

## Awareness and Practices about Silicosis among the Sandstone Quarry Workers in Desert Ecology of Jodhpur, Rajasthan, India

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**ABSTRACT** Silicosis is the oldest recorded chronic challenging public health problem globally and particularly in developing countries. Disease silicosis is not curable. Prevention of silicosis is the only option for its control. Community awareness towards silicosis becomes more important tool in this situation. A cross-sectional study was conducted using questionnaire technique to assess awareness and practices regarding silicosis among the sand stone quarry workers in Jodhpur district of Rajasthan. Majority (73.1%) of the workers were from Meghwal and Bheel communities. Literacy status of the respondents was 28.5%. About two- third (69.9%) of the sandstone quarry workers were aware of the causes of silicosis and this proportion increased with the literacy status, 65.8% in illiterate to 95.7% in middle school and above education. About one- third (32.7%) of the sand stone quarry workers reported cough with breathlessness as the most important symptom of silicosis and this also increased with the literacy status of the respondents (22.3% in illiterate to 73.9% in highly literate. Majority of the respondents knew that silica produced by dry drilling, followed by removing overburdens, making manual holes, separating stone slabs, loading and unloading, blasting rocks and velocity of winds were the main cause of silicosis. All most all the sandstone quarry workers were not using any preventive measures for the silica inhalation through respiration due to lack of awareness about silicosis. Continuous effort is needed to make them aware about causation, sign and symptoms, preventive measures and management of disease.

### INTRODUCTION

Silicosis is the oldest recorded untreatable chronic occupational lung disease caused by 'Silica', that kills thousands of people all over the world every year (Mittleman et al. 1982; Elmes 1994; Leitch 2000; Kimura et al. 2010). This disease is irreversible and the disease progresses even when exposure stops. Extremely high exposures are associated with much shorter latency and more rapid disease progression (Park et al. 1991; Rajnarayan et al. 2004). Less than 10 micron size fine crystalline particle of silica goes into lungs through respiration and hits them directly. The hit spot by silica heals its own and develops into nodes. The sand stone quarry worker feels obstruction and restriction in respiration by working in the mines and the vital capacity of lungs reduces considerably (Ghotkar et al. 1995; Singh et al. 2006, 2007). He becomes unable to work after due course of time in sand stone quarries. Ultimately, the patient becomes unable to earn livelihood during his illnesses thus creating economic

pressure on his family and he becomes a socio-economic burden on others for his remaining life. Silicosis being non-curable disease leads to premature death, around 10–15 years before and about 10% sand stone quarry workers suffered with silicosis and among them, about every second silicotic patient suffered with the pulmonary tuberculosis (Mathur 1996). Prevention is the only method to reduce the disease burden in the population. Though a lot is known about the disease and its associated complication yet it is not properly known to the workers and if some of them know even then they can not quit the job due to poverty related issues. There are many more factors which influence the control activities of this disease in the communities. Awareness and practices about the disease among the quarry workers are the most important factors. Therefore, the present study was focused on investigating the knowledge, practice and perception of the sand stone quarry workers about silicosis so that an awareness and change in the working practices can be incorporated in the worker of sandstone quarry workers to increase their healthy life.

### MATERIALS AND METHODS

Jodhpur district situated in the western part of Rajasthan state between 26°–27°.37' north latitudes and 72°.55'–73°.52' east longitudes, it

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is also known as the gate of the great Indian Thar desert. The study was conducted during the year 2007-2008 on the basis of presence of maximum number of sand stone quarries within the district boundary as compare to other districts in desert part of Rajasthan. Agriculture is the number one occupation and sandstone quarrying is second one, which yields bread and butter to the population. During the drought years sandstone mining becomes first occupation due to which maximum people earn their livelihood. The sandstone mining is into existence since more than 500 years. This stone is famous as Jodhpuri sandstone which is used for glorious and historical buildings in India as well as abroad. There are about 15000 sand stone quarries which are operated openly in very small units as an unorganized sector. Soorsagar, Keru, Khari Beri, Bhuri Beri, Hanuman Bhakari, Mandor, Balesar and Barli are the sandstone quarry sites. From these sites 49 sandstone quarries were selected following random sampling method. A total of 376 sandstone quarry workers were selected for the study who gave their verbal as well as written consent to participate in the study. 5-10 workers were selected per quarry for taking part in the study. Interview technique was used to collect information on the pre-tested schedules. Before initiating the study a good rapport was established with the workers by explaining them about the aims and objectives of the investigation. The study schedule was prepared in English, but it was communicated to the workers in local dialect, that is either in Hindi or Marwari to avoid gap in communication. Schedules included open ended as well as multiple choice questions. The information was based on some important medico-social factors such as age, sex, religion, caste, place of residence, age at start of working, type of work, duration of working, perception and knowledge about disease, treatment and preventive measures etc. The collected data organized and analysed in through computer software Epi Info 6.

