Research Article

Respiratory Effects of Air Pollution in Traffic Police Personnel in The Metropolitan City of Hyderabad: a Cross-Sectional Study

Dr. B. Gokulavasanth[1*], Dr. Mahaboob Khan[2], Dr. Kartheka[3], Dr. Parathkumar[4],Dr.Sravan G[5],Dr. Rajesh P[6]

[1*]Assistant professor Department of Respiratory Medicine, JR Medical College and Hospital, Tindivanam, Tamil Nadu, India b.g.vasanth35@gmail.com
[2]MD, FCCP
[3]MD
[4]MD
[5]MD
[6]MD, Government General And Chest Hospital Hyderabad India

Abstract

Background: Traffic police personnel are continuously exposed to vehicular air pollution. This study aimed to assess the respiratory effects of air pollution in traffic police personnel in Hyderabad, India.

Methods: This cross-sectional study included 103 traffic police personnel aged 20-60 years with at least 2 years of service, working in the Greater Hyderabad Municipal Corporation area, and was conducted at a tertiary care chest hospital from November 2019 to November 2021. Symptoms were recorded with a respiratory questionnaire and spirometry was performed.

Results: Of the 103 personnel, 67 (65.0%) were male, 42 (40.8%) had more than 10 years of service
and 24 (23.3%) were smokers. Eye burning (27.2%), shortness of breath (23.3%) and cough (22.3%) were the commonest symptoms. Small airway disease was found in 55 (53.4%) and obstructive airway disease in 3 (2.9%), and 45 (43.7%) had normal spirometry. Peak expiratory flow rate (PEFR) was significantly lower in personnel with more than 5 years of service ($p = 0.003$), with no difference in forced vital capacity (FVC), forced expiratory volume in 1 second (FEV1) or forced expiratory flow at 25-75% of FVC (FEF25-75%). Smokers had significantly lower PEFR ($p = 0.013$) and FEF25-75% ($p < 0.001$) than non-smokers.

Conclusion: Respiratory symptoms and small airway disease were common among traffic police personnel, and PEFR was lower in those with longer service and in smokers. Periodic spirometric health monitoring is recommended.

Keywords: Air pollution; Occupational exposure; Police; Respiratory function tests; Spirometry; Vehicle emissions.

INTRODUCTION

From smog hanging over cities to smoke inside the home, air pollution poses a major threat to health and climate. World Health Organization (WHO) data show that 9 out of 10 people breathe air that exceeds WHO guideline limits, with low- and middle-income countries suffering the highest exposures. The combined effects of ambient (outdoor) and household air pollution cause about seven million premature deaths every year, as a result of increased mortality from stroke, heart disease, chronic obstructive pulmonary disease (COPD), lung cancer and acute respiratory infections.[1]

Emission of pollutants from automobiles has the potential to raise the level of pollutants such as carbon monoxide, oxides of nitrogen, particulate matter and hydrocarbons in the atmosphere, and these adversely affect the health of the individual.[2,3] The most common route by which pollutants enter the human body is inhalation, and hence the respiratory system is the primary target of the adverse effects of air pollution, leading to chronic respiratory diseases.[4,5] It has been estimated that 235 million people have asthma and 64 million have COPD worldwide, and many studies have shown that people who are more exposed to air pollution may suffer from respiratory illness.[6,7]

Studies of traffic police personnel in India have reported impaired lung function. Gupta et al. found that nonsmoking traffic policemen in Patiala recorded a significant decline in forced vital capacity (FVC), forced expiratory volume in one second (FEV1) and peak expiratory flow rate (PEFR) when compared with controls, probably due to exposure to vehicular pollution.[8] Sasikumar et al. found that 250 traffic police personnel in Chennai had significantly lower FEV1, FEV1/FVC ratio and forced expiratory flow at 25-75% of FVC (FEF25-75%) than less-exposed controls, and those with a longer duration of exposure had significantly reduced lung function.[9] Similar respiratory impairment was reported among traffic police in Saurashtra,[10] Pondicherry [11] and Jalgaon.[12]

There are some professions in which continuous exposure to the external atmosphere is mandatory, and one such profession is the traffic police, who are continuously exposed to air pollution which adversely affects their respiratory health. Hyderabad is a metropolitan city with a population of more than 10 million and one of the busiest cities in India, with continuous movement of automobiles contributing to air pollution.[13] Traffic personnel who work in Hyderabad may therefore be more prone to develop respiratory morbidity than individuals who do office work. Hence this study was conducted to assess respiratory symptoms and spirometric lung function abnormalities among traffic police personnel exposed to traffic-related air pollution and to evaluate the association of duration of occupational service and smoking status with lung function parameters.

