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Prevalence of respiratory morbidities and lung function outcome in Traffic Police in eastern Nepal

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ABSTRACT

Introduction: Outdoor air pollution is a cause for occupational lung disease. A community vulnerable to lung health hazards of outdoor air pollutants from vehicle emissions is traffic police, whose long duration of outdoor work, with no proper protective equipment, predisposes them to respiratory symptoms such as cough, dryness of nose, throat irritation and wheezing due to the air pollutants causing inflammation of the airways. The risks to lung function and development of respiratory disease are not known in traffic police in eastern Nepal.

Objectives: To determine respiratory morbidities and lung function values of traffic police working in eastern Nepal.

Methodology: This cross-sectional study was conducted for 6 months, from 1st January to 30th June 2022, in traffic police using a structured questionnaire adapted from American Thoracic Society and National Heart & Lung Institute and portable spirometry, at the duty posts or office. Data were represented using descriptive statistics.

Results: The study enrolled 129 traffic police in eastern Nepal, 109 (84.50%) were male and 20 (15.50%) females, mean age 34.50 (± 8). Mean duration of active duty was 9.76 years (± 6.19). Cough was present in 33 (25.58%), 50 (38.76%) phlegm, 37 (28.68%) dyspnea, and 28 (21.71%) noisy breathing.

Mean FEV₁% in ≤ 5 years exposure was 76.75 (± 17.28), and 65.26 (± 18.88) in > 15 years. Mean FVC% in ≤ 5 years exposure was 81.81 (± 20.56) and 76.18 (± 19.77) in those working > 15 years. Mean FEF₂₅₋₇₅% in ≤ 5 years was 73.69 (± 23.73), which was 62.04 (± 33.97) in those > 15 years. The spirometry analysis suggested obstructive airways disease in 90 personnel (69.8%), restrictive disease in 80 (62%), mixed airways disease in 72 (55.8%), and small airways disease in 52 (40.3%).

Conclusion: There was increased burden of respiratory problems such as cough with sputum production, noisy breathing, and dyspnea and lower lung volumes and flows among traffic police working in different parts of eastern Nepal. Long duration of exposure to traffic environments resulted in spirometry analyses suggestive of obstructive and restrictive airways diseases.

INTRODUCTION

An emerging risk to respiratory health is ambient air pollution. The World Health Organization estimated in 2016 that 91% of the world population lived in areas where air quality guidelines levels were not achieved.¹ Traffic police are prone to inhalational exposure to vehicular emissions which contribute to poor air quality, such as benzene, carbon monoxide, carbon dioxide, nitrogen oxides, lead and many other toxic aerosols, and particulate matters less than 10 micrometers (PM₁₀), owing to long duration of working hours per day. Moreover, the ambient particulate matter (PM₁₀)

in Kathmandu valley in high density traffic areas was $822 \mu\text{g m}^{-3}$, exceeding the average 24 hour limit value of $120 \mu\text{g m}^{-3}$.² These harmful chemicals are causes of many respiratory symptoms and declining lung function in traffic police.

The data for Biratnagar from World Air Map (Plume Labs' Application) indicated an air quality index (AQI) of 106 (very poor), whereas in the neighboring town of Damak, it was 122, and in Jhumka, it was 82 in the month of April 2022. On average, the air quality index of Biratnagar remained at this level for 124 days a year, with an annual average of 69 AQI. The AQI of Kathmandu was 350 (hazardous) based on data from the Government of Nepal, Ministry of Population and Environment.³ The information on air quality index of different urban centers in Nepal raises questions on state of lung health of vulnerable community such as traffic police, and the state of air quality has worsened in Biratnagar over the past years. The past 5 years has seen rapid urbanization, extensive road constructions and worsening dust and vehicular pollution. Being an industrial city, Biratnagar is exposed to agricultural, industrial, and vehicular pollutants perennially.

Prevalence of noncommunicable diseases like chronic respiratory diseases such as Asthma, Chronic Obstructive Pulmonary Disease (COPD) and Hypersensitivity Pneumonitis is high globally, with the data from Nepal in 2016 showing 66% (121,100) of all deaths (183,000) due to noncommunicable diseases.⁴ However, global burden of chronic respiratory diseases attributed to the workplace is not known owing to poor survey.⁵ The common symptoms attributed to air pollution are cough, sputum production, dryness of nose, throat irritation, breathlessness and wheezing. A study conducted by Acharya observed that traffic police personnel in Kathmandu suffered from nasal dryness, fatigue, and headache.⁶ In a study by Kandel, 6.4% traffic police personnel in Kathmandu had a low FEV1/FVC ratio as compared to normal population.⁷ Prolonged duration of exposure of individuals to traffic environment showed lower forced expiratory volume in 1 second (FEV1) and in forced vital capacity (FVC).⁸ The impact on lung health of traffic police working in areas of eastern Nepal is not known.