## RESULTS

### Socio-demographic Characteristics

After agriculture, mining is second common source of income in the desert part of Rajasthan. On the contrary, it becomes commonest oc-

cupation during the drought years. A part of regular sandstone quarry workers, small farmers, agricultural labourer and others who are related with agricultural works earn their livelihood by joining the quarry work after monsoon crop that is *kharif* (There is rain fed single cropping pattern from July to September) and during the drought year. About seven per cent (7.2%) sand stone quarry workers were < 20 years of age, 46.3 % were between 20-29 years, 29.8% were between 30-39 years, 11.4% were in age group of 40-49 years and 5.3% were > 50 years of age, most of the quarry workers were between age of 20-39, it is also the age when most of the silicosis patients dies. Out of 376 quarry workers males were 97.3% and females were 2.7% this shows that males were significantly higher in these quarry and more prone to disease. 93.1% were Hindus and 6.9% non-Hindus. Among the Hindus 6.6% were high caste, 11.7% were backward caste and 81.7% were scheduled caste and schedule tribes. Majority, 71.5% were illiterate followed by literate 14.4%, primary level education 8.0%, middle school and above 6.1%. About thirteen per cent (13.3%) workers were living near their quarrying site, 30.3% within the mining area and 56.4% out side area of mines. Nearly ninety per cent (90.4%) were smokers, 69.9% alcoholics and 23.1% were opium users, more than half of the workers were using more than one such habit. Around fifty- one per cent (51.3%) were drillers or hole makers, 46.8% stone cutters, 39.9% labourers and 27.1% doing all type of work. It was found that most of the workers (49.2%) were working in the mines for 3-5 years only 33.5% had duration of work 5-9 years, 12.0% 10 -15 years, whereas only a few (5.3%) working for more than 16 years (Table 1).

### Causation of Silicosis

The respondents called Silica as "*Khank*" in their local dialect that is, Marwari. This *khank* was generated due to activities for mining and its fine particles (<10 microns) are lifted in air of sandstone mining area and before settling down it is inhaled by the workers who are exposed and undertaking this activity without any protection. These particles go into lungs through respiration and hit there and create a wound. After curing the wounded spots become nodes. These nodes create fibrosis and at later stages of silicosis.

**Table 1: Socio-demographic characteristics of sand stone quarry workers, Jodhpur, Rajasthan (n=376)**

<i>Characteristics</i>	<i>Numbers</i>	<i>Percentage</i>
<i>Age</i>		
<20	27	7.2
20-29	174	46.3
30-39	112	29.8
40-49	43	11.4
>50	20	5.3
<i>Sex</i>		
Male	366	97.3
Female	10	2.7
<i>Religion</i>		
Hindu	350	93.1
Other than Hindu	26	6.9
<i>Caste</i>		
General Caste	23	6.6
OBC	41	11.7
SC and ST	286	81.7
<i>Education</i>		
Illiterate	269	71.5
Literate	54	14.4
Primary	30	8.0
Middle school and above	23	6.1
<i>Place of Living</i>		
On the work site temporary stay	50	13.3
Temporary stay with in the mining limit	114	30.3
Villages/ towns	212	56.4
<i>Personal Habits</i>		
Smokers	340	90.4
Alcoholics	263	69.9
Opium addicts	87	23.1
<i>Type of Work</i>		
Cutters	176	46.8
Hole makers	193	51.3
Labours	150	39.9
All type of work	102	27.1
<i>Duration of Work</i>		
<5 Years	185	49.2
5-9 Years	126	33.5
10-15 Years	45	12.0
>16 Years	20	5.3

There was a positive correlation between education and awareness about silicosis (65.8% in illiterate to 95.7% respondent of middle school educated). More than two- third (69.9%) of the sand stone quarry workers were aware

of the cause of silicosis and this knowledge increased with the literacy status, 65.8% in illiterate to 95.7% in middle school and above. This is evident through the data that illiterate group of respondents have suggested some other reasons also for the cause of silicosis. A few (3.7%) of the respondents also considered impure water, 6.9% impure food and lifestyle, 3.5% poor hygiene and 5.6% changing environment as the cause of disease (Table 2).