Objectives

To determine the prevalence of respiratory symptoms, assess spirometric parameters including FVC, FEV_1, PEFR and FEF 25-75%, compare lung function between personnel with shorter and longer durations of occupational service, and evaluate differences in lung function between smokers and non-smokers.

MATERIALS AND METHODS

This cross-sectional study was conducted in the Department of Pulmonary Medicine, Government General and Chest Hospital / Osmania Medical College, Hyderabad, Telangana, India, the largest tertiary care centre in the state of Telangana, from November 2019 to November 2021. The study population was traffic police personnel working within the Greater Hyderabad Municipal Corporation limits, and 103 personnel were included.

Ethical clearance was obtained from the Institutional Ethics Committee, Osmania Medical College, Hyderabad (ECR/300/Inst/AP/2013/RR-19), and written informed consent was obtained from all participants.

Inclusion and Exclusion criteria

Traffic police personnel of either gender aged 20-60 years with a minimum of 2 years of service as traffic police, who were present on the day of the study and willing to give informed consent, were included. Personnel with less than 2 years of service, those with an acute illness, those absent on the day of the study and those not willing to give informed consent were excluded.

Methods

A detailed history was taken using a respiratory questionnaire covering respiratory and other symptoms, years of service, working hours per day, duty days per week, post location, use of personal protective equipment (PPE), comorbidities, disability at the workplace due to symptoms and smoking history, including pack-years. A physical examination was conducted, height and weight were measured and significant findings were noted.

Spirometry was performed using an MIR Spirolab spirometer according to American Thoracic Society (ATS) recommendations,[14] and the values were interpreted by comparison with predicted values derived from a healthy population. Subjects were advised to avoid full meals for 2 hours, alcohol for 4 hours, short-acting bronchodilators for 6 hours and long-acting bronchodilators for 12 hours before the test. Seated comfortably with a nose clip in place, the subject inhaled deeply and blew out as fast and as hard as possible for a minimum of 6 seconds, and then inhaled deeply to complete the flow-volume loop. A minimum of three acceptable manoeuvres was performed, the two largest FVC and FEV1 values were required not to vary by more than 0.2 L, and the best of three trials was taken for analysis.

Normal spirometry was defined as FEV1 and FVC above 80% of predicted with an FEV1/FVC ratio above 70%; an obstructive pattern as FEV1 below 80% of predicted with FEV1/FVC below 70%; a restrictive pattern as FVC below 80% of predicted with FEV1/FVC of 70% or more; and a mixed pattern as FVC and FEV1 below 80% of predicted with FEV1/FVC below 70%. A decrease in FEF25-75%, which reflects flow in the small airways (internal diameter less than 2 mm), was taken as suggestive of small airway disease.

Statistical Analysis

Data were entered in Microsoft Excel 2010 and analysed using Microsoft Excel 2010 and Epi Info 7.2.0. Continuous variables were presented as mean ± standard deviation (SD) and categorical variables as number (percentage). Student's t-test was used to compare continuous variables between groups. A p value of less than 0.05 was considered significant.

RESULTS

A total of 103 traffic police personnel were studied. The largest age group was 30-39 years (38, 36.9%), followed by 40-49 years (37, 35.9%) and 20-29 years (28, 27.2%); 67 (65.0%) were male and 36 (35.0%) female. Most lived in residential areas (87, 84.5%). Forty-two (40.8%) had more than 10 years of service, 32 (31.1%) 5-10 years and 29 (28.2%) 3-5 years. Fifty-three (51.5%) worked

less than 8 hours a day and 50 (48.5%) ≥8 hours, 66 (64.1%) were on duty daily and 37 (36.0%) on alternate days, and 70 (68.0%) were posted in the city. PPE was used by 81 (78.6%). Twenty-four (23.3%) were smokers and 19 (18.4%) had more than 20 pack-years of smoking. Hypertension alone was present in 11 (10.7%), diabetes alone in 3 (2.9%) and both in 1 (1.0%), while 87 (84.5%) had no comorbidity; 17 (16.5%) reported a disability (Table 1).

