

SILICO-TUBERCULOSIS:

A research study on prevalence and prevention of silico-tuberculosis in stone mines 2020.

Conducted by -

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FOREWORD

Historically, the trade of mining has been severely impacted by occupational health hazards. In many parts of the world, mines of various minerals have boosted industrial growth and have generated large revenues and employment opportunities. Consequently, millions around the world have earned their bread by working in the mines and have supported their families. Ironically, the standards of health safety in a lot of mines have remained an issue of great concern presenting potential threats to mineworkers. While change has taken place towards improvements in many regions, it has certainly been inadequate.

In the stone mines of Odisha, State of India, prevalence rates of silicosis and tuberculosis are high among mine workers. Due to consistent inhalation of silica over a long period of time and due to increased vulnerability towards mycobacterium tuberculosis as a result of poor nourishment, many, a large number of mineworkers suffer with either silicosis or tuberculosis, or with both.

The combination of these two diseases, one of inflammatory in nature and infectious by origin, one irreversible and incurable and one curable, is a fatal condition causing high morbidity and mortality.

JRP, as an organization working at the grass-roots, has always stood up for the development of mining community. Among many initiatives that JRP has taken up for mineworkers, delivery of healthcare and advocating for occupational health safety have been of significant importance for our work. This study is an attempt to understand various aspects of silico-tuberculosis looking into both history and future. The overall goal of the study is to prepare working in mines and people working with mineworkers to combat with this deadly threat.

The study has taken up a comprehensive approach by studying existing literature, reviewing ground realities, organizing extensive medical tests and taking expert opinion

PREFACE

While extraordinary research work is going on in various parts of the world, which includes medical field also & luxurious facilities are being created for diagnosis & treatment of various minor & major health problems, millions of children are becoming orphans just because of father & mother are not protected against deadly but preventable disease—silicosis. On top of that when this disease gets company of tuberculosis, death comes uninvited when the children are in greater need of father (and mother.) The irony is, father has no choice but to die of hunger on one side or die of silico-tuberculosis on other side while working in mines. Disease is an unavoidable choice because, hunger will kill in few days & disease will kill in few years. Taking advantage of this helpless situation, owners of mines & ignorance coupled with inhuman behavior & apathy of government officials, a large number of workers are suffering from multiplicative effect of silicosis & tuberculosis.

JRP, a development organization, is working for mine workers issues for more than last 15 years. Out of experience & concern for mine workers & their family members, the organization has decided to prepare some preliminary report to base revolutionary actions for prevention of not only silico-tuberculosis but also reduce the sufferings of mine works & their family members. As a result of this I had accepted an opportunity given by GRAVIS to document the problem of silico-tuberculosis & set the ball rolling for concrete actions for prevention of this deadly combination of the evils.

The report narrates problems, situation & factors creating the problems & suggested solutions & strategy for solving the same.

1. BACKGROUND

Health hazard of Silicosis has been a major health setback of the working class people who are working for their livelihood in the Factories, Mines & Quarries, Stone Crushers & Cutting and other setups.

The 'right to life' as mentioned under Article 21 of the "Constitution of India" signifies not merely living or the physical act of breathing. It has a much more profound meaning that signifies the: Right to live with human dignity; Right to livelihood; Right to health; Right to pollution free air; and Right to live a quality life and anything and everything that fulfills the criteria for a dignified life, but however India being a welfare state till date the state machinery has failed to implement the true sense of Article 21 of the Constitution of India, and one such bright example is the health hazard of Silicosis for the working class people. For more than one hundred years, silica dust has been linked to higher TB prevalence rates among workers in dusty occupations. Multiple studies from India and abroad have demonstrated that silica-dust exposures among miners, building and construction, stone cutting/crushers, pottery, steel and allied factory, ceramic, thermal power and other workers increases the risk of active TB by three to four times. The combination of silicosis and HIV further increases the risk of acquiring active TB by 15 times.

We note that the National Strategic Plan does acknowledge the risk to mine and stone crusher workers as priorities for active case finding, but it fails to mention other silica-exposed workers and it does not provide any road map for preventing TB among this vulnerable population. The five prioritized risk groups listed (page 66) mention silicosis patients, but not silica-exposed workers. In addition, we know that informal sector workers tend to have higher silica dust exposures and less access to medical services and therefore this subpopulation should be given greater attention.

The recent UN General Assembly Declaration from the High-level Meeting on TB requires countries to commit to “implementing primary prevention in high-risk occupations by reducing silica dust exposures in mining, construction and other dusty workplaces.” Efforts to target vulnerable workers and communities should incorporate training with strategies to implement silica-dust control measures.

