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POINT PREVALENCE OF LUNG FUNCTION ABNORMALITIES IN ADULT PATIENTS WITH RESPIRATORY SYMPTOMS – A PILOT STUDY IN AN INDUSTRIAL BELT IN WEST BENGAL.

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Abstract
Residents of industrial areas are exposed to higher level of air pollution leading to increased risk of lung diseases. In this non-interventional point prevalence study we aim to estimate the point prevalence of respiratory abnormalities including florid ling diseases among adult subjects with respiratory symptoms living in an industrial belt of Haldia in Purba Medinipur district of West Bengal. Our study results showed high prevalence of lung function abnormalities among the adult residents. 48% patients showed decreased FEV1, FVC or both. Guideline defined COPD & asthma was 7.8% & 5.9% respectively. 33.33% patients also had Pre-COPD including PRISm. Prevalence of low FEF_{25-75} with probable Small Airways Disease (SAD) was found to be around 39%. All the recruited patients presented for the first time to a specialist's clinic showing a serious lack of awareness of respiratory diseases & their impact in the society. We conclude that residents of this industrial area have high prevalence of lung function abnormalities and more improved measures for prevention & management needs to be undertaken.

Key Words – Industrial area, Lung function, Air pollution, COPD, Asthma, Small Airways disease, Pre-COPD

Introduction

Air pollution (AP) is the most common cause of lung abnormalities in both adults and children. Industrial areas usually have more polluted air and poor Air Quality Index (AQI). Residing & growing up in industrial areas can significantly increase the risk of developing various lung abnormalities due to exposure to air pollution and workplace hazards. These abnormalities can range from chronic respiratory conditions like COPD and asthma to more serious illnesses such as lung cancer and interstitial lung diseases. AP has been incriminated as a cause and aggravating factor in respiratory diseases like COPD[1,2], asthma[2,3] as well as lung cancer[4,5].

Spirometry with forced respiratory manoeuvre is the most common and the first pulmonary function test (PFT) performed by clinicians worldwide to assess lung function parameters objectively. Both GINA & GOLD guidelines provide criteria to identify obstructive & restrictive lung diseases like asthma and COPD based on spirometry findings[6,7]. Spirometry is essential to assess and monitor respiratory health. Moreover, spirometry adds prognostic value to other well-accepted health markers used in clinical practice, such as blood pressure, body mass index, glucose and blood lipids, by identifying individuals at risk, not only of respiratory diseases, but also of other non-communicable diseases (NCDs), particularly cardiovascular and metabolic disorders[8]. As most respiratory diseases are progressive in nature, early detection through spirometry and adequate management can help respiratory patients to lead a better life.

Objective

In the present study we aimed to determine the point prevalence of lung function abnormalities in patients presenting to pulmonologist's OPD with respiratory symptoms residing in an industrial area of Haldia in Purba Medinipur district of West Bengal, India.

Methodology

Adult patients with chronic respiratory symptoms were included in the study. Presence of two or more symptoms like cough, expectoration, chest tightness, wheezing, breathlessness was considered as respiratory symptoms. Patients presenting for the first time to the specialist's clinic were recruited as study subjects after obtaining their consent. All participants included in the study were advised spirometry to assess lung function and the anonymised data were analysed to obtain study results.

The following lung function parameters were documented - Forced expiratory volume in 1 second (FEV1) pre & post bronchodilator (BD) administration, Forced Vital Capacity (FVC) pre & post BD, FEV1/FVC ratio post BD, and FEF25-75% post BD to look for probable small airways disease (SAD). FEV1<80% and FVC<80% both pre & post BD was considered as having probable obstructive and restrictive lung diseases respectively. FEV1/FVC <70% was also considered as having abnormal spirometry with airways obstruction. Range of FEF_{25-75} varies wildly according to published literature but most studies provide a range of 65 -140% as normal[9,10], based upon this a cut-off value of 65% has been taken as the lower limit of normal and subjects having <65% of predicted FEF_{25-75} has been documented as having probable SAD. All patients with FEV1>80% of predicted, FVC >80% of predicted and FEV1/FVC>70% were considered healthy.

