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Effect Of Exposure To Dust On Peak Expiratory Flow Rate In Construction Site Workers- A Prospective Comparitive Study

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Abstract:

Background: *Peak expiratory flow rate (PEFR) is the maximum velocity of the air which is forced out of the lungs, recorded in litres per minute. Peak flow rate primarily reflect large airway flow and depends on the voluntary effort and muscular strength of the person. It may be reliably recorded using portable equipment called peak flow meter and thus can be used for field studies. Factors influencing the PEFR are age, sex, weight, nutritional status and pollutants. Dust from various sources like building construction site, road construction work and tunnel construction site can reduce the lung function.*

Objectives*: To evaluate the effect of exposure to construction site dust on peak expiratory flow rate among the construction site workers.*

Materials of method: *Mini Wright's peak flow meter (MICROPEAK PEAK FLOW METER)*
Inch tape &Weighing balance.
This study was carried out after receiving the clearance of institutional ethics committee.
A total number of 200 male subjects were taken for this study, belonging to same socio economic status. Among that 100 males working in construction site and 100 control subjects (not working at the construction site). Subjects recruited for this study was of 18-40 years age. Both smokers and non-smokers were included in the study since it was difficult to obtain construction workers who were totally non-smokers. The subject details like age, sex, weight etc., were noted and it was also noted number of years working in the construction site. Nature of the study was explained and informed consent was obtained from each subject prior to participation in this study. Subjects with the family history of asthma, chronic respiratory disease and cardiovascular disease were excluded from this study.

Result: *A total of 200 male subjects were taken for the study. All the subjects were in the same socio economic status. These 200 subjects were divided into 2 groups. Group A (control: n= 100, people not involved in the construction work) with the same socio economic status and Group B (exposed: n= 100 workers exposed to construction site dust) exposed group. In this study only negligible subjects are none smokers and most of them are smokers in both groups we are not grouped them separately for analysis.*

Conclusion: *Chronic exposure to the construction site dust will affect the lung function. We recommend safeguarding the health of the workers in the construction site by providing adequate protective measure materials. The management should embark on safety in the working environment and conduct health education and training on hazards of exposure to construction site dust, safety precautions and its practices.*

Keywords: *Peak Expiratory flow Rate (PEFR), Construction, workers, dust & exposure.*

Introduction: Peak Expiratory Flow Rate (PEFR) reflects the strength and condition of the respiratory muscles and the degree of air flow limitation in large airways. PEFR is the maximum velocity of the air which is forced out of the lungs, recorded in liters per minute. It is widely adopted technique to assess and monitor the airway obstruction. It is a simple and easy procedure to evaluate respiratory function.Peak expiratory flow monitoring can be done with the help of Wright's peak flow meter, which is the portable Instrument; hence it can conveniently be used at field level. Construction work involves the usage of cement, sand, brick and several other things, the dust of which can influence the normal lung function. Construction site workers will get exposed to different types of dust like cement dust, sand dust and brick dust. All these can influence the lung function. The lung