Published studies have demonstrated that the adoption of low-cost wet processing methods in India can reduce respirable silica dust among highly-exposed workers by 80% in these operations. Studies conducted among miners and quarry workers have shown that reducing silica dust can significantly reduce TB incidence. In acknowledging these risks, other national TB programmes have adopted policies calling for increased regulation to improve workplace dust controls.

There are more than 2345 Stone mines in Odisha, which provides essential support to livelihood generation. Thousands of mines employ a large number of people especially tribal with overall estimate for the state exceeding 2 million people. Mineworkers in these mines work in unsafe conditions, are unpaid and undernourished, and suffer with various health problems.

Silicosis and tuberculosis are two commonly found respiratory diseases that mineworkers suffer with. Silicosis is a dust-borne disease that causes irreversible and fatal changes to the lung tissue. Tuberculosis is infectious and caused by mycobacterium tuberculosis. Both silicosis and tuberculosis are potentially life threatening diseases. While TB can be treated completely with adequate medication, silicosis can only be provided palliative support. Mineworkers suffering with either of these diseases, have a great risk of developing the other disease. Co-existence of silicosis and tuberculosis is known as silico-tuberculosis, prevalence of which is high in stone mines of Odisha. Silico-tuberculosis over the years has affected mining community profoundly causing significant social and economic loss.

2. AIMS AND OBJECTIVES OF THE STUDY

The proposed research study aimed on studying the prevalence of silico-tuberculosis and understand its genesis with following specific objectives:

1. Study the prevalence of silico-tuberculosis among mineworkers of Odisha.
2. Understand the genesis of the disease and analyze precipitating, underlying factors
3. Study health safety arrangements and existing health services and underline gaps causing occupational health problems and their complications
4. Review of literature about situational analysis of the national, regional and global levels and draw lessons from other areas
5. Suggest remedial measures to reduce the incidence and prevalence of the disease
6. Analyze public health perspectives of silico-tuberculosis and initiate the process of comprehensive prevention of silico-tuberculosis

As an overall outcome, the study aimed at the following:

1. Increased awareness of the disease among mineworkers, mine owners, healthcare providers, government authorities and development agencies
2. Health safety measures to be practiced in stone mines.
3. Enhanced capacities of healthcare providers in detecting (Suspecting & investigating) the disease and supporting the patients.
4. Incidence and prevalence of silico-tuberculosis reduced

3. METHODOLOGY OF THE STUDY

Population sampling

Study area included 02 districts of Odisha in general namely Khurda, Jajpur, and stone mines situated in vicinity of Bhubaneswar city in particular. All mine workers of these mines were considered as the sample population. This includes retired mine workers also. Here usually the word “retired” means worker had to stop working because of illness or incapacity to work. Due to inbuilt resistance of mine owners & pressing need of workers to work, it will not possible to take systematic random sample from a ready sampling frame. Also there is no list of all workers available as, often, it is rotating short term work assignments in particular mines. It is estimated that around 20000 workers are working in mines in study area. Therefore it was decided to go ahead with self-selected sample of mine workers who responded to an appeal for health check up at the various mines and/or at the residential habitats by workers of JRP. However it was decided to include all major areas where mines are located. Following mining areas were visited for the study:

Bhubaneswar (Khurda) and Jajpur (Chandikhole).

There are all chances that either cooperative workers came forward or workers who felt need of check up came forward. Overall, 250 mine workers interviewed by paramedical workers & 100 mine workers underwent medical check-up. As this is not strictly representative population based study of mine workers, word prevalence was difficult to use in its strict scientific meaning, however as there was no systemic bias with its due limitation in this study we used the term prevalence of various morbidity among the population of the workers who undergone the study.

Study design

It was a cross sectional study without any specific intervention or control groups.

Duration - The study was conducted between December 2019 and April 2020 and could not be continued due to COVID-19. The main data collection for medical check-up was done in months of February 2020. Data- entry, data analysis & report writing was carried out in rest of the period. Review of literature was carried out thorough out the study period.

The team

The total 4 young paramedical staff were divided into 2 teams as per the area covered. It was planned in such a way that each study subject (mine worker) at least got optimum time required for interview or health check-up as per the respective tool. Although the doctor, medical students and paramedical staff - all are well trained, they were oriented by the community health expert, special additional training was also given for respiratory function test to two persons. One of that person was from local who understands local language & had postgraduate qualification and other person were having medical background with more than 02 years experience.



