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The Chronic Battle to Prevent Silicosis in Workers' Lungs A passive surveillance study.

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Abstract

Silicosis in Tamil Nadu: A passive surveillance study. Inhaling crystalline silica dust leads to the interstitial lung disease known as silicosis. Although though it is one of the oldest occupational diseases, it still contributes to morbidity and mortality globally. The International Project on the Global Elimination of Silicosis, which identifies occupational groups at risk, was created by the World Health Organization and the International Labour Organization (WHO/ILO), who are aware of the current issue. We present three cases of silicosis in young construction workers who were handling artificial silica conglomerates, which exposed them to high quantities of silica.
This study's primary goals include locating new risk factors, emphasizing the risks associated with substance use in the absence of precautions, and emphasizing the value of employment history in preventing underdiagnosis of this condition.

Purpose of review:
This particular review focusses on the burdens of silicosis faced by workers in industry and its clinical manifestations reported from India.

Key points:
- There are an estimated 11.5 million workers exposed to silica dust in India in both organized and unorganized sectors.
- Several recent studies report high prevalence of silicosis in workers engaged in quartz mills, stone-grinding and the construction industry.
- Tuberculosis is reported in up to 25% patient with silicosis
- Connective tissue disorders and lung cancer are important associations and complications of silicosis
- The National Human Rights Commission has made several important recommendations to the Parliament of India to reduce the burden of silicosis.

Keywords: Silicosis, Occupational history, Occupational health and safety in workplace, safety measures.

Introduction

Silicosis is an irreversible, progressive interstitial lung disease brought on by crystal-line silica inhalation. Millions of people worldwide who work in hazardous, dusty industries are afflicted by this fatal disease. [1] According to a World Health Organization (WHO) research from 2002, pneumoconiosis brought on by airborne particles results in 30,000 deaths and 12,88,000 lost Disability Adjusted Life Years (DALYs) yearly. [2] Two-thirds of all work-related deaths worldwide are caused by Asia, followed by Africa (11.8%) and Europe (11.7%). [3] Silicosis continues to be one of the most significant occupational health conditions in the world due to its propensity to lead to progressive physical disability.

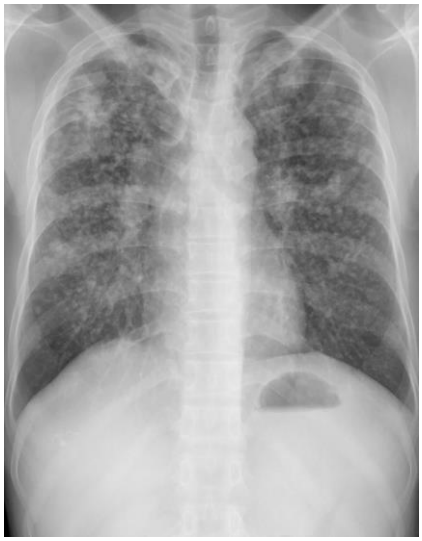
The prevalence of silicosis varies greatly in India, from 3.5% in an armoury to 54.6% in the slate-pencil sector [4], and this difference is caused by various silica concentrations in the workplace, exposure times, and job demands. Workers may come into contact with crystalline silica while performing a variety of tasks, including those related to agriculture, construction, glass manufacturing, mining, and quarrying. [5] Compared to older silica or geologically old clays, freshly fractured silica (i.e., blasting, drilling) has a considerable negative impact on health (fractured through the natural process). [6]
Occupational disorders include silicosis, pulmonary TB, chronic bronchitis, emphysema, lung cancer, and mycobacterial, fungal, and bacterial lung infections are all linked to breathing in respirable crystalline silica. In addition, extra-pulmonary diseases linked to crystalline silica dust exposure include extra-pulmonary tuberculosis, autoimmune diseases or immunologic disorders (such as scleroderma, systemic lupus erythematosus, rheumatoid arthritis, and sarcoidosis), chronic renal disease, subclinical renal changes, and cancers. [1,7]. In low- and middle-income nations, tuberculosis, the clinical consequence of silicosis (also known as silico-tuberculosis), continues to be a major public health concern. [8] Mine employees exposed to silica, whether or not they have silicosis, are more susceptible to developing tuberculosis. A patient with silicosis has a higher (2.8 to 39 times higher) chance of contracting tuberculosis than someone in good health. [9]

After a thorough review of the literature, it was discovered that there aren't many research showing how common silicosis and other respiratory morbidities are among Indian sandstone mine workers. In light of this, a study was designed to determine the prevalence of silico-tuberculosis, silicosis, and other respiratory morbidities in sandstone mine employees in Tamil nadu district.

