properly maintained.

(viii) If the profusion of any type of pneumoconiotic opacities in chest radiograph is 1/0 or above as per ILO Classification, the case shall be certified and notified as pneumoconiosis.

(ix) One of the medical examination of every person should be arranged within one year of his superannuation.

(x) To monitor the progress of profusion in certified cases of pneumoconiosis medical examination should be conducted at shorter intervals.

4.4 Recommendations of Xth Conference on Safety in Mines Relating to Occupational Health and Hygiene [13]

The Xth National Conference on Safety in Mines held in Delhi on 26th and 27th November, 2007 has made comprehensive recommendations on Occupational Health Surveillance and other occupational health and hygiene issues. Some of the important recommendations are;

Review of Status of Implementation of Recommendations of the 9th Conference on Safety in Mines

- The recommendations of DGMS (Tech) Circular No.18 of 1975 shall be implemented forthwith. (Protection of workers against Noise & Vibration in Working Environment.)

- Audiometry should be introduced, as a part of mandatory medical examination, for persons seeking employment in mines and for persons engaged in Operations / areas where noise level exceeds 90 dB(A).

Occupational Health Surveillance in Mining Industry

- All chest radiographs of Initial and Periodical Medical Examinations in private mines shall be classified for detection, diagnosis and documentation of pneumoconiosis in accordance with ILO classification for pneumoconiosis.

- The PME Medical Officer in every PME centre of private mines shall be trained in occupational health and use of ILO classification for pneumoconiosis.

- Each mining company operating mechanized mines shall set up an Occupational Diseases Board consisting of one occupational Health Physician, one radiologist and one general physician.

Occupational Health Surveillance and Notified Diseases.

Noise mapping should be made mandatory of various work places in the mine premises based on the various machines being used in concerned mines along with personal noise dosimetry of individual workmen exposed to noise level above 85 db(A)

Vibration studies of various mining machinery required to be done before their introduction in mining operations as per ISO standards.

Ergonomical assessment of all latest machines, before their introduction into mining operation as per ISO standards. Ergonomical assessment should include:

* Assessment of work process.
* Assessment of working Aids/tools
* Assessment of working posture

Potability tests of drinking water supplied to the mine employees, to be made mandatory once in a year irrespective of its source, preferably after Rainy seasons, the sample of water should be collected from the points of consumption

Initial medical examination shall be made mandatory for all mining employees whether permanent, temporary or contractual, before they are engaged in any mining job.

The frequency of periodic medical examinations should be brought down from existing five years to three years for the mining employees above 45 years of age. This should be implemented in three years.

Standards of medical examinations for both Initial and Periodic should be modified as mentioned below in order to ensure early diagnosis of more diseases caused or get aggravated due to employment in mines.

(a) In addition to measurement of blood pressure, detailed cardiovascular assessment of employees should be done. This should include 12 leads electrocardiogram and complete lipid profile.

(b) Detailed neurological examinations including testing of all major superficial and deep reflexes and assessment of peripheral circulation to diagnose vibrational syndromes.

(c) In addition to routine urine, fasting and post-parandial blood sugar should be included for early diagnosis of diabetes mellitus.
(d) Serum Urea and Creatinine should be included for assessment of Renal function.

(e) Hematological tests like Total count, Differential count, percentage of Hemoglobin and Erythrocyte Sedimentation Rate should be included to diagnose Blood Dyscrasias.

Special tests should be included in the PME for employees exposed to specific health hazard;

(a) For employees exposed to manganese, special emphasis should be given to behavioral and neurological disturbances such as speech defect, tremor, impairment of equilibrium, adiadochokinesia H2S and emotional changes.

(b) For persons exposed to lead, PME should include blood lead analysis and delta aminolevulinic acid in urine, at least once in a year.

(c) Employees engaged in food handling and preparation and handling of stemming material activities should undergo routine stool examination once in every six months and sputum for AFB and chest radiograph once in a year.

(d) Employees engaged in driving/ HEMM operation jobs should undergo eye refraction test at least once in a year.

(e) Employees exposed to ionizing radiation should undergo Blood count at least once in a year.

It is proposed to include following diseases in the list of Notified diseases under Section 25 (1) of Mines Act, 1952:

(a) All other types of Pneumoconiosis excluding Coal workers

pneumoconiosis, Silicosis and Asbestosis. This includes Siderosis & Berillyosis.

(b) Noise induced hearing loss.

(c) Contact Dermatitis caused by direct contact with chemicals.

(d) Pathological manifestations due to radium or radioactive substances.

For smaller mines where PME facilities are not existing, medical examinations can be done through other competent agencies.

5.0 STATUTORY PROVISIONS UNDER WORKMEN COMPENSATION ACT, 1923. [14]

Section 3 Employer's Liability for compensation:

A. (2) If a workman employed in any employment specified in Part A of Schedule III contracts any disease specified therein as an occupational disease peculiar to that employment, or if a workman whilst in the service of an employer in whose service he has been employed for a continuous period of not less than six months (which period shall not include a period of service under any other employer in the same kind of employment) in any employment specified in Part B of Schedule III, contracts any disease specified therein as an occupational disease peculiar to that employment, or if a workmen, whilst in the service of one or more employers in an employment specified in Part C of Schedule III for such continuous period as the Central Government may specify in respect of each such employment, contracts any disease specified therein as an occupational disease peculiar to that employment, the contracting of the disease shall be deemed to be an injury by accident within the meaning of this section and, unless the contrary is proved the accident shall be deemed to have arisen out of, and in the course of the employment :

[Provided that if it is proved –

(a) That a workman whilst in the service of one or more employers, in any employment specified in Part C of Schedule III, has contracted a disease specified therein as an occupational disease peculiar to that employment during a continuous period which is less than the period specified under this sub-section for that employment, and

(b) That the disease has arisen out of and in the course of the employment, the contracting of such disease shall be deemed to be an injury by accident within the meaning of this section :

Schedule III, Part C

1.	Pneumoconioses caused by sclerogenic mineral dust (Silicosis, anthracosilicosis, asbestosis) and silico-tuberculosis : provided that silicosis is an essential factor in causing the resultant incapacity or death.	All work involving exposure to the risk concerned.
2.	Bagassosis	All work involving exposure to the risk concerned.
3.	Broncho-pulmonary diseases caused by cotton flax hemp and sisal dust (Byssinosis)	All work involving exposure to the risk concerned.
4.	Extrinsic allergic alveolitis caused by the insulation of organic dusts.	All work involving exposure to the risk concerned.
5.	Broncho-pulmonary diseases caused by hand metals.	All work involving exposure to the risk concerned.

Model Draft Rules – Workmen's Compensation (Occupational Diseases) Rules, 1961.