function parameters like vital capacity and FEV, PEFR, were significantly lower in workers exposed to cement dust compared to those unexposed [1]. Exposure to cement dust has led to impairment of the respiration and prevalence of respiratory symptoms among the workers [2]. The severity of the problems was directly proportional to the duration of exposure to silica dust[3]. The job type appeared to be the main predictor of exposure to inhalable dust at the construction site [4]. Most of the studies were done abroad in cement industries which mainly focused on Portland cement exposure [5&6].Underground construction workers and building demolition workers are exposed to dust alpha quarts, nitrogen dioxide and oil mist which are associated with development of chronic impairment of lung function [7&8]. Cross shift studies in cement production workers showed a marked reduction in lung function this Attributed to job task, peak exposure[9]. There is an increased prevalence of acute and chronic respiratory symptoms as well as reduced lung function among the high dust exposure cement production workers leading to changes in lung function [10]. Prevalence of respiratory symptoms was higher among factory workers in the packing and raw mill area. There is no association between cement dust and lung function impairment partly because of the dust reduction measures that were taken in the factory and also because of short time exposure to cement dust [11]. Prevalence of wheezing, shortness of breath, cough, phlegm, dyspnea, higher among the workers who exposed to cement dust. This study confirms that the exposure to cement dust in association with acute respiratory symptoms and chronic ventilatory function impairment [6].There is an significant reduction in the mean values of FVC, FEV1, FEV, FVC%, PEFR and FEF 25-75% in the demolition workers compared with the control and it is directly proportional to impairment of the lung parameters to the duration of exposure to air borne particulates like asbestos, lead, silica, concrete cement and stone [8].The highest inhalable cement dust concentration at the construction site was observed for concrete repairers, floor screed layers, and tiles setters. The main determinant for personal inhalable dust exposure appeared to be job type [4]. The cement factory workers, when compared to controls, had a higher prevalence of chronic respiratory symptoms and significant reduction in the lung function in follow up period of one year. FEV1 and FEV1/FVC were significantly where reduced among the cleaners and exposed group but not among the control group [10].Crystalline silica induced activation of pulmonary phagocytes is considered important in the generation of oxidants than in turn injure the lung cells [12].The exposure to low levels of concrete dust containing crystalline silica associated with a significant small loss of lung function (FEV1/FVC ratio, and MMEF). Lung function loss seems to be produced by smoking cigarette and dust containing free silica in amounts insufficient to cause pulmonary silicosis [13]. Subjects with high dust exposure who developed silicosis are at increased risk of lung cancer [14]. Asphalt dust produced during the road construction process held inside the bigger construction industry. Asphalt workers there is an increased risk of respiratory symptoms of eye irritation, chest tightness, and shortness of breathing on exertion, wheezing, lung function decline, and COPD, compared to other construction workers. The ratio of FEV1/FVC was significantly decreased in the asphalt workers than the outdoor construction site workers [15].Construction site dust is combination of cement, sand dust, brick dust, produced during the construction activity and can have an adverse influence on the lung function of those workers involved in it. But, there are not many studies which have been carried out abroad or in India on construction site workers, hence, this study was performed to access the effect of dust, created during the construction activity on peak expiratory flow rate.Therefore, the purpose of the study is to evaluate the effect of construction site dust on Peak expiratory flow rate in Indian population.

MATERIALS AND METHODS

Mini Wright's peak flow meter (MICROPEAK PEAK FLOW METER), Inch tape &Weighing balance

This study was carried out after receiving the clearance of institutional ethics committee.

The study was conducted at various construction sites in and around Chennai, Tamil Nadu, and data collection was coordinated through a tertiary care hospital in Chennai. The sample size was determined based on previous literature that reported changes in PEFR among dust-exposed workers. Using a confidence level of 95% and power of 80%, the required minimum sample size was calculated to be 100 participants per group (exposed and control), accounting for potential variability and dropouts. The study being prospective comparative study, a total number of 200 male subjects were taken for this study, belonging to same socio-economic status. Among that 100 males working in construction site and 100 control subjects (not working at the construction site). Subjects recruited for this study was of 18-40 years age. Both smokers and non-smokers were included in the study since it was difficult to obtain construction workers who were totally non-smokers. The duration of the study was 6 months, carried out between January 2024 to June 2024. The subject details like age, sex, weight etc. were noted and it was also

noted number of years working in the construction site. A convenience sampling technique was used. Male workers aged 18–40 years working at construction sites were approached and included after obtaining informed consent. Control subjects of similar age and socioeconomic background not involved in construction work were selected from the general population. Nature of the study was explained and informed consent was obtained from each subject prior to participation in this study. Subjects with the family history of asthma, chronic respiratory disease and cardiovascular disease were excluded from this study.

Procedure for recording PEFR:

The subject was instructed to take a deep breath and place the mouthpiece of the instrument firmly in between his teeth and the mouthpiece was to be sealed with lips tightly. Then the subject was asked to expire forcefully into the flow meter with nose clipped in a single effort. The peak expiratory flow rate was noted. Three readings were taken in standing posture with the gap of 2 mins between each reading. Best of three recording was taken as the final value. PEFR was recorded in the morning (between 7-9 am) before the workers started their construction work and in the evening (7-8 pm) after finishing their work shift and after one hour of rest. Details (height, weight etc.,) of the subjects were noted.