The objectives of the study were to determine prevalence of respiratory morbidities in traffic police and to measure their pulmonary function values.

METHODOLOGY

It was a quantitative, community based, cross-sectional, analytical study, conducted in regions of eastern Nepal, namely Biratnagar, Itahari, Dharan, Bhojpur, Sundarharaincha, Birtamode, Damak, Inaruwa and Ramdhuni, from 1st January to 30th June 2022, by the department of Internal Medicine, Birat Medical College Teaching Hospital, Biratnagar. The study was reviewed and approved by the Institutional Review Board of Birat Medical College Teaching Hospital (IRC-PA-186/2078-79). Data was obtained at site of duty of traffic police and office, after written and informed consent. The study included police aged

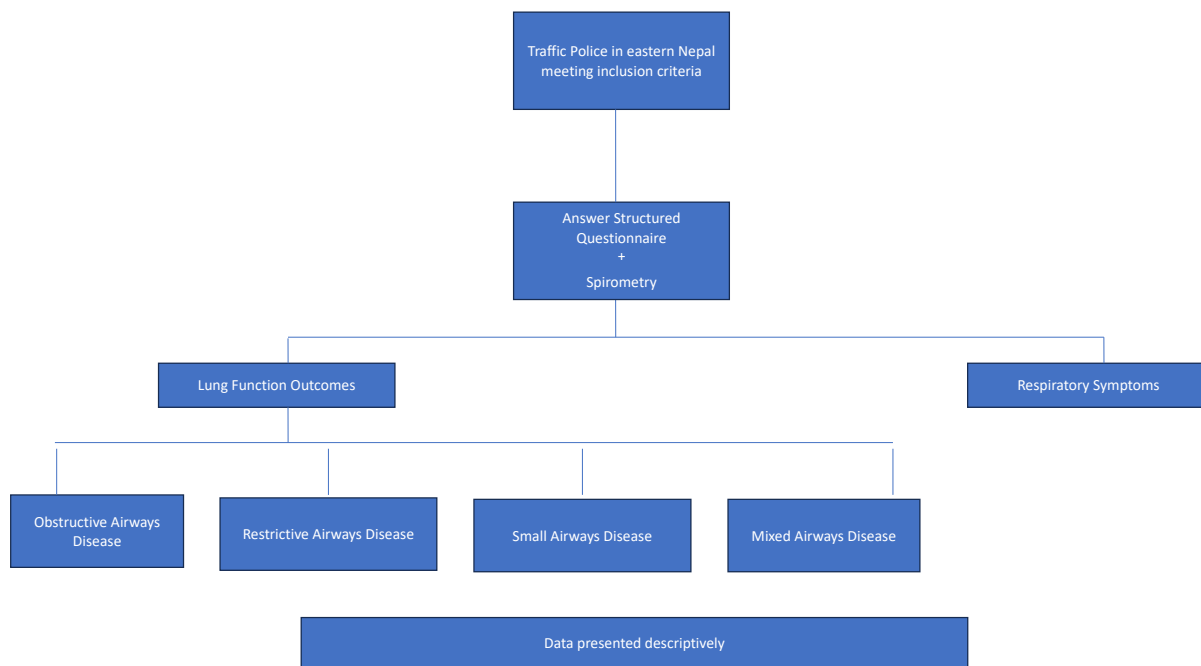
more than 14 years, working as road traffic police personnel for at least 6 months in eastern Nepal and giving consent, and those who did not agree to be enrolled in study were excluded. Non-probability total enumeration method was used for consecutive collection of sample. There were 129 traffic policemen at the time of the study.