The Central Government had also formulated Model Draft Rules – Workmen"s Compensation (Occupational Diseases) Rules, 1961. However these rules were ratified by few states only and could not come into force in majority of the states. The relevant provisions of the rules are reproduced below;

(e) " Pneumoconiosis" means silicosis or coalminers pneumoconiosis or asbestosis or bagassosis or any of those diseases accompanied by pulmonary tuberculosis;.

(5) Medical conditions under which pneumoconiosis may be considered to be an occupational disease-

(1) The diagnosis of pneumoconiosis shall be carried out with all the necessary technical guarantees. Proof of the degree of development of the pathological or anatomical changes in the respiratory and cardiac systems shall be furnished by the radiographic record and other laboratory records, which shall be

accompanied by the report of a full clinical examination, including a report of the industrial history of the person concerned, the record of all occupations in which he has been employed, the nature of the harmful dusts to which he was exposed and the duration of such exposure.

(2) For entitlement to compensation, silicosis and coal miners‟ pneumoconiosis shall fulfil the following radiological and clinical conditions:

(a) The radiological examination of the workmen must reveal –

(i) The appearance of generalised micronodular or nodular fibrosis covering a considerable part of both lung fields whether accompanied or not by signs of pulmonary tuberculosis: or

(ii) In addition to a marked accentuation of the pattern of both lungs, the appearance of one or several pseudotumoral fibrotic formations, whether accompanied or not by signs of pulmonary tuberculosis; or

(iii) The appearance of both of these types of fibrotic lesions at once, whether accompanied or not by signs of pulmonary tuberculosis;

(b) Serial radiological pictures taken over a period during periodical medical examinations shall, as far as possible, be considered in making definite diagnosis in cases where doubt exists;

(c) Radiological interpretation shall be based on the standard International classification laid down by the International Labour Organisation (Geneva Classification).

(d) The clinical examination of the workman concerned must reveal a decrease or deterioration of the respiratory function or cardiac function, or a deterioration of the state of general health, caused by the pathological processes specified above.

(6) Evaluation of disablement –

(1) The evaluation of disablement shall be made by reference to the physical (anatomical, physiological, and functional) and mental capacity for the exercise of the necessary functions of a normally occupied life which would be expected in a healthy person of the same age and sex. For such assessment, recognised

cardio-respiratory function tests shall be used to assess the degree of cardio-respiratory function impairment.

(2) It shall be determined whether the disablement is temporary or permanent and also the percentage loss of function as it pertains to the loss of working capacity for receiving compensation.

(3) Assessment of disablement shall be proportionate to the loss of earning capacity, total disablement being taken to be 100% loss of earning capacity.

6.0 BACKGROUND OF THE ISSUE

ARAVALI under its Family Livelihood Resource Centre (FLRCs) initiative, working in Karauli district through Dang Vikas Sansthan (DVS) observed that one of the main livelihood source in this area is mining, and the persons engaged in mining activities were suffering from respiratory symptoms which affected their livelihood due to suspected tuberculosis (TB). As field organization DVS while engaging with poorest mine worker‟s families found that Out of 82 families comprising of 116 registered under the programme, 56 are engaged in mining. In most of the families, it was observed that the male members of the family have died at an early age due to suspected TB. The majority of persons who had died or are suffering from respiratory diseases had prolonged history of working in stone mines. Therefore in view of the occupational history, it was suspected that the respiratory symptoms possibly could be due to silicosis. However, as there is no expertise and facilities to diagnose silicosis in the District hospital, cases are mostly treated as Pulmonary TB with very little response.

ARAVALI approached NIMH for guidance and suggestions on the issue. The Director, NIMH visited some of the mines along with ARAVALI representatives and after preliminary visit to mines and detailed discussions, it was suggested to carry out detailed investigation of the persons including chest x-ray. The officials of ARAVALI arranged for medical investigations of persons which included detailed work history, respiratory symptoms, history of treatment, chest radiograph, sputum examination and pulmonary function test. The medical records were submitted to NIMH for evaluation and opinion.

7.0 OBJECTIVES

The main objectives of the present study includes

1. To evaluate medical records of persons with history of work in stone mines for detection of silicosis
2. To suggest measures for management and rehabilitation

8.0 MATERIALS & METHODS:

ARAVALI under its Family Livelihood Resource centres Programme conducted medical examination of 101 persons including 9 females who had been suffering from various respiratory symptoms and had the history of work in stone mines. The medical examination included detailed history of working in mines, respiratory symptoms, history of treatment for tuberculosis, sputum examination, pulmonary function test and chest radiographs. The medical records of 101 person were initially screened but in view of high prevalence of suspected cases of silicosis, it was decided to conduct proper evaluation of medical records and evaluation of chest radiographs in accordance with ILO classification at NIMH under standardized conditions. Therefore, all medical records were brought to NIMH and evaluated by three specialist experienced in evaluation of chest radiographs as per ILO classifications of radiographs for Pneumoconiosis, 2000.

The pulmonary function test were evaluated based on the recorded value of FEV_1, FVC and classified as restrictive, obstructive and mixed defects and as mild, moderate or severe defects as per standard practice.

9.0 RESULTS AND DISCUSSION

9.1 The study population

The age wise distribution of examined persons is given in table-2.

Table - 2

Age Group	Male	Female	Total
20-30	4	0	4
31-40	24	6	30
41-50	36	3	39
51-60	23	0	23
>60	5	0	5

The table-3 shows distribution of person according to history of work in stone mines.

Table - 3

Duration of Exposure	Male	Female	Total
< 10	9	9	18
11-20	41	0	41
21-30	31	0	31
> 30	11	0	11
TOTAL	92	9	101

Evaluation of records showed that 7 out of 9 female subjects had no history of work in the mines. The records revealed that 17 persons had history of hemoptysis. The sputum of all subjects was negative for AFB. Out of 101 persons 67 had completed DOTS (Directly Observed Treatment, Short Course) therapy, while 13 subjects are still on DOTS for Pulmonary Tuberculosis being provided by the district hospital.

9.2 Chest X-ray:

The chest radiographs of 101 subjects were evaluated as per ILO classification of Radiographs of Pneumoconiosis, 2000 under standardized condition.[15]

Each radiograph was classified for film quality, type of opacities, profusion of opacities, extent and other abnormalities. The findings were noted in a standardized radiograph reading sheet.

9.2.1 Technical Quality

The technical quality was evaluated as below:

1. Good
2. Acceptable, with no technical defects likely to impair classification of the radiograph for pneumoconiosis
3. Acceptable, with some technical defects but still adequate for classification purpose.
4. Unacceptable for classification purpose.

