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Research Article

Pulmonary Function Test Changes in Foundry Workers of Ahmedabad District Population

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Abstract: ***Background:*** Lung reactions to exposure to dust, gases, and fumes at work places have been studied in different populations. The emission level of pollutants that emit particulate matter less than 10 micrometers in size (PM 10) has been found very high in Ahmedabad. Processes in the foundry production involve the potential hazards for inhalation exposures that may lead to respiratory diseases, metabolic disorders of trace elements. However, the dependence of lung dysfunction on the metal toxicity is unclear. The aim of this study was to assess the parenting stress levels in parents of children who have cerebral palsy as compared to parents of normal children. Further objectives were to ascertain variables predictive of parenting stress levels. ***Methods:*** A Cross-Sectional comparative study was conducted on foundry workers from naroda Ahmedabad and normal subjects from V.S hospital campus, Ahmedabad.. A total of 20 foundry workers underwent pulmonary function testing. Their spirometry parameters were compared with 20 ages-matched, healthy controls. ***Results:*** A significant reduction ($P < 0.001$) was found in the spirometry parameters, such as, forced expiratory volume in the first second (FEV1), FEV1/FVC (%), MVV in foundry workers, as compared to the controls. The mean values of FEV1/FVC (%) were significantly increased ($P < 0.001$). ***Conclusions:*** The results of this study confirm that Iron foundry workers were found to have a lower lung function than normal subjects.

Keywords: foundry workers, Occupational exposure, restrictive impairment, spirometry.

INTRODUCTION

Foundry workers may be exposed to many potential (health and safety hazards). Occupational exposure to dust, fumes and gases are associated with increased prevalence of respiratory symptoms and impairment of lung function (Lebowitz, M. D. 1981; Becklake, M. R. 1989; Xu, X. *et al.*, 1992; Oxman, A. D. *et al.*, 1993; & Korn, R. J. *et al.*, 1987). Exposure response relations between occupational agents and chronic respiratory symptoms have also been reported (Korn, R. J. *et al.*, 1987; & Lebowitz, M. D. 1977). However, factors associated with life style have also been identified as causing a deterioration of lung function. A recent statement of the ATS addressed the occupational contribution to the burden of airway disease (Balmes, J. *et al.*, 2003). Kuo HW *et al.*, found that prolonged exposure to free silica, and smoking habits, can result in respiratory abnormalities among foundry workers (Kuo, H. W. *et al.*, 1999).Wang ML *et al.*, (1996) found that Exposure to dusts in steel workers has also been strongly associated with reductions in FVC, FEV_1, and FEV_1/FVC% (Wang ML *et al.*, 1996).This study was designed to assess the effect of occupational exposures to dusts, fumes, and gases on the lung function of the workers at a cast iron foundry. Normal subjects as a control group was also studied for their lung function profile (FVC, FEV1, FEV1/FVC, and MVV).

METHODOLOGY

- **Study Design** : Cross-Sectional comparative study
- **Sample Population**: Foundry workers from Naroda,Ahmedabad and Normal subjects from V.S hospital campus, Ahmedabad.
- **Sample Size** :40 subjects
- **Sampling Technique** : Simple Random method

Inclusion Criteria:

- **For Group A**:
  - Work in Foundry worker ≥ 2 years
  - Age: 20 to 50 Years
  - Gender: Male
  - Subjects who are able to comprehend commands
  - Willing to participate

- **For Group B**:

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- Work in any field except foundry
- Age: 20 to 50 Years
- Gender: Male
- Subjects who are able to comprehend commands
- Willing to participate

Exclusion Criteria:

- Subjects with known Cardiovascular, Respiratory and Neurological problems.
- Diabetes Mellitus
- Musculoskeletal disorders such as kyphosis and scoliosis

Material Used:

- Computerized spirometry,
- Weighing machine,
- Measure tape,
- Pen,
- Paper,
- Consent form

Computerized Spirometry

Outcome Measures:

- FEV_1,
- FVC,
- FEV_1/FVC,
- MVV

Procedure

- A cross sectional comparative study was conducted on foundry workers from naroda Ahmedabad and normal subjects from V.S hospital campus, Ahmedabad.
- Students were informed about the nature of study, procedure and informed consent was taken from the each volunteer.
- Body mass index was calculated using Quetelet formula BMI = weight in kilograms / height in m^2.
- The lung function tests (FVC, FEV_1, FEV_1/FVC and MVV) were carried out using a computerized spirometer (Helios) as per ATS criteria.
- The procedure was demonstrated to the participants and they were given opportunity to perform several practice efforts.
- Measurements were made in an upright seated position with nose clips.
- One-way disposable mouthpieces were used and the inside of the rubber bellows was cleaned regularly with methylated spirit to minimize cross-infection.
- Three spirometry trials were then performed to ensure uniformity.
- The highest values were recorded for analysis.