Results

Total 204 patients were recruited as study subjects. There are 112 male patients (54.9%) and 92 female patients (45.1%) recruited in the study. Age in years ranged from 18 years to 74 years. Mean age was 50.59±15.15 years. Mean age of males and females were 53.5±15.4 years and 46.83±14.08 years respectively. Average height of all subjects was 159.35±9.34 cm and that of male & females were 165.07±6.92 cm & 152.39±6.85 cm respectively. Mean BMI of all subjects was 23.77±4.22 and that of male & female participants were 23.23±3.38 & 24.44±5.12 respectively. Among all subjects, 11.76% were underweight (<18.5 BMI), 54.9% were having normal BMI (18.5 – 24.9), 27.45% were overweight (25-29.9) and 5.89% were obese (>30). Table 1. Shows the demographic characteristics of recruited patients.

Table 1. Demographic characteristics of study subjects (Mean±SD)

Characteristics	All subjects	Males	Females
Number	204	112 (54.9%)	92 (45.1%)
Mean Age in years	50.59±15.15	53.5±15.4	46.83±14.08
Mean height in cm	159.35±9.34	165.07±6.92	152.39±6.85
Mean weight in kg	60.37±11.66	63.61±11.76	56.43±10.29
Mean BMI	23.77±4.28	23.23±3.38	24.44±5.12

Spirometry showed out of 204 patients, 108 patients (52.9%) patients had normal FEV1, FVC and preserved FEV1/FVC ratio. But among them, 20 patients (18.5%) showed FEF_{25-75} <65% predicted and 4 patients (3.7%) showed FEF_{25-75} <60% of predicted.

96 patients out of total 204 subjects (48.1% of total subjects) showed abnormal spirometry with obstructive/restrictive/mixed disease. 84 subjects (87.5%) with abnormal spirometry had mixed disease (both FEV1, FVC <80%). Only 4 patients out of 96 had pure obstructive abnormality (FEV1<80%) and was diagnosed with asthma fitting GINA 2025 defined criteria[6]. Another 8 patients with mixed abnormality were also diagnosed with asthma. 8 patients had purely restrictive abnormality (FVC<80%) with preserved FEV1/FVC ratio. 16 patients were diagnosed with COPD fitting the criteria of GOLD 2025[7]. 4 COPD patients has also increased bronchodilator reversibility of ≥12% but <200 ml increase FEV1 showing ACO like pattern.

There was high prevalence of low FEF_{25-75} in subjects with abnormal spirometry. 60 patients out of 96 (62.5%) had values <65% and all of them were<60% of predicted which suggest probable SAD. Table 2. Shows lung function parameters of healthy (normal spirometry) individuals and subjects with abnormal spirometry. Figure 1, 2 &3 shows comparative lung function parameters of subjects with normal and abnormal spirometry.

Table 2. Major lung function parameters of all study subjects in Mean±SD.

Categories	% pred FVC		% pred FEV1		% pred post BD FEV1 /FVC	% pred FEF_{25-75}	
	Pre BD	Post BD	Pre BD	Post BD		Pre BD	Post BD
All, n=204	79.3±28.05	80.07±27.8	84.01±33.9	84.01±33.9	105.7±18.6	69.8±35.4	70.5±37.2
Normal Spirometry, n=108	101.8±13.9	102.2±13.6	110.5±15.1	110.9±66.6	108.9±10.1	88.4±25.2	89.8±30.2
Abnormal Spirometry, n=96	56.1±18.3	57.1±18.7	56.4±24.8	59.4±25.3	102.5±24.1	50.5±34.1	50.5±33.1
Obstructive, n=4	66	77	77	92	119	77	93
Restrictive, n=8	72±1.1	74.5±3.7	84.5±0.5	89.5±0.5	88.3±0.8	84.5±1.6	91±5.3
Mixed, n=84	51.5±14.3	52.1±14.7	49.4±18.7	51.9±19.03	75.3±18.4	43.2±31.9	42±28.9

Figure 1. Scatter diagram of % predicted FVC of Healthy (a) and individuals (b) with abnormal spirometry. (a) (b)

