



Research Article

Journal of MAR Pulmonology (Volume 5 Issue 5)

Impact of Adherence to Preventive Health Measures in Occupational Safety and Spirometry Parameters of Traffic Policemen in Chennai (India) - A Quasi Experimental Study

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Received Date: January 17, 2023

Published Date: February 01, 2023

Abstract

Background: Air Pollution is considered as the prominent health issue in the Indian Metropolitan cities mainly due to the unplanned urbanisation and exponential increase in the vehicular usage. Traffic Policemen are highly susceptible to such adverse environment and are readily available to develop lung related diseases.

Objective: To determine the impact of adherence to preventive health measures in occupational safety and spirometry parameters of traffic policemen in Chennai

Methods: This quasi-experimental study selected 100 study participants through convenience sampling method belonging to Chennai Traffic Police department. All the participants were male and around 30 years of age. Spirometry is used for data collection. Six-month intensive PPE intervention via social media (WhatsApp) was done after initial data collection and processed with SPSS version 20.

Result: The demographic characteristics revealed the mean age to be 46.478 ± 12 and the mean experience to be 21.3 ± 8.59 . Obstructive pattern is observed in 20% of the population due to atopy and restrictive pattern is observed in 43% due to elevated BMI through spirometry. After intervention, the hours of cloth, surgical, and N-95 mask use increased from 3.82, 2.70, and 2.0 correspondingly to 6.64, 5.58, and 4.20.

Conclusion: The intervention increased the adherence to PPE and resulted in the adoption of positive lifestyle modification among the investigated participants.

Keywords: Air Pollution, Respiratory problems, Traffic Policemen, Personnel protective Equipment, Masks

Introduction

In India, air pollution is observed to be a predominant problem associated with adverse health effects [1, 2]. In specific, metropolitan cities like Chennai, Mumbai, Delhi, and Bengaluru contributes to the high level of air pollution that consequently leads to potential impacts such as respiratory diseases, malignancy risk, cardiovascular diseases and premature death [3, 4]. Other acute effects include eye and nose irritation, headache, cough and fatigue. These hostile impacts are most frequent to the people participating in various kind of outdoor occupations connected with polluted and noisy environment [2, 5].

The ambient air pollution are mainly derived from fuel combustion that contains primary polluting substances like sulphur di oxide, nitrogen di oxide, carbon monoxide, ammonia (NH₃), particulate matters etc., [6, 7]. Further secondary polluting substances like acidic aerosols, xylene, benzene, toluene and oxidant pollutants due to phytochemical reactions of nitrogen oxides and hydrocarbons[8, 9] also pollutes the environment. This study focussed on traffic policemen, who were constantly being exposed to toxic air pollutants and vehicular emissions [10]. The policemen were made to perform their duties, regardless to such occurrences and worst weather conditions, leading to continuous apprehension to undesirable health outcomes and physiological stress [11, 12]. In general the policemen need to spend their optimal time in helping the public and have no time to oversee their health concern [13]. Furthermore, the Police Act, 1967 section 21 describes that the regulation, control and maintenance of traffic flow on the public roads confine to the responsibilities of the concerned traffic policemen. With such long-lasting and higher responsibilities, they have no other possible choice to hide from the polluted environment.

The following session describes the information on the existing research articles on air pollution and accompanied diseases on traffic cops. This information revealed significant characteristics in relation to the study and observed that more optimisation and recommendations has to be provided in the upcoming studies. The present research has been motivated by unconditional enthusiasm of traffic Policemen and aim to prevent the respiratory problems including Chronic Obstructive Pulmonary Disorder, lung cancer among the traffic police population in Chennai.

Objectives

To determine the impact of adherence to preventive health measures in occupational safety and spirometry parameters of traffic policemen in Chennai.

To assess the baseline and post interventional (health education and PPE) impact on respiratory symptoms and lung function parameters by spirometry.

Paper Organization

This paper is organised as follows: Section 1 provides the introduction of the study, section 2 presents the methodology of the projected work in detail, section 3 deliberates the results in detail followed by discussion of the result in section 4. Section 5 concludes the work.

