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Original Research Article

An Occupational Contingency in Traffic Police Personnel and Factory Workers In and Around Pune City

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ABSTRACT

Background: Workplace can be unpleasant, if hazardous irritants found in the environment, especially the respiratory irritants at making them susceptible for compromised lung functions. There are certain working sector groups where they are exposed to dust, air pollution and toxic substances which are harmful to their health.
Aim: Examination and comparative analysis of effects of exposure to air pollution and toxic chemicals on pulmonary functions among traffic police personnel (TRP) and factory workers (FW).The study group was compared with healthy subjects.
Settings and Design: Cross-sectional study.
Materials and Methods: The present study was carried out to examine the FEV1, FVC and $FEF_{25-75\%}$ for evaluating the lung functions in 90 subjects (30 controls and 60 workers from above two groups) with median age 35 years.
Results: A significant difference was observed between pulmonary functions of control group and study groups. The traffic police personnel were found to have significantly low ($p<0.001$) levels of FVC and FEF25-75% as compared to controls, while FEV1 was found to be affected in factory workers.
Conclusion: There is a significant decrement in lung function parameters in the traffic personnel as well as factory workers. Therefore it points out that there is restrictive disease, and small airway disease and obstructive disease developing in these particular working sectors.

Key words: Pulmonary Function Test, traffic police personnel's, factory workers, airway disease.

INTRODUCTION

Pune is the ninth most populous city in India and the second largest in the state of Maharashtra. Since the 1950s and 1960s, Pune has had traditional old economy industries which continue to grow today. Furthermore, the city is also known for manufacturing and automobiles, as well as government and private sector research institutes. Pune is also one of the fastest growing cities in the Asia-Pacific region. [1]

The Pune Municipal Corporation (PMC) has also claimed in its draft environment status report (ESR) for 2013-14

that Pune city air has become more polluted due to the rise in vehicular population in the city. The air quality status data for Pune for 2013-14, released by the Maharashtra Pollution Control Board (MPCB) recently, shows that several areas in the city have been recording pollution levels which are considerably above the permissible limits since 2005. The report also found high carbon monoxide (CO) and benzene concentrations in Pune in comparison to other cities, including Mumbai. [2] Air pollution being a significant risk factor for multiple health conditions including respiratory infections, heart disease and lung cancer, according to the WHO. [3]

Growing traffic pollution in India is a major hazard especially to those living and working in the cities and the rising ambient air pollution poses particularly high risk to some occupational groups. As a consequence of the nature of their job, police personnel in the traffic as well as law and order sections are continuously exposed to toxic pollutants emitted from the automobiles. Due to the fact that most of them work for a minimum of about 8 hours per day on almost all days of a week throughout the year on traffic control/patrolling duties, predisposes them to severe respiratory morbidities, decreased lung function and other health problems like hearing impairment, eye related problem. [4]

India being one of the leading nations in steel industry and the art of making iron and steel has been known and practised in India since ancient times, while the foundation was laid by Jamsetji Tata at Jamshedpur which has its largest steel plant. As the 21st century begins, steel is stronger and more durable than earlier steel; it continues to be used in new ways, such as in eyeglass frames, jet aircraft, the space shuttle, and surgical instruments. Steel is indispensable in our modern society; it is now less expensive relative to the per capita gross national product than it was 50 years ago. Steel is the most recycled material by weight. [5]

Steel plant workers are at major potential health problem. There is evidence that exposure to irritant dust and fumes may make steel workers more susceptible to reversible narrowing of air ways (Asthma) which overtime may become permanent. [6]

In the past numerous epidemiological studies have documented detrimental effects on pulmonary function and other health hazards. But very few studies have compared between outdoor exposure and indoor exposure to harmful toxins and pollutants. Therefore this study was carried out to evaluate the risk to air pollution & vehicular exhaust and indoor harmful fumes of toxic chemicals & steel dust on pulmonary function tests and also providing recommendations for medical surveillance, awareness, respiratory protection, personal protection and occupational safety which will further decrease the morbidity.

MATERIALS AND METHODS

The subjects for the present cross-sectional study were selected from the population in and around Pune city. All subjects were male, age group 20 to 40 years, working in (Pimpri) Pune city for more than one year and exposed to air pollution, dust and toxic chemicals for minimum six hours of a day (at least 5 days per week for more than 1 year).Smokers and tobacco chewers and any underlying cardio-respiratory condition, severe or uncontrolled hypertension and malignancy were also excluded.

Detailed history of each subject and their duration of exposure were noted. Study group comprised of (n=60 subjects, 30 in

each group) traffic police personnel (TRP) and factory worker (FW). 90 subjects with median age (35 years) were studied. The study group was compared with control group consists of 30 healthy subjects age and sex matched. Written informed consent was taken from each subject. Anthropometric measurements like height and weight was recorded which was followed by pulmonary function tests.

Pulmonary Function Test:

The pulmonary function tests were carried out by handheld spirometer using the standard laboratory methods. [7] The spirometer was calibrated regularly.

