

# Effect of automobile exhaust on pulmonary function tests among traffic police personnel in Kashmir valley

Muzafar Naik<sup>1</sup>, Aabid Amin<sup>2</sup>, Mehfooza Gani<sup>3</sup>, Tariq Ahmed Bhat<sup>1</sup>, Abdul Ahad Wani<sup>1</sup>

<sup>1</sup>Department of Medicine, SKIMS Medical College, Srinagar, Jammu and Kashmir, India, <sup>2</sup>Department of Internal Medicine, SKIMS, Srinagar, Jammu and Kashmir, India, <sup>3</sup>Department of Anesthesia, SKIMS, Srinagar, Jammu and Kashmir, India

## ABSTRACT

**Background:** Automobile exhaust is an important cause of air pollution, which is a leading health menace and is growing perpetually. Traffic police personnel are exposed to automobile exhaust more than anyone else, and the resulting lung involvement may be asymptomatic. **Materials and Methods:** This observational cross-sectional study was conducted among 136 traffic police personnel, aged 18–59 years, working for more than 6 months in the traffic police of Kashmir valley. In addition, 140 age- and sex-matched, healthy unexposed Kashmiri's served as controls. Pulmonary functions were measured by RMS Helios 401 PC based spirometer. **Results:** Sixteen (11.2%) out of 136 traffic police personnel had abnormal pulmonary function test (PFT) as compared to 5 (3.6%) out of 140 controls. Traffic police personnel's had significantly declined forced expiratory volume in 1 s (FEV 1) and forced vital capacity. Eight (5.8%) had obstructive, 7 (5.1%) had restrictive, and 1 (0.7%) traffic police personnel had mixed pattern on PFT. Duration of exposure to automobile exhaust of more than 10 years was significantly associated with pulmonary function abnormality ( $P = 0.038$ ). **Conclusion:** Air pollution due to automobile exhaust may be the factor responsible for pulmonary function abnormalities in traffic police personnel. Besides protective measures during duty hours, traffic police personnel should be subjected to periodic assessment of their lung functions.

**KEY WORDS:** Air pollution, automobile exhaust, pulmonary function test, traffic police personnel

**Address for correspondence:** Dr. Tariq Ahmed Bhat, Department of General Medicine, SKIMS Medical College and Hospital, Srinagar-190015, Jammu and Kashmir, India.  
E-mail: drtariqbhat629@gmail.com

**Submitted:** 04-Jun-2021    **Accepted:** 15-Oct-2021    **Published:** 28-Feb-2022

## INTRODUCTION

The Indian economy has shown tremendous growth in the past few decades, which raised the living standards of the people. Similar trend has been recorded in the valley of Kashmir, which resulted in the manifold growth in automobiles. A large chunk of population is involved in this sector directly or indirectly. In this context, occupational health hazards due to inhalation of petrol fumes are gaining significance.

The traffic policemen have to undergo physical strain in an environment polluted by fumes, the exhaust of vehicles, and blow of dust in the air by a speeding vehicle, etc. Petroleum products and its exhaust can cause significant respiratory symptoms such as chronic cough, breathlessness, and wheezing.<sup>[1,2]</sup> In high concentrations, they cause marked systemic pulmonary inflammatory response. The particles generated from petrol exhaust are extremely small and are present in the nuclei or

This is an open access journal, and articles are distributed under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike 4.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.

**For reprints contact:** WKHLRPMedknow\_reprints@wolterskluwer.com

**How to cite this article:** Naik M, Amin A, Gani M, Bhat TA, Wani AA. Effect of automobile exhaust on pulmonary function tests among traffic police personnel in Kashmir valley. Lung India 2022;39:116-20.

Access this article online	
<b>Quick Response Code:</b> 	<b>Website:</b> www.lungindia.com
	<b>DOI:</b> 10.4103/lungindia.lungindia_323_21

accumulation modes, with diameters of 0.02 nm and 0.2 nm, respectively. Further, the surface area is large, and so they can carry much larger fraction of toxic compounds, such as hydrocarbons and metals on their surface. They can remain airborne for longer periods and deposit in greater numbers and deeper into the lungs when compared to the large-sized particles.<sup>[3]</sup> Transport of oxygen to cells is hindered by methHb, a by-product of benzene metabolism in the body resulting in functional anemia.