Silica

Silica is the name given to minerals with the chemical formula SiO_2, which combine silicon and oxygen. It can be either free, in which case there is only SiO_2, or mixed, in which case SiO_2 has chemically joined with another atom or molecule. As the silica problem only affects free silica, the distinction must be understood. Sand, quartz, and granite rock make up the bulk of crystalline silica.

Free silica may occur as amorphous-free silica, of which there are many forms, and crystalline-free silica, of which there are five principal forms. Certain materials contain both amorphous and crystalline-free silica. Silica-related diseases are associated only with crystalline-free silica.



Chest X-ray of a sandstone mine worker.

The some of the common examples of crystalline-free silica are beach or bank sands. A third form of free silica is fused silica which is produced by heating either the amorphous or crystalline forms. Other forms include cristobalite and tridymite.
According to geological statistics, the second most frequent mineral in the earth's crust is quartz, a major type of silica. Both sedimentary and igneous rocks can be easily identified to contain quartz. Many types of rocks can have varied amounts of quartz; for instance, granite can have a quartz content ranging from ten to forty percent; shales have an average quartz content of 22 percent; and sandstones can have an average quartz content of 70 percent.

Exposure in the Construction Phase

It is thought that exposure during sandblasting is particularly dangerous. Sandblasting is a technique used to remove paint and corrosion from various surfaces, including tanks, metal bridges, and stone structures. Jack-hammer operations, rock/well drilling, concrete mixing, concrete tunnelling, and cutting and sawing of brick and concrete block are further construction processes that could generate crystalline silica dust.
Tunneling operations, repair, or replacement of linings of rotary kilns and cupola furnaces, and setting, laying, and repairing railroad tracks are also potential sources of exposure. Concrete and masonry products contain silica sand and rock containing silica.

The following activities expose construction workers to respirable crystalline silica, primarily:

- Destruction of masonry and concrete constructions.
- Rock is crushed, loaded, transported, and dumped.
- Rock drilling, chipping, and hammering.
- Silica sand was used as the abrasive in the blasting process.
- Concrete blasting with abrasives (regardless of abrasive used).
- Concrete or masonry sawing, pounding, drilling, grinding, and chipping.

- Dry sweeping or blowing concrete, rock, or sand particles with pressured air.
- Several traditional brick manufacturing procedures

Silicosis

One of the oldest occupational diseases in the world, silicosis dates back to classical Greece. due to the 1800s. Other names for the health issues brought on by exposure to crystalline silica dust include consumption, ganister disease, masons' sickness, miner's asthma, miner's phthisis, potters' rot, sewer disease, stonemason's disease, chalicosis, and shistosis.
The body's reaction to the presence of silica dust in the lungs causes silicosis (s). The alveoli (air sacs), which are the innermost layers of the lung and where the exchange of oxygen and carbon dioxide occurs, can be reached by the respirable fraction of the dust, which is commonly defined as particles smaller than five millionths of a meter.

dioxide happens. Crystalline silica particles that are inhaled by workers settle on the alveoli, where white blood cells called macrophages attempt to remove them. Yet, the unbound crystalline silica particles induce the macrophages to rupture. Around the entrapped silica particles, the lung tissues respond by generating fibrotic nodules and scarring.

Formation of large numbers of "scars" following prolonged exposure causes the alveolar surface to become less elastic. This is noticed as shortness of breath following exertion. Symptoms seldom develop in less than five years and, in many cases, may take more than 2 years to become disabling or cause death.
A worker's lungs may react more severely to silica sand that has been freshly fractured (sawed, hammered, or treated in a way that produces airborne dust). This factor may contribute to the development of acute and accelerated forms of silicosis.

Factors That influence Silicosis Development
Development of silicosis is influenced by several factors which include:

- Form of the silica
- Content of crystalline-free silica in the dust
- Amount and kind of dust inhaled
- Relative size of the inhaled particles
- Length of exposure
- Individual resistance
- Smoking habits
- Disease status
- Age

Types of Silicosis
Depending on the amount of silica in the air, workers may acquire one of three kinds of silicosis:

Chronic silicosis, which often develops after ten or more years of exposure to relatively low quantities of crystalline silica.

Accelerated silicosis, which develops five to ten years after the initial exposure and is brought on by exposure to high quantities of crystalline silica.

Acute silicosis, which can manifest symptoms between a few weeks and four or five years after the initial exposure and occurs where exposure concentrations are highest.

