Section: Community Medicine

Original Research Article

OCCUPATIONAL HEALTH INITIATIVE: SILICOSIS SCREENING CAMP FOR STONE CRUSHER ZONE WORKERS IN FARIDABAD, HARYANA, INDIA

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ABSTRACT

Background: After agriculture, industries are the second largest sector where the workforce of India is employed. They are economically productive population whose right to health is country's responsibility. Stone crushers are one such sector which contribute to the raw material for any infrastructure of the country. **Objective:** Hence the workers employed in stone crusher zones were screened for silicosis using camp based approach.

Material and Methods: A descriptive study was conducted among 40 crusher sites of Faridabad, Haryana. 159 workers were screened for symptoms and signs of any respiratory illnesses and lifestyle disorders. Chest X ray was conducted for those screened by a respiratory medicine physician based on clinical history, examination. Workers with findings suggestive for silicosis on X ray were called for high resolution commuted tomography (HRCT) at the tertiary care center.

Results: On screening the 159 workers 36.5 % reported history of breathlessness, 35.8% had cough (dry and expectorant). Median duration of cough was 20.0 (IQR; 7.0-30.0) days. 66 were found eligible for X ray, of which 17 workers reports were suggestive of silicosis and 49 were either reported as infective etiology or other abnormalities which needed further investigations. Of these 17 only 11 turned up to the tertiary care center and HRCT conducted on them all were suggestive of silicosis changes in lungs.

Conclusion: Out of 159 workers 6.9% were found with silicotic changes in their lungs. Catching them early in the course of disease is the motive of camp based screening. Owing to their socio economic status and being mostly a daily wager; leaving the job remains a dilemma for the worker.

Keywords: Restrictive lung disease, Quary workers, ESIC insured workers.

INTRODUCTION

Stone crushers in India produce crushed stone of variable size as raw material for various construction of roads, bridges, buildings, etc. It provides employment to many engaged as miners, operator of machines crushing plant, transportation, etc. This sector is major source of earning for uneducated or less educated poor unskilled men who migrate from rural areas to suburban and urban areas. Most of these crushers are located nearby cities where major construction is under process.[1]

The stone crushing industry is source of dust, fine particulate matters of silica and heavy metals suspended in air for long time. These particulate matters pose various health threats related to eye, skin, and lungs. The eligible workers at these stone crusher zones are insured under Employees state insurance (ESI) act, under which they are liable to be provided with sickness, medical and other benefits. The medical benefits are provided at ESI dispensaries and hospitals. Many a times the workers in fear of losing their daily pay cannot attend the dispensary for their signs and symptoms.

Department of Community Medicine of ESIC MC and Hospital, Faridabad has been involved to conduct daily health screening camps in the factories. Workers are screened at their work place by a team of doctors and paramedical staffs on all working days. This initiative has been found to be a great benefit for the workers as they get necessary investigations and health advice at their work place. It has not only saved their wages for the day many chronic diseases like high blood pressure and diabetes have been diagnosed in these camps.

Silicosis is the major health hazard in workers exposed to silica all over the world.[2] Stone cutter workers are at increased risk for developing silicosis.[3,4] Silicosis remains one of the most ancient occupational lung diseases, yet it continues to result in substantial illness and death globally.[5]

Using this camp approach, the stone crusher zone workers were screened for symptoms suggestive of silicosis and those who were found positive on screening were called to the hospital for further work up.

MATERIAL AND METHODS

A descriptive cross sectional study was conducted in form of health screening camp at stone crusher zone situated in Pali, Faridabad, a north India district in state of Haryana. It was conducted between February and April 2023. There were around 40 crushers working in the area. A total of 159 workers present at the time of visit were examined.

Data Collection

A team of doctors along with paramedical staffs like X ray technician, Lab assistants were part of the medical team who visited the area. Data was collected using a close ended, structured questionnaire having five sections- socio-demographic, personal habits, general physical examination, anthropometry, and basic lab investigations.

Weight was measured using standardized portable scale. Height was measured using a stature meter. Blood Pressure was measured after 10 minutes' rest, with subjects in a seated position using OMRON digital automatic BP apparatus (HEM-7121J). Systolic and Diastolic Blood Pressure (SBP & DBP respectively) were measured over two readings, with the average of two readings recorded.

