

EFFECT OF DUST AND AUTOMOBILE EXHAUST FUMES ON SECURITY GUARDS IN BATHINDA CITY

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DOI: 10.5455/ijmsph.2013.2.404-407 Received Date: 31.01.2013

Accepted Date: 01.02.2013

ABSTRACT

Background: Environmental pollution is a worldwide phenomenon. Exposure to vehicle emissions increases the risk to reduced lung function and deteriorating cardiovascular performance.

Aims & Objective: To measure the effect of dust and automobile exhaust fumes on security guards.

Material and Methods: The study was conducted in 150 healthy non-smoking male security guards of age group 20-40yrs. Peak Expiratory Flow Rate (PEFR) was measured using Wrights peak flow meter and acute changes in oxygen saturation (SPO₂) were determined using Digital finger Pulse Oximeter in equal number (n=50 each) of security guards working outside office, in open parking and in basement parking. Statistical analysis was carried out by unpaired student's t-test.

Results: PEFR was found to be lower (427.0 ± 11.12 L/min) in security guards working in basement parking of shopping malls as compared to security guards working in open parking (430 ± 12.92 L/min) and outside office buildings (443 ± 13.29 L/min). Acute change in Oxygen saturation, (SPO₂) were normal in each occupation but were significantly lower in security guards in basement parking $p < 0.001$ as compared to security guards outside offices.

Conclusion: Exposure to exhaust and fumes, inside the basement parking, cause more health risk to security guards than the security guards working in open parking or outside official buildings exposed vehicular exhaust.

KEY-WORDS: Oxygen Saturation; Parking Area; Peak Expiratory Flow Rate; Security Guards

Introduction

The Bathinda city in Punjab has witnessed a great development in last 5-6 years. A recent census showed an increase of 2.8% per annum population growth whereas the average growth rate of registered vehicles was recorded as high as 80%. The pollution caused by automobiles affect the human health. Both petrol and diesel undergo combustion in automobile engines and give rise to combustion-derived nanoparticles (CDNPs). Diesel exhaust particles are the most common CDNPs in the urban environmental air. These particles are highly respirable and have a large surface area where organic materials can be adsorbed easily. The particles which are generated from diesel exhaust are sub-micronic by virtue of their greater surface area-to-mass ratio- and can carry a larger fraction of toxic hydrocarbons and metals on their surface. They can remain airborne for longer time periods and can be deposited in greater numbers and deeper into the lungs than the large-sized particles.^[1] Long-term exposure to fine particulate air

pollution is associated with an increased risk of mortality, primarily cardiopulmonary mortality.^[2,3] The general trend of the average amount of Particulate Matter (the suspended particular matters in the air which are inhaled by human beings), has been recorded at 92 micron gram per cubic metre as minimum and concentration is 126 micron gram per cubic metre as maximum in Bathinda city. The techniques routinely used for measuring ambient air pollution are not suitable for indoor surveys because of cost, bulk; noise or amount of air displaced and varying nature of the pollutants.

Although many studies have been done to see the effect of vehicular traffic on the roads but less attention has been given to the effect of exhaust from vehicles in parking areas. The associations of particulate air pollution with cardiac and respiratory morbidity and mortality has been demonstrated in earlier studies but epidemiologic evidence of particulate-related decreases in oxygen saturation as an explanation for these associations is very less. The present study was

thus undertaken to establish the effect of pollutants in the form of auto exhaust, gases, etc. on healthy, non-smoking security guards by measuring their peak expiratory flow rate (PEFR) and oxygen saturation.

