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RESPIRATORY SYMPTOMS, SPIROMETRIC, AND RADIOLOGICAL ESTIMATION OF STONE CRUSHER WORKERS

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Abstract- *The study was carried out among stone crusher workers and nearby residents in Shankargarh, Prayagraj, Uttar Pradesh, India, where entire families including women and children, crush boulders of silica and work on stone crusher units for a living as the land is mostly rocky and not suitable for cultivation. The various crushing operations involved in stone crushing e.g. blasting, manual cutting, crushing and transportation emit fugitive stone dust. These fine aerosol of stone dust causes health problems among the stone crusher workers and nearby residents. Sputum examination (AFB), Spirometry (PFT) and Radiology was carried out to assess the prevalence of lung problems, tuberculosis and other occupational diseases. Present study reflects that the values of all parameters are abnormal in most of the stone crusher workers and they have health problems. So it is recommended that regular health checkup of these crusher workers should be done and they should be promoted to use the protective and preventive measures to minimize the health hazards.*

KEYWORDS: Stone crusher workers, Tuberculosis, Spirometry, Radiology.

INTRODUCTION:

Silica dust exposure is common in many industrial operations worldwide. Mining is a major economic activity in many developing countries. Operations whether small or large magnitude affects the environment, emitting enormous quantities of dust. Mine and stone crushing industry in India has been growing rapidly due to increasing demand from the construction industry. Stone crushing in India is basically a labour intensive small scale industry, where most of the operations are performed manually (Aslam et al., 1992), (Singh G. and Pal A. 2010). In India, due to lack of resources and awareness at stone-crushing sites, the preventive measures against inhalation of dust particle are generally poor. Therefore, workers exposed to silica dust over a long time can develop a considerable lung function impairment that cannot be reversed.

Central Pollution Control Board, (2012) have carried out a study on "Report of the Expert Committee on the Environmental Problems due to Stone Crushers and Related Activities in Sonebhadra District". Sinha, B. K and Choudhary, S., have undertaken a study on "Environmental Pollution and Health. Khaleque, A. and Elias, M.S., have carried out a study on "Environmental Pollution and Health Problems of Industrial Workers in Bengaladesh".

There are many respiratory diseases that have been documented in literature as being related to work either as a direct casual agent or due to work exposures (Hendrick et al., 2002). Tuberculosis is a communicable disease highly prevalent in India, does particularly afflict the working populations in dusty industries. In Stone crushing occupations the peoples are in a greater level of exposure to silica dust so that they are susceptible to TB. Spirometric measurements (Pulmonary Function Test) and Chest Radiographs presents evidences of respiratory impairments and infections in lungs. The long term exposure of workers to silica dust causes silicosis, the pneumoconiosis.

Mining activities always have negative impact on environmental quality (Eggert, 1994; Ripley et al., 1996; Gabler and Schneider, 2000; Karbasi et al., 2007. The environmental pollution caused by mining depends on the mineral being mined, the methods of mining and various other factors (Ghose, 2007). Exposure to heavy dust concentration from stone crushers may produce several diseases, chief among them being pneumoconiosis (Zenz et al., 1994). Silicosis, caused by inhalation of dust containing silica, is an important form of this disease. Respiratory damage resulting from such exposures can range from reversible functional changes to reversible damage to the lungs and in some extreme exposures, causes lung cancer (Mathur and Chaudhary,1996). As per government records (DMG, 2014), 57 mines are being operated in the region on 206 acre land villages of Shankargarh, Uttar Pradesh, India. These mines are distributed in 21 villages. Sonbarsa occupies the largest area under mine followed by Chatehara-Ghurehtha, Kohandia, Uthgi-Uparhar, Hinauti Pandey and Geenj. These regions are rich in sand stone deposits and structurally the deposits are horizontally layered.

The study site Geenj, Hinauti Pandey and Garha Katra of Shankargarh granite mining is one of the main economic activities that engaged many people both men and women. Literacy level is very poor and almost all females are illiterate who work as mining labourers in silica mines. Economic strata of people lie in one class only, as all are under very poor group (Mishra A. 2015). The various unit operations involved in these stone crusher units e.g. drilling, blasting, crushing, screening, loading, unloading and transportation emit process and fugitive dust. These substantial fugitive dust emissions pollute the ambient air quality and surrounding environment.