Apart from organic petrol products and automobile exhaust, the traffic policemen in metropolitan cities posted at busy intersections are exposed to very high levels of pollution. Carbon monoxide is an important component of air pollution caused by traffic exhaust fumes. According to a recent study conducted by All India Institute of Medical Sciences in collaboration with the Central Road Research Institute, the carbon monoxide level among traffic police is 20 times higher than that found in the office environment. Carbon monoxide inhalation displaces oxygen on the hemoglobin molecule, causing hypoxia, carboxyhemoglobinemia, and ultimately death when the level of carbon monoxide becomes high. As per findings of this study, the concentration of oxides of nitrogen at busy intersections was 5–12 times higher than in office environment. Particulate matter concentration was found to be 2–6 times higher.

Increased exposure to exhaust from automobiles and major air pollutants in traffic policemen can further hamper their lung physiology. Major automobile exhaust contents are carbon monoxide, sulfur dioxide, NO<sub>2</sub>, and solid particulate matter. Solid particulate matter produced from emissions gets adsorbed onto soot particles and penetrates the lungs increasing the risk of pneumoconiosis and malignancies.<sup>[4]</sup>

For years together in busy traffic signal areas, traffic policemen get exposed to vehicular emission. The average daily exposure to these chemicals amongst traffic policemen in India generally exceeds to about 8 h/day and six days/week. Some of them are working for more than 10 years now. Studies on health condition in traffic policemen have concentrated more on clinical symptoms with limited reports on lung function. Hence, it was deemed necessary to carry out a detailed study on lung function abnormalities among traffic policemen caused due to work exposure, which has not been carried out in this geographical area.

## MATERIALS AND METHODS

This study was conducted by the Department of General Medicine, Sher-i-Kashmir Institute of Medical Sciences (SKIMS) Srinagar/SKIMS-Medical College and Hospital (SKIMS-MCH) Srinagar over a period of 2 years (from July 2016 to June 2018) in collaboration with traffic police department, Kashmir division.

Official approval was sought from the Deputy Inspector General of police, traffic police department, Kashmir division. Subsequently, SSP traffic city and SSP traffic rural Kashmir division directed traffic police personnel from the districts under their jurisdiction of Kashmir division to participate in the study. Traffic city comprised of Srinagar district whereas rest of the districts (Ganderbal, Anantnag, Kulgam, Shopian, Pulwama, Budgam, Bandipora, Baramulla, Kupwara) comprised traffic rural. Randomly selected 15 personnel from traffic city and 10 personnel from traffic rural underwent pulmonary function tests (PFTs) per week at traffic Police Lines, Srinagar. Age-adjusted healthy smoker and nonsmoker male attendants who accompanied the patients visiting the SKIMS Hospital Srinagar and SKIMS-MCH, Bemina, Srinagar, comprised the controls. A written and informed consent was sought from subjects of traffic police personal and controls comprising of only males in between the age group of 18–59 years.

## Subjects

A total of 176 traffic personnel's (aged 18–59 years) working for more than 6 months with no known respiratory illness participated in the study. However, the PFT of only 136 personnel was acceptable and 40 personnel could not perform the PFT according to the GOLD 2016 criteria. Two hundred controls underwent PFT, among which only 140 could perform it according to the GOLD 2016 criteria, and the rest 60 controls were excluded from the study [Table 1].

The subjects were subjected to the following protocol/ investigations.

Complete medical history and full clinical examination were recorded. The subjects were evaluated clinically for respiratory symptoms such as cough, expectoration, and breathlessness (which were graded according to mMRC Dyspnoea Scale). In the history, duty hours and work experience was also enquired about. Exposure was calculated as per exposure index\*.