Study Variables

Hypertension: Hypertension was defined according to the eighth report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (JNC 8) as systolic value of ≥ 140 mmHg AND / OR diastolic ≥ 90 mmHg. Person who was already diagnosed by a registered medical practitioner and/or was put on anti-hypertensive drugs was used as known case of hypertension.

Obesity: Body mass Index (BMI) calculated as per Quetlets formula (Wt. (kg)/ Ht. $(m)^2$) of between equal to 23-24.99 was considered overweight and more than or equal to 25 was considered as obese.

Silicosis: The findings of chest X-ray and high-resolution computed tomography (HRCT) were noted as per the National Institute for Occupational Safety and Health of the Centers for Disease Control and Prevention (CDC/NIOSH 2.8(e), Revised January 2015) and International Labor Organization (ILO-2011) classification of radiograph of, pneumoconiosis for epidemiological investigation.[6] The radiological observations of all patients were reported based on mutual consensus among respiratory physicians, and in-case of discrepancy, an opinion was sought from a radiologist.

Ethical Consideration

Ethical approval was obtained from the Ethics Committee of ESIC Medical College and Hospital, Faridabad, Haryana before the commencement of the study (registered number 134X/11/15/2023-IEC/DHR/121). Informed verbal consent was obtained from all participants, ensuring their voluntary participation after informing them that this information will be purely used for academic purposes. The manuscript does not contain any individual person's data in any form. All the workers with positive finding while screening was given further diagnostic and curative services at the center where the study was conducted.

Statistical Analysis

The collected data was entered in Microsoft spreadsheet and analysed for descriptive statistics. Test of significance like chi square (for categorical variables) and ANOVA (for continuous variables) were conducted using Epi info version 7.

RESULTS

About 159 male workers participated in the camp. All used to work in one shift only. The mean age of the participant was 35.5 with SD of 8.6 years. Majority resided in rural area (71.1%) and more than half were educated upto primary school (56.6%). 5% of the workers were known hypertensives and 34.6% were screened to be hypertensive as per criteria of BP more than 140 and/or 90 mm of Hg. Two workers had history of treatment completed pulmonary TB (1.3%). Around half of the workers were obese according to Asian BMI criteria (50.9%). On history and examination, 36.5 % of participants reported history of breathlessness, 35.8% had cough (dry and expectorant). Median duration of cough was 20.0 (IQR; 7.0-30.0) days. [Table 1]

The participants with any symptom were further evaluated by a chest physician present in the camp. 66 individuals were further advised chest X-ray based on respiratory examination. The chest X rays were conducted using portable X ray machine at the site of camp. All 159 participants were advised for blood examination for blood count, hemoglobin,

liver, and kidney function. Out of 159 only 147 consented to give blood sample for examination.

The reporting of abnormal chest X rays was done by the radiologist at the tertiary care center. Out of 66, X rays of 17 participants were suggestive of silicosis and 49 were either reported as infective etiology or other abnormalities which needed further investigations. Those with other abnormalities were sent for sputum examination and other evaluation by chest physician. Most of the participants whose X rays were suggestive of silicosis were operators in the stone crusher zone. All the workers whose X rays were suggestive of silicosis were contacted and requested to get their HRCT chest done. Out of 17 workers of crusher zone, 11 workers underwent HRCT chest and the report was found to be suggestive of silicosis. (Figure 1) Rest of the workers could not be contacted.11.1% in 20-29 years and 17.1% in 30-39 years age group were diagnosed with silicosis. One out of two participants with age more than 60 years had silicotic changes and other had other abnormal X ray findings. Mean duration of per day working hours was slightly higher among those with silicosis (10.18 hours (2SD;1.74)) as compared to those with other findings in CXR (10.14 (1.83)). Out of those working all days a week at stone crushers had a higher proportion of silicosis (12.1%) and abnormal chest X ray findings (34.5%) as compared to those who worked six days a week. [Table 2]