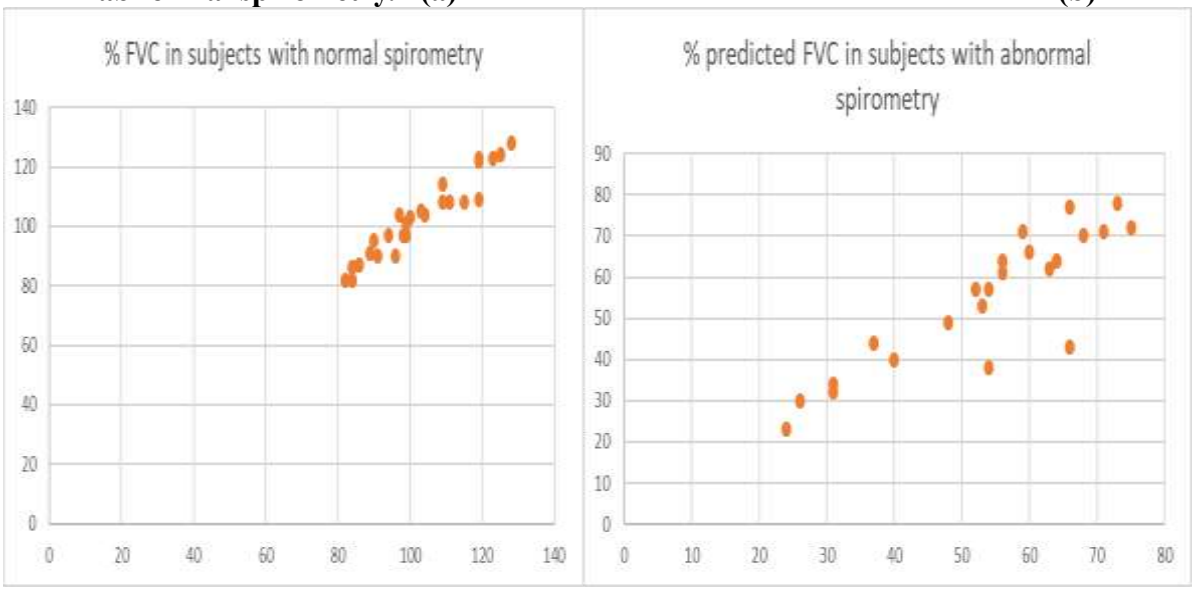


Figure 2. Scatter diagram of % predicted FEV1 of Healthy (a) and individuals (b) with abnormal spirometry. (a) (b)

