

Assessment of Peak Expiratory Flow Rate and Its Correlation with Working Hours and Years of Experience in Street Vendors in South Pune.

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ABSTRACT

BACKGROUND: This study was aimed to assess the peak expiratory flow rate in street vendors in the Southern Pune region and to correlate the readings with working hours and years of experience. The deterioration of the surrounding environment, air, and the soil we live on has been largely attributed to vehicle pollution. There is an increase in the number of vehicles in the urban areas especially the metropolitan cities as compared to the rural areas. This leads to an increase in vehicular emissions which may compromise the quality of the air we breathe. Evaluation of air quality has shown a drastic decline in Air Quality Index with its value being 104 for the Pune region in the year 2024^[1]. This declines the quality of air that is inhaled. Street vendors are more vulnerable in this regard because they are exposed to the pollutants and emissions daily for an extended period. Peak expiratory flow rate is a useful indicator of effort-dependent airflow and a stand-in for respiratory function.

METHODS: The study enrolled a total of 69 participants of street vendors in the South Pune region. The device used for the assessment was a peak flow meter (Breathometer by Cipla) with a detachable mouthpiece for every individual. Consent was taken and individuals were thoroughly explained the procedure. Three readings were taken and the highest was recorded.

RESULTS: The result of this study shows that the mean of Actual PEFr which is 352.54 L/Min was statistically significantly less than the Predicted PEFr value which is 420.52 L/Min with $p=0.001$. In this study, there was a negative correlation between the number of hours spent on the street increases and the number of working years increases with PEFr with $r = -.469$ and $r = -.494$ respectively.

CONCLUSION: This study concludes that the respiratory functions of street vendors as measured using PEFr are significantly reduced due to constant exposure to air pollution. Also, it was observed that those who worked for more hours and had more years of experience showed more reduction in PEFr.

KEYWORDS: Peak Expiratory Flow Rate(PEFR), Street Vendors, Air Pollution

INTRODUCTION

Respiration is the process by which gases are exchanged but one of the functions of the upper respiratory tract is to prevent the dust particles. Dust particles, which enter the nostrils, are prevented from reaching the lungs by the filtration action of the cilia. Those dust particles, which escape nasal hairs and nasal mucous membrane, are removed by the phagocytic action of macrophages in the alveoli. However,

particles which escape the protective mechanisms in the nose and alveoli are thrown out either by cough reflex or by sneezing reflex. Therefore, if these defence mechanisms are impaired these particles can cause major damage.^[2]

The air we breathe is an essential ingredient for our well-being and for a healthy life. A good quality of air is an important factor for the normal health of an individual. In 2016, the WHO estimated 91% of the world's population was breathing low-quality air than the WHO guideline. Air pollution irritates the airway, and some air pollutants go deep into the lungs and result in inflammation thus lowering normal lung function.

In India, nearly 2-2.5% of the total urban population is involved in street vending. Maharashtra and Delhi have the largest numbers of street vendors as compared to other states in India.^[3] Like other occupations, both men and women are engaged in street vending. This is one of the occupational populations that are unknowingly exposed to hazards of pollutants but have never been taken care of.

PEFR Peak expiratory flow rate is a surrogate measure of respiratory function and an effective measure of effort-dependent airflow. PEFR is one of the most commonly used tools for community screening for obstructive lung disorders. The maximum rate of flow during forced expiration, beginning with full inspiration, is known as PEFR. Typically, the highest flow rate happens in the first 200 milliseconds after expiration. Because maximal airflow happens during the effort-dependent part of the manoeuvre, PEFR takes muscle strength and voluntary effort into account in addition to airway diameter.^[4]

Thus, the purpose of the study is to find out the PEFR of street vendors and to correlate it with their predicted PEFR to better understand the lung functions of the vendors.

MATERIALS AND METHODS

Inclusion criteria: The inclusion criteria for this study include both female and male vendors belonging to age between 18-40. We included vendors who had experience of at least 1 year of work. The participants should work at least 6 hours per day. The study includes nurses of both genders. The participants should be willing to participate in the study.

Exclusion criteria: The exclusion criteria of this study include Individuals with known respiratory conditions.

Individuals who are currently suffering from infections and showing any symptoms like cold, fever and smokers. These criteria aim to ensure that the study focuses on participants who do not have pre-existing conditions that could potentially confound the results.