Tools -

Detailed tools will be developed and will be pretested. Study includes five major components as under. **Interview of mine workers by paramedics** - Details of symptoms & allied conditions of at least 250 mine workers.

(I) Medical check-up by doctor with help of medical students- Medical check-up of 250 mine workers.

(II) Field visit to mines and interview with various categories of key informants by principal investigator with team members of JRP.

(III) Case study writing & informal discussion with mine workers and mine owners

The tools will be developed by discussion with respective team members. Tool will be pretested by staff involved and it will be used after due modification. In addition to examination at site, as per the necessity, patients will be advised referral to nearby govt. or charitable health care facility. Appropriate advice for follow up will be given. Patients will be also advised for necessary investigations, but it will not be possible to collect and incorporate additional findings in analysis.

Data-Analysis

The data collected will be in excel and data will be verified in minimum 10% subjects in tool II. For diagnosis, judgment will be taken based on the symptoms and clinical signs and mainly it will be classified according to the system affected when it will be not the focus of study. For respiratory diseases, help of X-ray findings, sputum for AFB and other investigations will be used if already patient has report of the same. Support of respiratory function test will be taken as additional tool for judgment. Case papers will be also used for past history, when available, particularly for Tuberculosis.

Tools used :

As a proceeding to history and clinical examination, it is recommended that a CBC (complete blood count with ESR levels), sputum smear microscopy and sputum culture (induced sputum culture, if necessary, since it has good sensitivity) be performed, as well as chest X-ray⁽³³⁾ Interpretation of the Chest X ray film of the silicosis is difficult. High degree of suspicion is based on:

- Radiographic abnormalities in the apical area of either lung
- Poorly demarcated infiltrates of variable size that do not cross the lung fissures
- Rapidly developing soft nodulation
- Conglomerate massive shadowing
- Opacities may surround pre-existing silicotic nodules
- Presence of a cavity in a nodule
- High TLC count and ESR count

- Sputum Positive for Acid Fast Bacilli on ZN Staining
- CBNAAT (Cartridge based Nucleic Acid Amplification Test) positive for Mycobacterium Tuberculosis.

Additional findings

- Rapid changes in the radiographic picture
- Development of pericardial or pleural effusion
- Bronchial stenosis especially right middle lobe

Selection of patients for treatment

- History of exposure to silica.
- X-ray film suggestive of actual silico-tuberculosis.
- Serial x-ray film evidence of progression of disease.
- Other evidence of sign symptoms, such as hemoptysis, pleural effusion, or fever, elevated sedimentation rate
- Silico-tuberculosis affects not only the parenchyma but also the arteries and the veins.
- There is a thickening of the intima, hyaline and lipid degenerations, scars in the vessels, impeding the blood circulation.
- Moreover, tuberculous cavities often occur inside silicotic nodes, which can hardly be reached by chemotherapeutic drugs.
- Fibrotic scars can prevent the collapse and scarification of a cavities
- HRCT has been established in patients with silico-tuberculosis
- Prolongation of the continuation phase from 4 to 6 months decreased the rate of relapse from 22 to 7%. ⁽³⁸⁾
- Presently, a closely supervised eight to nine months treatment is recommended.

OBSERVATIONS AND FINDINGS –

As discussed in the methodology section, a team of medical doctors, para-medics and field workers carried out an extensive medical and socio-economic survey of 250 mineworkers. This section will summarize the findings of the survey and will give a picture of mineworkers' health and prevalence of silico-tuberculosis

Analysis of information collected with help of Tool I from 250 mine workers

- 1. Age analysis** - clearly shows that 40 % of mine workers were between the age of 20 to 30 years and hardly around 24% were above 50 years of age.

age group	Frequency	Percent
<=17	34	13.6
18-20	26	10.4
21-30	100	40
31-40	56	22.4
41-50	24	9.6
51-60	60	24
Total	250	

- 2. Education Status** – shows that 95.6 % were illiterate and a minimal percentage of 3.2% were educated till 10th Grade.

Education	Male (No and %)	Female (No and %)	Total (No and %)
12 th Grade	01	00	01%
11-12 th Grade	02	00	0.8%
8-10 th Grade	04	04	3.2%
Elementary	00	00	0%
Literate	00	00	0%
Illiterate	190	49	95.6%
Total	197	53	
%	78.8	21.2	

- 3. Working Years ; Duration of Job** – maximum number of workers are working since a duration of 6 to 10 year followed by the other category where they have been working since 2 to 5 years.