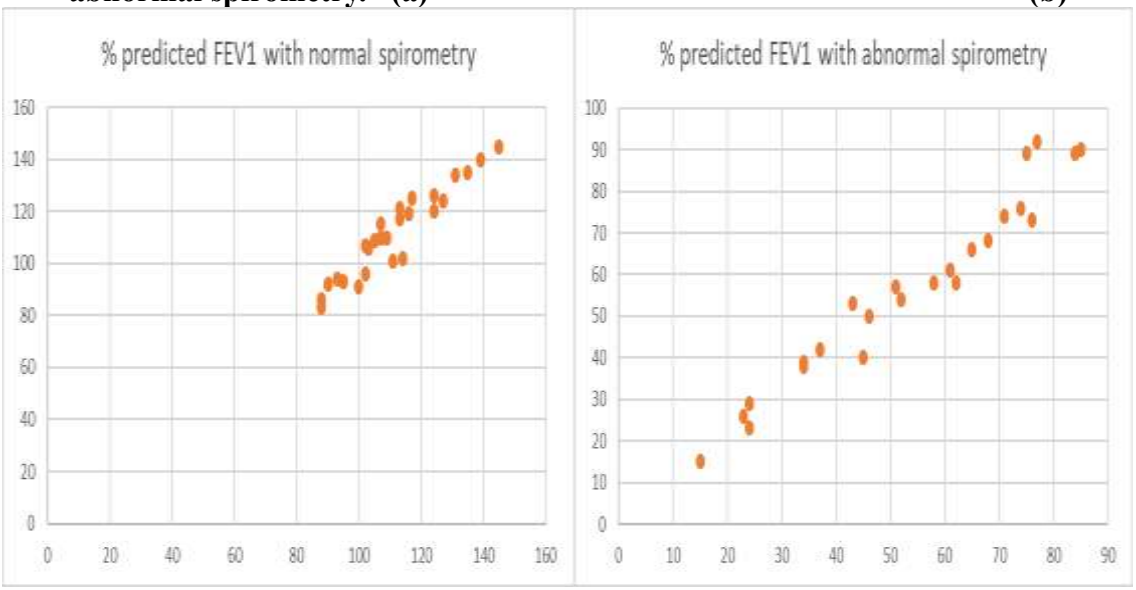
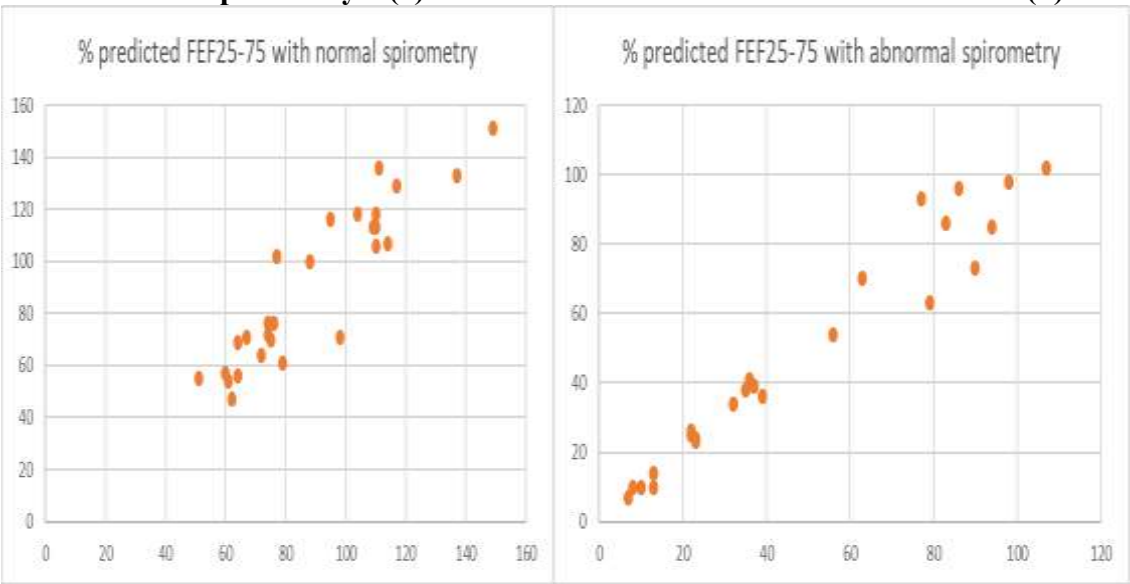


Figure 3. Scatter diagram of % predicted FEF_{25-75} of Healthy (a) and individuals (b) with abnormal spirometry. (a) (b)



Along with Asthma & COPD, 68 patients among 204 study subjects (33.33%) had some spirometric abnormality with respiratory symptoms and preserved ratio of FEV1/FVC fitting the criteria of Pre-COPD[7,11,12]. Among these 68 patients, 60 patients (29.4%) had FEV1<80% with preserved FEV1/FVC ratio putting them in PRISm category as defined by GOLD and other published literature[7,13].

It is also worth noting that 24 out 204 patients (11.8%) consulted a specialist for the first time with <50% of FVC predicted and 16 patients (7.8%) with <50% of FEV1 Predicted which suggest that awareness about respiratory diseases are still lacking in the society.

There was appreciable difference in mean FEV1, FVC, FEV1/FVC, FEF_{25-75} between the two groups with normal & abnormal spirometry. The difference in mean values were statistically significant for FVC (unpaired t test, two tailed p< .0001, 95% C.I 40.619 – 49.581), FEV1 (two tailed p< .0001, 95% C.I 37.261 – 65.739), FEV1/FVC (two tailed p = .0124, 95% C.I 1.397 – 11.403) and FEF_{25-75} (two tailed p <.0001, 95% C.I 30.561 – 48.039). Low FEF_{25-75} found to be much more prevalent in subjects with abnormal spirometry even if the FEV1/FVC ratio is normal compared to individuals with normal spirometry for both cut off values of <65% and <60% of predicted (chi square statistic 41.2433, p< .00001 and chi square statistic 81.6051, p< .00001 respectively).

Overall point prevalence estimated from our study are as follows –

- COPD – 16 patients out of 204 subjects – 7.8%
- Asthma – 12 patients out of 204 subjects – 5.9%
- Non-specific lung function abnormality including PRISm, Pre-COPD, Mixed disease – 68 patients out of 204 subjects – 33.33%
- Low FEF_{25-57} <65% of predicted was present in 80 subjects (39.2%) and FEF_{25-75} <60% of predicted was present in 64 subjects (31.4%).