MATERIALS AND METHODS:

The study area Shankargarh region is located between 25°10'N to 25°20'N latitude and 81°37'E to 81°45'E longitude. A detailed health impact survey of stone crusher workers and nearby residents was carried out at Geenj, Hinauti Pandey and Garha Katra, villages of Shankargarh, U.P., India. Health survey e.g. General clinical examination, Tuberculosis (AFB Test), Spirometry (Pulmonary Function Test), and Radiology was undertaken. Tuberculosis test was done by AFB (Acid Fast Bacillus) Test. Pulmonary Function test was carried out using Spirometer. Radiology (X-ray) of workers was done to check condition of lung. The objective of the study was to assess the respiratory problems occurring due to exposure to silica dust. The dust exposure effects on the workers and resultant health hazard are discussed as-

2.1 SPUTUM EXAMINATION OF STONE CRUSHER WORKERS:

Sputum examination was carried out by AFB (Acid Fast Bacilli) Test to determine Pulmonary Tuberculosis caused by Mycobacterium tuberculosis bacteria. Sputum of Fifty workers (36 male and 14 female) from Geenj, Twenty five workers (18 male and 07 female) from Hinauti Pandey and Fifty workers (36 male and 14 female) from Garha Katra was examined. AFB positive and AFB negative results are shown in Table 1-

Table 1: Sputum Examination Of Stone Crusher Workers-

Study Area	Age Group	Male No. AFB Examined/ No. AFB Positive (%)	Female No. AFB Examined/ No. AFB Positive (%)	Effective % No. AFB Examined / No. AFB Positive (%)
Geenj	<25	05/00=00	02/00=00	07/00=00
	25-35	11/00=18	03/00=00	14/02=14
	35-45	16/04=25	05/01=16	21/05=23
	>45	06/02=33	02/01=50	08/03=37
Hinauti Pandey	<25	04/00=00	00/00=00	04/00=00
	25-35	05/00=00	01/00=00	06/01=00
	35-45	08/02=25	03/00=00	11/02=18
	>45	03/01=33	01/00=00	04/01=25
Garha Katra	<25	06/00=00	02/00=00	08/01=00
	25-35	13/03=23	04/01=25	17/04=23
	35-45	11/03=37	03/01=20	14/04=28
	>45	09/03=33	02/02=100	11/05=45

2.2 SPIROMETRY OF STONE CRUSHER WORKERS:

Spirometric measurement (Pulmonary function test) was done for measuring lung function volume of stone crusher workers through Spirometer and to analyze the factors affecting them. FVC (Forced expiratory vital capacity) and FEV1 (Forced Expiratory volume during one second) was measured to find out the ratio FEV1/FVC. In the normal person the ratio is about 80 %. However, in airway obstruction this value has decreased to 47 %. In serious airway obstruction this reduces to 20 %. Workers with Obstructive lung diseases include conditions that make it hard to exhale all the air in the lungs. Workers with restrictive lung disease have difficulty fully expanding their lungs with air (Hopkins Interactive Physiology). The lung function parameters were measured in relation to age, sex and duration of exposure which are presented in following tables:

Table 2: Lung Function Parameters Of Stone Crusher Workers: According To Age Group

Study Area	Age Group	No. of workers	FEV1 (lit.)	FVC (lit)	FEV1/FVC %
Geenj	<25	07	2.29±0.59	3.32±0.40	68-76
	25-35	14	2.32±0.25	3.43±0.20	67-70
	35-40	21	2.20±0.90	3.41±0.92	64-73
	>45	08	2.00±0.12	3.48±0.15	57-67
Hinauti Pandey	<25	04	2.58±0.70	3.37±0.36	76-80
	25-35	06	2.34±0.61	3.50±0.30	68-74
	35-40	11	2.09±0.42	3.00±0.33	68-72
	>45	04	2.00±0.55	3.33±0.67	60-69
Garha Katra	<25	08	2.25±0.64	3.23±0.55	69-74
	25-35	17	2.26±0.43	3.45±0.55	65-68
	35-45	14	1.98±0.97	3.20±0.11	61-63
	>45	11	2.01±0.22	3.44±0.48	58-63