Precautions observed during the manoeuvre:

It was ensured that the subject was comfortable and relaxed.Apparatus was sterilized and cleaned properly.Subject was trained adequately to perform the different manoeuvre.Subject was instructed to hold the instrument such a way that the hand did not obstruct the movement of the pointer.The pointer was kept at the lower most level. Both the nose where closed while performing the manoeuvre.

Body mass index (BMI)

BMI was calculated from height and weight of the subject by using formula

BMI=weight (kg)/ height (m) ^{2}.

Body surface area (BSA)

BSA was calculated by using Dubois formula as follows. BSA $(m)^2$= weight(kg) $^{0.425}$ x height (cm) $^{0.725}$ x 0.007184 [16].

RESULTS:

To analyze the variation of PEFR comparison between exposed and control group made by one way analysis of variance (one way ANOVA). p value <0.05 was taken as the level of significance (Turkey's test).

A total of 200 male subjects were taken for the study. All the subjects were in the same socio economic status. These 200 subjects were divided into 2 groups. Group A (control: n= 100, people not involved in the construction work) with the same socio economic status and Group B (exposed: n= 100 workers exposed to construction site dust) exposed group. In this study only negligible subjects are non-smokers and most of them are smokers in both groups we are not grouped them separately for analysis.

PEFR was recorded at morning (6-7am) before they start the work, and in evening after finishing the work (6-7pm) after one hour of rest. PEFR was recorded in standing posture with nose clipped.

The subjects in group B were involved in construction work for the duration of 1 to 20 years.

Details of the subjects taken for the study are provided in table I.

Table 1: comparison of both involved and not involved in construction works

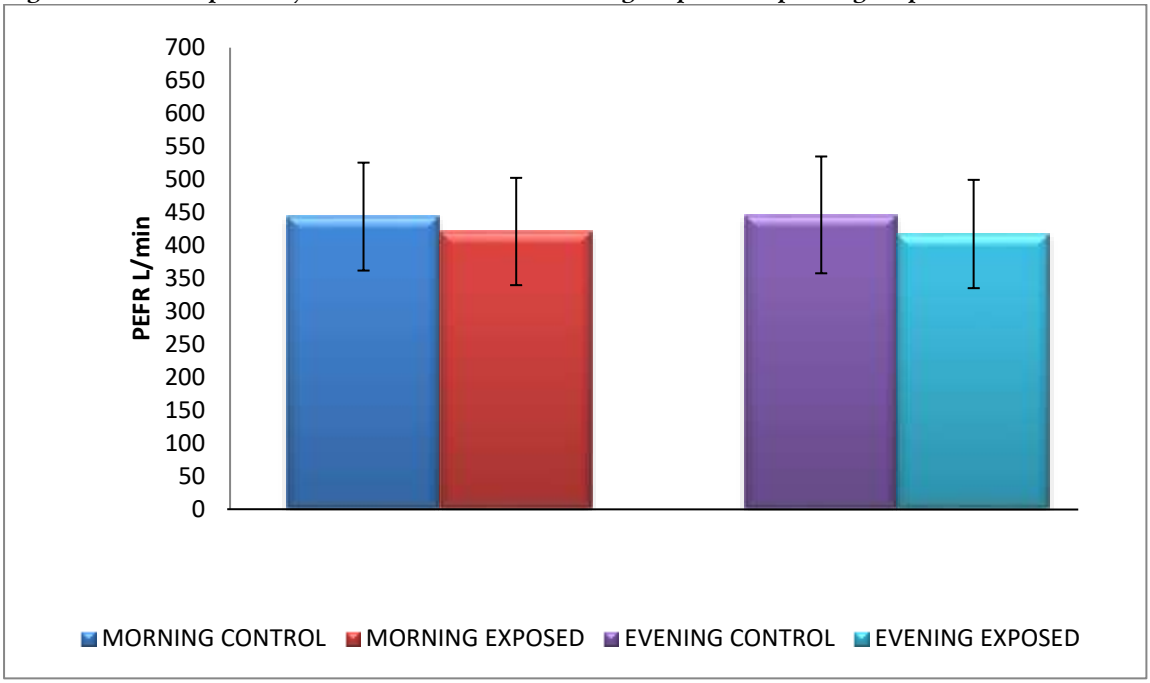
Content	Group A (control subjects not, involved in construction work)	Group B (Exposed subjects Involved in construction work)
Total subjects(male)	100	100
Age	29.89±11.25 (years)	29.71±9.78 (years)
Height	163.90±8.53(cm)	162.13± 6.37(cm)
Weight	62.19±12.25(kg)	57±8.75(kg)
BMI	22.93±4.30(m^2)	21.70±3.27(m^2)