Materials and Methods

The study was conducted in months of Nov-Dec 2012 in 150 security guards working in six open parking areas in the city, five official buildings and three basement parking in newly constructed malls in Bathinda city. The security guards were divided equally (n=50 each) in three categories depending on their work, (a) security guards outside official buildings; (b) security guards in open parking and (c) security guards in basement parking. Only healthy, non-smoking male security guards with same anthropometric measurements, and at least 3 years of duration of exposure were included in the study. The vehicles movement on an average recorded in all the areas in study were 100 vehicles in 24 hrs. Security guards with unstable angina, arrhythmias (such as atrial flutter or fibrillation), and the presence of a pacemaker or with history of allergy or respiratory disorder were excluded from the study. Prior to initial testing all selected subjects were given a complete explanation of the purposes, procedures and potential risks and benefits involved in the study and their consent was taken in this regard. The study was approved by the local institutional ethical committee.

A detailed history including the history of diet and lifestyle was taken and general physical and systemic examination was done. Weight was taken on a weighing scale with standard minimum clothing to the nearest 0.5 kg. Height was recorded in cm without shoes.

Measurement of Peak Expiratory Flow Rate (PEFR)

Peak expiratory flow rate was measured with mini-Wright peak flow meter. The test was performed in standing position holding the peak flow meter horizontally. A tight fitting disposable cardboard mouthpiece was inserted in the inlet nozzle. After proper rest, subject was requested to take a deep breath and exhale as forcefully as

possible in one single blow into the instrument. The procedure was repeated three times and best of the three was recorded.

Oximetry Data

Oxygen saturation (SpO₂) was determined using Digital finger Pulse Oximeter. Patients were seated for ≥ 15 min before three measurements were taken at 30-s intervals on the left index finger of each subject. The highest value of blood oxygen saturation measured with pulse oximetry (SpO₂) was retained. The right index finger was used in left-handed subjects. In case of an injured nail, another finger on the same hand was used. It was also ensured that subjects were not wearing nail polish; if they were it was removed. Measures were taken for after spending ≥ 30 min in heated rooms. The pulse oximeter was tested weekly for accuracy by comparing SpO₂ with the SaO₂ of arterial blood gases.

Statistical Analysis

Statistical analysis was carried out by unpaired 't'-test. The data were expressed as Mean \pm SD and the p value < 0.001 was taken as highly significant.

Results

Table-1: Peak Expiratory Flow Rate (PEFR)

Occupation	PEFR (L/min)
Security Guards in Official Buildings	443.40 \pm 13.29
Security Guards in Open Parking	430.00 \pm 12.92
Security Guards in Basement Parking	427.00 \pm 11.12

Values are in Mean \pm SD

Table-2: Comparison of Peak Expiratory Flow Rate (PEFR)

Occupation	T Value	P Value	Significance
Security Guards in Official Buildings Vs Security Guards in Open Parking	4.88	0.1 - 0.001	Significant
Security Guards in Open Parking Vs Security Guards in Basement Parking	1.49	> 0.1	Non-Significant
Security Guards in Official Buildings Vs Security Guards in Basement Parking	6.69	$< .001$	Highly Significant

Table-3: Oxygen Saturation (SpO₂)

Occupation	SpO ₂ (%)
Security Guards in Official Buildings	99.3 \pm 0.63
Security Guards in Open Parking	98.84 \pm 0.67
Security Guards in Basement Parking	98.54 \pm 1.11

Values are in Mean \pm SD

Table-4: Comparison of Oxygen Saturation (SPO₂)

Occupation	T Value	P Value	Significance
Security Guards in Official Buildings Vs Security Guards in Open Parking	3.53	0.01-0.001	Significant
Security Guards in Open Parking Vs Security Guards in Basement Parking	1.64	>0.10	Non-Significant
Security Guards in Official Buildings Vs Security Guards in Basement Parking	4.23	<0.001	Highly Significant

Discussion

With increasing motorisation throughout the world the emission of potentially hazardous substances is increasing. The WHO technical report of 1969 stated that automobile exhaust was an important irritant in most instances, which affected the respiratory tract. It is essential to detect and treat respiratory obstruction at an early and reversible stage for the prevention of permanent damage. In the persons who are exposed to these pollutants, pulmonary function tests are used as screening tests to determine their effects.^[4] The peak expiratory flow rate (PEFR) is one such parameter that can be easily measured.^[5] In our study the peak expiratory flow rate measured were lower in security guards in open parking areas continuously exposed to exhaust and fumes as compared to security guards outside official buildings. On exposure to exhaust fumes, similar decrease in PEFR in traffic policeman has been observed as compared to healthy population of Jalgaon.^[6]