Table 1. Demographic, occupational and clinical characteristics (n = 103)

Characteristic		n (%)
Age group (years%)	20-29	28 (27.2%)
	30-39	38 (36.9%)
	40-49	37 (35.9%)
Gender	Male	67 (65.0%)
	Female	36 (35.0%)
Area of residence	Residential	87 (84.5%)
	Industrial	16 (15.5%)
Years of service	3-5	29 (28.2%)
	5-10	32 (31.1%)
	>10	42 (40.8%)
Working hours per day	<8	53 (51.5%)
	≥8	50 (48.5%)
	Daily	66 (64%)
Characteristic		**n (%)**
Duty days per week	Alternate days	37 (36%)
Post location	Highway	33 (32.0%)
	City	70 (68.0%)
Use of PPE		81 (78.6%)
Smokers		24 (23.3%)
Smoking >20 pack-years		19 (18.4%)
Comorbidities	Hypertension	11 (10.7%)
	Diabetes mellitus	3 (2.9%)
	Hypertension and diabetes	1 (1.0%)
	Hypothyroidism	1 (1.0%)

	None	87 (84.5%)
	Disability	17 (16.5%)

The commonest symptoms were eye burning (28, 27.2%), shortness of breath (24, 23.3%) and cough (23, 22.3%), followed by gastro-oesophageal reflux disease (GERD) symptoms and upper respiratory tract infection (URTI) (16, 15.5% each), sputum (15, 14.6%), wheeze (6, 5.8%) and chest tightness (3, 2.9%). Apart from respiratory symptoms, low back ache was common and was present in 34 (33.0%) (Table 2).

Table 2. Respiratory and other symptoms (n = 103)

Symptom		n (%)
Respiratory and related symptoms	Eye burning	28 (27.2%)
	Shortness of breath	24 (23.3%)
	Cough	23 (22.3%)
	GERD symptoms	16 (15.5%)
	URTI	16 (15.5%)
	Sputum	15 (14.6%)
	Wheeze	6 (5.8%)
	Chest tightness	3 (2.9%)
	mMRC	1 (1.0%)
Other symptoms	Low back ache	34 (33.0%)
	Headache	4 (3.9%)
	Low back ache and headache	1 (1.0%)
	Ankle pain	1 (1.0%)
	Itching	1 (1.0%)
	Myalgia	1 (1.0%)
	Rashes	1 (1.0%)
None		60 (58.3%)

On spirometry, only 1 (1.0%) participant had an FEV1/FVC ratio below 70%, while 55 (53.4%) had a reduced FEF25-75%. Overall, 3 (2.9%) had obstructive airway disease, 55 (53.4%) small airway disease and 45 (43.7%) were normal (Table 3).

Table 3. Spirometric findings (n = 103)

Finding	n (%)
FEV1/FVC <70%	1 (1.0%)
Reduced FEF25-75%	55 (53.4%)

Finding	n (%)
Spirometric diagnosis	
Obstructive airway disease	3 (2.9%)
Small airway disease	55 (53.4%)
Normal	45 (43.7%)

There was no significant difference in FVC, FEV1 and FEF25-75% between personnel with less than 5 years and more than 5 years of service, whereas PEFR was significantly lower in those with more than 5 years of service (Table 4).

Table 4. Lung parameters according to the duration of service

Lung parameter	Service <5 years (n = 29)	Service >5 years (n = 74)	p value
FVC	0.65 ± 0.37	0.66 ± 0.37	0.902
FEV1	0.52 ± 0.33	0.50 ± 0.40	0.812

PEFR	1.04 ± 0.60	0.69 ± 0.49	0.003
FEF25-75%	1.28 ± 1.09	1.30 ± 0.85	0.921

Smokers had significantly lower PEFR and FEF25-75% than non-smokers, with no significant difference in FVC and FEV1 (Table 5).

Table 5. Lung parameters in smokers and non-smokers

Lung parameter	Smokers (n = 24)	Non-smokers (n = 79)	p value
FVC	2.61 ± 1.69	2.83 ± 0.68	0.349
FEV1	3.27 ± 1.98	3.38 ± 1.15	0.734
PEFR	7.90 ± 0.90	8.26 ± 0.50	0.013
FEF25-75%	2.54 ± 0.54	3.11 ± 0.56	<0.001

DISCUSSION

The aim of this study was to study the effect of air pollution in traffic police personnel who are exposed to a dusty and smoky environment. Small airway disease was found in more than half of the personnel, whereas obstructive airway disease was uncommon.

In the present study, 36.9% of the personnel belonged to the age group of 30-39 years, followed by 40-49 years (35.9%). The mean age of traffic police personnel was 38.03 ± 10.95 years in the lesser-exposure group and 39.43 ± 13.87 years in the greater-exposure group in the study by Sasikumar et al.,[9] 37.98 ± 11.65 years in the study by Makwana et al.[10] and 39.8 ± 5.80 years in that by Gupta etal.[8] The majority of traffic police personnel were aged 30–49 years, consistent with age distribution reported in previous studies.

