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ENVIRONMENTAL IMPACT OF AIR POLLUTION FROM THE CEMENT INDUSTRIES IN KADAPPA DISTRICT IN ANDHRA PRADESH STATE IN REFERENCE TO THE RESPIRATORY SYNDROMES

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ABSTRACT
This study examines the significant different in seasonal variations of air pollutant concentrations of Particulate matter, SO2, NO2, CO and metals like chromium, lead and nickel collected over six spots near the cement industrial plants in Kadappa district due to cement industries. Occupational cement dust exposure has been associated with an increased risk of respiratory diseases in workers who are employed in cement industries are exposed to cement dust for long periods. The adolescent were affected 35 % (male – 20 % and female - 15 %), and old age about 45 % were found. Almost all the persons affected by mild type were reversible to normalcy after inhalation of bronchodilators; severe form of bronchial asthma and COPD response to moderate state. 50 % of severe form of bronchial asthma (status asthmaticus) died during the period of study. Simple test like peak flow meter identified the affected persons and the spirometry study proves the severity. The high morbidity and mortality among the cement industry workers and dwellers in nearby industrial areas may be due to elevated levels of urinary and blood chromium and lead levels and resulting from increased air levels of chromium and lead at the work place.

KEY WORDS: Air Pollutants, COPD, Asthma, Spirometry, restriction, Kadappa district.

1. INTRODUCTION

This epidemiological study examined the atmospheric pollution and severe diseases created by some cement disposal facilities in the Kadappa district of Andhra Pradesh. Cement industry is considered as a major pollution problem on account of dust and particulate matter emitted at various steps of cement manufacture. Cement dust consists of many toxic constituents such as particulate matters, SO2, NO2 and CO and metals like nickel, cobalt, lead, and chromium. Many organic compounds of industrial origin contribute to airborne public health concerns, as well as environmental problems. High levels of air pollution can adversely affect lung function and triggers asthma and COPD exacerbations. People living in areas with more cement industries, are at particular risk of respiratory diseases. A survey has been carried out in adults and old age persons in six spots, selected in Kadappa district having cement industries which include, Yerraguntla, Mylavaram, Kamalapuram, Chilmakar, Krishna nagar and Nallalingayyapalli.

Chronic exposure to Portland cement dust has been reported to lead to a greater prevalence of chronic respiratory symptoms and a reduction of ventilatory capacity. The seriousness of pulmonary function impairment and respiratory disease has been consistently associated with the degree of exposure. Therefore, it is mandatory to evaluate the mutagenic effects of occupational exposure to cement dust in such workers and dwellers in nearby cement industrial areas. Since bronchial asthma and COPD are diseases can be aggravated by inhaled compounds, and thereby health effects of air pollutants have received attention. In fact various studies have demonstrated that inhalation of air pollutants such as, chromium, lead, nickel, NO2, SO2, CO2 either individually or in combination, can enhance the airway response to inhaled allergens in a topic of subjects inducing asthma and COPD exacerbations.

Many studies have shown an association between current daily levels of air pollution and daily mortality by respiratory and cardiovascular causes in the general population. In the present study, we analyzed the samples of 1000 male workers including 454 smokers and 546 non- smokers who were employed in cement industry for a period of 1-3years. For comparison, 100 controls (including 43 smokers and 57 non- smokers) of the same age group and socio- economic status were also studied. Controls had no exposure to cement dust or any known physical or chemical agent. A significant increase in the incidence of chromosomal aberrations was observed in the exposed group when compared to the control group. The results were analyzed separately for non-smokers and smokers. The chromosomal damage was more pronounced in the smokers when compared with the non-smokers both in control and exposed groups. A significant increase in the frequency of chromosomal aberrations was also observed with increase in age in both control and exposed subjects.

A number of emergency department studies have corroborated findings from mortality and hospital admission associated with ambient air pollution and respiratory outcome. We obtained the data on more than 6000 patients of emergency department of 10 hospitals in Kadappa district during the period of 2014 - 2017. The basic diagnostic work-up including history –taking, clinical findings, and simple functional tests alone, suffices enough for the family doctor rapidly differentiate between an obstructive and restrictive pulmonary disease.

2. MATERIALS AND METHODS

The cement industry workers and dwellers from various places of Kadappa district attending emergency room services (hospitals) either for asthma or COPD were recruited during the years 2014 to 2017 Table-1.Vital status was obtained through record linkage of the people of the cohort with the Catalonia Mortality Registry for the years 2015 to 2017. A total of 1000 people (of the 1250 in the initial cohort) had a diagnosis of asthma and COPD, 50 of whom died in the period 2014 to 2017 and were used in analysis. Poisson regression time series models were fitted for each pollutant (in a log-linear form) and each different category of mortality following the APHEA methodology [14] and adding the natural logarithm of the number of patients who are still alive. To evaluate dyspnea and determine the restriction of the affected COPD patients. The following parameters were studied.

