



## EVALUATION OF EXERCISE CAPACITY AND DIFFUSION STUDY IN APPARENTLY HEALTHY SELAM (SILICA BASED INDUSTRY) WORKERS IN AGRA REGION

### Medicine

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### ABSTRACT

**Introduction:** Occupational exposures play an important role in many diseases. Hazardous exposure in the work place and elsewhere in environment continue to contribute in the burden of lung diseases. Workers working in silica based industries in Agra region of northern India are called Selam Workers.

**Aims And Objectives:** Evaluation of exercise capacity and diffusion study in apparently healthy Selam workers in Agra region. To assess the relationship between exercise tolerance and diffusion capacity in Selam workers.

**Material & Methods:** An observational and randomized case(n=30) control(n=28) study was carried out between apparently healthy selam workers and unexposed healthy persons of Agra region. Inclusion Criteria was apparently healthy selam workers who were engaged in this occupation for at least five years and age less than 75 years. Persons having active pulmonary tuberculosis, cor-pulmonale, cognitive impairment, diabetes mellitus, history of recent surgery and history of recurrent haemoptysis were excluded from the study.

**Results:** All the patients of mean age 28.76 years, were properly matched with no significant difference with respect to age, sex, height, weight and BMI. On comparing cases with controls, there was no significant difference in oxygen saturation (Mean+SD) at rest ( $p=0.073$ ), functional exercise capacity as judged by six minute walk distance (Mean+SD) ( $p=0.597$ ), respiratory rate at rest (mean+SD) ( $p=0.131$ ) and diffusion lung capacity (DLCO) (Mean+SD) ( $p$  value=0.348).

**Conclusion:** Studies with large sample size and longer duration of exposure are needed to evaluate effects of silicosis.

### KEYWORDS

#### INTRODUCTION

Occupational exposures that can cause lung diseases (Pneumoconiosis) are mineral dust (asbestos, silica and coal), biological factors (animal exposure, microbial agents), metals (beryllium, cobalt, aluminum) or inorganic gases (carbon mono-oxide, chlorine, nitrogen oxide) in various industries like mining, agriculture, forestry or welding. Historically, *Pneumoconiosis* has been the most commonly diagnosed occupational lung disease. Worldwide *Silicosis* remains the most common occupational lung disease. Industries involved in silicosis include stone cutting, quarrying and rock blasting, construction and founding of ferrous and non-ferrous metals. Silicosis develops from the inhalation of silica particles in the lung parenchyma and the tissue reaction to it which is characterized by discrete nodular pulmonary fibrosis and as the disease progresses by conglomerate fibrosis and respiratory impairment. People suffering from silicosis are also at increased risk of other pulmonary diseases, such as bronchitis, tuberculosis and lung cancer.

Features of silicosis include shortness of breath, fever, loss of appetite, chest pain and ultimately respiratory failure. Breathlessness, a hallmark symptom of silicosis is present on unusual effort initially but eventually, present during day to day activity or even at rest. *Exercise intolerance* a characteristic and troubling manifestation, is because of a combination of exertional dyspnoea and lack of fitness. These reduce social interaction and promote depression, which further worsens the impact of dyspnoea. This vicious cycle of social isolation, depression, immobility, dyspnoea and lack of fitness in silicosis contribute greatly to morbidity associated to silicosis.

A number of *diagnostic* tests can be helpful in the diagnosis of silicosis such as chest radiography, CT & HRCT and Pulmonary Function Tests (PFTs). PFTs include spirometry, lung volumes and diffusion capacity. The pulmonary diffusing capacity ( $D_L$ ) of a gas provides an estimate of its rate of transfer from the alveoli into capillary blood. The only gases that have measurable diffusing capacities are those with low solubility in blood, these gases include oxygen, carbon-mono-oxide and nitric oxide.

#### REVIEW OF LITERATURE

The name *silicosis* (from the Latin *silex*, or flint) was originally used in 1870 by Achille Visconti (1836-1911), prosecutor in the Ospedale Maggiore of Milan. In 1713, Bernardino Ramazzini noted asthmatic symptoms and sand-like substances in the lungs of stone cutters.

Owens GR et al (1984) evaluated 48 patients with COPD by means of pulmonary function and exercise testing to determine whether any tests of pulmonary function could predict the development of arterial desaturation during exercise and found that only two indices – diffusion capacity of lung and forced expiratory volume in one second were predictive of desaturation. Nordenfelt I et al (1987) studied 30 patients with both restrictive and obstructive diseases and conducted ordinary pulmonary functions tests and in addition the diffusion capacity was measured at rest. Nellore Mohan Rao et al (2006) conducted study among 106 female quartz grinders at Chota Udepur, Vadodara district, Gujarat State. Mohsenifar Z et al (2003) demonstrated that patients with reduced DLCO, particularly when <20% of predicted, were more likely to have reduced PaO<sub>2</sub> at rest and are more likely to require supplemental oxygen with low levels of activity.

#### AIMS AND OBJECTIVES

1. Evaluation of exercise capacity and diffusion study in apparently healthy Selam workers in Agra region.
2. To assess the relationship between exercise tolerance and diffusion capacity in Selam workers.
3. To evaluate the rate of decline in diffusion capacity and exercise capacity.

#### MATERIAL & METHODS

An observational and randomized case(n=30) control(n=28) study was carried out between apparently healthy selam workers and unexposed healthy persons of Agra region.