The mean PEFR values between the control group and the exposed group has been showed in table 2

TABLE: 2 Morning (6-7am) and evening (6-7pm) Peak Expiratory Flow Rate between the control and exposed group

Sessions	PEFR (L/min)		Significance
	Group A (control)	Group B (exposed)	
Morning	443.60±81.89	418.30±81.42	0.096
Evening	446.20±88.65	417.20±82.18	0.767

Figure 1: Peak expiratory flow rate between control group and exposed group.



The difference in the mean PEFR between morning control and morning exposed is not significant ($p<0.096$) and in the evening the comparison of PEFR between control and exposed group are not significant ($p<0.076$)

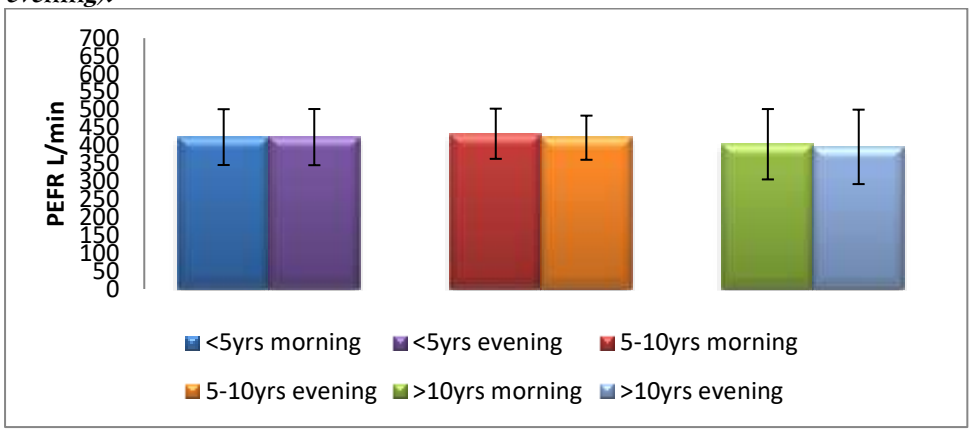
The exposed subjects in group B were grouped on the duration of their exposure to construction site dust

Table: 3 Classification of subjects based on duration of exposure among the construction workers.

Group	**No .of subjects**	**Age (years)**	**Height (cm)**	**BMI (m^2)**	**PEFR Morning (L/min)**	**PEFR Evening (L/min)**
I	58	27.81±9.84	162.81±6.49	20.80±2.77	423.79±77.90	423.79±78.37
II	19	25.68±4.60	161.57±6.44	22.22±2.96	433.15±70.00	422.10±61.60
III	23	29.17±7.13	160.86±5.89	22.86±4.30	403.91±98.19	396.52±103.86

Group I – subjects had less than 5 years of exposure to construction site dust
Group II-Subjects had the exposure duration of 5 to 10 years to construction site dust.
Group III-Subjects had the exposure duration of above 10 years to construction site dust.

Figure 2: PEFR values among the various groups exposed to the construction dust (morning and evening).



