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ASSESSMENT OF RESPIRATORY HEALTH PROBLEMS AMONG SCHOOL CHILDREN DUE TO EXPOSURE TO AIR POLLUTANTS FROM CEMENT MANUFACTURING PLANTS

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Abstract: A thorough study was carried out ,in different area's schools, on school children residing near cement plants located at western Rajasthan, to assess the association between air pollution with exposure duration and respiratory health of school children exposed to polluted environment for different duration. The study areas (schools) are located with in 2-3 kmts .radius from the cement plants. The purpose of the study is to assess the correlation between concentration of air pollutants (indicator –Air Quality Index) with exposure duration and respiratory health of school children residing near cement plants. Respiratory symptoms were observed with the help of questionnaire and pulmonary tests by electronic spirometer. The air pollutants emitted by plants were measured by standard air sampler and relevant testing equipments. Prevalence of acute respiratory symptoms was observed to be slightly higher, around 8% and FEV1 was lower in few cases among the school children in comparison to controlled or unexposed school children. An association between pollution concentration, exposure duration and prevalence of respiratory symptoms (cough) was derived for exposed and unexposed category of school children. Few school children , residing near cement plants, were also found to have eyes and skin irritations. The difference in FVC was marginal but, significant difference of FEV1 observed in exposed and unexposed school children. In conclusion, higher exposure duration with high pollutant concentrations is associated with enhancement in respiratory symptoms and decrease in FEV1 of school children residing near cement plants.

I. INTRODUCTION

The cement production from the raw materials like lime stone, clay, and gypsum is invariably a dusty and dirty operation resulting in polluted exposure of all living being close to the cement factories. The process to convert these raw materials into cement involves burning at very high temperature exceeding 1500 degrees C in long kilns. In most of the cement plants this heat is generated by burning fossil fuel ie Coal which itself amounts to greater pollution, if process is left unchecked. The use of protective measures is recommended beyond a level of pollution but, in developing countries neither the industries provide these measures nor the public at large prefer to use the same. The effect of pollution and cement dust has led to mild impairment of respiration and a prevalence of respiratory symptoms especially among school children residing near the cement plants. The degree of impairment of the respiratory function has been explained to depend on the years of exposure in different studies. The important parameters used for the assessment of respiratory functions in such studies involves Vital Capacities , FEV1 (Forced Expiratory Volume in 1 second), FEV1 % (Forced Expiratory Volume in 1 second as a percentage of forced vital capacity.), and PEFR (Peak Expiratory Flow Rate)( ). Further, previous researchers have worked on the subject matter of school children either by considering the concentration of different pollutants from cement plants with exposure duration as variable or both together. In this study work we have studied pulmonary functions of school children residing near the cement plants under different exposure duration and derived the correlation between pollution concentration of cement plants with exposure duration of school children exposed to this environment being stayed near cement plants.

II. POLLUTANTS FROM CEMENT PLANTS

Cement plants are a significant source of sulfur dioxide, nitrogen oxide and carbon monoxide, which are associated with the following health and environmental impacts: Nitrogen oxide (NOx) can cause or contribute to a variety of health problems and adverse environmental impacts, such as ground-level ozone, acid rain, global warming, water quality deterioration, and visual impairment. Affected populations include children, people with lung diseases such as asthma, and exposure to these conditions can cause damage to lung tissue for people who work or exercise outside. Sulfur dioxide (SO2) in high concentrations can affect breathing and may aggravate existing respiratory and cardiovascular disease. Sensitive populations include asthmatics, individuals with bronchitis or emphysema, children, and the elderly. SO2 is also a primary contributor to acid deposition, or acid rain. Carbon monoxide (CO) can cause harmful health effects by reducing oxygen delivery to the body's organs and tissues, as well as adverse effects on the cardiovascular and central nervous systems. CO also contributes to the formation of smog (ground-level ozone), which can cause respiratory problems.