For the purpose of the study, lung function outcomes were defined as obstructive airways disease, restrictive airways disease, small airways disease, and mixed airways disease. Forced expiratory volume in 1 second (FEV1) is the amount of air exhaled in the first second of a full forced expiration, expressed as a percentage of predicted value, and is a measure of airway obstruction. In normal individuals, its value is more than the lower limit of normal (LLN).^{9,10} The spirometry device used all-age multi-ethnic Quanjer (Global Lung Function Initiative 2012) reference values.¹¹ Obstructive airways disease is defined as FEV1 percent predicted value less than lower limit of normal and/or FEV1/FVC ratio less than lower limit of normal.^{9,10} Forced vital capacity (FVC) refers to amount of air forcefully exhaled after a full inspiration, expressed as percentage of predicted value. Forced expiratory flow 25%-75% (FEF_{25-75%}) is a measure of airflow halfway through exhalation, and a value less than lower limit of normal is suggestive of small airways disease and is expressed as percentage of predicted value. Restrictive airways disease is present when percent predicted value of FVC is less than lower limit of normal, with normal to high FEV1/FVC ratio, and normal FEV1 value.^{9,10} Mixed airways disease is defined as spirometry values depicting both obstructive and restrictive airways diseases with or without small airways involvement. In this study, upper airways cough syndrome refers to presence of nasal irritation, dryness and congestion of nostrils, throat irritation and throat pain.

The modified Medical Research Council (mMRC) scale is a tool to measure patient's disability due to breathlessness on daily activities using a self-rated scale of 0 to 4. Scale 0 is no breathlessness except on strenuous exercise; scale 1 is breathlessness when hurrying on level or walking up slight hill; scale 2 is breathlessness causes the patient to walk slower than people of same age on level, or if patient has to stop to catch breath when walking at own pace on level; scale 3 is when patient stops for breath after walking approximately 100 meters or after few minutes on level; and scale 4 is state when patient is too breathless to leave house, or breathless when dressing or undressing.¹² A structured questionnaire adapted from American Thoracic Society and National Heart & Lung Institute, Division of Lung Disease (ATS-DLD 78-A) was used to record data on socio demographic information, occupational history and respiratory symptoms of cough, sputum production, phlegm, noisy breathing, dyspnea, past respiratory illnesses, co-morbidities such as chronic bronchitis, emphysema, asthma, hypertension or heart diseases, and family history of respiratory illnesses.¹³ Hand-held portable spirometer EasyOne[®] Air designed by NDD Medical Technologies was used to document lung function, which has been observed to yield valid results.¹⁴

All subjects meeting inclusion criteria were evaluated on-site (at their respective office or duty post) by the structured questionnaire and subjected to a portable spirometry test, after due consent from subjects. The questionnaire was self-answered in Nepali language, and the portable spirometer was performed by a trained health assistant. Data was recorded

using a spreadsheet of Microsoft Excel 2003 worksheet and converted into Statistical Package for Social Science version 11.5 for statistical analyses. Descriptive statistics were calculated as mean, standard deviation, and percentages. Information was arranged in tabular and graphical representations.



RESULTS

The study enrolled 129 traffic police in eastern Nepal, with a mean age of 34.50 (±8), and 112 had formal education (86.82%). Only 5 Dalit (3.86%) and 21 Madheshi (16.28%) personnel were noted. The sociodemographic characteristics are depicted in table 1.

Of the 129 traffic police, 23 (17.83%) had cigarette smoking history, with 10 (43.48%) active smokers. None of the police personnel wore protective face mask during duty hours.

It was observed that 1 personnel had a history of acute bronchitis before age 16 years, and 3 (2.33%) had pneumonia at age 16, 18 and 25 years respectively. Acute bronchitis was observed in 2 police, at age of 25 and 5 years respectively. No past illnesses of chronic bronchitis, Emphysema, Asthma, chest trauma or heart disease were observed.

Table 1. Sociodemographic profile of traffic police personnel (n=129)

Category	N (%)
Gender	
Male	109 (84.50)
Female	20 (15.50)
Age (mean years ±SD)	34.50±8
Marital Status	
Single	24 (18.60)
Married	105 (81.40)
Race & Ethnicity	
Dalit	5 (3.86)
Janjati	38 (29.46)
Madheshi	21 (16.28)
Brahmin	65 (50.39)
Education	
Informal	17 (13.18)
Formal	112 (86.82)
Smoking History	
Cigarette Smoker:	23 (17.83)
Bidi Smoker:	6 (4.65)

The mean duration of active duty was 9.76 years (±6.19), with

65 traffic police posted in Biratnagar (50.39%), 19 (14.73%) in Itahari, 8 (6.20%) in Inaruwa, 5 (3.88) in Gramthan Gaunpalika. In Koshi Gaunpalika, there were 4 (3.10%); Barju, Koshiharaincha, Katahari, Budhiganga gaunpalika, and Ramdhuni 3 each (2.33%); Rajbiraj and Sunwarshi 2 each (1.55%), and 1 each (0.77%) from Arjundhara, Bhojpur, Birtamode, Deumai nagarpalika, Rangeli, Dharan Damak, Khandbari and Laukahi.