**Symptoms of Silicosis**

About one- third (32.7%) of the sandstone quarry workers attributed cough with breathing difficulties as the most important symptom of silicosis and this also increased with the literacy status of respondents (22.3%) in illiterate to 73.9% in high literate (Table 3) but some of the respondents also mentioned fever for more than 15 days (20.5%), fever with loss of weight (20.7%) or weakness, loss of appetite and fever in the evening (12.2%) as main symptoms of silicosis. About fourteen per cent (14.1%) respondents were not aware about symptoms of silicosis.

**Silica Generation in Sandstone Mining**

Majority of the respondents knew that silica is produced by dry drilling (41.0%) followed by silica produced by removing overburdens, making manual holes, separating stone slabs, during loading and unloading, blasting, windy environment etc (21.5%). Almost 16% respondents replied that silicosis could be prevented. Knowledge about silica was significantly better among literate than illiterate. Nearly seven per cent (6.6%) workers stated that wet drilling can stop silica in mining environment. The role of literacy was not seen at different education level. Thirteen per cent respondents mentioned that

**Table 2: Knowledge about causation of silicosis among sand stone quarry workers in Jodhpur, Rajasthan**

<i>Cause</i>	<i>Illiterate n=269</i>	<i>Literate n=54</i>	<i>Primary n=30</i>	<i>Middle and above n=23</i>	<i>Total n=376</i>
Silica dust <10 Micron size	177 (65.8)	39 (72.2)	25 (83.4)	22 (95.7)	263 (69.9)
Impure water	13 (4.8)	1 (1.9)	00	00	14 (3.7)
Poor Hygiene	10 (3.7)	2 (3.7)	1 (3.3)	1 (4.3)	13 (3.5)
Changing environment	17 (6.3)	2 (3.7)	1 (3.3)	00	21 (5.6)
Impure food	20 (7.4)	4 (7.4)	2 (6.7)	00	26 (6.9)
Don't know	32 (11.9)	6 (11.1)	1 (3.3)	00	39 (10.4)

Figures in parenthesis denote column percentage

**Table 3: Knowledge regarding symptoms of silicosis among sand stone quarry workers in Jodhpur, Rajasthan**

Symptom	Illiterate n=269	Literate n=54	Primary n=30	Middle and Above n=23	Total n=376
Malaise, disturbed sleep, hoarseness, giddiness and headache with fever	69 (25.7)	5 (9.3)	2 (6.7)	1 (4.3)	77 (20.5)
Fever with loss of weight	65 (24.2)	7 (13.0)	3 (10.0)	2 (8.7)	78 (20.7)
Cough with breathlessness and chest pain	60 (22.3)	25 (46.3)	20 (66.7)	17 (73.9)	123 (32.7)
Weakness, loss of appetite and fever	34 (12.6)	8 (14.8)	4 (13.3)	1 (4.3)	46 (12.2)
Don't know	1 (15.2)	9 (16.7)	1 (3.3)	1 (4.3)	53 (14.1)

Figures in parenthesis denote column percentage.

mask can prevent entry of silica through respiration in lungs.

### Management of Silicosis

As a matter of fact, only 8.5% knew that as such there is no treatment for silicosis. 7.7% stated that prevention is the only solution to the problem. Further, 7.8% respondents knew that doctors give antibiotic drugs for other infection supplementary to relief to the silicotic patients and 7.1% were able to tell name of the drugs. 11.7% respondents thought silicotic patients get medicine free of cost from the hospitals and 14.1% expressed that instruction was given by the health personal how to consume the medicines while 31.1% respondents expressed their views regarding avoidance of some food during suffering from silicosis (Table 4). Nearly forty- nine per cent (48.9%) respondents expressed the view that working capacity was reduced due to silicosis among the patients.

### Preventive Measures against Silicosis

Prevention is the only treatment of silicosis. None of the workers was using wet drilling. Similarly, none of the worker was using mask

to prevent silica from inhalation. Somehow, some of the workers were using cloth on their mouth and nose to prevent the silica inhalation as and when clouds of dust were produced at the time of dry drilling, making *jhiri* (cut mark between two stone slabs), blasting the rocks, dumping the waste material, during loading and unloading the materials, removing the over burdens and at the time of vehicles movement. Very few (3.4%) were eating about 100 gm jaggery every day to bring out the silica particles which were inhaled during the work in a day as preventive measures also (Table 5).