Table 4 shows the distribution according to the technical quality of radiographs

Table - 4

Quality of Film	Number
1	6
2	14
3	79
4	2
Total	101

The subjects with chest radiograph of quality 4 or unacceptable and female subjects with no history of work in stone mines with essentially normal chest radiographs were excluded from further analysis.

9.2.2 Small Opacities:

Profusion of small opacities was determined by comparison with standard radiographs and recorded as one of the categories: **0. 1, 2 or 3.**

Increasing profusion of small opacities >>>>>>>>>>>>>>>>>>>>>>>>>>>>												
Categories	**0**			**1**			**2**			**3**		
Subcategories	**0/-**	**0/0**	**0/1**	**1/0**	**1/1**	**1/2**	**2/1**	**2/2**	**2/3**	**3/2**	**3/3**	**3/+**

Shapes and size was determined by comparison with standard radiographs. The predominant shapes and size was recorded using two of the following letters: **p, q, r, s, t or u.**

Out of 101 radiographs evaluated as per the ILO Classification 2000, the distribution of profusion on 12 point scale was as follows;

Category 0 (0/-, 0/0, 0/1) **20 (Normal)**

Category 1 – subcategory: **1/0 – 9 (suspected cases of silicosis)**
1/1 – 10 (silicosis)
1/2 – 1 (silicosis)

Category 2 - subcategory: **2/1 – 8 (silicosis)**
2/2 -- 15 (silicosis)
2/3 – 6 (silicosis)

Category 3 - subcategory: **3/2 – 4 (silicosis)**
3/3 -- 13 (silicosis)
3/+ – 7 (silicosis)

Category 0 refers to absence of small opacities or the presence of small opacities that are less than category 1

Category 1: 1/0 - refers to suspected cases of silicosis (9)
1/1 and above - refers to silicosis (62)

The finding of classification of pneumoconiotic opacities are summarized in table-4 as per major category classification

Table - 5

Category	Number of
Category - 0	**20***
Category - 1	**20**
Category - 2	**29**
Category - 3	**24**
Total	**93**

***Includes 8 cases with radiological evidence of Pulmonary Tuberculosis with no Pneumoconiotic opacities**

Majority of small rounded opacities were of type "r" i.e. opacities with diameter exceeding 3 mm and up to about 10 mm

Fig-2 and Fig-3 shows the photograph of chest radiograph of subjects with category 3 silicosis and category 3 silicosis with tuberculosis respectively.

Fig-2: Chest radiograph with category 3 silicosis


Fig-3: Chest radiograph with category 3 silicosis with tuberculosis

9.2.3 Large Opacities:

A large opacity is defined as an opacity having the longest dimension exceeding 10 mm.

Category A: One large opacity having the longest dimension up to about 50 mm, or Several large opacities with the sum of their longest dimensions not exceeding about 50 mm

Category B: One large opacity having the longest dimension exceeding 50 mm but not exceeding the equivalent area of the right upper zone, or several large opacities with the sum of their longest dimensions exceeding 50 mm but not exceeding the equivalent area of the right upper zone

Category C: One large opacity which exceeds the equivalent area of the right upper zone, or several large opacities which, when combined, exceed the equivalent area of the right upper zone

Fig-4: Chest radiograph showing silicosis with PMF

The chest radiographs of 16 workers showed large opacities suggestive of Pulmonary Massive Fibrosis (PMF). Fig-4 shows the photograph of chest radiograph of silicosis with Progressive Massive Fibrosis. The distribution of cases is given in table-6

Table - 6

Sr. No	Type of Large Opacity	Number of subjects
1	**Category A**	**1**
2	**Category B**	**7**
3	**Category C**	**8**
	Total	**16**

The further analysis of result showed that occurrence and profusion of pneumoconiotic opacities due to silicosis and progressive massive fibrosis were directly related to the number of years of work in stone mine (Table 7). Longer the duration of work, higher was the profusion and category of PMF (Table 8 & 9)

The distribution of cases of silicosis and progressive massive fibrosis alongwith number of subjects according to the years of work in mines is give in Table-7

Table – 7

Years of work	Silicosis	PMF	Total Number of Subjects
< 10	7 (63.6)	1 (9.0)	11
11-20	30 (73.1)	7 (17.0)	41
21-30	25 (83.3)	4 (13.3)	30
> 30	11 (100)	4 (36.3)	11
Total	73 (78.4)	16 (17.2)	93

Note:- The numbers in parenthesis indicates % of subjects suffering from silicosis and PMF

Table-8 shows distribution of category of silicosis according to number of years of service in mines.

Table - 8

Years of work	Category 1	Category 2	Category 3	Total Number of cases of Silicosis
< 10	2	4	1	7
11-20	11	8	11	30
21-30	5	13	7	25
> 30	2	4	5	11
Total	19	29	25	73

Table-9 shows distribution of cases of progressive massive fibrosis according number of years of service in mines.

Table 9

Years of work	Category A	Category B	Category C	Total Number of cases of PMF
< 10	-	1	-	1
11-20	-	2	5	7
21-30	1	2	1	4
> 30	-	2	2	4
Total	1	7	8	16

9.2.4 Other important radiological findings:

Other important findings in chest radiographs included 8 cases of radiological evidence of Pulmonary Tuberculosis. In 17 subjects there was evidence of silicosis associated with pulmonary tuberculosis, henceforth termed as Silico-tuberculosis.

9.3 Pulmonary Function Test (PFT)

Following criterion was followed for interpretation of Pulmonary Function Tests;

1. Measured FVC less than 80% of predicted FVC was termed as Restrictive impairment
2. FEV_1/FVC ratio less than 70% was termed as Obstructive impairment.
3. Combination of restrictive and obstructive impairment was termed as Mixed

(FVC = Forced Vital Capacity; FEV_1 = Forced Expiratory Volume in one second)

Pulmonary Function Test reports of 83 subjects were available and were evaluated. Pulmonary Function Test of **9 (10.8%)** subjects was found to be normal, **13** (**15.6 %)** subjects had mild restrictive impairment, **19 (22.8%)** showed moderate restrictive impairment and **42 (50.6%)** subjects had severe restrictive impairment. (Table – 10)

Table - 10

Pulmonary Function Test	Number of Subjects
Normal	9
Mild Restrictive	13
Moderate Restrictive	19
Severe Restrictive	42
Total	83

Details of finding of evaluation of each medical records is given in Annexure -1

Details of x-rays evaluation of individual subjects is given in Annexure - 2

10.0 DISCUSSION:

The results of evaluation of medical records of 101 subjects submitted by ARAVALI to National Institute of Miners" Health show that majority of the subjects who had worked in stone mines had radiological evidences of silicosis. Of the 93 subjects with history of work in mines, 73 (78.5%) had evidence of silicosis and 16 (21.9%) of them had developed Progressive Massive Fibrosis. This is extremely alarming. As is evident from table-4, 53 of these had silicosis of category 2 or higher which indicates advance stage of the disease. Similarly, all except one case of Progressive Massive Fibrosis were of category B or C showing advance stage of disease.

