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Original article

Effects of Chalk dust on Peak Expiratory Flow Rate in School Teachers

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ABSTRACT

Introduction: Chalk and board is a traditional and still the most commonly used teaching aid in developing countries like India. Chalk is major source of fine particulate matter in classroom, which may produce pulmonary function impairments. **Aims and objectives:** The objective of the study was to compare Peak Expiratory Flow Rate (PEFR) of school teachers exposed to chalk dust with matched controls. **Materials and methods:** A comparative study was conducted in total of 150 participants, 75 teachers (study group) exposed to chalk dust and 75 controls. PEFR was measured in all participants using Cipla's peak flow meter with EU scale. PEFR in the study and control groups were compared for both males and females using unpaired t test. **Results:** PEFR was significantly lower in study group (teachers) as compared to controls in both males (t value -5.350, $p<0.05$) and females (t value -5.101, $p<0.05$). **Conclusion:** Teachers using chalk and board are at an increased risk of developing occupationally related pulmonary function impairments and hence there is a need to shift from routine chalk and board to marker and whiteboard.

KEYWORDS: PEFR, Chalk dust, Teacher

INTRODUCTION

Occupational and environmental lung diseases are one of the major problems of clinical medicine. About 15–20% of the burden of adult asthma and chronic obstructive pulmonary disease (COPD) has been estimated to be due to occupational factors [1]. Studies have been conducted to demonstrate adverse effects of occupational dust on the respiratory function of workers in various industries [2,3,4,5].

Occupational exposure to chalk dust is very common in teachers. Chalk and board is a traditional and still the most commonly used teaching aid in developing countries like India. Chalk dust is major source of fine particulate matter in classrooms [6,7]. Dustless or antidusting chalks which are actually less dust producing chalks are available in market [8]. But these are less commonly used in developing countries because of their high cost as compare to dusty chalks. Total amount of dust produced with dustless chalks is less as compare to dusty chalks but contain high percentage of respirable dust(<4.5 µm) [8], hence are not totally harmless.

Chalks (dusty or dustless) are commonly made up of limestone ($CaCO_3$) and/or gypsum (dehydrated form of $CaSO_4$) as their main constituent. Kaolinite (hydrated aluminum silicate), carboxy methyl cellulose (CMC), poly vinyl alcohol, starch are present in small quantities. It may also contain some impurities like sillica and colored chalks contain some metals [9].

Studies have shown that limestone (natural chalk) factory workers have increased prevalence of respiratory symptoms [10]. Results of a survey conducted in Spain showed that shaking and/or frequent use of the eraser or of chalk in class was associated with an increased risk of respiratory symptoms [11].

A comparative study showed that deposition of chalk dust in lungs has caused interstitial pneumonia with multiple bullae throughout the lungs, including the lower lobe in three patients whose lifetime occupation was teaching in school [12].

Studies conducted to demonstrate effects of chalk on respiratory function of teachers are very limited. Present work was undertaken to find if use of chalk affects the peak expiratory flow rate (PEFR) in the teachers. Out of all the pulmonary function tests, PEFR was selected for the study because it can be easily measured with a small portable instrument which can be carried to the field for testing. It gives an idea about the airway narrowing [13].

MATERIALS AND METHODS

The present study was designed as a comparative study. Cluster sampling was used to select participants from the population. Various schools and other offices were selected randomly and permission from the head of institute was obtained to conduct the study in their premises. Permission from institutional ethical committee was obtained before starting the study.

A total of 150 participants whose age ranged from 20 to 50 years were included in the study. The study group included 75 teachers using chalk and blackboard as their primary teaching aid for an average of 15 hours in a week for at least one year. The controls were 75 people residing in the same region but having no exposure to chalk dust or any other occupational dust. Smokers and those having history of any major illness affecting respiratory system were excluded from the study. Persons currently suffering from respiratory illness were also excluded from the study.