Statistical analysis

- Statistical tests were performed using Graph pad.
- Level of significance was kept at 5%.

RESULTS

- Data was analyzed by using unpaired t-test to determine whether or not there was a difference in lung function among the participants in the two groups, where significant difference was found.
- The results of anthropometric parameters and The pulmonary function tests parameters of the foundry workers and normal subjects are given in Table 1.

Table.1

PARAMETERS	FOUNDRY WORKERS (Mean ± SD)	NORMAL SUBJECTS (Mean ± SD)	P value
AGE(years)	35.05 ± 8.71	31.95 ± 9.36	0.2852(NS)
WEIGHT(kg)	57.80± 6.19	67.75±12.64	0.0031
HEIGHT(m)	1.620± 0.068	1.673±0.072	0.0215
BMI(kg/m^2)	22.07±2.28	24.11±3.32	0.0299
FEV_1(L)	2.420±0.547	3.128±0.431	<0.0001
FVC(L)	2.420±0.717	3.274±0.575	0.0002
FEV_1/FVC(%)	79.49±14.72	95.27±5.63	<0.0001
MVV(L/min)	83.35 ±28.95	118.3±20.36	<0.0001

- [Table 1: The results of anthropometric and the pulmonary function tests parameters, p<0.05, NS= non significant]
- When results were compared, it was found that there is significant difference in FEV_1, FVC, FEV_1/FVC ratio and MVV among 2 groups (p<0.0001.p<0.0002,p<0.0001,p<0.0001 respectively).
- The data was also represented in graph form as shown in graph 1,2,3 and 4. Graph 1,2,3,4 showing

difference in FEV_1, FEV_1/FVC, FVC and MVV level between foundry workers and normal subjects respectively.