Table 7, 8 and 9 show that the occurrence and stage of silicosis and Progressive Massive Fibrosis are related to years of work in stone mines. Longer the duration of work, higher is the occurrence and advancement of silicosis. It is possible that some of the subjects who developed silicosis and PMF at early age may have started work in mine at young age.

As expected, silicosis developed after 10 years of working in the mines, though it is likely that a number of cases may have occurred earlier than 10 years. With increasing number of years of work in mines the prevalence of silicosis increased and practically every subject developed silicosis who had worked for more than 30 years in mines. Similarly, the category of silicosis and prevalence of PMF also increased with increasing number of years of work as shown in table 8. As expected, because of advanced stage of silicosis and PMF, 74 (89%) of 83 subjects had pulmonary function impairment.

It is also observed that 25 (26.8%) of the subjects had radiological evidence of pulmonary tuberculosis which is extremely high and 17 of these had associated silicosis. It is known that silicosis tends to predispose to tuberculosis and may be a contributing factor towards high prevalence of tuberculosis.

Overall based on the evaluation of results of medical records provided to the institute of persons who had history of work in stone mines, it can be concluded that a large proportion of them suffer from silicosis and some of them suffer from advance stage of Progressive Massive Fibrosis invariably complicated by associated pulmonary tuberculosis. It is no wonder that majority of these cases are diagnosed as

pulmonary tuberculosis and are repeatedly given anti-tuberculosis treatment with little response.

The present study cannot be considered as representative of prevalence of silicosis and PMF in stone workers of the Karauli District as the study population included only those subjects who had been suffering from respiratory disorders. The actual prevalence of silicosis may vary considerably as it does not include persons working in mine who do not suffer from any respiratory symptoms at present. It also does not take into account those who may have died due to silicosis and PMF. Therefore, a large scale study is required to determine prevalence of silicosis among the stone mines workers in this area.

11.0 SUMMARY & CONCLUSION

Silicosis remains the most important occupational lung disease for the persons employed in mines. Though, reliable statistics of prevalence of silicosis in Indian mines are not available, it is estimated that a significant proportion of workers may be suffering from silicosis more so in small scale and unorganized mines. In Rajasthan, stone mining is being carried out in Jodhpur, Bharatpur, Karauli and many other districts. In Karauli area, ARAVALI, one of the Government of Rajasthan NGO has been working on the livelihood project. It had observed that many of the workers engaged in stone mining have been suffering from respiratory problems and being treated as cases of tuberculosis with very little response. National Institute of Miners" Health in collaboration with ARAVALI evaluated the medical records of 93 subjects suffering from various respiratory problems and with the history of work in stone mines. Evaluation of medical records including chest x-rays have showed that 78.5% of subjects have evidence of silicosis of which 21.9 % had Progressive Massive Fibrosis. Majority of the subjects were suffering from advance stage of silicosis. It is also observed that 26.8% of persons had radiological evidence of pulmonary tuberculosis and 23.2% of subjects with silicosis had associated tuberculosis..

On the basis of evaluation of records, it is evident that many workers engaged in stone mining in this area may be suffering from silicosis and associated tuberculosis. As majority of these workers belong to the poorest of poor class, the livelihood of the persons is affected due to occurrence of silicosis and pulmonary tuberculosis. There is urgent need for devising an intervention programme for providing medical services and rehabilitation of these persons including compensation for occurrence of silicosis

as silicosis is a compensable disease under Workmen Compensation Act. All cases of silicosis also need to be notified to the enforcement agency i.e. Directorate General of Mines Safety as required under Mines Act, 1952.

In this regard, the DGMS (Tech) (S&T) Circular No. 01 of 2010 on "Respirable Dust Measurement and Control to prevent Pneumoconiosis in Mine" and DGMS (Tech) (S&T) Circular No. 01 of 2011 on "Guidelines on Occupational health Survey (Medical Examination) of persons working at places or operations/processes prone to generate airborne dust" which also includes the recommendation of National Human Right commission on "Preventive, Remedial, Rehabilitative and Compensation aspects of Silicosis" with the aim to significantly reduce the prevalence of Pneumoconiosis/ Silicosis by 2015 and to totally eliminate Pneumoconiosis/ Silicosis at workplace by 2030 in line with ILO/WHO Global Programme on Elimination of silicosis are significant. However, it will remain a distant dream without a concerted effort by all concerned.

12.0 RECOMMENDATIONS

1. There is immediate need for starting an intervention programme to provide treatment to the persons affected with silicosis.

2. A comprehensive study involving all persons engaged in stone mining should be carried out to determine prevalence of silicosis in the area.

3. The persons affected with silicosis need to be compensated as provided under Workmen Compensation Act, 1923.

4. All cases of silicosis should be notified to Directorate General of Mines Safety, as provided under Mines Act, 1952.

5. A detailed study on airborne dust levels and suitable dust control measures should be carried to reduce dust exposure to persons engaged in stone mining.

6. The mine owners and workers need to be educated and made aware of health hazards of stone dust and preventive measures required to be taken.

7. A special drive needs to be launched for detection and treatment of persons suffering from Pulmonary Tuberculosis in stone mines.

8. All persons engaged in stone mines should undergo periodic medical examination regularly.

9. An effective rehabilitation programme should be undertaken for persons suffering from silicosis.

10. There is need to train local doctors in diagnosis of silicosis as large number of cases are misdiagnosed as cases of Pulmonary Tuberculosis.