Working Since year	Male	Female	Total
1	12	06	08
2 to 5	30	35	65
6 to 10	78	55	133
11 to 20	25	13	38
21 to 40	03	03	06
Total	148	112	250
%	59.2 %	44.8 %	100 %

- 4. Symptomatic presentations** – extensive history taking and systemic examination of all the stone crusher workers helped us in finding out that 26% of them had cough, 25.6 % had weakness and 15.6 % had breathlessness which are classical features of various respiratory illness including tuberculosis and silicosis.

Symptoms	number	percent out of 250
Breathlessness	39	15.6%
chest pain	04	1.6%
Cough	65	26%
Fever	20	8%
Giddiness	12	4.8%
Headache	35	14%
loss of appetite	11	4.4%
Weakness	64	25.6%
Total		

5. Special Laboratory Investigations - Out of the 250 examined workers, 100 of them were selected depending on the positive history, positive clinical features and local as well as systemic examination. The findings are summarized after the tabulation which follows :

NAME	AGE-SEX	CBC WITH ESR (Relevant positive findings)	SPUTUM AFB	CHEST X-RAY PA VIEW	X-RAY KNEE JOINT AND C-SPINE	CBNAAT
	18/M	Normocytic normochromic anemia	NEGATIVE	Normal X-Ray	Normal X-Ray	Negative
	38/M	Macrocytic Anemia	NEGATIVE	Normal X-Ray	Normal X-Ray	Negative
	45/M	Macrocytic Anemia	NEGATIVE	Normal X-Ray	Cervical vertebra stenosis at level of C4-C5	Negative
	19/M	Normal CBC	NEGATIVE	Normal X-Ray	Normal X-Ray	Negative
	51/M	Moderate leukocytosis with Raised ESR	POSITIVE	Upper zone consolidation	Normal X-Ray	Positive and sensitive to HRZE
	37/F	Macrocytic Anemia	NEGATIVE	Normal X-Ray	Normal X-Ray	Negative
	31/M	Normal CBC	NEGATIVE	Normal X-Ray	Normal X-Ray	Negative
	40/M	Moderate leukocytosis with Raised ESR	POSITIVE	Upper zone consolidation	Normal X-Ray	Positive and sensitive to HRZE
	52/F	Macrocytic Anemia	NEGATIVE	Normal X-Ray	Normal X-Ray	Negative
	16/M	Microcytic Hypochromic Anemia	NEGATIVE	Normal X-Ray	Normal X-Ray	Negative
	55/M	Macrocytic Anemia	NEGATIVE	Normal X-Ray	Normal X-Ray	Negative
	17/M	Microcytic Hypochromic Anemia	NEGATIVE	Normal X-Ray	Cervical vertebra stenosis at level of C4-C5	Negative
	55/M	Macrocytic Anemia	NEGATIVE	Normal X-Ray	Normal X-Ray	Negative
	58/F	Normocytic normochromic anemia	NEGATIVE	Multiple patchy consolidations and ground glass opacities in middle and lower zone.	Normal X-Ray	Negative
	20/M	Normal CBC	NEGATIVE	Normal X-Ray	Normal X-Ray	Negative
	52/M	Macrocytic Anemia	NEGATIVE	Normal X-Ray	Normal X-Ray	Negative
	17/M	Raised ESR with Mild Leukocytosis	POSITIVE	Upper zone consolidation	Normal X-Ray	Positive and sensitive to HRZE
	40/M	Normal CBC	NEGATIVE	Normal X-Ray	Normal X-Ray	Negative
	38/F	Normal CBC	NEGATIVE	Normal X-Ray	Normal X-Ray	Negative
	17/M	Macrocytic Anemia	NEGATIVE	Normal X-Ray	Normal X-Ray	Negative
	23/F	Normal CBC	NEGATIVE	Normal X-Ray	Normal X-Ray	Negative
	15/F	Microcytic Hypochromic Anemia	NEGATIVE	Normal X-Ray	Normal X-Ray	Negative
	28/F	Microcytic Hypochromic Anemia	NEGATIVE	Normal X-Ray	Normal X-Ray	Negative
	26/F	Microcytic Hypochromic Anemia	NEGATIVE	Normal X-Ray	Normal X-Ray	Negative
	15/F	Microcytic Hypochromic Anemia	NEGATIVE	Normal X-Ray	Normal X-Ray	Negative
	38/M	Moderate leukocytosis with Raised ESR	POSITIVE	Upper zone consolidation	Normal X-Ray	Positive and sensitive to HRZE
	43/M	Microcytic Hypochromic Anemia	NEGATIVE	Normal X-Ray	Normal X-Ray	Negative