2.1. Air monitoring of toxic metals and gaseous pollutants External exposure at the work places and surrounding areas were estimated by personal air monitoring during the work shift. Daily information on levels of cement dusts, lead, chromium (VI), NO2, CO, temperature and relative humidity was collected from cement industry accumulated places in Kadappa district namely Yerraguntla, Mylavaram, Kamalapuram, Chilmakar, Krishna nagar and Nallalingayyapalli during the years 2014 to 2017.

The airborne particulate sampling was performed on quarz microfiber filters (Whatman QM-A, diameter 37 mm) in Millipore filter holders. The concentrations of the total particulate were determined by weighing the filter and calculated in milligrams per cubic meter Table- 2.

2.2. Clinical examination

A detailed physical examination of the nervous, respiratory, cardiovascular, dermatological and musculoskeletal system was conducted at a health examination camp set up at the work place in the cement industry.

2.3. Lung function testing

A precalibrated portable computerized spirometer (Auto spiror Model HS-1, Tuda aptics, Japan) was used to record the spirometric functions. The observed values were compared with the predicted values of Rastogi et al. The peak expiratory flow rate was measured by a peak flow meter (standard model-clement clake, U.K) and the highest values were taken into account.

2.4. Detection of Chromium and Lead levels in Human blood and Urine samples

The blood chromium levels and lung functions of the tannery workers and nearly dwellers who are potential candidates for chromium and lead inhalation. The hospital staff served as control group. The measurements of chromium and lead levels were performed using atomic absorption spectrophotometry. We observed that blood chromium levels of the cement industry workers, nearby dwellers and controls were found to be 0.4589 mg/L, 0.5251 mg/L, 0.6240 mg/L, 0.6582 mg/L, and 0.7580 mg/L respectively and the urine chromium levels were found to be 32 µg /L, 35 µg /L, and 40.5 µg /L and 44.5 µg /L respectively. Similarly, we observed, the blood lead levels were found to be 0.2065 µg/dL, 0.2421 µg/dL, 0.3867 µg/dL, 0.4219 µg/dL, 0.4965 µg/dL, 0.5824 µg/dL and 0.6210 µg/dL respectively and the urine lead levels were found to be 19 µg /L, 24 µg /L and 30 µg /L and 35 µg /L respectively.

3. RESULTS

All studies consistently found a higher prevalence of symptoms of breathlessness or COPD in areas with higher particulate air pollution due to evolution of higher percentage of cement dust contains chromium, lead, nickel, cobalt, NO2, SO2, CO and particulate matters exhausted from the cement plants. Studies on daily admissions in emergency rooms and hospital admissions were specific for asthma and COPD conducted during the 2014 to 2017 in six spots in Kadappa district namely Yerraguntla, Mylavaram, Kamalapuram, Chilmakar, Krishna nagar and Nallalingayyapalli where many cement industries located. The association of particles and gaseous pollutants were higher in nearby cement industry areas and slowly decreased in far away places.

There are few cross- sectional studies of lung function was conducted among adolescents between the age limit of 15 to 65, about 30% severe obstruction, 35% moderate obstruction, and 20% mild obstruction. Table-3, Graph-1. This epidemiology study proves the COPD patients of air pollution of mild, moderate and severe disease based on the percentage predicted FEV1. In contrast, the effects are larger in young males who spent more time outdoors. Regular use of appropriate personal protective equipment, if available at the worksite, could protect cement workers from adverse respiratory health effects. Studies on lung function in children, the age limit upto 12 years during 2014 – 2017 did not observe any association with pulmonary function and lower levels of forced vital capacity (FVC) and FEV1. Five cohort studies have proved a decline in the lung function, at the end of year (2014-2017) and conforms a point-source of an industrial pollution rather than the urban pollution. Table-4.