As depicted in Table 2, 33 (25.58%) traffic police complained of coughing, with a mean duration of 2.9 years (± 1.85). Phlegm production was present in 50 (38.76%) for mean duration of 2.13 years (± 2.1), and noisy breathing was present in 28 police (21.71%) for mean duration of 2.35 years (± 1.5).

Table 2 : Respiratory symptoms in traffic police personnel (n=129)

Symptom	N (%)
Cough	33 (25.58)
Duration (years, mean \pm SD)	2.9 \pm 1.85
Phlegm	50 (38.76)
Duration (years, mean \pm SD)	2.13 \pm 2.1
Noisy Breathing	28 (21.71)
Duration (years, mean \pm SD)	2.35 \pm 1.5
Dyspnea	37 (28.68)
mMRC 0	32 (86.49)
mMRC 1	1 (2.70)
mMRC 2	2 (5.41)
mMRC 3	2 (5.41)
mMRC 4	0
Upper Airways Cough Syndrome	3 (2.33)

Upper airways cough syndrome was present in 3 police, specifically nasal discharge, and 37 (28.68%) complained of breathlessness (dyspnea), with 32 (86.49%) complaining of mMRC grade 0 dyspnea, 2 each (5.41%) mMRC grade 2 and 3 dyspnea, and 1 personnel complained of grade 1 dyspnea. Respiratory symptom distribution is outlaid in figure 1.

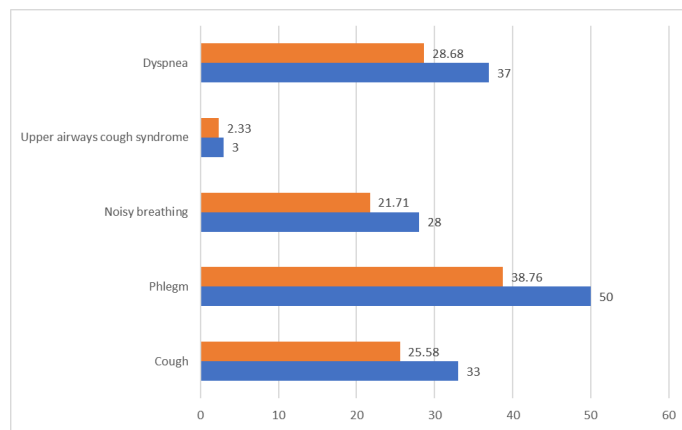


Fig 2: Respiratory symptom distribution (n=129)

Table 3 depicts the observed pulmonary function values in the traffic police personnel. Mean FEV1% of police working for at least 5 years was 76.75 (± 17.28), was 69.89 (± 14.53) in those working for 6 to 10 years, 73.25 (± 13.22) for those working 11 to 15 years, and 65.26 (± 18.88) in those who worked more than 15 years in traffic duty. The mean FVC% in police working at least 5 years was 81.81 (± 20.56) and was 76.18 (± 19.77) in those working for more than 15 years. Mean values of FEF25-75% in those working at least 5 years was 73.69 (± 23.73), which was only 62.04 (± 33.97) in those who worked for more than 15 years.

Table 3: Lung function parameters of traffic police based on duration of occupation.

Duration of Occupation (years)	Parameter (mean % \pm SD)			
	FEV1%	FVC%	FEV1/FVC%	FEF25-75%
≤ 5 (n=36)	76.75 (± 17.28)	81.81 (± 20.56)	94.88 (± 10.76)	73.69 (± 23.73)
6 – 10 (n=46)	69.89 (± 14.53)	73.74 (± 14.63)	95.26 (± 12.07)	73.09 (± 30.22)
11 – 15 (n=20)	73.25 (± 13.22)	75.60 (± 12.85)	96.35 (± 8.44)	73.45 (± 28.51)
>15 (n=27)	65.26 (± 18.88)	76.18 (± 19.77)	86.02 (± 18.66)	62.04 (± 33.97)

Mean FEV1/FVC% values were 94.88 (± 10.76) in police who worked at least 5 years, and 86.02 (± 18.66) in those who worked 15

years or more.