		Microcytic Hypochromic Anemia	NEGATIVE	Normal X-Ray	Normal X-Ray	Negative
	54/M	Normocytic normochromic anemia	NEGATIVE	Normal X-Ray	Normal X-Ray	Negative
	50/M	Microcytic Hypochromic Anemia	NEGATIVE	Normal X-Ray	Normal X-Ray	Negative
	30/M	Microcytic Hypochromic Anemia	NEGATIVE	Normal X-Ray	Normal X-Ray	Negative
	16/F	Microcytic Hypochromic Anemia	NEGATIVE	Normal X-Ray	Normal X-Ray	Negative
	15/M	Macrocytic Anemia	NEGATIVE	Normal X-Ray	Normal X-Ray	Negative
	55/M	Macrocytic Anemia	NEGATIVE	Normal X-Ray	Normal X-Ray	Negative
	52/M	Microcytic Hypochromic Anemia	NEGATIVE	Normal X-Ray	Normal X-Ray	Negative
	55/F	Moderate leukocytosis with Raised ESR	POSITIVE	Upper zone consolidation	Normal X-Ray	Positive and sensitive to HRZE
	23/M	Normocytic normochromic anemia	NEGATIVE	Normal X-Ray	Normal X-Ray	Negative
	38/M	Macrocytic Anemia	NEGATIVE	Normal X-Ray	Normal X-Ray	Negative
	17/M	Microcytic Hypochromic Anemia	NEGATIVE	Normal X-Ray	Normal X-Ray	Negative
	28/F	Microcytic Hypochromic Anemia	NEGATIVE	Normal X-Ray	Cervical vertebra stenosis at level of C4-C5	Negative
	16/F	Microcytic Hypochromic Anemia	NEGATIVE	Normal X-Ray	Normal X-Ray	Negative
	34/F	Microcytic Hypochromic Anemia	NEGATIVE	Normal X-Ray	Normal X-Ray	Negative
	37/F	Normocytic normochromic anemia	NEGATIVE	Normal X-Ray	Normal X-Ray	Negative
	44/M	Macrocytic Anemia	NEGATIVE	Normal X-Ray	Normal X-Ray	Negative
	49/M	Microcytic Hypochromic Anemia	NEGATIVE	Normal X-Ray	Normal X-Ray	Negative
	51/M	Moderate leukocytosis with Raised ESR	POSITIVE	Upper zone consolidation	Normal X-Ray	Positive and sensitive to HRZE
	55/F	Microcytic Hypochromic Anemia	NEGATIVE	Normal X-Ray	Normal X-Ray	Negative
	38/F	Microcytic Hypochromic Anemia	NEGATIVE	Normal X-Ray	Normal X-Ray	Negative
	20/M	Normocytic normochromic anemia	NEGATIVE	Normal X-Ray	Normal X-Ray	Negative
	40/M	Microcytic Hypochromic Anemia	NEGATIVE	Normal X-Ray	Normal X-Ray	Negative
	20/M	Normal CBC	NEGATIVE	Normal X-Ray	Normal X-Ray	Negative
	20/M	Moderate leukocytosis with Raised ESR	POSITIVE	Upper zone consolidation	Normal X-Ray	Positive and sensitive to HRZE
	29/F	Microcytic Hypochromic Anemia	NEGATIVE	Normal X-Ray	Normal X-Ray	Negative
	14/F	Microcytic Hypochromic Anemia	NEGATIVE	Normal X-Ray	Normal X-Ray	Negative
	20/M	Moderate leukocytosis with Raised ESR	POSITIVE	Upper zone consolidation	Normal X-Ray	Positive and