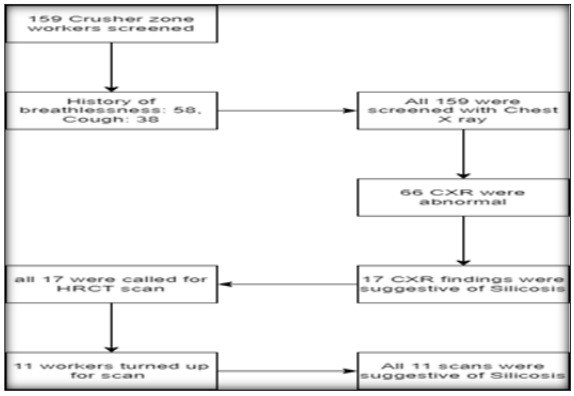

Figure 1: Flow of screening and diagnosis

Overweight and obesity was prevalent in all types of participants (silicosis, abnormal CXR and normal). Known case of Diabetics was highest among the Silicosis patients (23.5%) as compared to other groups. One case diagnosed with silicosis had history of pulmonary TB. Four cases with silicosis changes presented with no symptoms (23.5%). Average Hemoglobin of the participants was 14.8 gm/dl (min of 7.1gm/dl to 17.7gm/dl) and average serum protein was 8.3gm/dl. [Table 3]

Table 1: Socio demographic characteristics of the participant in crusher zone

	Characteristics	Frequency (%)
Age in years	20 –29	40 (25.2)
	30–39	72 (45.3)
	40–49	35 (22.0)
	50–59	10 (6.3)
	>=60	2 (1.3)
Education	Above graduation	2 (1.3)
	Upto graduation	5 (3.1)
	Upto matriculation	33 (20.8)
	Upto primary school	90 (56.6)
	Illiterate	29 (18.2)
Residence	Rural	113 (71.1)
	Urban	46 (28.9)
Marital status	Married	137 (86.2)
	Unmarried	22 (13.8)
Occupation nature	Driver	8 (5.0)
	Loader	35 (22.0)
	Accountant and other office work	43 (27.0)
	Machine Operator	73 (45.9)
Mean Working Hours (SD)		9.97 (1.75)
No. of working days in a week	Six	43 (27.0)
	Seven	116 (73.0)
Distance of residence from work place (km)	1 - 10	132 (83.0)
	11 - 20	22 (13.8)
	>20	5 (3.1)
Comorbidity	Diabetes Mellitus (DM)	15 (9.4)
	Hypertension (HTN)	5 (3.1)
	HTN and DM	3 (1.9)
	Pulmonary Tuberculosis (TB)	2 (1.3)
	None	134 (84.3)
Hypertension	Known case of HTN	8 (5.0)
	HTN on screening (BP: ≥140 and/or 90)	55 (34.6)
	Normal (BP: <140/90)	96 (60.4)
BMI (Kg/m2)	Underweight (<18.5)	5 (3.1)
	Normal (18.50-22.99)	37 (23.3)
	Overweight (23.00-24.99)	36 (22.6)
	Obese (>25.00)	81 (50.9)

Symptoms (current)	Breathlessness	58 (36.5)
	Weight loss	8 (5.0)
	Cough dry	19 (11.9)
	Cough expectoration	38 (23.9)
	Fever	2 (1.3)
	None	48 (30.2)
Signs on general physical examination	Pallor	8 (5.0)
	Icterus	16 (10.1)
	Clubbing	8 (5.0)
	Pedal edema	2 (1.3)
	None	132 (83.0)

Table 2: Distribution of demographic profile of the participants according to the radiograph findings

	Chest X ray findings				
	Silicosis N (%)	**Abnormal X Ray (Increased BV marking, LN, Infective) N (%)**	**Normal N (%)**	**Total**	**p value**
Total	17(10.7)	49(30.8)	93(58.5)	159(100.0%)	
Age group in years					
20 –29	1 (2.5)	9 (22.5)	30 (75.0)	40(100)	0.15
30–39	8 (11.1)	23 (31.9)	41 (56.9)	72(100)	
40–49	6 (17.1)	12 (34.3)	17 (48.6)	35(100)	
50–59	1 (10.0)	4 (40.0%)	5 (50.0)	10(100)	
>=60	1 (50.0)	1 (50.0)	0	2 (100)	
Education					
Above graduation	2 (6.9)	8 (27.6)	19 (65.5)	29 (100)	0.71
Upto graduation	13 (14.4)	30 (33.3)	47 (52.2)	90 (100)	
Upto matriculation	2 (6.1)	9 (27.3)	22 (66.7)	33 (100)	
Upto primary	-	1 (20.0)	4 (80.0)	5 (100)	
Illiterate	-	1 (50.0)	1 (50.0)	2 (100)	
Type of work					
Driver	-	3(37.5)	5 (62.5)	8 (100)	0.27
Loader	2 (5.7)	16 (45.7)	17 (48.6)	35 (100)	
Office work	4 (9.3)	11 (25.6)	28 (65.1)	43 (100)	
Operator/ Machineworker	11(14.9)	19(25.6)	43(58.9)	74(100)	
Type of residence					
Rural	12 (10.6)	36 (31.9)	65 (57.5)	113 (100)	0.90
Urban	5 (10.9)	13 (28.3)	28 (60.9)	46 (100)	
Marital status					
Married	16 (11.7)	45 (32.8)	76 (55.5)	137 (100)	0.15
Unmarried	1 (4.5)	4 (18.2)	17 (77.3)	22 (100)	
Mean duration of working hours (SD) per day	10.18 (1.74)	10.14 (1.83)	9.84 (1.72)	9.97 (1.75)	0.54
Number of working days in a week					
Six	3 (7.0)	9 (20.9)	31 (72.1)	43 (100)	0.11
Seven	14 (12.1)	40 (34.5)	62 (53.4)	116 (100)	
Distance of residence from work place (km)					
1 - 10	14 (10.6)	39 (29.5)	79 (59.8)	132 (100)	0.60
11 - 20	3 (13.6)	9 (40.9)	10 (45.5)	22 (100)	
>20	-	1 (20.0)	4 (80.0)	5 (100)	