Methodology

This section explains the conducted methodology in detail. The study design is as follows

Study Design: An observational and quasi-experimental study

Sample Size: 100

Study Duration: March 2020 to August 2021

Study Area: Southern Chennai traffic policemen assigned at traffic signals

Study Participants: Traffic policemen working in southern Chennai traffic signals.

Sampling Method: Convenience Sampling method

Inclusion criteria:

The participants within the age limit of 30 to 62 have been considered to the study.

Both male and female gender were included in the study

Policemen who use smartphone.

Exclusion criteria:

The participants with pre-existing respiratory diseases, active respiratory infections and smokers were excluded from the study. Further the participants who could not perform spirometry were also excluded from the study.

Evaluation of Parameters:

BMI, PFT Parameters such as FEV1), forced vital capacity (FVC), FEV1/FVC ratio, Forced Expiratory Flow 25-75 percent (FEF25-75 percent), and Peak Expiratory Flow (PEF)

Methodology

Initially the selected policemen were screened for ongoing respiratory illness or prior respiratory disease after an informed consent. People who fulfilled the requirements and expressed an interest in participating were accepted into the study after ethical committee clearance approved. At baseline all policemen were subjected to a semi-structured proforma , Clinical examination, and Spirometry. This cross sectional study has been performed with spirometry Interpretation by using Smart One Portable Bluetooth Spirometer. Bacterial viral filter and replaceable turbine were used for individual participant. Participants were made to sit comfortably and the procedure explained clearly to the patients in their own language. At least three tests of acceptable efforts are performed to ensure the reproducibility and the maximum effort of the patient. All patients had their forced expiratory volume in one second (FEV1), forced vital capacity (FVC), FEV1/FVC ratio, Forced Expiratory Flow 25-75 percent (FEF25-75 percent), and Peak Expiratory Flow (PEF) measured.

All study participants were involved through a common social media group(WhatsApp) by a smart mobile phone and weekly interventions to adherence to personal protective measures(masks) and health education was imparted to the participants through materials including pictures, posters and memes. At the end of six months, participants were re-evaluated using the structured Proforma , Clinical examination, Spirometry for all study participants was performed and adherence to PPE was evaluated.

Operational definitions

Preventive health measures-It is the goal of preventive healthcare to lighten the load of disease and its associated risk factors by preventing sickness from occurring. In this study primary level of prevention will be undertaken. Health education on harmful effects of air pollutants and the advantages of use of personal protective equipment will be highlighted.

Occupational safety- The usage of personal protection equipment (PPE) in the form of face masks (ideally N95) and others (surgical and cloth) and adherence to it will be the workplace safety precaution in my

study. Intensified health measure- Thrice weekly reminders on adherence to personal protective equipment and air pollution related posters/articles will be shared on WhatsApp forum.

Symptoms- Symptoms will be considered significant if the participant experiences repeated episodes in the past six months (minimum 3 episodes)

Ethical Clearance: Study was accepted by IHEC (institutional human ethical committee). The participants of the study were provided informed written consent, and only those who signed the informed consent were included in the study. Risk of the study and benefits explained. The participants were informed about the voluntary nature of their participation, prior to obtaining consent. Throughout the study, privacy was maintained.

Statistical methods and data analysis: The collected data has been entered in MICROSOFT-EXCEL 2015 and analysis was done using SPSS version 18. P value is used to find the significant difference between the variables. The demographic and predictor variables are analysed to reveal the possible relation between the usage of PPE.