Table-1.Hospitals admission of Patients affected by lung disorders during the year 2015-2017

YEAR	MALE	FEMALE
2014	6678	5090
2015	6702	5186
2016	6790	5260
2017	6813	5315

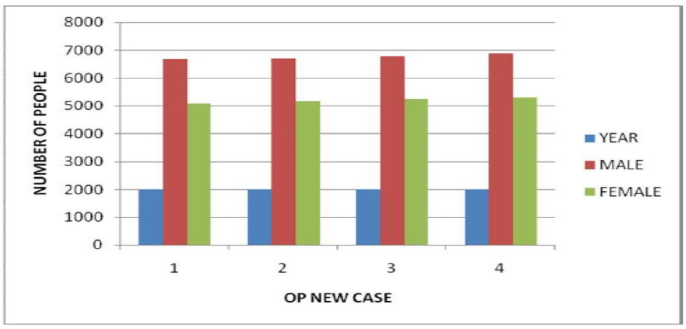

Table – 2 Detection of Ambient air quantity (12 hours) in near cement industry area of Govindapuram duringsummer season

Parameters	Ambient air(microgram/m3)	National ambient air quality standards as per Schedule VII (Nov.2015)(24 hrs) (microgram/m3)
Concentration of Non Respirable Suspended Particulate Matter(NRSPM -10	57.8	100
Concentration of Respirable Suspended Particulate Matter[size (RSPM -2.5)	24.9	60
Concentration of Sulphur-di-oxide (SO2)	11.9	80
Concentration of Oxides of Nitrogen (NO2)	24.8	80
Carbon monoxide (CO)	Less than 1.2	2
Ozone	2.0	85
Ammonia	BDL	400
Lead	0.005	1
Arsenic	BDL	--
Nickel	3.70	---
Benzene	0.005	----
Atmospheric pressure	756	----

BDL : Below detection Level , D.L : Detection Level, Ambient Temperature : 29^{o} C, Relative Humidity : 70%

Table- 3. Spirometry result of Severe Restriction

Age : 59 years			Sex : Male		
Weight : 51 Kg			Height : 152 cm		
Race : Asian					
Pred. Module : Government Hospital , Kadappa.					
Parameters	Predicted	Minimum observed	% of	Maximum observed	% of predicted
FVC	2.33	1.20	52	2.03	88
FEV1	1.87	0.78	42	1.39	74
FEV1/FVC %	76.5	65.5	86	68.3	89
PEF	6.95	1.76	25	3.26	47
MEF25-75 %	3.11	0.55	18	0.96	31
MEF75 %	6.12	0.97	16	2.16	35
MEF50 %	3.58	0.58	16	1.07	30
MEF25 %	1.09	0.34	31	0.47	43
FET	---	2.76	----	4.21	------

FVC : forced vital capacity; FEV1 : forced expiratory volume in one second, PEFR: peak expiratory flow rate, FEV25-75 : forced mild – expiratory volume, MVV: maximum voluntary ventilation.

Graph - 2: Spirometry result of Severe Restriction

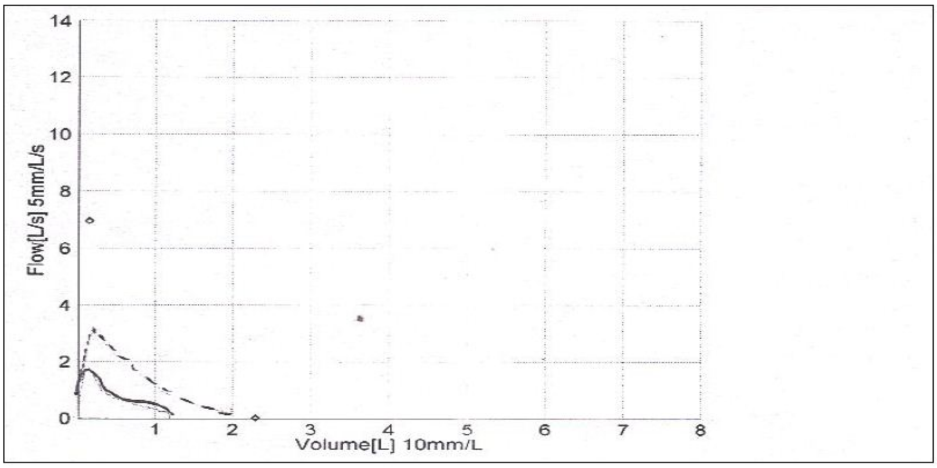

Table - 4 Cross sectional and cohort epidemiological studies on lung function and air pollution