Table 3: Distribution of Morbidity profile of participants among the groups divided based on Chest X ray findings

	Chest X ray findings			
	Silicosis N (%)	**Abnormal CXR (Increased BV marking, LN, Infective) N (%)**	**Normal N (%)**	**Total**
Total	17(100)	49(100)	93(100)	159(100)
BMI (Kg/m2)				
Underweight (<18.5)	-	-	5 (5.4)	5 (3.1)
Normal (18.50-22.99)	3 (17.6)	8 (16.3)	26 (28.0)	37 (23.3)
Overweight (23.00-24.99)	6 (35.3)	9 (18.4)	21 (22.6)	36 (22.6)
Obese (>25.00)	8 (47.1)	32 (65.3)	41 (44.1)	81 (50.9)

HTN as per BP measurement				
HTN (BP: ≥140 and/or 90)	8 (47.1)	23 (46.9)	32 (34.4)	63 (39.6)
Normal (BP: <140/90)	9 (52.9)	26 (53.1)	61 (65.6)	96 (60.4)
Known comorbidity				
Diabetes Mellitus	3 (17.6)	4 (8.2)	8 (8.6)	15 (9.4)
Hypertension	-	2 (4.1)	3 (3.2)	5 (3.1)
HTN and DM	1 (5.9)	-	1 (1.1)	2 (2.2)
Pulmonary TB	1 (5.9)	-	1 (1.1)	2 (1.3)
None	12 (70.6)	43 (87.8)	79 (84.9)	134 (84.3)
Symptoms*				
Breathlessness	5 (29.4)	22 (44.9)	31 (33.3)	58 (36.5)
Dry cough	4 (23.5)	7 (14.3)	8 (8.6)	19 (11.9)
Cough with expectorant	4 (23.5)	10 (20.4)	24 (25.8)	38 (23.9)
Weight loss	-	3 (6.1)	5 (5.4)	8 (5.0)
Fever	-	-	2 (2.2)	2 (1.3)
None	4 (23.5)	12 (24.5)	32 (34.4)	48 (30.2)
Median duration of cough in days (IQR)	20.0 (14.0-20.0)	15.0 (6.0-60.0)	17.0 (4.75-30.0)	20.0 (7.0-30.0)
Signs*				
Pallor	-	-	-	8 (5.0)
Icterus	4 (23.5)	1 (2.0)	11 (11.8)	16 (10.1)
Clubbing	2 (11.8)	1 (2.0)	5 (5.4)	8 (5.0)
Pedal edema	1 (8.9)	-	1 (1.1)	2 (1.3)
None	9 (52.9)	47 (95.9)	76 (81.7)	132 (83.0)
Mean Hemoglobin (g/dl) (SD)	15.1 (1.3)	14.8 (1.6)	14.8 (1.6)	14.8 (1.6)
Mean Total leucocyte count (SD)	8145.1 (1912.6)	8066.1 (2007.2)	7802.2 (1866.2)	7919.0 (1905.7)
Mean Creatinine (SD)	0.8 (0.1)	0.9 (0.1)	0.9 (0.1)	0.9 (0.1)
Mean Uric acid(SD)	5.3 (1.0)	5.6 (0.9)	5.5 (1.2)	5.5 (1.1)
Total protein	8.5 (0.5)	8.5 (0.7)	8.2 (0.5)	8.3 (0.6)
Median SGOT (IQR)	44.0 (27.5-54.0)	35.0 (26.0-42.0)	36.0 (28.0-42.0)	36.0 (28.0-44.0)
Median SGPT (IQR)	36.0 (25.0-55.0)	39.0 (32.0-58.0)	36.0 (26.0-53.0)	36.0 (36.0-53.0)