Exposure index = 0.52 (no. of hours per day × no. of days per week × no. of years). History of duty in rural or urban areas, history of usage of face masks and type of mask used, and smoking status were also recorded.

## Pulmonary function tests

The participants were subjected to spirometry as per the recommendations of GOLD 2016, using RMS Helios 401

**Table 1: Study population was further stratified**

Cases	Controls
Group 1: Included 68 traffic policemen, nonsmokers and without any present or past respiratory issues	Group 3: Included 70 healthy volunteers (nonsmokers) and without any present or past respiratory issues
Group 2: Included 68 traffic policemen, smokers and with or without any present or past respiratory issues	Group 4: Included 70 healthy volunteers (smokers) with or without any present or past respiratory issues

PC-based spirometer which was calibrated weekly. After at least 3 acceptable and 2 repeatable maneuvers (details mentioned below), four puffs (total of 400 µg) of salbutamol from a metered-dose inhaler (MDI) were administered to the participant if their FEV<sub>1</sub>/FVC was <0.70. A timer was set to sound 15 min after the last administered puff. Bronchodilator used was MDI salbutamol sulfate Inhalation I.P. 100 mcg/dose.

The lung function abnormalities were determined by value of FEV<sub>1</sub>, FEV<sub>1</sub>/FVC and FVC.

### Statistical analysis

Statistical data analysis was done utilizing SPSS 23. Normality of test was done by Shapiro-Wilk test. Median with interquartile range was calculated for age only as age was not normally distributed, and mean with standard deviation was calculated for height, weight, body mass index (BMI), number of years as smoker, pack-years, smoking index, FEV<sub>1</sub>, FVC, and FEV<sub>1</sub>/FVC. Nonparametric data between two groups were analyzed utilizing Mann-Whitney U-test. Parametric data between two groups were analyzed utilizing sample *t*-test. Nominal categorical data between the groups were compared using Chi-square test or Fisher's exact test as appropriate. Correlation between continuous variable was done using Pearson Correlation, whereas correlation between nominal categorical data between the groups was done by using Kendall's tau-b and Spearman's rho.  $P < 0.05$  was considered statistically significant.

## RESULTS

As per the design of the study, 136 male traffic police personnel (cases) and 140 healthy volunteers (controls) both smokers as well as non-smokers, without any present or past respiratory issues were evaluated. Our study revealed that no significant relation between age, weight, number of years as smokers, smoking index of both the groups; however, height of cases was more than the controls which can be explained by the fact that tall people are preferred in the police department [Table 2].

Sixteen (11.2%) out of 136 traffic police personnel had abnormal PFT as compared to 5 (3.6%) out of 140 age- and sex-matched controls, a result that was statistically significant ( $P = 0.010$ ) [Table 3].

The exposure index was higher in traffic police personnel with abnormal PFT than that of traffic police personnel with normal PFT ( $P = 0.044$ ). Among traffic police personnel's those with abnormal PFT, BMI was on lower as compared to those traffic police personnel with normal PFT, a difference that was statistically insignificant (0.087) [Table 4].

Although the percentage of smokers was higher in the traffic police personnel's group with abnormal PFT as

**Table 2: Demographic, clinical, and laboratory parameters of traffic police personnel (n=136) and controls (n=140)**

	Mean±SD		P
	Cases	Controls	
Age (years), median (IQR)	38 (7)	36 (15)	0.07
Height (cm)	173.8±5.9	168.4±6.7	0.000
Weight (kg)	73.9±10.2	71.7±9.6	0.098
BMI (kg/m <sup>2</sup> )	24.46±3.18	25.3±3.28	0.022
Number of years as smokers	6.65±8.14	6.91±9.20	0.896
Pack years	3.24±5.15	3.0±5.67	0.638
Smoking index	64.79±103.1	60.3±113.3	0.701
FEV <sub>1</sub> (L)	3.35±0.46	3.68±0.51	0.000
FVC (L)	4.19±0.52	4.55±0.56	0.000
FEV <sub>1</sub> /FVC	0.79±0.06	0.79±0.05	0.495