### DISCUSSION

The present study showed that 69.9% sand stone quarry workers knew the real cause of silicosis which is based on their educational status and their acquired knowledge on their observation with their co-workers who suffered with silicosis during the period of their working in the sand stone quarries. Rest of the respondent stated that silicosis is caused by impure water, poor hygiene, changing environment, impure food and lifestyle etc. This belief reflects states of mind, socio-cultural belief and perception about the disease. Further, almost

**Table 4: Knowledge regarding silica (only affirmative responses) in sand stone quarry workers in Jodhpur, Rajasthan**

Knowledge about silica	Illiterate n=269	Literate n=54	Primary n=30	Middle and above n=23	Total n=376
Silica produces by dry drilling	98 (36.4)	21 (38.9)	18 (60.0)	17 (73.9)	154 (41.0)
Silica produces by removing overburdens, making holes with chisel and hammer, mechanical dry drilling, separating stone slabs, during loading and unloading, blasting, high wind velocity and transportation.	64 (23.8)	13 (24.1)	3 (10.0)	1 (4.3)	81 (21.5)
Silica inhalation can be prevented	47 (17.5)	8 (14.8)	4 (13.3)	2 (8.7)	61 (16.2)
Wet drilling can stop flying silica in mining environment	14 (5.2)	7 (13.0)	3 (10.0)	1 (4.3)	25 (6.6)
Mask can prevent entry of silica through respiration in lungs	40 (14.9)	5 (9.3)	2 (6.7)	2 (4.3)	49 (13.0)

Figures in parenthesis denote column percentage.

**Table 5: Knowledge regarding management of silicosis (only affirmative responses) in sand stone quarry workers in Jodhpur, Rajasthan**

<i>Awareness about disease management</i>	<i>Illiterate n=269</i>	<i>Literate n=54</i>	<i>Primary n=30</i>	<i>Middle and above n=23</i>	<i>Total n=376</i>
There is no treatment for silicosis	21 (7.8)	5 (9.3)	2 (6.7)	4 (17.4)	32 (8.5)
Prevention is the only treatment for silicosis	13 (4.8)	6 (11.1)	4 (13.3)	6 (26.1)	29 (7.7)
Doctor gives antibiotic drugs for other infection not for silicosis	19 (7.1)	3 (5.6)	1 (3.3)	5 (21.7)	28 (7.8)
Know the name the drugs	10 (3.7)	4 (7.4)	5 (16.7)	8 (34.8)	27 (7.1)
Patients get medicine free of cost	24 (8.9)	7 (13.0)	6 (20.0)	7 (30.4)	44 (11.7)
Health-person tells how to consume it	26 (9.7)	9 (20.0)	8 (26.7)	9 (39.1)	53 (14.1)
Some foods should avoid during silicotic symptoms	101 (37.5)	8 (14.8)	6 (20.0)	2 (8.6)	117 (31.1)
Working capacity reduces	111 (41.3)	27 (50.0)	25 (83.3)	21 (91.3)	184 (48.9)

Figures in parenthesis denote column percentage

one- third (32.7%) of the respondents stated correct symptom of the disease. This percentage is nearly half of the causation of disease which is quite logical that they did not suffer from this disease. This level of awareness may be based on their conversation with the silicosis patients who may be their family member, relatives, friends and co-workers. On other hand, this awareness may be based on their acquired knowledge either from books or from history of sufferers. Further, regarding management of silicosis, they stated that at the initial stage of the disease, sandstone quarry workers suspect some lungs infection and try to treat at home with the local remedy. If response is not satisfactory they approach to the private health practitioners. Those health practitioners treat them with some antibiotic and combination of medicines on the basis of experiences and complaints of the patient. In some cases even anti-tuberculosis drugs are given. At last uncured patients approach to the government health facility for super speciality. In this process, more than ninety per cent (91.7%) patients were delaying for their correct diagnosis and appropriate medical aid for the silicosis. These findings are almost similar to the earlier study of Yadav et al. (2001). This is quite surprising that there is no impact of time gap and advancement in awareness and practice on the preventive devices among the sand stone quarry workers with regard to this occupational health hazard. Other workers also reported that in knowledge, attitude and practice studies, there is a huge gap between knowledge and practice of protective devices, despite universal knowledge about the devices only one-third used them in practice (Haldia et al. 2005). There is also lack of skilled treating physicians. The silicotic patients also

become physically and socio-economically dependent on others at this stage. The level of knowledge about management of silicosis was totally based on their knowledge by observing the silicosis patients or by own experience during illness of a known silicosis patient during his admission in the hospital or in the community where a person was suffering from silicosis.