Results

The following are results obtained from the investigation. Table 1 provides the demographic illustration of the study. The relation between pre and post intervention spirometry has been revealed in the above table 3, which state that there exists no significant difference between the PFT parameters and pre/post spirometer values. Table 4 state that 24% of the participants have reduced symptoms due to the usage of cloth mask. This table 5 represented that nearly 54.5% of the participants reduced their symptoms due to surgical mask. The p value state that there is significant difference between the symptoms before and after the use of surgical mask. Meanwhile this table 6 showed that the utilisation of N95 masks lead to the reduction of symptoms in about 44% of the study participants. This table 7 state that the duration of mask usage is significant between the pre and post intervention. The corresponding table b and c depicted the reports of usage of cloth mask, N95 mask and surgical mask respectively. This table 8 provides the report on the difficulties in using cloth, N95 and surgical mask in terms of cost, reusability issues and discomfort. It is observed that N95 mask is associated with more difficulties in usage. This table 9 depicts the shift over of the participants from cloth masks to N95 masks between this pre and post intervention period.

Parameters	Categorization
Age	>30 years
Years of exposure to air pollution	<10 years = 14 11 to 20 years =33 >30 years =53
BMI	<24.9 = 24 25 – 29.9 = 54 >30 = 22
Baseline symptoms	Normal = 56 Running Nose and Sneezing = 35 Breathlessness on exertion = 9
Baseline PFT Pattern	Normal = 37 Obstructive = 20 Restrictive= 43

Table 1 Demographic parameters associated with the study

Variable (N=100)	BMI	Mean	Standard deviation	P value
FEV1/FVC	<24.9	96.97	9.36	0.001
	25-29.9	78.12	16.1	
	>30	105.18	11.10	
FEV1%	<24.9	102.81	3.28	0.001
	25-29.9	81.41	13.97	
	>30	77.15	12.45	
FVC%	<24.9	106.98	11.21	0.001
	25-29.9	105.41	11.04	
	<30	74.08	13.5	

FEF25-75%	<24.9	106.07	12.31	0.001
	25-29.9	82.14	15.67	
	<30	93.85	21.31	
PEFR in %	<24.9	101.1883	2.72970	0.001
	25-29.9	88.8635	21.65868	
	>30	105.1562	5.66188	

Table 2: Association between BMI and PFT among the study participants at baseline

The initial spirometry revealed an obstructive pattern in 20% restrictive pattern in 43%. Obstructive pattern attributed to atopy and restrictive to increased BMI.

Table 2 represents the comparison on BMI on the restrictive pattern of spirometry. Here it is observed that All restrictive pattern correlated with BMI more than 25.

Symptoms	Total	Normal PFT	Abnormal Obstructive PFT	PFT Restrictive PFT	Percentage %
Breathlessness on exertion	9	0	0	9	100%
Running nose, sneezing, occasional cough	35	15	20	0	57%

Table 3 : Comparison between PFT pattern and symptomatology

In this table while comparing the symptomatic participants with PFT abnormalities we notice that all patients who had breathlessness on exertion had restrictive pattern and 57% of the participants with obstructive pattern on PFT had allergic symptoms.

PFT parameters	Post intervention Mean ± SD	Pre intervention Mean ± SD	P value
FEV1/FVC %	88.38 ± 17.92	88.59 ± 18.02	0.05
FEV1%	85.79 ± 15.53	85.61 ± 15.39	0.06
FVC%	99.33 ± 17.67	98.89 ± 17.59	0.08
FEF25-75%	90.51 ± 19.59	90.46 ± 19.03	0.92
PEFR%	97.12 ± 18.00	95.40 ± 17.67	0.07

Table:4 Post and Pre Intervention Spirometry

CLOTH	SYMPTOMS POST			P Value
	Normal n (%)	PRESENT n (%)	REDUCED n (%)	
Normal	36 (100)	0	0	0.001
PRESENT	0	19 (76.0)	6 (24.0)	
Total	36 (59.0)	19 (31.1)	6 (9.8)	

Table 4: Assessment of symptoms during before and after intervention among the cloth mask participants

SURGICAL MASK	SYMPTOMS POST			P Value
	Normal n (%)	PRESENT n (%)	REDUCED n (%)	
Normal	13(100.0)	0 (0.0)	0 (0.0)	0.001
PRESENT	1 (9.1)	4 (36.4)	6 (54.5)	
Total	14 (58.3)	4 (16.7)	6 (25.0)	