SD: Standard deviation, IQR: Interquartile range, BMI: Body mass index, FEV<sub>1</sub>: Forced expiratory volume in 1 s, FVC: Forced vital capacity

**Table 3: Pulmonary function test abnormality in cases and controls**

	Normal PFT (%)	Abnormal PFT (%)	P
Cases (traffic personnel)	120 (88.2)	16 (11.2)	0.010
Controls	135 (96.4)	5 (3.6)	

PFT: Pulmonary function test

**Table 4: Demographic, clinical, and laboratory parameters among cases (traffic police personals) with abnormal and normal pulmonary function test**

	Normal PFT	Abnormal PFT	P
Age (years), median (IQR)	38.67 (7)	37 (6)	0.094
Height (cm), median (IQR)	172 (7)	178 (13)	0.031
Weight (kg), median (IQR)	74 (13)	72 (14)	0.766
BMI (kg/m <sup>2</sup> ), median (IQR)	24.4 (4.2)	22.3 (4.0)	0.087
Years as smokers, mean±SD	6.35±7.97	8.88±9.30	0.247
Pack years, mean±SD	3±4.87	5.02±6.88	0.143
Smoking index, mean±SD	60.05±97.43	100.31±137.60	0.143
Duty (h/day), median (IQR)	14 (0)	14 (0)	0.590
Years in service, median (IQR)	2 (3)	2 (4)	0.293
Exposure index, median (IQR)	87.36 (143.5)	218.4 (207.4)	0.044

PFT: Pulmonary function test, SD: Standard deviation, IQR: Interquartile range, BMI: Body mass index

compared to those with normal PFT, the difference was statistically insignificant ( $P = 0.595$ ) [Table 5].

It is clear that more years of service means more exposure to dust, automobile exhaust, and other pollution factors. During the study, it was observed that length of service in traffic police has directly adverse effects on the health status of traffic police personnel ( $P = 0.038$ ) [Tables 6 and 7].

Clinical study of PFT in both cases as well as controls shows that there are more persons with respiratory disorders in traffic police personnel than controls. The study further reveals that among traffic police personnel obstructive pattern is dominant in smokers and restrictive pattern dominated in nonsmokers [Table 8]. As derived using Pearson Correlation, there is an insignificant negative relationship between exposure index and FEV<sub>1</sub>,  $r(134) = -0.140$ ,  $P = 0.104$ .

**Table 5: Relation of smoking status with pulmonary function test abnormality in traffic police personnel**

	Nonsmoker (%)	Smoker (%)	P
Traffic personnel with normal PFT	61 (50.8)	59 (49.2)	0.595
Traffic personnel with abnormal PFT	7 (43.7)	9 (56.3)	

PFT: Pulmonary function test

**Table 6: Relation of duration of exposure to automobile exhaust with pulmonary function test abnormality of traffic police personnel**

Exposure	Duration ≤10 years (%)	Duration >10 years (%)	P
Cases with normal PFT	114 (95)	6 (5)	0.038
Cases with abnormal PFT	13 (81.3)	3 (18.8)	

PFT: Pulmonary function test

**Table 7: Patterns of abnormal pulmonary function test in cases (traffic police personnel) and controls**

	Normal (%)	Obstructive (%)	Restrictive (%)	Mixed (%)	Total
Cases	120	8 (5.88)	7 (5.14)	1 (0.73)	136
Controls	135	3 (2.14)	1 (0.71)	1 (0.71)	140

**Table 8: Relation of smoking status with a pattern of abnormal pulmonary function test in cases (traffic police personnel's)**

	Obstructive	Restrictive	Mixed
Traffic (nonsmoker)	1	5	1
Traffic (smoker)	7	2	0
Total traffic police (%)	8 (5.88)	7 (5.14)	1 (0.73)

## DISCUSSION

Occupational lung diseases are the modern day public health issues that can be avoided by proper insight of occupational hazards and implementation of preventive strategy at workplaces. Materials inhaled inconspicuously at workplaces may lead to all major chronic lung diseases. Hence, identifying work-place related particles that can cause disease is important because it can prevent the illness in an individual as well as the whole of the community. Traffic policemen like others are also vulnerable to fall prey to the consequence of occupational hazard by inhaling the toxic gases emitted by the automobile engines.