DISCUSSION

This study was carried out to find the effect of exposure to construction site dust on Peak expiratory flow among the construction site workers, and our finding shows no change in PEFR between the unexposed group (subjects not involved in the construction site work) and exposed group (subjects involved in the construction site work) no change in Peak expiratory flow rate.Variation in peak expiratory flow rate has been suggested an important measurement in screening of respiratory disease (silicosis) as well as for assessing disease severity and prognosis.In rapidly developing cities like Chennai we can see large number of construction projects going on. Persons those who are involved in the construction work may get exposed to various hazardous substances and physical agents, e.g. silica dust, concrete, cement, stone, sand dust etc. Silica is found in many building construction materials such as natural stone, brick and in concrete. Exposure to excessive dust can cause silicosis, a disease resulting in lung problems. According to (NIOSH) National Institute for Occupational Safety and Health, due to wide spread use of crystalline silica across the major industrial group like construction lead on to increase the number of silicosis related deaths.PEFR also depends up on the nutritional status of the subject recruited in our study both control and exposed subjects selected from same socio economic status. So the PEFR values are same between the control and experimental groups.No change in PEFR was observed values between the control group and exposed group people who are working in the construction industry. It may be due to less exposure to the construction site dust because person those who are working in the construction industry not a permanent employee. So chronic cement dust exposure impairs the Lung functions [(1)]. So this acute duration of exposure to construction site dust will not produce significant change in the PEFR values between the groups in our study. There are several studies saying that there is an association between cement dust exposure and lung function reduction [(10&2)]. Our study findings are in contrast to these findings. They have reported there is a significant reduction in PEFR values and lung functions among the exposed group than the unexposed group. Most of these studies are done among the cement factory workers in that they have found reduction in lung function among the high dust exposure group like stone crushing section and packing section workers (more than five years of exposure) excluding years in other section shows higher incident of reduction in lung function [(10)]. The job type appeared to be the main predictor of exposure to inhalable dust concentration at construction site. Inhalable dust concentration in the cement production plants usually considerably higher than at the construction site. [(4)]But our study has been done among the construction workers. Respirable dust generation at the construction site usually low than the cement production industries, because now a days most of the construction industries not making their cement mix inside the construction site they will made it outside the construction site. So once the cement gets mixed with the water the amount of respirable dust which can be released from cement gets reduced and also in construction site all the workers are not going to prepare the cement mix and also no one permanently fixed for making the cement mix in most of the construction industry. Hence chance of respiratory illness is less and PEFR maintained in normal physiological limits among the exposed group in our study.The lung function of the cement workers decreased with the duration of employment. There is no association between cement dust and lung function [(11)]. This study shows the result similar to our study. This could be due to short time exposure to the dust. Chronic silicosis usually takes 20 to 45 years to develop as a result of prolonged exposure to crystalline silica (MNOSHA)

Minnesota department of labor industry. In our study most of the workers are not permanent workers at construction work like cement factory workers.In our Study we grouped our experimental subjects in to three categories. Group I subjects had less than 5 years of exposure, Group II subjects had 5 to 10 years of exposure and in group III subjects had more than 10 years of exposure among three groups the group III peoples had a low PEFR values than other two groups which proves that the longest exposure to the cement dust will affects the lung function. The rate of deterioration of in ventilatory indices was faster in the older workers with longest exposure [17]. Our study findings support the findings of [1].In our study the mean average exposure range (5 to 20) years, so exposure duration is less due to this our study most of the subjects had work duration in the construction site is less also they are not working permanently in the construction site. And Out of 100 exposed subjects most of the participants had shorter duration of exposure because of this factor our result shows no change in PEFR value.

CONCLUSION

This study we observed no change in peak expiratory flow rate between exposed group subjects working in construction site and control subjects not working in the construction site.Hence it can be said that dust exposure at construction site do not affect the peak expiratory flow rate of the workers working there.Chronic exposure to the construction site dust will affect the lung function. We recommend safeguarding the health of the workers in the construction site by providing adequate protective measure materials. The management should embark on safety in the working environment and conduct health education and training on hazards of exposure to construction site dust, safety precautions and its practices.

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