In the present study, 40.8% had more than 10 years of experience, 31.1% 5-10 years and 28.2% 3-5 years. Sasikumar et al. reported that 15.72% had less than 5 years, 31.85% 5-10 years, 35.88% 11-20 years and 16.53% more than 20 years of experience,[9] Makwana et al. that 56% had less than 4 years and 44% more than 4 years,[10] and Gupta et al. that 66% had less than 8 years and 34% more than 8 years of experience.[8] In the present study, 51.5% worked for less than 8 hours a day, whereas in the study by Gupta et al. 66% worked for more than 8 hours.[8] Smoking was present in 23.3% of the present study population, similar to the 27% reported among traffic police by Makwana et al.[10] The distribution of service duration varied across studies, but still most of traffic police personnel had more than 10 years of service and experienced an exposure of ≥8 hrs a day.

In the present study, cough was present in 22.3%, shortness of breath in 23.3%, wheeze in 5.8% and eye burning in 27.2% of the personnel, and apart from respiratory symptoms, low back ache was common (33.0%). Gupta et al. found cough in 68%, shortness of breath in 22% and irritation of the respiratory tract in 36% of traffic policemen.[8] Pajanivel et al. found cough in 52% of 94 traffic policemen in Pondicherry,[15] and Dey et al. found that any type of respiratory symptom was highest in the north zone of Kolkata, followed by the south and central zones.[16] Respiratory symptoms were common among traffic police personnel, with shortness of breath, cough and eye burning being frequently reported.

In the present study, only 1.0% had an FEV1/FVC ratio below 70%, 53.4% had a reduced FEF25-75%, indicating small airway disease. Sasikumar et al. found that exposed traffic policemen had significantly lower FEV1 (2.79 ± 0.51), FEV1/FVC (78.40 ± 7.67) and FEF25-75% (2.66 ± 0.83) than controls with less exposure, with no significant change in FVC and PEFR.[9] Kumar et al. found that prolonged exposure to ambient air pollution leads to a trend towards obstructive features among traffic policemen,[17] and Dudhmal et al. found that FVC, FEV1 and FEV1/FVC% were reduced significantly in traffic policemen compared with controls.[18] The reduced FEF25-75% suggests the need for assess small airway function among traffic police personnel, other studies also supports this.

In the present study, there was no statistically significant difference in FVC, FEV1 and FEF25-75% by duration of service, but PEFR was significantly lower in traffic police personnel with more than 5 years of service. Sasikumar et al. found that as the years of experience increased, all the pulmonary function parameters decreased significantly, and traffic policemen with more than 20 years of experience had a significant decline in pulmonary function.[9] Makwana et al. found that personnel with more than 4 years of exposure had lower values of pulmonary function parameters than those with less than 4 years,[10] and Gupta et al. found a decline in all spirometric parameters as the duration of exposure increased, with FVC 2.7 L, FEV1 1.8 L and PEFR 7.5 L/s in traffic policemen with more than 8 years of exposure compared with 2.9 L,
2.3 L and 7.7 L/s in those with less than 8 years.[8] Maddur et al. in Telangana also found that the respiratory function of traffic police declined with increasing age and duration of exposure.[19] Studies have reported reduction in pulmonary function with increasing occupational exposure, suggesting the respiratory effects caused by prolonged traffic-related air pollution exposure.

In the present study, PEFR and FEF25-75% were significantly lower in traffic police personnel who were smokers, with no significant difference in FVC and FEV1. Makwana et al. found that smokers had lower values of almost all parameters compared with non smokers, but the difference was not statistically significant.[10] Pal et al. found that chronic smoking worsened the decrease in lung function in traffic police personnel,[11] and Dey et al. found that the habit of smoking had a significant effect on pulmonary function test parameters.[16] The use of masks, periodic health check-ups and avoidance of smoking may help to prevent respiratory damage in traffic police personnel.

CONCLUSION

Respiratory symptoms such as cough, shortness of breath and eye burning, as well as upper respiratory tract infection and low back ache, were common among traffic police personnel in Hyderabad. Small airway disease was the commonest abnormality on spirometry, while obstructive airway disease was uncommon. Peak expiratory flow rate was lower in personnel with longer service, and peak expiratory flow rate and FEF25-75% were lower in smokers.

Limitations

There was no unexposed comparison group, so the abnormalities cannot be formally attributed to occupational exposure, and pollutant concentrations were not measured, so exposure was inferred from job title and years of service. The design was cross-sectional and single-centre with 103 participants, no post-bronchodilator testing was done, symptoms were self-reported, and the reference equations used for predicted values were not specified. A longitudinal study with an unexposed control arm, quantified personal exposure and repeat spirometry would separate the contribution of occupational exposure from that of age and smoking.

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