Patient position and procedure:

The subject was made to sit comfortable and was asked to remove or loosen all restricting clothing. The nose clip was applied with a tissue and a tissue was handed to the patient for use while removing the mouthpiece. Subject was asked to gently press the nose clip to test for leaks. The subject was then handed the measuring device and asked to place the mouthpiece in the mouth, chin slightly elevated, the neck stretched and was allowed to get accustomed to breathing into the apparatus. When the subject reached the end of a normal expiration, he was instructed to perform forced vital capacity maneuver. This manoeuver entailed two steps: a full inspiration, followed by a rapid, forceful, maximal expiration into spirometer for 6 seconds or more. After recording nose clip was also removed. Following parameters were assessed by this maneuver: [8]

1) **FVC:** Forced vital capacity. The maximum volume of air that can be expired (or inspired) during a manoeuvre using maximal effort [10]
2) **FEV1:** Volume of air that can be forcefully expired in the first second of the maximal expiration. A reduced FEV1 is only suggestive of obstructive disease. While reduction in both FEV_1 and FVC are suggestive of restrictive disease [10]
3) **$FEF_{25-75\%}$**: Forced expiratory flow during the middle half of the FVC manoeuvre. It is regarded as more sensitive but more variable measure of narrowing of smaller airways than provided by FEV1 [10]

Statistical analysis:

Data was expressed as Mean ± SD. Statistical analysis was done by using Student's unpaired 't' test in Microsoft office excel and $P<0.001$ was considered as highly significant. We carried out our study between April 2014 to October 2014 after obtaining the ethical clearance from the institutional ethical committee.

RESULT

The present study was carried out to observe the pulmonary functions of traffic police personnel and factory workers and how their working environment affected their health.

The demographic features and work related characteristics of the study population are given in the Table1.

Table 1: Demographic Features and Working characteristics of study population:

Groups	Age (Yrs) Mean ±SD	Height (cms) Mean ±SD	Weight (Kgs) Mean ±SD	Working Hours (per/day) Mean ±SD
Control	32 ± 5.71	165.9 ± 8.0	70.7 ± 11.5	8.21 ± 0.48
TRP	31.1 ± 5.60	172.8 ± 8.19	71.9 ± 8.20	9.93 ± 1.68
FW	28.7 ± 7.12	169.5 ± 6.56	63.6 ± 8.47	9.36 ± 0.85

* TRP -Traffic police personnel, FW- Factory workers

In our study lower levels of FVC, FEV1 and $FEF_{25-75\%}$ values were found in study groups (Table 2) as compared to controls.

Table 2: Comparison of FVC, FEV1,FEF25-75% in control group and study group

Groups	FVC(L) Mean ±SD	FEV1(L) Mean ±SD	FEF 25-75%(Lit/sec) Mean ±SD
Control	4.01 ± 0.82	7.38 ± 27.5	4.28 ± 0.81
TRP	1.97 ± 0.28	1.77 ± 0.12	1.25 ± 0.46
FW	2.50 ± 0.18	1.40 ± 0.18	2.84 ± 0.74
Statistical analysis: p value			
TRP Vs Control	0.000	0.000	0.000*(HS)
FW Vs Control	0.000	0.000	0.000*(HS)

* p< 0.001 Highly significant *HS (Highly significant)

When PFT was compared between both study groups, it was observed that FVC and FEF25-75% was significanlty less in TRP as shown in Table 3.While only FEV1 was found to be more affected in FW. The difference between the groups was statistically significant.

Table 3: Comparison of FVC, FEV1, FEF25-75% in traffic police personnel & factory workers

Parameters	Traffic police personnel	Factory workers	P Value
FVC(L) Mean ±SD	1.97 ± 0.28	2.50 ± 0.18	0.000*(HS)
FEV1(L) Mean ±SD	1.77 ± 0.12	1.40 ± 0.18	0.005**(S)
FEF25-75%(Lit/sec) Mean ±SD	1.25 ± 0.46	2.84 ± 0.74	0.000*(HS)

* p< 0.05 Significant, p< 0.001 Highly Significant
** HS (Highly significant), S (significant)

DISCUSSION

Occupational environment is the sum of external conditions and influences which prevails at workplace. Since our study is all about the environmental hazards, therefore the presence of various irritants especially the respiratory irritants at work place can be unpleasant and distracting, leading to poor morale and decreased productivity. The present study was there FPRE undertaken to identify the changes in lung functions in traffic police personnel and factory workers.

In Table 1 demographic features and working characteristics of study population were matched. Mean working hours were more in the traffic police personnel (9.93±1.68) than factory workers (9.36±0.85). In our study there was a significant reduction in FVC, FEV1 and FEF25-75% in traffic police personnels and factory workers (Table 2) as compared to their matched controls. Wang et al found similar trend of FVC and FEV1 decrement in the subjects of Chongqing city of China exposed to particulate matter in both urban and suburb areas. [9]

A Turkish study showed that the traffic police personnel are the population group under risk due to the inhalation of carbon monoxide (CO) rich air while on duty at the crowded cross-sections of the city. [10]

Traffic policemen who work in the busy traffic signals areas for years are exposed to the risk of air traffic pollutants. In the long run the pollutants may produce disease like asthma and bronchitis in the exposed individuals with changes in normal lung functions. [11,12] For that matter even the workers working in steel factory are also exposed to harmful chemicals if no precautionary measures were followed.

