

# Effect of Chalk Dust Exposure on PEFR and CAT in School Teachers

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## Abstract

In teachers, occupational exposure to chalk dust is very common. Classrooms contain of fine particulate matter that source from chalk dust.

To further evaluate and study the symptoms of respiratory illness in school teachers, the present study was conducted in order to evaluate individual's degree of obstruction using the PEFR, and its impact on their overall health, using COPD assessment test.

This comparative study was conducted in 40 School teachers and 40 normal healthy individuals. The data for this study was collected using mini Bell's PEFR device and the COPD Assessment test (CAT). An analysis of the data showed that the mean CAT score of group A (teachers) was significantly higher ( $p=0.001$ ) than group B (normal individuals). The mean PEFR for group B was higher than group A, although the difference was not statistically significant.

Hence, the study concluded that respiratory symptoms significantly impacted the health of school teachers. They also showed signs of airway obstruction as compared to normal individuals.

**Keywords:** chalk dust exposure, PEFR, CAT, teachers.

## Introduction

Any infectious disease of upper or lower respiratory tract is termed as respiratory tract infection. Laryngitis, common cold, pharyngitis, acute rhinitis are few upper respiratory tract infection. Some examples of lower respiratory tract infections are acute bronchitis, bronchiolitis, pneumonia etc. <sup>(1)</sup>. The main causes of respiratory tract infections were found to be allergens, smoking, bacterial viruses, direct contact with an infected person etc <sup>(3)</sup>. Whereas it was found that respiratory tract infections (RTI) can also be caused due to indoor air pollution in households using biomass fuels <sup>(4)</sup>.

Acute respiratory tract infections cause 3.9 million deaths every year, throughout the world, as per World Health Organization. <sup>(5)</sup> Studies have shown that RIT's prevails in about 33.5% of people in India <sup>(15)</sup>. In a study done on teachers in India, the prevalence of various respiratory symptoms was found to be 28.35% <sup>(16)</sup>.

In teachers, occupational exposure to chalk dust is very common. Classrooms contain of fine particulate matter that source from chalk dust. Limestone or gypsum are usually the main constituents of chalks. Kaolinite, carboxy methyl, poly vinyl alcohol, starch etc are also present in small quantities; colored chalks contain some metals <sup>(6)</sup>. Studies have stated that there was increased prevalence of respiratory symptoms in natural chalk factory workers <sup>(7)</sup>. A study conducted in Spain showed that frequent use of the duster or chalk in class was associated with an increased risk of respiratory symptoms <sup>(8)</sup>. A study done on school teachers showed that the deposition of chalk dust in lung has caused interstitial pneumonia with multiple bullae <sup>(9)</sup>.

Another risk factor for respiratory impairment can be poor ventilation of the classrooms <sup>(10)</sup>. It is seen that there is a regular exposure to pollen grains of the teachers in the school play gardens. Pollen grains are aeroallergens and are important cause of pollinosis. Inhalation of

airborne pollen directly targets the respiratory system and in turn causes allergic rhinitis, allergic alveolitis, asthma etc.<sup>(11)</sup>.

The severity of obstructive airway disease is assessed using various Lung function tests. They evaluate the effects of various therapeutic regimens and provide a better understanding of disordered pulmonary physiology. One such accepted index of pulmonary function is PEFr and is widely used in respiratory medicine<sup>(12)</sup>.

Measurement of PEFr is simple, non-invasive, rapid and economical method to access the strength and speed of expiration in L/min, through a forced expiration from total lung capacity<sup>(12)</sup>.

Although spirometry is required for diagnosis of COPD it does not measure patient's perspective with respect to symptoms, function or overall health condition.

The COPD assessment test represents a move towards individualized treatment for COPD patients. CAT has been found to have a high validity not only in COPD but also in general population<sup>(13)</sup>. As part of the BREATHE study, CAT has been tested in general population in the Middle East<sup>(14)</sup>.

A study done on school teachers in India, who were exposed to chalk dust on daily basis stated that teachers are at an increased risk of developing occupationally related pulmonary function impairments<sup>(6)</sup>. To further evaluate and study the symptoms of respiratory illness in school teachers, we conducted the present study to evaluate the effect of chalk dust allergy using PEFr and CAT score in school teachers.

### Methodology

- Research approach: Comparative/ Analytical study.
- Sampling: convenient sampling.
- Sample size: 80 Group A- 40 School teachers. Group B- apparently healthy individuals who were non-teachers.
- Duration of study: 6 months.
- Study setting: Various schools of Mumbai.

Inclusion criteria:

- Group A:

1. Teachers using chalk and blackboard as their primary teaching aid for an average of 15 hours in a week for at least 1 year.
2. Subjects ranged from 20 to 60 years.
3. Subjects having no history of respiratory disorders in past 2-3 months.

- Group B:

1. Individuals who are not in the teaching profession.
2. Individuals who are not exposed to chalk dust.
3. Subjects ranged from 20 to 60 years.
4. Subjects who do not have history of respiratory disorders in past 2-3 months.