Table 3. Lung Function Parameters Of Stone Crusher Workers: According To Sex Group

Study Area	Sex Group	No. Of Workers	FEV1 (lit.)	FVC (lit)	FEV1/FVC %
Geenj	M	36	1.91±1.52	3.50±0.20	61-78
	F	14	2.10±0.20	3.31±0.18	63-69
Hinauti Pandey	M	18	2.00±1.73	3.29±0.45	60-79
	F	07	2.07±0.37	3.03±0.35	68-70
Garha Katra	M	36	1.50±1.73	3.20±0.70	46-73
	F	14	1.70±1.30	3.25±0.40	52-67

Table 4. Lung Function Parameters Of Stone Crusher Workers: According To Duration Of Exposure

Study Area	Duration Of Exposure	No. of workers	FEV1 (lit.)	FVC (lit.)	FEV1/FVC %
Geenj	5-15	29	2.20±0.52	3.18±0.20	69-78
	>15	21	1.98±1.10	3.50±0.31	61-63
Hinauti Pandey	5-15	19	2.37±0.73	3.35±0.45	70-79
	>15	06	2.00±1.07	3.29±0.03	60-68
Garha Katra	5-15	30	2.30±0.73	3.40±0.70	67-73
	>15	20	1.50 ±0.70	3.20± 0.25	46-52

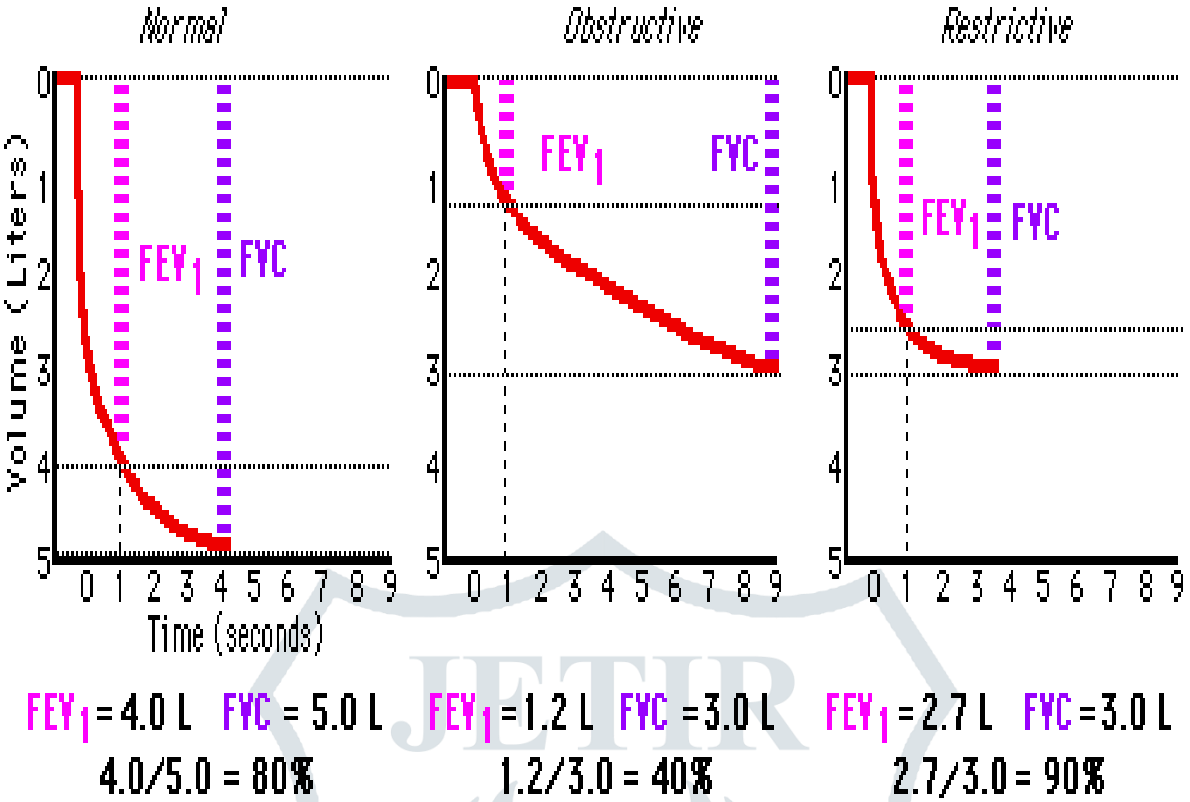

Figure 1- Graphical Presentation Of Lung Function Parameters Of Crusher Workers
(Source: Hopkins Interactive Physiology)