Author Reference	Location	Age	Lung function measure	Effect
Cross Sectional Studies				
Children				
X	Yerraguntla	5-8	FVC, FEV, FEV1	No association
Y	Mylavaram, Kamalapram, Chilmakar	8-12	FVC, FEV, FEV1	-1.6 per 6 µg. m-3 sulphates
Z	KrishnaNagar, Nallalingayyapalli	10-15	FVC, FEV, FEV1	-1.3 per 6 µg. m-3 sulphates
Adult				
X	Yerraguntla	35-55	FVC, FEV, FEV1	-2.7 % per 52 nmol m-3 acidity
Y	Mylavaram, Kamalapram, Chilmakar	55-75	FVC, FEV, FEV1	-2.9 % per 52 nmol m-3 acidity
Z	KrishnaNagar, Nallalingayyapalli	Above 75	FVC, FEV, FEV1	-1.9 % per 34 µg m-3 TSP
Cohort studies				
X	Yerraguntla	8-10	ΔFEV1	-0.026 mL day-1 per ppb of SO2
Y	Mylavaram, Kamalapram, Chilmakar	10-12	ΔFEV1	-0.028 mL day-1 per ppb of SO2
Z	KrishnaNagar, Nallalingayyapalli	35-75	ΔFEV1	-22.3 and -8.6 mL yr-1 in males and females

FVC: forced vital capacity; FEV1 : forced expiratory volume in one second, TSP: total suspended particles, FEV25-75 : forced mild – expiratory volume.

We have evaluated the relationship between pulmonary function tests (PFTs), thorax high resolution computed tomography (HRCT) images and scintigraphic studies in more than 1000 patients (mean age10-75 + / - 5.5 years), in near cement industrial areas during 2014-2017. The lung function in children of age upto 12 years did not observe any association with pulmonary function and lower levels of forced vital capacity (FVC) and FEV1 [17,18]. The mean forced vital capacity (FVC) values of patients were (4.52 + / - 0.5 mL (70%), whereas the mean forced expiratory volume in one second (FEV1) were found to be (93 + / - 0.5 mL (90%)). The ratio of sulphur dioxide diffusion capacity to alveolar ventilation (DLCO/VA) was 3.15 + / - 0.88 mL/min/mmHg/L, and the mean partial oxygen (and carbon dioxide (CO2) pressures were 68.5 + / - 11.05 mmHg and 37.8 + /- 5.8 mmHg respectively. For each patient, thorax HRCT and V/Q scintigraphic images of both lungs were divided into upper, mild and lower zones during examination. Visual scoring for the assessment of emphysema on thorax HRCT were used and images were graded from mild to severe (& lt ; or 25% - & gt ; or = 75%).

4. DISCUSSION

Pulmonary function was assessed and pulmonary function impairment was calculated for the exposed and the unexposed workers. A higher percentage of the exposed workers reported recurrent and prolonged cough (30%), phlegm 25%), wheeze (8%), dyspnoea (21%), bronchitis (13%), sinusitis (27%), shortness of breath (8%) and bronchial asthma (6%). Ventilatory function (VC, FVC, FEV1, FEV1/VC, FEV1/FVC and PEF) was significantly lower in the exposed workers compared with unexposed workers. These differences could not be explained by age, body mass index (BMI) or pack-years smoked. Ventilatory function impairment, as measured by FEV1/FVC, showed that 36% of the exposed workers had some ventilatory function impairment compared with 10% of those unexposed. Certain jobs with greater exposure to cement dust had lower ventilatory function compared with others among the exposed workers.

5. CONCLUSION

This study recommends that the bio monitoring of air levels of chromium and gases levels at the work place and the nearby surroundings that can be used as a tool for mitigating health hazards and risk factors in the exposed community. A significantly higher incidents of airway limiting disease of COPD more in female to male by the ratio of 25 % vs 10 % and asthma disease more in female to male by the ratio of 15 % vs 20 % during the period of 2016-2017 year. Those who were having higher concentration of chromium and lead levels in blood and urine were having severe form of COPD and asthma and there were no neurological deficit as the leaf levels were below the toxic levels.

This study recommends that the bio monitoring of air levels of chromium, PM and other organic pollutants levels at the work place and the nearby surroundings that can be used as a tool for mitigating health hazards and risk factors in the exposed community. Patients with respiratory disease alone stop exercising at a heart rate below the maximum predicted for their age, since the factor limiting exercise in both obstructive and restrictive disease is the ventilatory capacity. In patients with airways obstruction or restrictive lung disease, the 12 minute walking distance correlates better with FVC than FEV1. Physicians who serve as informers for cement industry workers and people who are living near industry areas, or for daily walking should be aware of the health implications of pollution alerts to provide appropriate guidance to children and adults, particularly in communities with high levels of ambient air pollutants.