#### Exclusion criteria:

- Group A:

1. Smokers
2. Subjects having history of respiratory disorder in past 2-3 months.
3. Subjects currently suffering from any respiratory disorders.
4. Subjects currently on medication- spacers, bronchodilators etc.

- Group B:

1. Smokers.
2. Subjects having history of respiratory illness.
3. Subjects currently on medications- spacers, bronchodilators etc.

### Materials and Method

An ethical clearance was obtained from the institution before initiating the study. Prior consent was taken from all the subjects of this study, and their confidentiality was ensured. This comparative study was carried out in various schools of Mumbai. A total of 40 school teachers and 40 apparently healthy individuals who were non-teachers between the age group of 20 to 60 years were included in the study.

**Material used:**

- 1) Peak expiratory flow meter.
- 2) Mouthpieces

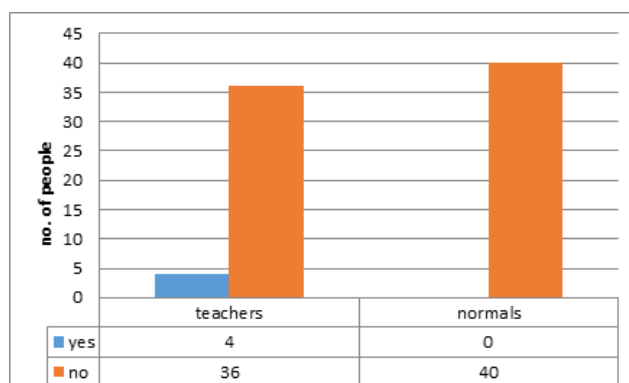
• **Method:**

Detailed history was obtained from each participant and brief examination was performed. PEFR was measured using mini bell PEFR device in sitting position. Three readings were taken and the best of three reading was considered. CAT was given to the subjects and based on the answers the CAT score was evaluated. Data was analyzed using unpaired t test for comparison between the study group and controls. The information obtained was presented in the form of Tables and graphs.



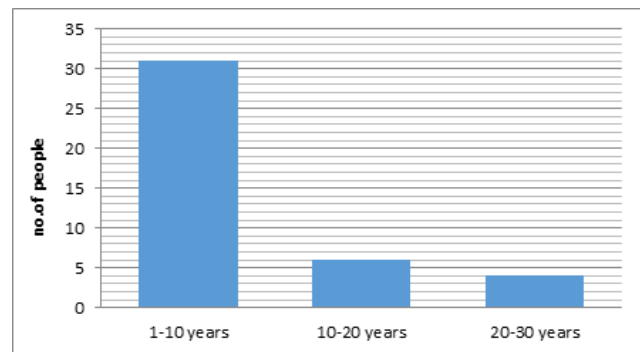
Figure 1: Assessment of PEFR

**Results and Findings**



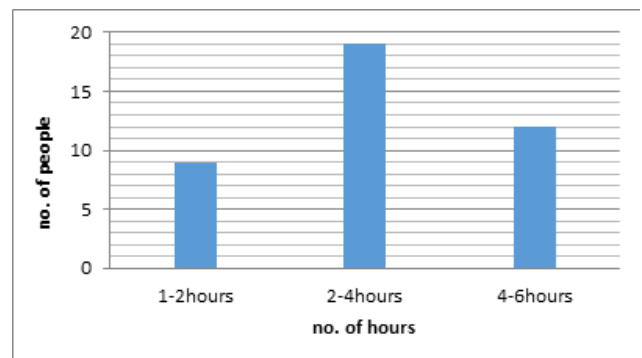
Graph 1: Distribution based on previous respiratory illness

**Inference:** 4 subjects from group A had history of respiratory illness.



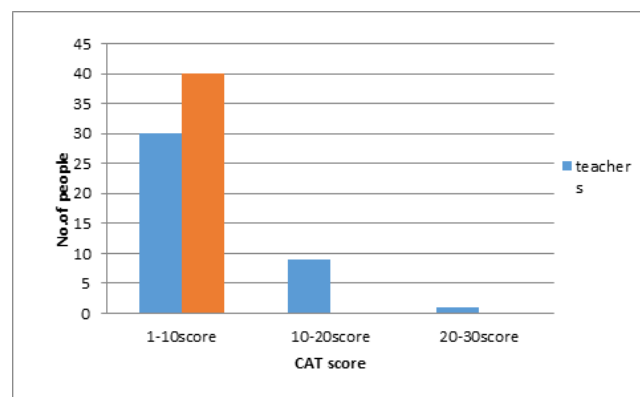
Graph 2: Distribution of the work experience of group A

**Inference:** graph 2 shows the maximum teachers (31) had teaching experience between 1 -10 years.



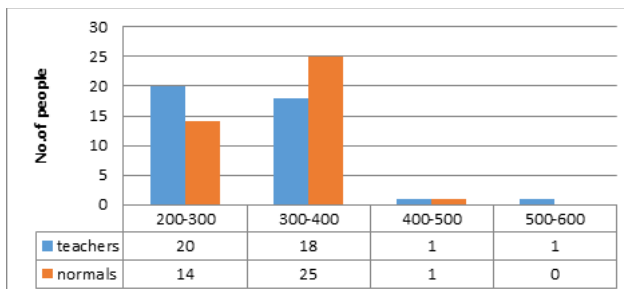
Graph 3: Distribution based on number of hours exposed to chalk dust by group A on daily basis

**Inference:** graph 3 depicts that the number of hours group A is exposed to chalk dust on daily basis is 2-4 hours with mean being  $3.52 \pm 1.28$



Graph 4: Comparison of COPD Assessment Test score between Group A and Group B.