#### Inclusion Criteria

- Apparently healthy selam workers who were engaged in this occupation at least for five years.
- Age less than 75 years
- Controls- who are not exposed to selam

#### Exclusion Criteria

Persons having active pulmonary tuberculosis, cor-pulmonale, cognitive impairment, diabetes mellitus, history of recent surgery, history of recurrent haemoptysis, neuromuscular disorders, pleural effusion, respiratory failure, oxygen saturation less than 88% at rest.

Lung Function Assessment, Nutritional Status Assessment, Body Mass Index and Exercise Performance Assessment were done for all patients.

**Six Minute Walk Test (6 MWT)** : This is a timed walk test for objective evaluation of functional exercise capacity. This self-paced timed walk test assesses the submaximal level of functional capacity. Because most activities of daily living are performed at submaximal levels of exertions, the 6 M WT may better reflect the functional exercise level for daily physical activity.

## OBSERVATIONS AND RESULTS

### Distribution Of Cases And Controls According To Height, Weight And Body Mass Index (BMI)

Group	Height (meters) (Mean±SD)	Weight (kg) (Mean±SD)	BMI (kg/m <sup>2</sup> ) (Mean±SD)
Cases (n=30)	165.89±4.47	62.58±9.45	22.86±3.20
Controls (n=28)	169.50±6.47	69.21±8.85	24.28±2.29

### Distribution Of Cases And Controls According To Different Characteristics

S No	Characteristic (distribution of cases and controls)	Cases (n=30)	Controls (n=28)	p Value
1.	Base Line Functional Exercise Capacity (Six Minute Walk Distance) (Mean±SD)	542±46.79	535±46.77	0.597
2.	Blood oxygen saturation (SaO <sub>2</sub> ) (Mean±SD)	95.4±1.75	96.3±2.09	0.074
3.	Respiratory rate at rest (Mean±SD)	20.13±2.55	19.17±2.19	0.131
4.	Respiratory rate after exercise (6MWT) (Mean±SD)	21.26±2.30	20.67±3.28	0.432
5.	Diffusion Lung Capacity (DLCO) (Mean±SD)	27.48±4.61	28.63±4.71	0.349

### Comparison Of Differences In Diffusion Lung Capacity (DLCO) According To Duration Of Exposure In Selam Industry

Group	Duration of exposure	diffusion lung capacity (DLCO) Mean ± SD	p Value
Case (n=14)	5-10 yrs	29.47±3.58	0.234
Control (n=12)	5-10 yrs	31.73±4.12	
Case (n=10)	>10 yrs	28.70±2.74	0.749
Control (n=10)	>10 yrs	29.14±3.44	
Case (n=6)	>15 yrs	21.54±4.76	0.573
Control (n=6)	>15 yrs	22.78±2.12	

### Comparison Of Differences In Exercise Capacity (6MWT) According To Duration Of Exposure In Selam Industry

Group	Duration of exposure	6MWT Mean ± SD	p Value
Case (n=14)	5-10 yrs	543.28±47.27	0.883
Control (n=12)	5-10 yrs	540.75±38.53	
Case (n=10)	>10 yrs	559.30±41.77	0.719
Control (n=10)	>10 yrs	551.40±54.28	
Case (n=6)	>15 yrs	510.16±43.93	0.542
Control (n=6)	>15 yrs	496.50±29.70	

## DISCUSSION

Silicosis causes fibrosis and destruction in the lung that proves fatal in due course of time. In India, an estimated three million workers are exposed to silica in mines and in industries, such as stone cutting, silica milling, agate, slate pencil, etc. Among these, the highest prevalence of silicosis is in the slate pencil industry (54.5%) followed by workers in agate industries (38%).

In present study, all the patients of mean age 28.76 years, were properly matched with no significant difference with respect to age, sex, height, weight and BMI.

When we compared diffusion lung capacity (DLCO) between cases (n=30) and controls (n=28) then we found that there was decrease in DLCO in cases as compared to control but statistically it was not significant (p=0.34).

We compared *diffusion lung capacity* (DLCO) between two groups according to *duration of exposure*. On comparing between 5-10 years duration, we found that there was decrease in DLCO in cases but statistically it was not significant (p=0.238). When duration of exposure was >10 years, we found that there was decrease in DLCO in cases but statistically it was also not significant (p=0.749). When duration of exposure was >15 years, we found that there was decrease in DLCO in cases but statistically it was not significant (p=0.574).

When we compared *functional exercise capacity* (6MWT) between cases (n=30) and controls then there was decreasing trend in 6MWT values in cases as compared to control but statistically it was not significant (p=0.597). When duration of exposure was between 5-10 years then we found that there was decrease in 6MWT in cases but statistically it was not significant (p=0.883). When duration of exposure >10 years then we found that there was decrease in 6MWT in cases but statistically it was not significant (p=0.719). When duration of exposure was >15 years then we found that there was decrease in 6MWT in cases but statistically it was not significant (p=0.541).

We compared *Arterial Oxygen saturation* (SPO<sub>2</sub>) between cases (n=30) and controls (n=28). We found that there was decrease in SPO<sub>2</sub> in cases as compared to control.

We compared *respiratory rate* between cases (n=30) and controls (n=28). We found that there was increase in respiratory rate after 6MWT although statistically it was not significant (p=0.431).

## CONCLUSION

In the present study, we found changes in cases versus controls, but they were statistically insignificant. Further studies should be conducted for larger samples with longer duration of observation, may be for 20-25 years time period to evaluate the effects of silicosis.

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