

**Use of E-Cigarettes and its Effects on Lung Functions****Mukunth Kirubasankar<sup>1</sup>, Sabarinath Ravichandar<sup>2</sup>, Kavyasri J.<sup>3</sup>**<sup>1</sup>Third Year MBBS Student, Sree Balaji Medical College and Hospital (SBMCH), Chromepet, Chennai, Tamil Nadu, India.<sup>2</sup>Assistant Professor, Department of Respiratory Medicine, Sree Balaji Medical College and Hospital (SBMCH), Chromepet, Chennai, Tamil Nadu, India.<sup>3</sup>Third Year MBBS Student, Sree Balaji Medical College and Hospital (SBMCH), Chromepet, Chennai, Tamil Nadu, India.

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Corresponding Author: Dr. Sabarinath Ravichandar

Conflict of interest: Nil

**Abstract**

**Background:** Electronic cigarettes are the most common form of electronic nicotine delivery systems (ENDS) and electronic non-nicotine delivery systems. E-cigarette emissions typically contain nicotine and other toxic substances that are harmful to both users, and non-users who are exposed to the aerosols second-hand. These devices have various names, including e-cigarettes, e-hookahs, vaporizer cigarettes, vapes, and vape pens. [1] The heating conditions, especially on humectants, flavourings and the low-quality materials used, have been associated with over-all effects on the lung, airway physiology (hyperreactivity, increased airway resistance, mucus hypersecretion), host defence and alveolar compartment.[2] Lung volume measures the amount of air present for a living being to inhale or exhale. On the other hand, lung capacity is the volume of air in the lungs upon the maximum effort of inspiration. [3] It is known that vape smokers are prone to lung obstructions and scarring. It is characterized by a spectrum of clinicopathological conditions mimicking pulmonary disease. In the US –2,807 cases of E-cigarette associated lung injury (EVALI) were documented in 2019, out of which 68 were fatal. Moreover, it has been reported that the heating process itself can lead to the formation of new decomposition compounds of questionable toxicity. [4] Nicotine e-cigarettes can cause dependence or addiction in non-smokers. Young non-smokers who use e-cigarettes are more likely than non-users to initiate smoking and become regular smokers. [5]

**Methods:** An offline survey was conducted with a self-prepared questionnaire among the sample size of 105 e-cigarette users of age group 18 and above coming to respiratory medicine OPD of Sree balaji medical college and hospital. The questionnaire included questions to analyze their knowledge, attitude and practice about e cigarette smoking habits. The descriptive statistics analysis was carried out including frequency and percentage. The results of the study were tabulated. Data entry and analysis:- Data entry was done in MS-EXCEL sheet, 2010 graph was presented in MS EXCEL, 2010.

**Results:** 78% of the study population was male, where 39% of them had 2 years and 13% of them had 4yrs of smoking history. Among the study population 30% of them smoked 1 to 100 puffs per day and 9% of them were symptomatic. The mean age among the study population was 24 years and mean FEV1 is 108.2 whereas FEV1/FVC IS 81.6. 4% of asymptomatic and 5% of symptomatic patients show decreased FEV1/FVC values and 5% of asymptomatic and 7% of symptomatic patients show decreased FEV1 values, thus in broad spectrum there are 9% of symptomatic and 91% of asymptomatic study participants.

**Conclusions:** The present study revealed that the Smoking Index of the individual has direct correlation with various medical Comorbidities and there is significant association between patients's FEV1/FVC values. The number of puffs was an important risk factor. There is a mild decrease in the FEV1, FVC, FEV25/75 and FEV1/FVC values of the e-cigarette users. Thus the erroneous belief that E-cigarettes are less harmful to health than tobacco-containing cigarettes must be addressed with urgency. Counseling on the cessation of vaping and offering them the needed support can make a difference in the patient's lives.

**Keywords:** E-Cigarettes, *EVALI*:- e-cigarette or vaping product use-associated lung injury, Spirometry, Pulmonary physiology.