						sensitive to HRZE
	16/F	Microcytic Hypochromic Anemia	NEGATIVE	Normal X-Ray	Normal X-Ray	Negative
	50/M	Normocytic normochromic anemia	NEGATIVE	Normal X-Ray	Normal X-Ray	Negative
	29/F	Microcytic Hypochromic Anemia	NEGATIVE	Normal X-Ray	Normal X-Ray	Negative
	36/F	Microcytic Hypochromic Anemia	NEGATIVE	Normal X-Ray	Normal X-Ray	Negative
	17/M	Microcytic Hypochromic Anemia	NEGATIVE	Normal X-Ray	Cervical vertebra stenosis at level of C4-C5	Negative
	39/M	Normal CBC	NEGATIVE	Normal X-Ray	Normal X-Ray	Negative
	40/M	Moderate leukocytosis with Raised ESR	POSITIVE	Upper zone consolidation	Normal X-Ray	Positive and sensitive to HRZE
	48/M	Microcytic Hypochromic Anemia	NEGATIVE	Normal X-Ray	Normal X-Ray	Negative
	52/F	Microcytic Hypochromic Anemia	NEGATIVE	Normal X-Ray	Normal X-Ray	Negative
	28/F	Microcytic Hypochromic Anemia	NEGATIVE	Normal X-Ray	Cervical vertebra stenosis at level of C4-C5	Negative
	30/F	Microcytic Hypochromic Anemia	NEGATIVE	Normal X-Ray	Normal X-Ray	Negative
	27/M	Moderate leukocytosis with Raised ESR	POSITIVE	Upper zone consolidation	Normal X-Ray	Positive and sensitive to HRZE
	19/M	Normal CBC	NEGATIVE	Normal X-Ray	Normal X-Ray	Negative
	22/M	Normal CBC	NEGATIVE	Normal X-Ray	Normal X-Ray	Negative
	38/F	Microcytic Hypochromic Anemia	NEGATIVE	Normal X-Ray	Normal X-Ray	Negative
	25/M	Normal CBC	NEGATIVE	Normal X-Ray	Normal X-Ray	Negative
	31/M	Moderate leukocytosis with Raised ESR	POSITIVE	Upper zone consolidation	Normal X-Ray	Positive and sensitive to HRZE
	32/M	Moderate leukocytosis with Raised ESR	POSITIVE	Upper zone consolidation	Normal X-Ray	Positive and sensitive to HRZE
	23/F	Microcytic Hypochromic Anemia	NEGATIVE	Normal X-Ray	Normal X-Ray	Negative
	23/M	Microcytic Hypochromic Anemia	NEGATIVE	Normal X-Ray	Normal X-Ray	Negative
	25/F	Microcytic Hypochromic Anemia	NEGATIVE	Normal X-Ray	Normal X-Ray	Negative
	29/F	Normocytic normochromic anemia	NEGATIVE	Normal X-Ray	Normal X-Ray	Negative
	20/M	Normocytic normochromic anemia	NEGATIVE	Normal X-Ray	Normal X-Ray	Negative
	28/F	Microcytic Hypochromic Anemia	NEGATIVE	Normal X-Ray	Normal X-Ray	Negative
	30/F	Microcytic Hypochromic	NEGATIVE	Normal X-Ray	Normal X-Ray	Negative

		Anemia				
	25/F	Microcytic Hypochromic Anemia	NEGATIVE	Normal X-Ray	Cervical vertebra stenosis at level of C4-C5	Negative
	29/M	Microcytic Hypochromic Anemia	NEGATIVE	Normal X-Ray	Normal X-Ray	Negative
	34/M	Moderate leukocytosis with Raised ESR	NEGATIVE	Upper zone consolidation	Normal X-Ray	Positive and sensitive to HRZE
	33/F	Microcytic Hypochromic Anemia	NEGATIVE	Normal X-Ray	Normal X-Ray	Negative
	28/M	Microcytic Hypochromic Anemia	NEGATIVE	Normal X-Ray	Normal X-Ray	Negative
	29/F	Microcytic Hypochromic Anemia	NEGATIVE	Normal X-Ray	Normal X-Ray	Negative
	23/M	Microcytic Hypochromic Anemia	NEGATIVE	Normal X-Ray	Normal X-Ray	Negative
	40/M	Moderate leukocytosis with Raised ESR	POSITIVE	Upper zone consolidation	Normal X-Ray	Positive and sensitive to HRZE
	52/M	Microcytic Hypochromic Anemia	NEGATIVE	Normal X-Ray	Normal X-Ray	Negative
	51/M	Microcytic Hypochromic Anemia	NEGATIVE	Normal X-Ray	Normal X-Ray	Negative
	52/F	Microcytic Hypochromic Anemia	NEGATIVE	Normal X-Ray	Normal X-Ray	Negative
	30/M	Normal CBC	NEGATIVE	Normal X-Ray	Normal X-Ray	Negative
	29/M	Moderate leukocytosis with Raised ESR	NEGATIVE	Upper zone consolidation	Normal X-Ray	Positive and sensitive to HRZE
	30/M	Normocytic normochromic anemia	NEGATIVE	Normal X-Ray	Normal X-Ray	Negative
	48/M	Microcytic Hypochromic Anemia	NEGATIVE	Normal X-Ray	Normal X-Ray	Negative
	49?M	Microcytic Hypochromic Anemia	NEGATIVE	Normal X-Ray	Normal X-Ray	Negative
	22/F	Microcytic Hypochromic Anemia	NEGATIVE	Normal X-Ray	Normal X-Ray	Negative
	35/F	Microcytic Hypochromic Anemia	NEGATIVE	Normal X-Ray	Normal X-Ray	Negative
	22/F	Microcytic Hypochromic Anemia	NEGATIVE	Normal X-Ray	Normal X-Ray	Negative
	31/M	Normal CBC	NEGATIVE	Normal X-Ray	Normal X-Ray	Negative