III. METHODS AND MATERIALS

The school children population in this study consists of the school children residing near the operating cement plants and exposed to different duration depending upon their stay in

schools. All the school children taken into account in this study were enrolled. They had been exposed to cement dust for a period of 3 to 12 years (mean ± SEM) years. An unexposed or controlled group of school children comprised of the school children belonged to the same socio-economic class as the exposed group, and residing far away from the cement factory. Only subjects who were non smokers and who had no history or signs of chronic cough, bronchitis, bronchial asthma or other signs and symptoms suggestive of respiratory diseases were eligible and selected into both the exposed and unexposed groups. Data collection was effected by way of an interviewer-administered structured questionnaire, to determine the socio-demographic characteristics, years of exposure as deduced from date of their admission in schools. Information on general health, history of past disease(s) and habits such as smoking and alcohol consumption were obtained. Lung function tests were carried out with a Electronic spirometer (Swiss make) and a Wright peak flow meter (UK). The procedures were carefully explained and demonstrated to each subject and then the tests were carried out. Each lung function parameter was measured with the help of a trained technician familiar with the procedure. The use of one observer per measurement was maintained throughout the study. Some of the readings were randomly repeated personally to validate their accuracy. Vital capacity, forced vital capacity, forced expiratory volume in 1 second, and forced expiratory volume in 1 second percent (as apercentage of forced vital capacity) were measured using a spirometer. The recording was done with each school children standing, without nose clips and with the lips firmly applied around the dispo mouthpiece. The study subjects (school children) inspired maximally and then expired as forcefully and rapidly as possible into the spirometer. Mostly three attempts were made and the best of the three spirogram was selected .The value of VC, FVC, and FEV1 was read off the selected spirogram. The Peak expiratory flow rate [PEFR], was measured with the subject standing, without nose clips and with lips firmly applied around the disposable mouthpiece. The subject inspired maximally and then expired as forcefully and rapidly into the peak flow meter as possible. The best of three readings was taken. All the lung function parameters were measured at ATPS (ambient temperature and pressure saturated with water vapour). The relationship between vital capacity with other pollution parameters and years of exposure was subjected to correlation analysis and a regression equation defining the relationship was derived

IV. RESULT AND DISCUSSION

The lung function parameters are recorded and presented in tabular form. These parameters did not differ significantly between the exposed and unexposed group of school children residing near the cement plants. The vital capacity($P<0.001$) and FEV1% ($P<0.005$) differed significantly in the exposed group of school children compared to the unexposed one while the forced vital capacity and the peak expiratory flow rate (PEFR) did not differ significantly.

The major observation of this work is that the lung function parameters, vital capacity and FEV1%, were marginally lower in some school children exposed to cement dust compared to those unexposed. This suggests that chronic cement dust exposure impairs lung function. However the forced vital capacity (FVC) and PEFR did not differ significantly in the exposed group compared to the unexposed. This underscores the importance of using several indices of lung function in comparative studies such as this. However, the present findings do not support the notion that chronic cement dust exposure does not impair lung function as reported by some workers. The results of the present study indicates that chronic exposure to cement dust has deleterious effect on the lungs. However the exact mechanism(s) by which it does this is unknown. It is yet to be determined whether these effects are due to directly cement dust or mediated by a metabolic product of cement dust. It may be interesting to further investigate about this phenomina. However, it has been suggested that the reduced FEV1% in some school children may be due to reflex bronchospasm triggered by inhaled irritant cement dust or as a result of type 1 hypersensitivity reaction .In fact the components of cement dust show irritating, sensitizing and pneumoconiotic properties. These effects of cement dust may account for the observed impairment of lung function observed in this study. In nutshell, the study results indicate the vital capacity and FEV1% were reduced in few school children exposed to cement dust in comparison to the unexposed or control subjects ,not exposed to the polluted environment. However , FVC and PEFR remained similar in both groups. These results also indicate the chronic and long time exposure to cement dust impairs lung function. Since,most of the modern cement plants are concerned about the pollution and adopting the suitable measures as well as protective gears , the impaired lung function indicates that the such pollution control measures were either ineffective or the school children have not taken any normal precautionary measure needs to be taken under exposure to polluted environment. It is further established that long term and chronic exposure to cement dust has adverse effect on lung function however, the effect is marginal but, can be fatal if ignored for the long time period in certain cases. It is suggested and recommended that to safeguard the health of workers, school children residing in nearby area and the host community around in general , the cement factory management embark on safety training in work environment and conduct health education programs for school children and for other inhabitants residing near to cement plants ,on safety precautions & practices to cement dust exposure. The cement plants should also acquire latest pollution control gadgets and ensure the strict compliance with their use. Also regular monitoring of cement dust levels and other associated pollutants in and around the cement factory environment should be the regular practice by use of innovative pollution control devices.

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