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RESEARCH ARTICLE

Peak expiratory flow rate in dry cell battery manufacturing workers in Nellore district

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ABSTRACT

Background: Carbon block is possibly carcinogenic to humans. Short-term exposure to high concentrations of carbon black dust may produce discomfort to the upper respiratory tract, through mechanical irritation. **Aims and Objective:** This study aims to evaluate the impact of the carbon block on the peak expiratory flow rate (PEFR) using Wright's peak flow meter. **Materials and Methods:** Peak flow meter was done by Wright's peak flow meter. The paired *t*-test was done to determine the significant difference between the employees and controls. **Results:** Peak flow rate was decreased with the duration of the work exposure in the workers compared to controls. **Conclusion:** Impairement of Peak Expiratory Flow Rate in carbon rod making workers due to long term exposure of carbon dust.

KEY WORDS: Carbon Rod; Peak Expiratory Flow Rate; Wright's Peak Flow Meter

INTRODUCTION

India is a developing country with majority of its masses living in rural areas.[1] Occupational or job stress may be defined as a "mechanism whereby the human body attempts to adapt to the environment." When the cause of the stress can be identified, is of short duration, and can be responded to by a specific set of actions that eliminate the cause, this is a healthy stress reaction. However, when the source of the stress is not identifiable, becomes excessive, repeated, prolonged, or continuous, it becomes "distress" and creates unhealthy physiological and psychological reactions. Occupational pulmonary diseases are more widespread and more disabling than any other group of occupational disease. Different occupational pulmonary diseases asbestosis, silicosis etc. are influenced by the type of dust, duration of exposure and the concentration and size of airborne dust in the breathing zone.[2-4]

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Panasonic Carbon India Company Limited is situated in the southern region of India. It manufactures different sizes of carbon rods depending on the grade of the carbon rod; some raw materials are used in the manufacturing of carbon rods. The raw materials such as coal coke, natural graphite, amorphous graphite, calcined petroleum coke, artificial graphite, carbon black, coal tar pitch, sulfur, and paraffin wax are used for manufacturing carbon rod.

As per customer specifications, selected raw materials are loaded into mixer and kept in running for specified time to get homogenous mixture and the load liquid pitch into mixer to make semi-solid for specified time, then unload the material into auto palletizing machine hopper to make cylindrical cakes. The cakes are fed into hydraulic press and extrude the carbon rods by maintaining required die temperature and using required dies and cutters. The green carbons are stacked in graphite case and then load into refractory car and filling the gap with coke and then send into tunnel kiln, in which temperature is maintained from 120°C to 1000°C. After

Table 1: Comparison of peak expiratory flow rate among the study group and control group

Parameters	Control group (*n*=50) mean±SD	Study group (*n*=50) mean±SD	*P*-value
Age (years)	41.43±11.304	46.63±8.402	0.51
Weight (kg)	62.78±9.544	90.22±9.529	0.000
Height (m)	1.6781±0.09350	1.5653±0.09958	0.000
BMI (kg/m^2)	22.161±1.8818	37.081±5.2036	0.000
PEFR (L/min)	385.56±89.521	212.53±58.527	0.000

Values expressed as mean±SD, *P<0.05 statistically significant. PEFR: Peak expiratory flow rate; BMI: Body mass index, SD: Standard deviation

coming from kiln, the baked carbons are snapped into single piece and send for wax treatment. Depend on the customer requirement, the carbon rods are dipped in wax solution for specified time. Then, the carbon rods are ground to the required dimensions in grinding process. At sorting section, defects are removed and good carbon rods are packed in pre-printed trays and boxes and shifted to finished go down.

MATERIALS AND METHODS

Ethical committee approval was obtained for this study. The present study was conducted to compare the peak expiratory flow rate (PEFR) in carbon rod making employees with age-matched healthy controls of both sexes for a period of 3 months. It was conducted in Panasonic Carbon Private Limited in Tada. Fifty employees with the age group of 20–60 years were included in this study who are having more than 2 years of experience. Healthy individuals with the age group of 20–60 years in both sexes in the same geographical area were taken as controls. Those with bronchial asthma, acute or chronic respiratory tract infection, acute or chronic cardiac disease, any systemic illness, structural deformity of the thoracic cage, habit of smoking and alcohol consumption, diabetes and any known endocrinal disorder, and pregnancy were excluded from the study.

Preliminary data and general examination were collected with the help of questionnaire. Before starting the study, written informed consent was obtained from all participants and the procedure to be performed was explained in detail in the local language to each patient.

PEFR

PEFR was measured with a Wright's peak flow meter (medical devices directive 93/42/EEC L169, EN ISO 13485, EN ISO 23747). All tests were performed with the subjects comfortably seated on a chair in a quiet room with optimum temperature during morning hours. Subjects were required to exhale as quickly as possible into the peak flow meter following maximum inspiration. Blowing technique was closely watched to ensure that a tight seal was maintained between lips and the mouthpiece of the peak flow meter. Three PEFR maneuvers were made by each subject, and the highest blow into each instrument was recorded. All measurements were carried out at the same time of the day.

Statistical Analysis

Student's *t*-test (paired *t*-test) has been used to find the significant changes of studied parameters in carbon rod making employees and healthy individuals. Collected data were statistically analyzed by SPSS software version 20. All values are expressed in mean ± standard deviation and $P < 0.05$ is considered as statistically significant.

RESULTS

The mean age of the controls was 41.43 ± 11.304 and the carbon rod making workers was 46.63 ± 8.402 years. Table 1 shows that PEFR of carbon rod making workers (212.53 ± 58.527 L/min) was lower than that of controls (385.56 ± 89.521 L/min), the difference was found to be highly significant ($P = 0.000$).

DISCUSSION

The raw materials such as coal coke, natural graphite, amorphous graphite, calcined petroleum coke, artificial graphite, carbon black, coal tar pitch, sulfur, and paraffin wax are used for manufacturing carbon rod. These materials may affect lung function. Especially carbon black, short-term exposure to high concentrations of carbon black dust may produce discomfort to the upper respiratory tract, through mechanical irritation.

In the present study, the carbon rod making workers showed a statistically significant decrease in PEFR ($P = 0.000$). The reduction in PEFR in workers might be due to inflammatory changes in the respiratory tract, which lead to an increased airway resistance and physically impeding the normal lung function as a result of the dust exposure. The results of our study supported with Wagh *et al*. done a study in Jalgaon urban center to assess the influence of workplace environment on lung function of flour mill workers found a significant reduction in PEFR compared to controls.[5] Saha *et al*., PEFR were noted in the exposed workers as compared to the control subjects, but it was not statistically significant.[6] A study conducted by Kandaswamy V et al on occupational hazards faced by workers at the textile industries in Tirupur, Tamilnadu had revealed that that most of the workers and family members suffer from either asthma, allergy, TB or from frequent attacks of cold.[7]

David Fishwick *et al*. conclude that PEFR is decreased when there is increase in years of exposure.[8] Limitations of our study were the less sample size. We did only PEFR; we did not perform any other pulmonary function test.

CONCLUSION

The findings of this study found that decreased peak expiratory flow and statistically highly significant due to long-term exposure to carbon block. It might be prevented by shift methods and providing mask during working hours and frequent health check-ups might be useful for the workers.

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