Silicosis Signs and Symptoms

The disease's early stages could go unnoticed. Long-term exposure may cause shortness of breath during exercise, a potential fever, and occasionally bluish skin near the lips or ear lobes. A person with silicosis is more vulnerable to infectious lung infections like tuberculosis. The symptoms of silicosis progression include exhaustion, severe breathlessness, lack of appetite, chest pains, and respiratory failure, which can be fatal**.**
Silica crystals and a protein substance are frequently found in the lungs of silicosis patients, according to medical examinations. Depending on how long it takes between exposure and the start of symptoms, pulmonary fibrosis (fibrous tissue in the lung) may or may not appear in acute cases of silicosis. Moreover, research suggests that crystalline silica may be a workplace carcinogen.

Diagnosis of Silicosis

The patient's medical history suggests silica dust exposure at work. In cases of uncomplicated silicosis, the physical examination is normal; however, in cases of chronic silicosis with conglomerate lesions, it may indicate tachypnea, fine to medium crackles, areas of hypo- and hyperresonance, diminished breath sound intensity, and decreased chest expansion.

In simple silicosis, chest X-rays show small, discrete, nodular lesions distributed throughout both lung fields but typically concentrated in the upper lung zones; the hilar lung nodes may be enlarged and exhibit “eggshell” calcification. In complicated silicosis, X-rays show one or moreconglomerate masses of dense tissue.
Pulmonary function tests show:

- Forced vital capacity (FVC) — reduced in complicated silicosis
- Forced expiratory volume in 1 second (FEV_1) — reduced in obstructive disease (emphysematous areas of silicosis); reduced in complicated silicosis, but ratio of FEV_1 to FVC is normal or high
- Maximal voluntary ventilation — reduced in restrictive and obstructive diseases
- Carbon dioxide diffusing capacity — reduced when fibrosis destroys alveolar walls and obliterates pulmonary capillaries or when fibrosis thickens the alveolocapillary membrane.

Imaging and arbitrary testing are primarily used to diagnose silicosis. They are frequently perplexing because a variety of other diseases, such as military tuberculosis, etc., also resemble such an x-ray image. Moreover, changes in lung function are not precisely diagnostic.

The development of specific biochemical markers for early disease detection is still in its infancy. The occupational health specialists in our nation have yet to fully resolve these problems, which are complicated by the logistics of radiological examination and interpretation.

Prevalence of silicosis in certain segments of construction industry of India

Indus-try	Prevalence (%)
Stone cutters	20.0
Stone cutters	25.0
Stone cutters	35.2
Foundries	27.2
Glass workers	7.3
Mica mines & mica processing	5.2
Quartz crushing	12.0
Stone quarry	22.0
Sand grinding	27.8
Traditional Brick kilns	6.2

The prevalence of silicosis varies between 5.2 and 35.0 percent in different sectors of the construction industry, according to data from research that are currently accessible.

In the Indian context, there is simply no consolidated data on the number of cases diagnosed, individuals awarded compensation under the Factories Act, those at risk, and industry-specific information on cases and those at high risk. Thus, it warrants immediate attention as it is a serious issue.

NGOs and labor activists have frequently brought attention to the issue. Stone quarries in Lal Quan near Delhi, a glass factory in Pondicherry, and other significant areas related to the building industry are some of the areas that are emphasized.

Global Program for Silicosis Elimination

A global program to eradicate silicosis worldwide by 2010 was introduced in 1995 by the WHO/ILO Joint Committee on Occupational Health. The goals are to: 1. provide an update on this subject; and 2. encourage each nation to create its own national silicosis elimination program. 4. Provide a knowledge

foundation for nations wishing to start a national programmed. 3. Organize their efforts in a more organized manner.

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Prevention and Control Measures

1. Exposure guidelines

Important steps to control silicosis include strict adherence to silica exposure limits, periodic evaluation, and downward revision when necessary.

The DGFASLI, Government of India, Ministry of Labour & Employment organised a national seminar on "Hazards of Asbestos and Silica in Construction Industry" on March 17, 2006. It was determined that the TLV for asbestos and silica for the construction sector can be the same as that suggested in the Factories Act after discussing the threshold limit value (TLV) for asbestos and silica.

According to section 41(f) of the Factories Act of 1948, the allowed amount for free silica is 0.1 mg/m3. About silica, it was noted that a more thorough investigation is need to be carried out in order to determine the threats caused by free silica in the building business. (13)

2. Medical vigilance and other precautions

The following precautions should be taken by the construction sector to prevent silicosis in its workforce.