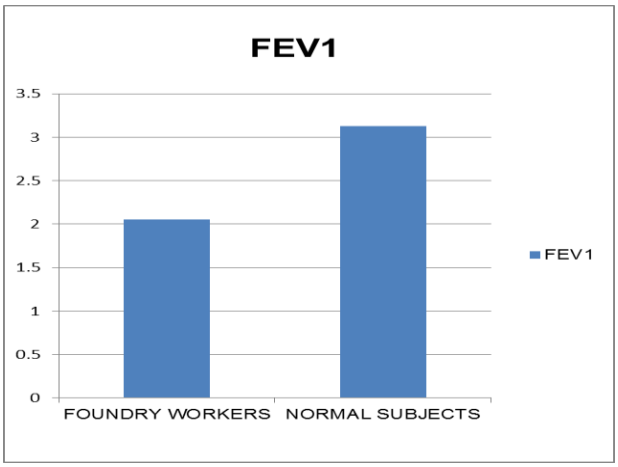

Fig.1 Difference in FEV_1 between foundry workers and normal subjects

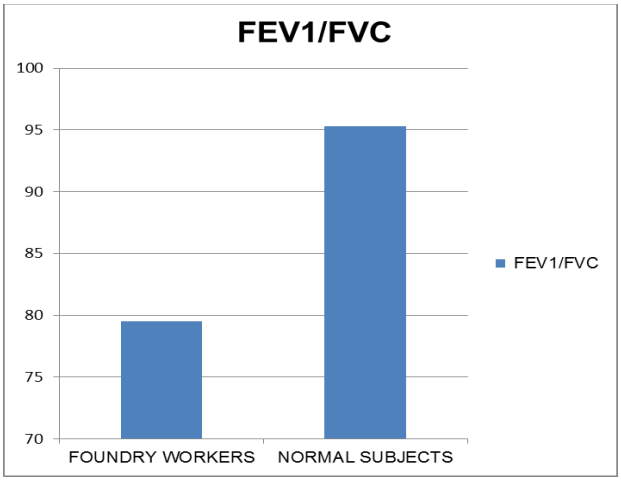

Fig.2 Difference in FEV_1 /FVC between foundry workers and normal subjects

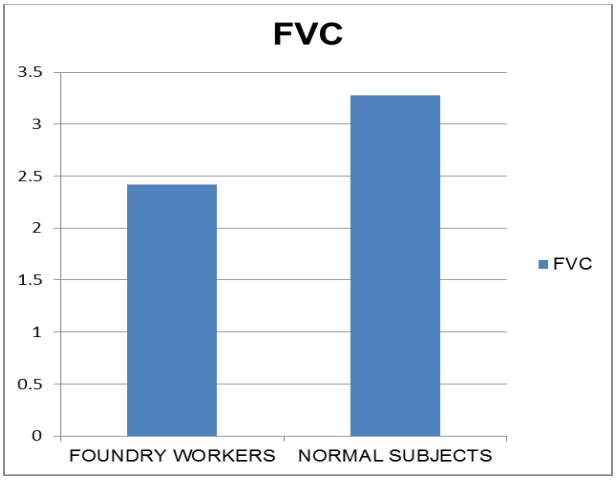

Fig.3 Difference in FVC between foundry workers and normal subjects

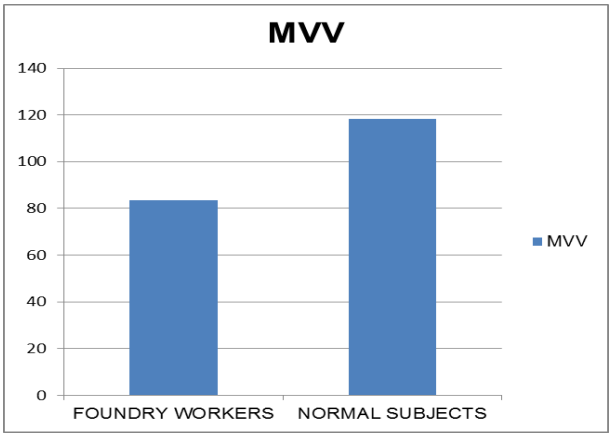

Fig.4 Difference in MVV between foundry workers and normal subjects

DISCUSSION

- This study was done with 20 foundry workers and 20 normal subjects recruited according to the inclusion and exclusion criteria.
- Both the groups were carried out the spirometry to evaluate the lung functions. Iron foundry workers were found to have been exposed to higher concentration of dust, fumes and gases than normal subjects.
- Foundry workers exposed to high concentrations of dust and fumes may have adversely affected the lung function profile, whose values for FEV_1,FVC, FEV1/FVC, and MVV were lower than the values among comparison the normal subjects where there was no occupational exposure to such air pollutants
- Similar effects were found by, J Gomes *et al.*, (2001), who carried out that, the type of job (81 iron foundry or 113 bottling plant worker) and also occupational exposure to dust significantly predicted lung function (VC, FVC, FEV_1/FVC, and PEF) indicating that occupational exposure to respirable dust in an iron foundry played a significant part in decreasing lung function of the exposed workers and in increasing the risk of chronic airflow limitations.
- Similar effects have been found by Zuskin E *et al.*, (1998), and Chia KS *et al.*, (1992), among brick manufacturing workers and among workers exposed to silica.
- Ozlemozdemil *et al.*, (1995) studied in 110 welders and 55 control groups with similar age, height and smoking habits. They found that welders working in a conditions of inadequate ventilation and have increased risk of chronic bronchitis, impairment of pulmonary function.
- In the study by Hnizdo *et al.*, (1990) on 2209 gold minersand 483 non-miners in South Africa, VC, FEV1, FEV1%and MMF tended to be decreased with increasing cumulative dust exposure, and among these measurements, the level of MMF decreased the most.

- Neukirch *et al.,* (1994) reported that lung function measurements, even after adjusting for age, weight and smoking habits, were significantly lower in the silica dust exposure group than in the control group, and that this was observed in both small and large airways.

CLINICAL IMPLICATION

- The non-use of respiratory protective equipment while at work increased the exposure and consequently heightened the risk of lung impairment and chronic airflow limitations in iron foundry workers. So use the respiratory equipment while work should be advised to decrease the risk of lung impairment in this field.

CONCLUSION

- Iron foundry workers were found to have a lower lung function than normal subjects.
- These workers were also at an increased risk of developing chronic respiratory airflow limitations than their counterparts in a non-polluted environment.
- The degree of lung impairment was higher among those workers exposed to higher concentrations of dust and gases and could eventually be a hindrance to their social life and wellbeing.

Ethical committee approval

- The study was approved by the institutional ethical committee of S.B.B College of physiotherapy, Ahmedabad. (Letter no: PTC/IEC/20/2012-13).

Limitation

- Small sample size

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