The probable cause for the decrease in pulmonary function test is the accumulation in peri-bronchial lymphoid and connective tissues along with varying degrees of wall thickening and remodeling in terminal and respiratory bronchioles arising from each pathway. Bronchiolar walls with marked thickening contained moderate to heavy amounts of carbon and mineral dust; and wall thickening is associated with increase in collagen and interstitial inflammatory cells including dust-laden macrophages. [13]

Surprisingly, in combination with particulate pollutants, SO2 and NO_2 have a greater chance to reach the deeper parts of the lungs. The gaseous pollutants may also alter the properties and concentration of surfactant and may thus contribute to the

early closure of small airways. Many terminal bronchioles may be compromised before other pulmonary function tests such as FEV1 are affected. [14]

The other studies on traffic police by Singh et al at Jaipur, India have also shown highly significant changes in FEV1 between control and study group. [15] But our study indicates that there is some degree of restriction present in the respiratory tract of traffic police personnel as indicated by FVC and FEF25-75% which makes them prone for restrictive disease. These changes might be in the tissue of the lungs due to chronic irritation by pollutants also prolonged exposure to various air pollutants and toxins more than 1 year, leads to obstructive and restrictive disorders of lungs.

In the other scenario metallurgical industry (steel) workers in the developing countries are often exposed to high concentrations of dusts and fumes that affect pulmonary function. [16] Our emphasis was also in these metal industry / factory workers where in they are constantly getting exposed to various dust particles of different metals while polishing framing grinding them. We also found significant decrease in FEV1 only as compared to other parameters in workers working in steel and other metal polishing factory. The development of respiratory diseases and other work related respiratory symptoms among the steel workers were related to a combination of dusts (which may acts as irritants in their own right) and irritant gases in the workplace as well as the effects of smoking and other ambient air pollution. [17]

Workers at steel manufacturing plants and iron foundries are exposed to a variety of agents including dusts from iron ore, coal, silica, and fumes and gases that comprise coke furnace emissions, metal fumes, iron oxides, and oxides of carbon, sulphur, and nitrogen. These workers, therefore, are at an increased risk of impaired lung function from chronic exposure to dust and fumes. A significant decline in lung function, consistent with slight airway obstruction, has been reported in steelworkers who worked in the continuous casting process. [18]

Kolarzyk et al has observed that 28.7% of the workers of the 'Sendzimir' Steel Mill, Cracow, Poland had chronic bronchitis. [19] In another cross-sectional study; exposure to dusts in steel workers has also been strongly associated with reductions in FVC, FEV1, and FEV1/FVC%. Significant decreases in FEV1 and FVC have been associated with increase in occupational exposures to gases and fumes. It was shown that all employees from of the steel mill, "NowaHuta", particulary coking plant workers, had the highest contribution to the coefficient of morbidity of diseases of airways. [20,21]

While intergroup comparison (Table 3) of pulmonary functions amongst TRP and FW showed significant reduction of FVC and $FEF_{25-75\%}$ in TRP suggestive of development of restrictive disease and small airway disease while reduced FEV1 was seen in factory workers which is suggestive of obstructive disease. However majority of the respondents who reported to us did not use respiratory protective measures especially the traffic police such as face mask, face barriers and disposable masks this was indeed the other aspect of our study. The use of appropriate personal protective equipment like respirator was literally absent among the police personnel. Decline in lung function is likely that the traffic police personnels have long working hours and are not only exposed to air pollutants but also inhalation of fuel vapour its fumes in heavy traffic which results in

alteration of pulmonary function. On the contrary factory workers did use masks and other protective measures but did show reduced FEV1, suggestive of obstructive disease.

Pulmonary function testing (PFTs) is a valuable tool for evaluating the respiratory system representing an important adjunct to the various lungs imaging studies. Awareness of the sources of air pollution in the community would help individuals avoid them. In order to reduce the impact it is recommended that they should use respiratory protective face mask during work. We also suggest pre-employment and periodic medical check-up like pulmonary function tests and also working hours can be reduced in order to avoid continuous exposure and future morbidity. Although spirometry can provide useful diagnostic and screening information, it has few limitations such as it can detect obstructive diseases in early stages but some restrictive it may not be sensitive enough.

CONCLUSION

The present study concluded that the parameters like FVC, FEV1 and FEF25-75% was adversely affected in the traffic police personnels and factory workers and resulting in impairment of their lung function. It was found that traffic police personnels are prone for developing restrictive disease and small airway disease. While the steel workers are likely to remain asymptomatic till significant pulmonary damage results or may present with subtle symptoms and are prone for obstructive disease in future. The impairment in lung functions is proportionate to the extent of exposure or the severity of exposure rather than duration of exposure. Early recognition and removal of susceptible workers from working place before deterioration is advisable.

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