Interpretation of Investigations :

100 stone crusher miners/workers out of 250 who were clinically symptomatic and presented with positive history were evaluated for complete blood count with ESR (erythrocyte sedimentation rate), Chest X-Ray PA view, Sputum for Acid Fast Bacilli, X-ray C-Spine, X-Ray Knee joint and CNAAT (Cartridge based Nucleic acid amplification test).

Out of the 100 miners, 50 showed microcytic hypochromic anemia with decreased MCV and Peripheral blood smear showing aniso-poikilocytosis with tear drop cells and pencil cells indicative of Iron Deficiency, 15 showing mild to moderate leukocytosis, 13 showed

normal CBC, 12 showed macrocytic anemia with increased MCV and peripheral blood smear showing macro-ovalocytes, few hyper-segmented neutrophils and polychromasia indicative of Megaloblastic anemia/ Vit B-12 or folate deficiency, 15 showed upper zone and middle zone patchy consolidations with all of those 15 showing positivity for CBNAAT sensitive for multi-drug (HRZE – isoniazid, rifampicin, pyrazinamide and ethambutol) and 13 showing positivity for sputum AFB, 6 showed changes in C-Spine indicative of Cervical Spondylosis. Only 1 person out of 250 miners had clinical features of silico-tuberculosis which included breathlessness, rhonchi and wheezes with VBS in both lungs and X-Ray showing multiple ground glass opacities in bilateral lungs.

This implies –

20 % of total miners evaluated - suspected Iron Deficiency Anemia

4.8 % of total miners evaluated - suspected megaloblastic anemia

6 % of total miners - tested positive for Tuberculosis

0.4 % of total miners - suspected Silico-Tuberculosis

2.4 % of total miners – cervical spondylosis

TOOL-2

BMI (Body Mass Index) – 72 % of the workers were identified to be malnourished with BMI ranging from (14 – 20) which is a massive number followed by 18 % of the workers falling under the normal BMI category.

kept

BMI	Frequency	Percent
14 to 20	180	72 %
21 to 25	45	18 %
26 to 30	25	10 %
31 to 35	0	0
Total	250	

Note-Names of patients were secret.

Eye Problems – Refractory error being the most common finding accounted for 8 % of the workers examined and the second most common disease being identified as cataract (mostly mature senile cataract) which needed surgical intervention for correction.

Problems	Frequency	Percent
Cataract	05	2 %
night blindness	02	0.8 %
Refractory error	20	8 %
No problem	223	89.2 %
Total	250	

Ear problems –

Out of 114 workers examined for deafness, 1 (0.9%) worker had total deafness & 8(7.0%)workers had mild deafness.

Dental problems

Out of 135 workers examined for dental problems 114 (84 %) had discoloration of teeth, mainly due to tobacco habits, 55 (40.7 %) had dental caries and 1 worker had bleeding gums.

Cervical lymph node

Out of 100, 09(3.2%) workers had enlargement of cervical lymph node and were further referred for FNAC.

Limb pain and varicose vein

Out of 100, 24(24%) workers had pain in upper limb and 39 (39%) had pain in lower limbs. Out of 100 workers, 5(5%) had varicose vein.

Respiratory system-

On examination of respiratory system of all 250 workers, crepitation, rhonchi or reduced air entry were found in 80(32 %) patients.

Other findings

Out of 250, 1(0.4%) had some abnormal heart sound.

Disease / condition	Number	% out of 250
ARTI	20	8%
Asymptomatic Respiratory tract problem	02	0.8%
Chronic Respiratory tract problem	14	5.6%
Pulmonary tuberculosis	15	06 %
Silico-tuberculosis (suspected)	01	0.4 %
All types of Respiratory problems (TOTAL)	52	20.8 %
circulatory system	5	2 %
Hepatomegaly	0	0
Joint problem	6	2.4 %
Digestive system problem	30	12 %
Eye problem	27	11.8 %
Myalgia & Bodyache	63	25.2 %
Nutritional disorder (average taken from suspected Iron Deficiency, Vit B12-Folic Acid deficiency and malnutrition)	80	32 %
skin problem	164	65.6 %
surgical problems	1	0.4 %
Urinary tract problem	0	0
Others	0	0

4. CONCLUSIONS AND RECOMMENDATIONS

It is extremely difficult and challenging to organize a systematic effort to reduce the problem of silico-tuberculosis to an acceptable level up to an extent that it ceases to be a major public health problem. Looking at various constraints like poverty, lack of opportunity for other employment for livelihood, lack of health & legal monitoring, absence of treatment for silicosis etc., efforts required to prevent silicosis in new generation will be huge.