Study design:

Type of Study: Observational study

Duration of study: 6 months

Study setting: Pune

Sampling design:

Sample size: 69

Sampling method: Convenient sampling

Material used:

Peak Flow Meter by Cipla

Procedure: A total of 69 participants were included in the study based on the inclusion and exclusion criteria. Consent was taken from every individual. Individuals were approached for participation, PEFR procedure was explained to each one of them. Demographic data was noted. PEFR was measured by using

a peak flow meter (Breathometer by Cipla). Subjects were asked to stand and hold the peak flow meter without restricting the movements of the marker. Subjects were asked to take a deep breath, put the disposable mouthpiece into the mouth and breathe out as hard and fast as they could. Subjects were taught to blow fast and hard through the disposable mouthpiece by making a tight seal around it. Position of the head should be in a neutral position, neither flexed nor extended. Three measurements were taken and the highest was recorded. Predicted PEFR was then calculated for everyone individually. All the data was analysed using SPSS 20.0 and Microsoft Excel 2013 software. Data is represented in the form of frequency and percentage tables. Graphical presentation is used wherever necessary. An unpaired t-test was done to study the correlation between the recorded and predicted PEFR. Karl Pearson Correlation test was done to check the correlation between number of working hours and years of experience with PEFR.

RESULTS: A total of 69 participants were included in the study from age between 18 to 40 years and with a minimum work experience of 1 year. Individuals with known respiratory conditions and individuals who are smokers were excluded from the study.

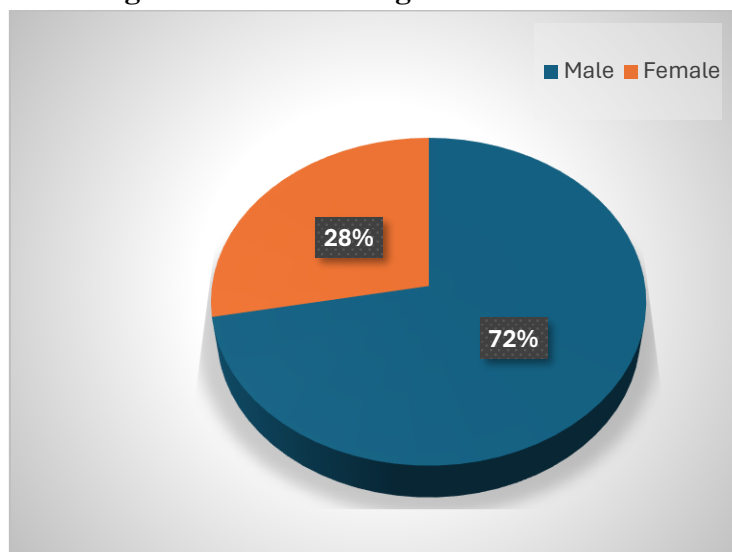
GENDER DISTRIBUTION

Interpretation: The table below shows the gender distribution among the sample respondents, and it is observed that male vendors outnumber female vendors which 72 and 28 percent respectively.

Table 1: Gender distribution

Gender	Frequency	Distribution
Male	50	72%
Female	19	28%
Total	69	100%

Figure 1: Pie chart of gender distribution



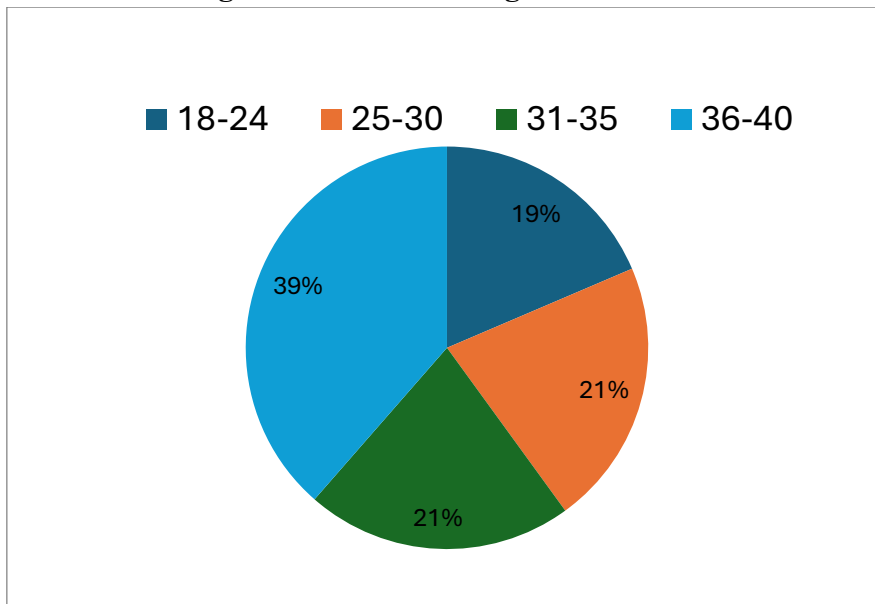
AGE DISTRIBUTION

Interpretation: The table below shows the age distribution among the sample respondents, and it is observed that individuals aged 36 to 40 years are more in number as compared to the other age categories.