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ANNEXURE-1

Sr.No.	Name	X-ray No.	Age	Sex	Address	Name of Mine	No. of yrs. Worked in mine	Complaints if any	H/o Anti TB treatment	PFT
1	Dayaram	4302	50	M	Vinega village	Vinega Stone Mine	30	No	DOTS Completed	Severe Restriction
2	Rameshwar	4303	35	M	Vinega village	Vinega Stone Mine	12	Hemoptysis & Cough since 3-4 months	DOTS Completed	Normal
3	Vasudeo	4304	32	M	Vinega village	Vinega Stone Mine	14	No	DOTS for 4 months	Normal
4	Pannoo	4305	48	M	Vinega village	Vinega Stone Mine	25	Hemoptysis & Cough since 3-4 months	DOTS Completed	Severe Restriction
5	Mawasi	4306	43	M	Vinega village	Vinega Stone Mine	25	No	DOTS Completed	Mod.Restriction
6	Kunjlal	4307	40	M	Vinega village	Vinega Stone Mine	27	Cough with Hemoptysis	DOTS Completed	Severe Restriction
7	Amarbai	4308	38	F	Vinega village	Vinega Stone Mine	0	No	DOTS Completed	Mod.Restriction
8	Meethalal	4317	34	M	Guvreda village	Guvreda Stone Mine	18	Cough with Hemoptysis	DOTS for 4 months	Mod.Restriction
9	Bharosi	4335	26	M	Manchi village	Manchi Stone Mine	20	Cough with Hemoptysis	DOTS Completed	Not Done
10	Amarlal	4336	46	M	Manchi village	Manchi Stone Mine	9	No	DOTS Completed	Mod.Restriction
11	Shivcharan	4337	40	M	Manchi village	Manchi Stone Mine	18	No	DOTS for 4 months	Mild Restriction
12	Pappu	4338	55	M	Manchi village	Manchi Stone Mine	40	Hemoptysis	DOTS for 4 months	Mod.Restriction
13	Mulchand	4339	75	M	Manchi village	Manchi Stone Mine	20	No	DOTS Completed	Severe Restriction
14	Vishan	4340	65	M	Manchi village	Manchi Stone Mine	40	No	DOTS Completed	Severe Restriction
15	Virju	4342	35	M	Manchi village	Manchi Stone Mine	15	No	DOTS Completed	Not Done
16	Jagan	4343	54	M	Virvas village	Virvas Stone Mine	23	Cough with Hemoptysis	DOTS Completed	Severe Restriction
17	Rambabu	4344	32	M	Manchi village	Manchi Stone Mine	13	No	DOTS Completed	Mod.Restriction
18	Bhavarsingh	4345	32	M	Manchi village	Manchi Stone Mine	8	No	----	Not Done
19	Radhey	4346	45	M	Vinega village	Vinega Stone Mine	25	Cough with Hemoptysis	DOTS Completed	Mod.Restriction
20	Bhurilal	4347	43	M	Vinega village	Vinega Stone Mine	23	Cough with Hemoptysis	DOTS Completed	Severe Restriction
21	Kamal	4403	50	M	kote village	Kote Stone Mine	25	No	DOTS Completed	Mod.Restriction
22	Kalyan	4404	45	M	Chabar village	Chabar Stone Mine	30	No	DOTS Completed	Mod.Restriction

23	Gyarsiya	4405	55	M	kote village	Kote Stone Mine	35	Cough with Hemoptysis	DOTS Completed	Severe Restriction
24	Babu	4406	45	M	Chabar village	Chabar Stone Mine	25	No	DOTS Completed	Normal
25	Kedarbai	4407	40	F	Chabar village	Chabar Stone Mine	0	No	DOTS Completed	Normal
26	Babu	4408	42	M	kote village	Kote Stone Mine	28	No	DOTS Completed	Normal
27	Bharosi	4409	70	M	kote village	Kote Stone Mine	40	Cough with Hemoptysis	DOTS Completed	Severe Restriction
28	Sarpoo	1437	59	M	Guvreda village	Guvreda Stone Mine	35	Hemoptysis	DOTS Completed	Not Done
29	Harilal	4456	32	M	kote village	Kote Stone Mine	17	No	----	Severe Restriction
30	Jagdish	4457	55	M	Mahuakheda village	Mahuakheda Stone Mine	15	Hemoptysis	DOTS for 4 months	Severe Restriction
31	Badri	4458	50	M	Bhauapura village	Bhauapura Stone Mine	25	No	DOTS Completed	Normal
32	Bhawarlal	4459	40	M	Bhauapura village	Bhauapura Stone Mine	20	No	DOTS Completed	Not Done
33	Heerachand	4460	60	M	Bhauapura village	Bhauapura Stone Mine	28	No	DOTS Completed	Severe Restriction
34	Sualal	4465	50	M	Bhauapura village	Bhauapura Stone Mine	35	Hemoptysis	DOTS Completed	Severe Restriction
35	Ramful	4516	60	M	Guvreda village	Guvreda Stone Mine	30	No	DOTS Completed	Mod.Restriction
36	Ramkesh	4517	23	M	Guvreda village	Guvreda Stone Mine	6	No	DOTS Completed	Normal
37	Omprakash	4518	49	M	Guvreda village	Guvreda Stone Mine	30	No	DOTS 3 month, left	Mod.Restriction
38	Parbhati	4519	65	M	Guvreda village	Guvreda Stone Mine	35	No	DOTS 4 month	Severe Restriction
39	Kewal	4520	60	M	Guvreda village	Guvreda Stone Mine	30	No	DOTS Completed	Mild Restriction
40	Rashid	4522	45	M	Guvreda village	Guvreda Stone Mine	20	Hemoptysis	DOTS Completed	Mild Restriction
41	Sarvan	4523	65	M	Guvreda village	Guvreda Stone Mine	32	No	DOTS 4 month	Severe Restriction
42	Sumer	4524	45	M	Guvreda village	Guvreda Stone Mine	15	No	DOTS Completed	Mod.Restriction
43	Parvatsingh	4556	58	M	Kasara village	Kasara Stone Mine	7	Hemoptysis	DOTS Completed	Severe Restriction
44	Pritam	4557	50	M	Kasara village	Kasara Stone Mine	12	Hemoptysis	DOTS Completed	Mod.Restriction
45	Virju	4558	52	M	Kasara village	Kasara Stone Mine	20	No	DOTS Completed	Severe Restriction
46	Babu	4559	48	M	Kasara village	Kasara Stone Mine	30	No	----	Mod.Restriction
47	Vaid	4560	45	M	Kasara village	Kasara Stone Mine	11	No	DOTS 5 months	Mild Restriction
48	Gordhan	4561	40	M	Kasara village	Kasara Stone Mine	12	No	DOTS Completed	Mod.Restriction
49	Amarsingh	4631	36	M	Sorya village	Sorya Stone Mine	12	No	----	Severe Restriction
50	Swaroop	4632	45	M	Sorya village	Sorya Stone Mine	19	No	DOTS Completed	Not Done
51	Ramesh	4633	45	M	Daluapura village	Daluapura stone Mine	14	No	DOTS Completed	Not Done