Table 4: Lung function outcome in traffic police (n=129)

Outcome	n (%)
Normal airways	32 (24.81)
Obstructive airways disease	19 (14.73)
Restrictive Airways Disease	5 (3.88)
Mixed Airways Disease	73 (56.59)
Small Airways Disease	0

Abnormal lung function outcome was observed in 97 (75.19%) policemen, of which obstructive airways disease was observed in 19 personnel (14.73%), restrictive disease in 5 (3.88%) and mixed airways disease in 73 (56.59%).

DISCUSSION

The past decade has observed rapid urbanization in eastern Nepal, and occupational hazard such as road traffic pollution has increased with traffic police personnel subjected to a vulnerable lung health outcome owing to first-hand exposure to the pollutants. Present study observed 25.58% police in eastern Nepal complaining of cough. Several studies have reported respiratory symptoms of cough, breathlessness, and phlegm in traffic police.^{6,7,15} Present study noted 38.76% had phlegm that was predominantly early morning and chronic. The study observed that 21.71% of traffic police had noisy breathing which was similar to a study in Bengaluru, India where 12.9% traffic policemen complained of cough, noisy breathing, and dyspnea.¹⁶

Of the 129 traffic policemen, 37 (28.68%) reported dyspnea, predominantly mMRC grade 0 (86.49%), which was similar to a Kathmandu study of 106 traffic police, where 27 (25.47%) traffic police personnel had breathlessness.¹⁵ Similarly, a study from Patiala, India observed breathlessness in 22% police personnel, who worked for more than 8 years in road traffic environment.¹⁷ Upper airways cough syndrome was observed only in 3 (2.33%) traffic police, and a study by Acharya of traffic police in Kathmandu noted complaints of nasal dryness.⁶ There were 23 (17.83%) police personnel with cigarette smoking history and 10 (43.48%) were active smokers at the time of study, and while there is lack of data on smoking history police personnel in Nepal, the Bengaluru study observed 54 (24.9%) traffic police to be current smoker.¹⁶

In the present study, the mean FEV1/FVC ratio did not decrease in traffic police working for less than 15 years but did decrease in personnel working for more than 15 years in traffic duty. A study done in Kathmandu also observed FEV1/FVC values to be normal in police working for more than 8 years.¹¹ The present study observed that the spirometry parameters of FEV1% and FEF_{25-75%} were decreased in police personnel working for more

than 15 years, as compared to those working for less than 15 years, implying development of obstructive airways disease and small airways disease. The study done in Kathmandu also demonstrated that FEV1 and FEF_{25-75%} were lesser in traffic police personnel. These lung function parameters were also found to be decreased in studies from different cities, with longer duration of exposure to road traffic environment being the possible cause for the decline in lung function.^{12,13}

In the study, spirometry values measured suggested development of obstructive airways disease, restrictive airways disease, and mixed airways disease.

CONCLUSION

The study demonstrated development of respiratory symptoms such as cough, noisy breathing, and dyspnea, in traffic police working in different parts of eastern Nepal, over a period of 2 to 3 years of exposure to road traffic environment. There is development of obstructive airways disease, small airways disease, restrictive airways disease as well as mixed airways disease. No compliance to personnel protective equipment in the workplace, long duration of duty in dusty environments are probable factors for the respiratory symptoms and lung function impairment.

RECOMMENDATIONS

It is recommended to further assess for development of chronic respiratory diseases such as chronic obstructive pulmonary disease, chronic bronchitis and restrictive lung disease by use of lung volume and DLCO-capable pulmonary function tests, timely referral to pulmonologist for regular medical assessment, and to ensure adequate use of respirator masks during traffic duty and decrease duration of duty posting for each personnel.

LIMITATIONS OF THE STUDY

The study did not use pulmonary function tests with ability to assess lung volumes and diffusing capacity of the lungs for carbon monoxide (DL_{CO}), which would have provided better measures of lung function status of the police personnel. Lung function outcomes could also be linked to smoking history and further analysis is required.

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CONFLICT OF INTEREST

None

FINANCIAL DISCLOSURE

None

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