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**Introduction**

Electronic cigarette is a battery-operated device that emits a vaporized solution to inhale. Usually, the

solution contains nicotine. The aim is to provide the sensation of inhaling tobacco smoke, without the

smoke. An e-cigarette has three main parts:-A rechargeable lithium battery, vaporization chamber and a container such as a Cartridge or tank filled with E-liquid. The charged battery is connected to the vaporization chamber, a hollow tube that contains electronic controls and an atomizer -the component that creates the vapour. [6]

Major components of E-cigarettes are: [7]

- 1) Additives such as vegetable glycerine (VG) and Propylene glycol which play a role in creating vapours that can be inhaled through a mouth-piece.
- 2) Flavorings and E- liquids contain Acrolein and tetrahydrocannabinol (THC) which are responsible for making the person feel high.
- 3) Nicotine and other Cannabinoids and heavy metals such as nickel and lead.
- 4) Device materials- Wire, Atomizers, Fiberglass wicks and Solder joints.

#### Mechanism

The basic operation of e-cigarettes generally follows several steps and includes drawing on the e-cigarette, activation of a heating element such as vegetable glycerine and Propylene glycol, and vaporization of the contained liquid, which acts as a carrier for nicotine and flavourings. Aerosolized droplets of liquid subsequently flow into the user's mouth and are inhaled into the lungs. Thus, E-cigarette use is commonly referred to as 'vaping', Hence, continuous usage of E-cigarettes is associated with pulmonary illnesses such as lung scarring, damage to small passageways in the lungs, chemicals can cause Alveolar haemorrhage and ultimately decreased lung function rates.[8]

#### Aim

To study the use of E-cigarettes and its Detrimental effects on lung functions, obstructive lung conditions, and the co-relation between the duration of E-cigarette smoking and the number of puffs with the lung function of the individual.

#### Materials and Methods

The present study was conducted from April 2023 to October 2023. It was a cross-sectional study done by registering E-cigarette users of age 18 and above coming to respiratory medicine OPD, SBMCH using a self-prepared offline questionnaire. The sample size was calculated using the formula:

$$N = \frac{Z_{\alpha/2}^2 * P * (1 - P) * D}{E^2}$$

N equals to sample size of the study, which is 105 participants, and the anticipated duration for the cross-sectional study is 6 months. Study tool mainly used was the Spirometer (**Schiller Spirovit SP-1 G2**) to measure the pulmonary function variables.

#### Inclusion Criteria

Patients who are E-cigarette users of both genders are included.

#### Exclusion Criteria

Patients who are non-E-cigarette users are excluded.

#### Procedure

Registering all the E-cigarette users of age 18 and above, Informed consent and detailed history was taken, Spirometry test was done, Results were analyzed and data recording was done in the Department of Respiratory Medicine, SBMCH.

Data entry and analysis:- Data entry was done using MS-EXCEL sheet, 2010 Graph was presented in MS EXCEL, 2010.

#### Statistical Analysis

CHI-SQUARE TEST shows that there is a significant association between patient's FEV1/FVC values when compared with the years of smoking and number of puffs per day and if he is symptomatic with p-value<0.05. Also there is a significant association between the patient's FEV1 values when compared with years of smoking and number of puffs per day and if he is symptomatic with p-value<0.05.

MANN WHITNEY U TEST shows that there is a significant mean difference between patient's years of smoking when compared with FEV1/FVC with p-value<0.05. There is a significant mean difference between patient's years of smoking when compared with FEV1 with p-value<0.05.

The statistical analysis clearly indicates that 12% shows mild obstruction in FEV1 values and 9% shows mild obstruction in FEV1/FVC values.

#### Ethical Consideration

Study was approved by the scientific research committee and Ethical Committee of Sree Balaji Medical College and Hospital, Chromepet.

Study participants were included in the study only after written Informed consent was obtained from them

#### Result

This systematic review was designed to determine the effects of vaping on measures of lung function.