52	Sitaram	4634	52	M	Daluapura village	Daluapura stone Mine	30	No	----	Not Done
53	Shivnarayan	4635	52	M	Sorya village	Sorya Stone Mine	20	No	DOTS Completed	Not Done
54	Roshan	4636	55	M	Sorya village	Sorya Stone Mine	20	No	DOTS Completed	Not Done
55	Mangilal	4637	45	M	Daluapura village	Daluapura stone Mine	18	No	DOTS Completed	Not Done
56	Prakash	4638	35	M	Daluapura village	Daluapura stone Mine	12	No	DOTS Completed	Not Done
57	Ramgilas	4639	32	M	Daluapura village	Daluapura stone Mine	8	No	DOTS Completed	Severe Restriction
58	Gopal	4640	48	M	Daluapura village	Daluapura stone Mine	12	No	DOTS Completed	Mod.Restriction
59	Amarlal	4641	34	M	Sorya village	Sorya Stone Mine	8	No	----	Not Done
60	Ramphal	4642	39	M	Kosra village	Kosra Stone Mine	14	No	DOTS Completed	Mild Restriction
61	Puran	4645	50	M	Kosra village	Kosra Stone Mine	25	No	DOTS Completed	Severe Restriction
62	Moharsingh	4646	36	M	Kosra village	Kosra Stone Mine	8	No	DOTS Completed	Severe Restriction
63	Hansram	4647	35	M	Kosra village	Kosra Stone Mine	10	No	DOTS 3 months	Not Done
64	Shyamlal	4648	40	M	Sorya village	Sorya Stone Mine	17	No	DOTS Completed	Mod.Restriction
65	Budhu	4649	60	M	Kosra village	Kosra Stone Mine	12	No	DOTS 3 months	Severe Restriction
66	Bharosi	4650	52	M	Kosra village	Kosra Stone Mine	20	No	DOTS Completed	Severe Restriction
67	Ramgilas	4651	36	M	Kosra village	Kosra Stone Mine	15	No	DOTS Completed	Severe Restriction
68	Nekram	4654	49	M	Kosra village	Kosra Stone Mine	12	No	DOTS Completed	Mod.Restriction
69	Ramjilal	4872	55	M	Ratiyapura village	Ratiyapura Stone Mine	25	No	DOTS Completed	Severe Restriction
70	Ummed	4873	45	M	Ratiyapura village	Ratiyapura Stone Mine	25	No	DOTS Completed	Severe Restriction
71	Veersingh	4874	29	M	Ratiyapura village	Ratiyapura Stone Mine	8	No	DOTS Completed	Mild Restriction
72	Haricharan	4875	43	M	Ratiyapura village	Ratiyapura Stone Mine	17	No	----	Mild Restriction
73	Ramraj	4876	49	M	Ratiyapura village	Ratiyapura Stone Mine	23	No	DOTS Completed	Severe Restriction
74	Kesuli	4877	49	F	Ratiyapura village	Ratiyapura Stone Mine	0	No	----	Normal

75	Kewal	4878	55	M	Ratiyapura village	Ratiyapura Stone Mine	30	No	DOTS Completed	Severe Restriction
76	Manrup	4879	58	M	Ratiyapura village	Ratiyapura Stone Mine	32	No	DOTS Completed	Mild Restriction
77	Savitri	4880	40	F	Ratiyapura village	Ratiyapura Stone Mine	0	No	----	Mild Restriction
78	Ramkhiladi	4904	52	M	Sankda village	Sankda Stone Mine	16	No	----	Severe Restriction
79	Thandi	4905	34	M	Sankda village	Sankda Stone Mine	15	No	DOTS 2 months	Severe Restriction
80	Kishanlal	4906	54	M	Sankda village	Sankda Stone Mine	25	No	----	Severe Restriction
81	Subhaisingh	4907	48	M	Arampura village	Arampura Stone Mine	15	No	----	Severe Restriction
82	Somle	4908	39	M	Sankda village	Sankda Stone Mine	20	No	----	Severe Restriction
83	Badri	4909	50	M	Arampura village	Arampura Stone Mine	20	No	DOTS Completed	Severe Restriction
84	Bharatbai	4910	40	F	Arampura village	Arampura Stone Mine	3	No	DOTS Completed	Severe Restriction
85	Shreebai	4911	45	F	Arampura village	Arampura Stone Mine	3	No	DOTS Completed	Severe Restriction
86	Ramjilal	4912	55	M	Sankda village	Sankda Stone Mine	18	No	DOTS Completed	Normal
87	Vasanti	4998	50	F	Machet village	Machet Stone Mine	0	No	----	Not Done
88	Chunni	4999	55	M	Machet village	Machet Stone Mine	30	No	DOTS Completed	Not Done
89	Mohanlal	5000	45	M	Machet village	Machet Stone Mine	24	No	DOTS Completed	Severe Restriction
90	Suganlal	5001	48	M	Machet village	Machet Stone Mine	25	No	DOTS Completed	Not Done
91	Rishpal	5010	32	M	Vichpuri village	Vichpuri Stone Mine	15	No	----	Not Done
92	Ramswaroop Panna	5011	50	M	Vichpuri village	Vichpuri Stone Mine	32	No	----	Mild Restriction
93	Ramswaroop Gulab	5012	45	M	Vichpuri village	Vichpuri Stone Mine	20	No	DOTS 3 month	Severe Restriction
94	Harisingh	5013	48	M	Vichpuri village	Vichpuri Stone Mine	30	No	DOTS Completed	Mild Restriction
95	Gopal	5014	38	M	Vichpuri village	Vichpuri Stone Mine	22	No	----	Mod.Restriction
96	Bhairolal	5015	30	M	Vichpuri village	Vichpuri Stone Mine	14	No	----	Mild Restriction
97	Kiranbai	5016	40	F	Vichpuri village	Vichpuri Stone Mine	0	No	----	Severe Restriction
98	Dhanbai	5017	40	F	Vichpuri village	Vichpuri Stone Mine	0	No	----	Severe Restriction
99	Ghanshyam	5018	47	M	Vichpuri village	Vichpuri Stone Mine	25	No	----	Severe Restriction
100	Ramswaroop	5028	55	M	Ratiyapura village	Ratiyapura Stone Mine	32	No	DOTS Completed	Mild Restriction
101	Buddhi	5029	50	M	Machet village	Machet Stone Mine	28	No	DOTS Completed	Severe Restriction