6. REFERENCES

- Jedrychowski W, Flak E, Mroz E. The adverse effect of low levels of ambient air pollutants on lung function growth in preadolescent children. Environ Health Perspect 1999, 107: 669-674.
- Dodge R, Solomon P, Moyers J, hayes C. A longitudinal study of children exposed to sulphur oxides. Am. J. Epidemiol 1985, 121: 720-736.
- Jedrychowski W, Flak E, Mroz E. The adverse effect of low levels of ambient air pollutants on lung function growth in preadolescent children. Environ Health Perspect 1999; 107: 669-674.

- Frisher T, Studnicka M, Gartner Ch, et al. Lung function growth and ambient ozone. A three year population study in school childran. Am J Respir Crit Care Med 1999; 160: 390 – 396.
- Katsouyanni K, Schwartz J, Spix C, et al. Short term effects of air pollution on health: a European approach using epidemiologic time series data: the APHEA protocol. J Epidemiol Community Health 1996; 50: S12-18.
- Sunyer J, Anto JM, McFarlane D, et al. Sex differences in mortality of people who visited emergency rooms for asthma and chronic obstructive pulmonary disease. Am. J. Respir Crit Care Med 1998; 158:851-6.
- Schwartz J. What are people dying of on high air pollution days? Environ Res 1994; 64 : 26 – 35.
- Zmirou D, Schwartz J, Saez M, et al. Time – series analysis of air pollution and cause-specific mortality Epidemiology 1998; 9: 495 – 503.
- Kumar, S. S., N. A. Singh, V. Kumar, B. Sunisha, S. Preeti, S. Deepali and S.R. Nath., "Impact of dust emission on plant vegetation in the vicinity of cement plant." Environmental Engineering and Management Journal 7(1): 31-35.
- Lal, B. and R. S. Ambasht (1982). "Impact of cement dust on the mineral and energy concentration of Psidium guayava." Environmental Pollution Series A, Ecological and Biological 29(4): 241-247.
- Mishra, G. P. (1991). "Impact of industrial pollution from a cement factory on water quality parameters at Kymore." Environment & Ecology 9(4): 876-880.
- Baby, S., N. A. Singh, P. Shrivastava, S. R. Nath, S. S. Kumar, D. Singh and K. Vivek (2008). "Impact of dust emission on plant vegetation of vicinity of cement plant." Environmental Engineering and Management Journal 7(1): 31-35.
- Dietz, A., H. Ramroth, T. Urban, W. Ahrens and H. Becher (2004). "Exposure to cement dust, related occupational groups and laryngeal cancer risk: Results of a population based case-control study." International Journal of Cancer 108(6): 907-911.
- Mwaiselage, J., B. Moen and M. Bråtveit (2006). "Acute respiratory health effects among cement factory workers in Tanzania: an evaluation of a simple health surveillance tool." International Archives of Occupational and Environmental Health 79(1): 49-56.
- Peters, S., Y. Thomassen, E. Fechter-Rink and H. Kromhout (2009). "Personal exposure to inhalable cement dust among construction workers." Journal of Environmental Monitoring 11(1): 174-180.
- Fatima, S. K., C. V. Ramana Devi, P. A. Prabhavathi and P. P. Reddy (1997). "Blood serum protein and calcium levels in Portland cement factory workers." Indian Journal of Environment and Toxicology 7(2): 56-57.
- Al-Neaimi, Y. I., J. Gomes and O. L. Lloyd (2001). "Respiratory illnesses and ventilatory function among workers at a cement factory in a rapidly developing country." Occupational Medicine 51(6): 367-373.
- Fatima, S. K., P. A. Prabhavathi, P. Padmavathi and P. P. Reddy (2001). "Analysis of chromosomal aberrations in men occupationally exposed to cement dust." Mutation Research/Genetic Toxicology and Environmental Mutagenesis 490(2): 179-186.
- Chaney, R.L., Strrett, S.B. and Mickle, H.N. 1984. In Proc. Symp. Heavy Metals in Urban soils (ed. Preer, J.R.) Univ. Dist. Columbia, Washington, pp. 37-84.
- Chung, K. F., Pavord, I. D. April 2008. "Prevalence, pathogenesis, and causes of chronic cough". Lancet 371 (9621):1364–74.

- Chaney, R.L., Strrett, S.B. and Mickle, H.N. 1984. In Proc. Symp. Heavy Metals in Urban soils (ed. Preer, J.R.) Univ. Dist. Columbia, Washington, pp. 37-84.
- Chung, K. F., Pavord, I. D. April 2008. "Prevalence, pathogenesis, and causes of chronic cough". Lancet 371 (9621):1364–74.