But hope is definitely there because of existence of many positive findings like good rapport of voluntary organization with workers, mine workers have opportunity to work in united manner in a small or large groups, unions are already formed, some of the employers are ready to listen to newer changes required, technology for reduction of dust production is available in some stone crushers, legal action are likely to take shape in near future, national health insurance scheme for BPL families by government is likely to take momentum etc.

Looking at both negative & positive factors, following recommendations may be considered for further action:

1. Documentation of problem in a dynamic manner with a small but a constant format.
2. Keeping an account of positive and negative factors at half yearly interval with help of ready to use check list.
3. Starting a project of handling 8 to 10 mines (one in each area) by association of mine workers on cooperative basis for demonstration purpose. Or the same task may be done by collaborating voluntary organizations or some committed mine owners. If everything fails in this direction government may be approached.
4. Use of water sprinklers and mist sprayers as dust suppression technique with proper plotting and engineering tools.
5. Legal provisions should be modified and implemented in such a way, so that each mine worker is to be enrolled at appropriate authority before starting work and irrespective of temporary or permanent status or place of mine. They are to be given compulsory 2 days training before starting work and regularly continuing education may be given at 3 years interval.
6. Compensation amount of Rs.5 Lakhs for each silicosis patient or to his/her family should be considered.
7. Medical measures – Active health surveillance of the workers in both pre-employment and post-employment Periods should be carried out. Health surveillance is collecting and using information about workers' health, related to their work. The early detection of breathing problems, weakness, cough etc suggestive of lung damage is must. By all means workers' health should be protected by reducing exposure to dust. Safety measures like masks and respirators should be compulsory for all workers and should be provided by the stone crusher owners Simple measures like respiratory rate, pulse rate, weight, mid upper arm circumference, recording of severity of symptoms etc can be very useful. A local graduate can be trained to do respiratory function test at regular interval. X ray is recommended as part of the clinical investigation of an individual who reports new or worsening respiratory or other symptoms for significant duration. Symptom enquiry is also needed where there is a risk of tuberculosis. In all cases of cough lasting for more than a month, sputum slides should be taken for examination of TB bacilli. Employer should keep a health record, and encourage workers to keep a copy of their results in case they change jobs. Ideally, assess workers' respiratory and other health before they start a relevant job, to provide a baseline. (Perhaps using a questionnaire and lung function assessment). Regular tests – this could involve a questionnaire and possibly lung function assessments. A responsible person should be appointed, supported by the health professional, to report any symptoms that occur between tests. Simple attendance records can help to find out sickness absenteeism & it can indirectly suggest further investigations.
8. Record maintenance by mines owner-
 - List of ongoing activities
 - Worker's name, address and Insurance number if any.
 - products or process they work on, and how often;
 - Protective measures provided and utilized.

- date of starting work with the product or process; and
- The fitness for work statement.
- Detail pre placement and periodic health examination records for each worker's should be maintained carefully.

9. Monitoring of the environment for hazardous dust particle .

10. Enough quantity of nutritious food can be ensured by subsidized food or better distribution of cereals through public distribution system. Small plants like “ saga – special varieties of green leafy vegetable” can be grown even in small mud vessels to provide protective vitamins like Vitamin A. In absence of availability of milk, fresh vegetables etc. sprouted pulses etc could be a good source of vitamins.

11. Training should be made compulsory and imparted free of cost for day to day managers of mines. It may be of 2 to 3 days duration.

12. Mobile health & life support centre can be very useful. This may be deployed for 3000 to 5000 mine workers' family.

13. All kind of routine primary health care services are to be provided by stationary units by special allocation for this area.

14. Loan facility may be created by microfinance & banking system. This can lead to unnecessary burden of interest.

15. All the workers should be insured with proper health insurance.

Stone mines will continue to benefit our lives, our homes and our building. Therefore, the trade will continue further and will grow further. However, the sufferings of the people working in it must reduce, if not completely eliminated. A systemic approach coupled with strong will is required to look into the occupational health safety standards, and to ensure that sincere and sustainable efforts are made.