Table 2: Age distribution

Age Group	Distribution
18-24	19%
25-30	21%
31-35	21%
36-40	39%

Figure 2: Pie chart of age distribution



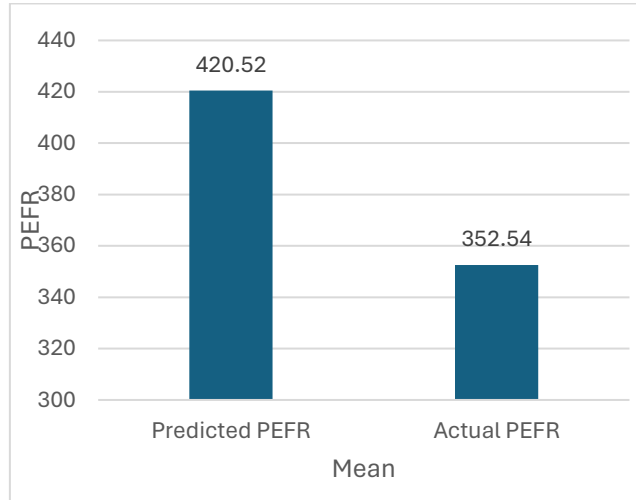
COMPARISON OF ACTUAL AND PREDICTED PEFR

Interpretation: The table below shows that the mean of Actual PEFR which is 352.54 L/Min was less than the Predicted PEFR value which is 420.52 L/Min with p-value 0.001 stating that there is a significant reduction in Actual PEFR as compared to Predicted PEFR.

Table 3: Comparison of actual and predicted PEFR

Variable	Mean	SD	t-value	p-value
Predicted PEFR	420.52	85.63	4.325	0.001
Actual PEFR	352.54	98.55		

Figure 3: Comparison of actual and predicted PEFR



CORRELATION OF NUMBER OF HOURS SPENT ON THE STREET AND PEFR

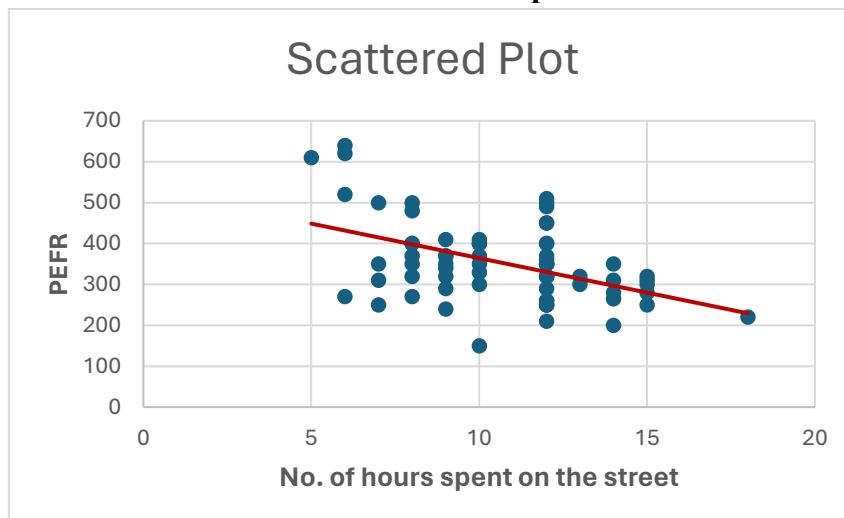
Interpretation:

Correlation coefficient r -value for number of hours spent on the street and PEFR has been recorded as -0.469 which is statistically significant at 5% level with non-linear association. The table below shows that as the number of hours spent on the street increases, there is a decline in the Peak Expiratory Flow Rate of the subject. This shows that there is an inverse relationship between these two factors with the r -value recorded as -0.469. This concludes that there is a negative correlation between actual PEFR, and the number of hours spent on the street.

Table 4: Correlation of number of hours spent on the street and PEFR

Variable X	Variable Y	r-value	p-value	Results
Number of hours spent on the street	PEFR	-0.469	0.000	Significant at 5% Non-Linear association

Figure 4: Correlation of number of hours spent on the street and PEFR



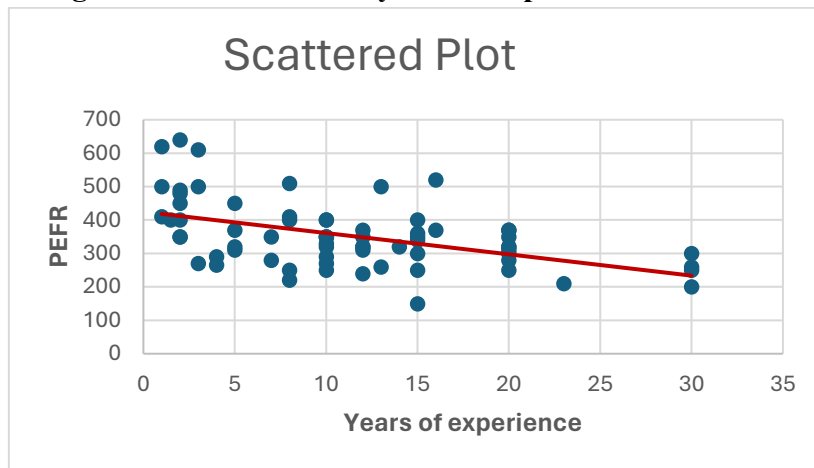
CORRELATION OF YEARS OF EXPERIENCE AND PEFR