- Training and information to workers on crystalline silica
- Availability of air and medical surveillance data to workers
- Equipment maintenance program
- Respiratory protection program
- Isolated personal hygiene facilities, eating facilities, and a clothing change area
- Record keeping
- Housekeeping program
- Construction safety and health program
- Regulated areas/warning signs
- Ongoing personal air monitoring program
- Dust control program.

Conclusion

The country's construction workers face a major but avoidable health risk from occupational exposure to respirable crystalline silica. Each year, untold numbers of worker deaths from silicosis and other silica-

related conditions like pulmonary tuberculosis (TB), lung cancer, and scleroderma occur either unreported or misdiagnosed.
the following issues are of significance today

a. Lack of accurate information on the exact prevalence of silicosis and other diseases connected to silica A plan to end or reduce silicosis in the Indian construction sector Regulatory guidelines (TLVs) for dust must be updated
b. Construction workers' exposure to silica and their risk of TB and cancer
c. Silica exposure response and a range of health effects
d. The necessity to create such information and come up with strategies to exploit it. Genetic susceptibility/immunity among silica exposed workers.

The Planning Commission, the Government of India, and the Indian construction sector collaborated to establish the Construction Industry Development Council (CIDC) (14). The Council gives the industry the push and the organizational framework it needs to improve quality standards for the first time in the nation. This would ensure that the government, industry, and peer groups in society have a greater understanding of the interests of the construction industry.

In order to help the Indian construction sector, meet the challenges of the future, CIDC aspires to act as a change agent to start and speed up a process of self-reform. The CICD might serve as a nodal agency for the prevention and control of silica-related diseases among its personnel in addition to resolving economic, social, and engineering challenges.

Appendix

This article shows the influencing factor of **Silicosis** and problems faced by them in detailed. Regarding that the treatment done, medication steps, control measures to be done are explained.

Conflict of Interest

This research was supported by **SRM Valliammai Engineering College** and Ikon engineers and my sincere thanks for my staffs supporting me to do this project in successive way.
The main scope to choose this topic is for the workers working in a construction site in an informal sector organization, sometimes have to walk for some distance near construction site for multiple times, this results in various side effects silica dust present in atmosphere. Also place where he/she have to stand do face the syndrome and symptoms of the syndrome. Ongoing with the topic we can get awareness regarding this disease in future.

Acknowledgement

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Authors' Biography

Short biography of each author may be included, with/without photographs, after main content of the research paper and before references. The biography may only include details related to current position/designation of the authors. No personal detail can be included in biography.

References

References within Main Content of the Research Paper

1. National Institute of Occupational Health. Evaluation of health hazards in quartz crushing industry and evaluation of dust control measures. Annual Report, 1985-86, p.1, 1986.
2. National Institute of Occupational Health. Pilot survey of stone quarry workers in Jakhlaun area of Lalitpur district (U.P.). Annual Report, 1986-87, p.37, 1987.
3. National Institute of Occupational Health. Study of silicosis in sand grinding workers. Annual Report, 1988-89, p.1, 1989.
4. Srivastava AK et al Health risk assessment of brick kiln workers. In J Occ Env Med; 6(4),150-155,2002.
5. http://dgfasli.nic.in/seminar/proceedings.htm
6. http://www.cidc.in
7. Kulkarni GK. Construction industry: More needs to be done. Indian J Occup Environ Med 2007; 11:1-2.
8. *www.ilo.org/public/english/protection/safework/health/session13/dr_fedotov_ilo.pdf*
9. World Health Organization. The Global Occupational Health Network. Gohnet Newsl. 2007;(July):1–32.
10. Evelyn Kortum E, Kati Bozsoki C-E, World Health Organization. The Global Occupational Health Net-work: Elimination Of Silicosis [Internet]. 2007 [cited 2019 May 22]. Available from: www.asosh.org/ World-Links/TopicSpecific/silica.htm#ZA International Agency For Research on Cancer IARC Monographs On The Evaluation Of Carcinogenic Silica, Some Silicates, Coal Dust.
11. National Institute of Occupational Health. Evaluation of health hazards in quartz crushing industry and evaluation of dust control measures. Annual Report, 1985-86, p.1, 1986.
12. National Institute of Occupational Health. Pilot survey of stone quarry workers in Jakhlaun area of Lalitpur district (U.P.). Annual Report, 1986-87, p.37, 1987.
13. National Institute of Occupational Health. Study of silicosis in sand grinding workers. Annual Report, 1988-89, p.1, 1989.
14. Srivastava AK et al Health risk assessment of brick kiln workers. In J Occ Env Med; 6(4),150-155,2002.
15. http://dgfasli.nic.in/seminar/proceedings.htm
16. http://www.cidc.in