The PEFR is helpful in evaluating the extent and the rate of progression of the disease process.^[7] The PEFR is an effort dependent parameter which emerges from the large airways within about 100-120 m of the start of the forced expiration.^[8] It remains at its peak for about 10 m.^[9]

In open parking exposure to sun results in increasing boundary layer height of the particulate matter that leads to increase in ventilation coefficient which further leads to farther disposal of aerosols. Thus, increase ventilation coefficients lead to decrease in concentration of particulate matter in open parking area as compared to basement parking of the malls. Peak expiratory flow rates were lower in security guards in basement parking as

compared to security guards in open parking area and security guards in buildings. Our findings are similar to earlier studies where decrease in lung function has been observed in officers directing traffic in tunnels and in men working in bus garages.^[10,11] In contrast, underground miners who were exposed to diesel emissions did not show any differences in respiratory function or chronic respiratory symptoms.^[12] The Peak Expiratory flow Rate was recorded significantly lower in security guards in basement parking probably because of localized concentration of exhaust fumes and dust in the basement and lack of access to outside fresh air. Lack of proper ventilation and humidity in basement parking causes exposure to dust mites & airborne spores of fungal moulds besides exhaust and dust. Dampness and mould in buildings have been associated in many studies with adverse respiratory health effects.^[13,14] Airborne infections are much more likely to spread indoors than outdoors as the dilution in outdoor air is usually so great that chances to become infected are negligible even on inhaling enough infectious droplet nuclei.

The level of oxygen saturation (SPO₂) was apparently normal in all the security guards. This clearly demonstrates that despite the apparent reduction in the PEFR their level of oxygen saturation was not yet impaired. It is concluded from a study done in elderly, male individuals that the effects of particulates on hypoxia might be most relevant in older and sicker individuals. ^[15] Our study was done in younger age group so this may be another reason for normal oxygen saturation SPO₂ with exposure to exhaust.

However, significant difference in oxygen saturation was seen in security guards in basement parking than those working outside official buildings. This small decline in oxygen saturation potentially represents a subtle local airway and alveolar inflammatory effect. Exposure to the organic compounds found in diesel exhaust and on the surface of the particle have also been linked to allergy, airway inflammation and changes in airway function.^[16-18] As the present study was conducted in winter and spring, pulse oximetry readings may also be affected by physiological processes, such as vasoconstriction

in reaction to the cold. However, in the present study the SpO₂ measures were performed after at least 30 min spent in a heated room.

Potential limitations of the study include the lack of information about environmental tobacco smoke exposure in the home (but the majority of the participants lived alone and were non-smokers), nor was direct monitoring of particulates in the home performed as part of this study.

Conclusion

Exposure to exhaust fumes and dust affect the health status of the security guards. Security guards working in basement parking are at greater risk because of additional effects of indoor pollution besides exposure to exhaust and fumes. The security guards in basement should undergo regular health check up to identify respiratory symptoms if any at the earliest and follow suitable management procedures. Care should be taken for proper ventilation of basements and restriction of fitting of other air polluting machinery like generators in the basements should be avoided. Wearing of facemasks and air filters should be encouraged in basement parking. Long duty hours in basement parking should be reduced and use of air filtering devices should be done. Health problems related to ventilation and microbiology problems in basement parking should be further studied.

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Cite this article as: Kaur S, Maheshwari A. Effect of dust and automobile exhaust fumes on security guards in Bathinda city. *Int J Med Sci Public Health* 2013; 2:390-393.

Source of Support: Nil

Conflict of interest: None declared