Table 5: Assessment of symptoms during before and after intervention among the surgical mask participants

N 95 MASK Pre-intervention symptoms	SYMPTOMS POST			P Value
	Normal n (%)	Present n (%)	Reduce n (%)	
Normal	6(100.0)	0 (0.0)	0 (0.0)	0.001
PRESENT	0 (0.0)	5 (55.6)	4 (44.4)	
Total	6 (40.0)	5 (33.3)	4(26.7)	

Table 6: Assessment of symptoms during before and after intervention among the N-95 mask participants

Intervention

	Pre-intervention	Post intervention	P value
Hours of mask usage	3.60 ± 1.23	6.09 ± 1.28	0.001

Before intervention	Cloth mask	Surgical mask	N-95 mask	P value
Hours of mask usage	3.82 ± 1.19	2.70 ± 0.48	2.0 ± 0.63	0.001

After intervention	Cloth mask	Surgical mask	N-95 mask	P value
Hours of mask usage	6.64 ± 1.07	5.58 ± 0.79	4.20 ± 0.77	0.001

Table 7: Assessment of participant’s hours of usage of mask pre and post

Mask type	Cost	Discomfort	Reusability Issues
Cloth	10 %	10%	10%
Surgical	40 %	40%	80%
N-95	80 %	85%	85%

Table 8: Feedback on difficulties of mask usage

Pre Intervention mask type	Post intervention mask type			
	Cloth N(%)	Surgical mask N(%)	N-95 N(%)	Total
Cloth	61 (0.0)	14 (16.7%)	9 (10.7)	84 (100.0)
Surgical mask	0 (0.0)	10 (100.0)	0 (0.0)	10 (100.0)
N-95	0 (0.0)	0 (0.0)	6 (100.0)	6 (100.0)
Total	61 (61.0)	24 (24.0)	15 (100.0)	100 (100.0)

Table 9: Pre and Post intervention mask types

Discussion

This study determined the positive influence on the health education and preventive health measures among the Chennai traffic Policemen through the evaluation of spirometry values. The mean age was 46.47 ± 8.22 and years of experience of 21.30 ± 8.59 . All the study subjects were male. The initial spirometry revealed an obstructive pattern in 20% restrictive pattern in 43%. Obstructive pattern attributed to atopy and restrictive to increased BMI. The following are the discussion of results obtained from comprehensive statistical analysis through SPSS version 20. Our study intended to ensure occupational safety to cops by creating awareness about the significance of wearing masks. Similar to our study [14] aimed to evaluate and compare the adverse effects of respiratory symptoms among traffic policemen working in urban polluted environment. This cross-section study [14] has been performed among 369 Bangladesh participants through random sampling. Our study has been conducted through convenient sampling method and hence only 100 participants were enrolled with precise relation to the study.[15] also conducted a face mask surveillance study among the Chennai population suggesting that PPE is more important for metropolitan cities like Chennai. These findings suggested several other valuable investigation for attaining the targeted occupational health interventions which can be processed through the prompt utilization of protective masks and knowledge sharing.

The demographic characteristics like age, BMI, experience were presented and discussed with other related studies. The mean age of our study participants was 46.47 ± 8.22 , mean BMI was 27.36 ± 3.73 and

mean year of experience was 21.30 ± 8.59 . This data is observed to be similar to among traffic policemen conducted in Chennai by [16] where the average age was 39.43 ± 13.87 and mean Body mass index was 26.40 ± 4.90 . [17] evaluated the weight, height and BMI as the baseline demographic variables and spirometry test parameters of the traffic policemen presenting to Gangtok town. This article compared and measured the outcomes with general police personnel and concluded that the traffic policemen in Gangtok were found with decreased PFT.

When discussing about symptomatology, 56% of the investigated population were observed with respiratory symptoms such as 35% with rhinitis, cough, and sneezing and 9% with breathlessness on exertion. by [18] where rhinitis and sneezing was 36% whereas coughing was more in this study which was nearly 68% and breathlessness was in 22% of the population. On contrary a study conducted by [19] among traffic policemen showed allergic rhinitis prevalence was only 17.5%, cough and breathlessness was 12.9%. In a systematic review done by [20] concluded that various studies have shown that inhalation of particulate matter will lead to pathogenesis of airway inflammation and exacerbation of respiratory disease.