2.3 RADIOLOGY:

Silica dust less than 10 microns in size (cannot be seen with the eye) are respirable and enters to the lung. So X-ray surveillance may be initial means of disease diagnosis. The chest X-ray of some workers working from more than 10 years having coughing, wheezing and shortness of breath was done to find out the effect of silica dust on lungs. The findings are:

Table 5. Radiology (X-Ray) Observation Of Crusher Workers:

Study Area	No. Of Workers	Normal Radiographs	Abnormal Radiograph	Abnormal Radiograph (%)
Geenj	10	07	03	30
Hinauti Pandey	06	05	01	16
Garha Katra	12	07	05	41

RESULT AND DISCUSSION:

It has been found that most of the crusher workers are affected with persistent cough, weight loss, chest pain etc. which is the most common symptom of pulmonary tuberculosis. Table-1 show the distribution of TB cases according to study variables among the stone crushers workers. It can be seen that those age group more than 35 years and those employed for ≥05 years had higher prevalence of TB. The workers who were smokers had higher risk of TB. In Geenj and Garha Katra villages most of the crusher

workers are diagnosed with TB, and according to DOTS report the average life span of a worker is 40-50 years. According to Occupational Knowledge International Silica released from stone crushing is causing an epidemic of silicosis, cancer, other lung diseases and increases the risk of acquiring Tuberculosis (TB).

Table-2, 3, 4 and Figure 1 shows the distribution of lung function parameters. These tables and figure represent that the workers of older age groups and those who are working for more than 15 years have lower FEV1/FVC % than that of normal which is 80 %.

Radiological study as presented in Table-6 shows 30 % workers in Geenj, 16 % workers in Hinauti Pandey and 41 % workers in Garha Katra have abnormal radiology report. Radiological report Shows rounded opacities beginning in upper and middle lobe of lung and massive hilum shadowing. Dust deposits in the lungs, damages lung tissue, and causes scarring. Disease development typically takes over 10 years of dust exposure. Pneumoconiosis and silicosis results from inhalation of respirable silica dust.

It is well documented that chronic and, in some cases, acute exposure to dust containing silica can cause serious health problems (IARC, 1997). The constant and heavy exposure to this silica dust may result in death. Silica dust also tends to increase the risk to individuals of developing lung cancer, auto immune diseases etc.

Investigations have revealed that the workers were not aware about the proper safety and control measures. Most working women usually left their children near working place hence they also get exposed to dust. Children are more sensitive to the dust. The SPM (Suspended Particulate Matter) generated by silica mining and from the group of loose rock pieces on the side of mines, is posing threat to the local environment.

It can therefore be concluded that stone crushing workers who are exposed to approximately 100 % free silica have deteriorated lung function and it can be attributed mainly to respiratory epidemiological factors such as age, sex, duration of exposure and smoking. The pulmonary function of the workers having tuberculosis was also found to be deteriorated. This deterioration in pulmonary function is only noticed in the advanced stages of the disease when much of the lung tissue is damaged, so that a periodic measurement of lung functions should be done for detecting lung abnormalities in the early stage. There is immediate need to formulate a comprehensive, occupational and environmental health management strategy for stone crushers. Remedial and control measures can improve the environmental conditions at the stone crushers to a considerable extent by which the crusher workers health can be improved.

Most of the stone crushers in these areas have inadequate dust control system so that dust emission is substantial which leads to adverse impact on workers health and as well as surrounding environment. No health facilities are being provided to the workers at most of the mining site. It is therefore suggested that the workers should be provided with suitable disposable type dust respirators for respiratory protection. Workers should be informed of the hazardous nature of silica dust, the results of workplace monitoring and medical tests, and the correct usage and maintenance of respirators. Adequate general ventilation must be provided to draw dust away from the workers. Spraying water can reduce the amount of silica dust. Growing the green belt along the periphery of the crushing unit or the crushing zone may reduce the dust in crushing units and nearby areas.

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