Interpretation: Correlation coefficient r- value for years of experience score and PEFR has been recorded as -0.494 which is statistically significant at 5% level with non-linear association. The below table shows that as the number of years of experience increases, there is a decline in the Peak Expiratory Flow Rate of the subject. This shows that there is an inverse relationship between these two factors. This concludes that there is a negative correlation between actual PEFR and the years of experience.

Table 5: Correlation of years of experience and PEFR

Variable X	Variable Y	r-value	p-value	Results
Years of experience	PEFR	-0.494	0.000	Significant at 5% Non-Linear association

Figure 5: Correlation of years of experience and PEFR



DISCUSSION

The Air Quality Index (AQI) of Pune has been recorded as 104 AQI which means that the air quality is poor in this city. The current PM 2.5 concentration in Maharashtra is 2.5 times above the recommended limit given by the WHO 24-hour air quality guidelines value.

Air pollutants such as nitrogen oxides, ozone, sulfur dioxide, carbon monoxide, and particulate matter affect different parts of the respiratory tract via a variety of mechanisms resulting in respiratory symptoms.^[5] These air pollutants have both acute and chronic effects on the respiratory health. There is a lack of awareness in this population regarding air pollution and its dangerous effects on the respiratory health of these individuals. Symptoms such as nose and throat irritation have been reported after exposure to increased levels of sulfur dioxide^[6] and nitrogen oxides^[7]. Air pollutants such as nitrogen oxides also can increase the susceptibility to respiratory infections.^[8] Particulate matter that penetrates the lung epithelium can initiate lung inflammation, worsening pre-existing lung conditions and exacerbating symptoms of asthma and chronic obstructive pulmonary disease. Major neglect towards health such as decreased hygiene and failure to take preventive measures such as masks, can cause serious respiratory complications. Determinants like particle size, water solubility and chemical reactivity regulate where air pollutants will impact the respiratory tract. Highly water-soluble and reactive irritants, such as sulphur dioxide and aldehydes, readily dissolve into the water around the nasal mucosa and initiate an

inflammatory response, consequently having the greatest impact on the upper respiratory tract.^[14] Ozone has medium water solubility so it can reach the trachea and bronchi, whereas low solubility gases like nitrogen dioxide, are also able to escape the defensive properties of the respiratory tract mucosa and reach the bronchioles and alveoli.^[9] Particulate matter may be deposited in three different regions of the respiratory system which are extra thoracic (nasal, pharyngeal and laryngeal passages), tracheobronchial and alveolar (pulmonary). Inhaled fine particle pollution deposited on the surface of the airways is cleared by two mechanisms namely mucociliary clearance and phagocytosis.

Mucociliary clearance is a vital self-clearing process of the airways and removes the most inhaled particles deposited in the tracheobronchial airways.^[9] Mucociliary transport in healthy individuals clears most insoluble particles within 24 hours of deposition under normal conditions although this can be impaired when air pollutants damage the respiratory lining and induce temporary dysfunction of ciliary movement. This can result in symptoms such as productive cough and dyspnoea. Particles that escape the mucociliary defence mechanisms can enter the lower airways and alveolar region.^[10] On the other hand, phagocytosis by macrophages is the primary clearance mechanism for removing any foreign material such as particles or microorganisms from the alveolar region. Following exposure to particulate matter, alveolar macrophages secrete an array of pro-inflammatory mediators, leading to apoptosis and induction of local and systemic inflammatory responses. These macrophages were found to interact with airway epithelial cells to augment the production of a variety of chemokines and cytokines, leading to inflammatory airway responses.^[11] The efficiency of phagocytosis decreases with decreasing particle size below about 1 μm . Ultrafine particles ($<0.1 \mu\text{m}$) may be deposited in the alveoli and subsequently absorbed into the bloodstream.^[12] Consequently, the pulmonary defence system may get overworked by prolonged, frequent exposure to air pollution.

CONCLUSION

This study concludes that the respiratory functions of street vendors as measured using PEFr are significantly reduced due to constant exposure to air pollution. Also, it was observed that those who worked for more hours and had more years of experience showed more reduction in PEFr.

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