Discussing about PFT pattern, in our study out of 100 participants 37% had normal spirometry, 20% had obstructive pattern and 43% had restrictive pattern. FVC and FEV1 was reduced and this reduction was statistically significant, this reduction shows that there is some degree restriction in the respiratory tract of traffic policemen. This restriction might be due to increased BMI. Obstructive pattern may be due to chronic irritation by the exhaust particles from the vehicles. Our study findings are in consensus with other studies conducted by [21, 22].

The PEFR (Peak expiratory flow rate) otherwise known as maximal expiratory flow rate signifies the capacity of expiratory muscles. And FEF_{25%-75%} denotes the free flow of air during expiration. In our study both PEFR and FEF_{25%-75%} are significantly lower when compared to predictive values. This indicates that might be small airway obstruction which needs further follow up. Our study findings are in consensus with other studies conducted by [18, 23, 24].

The following provides the discussion on the impact of BMI and PFT among the study participants. In our study FEV1, FVC was reduced among overweight and obese individual in comparison to normal BMI traffic policemen whereas ratio (FEV1/FVC) was increased for obese and overweight individuals in comparison to normal. All these differences were statistically significant as the p values was 0.001. Our study findings suggested that overweight individuals are mostly having restrictive pattern in lung function

test. Hence it is evident that obesity and overweight causes various patterns of alteration to PFT parameters based on severity[25]. Obesity has been observed to reduce lung volumes and capacities through lowering both lung and chest wall compliances.

In our study FEV1, FVC was reduced among overweight and obese individual in comparison to normal BMI traffic policemen whereas ratio (FEV1/FVC) was increased for obese and overweight individuals in comparison to normal. All these differences were statistically significant as the p values was 0.001. Our study findings suggests that overweight individuals are mostly having restrictive pattern in lung function test. Our findings concluded that obesity is harmful to lung function and that weight loss should be emphasized in the management of airway disease. Hence it is evident that obesity and overweight causes various patterns of alteration to PFT parameters based on severity. Obesity has been observed to reduce lung volumes and capacities through lowering both lung and chest wall compliances.

In this study, FEV1 and PEFr were reduced among 57% of study participants who had history of allergy to dust and allergic symptoms (running nose and sneezing) in comparison those who didn't have symptoms. FVC was normal in these participants. In a research conducted by [26] [27], they discovered a strong link between upper and lower respiratory illness[19]. They established that eosinophilic chronic rhinosinusitis patients have latent obstructive lung function test abnormalities in their study. As a result, these patients must be closely monitored for lung function abnormalities.

This is one of the very few studies providing information regarding health education and preventive measures among the traffic policemen followed up over a period of 6 months. When discussing about the limitations, there exists limited sample size. Further short follow up period because of COVID pandemic restrictions information on mask usage behaviour could have been better studied during non COVID period. Due to COVID situation AQI could not be measured.

The hours of usage of mask have significantly increased from 3.82, 2.70 and 2.0 for cloth, surgical mask and N-95 mask respectively to 6.64, 5.58 and 4.20 post intervention. Thus in our study we found that there was an improved adherence to PPE due to the impact of health education. The usage of personal protective equipment and adherence significantly reduces the symptoms related to dust exposure. However long term followup is necessary to choose the right type of mask and assess effect of air pollution through spirometry on lung function. Hence we recommend the adherence to PPE for all traffic policemen posted in traffic junctions.

Conclusion

The traffic policemen are constantly exposed to outdoor air pollution causing increased respiratory morbidity and mortality. The continuous health education on air pollution and personal protective measures at regular intervals are mandatory to improve adherence. The impact of adherence, change in behaviour and lifestyle modification helps in significantly reducing the exposure, symptoms and improves respiratory health among traffic policemen.

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