Informed written consent was obtained from each participant. Detailed occupational history was obtained from each participant and brief examination was performed. Peak expiratory flow rate (PEFR) was measured using Cipla's peak flow meter with EU scale. Each participant was given a trial of instrument before taking reading. Three readings were taken for each participant in standing position and best of the three was considered as PEFR of that participant. Data was analyzed using unpaired t test for comparison between the study group and controls.

RESULTS

Out of 150 participants, 92 were females (54 study and 38 controls) and 58 were males (21 study, 37 controls). As PEFR varies with sex, study and control groups are compared separately in males and females. Table 1 shows comparison of demographic parameters, age and height between study and control group. There is no significant difference in age and height in case of female participants (p values 0.063 and0.160). While in case of male participants height shows no significant difference (p value 0.409) but there is significant difference in age (p value 0.024).

Table 1: Comparison of demographic parameters in study and control group

		Study (X±SD)	Control (X±SD)	t	df	P value
Male	Age	36.38± 5.55	40.73± 7.46	-2.327	56	0.024
	Height	167.90±5.80	166.68±5.18	0.832	56	0.409
Female	Age	36.33± 7.4	33.34± 7.68	1.880	90	0.063
	Height	158.63±4.76	157.13±5.32	1.417	90	0.160

Table 2 shows comparison of PEFR in study and control groups. There is significant difference in PEFR of study and control group in case of both males and females.

Table 2: Comparison of PEFR in study and control groups

	Study(X±SD)	Control (X±SD)	t	df	P value
Males	445.71±61.45	527.03±52.11	-5.350	56	0.000
Females	320.93±49.50	374.47±49.69	-5.101	90	0.000

DISCUSSION

In the present study it is noted that peak expiratory flow rate of teachers who are exposed to chalk dust is significantly less as compared to controls, while the demographic parameter height and age are comparable in study and control group in case of female participants. In case of male participants height was comparable but age showed a significant difference in study and control group. Males due to the differences in their anatomic and physiologic characteristics show higher PEFR than females.

The effects of chalk dust on respiratory system have been demonstrated in a few studies. Ohtsuka Y, Munakata M, Homma Y and et al studied three patients with chronic interstitial pneumonia with many bullae in the lower lung fields whose lifetime occupation was teaching school. Pathological examination of autopsy lungs was done. Mineral content of two of them was analyzed and compared with mineral content of four control cases with idiopathic interstitial pneumonia (whose occupations were not teaching). Findings of this study showed that dust particles

and minerals which are usually present in chalk were high in teachers' lung suggesting that chalk dust is a cause of interstitial pneumonia in teachers [12]. A survey conducted in Spain shown that chalk dust is associated with an increased risk of many respiratory symptoms like wheezing, frequent respiratory infections and hoarseness [11].

Our findings are consistent with findings of studies conducted in chalk powder ($CaCO_3$) plants. In the chalk powder plant, all airflow parameters declined significantly with increasing dustiness and workers in dustiest workplace (chalk sacking) showed significantly lower airflow parameters than workers in other workstations [14]. Chalk dust behaves like any other particulate matter and remains suspended in air for sometime before settling on the floor and body parts of teachers and students. Nasopharynx is quite efficient in filtering larger particles. Particles, smaller than 5 µm, can penetrate to lungs and be deposited in alveoli [8]. These particles irritate respiratory passage causing inflammation, fibrosis and smooth muscle hypertrophy. All these may lead to airway narrowing and this may be the cause for less PEFR in teachers than control.

The present study has some limitations. The study was conducted on a small sample in only one area so results can't be directly applied to whole population. The study can be carried out on large sample selected from study population distributed in various geographic areas including both urban and rural areas. Only PEFR was measured, doing all pulmonary function tests may throw more light on the topic. Dose response relationship can't be calculated from the data collected in this study.

CONCLUSION

We can conclude from this study that teachers using chalk and board are at an increased risk of developing occupationally related pulmonary function impairments (airflow obstruction) and hence need to shift from routine chalk and board to marker and whiteboard.

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