Discussion

Residents living in industrial areas are exposed to higher level of air pollution as well as pollution of overall environment. Growing up and being exposed to pollution make the residents of industrial areas prone to develop pulmonary problems as evident from our study results where 48% of patients had lung function abnormalities. Similar findings were corroborated by Sang-yong Eom et.al. in their study done in South Korea[14]. They reported higher prevalence of respiratory symptoms as well as 26% increased risk of acute bronchitis in residents of industrial complex. In another study done by Dr. Manoj Kumar in an industrial town of Punjab found significantly higher prevalence of COPD &

asthma ((22.3% and 8.8% respectively) along with much higher prevalence of respiratory symptoms like cough, phlegm, wheezing & breathlessness[15].

Point prevalence of guideline defined COPD patients was found to be 7.8% which is very close to results published by other epidemiological studies conducted in India by Verma et. Al. & others which reported a prevalence of 8%[16,17,18]. Asthma prevalence in our study was 5.9%. Community studies done in India reported prevalence rate of 3.3% to 8.3%[17,19]. 8 COPD patients who were 60 & above, out of 16 presented for the first time in a specialist clinic. Similarly, all asthma patients were 40 years and above at the time of diagnosis. This shows a serious gap of public awareness about respiratory diseases especially in an industrial area where respiratory problems are supposedly much higher than any residential areas[20].

33.33% of study subjects were identified as having pre-COPD along with prevalence of PRISm was found to be around 29%. These are important entities as current understanding about treatment and progression of Pre-COPD & PRISm are still developing and are considered risk factors of developing florid COPD. Literatures published across the world have also shown spirometry defined COPD can underdiagnose clinically relevant COPD cases[21]. Study by Bergin et. Al. showed spirometry can be normal even when 20-25% of lung showed emphysema in computed tomography (CT) scan[22]. COPD gene study by Regan et. Al. reported that spirometry missed 42.3% patients having emphysema & 31% patients having airways disease[23]. There are similar studies showing underdiagnosis of COPD by spirometry defined criteria of FEV1/FVC<70%[24,25]. These evidences should prompt us to look at PRE-COPD & PRISm patients with more seriousness and they should be monitored and managed as undiagnosed COPD patients. One study from Japan reported prevalence of PRISm around 10%[26]. Another study from India reported prevalence of PRISm to be 30.26% and that of unrevealed COPD 31.58% which are very similar to our study results[27]. Another Indian study by Balachandran et. al. reported a prevalence of 25.5% in symptomatic patients[28]. In longitudinal analysis of NOVELTY cohort, Agusti et. al. reported prevalence of Pre-COPD and PRISm as 13% & 14% respectively[29]. All these studies including ours shows that probably in Indian patients, prevalence of COPD like condition is higher than the rest of the world.

Our study results showed high prevalence of low FEF_{25-75} of around 60% in subjects with abnormal spirometry and around 18% in subjects with normal FEV1, FVC, FEV1/FVC ratio. In a study by Do Sun Kwon et. al., the researcher commented that low FEF_{25-75} in patients with otherwise normal lung function is an early predictive marker of COPD[30]. FEF_{25-75} is a sensitive indicator of peripheral airways abnormality or airflow obstruction which is a hallmark of Small Airways Disease (SAD)[31,32,33]. Studies have shown that reduced FEF_{25-75} is quite common in COPD patients[34] as in our study all 16 COPD patients had <60% predicted FEF_{25-75}. Presence of low FEF_{25-75} even with normal FEV1, FVC may be used to identify patients at risk to develop pulmonary diseases especially COPD. Further studies are needed to identify clear cut off values or Lower Limit of Normal (LLN) as it will help clinicians to screen out patients at risk.

Conclusion

Our study showed higher prevalence and late presentation of lung diseases in residents of industrial area. Though diagnosed COPD/Asthma cases are similar to national averages, there was very high prevalence of Pre-COPD, PRISm, Low FEF_{25-75} suggesting early involvement of peripheral airways leading to increased risk of florid pulmonary disease development. Further larger randomised studies with adequate control subject may show further insight in development of lung diseases among residents of industrial areas and better preventive as well as curative measures can be taken improve the quality of life.

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