PFTs are noninvasive diagnostic tests that provide measurable feedback about the function of lungs. An assessment of lung volumes, capacities, and flow rates provide specific information for clinical diagnosis and research purposes. The study of PFTs in workers in different occupations define safe conditions and in assessing the effects of exposure to known hazards.

Our study revealed that 11.2% traffic police personnel had abnormal PFT as compared to 3.6% controls had abnormal PFT, which indicated the traffic police personnel are at increased risk of respiratory disorders as compared to unexposed individuals in the community. There are many studies on PFT in traffic police personnel; however, all

of them have focused on quantitative assessment of PFT and depicting decrease in FEV1, FVC, MVV, and PEFR without any data on the qualitative assessment of PFT in traffic police personnel. However, a study from Puducherry reported abnormal PFT in 28% of traffic police personnel.<sup>[5]</sup> Similarly another study from Ujjain revealed abnormal PFT in 40% of traffic police personnel.<sup>[6]</sup> In our study, 5.8% of cases had obstructive, 5.1% had restrictive, and 0.7% had mixed pattern of PFT. We found that among traffic police personnel obstructive pattern dominated in smokers and restrictive pattern dominated in nonsmokers. In the study from Puducherry, in which 28% of cases had abnormal PFT almost all had some obstructive pattern in PFT with a majority 21% having diagnosed with small airway disease, whereas Ujjain study revealed 33% had restrictive pattern, 4% obstructive pattern and 3% were having mixed pattern. The absence of control group in both of these studies can explain the reason for higher percentage of abnormal PFT. The diversity in pattern of PFTs may be due to the geographic, environmental, and genetic factors which need to be explored by further large-scale studies.

Our study reported a decline in FEV1 and FVC in traffic police personnels as compared to unexposed controls. Similar observations have been reported worldwide, including India.<sup>[7-15]</sup> Also decline in parameters of PFT of traffic police personnel have been reported from the Jammu division of Union territory of Jammu and Kashmir.<sup>[16]</sup>

Among the traffic police personnel with abnormal PFT, the percentage of smokers was slightly higher than those with normal PFT (56.3% vs. 43.7%); however, this relation was statistically insignificant. More years of service means more exposure to dust, automobile exhaust and other pollution factors which ultimately lead to an unavoidable corollary of occupational lung disease. The exposure index in traffic police personnel with abnormal PFT was higher than those with normal PFT, an observation that was statistically significant (218.4 vs. 87.36,  $P = 0.044$ ). In traffic police personnel with more than 10 years of service duration, the percentage of abnormal PFT was higher than those with <10 years of service duration, and it was clinically significant (18.8% vs. 5%,  $P = 0.038$ ). Increase in the duration of traffic duty has an increasingly harmful effect on the qualitative as well as quantitative lung functions of traffic police personnel. Air pollutants such as sulfur dioxide, carbon monoxide, nitric oxide, particulate matter, and ozone influence on the body and decrease the lung functions leading to abnormal PFT.<sup>[17]</sup> The oxidative stress on the lungs is thought to contribute to the genesis of obstructive, restrictive, and mixed patterns of PFT.<sup>[18]</sup>

## CONCLUSION

It is concluded that longer duration of exposure to automobile exhaust and absence of appropriate personal protective equipment like respirator masks during duty hours among the traffic police personnel lead to decline

in lung function. It is advised that traffic police personnel should regularly use respiratory mask during duty hours, and exposure to automobile exhaust should be quantitated periodically by calculating exposure index. The smoking habits of traffic police personnel should be strongly deprecated. Further studies correlating air quality index with exposure index and PFT abnormalities are warranted.

#### Financial support and sponsorship

Nil.

#### Conflicts of interest

There are no conflicts of interest.