**Inference:** The mean CAT score of group A was  $7.65 \pm 5.24$  and that of group B was  $2.2 \pm 1.43$ . The p value (0.0001) denotes high statistical significance.



**Graph 5: Comparison of Peak Expiratory Flow Rate between Group A and Group B.**

**Inference:** The mean PEFR of group A was  $340 \pm 68.12$  and that of group B was  $345 \pm 46.40$ . The p value (0.3673) was statistically not significant.

### Discussion

We conducted a study to evaluate the effects of chalk dust on PEFR and CAT in school teachers. A school was selected randomly to conduct the study. The study included a total of 80 subjects in the age group 20-60 years.

According to demographic details, the mean age of group A was found to be  $37.2 \pm 7.75$  and that of group B was found to be  $40 \pm 8.74$ . The mean BMI of group A was  $25.26 \pm 4.31$  and the mean BMI of group B was  $25.44 \pm 2.80$ .

Out of the 80 subjects, 2 were male, 1 in each group and the rest 78 were females.

The CAT is formulated such that the overall score ranges from 0-40<sup>(13)</sup>. The CAT scoring is classified into levels of impact. 5- Upper limit of normal in healthy non-smokers, <10 low, 10-20 medium, >20 high, >30 very high.

In our study out of 40 subjects from group A, 30 were in normal to low level impact category, 9 were in the medium level and 1 was in high level of impact category. Whereas, in the controls all of the 40 subjects were in the normal to low level impact category as shown in graph 4.

The CAT score comparison was done by applying the unpaired t test. It was noted that the CAT score of the teachers who were exposed to chalk dust was significantly higher as compared to controls. (P value 0.0001)

Ohtsuka et al stated in his study done on the teachers that, the school teachers who were suffering from

interstitial pneumonia and multiple bullae, had chalk dust in their lungs<sup>(9)</sup>. The main constituents of chalks are commonly found to be limestone and gypsum<sup>(6)</sup>.

Chalk dust also contains calcium sulfate or calcium carbonate which has acute health effects such as irritation to the eyes, respiratory tract, mucous membranes etc.

A previous study also states that fine particles of chalk may cause oxidative damages in alveolar macrophages and cause cytotoxicity<sup>(24)</sup>.

The measurement of PEFR is done according to the 3 zone classification of American lung association. Once the highest of three values is noted, it is classified into green, yellow or red zone. Peak flow in green depicts a good control over asthma, yellow zone indicates that the respiratory airways are narrowing and red zone indicates severe airway narrowing<sup>(25)</sup>.

In the present study the PEFR of group A was subjectively lower than compared to group B. The mean PEFR for group A was  $340 \pm 68.12$ . The mean PEFR for group B was  $345 \pm 46.40$ . However, there was no statistical significant difference in PEFR of group A as compared to group B (P value 0.3673).

Our findings were not in accordance with the study done on teachers by kamini D. Nikam, Munira A Hirkani<sup>(6)</sup>. Their study showed a significant lower PEFR in teachers as compared to controls.

The difference between the results of the two studies could be attributed to the following factors:

- less working hours of the teachers
- Conduction of study on a small sample size.
- The aerobic fitness of the subjects was not evaluated to check if the subjects are practicing daily aerobic exercises which may have given them a good lung capacity.
- Probable use of dustless chalks by some teachers.

It was observed that group B also had lower than normal PEFR. It may be due to the daily air pollution that they are exposed to. It could be indoor or outdoor air pollution. In a previous study done by E.Suguna it is stated that, one half of the world's population is exposed to solid fuel smoke produced by open fires. Solid fuel smoke has been associated with respiratory

tract infections<sup>(5)</sup>.

Other reasons for low PEFr in group B could be, having a less active lifestyle, no fitness regime etc.

In the present study it was also observed that teachers exposed to chalk dust daily for 5 or more hours either had a low PEFr or a high CAT score. The mean hours of exposure to chalk dust was  $3.52 \pm 1.28$ .

12 subjects in group A had exposure to chalk dust daily for 5 hours or more. The mean PEFr of these 12 subjects was found to be  $366 \pm 98.47$ . And the mean of their CAT was  $8.27 \pm 5.711$

### Conclusion

Thus we can conclude that the CAT was significantly higher in group A as compared to group B (p value 0.0001) indicating the affection of the respiratory airways.

PEFr of group A was subjectively lower than compared to group B. However, there was no statistical significant difference in PEFr of group A as compared to group B (P value 0.3673).

**Conflict of Interest:** The authors report no conflict of interest with respect to the present study.

**Source of Funding:** No funding was required for the present study.

**Ethical Clearance:** The study was approved by Institutional Ethical Committee of D.Y.Patil, School of Physiotherapy.

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