Annexure - 2

Sr. No.	Name	X-ray No.	Age	Sex	Name of Mine	No. of yrs. Worked in mine	X-ray Findings					
							Quality	Small Opacity		Large Opacity	Other Abnormality	Comments
								Shape & Size	Profusion			
1	Dayaram	4302	50	M	Vinega Stone Mine	30	3	r/q	2/2	---	tb	Siliosis with TB
2	Rameshwar	4303	35	M	Vinega Stone Mine	12	3	---	0/0	---	---	Normal
3	Vasudeo	4304	32	M	Vinega Stone Mine	14	2	---	0/0	---	---	Normal
4	Pannoo	4305	48	M	Vinega Stone Mine	25	3	r/r	3/+	---	---	Silicosis
5	Mawasi	4306	43	M	Vinega Stone Mine	25	3	---	0/0	---	---	Bilateral TB
6	Kunjlal	4307	40	M	Vinega Stone Mine	27	3	---	0/0	---	---	Tuberculosis Rt upper zone
7	Amarbai	4308	38	F	Vinega Stone Mine	0	3	---	0/0	---	---	Normal
8	Meethalal	4317	34	M	Guvreda Stone Mine	18	3	q/q	1/0	---	---	? Silicosis with TB
9	Bharosi	4335	26	M	Manchi Stone Mine	20	3	r/r	1/1	C	---	Silicosis ? PMF
10	Amarlal	4336	46	M	Manchi Stone Mine	9	2	---	0/0	---	tb	Old Healed TB
11	Shivcharan	4337	40	M	Manchi Stone Mine	18	3	p/q	2/1	---	---	Silicosis
12	Pappu	4338	55	M	Manchi Stone Mine	40	3	q/q	2/2	---	cv tb	Silico-tuberculosis
13	Mulchand	4339	75	M	Manchi Stone Mine	20	3	r/r	1/1	C	bu di em	PMF with gross distortion of lung structure
14	Vishan	4340	65	M	Manchi Stone Mine	40	3	r/r	3/3	B	ax bu cn em	Silicosis with PMF
15	Virju	4342	35	M	Manchi Stone Mine	15	3	r/r	1/1	---	---	Silicosis with TB
16	Jagan	4343	54	M	Virvas Stone Mine	23	3	r/r	2/2	---	ax tb	Silicosis with TB
17	Rambabu	4344	32	M	Manchi Stone Mine	13	1	---	0/0	---	---	Normal
18	Bhavarsingh	4345	32	M	Manchi Stone Mine	8	3	---	0/0	---	---	Normal
19	Radhey	4346	45	M	Vinega Stone Mine	25	3	r/r	3/3	---	---	Silicosis
20	Bhurilal	4347	43	M	Vinega Stone Mine	23	3	p/p	1/0	---	tb	Suspected silicosis
21	Kamal	4403	50	M	Kote Stone Mine	25	3	---	0/0	---	tb	Old Healed TB
22	Kalyan	4404	45	M	Chabar Stone Mine	30	3	p/q	1/0	---	---	Suspected silicosis
23	Gyarsiya	4405	55	M	Kote Stone Mine	35	3	r/r	3/+	B	ax bu cn di	Silicosis with PMF
24	Babu	4406	45	M	Chabar Stone Mine	25	3	r/r	2/2	---	---	Silicosis

25	Kedarbai	4407	40	F	Chabar Stone Mine	0	1	---	0/0	---	---	Normal
26	Babu	4408	42	M	Kote Stone Mine	28	3	p/q	1/1	---	---	Silicosis
27	Bharosi	4409	70	M	Kote Stone Mine	40	3	r/r	1/1	C	di em	Silicosis with PMF
28	Sarpoo	4421	59	M	Guvreda Stone Mine	35	3	r/r	2/2	C	bu di em es	Silicosis with PMF
29	Harilal	4456	32	M	Kote Stone Mine	17	3	q/p	2/2	---	---	Silicosis
30	Jagdish	4457	55	M	Mahuakheda Stone Mine	15	3	---	0/0	---	em	Bilateral TB
31	Badri	4458	50	M	Bhauapura Stone Mine	25	2	q/q	2/1	---	---	Silicosis
32	Bhawarlal	4459	40	M	Bhauapura Stone Mine	20	3	r/r	3/3	B	ax cn tb	Silicosis with PMF
33	Heerachand	4460	60	M	Bhauapura Stone Mine	28	3	r/r	3/+	---	ax	Silicosis
34	Sualal	4465	50	M	Bhauapura Stone Mine	35	2	r/r	2/3	---	---	Silicosis
35	Ramful	4516	60	M	Guvreda Stone Mine	30	3	r/r	2/2	---	---	Silicosis
36	Ramkesh	4517	23	M	Guvreda Stone Mine	6	3	---	0/0	---	---	Normal
37	Omprakash	4518	49	M	Guvreda Stone Mine	30	3	q/q	2/1	---	ax hi	Silicosis
38	Parbhati	4519	65	M	Guvreda Stone Mine	35	1	r/r	3/3	---	ax bu cn di em	Silicosis
39	Kewal	4520	60	M	Guvreda Stone Mine	30	3	r/r	2/1	---	tb	Silicosis with Old Healed TB
40	Rashid	4522	45	M	Guvreda Stone Mine	20	3	q/q	1/1	---	es od	Silicosis with haziness Lt upper zone ? Pneumonia
41	Sarvan	4523	65	M	Guvreda Stone Mine	32	3	r/r	3/3	---	es tb	Silico-tuberculosis
42	Sumer	4524	45	M	Guvreda Stone Mine	15	3	q/q	1/0	---	tb	Suspected silicosis with TB
43	Parvatsingh	4556	58	M	Kasara Stone Mine	7	3	p/p	2/2	---	---	Silicosis
44	Pritam	4557	50	M	Kasara Stone Mine	12	3	---	0/0	---	---	Normal
45	Virju	4558	52	M	Kasara Stone Mine	20	1	r/q	3/3	---	ax cn	Silicosis
46	Babu	4559	48	M	Kasara Stone Mine	30	3	r/r	3/+	A	ax	Silicosis with PMF
47	Vaid	4560	45	M	Kasara Stone Mine	11	2	q/p	1/0	---	---	Suspected silicosis
48	Gordhan	4561	40	M	Kasara Stone Mine	12	1	---	0/0	---	---	Normal
49	Amarsingh	4631	36	M	Sorya Stone Mine	12	3	r/r	2/1	---	tb	Silico-tuberculosis
50	Swaroop	4632	45	M	Sorya Stone Mine	19	3	r/r	3/3	---	ax	Silicosis