#### REFERENCES

- Uzma N, Salar BM, Kumar BS, Aziz N, David MA, Reddy VD. Impact of organic solvents and environmental pollutants on the physiological function in petrol filling workers. *Int J Environ Res Public Health* 2008;5:139-46.
- Singhal M, Khaliq F, Singhal S, Tandon OP. Pulmonary functions in petrol pump workers: A preliminary study. *Indian J Physiol Pharmacol* 2007;51:244-8.
- Wichmann HE. Diesel exhaust particles. *Inhal Toxicol* 2007;19 Suppl 1:241-4.
- Lewis TR, Campbell KI, Vaughan TR Jr. Effects on canine pulmonary function via induced NO<sub>2</sub> impairment, particulate interaction, and subsequent SO<sub>x</sub>. *Arch Environ Health* 1969;18:596-601.
- Ranganadin P, Chinnakali P, Vasudevan K, Rajaram M. Respiratory health status of traffic policemen in Puducherry, South India. *Int J Cur Res Rev* 2013;05:88-92.
- Bharti MK, Varudkar HG, Julka A. Effects of air pollutants on lung functions of traffic policeman of Ujjain, Madhya Pradesh, India. *Indian J Appl Res* 2018;8:40-1.
- Rastogi SK, Gupta BN, Tanveer H, Srivastava S. Pulmonary function evaluation in traffic policemen exposed to automobile exhaust. *Indian J Occup Health* 1991;34:67-71.
- Thippanna G, Lakhtakia S. Spirometric evaluation of traffic police personnel exposed to automobile pollution in twin cities of Hyderabad and Secunderabad. *Ind J Tub* 1999;46:129-31.
- Pal P, John RA, Dutta TK, Pal GK. Pulmonary function test in traffic police personnel in Pondicherry. *Indian J Physiol Pharmacol* 2010;54:329-36.
- Ingle ST, Pachpande BG, Wagh ND, Patel VS, Attarde SB. Exposure to vehicular pollution and respiratory impairment of traffic policemen in Jalgaon City, India. *Ind Health* 2005;43:656-62.
- Liwsrisakun C, Tungkanakorn S, Liewhiran A, Yutaboot Y, Paramontol T. Effects of air pollution on lung function: A study in traffic policemen in Chiang Mai. *Chiang Mai Med Bull* 2002;41:89-94.
- Tamura K, Jinsart W, Yano E, Karita K, Boudoung D. Particulate air pollution and chronic respiratory symptoms among traffic policemen in Bangkok. *Arch Environ Health* 2003;58:201-7.
- Saenghirunvattana S, Boontes N, Vongvivat K. Abnormal pulmonary function among traffic policemen in Bangkok. *J Med Assoc Thai* 1995;78:686-7.
- Ogunsola OJ, Oluwole AF, Asubiojo OI, Durosini MA, Fatusi AO, Ruck W. Environmental impact of vehicular traffic in Nigeria: Health aspects. *Sci Total Environ* 1994;146-147:111-6. [doi: 10.1016/0048-9697(94)90226-7.PMID:7517067].
- Proietti L, Mastruzzo C, Palermo F, Vancheri C, Lisitano N, Crimi N. Prevalence of respiratory symptoms, reduction in lung function and allergic sensitization in a group of traffic police officers exposed to urban pollution. *Med Lav* 2005;96:24-32.
- Raina V, Sachdev S, Gupta RK. Study of pulmonary function tests of traffic policemen in Jammu region. *JK Sci* 2014;16:122-5.
- Groneberg-Kloft B, Kraus T, Mark Av, Wagner U, Fischer A. Analysing the causes of chronic cough: Relation to diesel exhaust, ozone, nitrogen oxides, sulphur oxides and other environmental factors. *J Occup Med Toxicol* 2006;1:6.
- Kim JJ, Smorodinsky S, Lipsett M, Singer BC, Hodgson AT, Ostro B. Traffic-related air pollution near busy roads: The east bay children's respiratory health study. *Am J Respir Crit Care Med* 2004;170:520-6.