***multiple answers**

DISCUSSION

Based on chest X ray findings the prevalence of silicosis among screened workers was 10.7% whereas after removing the missing population the diagnosis based on CT scan yielded the prevalence to be 6.9%. This finding is particularly concerning, given the severe health implications of silicosis, including progressive lung damage and respiratory impairment. Govindagoudar MB et al., in their study from same area on crusher workers reported a prevalence of 9% using radiological diagnosis.[7] Nandi et al., in their analysis on sand stone workers of Rajasthan reported 52% with evidence of silicosis based on chest radiographs and 7.5% of those who had evidence of silicosis had progressive massive fibrosis.[8]

Majority of the occupationally exposed workers to stone dust belonged to 30-39 years age group. This was a decade lower as compared to workers in Rajasthan and Haryana where majority belonged to 40-49 years age group (34.6% and 41% respectively).[7,9] More than half attained formal education up to primary school. The majority of stone mine workers from central Rajasthan were illiterate (80%) which was in contrast to profile of workers from current study area where illiteracy was reported from 18% only.[9] However the profile of stone crusher workers from Bhopal by Narkhede et al., reported illiteracy rate of 10.4% only.[10]

Majority of workers were operating the machine used for crushing the stone (45.9%). In a case study by Marichamy V from 11 stone crushers of a district in Tamil Nadu 30% of the workers were engaged as operator or mechanic.[11] Contrast to current findings more than half of the workers from central Rajasthan used to break stones using chisel and hammer.[9] Majority of workers in the current study area worked all seven days a week and mean working hours of 9.97 hours a day. Concurrent to this the 38% of workers from Bhopal worked more than 10 hours a day and 33.8% worked 5-10 hours a day. Furthermore, the association between extended working hours and a higher incidence of silicosis warrants attention. The data suggests that workers with silicosis tend to work slightly longer hours per day, which may contribute to increased exposure to harmful occupational agents, thus elevating the risk of developing the disease.

Interestingly, a significant proportion of the workers diagnosed with silicosis exhibited no symptoms (23.5%), highlighting the insidious nature of the disease and the need for regular screening and comprehensive health assessments, particularly for individuals exposed to occupational hazards. Breathlessness was reported by majority of workers (36.5%) which was higher as compared to that reported by workers of Bhopal (29.9%). Cough with expectoration was the next most common symptom (23.9%) and median duration was highest among

those with silicosis. Sachdeva RA et al., in their profile of silicosis diagnosed patients from the tertiary care center reported more than 90% breathlessness as symptom and 61.9% with cough.[12] The data highlights some concerning health trends among the workers. Notably, a small percentage were known hypertensives (5%), while a significant proportion (34.6%) were identified as potentially hypertensive based on blood pressure criteria (>140/90 mm of Hg). Furthermore, a striking 1.3% of the workers had a history of completed pulmonary TB, suggesting a potential history of exposure to infectious agents. Machines have taken over manual labour work which has eased the work and reduce the vigorous activity to moderate or sedentary. Another key finding was the prevalence of obesity among the workers, with approximately half (50.9%) meeting the criteria for obesity according to Asian BMI standards. This high prevalence is particularly notable in the context of the health risks associated with obesity, such as cardiovascular diseases and metabolic disorders.

Studies across India have focused on pulmonary function of stone crusher workers. With the epidemiological transition other lifestyle diseases have also set in. Workers who were known case of diabetes were higher in proportion as compared to known case of hypertension among the current study population.

CONCLUSION

The data emphasizes the critical need for comprehensive occupational health and safety measures, early detection of occupational diseases, and the implementation of effective preventive strategies in high-risk industries. It is imperative to prioritize the well-being of workers by implementing stringent occupational health regulations, regular health screenings, and appropriate safety protocols to minimize the adverse health impacts associated with occupational hazards.

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Contribution: MK, MS, concept, and design; SS, data collection; LP, PG, analysis and interpretation of results. All the authors have read and approved the final version of the manuscript and agreed to be accountable for all aspects of the work.

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