Sandstone quarry workers were not using wet drilling as a most appropriate method to stop floating silica in the air while making holes through drilling. Regarding use of mask as a personal protection, expressed difficulty in breathing while chocking holes of mask with silica so frequently, removing and putting mask also was inconvenient at the time of smoking, taking water, tea, meal, etc. and changing cartage frequently found economic burden and as well as inconvenient to carry and procure it. It is significant observation of the study that the formal education of sand stone quarry workers did not play a vital role on their behavioral change. This is the serious message to the health policy planners, health educators, and health personnel for better understanding the situation and act accordingly under the Silico-sis Control Activities.

**CONCLUSION**

Sandstone quarries of Jodhpur district belong to unorganized sector. The sandstone mine owners are not implementing mine safety rules in their mines and the workers are also not following the safety rules. There is urgent need to give attention on the problem at every point of responsibility by everyone. Silicosis is an internal disease and disease progression is

hardly visible to the patient. Therefore, one cannot assess the magnitude of the problem. Health education, awareness about personal protection is a need to be carried out in the stone quarry workers to improve the healthy life span of the worker because being low socio-economic group they are neglected in several ways by the society and government.

### RECOMMENDATIONS

Proper health education about silicosis and awareness of personal protection and preventive measures against silicosis should be carried out in such a way that it should be need based, suitable for the area concerned and acceptable to the target groups for advocating demands and sustaining for their participation and involvement. Poor response towards practicing preventive measures against silica inhalation is very serious problem. Almost all workers were not practicing any method, could be due to poor awareness about silicosis preventive measures. This clearly highlights that they need to put more efforts on Information, Education and Communication (IEC) dealing with subjects on causation, signs and symptoms, early diagnosis, treatment and change of occupation. Vocational trainings are also required as a part of the control programme. The treating physicians are required to be given appropriate training for diagnosis and treatment of lung diseases.

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### REFERENCES

- Elmes PC 1994. Inorganic dusts. In: P A B Raffle, P H Adams, P J Baxter, W R Lee (Ed.): *Hunter's Diseases of Occupations*. London: Edward Arnold Publications, pp. 421–428.
- Ghotkar VB, Maladhure BR, Zodpey SP 1995. Involvement of lung and lung function tests in stone quarry workers. *Ind J Tub*, 42: 155-160.
- Haldiya KR, Sachdev R, Mathur ML, Saiyed HN 2005. Knowledge, attitude and practices related to occupational health problems among salt workers working in the desert of Rajasthan, India. *J Occup Health*, 47: 85-88.
- Kimura K, Nakano I, Ohtsuka Y, Okamoto K, Usami I, Onishi K, Kishimoto T, Genma K, Mizuhashi K, Sakatani M, Kaji H 2010. Today's occupational respiratory disease—From our recent investigations. *Hokkaido Igaku Zasshi*, 85(1):27-30.
- Leitch AG 2000. Functions of lungs. In: Anthony Seaton, Douglas Seaton, A Gordon Leitch (Eds.): *Rofion and Douglas's Respiratory Disease*. 5<sup>th</sup> Edition. Oxford: Blackwell Science Ltd., Vol. 1, 43–46.
- Mathur ML 1996. Silicosis among sand stone quarry workers of a desert district Jodhpur. *Ann Nat Acad Med Sci*, 32:113-8.
- Mittleman RE, Welti CV 1982. The fatal café coronary. *JAMA*, 247: 1285–1288.
- Park JE, Park K 1991. *Park's Textbook of Preventive and Social Medicine*. 13<sup>th</sup> Edition, Jabalpur.
- Rajnarayan R, Tiwari NG, Sathwara, Saiyed HN 2004. Serum copper levels among quartz stone crushing workers: A cross-sectional study. *Indian J Physiol Pharmacol*, 48(3): 337–342.
- Singh SK, Chowdhary GR, Purohit G 2006. Assessment of impact of high particulate concentration on peak expiratory flow rate of lungs of sand stone quarry workers. *Int J Environ Res Public Health*, 3(4): 355-359.
- Singh SK, Chowdhary GR, Chhangani VD, Purohit G 2007. Quantification of reduction in forced vital capacity of sand stone quarry workers. *Int J Environ Res Public Health*, 4(4): 296-300.
- Yadav SP, Mathur ML 2001. A study of medico-social problems of sand stone quarry workers in the Jodhpur district of north-west part of Rajasthan. *Proc National Seminar on Small Scale Mining*, pp. 152-157.