51	Ramesh	4633	45	M	Daluapura stone Mine	14	3	r/r	2/2	---	ax tb	Silico-tuberculosis with pleural thickening Lt. side
52	Sitaram	4634	52	M	Daluapura stone Mine	30	3	r/r	3/2	---	ax bu tb	Silico-tuberculosis
53	Shivnarayan	4635	52	M	Sorya Stone Mine	20	3	p/q	2/3	---	---	Silicosis
54	Roshan	4636	55	M	Sorya Stone Mine	20	1	r/r	2/3	C	ax	Silicosis with PMF
55	Mangilal	4637	45	M	Daluapura stone Mine	18	3	r/r	3/3	---	ax	Silicosis
56	Prakash	4638	35	M	Daluapura stone Mine	12	2	r/r	2/2	---	tb	Silicosis with Old Healed TB
57	Ramgilas	4639	32	M	Daluapura stone Mine	8	3	---	0/0	---	tb	Tuberculosis
58	Gopal	4640	48	M	Daluapura stone Mine	12	2	r/r	2/2	---	ax di tb	Silico-tuberculosis
59	Amarlal	4641	34	M	Sorya Stone Mine	8	2	r/q	2/2	---	tb	Silicosis with tuberculosis
60	Ramphal	4642	39	M	Kosra Stone Mine	14	3	---	0/0	---	---	Normal
61	Puran	4645	50	M	Kosra Stone Mine	25	3	p/q	1/0	---	tb	Suspected silicosis with TB
62	Moharsingh	4646	36	M	Kosra Stone Mine	8	3	r/r	2/2	---	ax	Silicosis
63	Hansram	4647	35	M	Kosra Stone Mine	10	2	r/r	2/2	---	tb	Silicosis with tuberculosis
64	Shyamlal	4648	40	M	Sorya Stone Mine	17	3	r/r	1/1	---	---	Silicosis
65	Budhu	4649	60	M	Kosra Stone Mine	12	3	r/r	3/3	---	ax	Silicosis
66	Bharosi	4650	52	M	Kosra Stone Mine	20	3	r/r	3/3	---	ax	Silicosis
67	Ramgilas	4651	36	M	Kosra Stone Mine	15	3	r/r	3/3	C	---	Silicosis with PMF
68	Nekram	4654	49	M	Kosra Stone Mine	12	2	q/q	1/0	---	tb	Suspected silicosis
69	Ramjilal	4872	55	M	Ratiyapura Stone Mine	25	3	r/r	1/1	B	di	Silicosis with PMF
70	Ummed	4873	45	M	Ratiyapura Stone Mine	25	3	q/q	2/1	---	tb	Silicosis with tuberculosis
71	Veersingh	4874	29	M	Ratiyapura Stone Mine	8	3	r/r	3/2	---	---	Silicosis with haziness Rt upper zone ? Consolidation

72	Haricharan	4875	43	M	Ratiyapura Stone Mine	17	2	q/r	1/1	---	---	Silicosis
73	Ramraj	4876	49	M	Ratiyapura Stone Mine	23	3	r/r	2/3	---	ax di em tb	Silicosis with tuberculosis
74	Kesuli	4877	49	F	Ratiyapura Stone Mine	0	3	---	0/0	---	---	Normal
75	Kewal	4878	55	M	Ratiyapura Stone Mine	30	3	r/r	3/+	---	ax di id ih	Silicosis
76	Manrup	4879	58	M	Ratiyapura Stone Mine	32	3	r/r	3/2	---	ax	Silicosis, pleural thickening Rt. Side
77	Savitri	4880	40	F	Ratiyapura Stone Mine	0	3	---	0/0	---	---	Normal
78	Ramkhiladi	4904	52	M	Sankda Stone Mine	16	3	r/r	3/3	B	ax di	Silicosis with PMF
79	Thandi	4905	34	M	Sankda Stone Mine	15	3	r/r	3/+	---	ax	Silicosis
80	Kishanlal	4906	54	M	Sankda Stone Mine	25	3	p/q	2/1	B	---	Silicosis with PMF
81	Subhaisingh	4907	48	M	Arampura Stone	15	3	p/p	1/0	---	hi	Suspected silicosis
82	Somle	4908	39	M	Sankda Stone Mine	20	3	r/r	3/2	C	ax di em	Silicosis with PMF
83	Badri	4909	50	M	Arampura Stone Mine	20	3	r/r	3/+	---	ax di	Silicosis
84	Bharatbai	4910	40	F	Arampura Stone Mine	3	3	r/r	1/0	---	hi es	Suspected silicosis
85	Shreebai	4911	45	F	Arampura Stone Mine	3	2	r/r	1/1	B	ax	Silicosis with PMF
86	Ramjilal	4912	55	M	Sankda Stone Mine	18	3	---	0/0	---	---	Normal
87	Vasanti	4998	50	F	Machet Stone Mine	0	3	---	0/0	---	---	Normal
88	Chunni	4999	55	M	Machet Stone Mine	30	3	r/r	2/2	C	ax di em	Silicosis with PMF
89	Mohanlal	5000	45	M	Machet Stone Mine	24	4	---	---	---	---	Repeat X-ray
90	Suganlal	5001	48	M	Machet Stone Mine	25	3	---	0/0	---	---	Normal
91	Rishpal	5010	32	M	Vichpuri Stone Mine	15	3	---	0/0	---	---	Normal
92	Ramswaroop Panna	5011	50	M	Vichpuri Stone Mine	32	3	q/p	2/1	---	---	Silicosis
93	Ramswaroop Gulab	5012	45	M	Vichpuri Stone Mine	20	3	---	0/0	---	---	Normal
94	Harisingh	5013	48	M	Vichpuri Stone Mine	30	3	r/r	3/3	---	ax	Silicosis
95	Gopal	5014	38	M	Vichpuri Stone Mine	22	3	r/r	2/3	---	ax	Silicosis

96	Bhairolal	5015	30	M	Vichpuri Stone Mine	14	2	---	0/0	---	tb	Tuberculosis
97	Kiranbai	5016	40	F	Vichpuri Stone Mine	0	2	---	0/0	---	---	Normal
98	Dhanbai	5017	40	F	Vichpuri Stone Mine	0	4	---	---	---	---	Repeat X-ray
99	Ghanshyam	5018	47	M	Vichpuri Stone Mine	25	3	---	0/0	---	bu di tb	Tuberculosis
100	Ramswaroop	5028	55	M	Ratiyapura Stone Mine	32	3	q/r	1/2	---	es tb	Silicosis with tuberculosis
101	Buddhi	5029	50	M	Machet Stone Mine	28	3	r/r	2/3	---	tb	Silicosis with tuberculosis

0/1 ----- **May be Treated Normal**

1/0 ----- **Suspected Silicosis**

1/1 and Above --- Silicosis

UR - Unacceptable for classification purposes

Symbols:

ax-coalescence of small opacities
bu-bulla (e)
cn-calcification in small pneumoconiotic opacities
cv-cavity
di-marked distortion of an intrathoracic structure
em-emphysema
es-eggshell calcification of hilar or mediastinal lymph nc
hi-- enlargement of non calcified hilar or mediastinal lymph nodes
id--- ill-defined diaphragm border
ih--- ill-defined heart border
tb- Pulmonary Kochs
od--- other disease or other significant abnormality