**Table 1: Presents descriptive statistics of e-cigarette users**

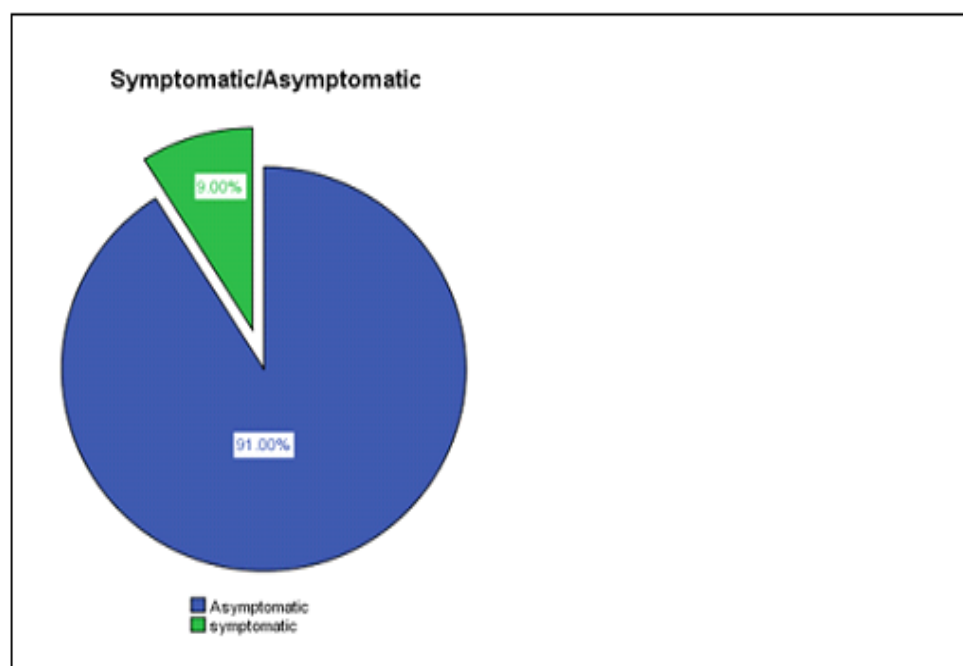
		Count	Column N %
Sex	F	22	22.0%
	M	78	78.0%
Years of smoking	0	2	2.0%
	1	22	22.0%
	2	39	39.0%
	3	19	19.0%
	4	13	13.0%
	5	5	5.0%
PUFF PER DAY	0-50	30	30.0%
	50-100	30	30.0%
	100	6	6.0%
	100-150	23	23.0%
	>150	11	11.0%
Symptomatic/Asymptomatic	Asymptomatic	91	91.0%
	Symptomatic	9	9.0%
Post-Bronchodilator Reversibility	Absent	100	100.0%

78% of the population was male where 39% of them had 2 years of smoking history and 13% of them had 4 years, among the study population 30% of them smoked 1 to 100 puffs per day and 9% of them were symptomatic.

**Table 2: Presents mean distribution of study population**

	Mean	Standard Deviation
Age	24	3
Years of smoking	2	1
FEV1	108.23	26.54
FEV1/FVC	81.61	8.26

The mean age among the study population was 24 years and mean fev1 is 108.2 whereas mean FEV1/FVC IS 81.6.



**Figure 1: Pie chart shows 9% of symptomatic and 91% of asymptomatic study participants**

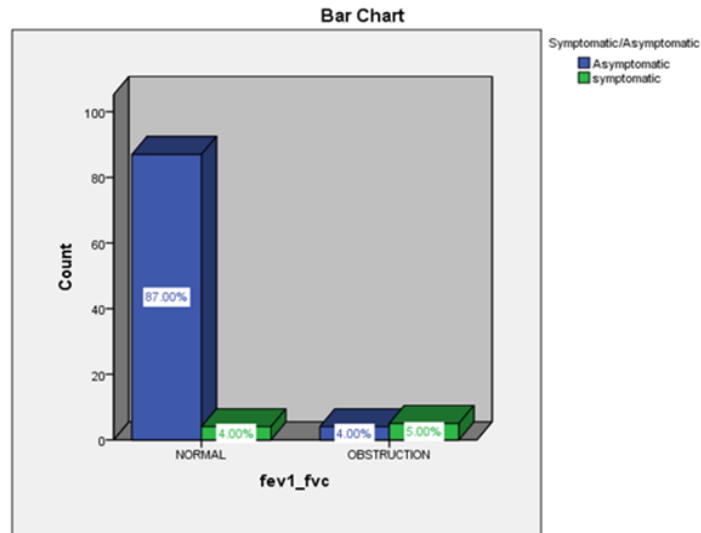


Figure 2: Bar chart shows the association between various variables to FEV1/FVC among study participants

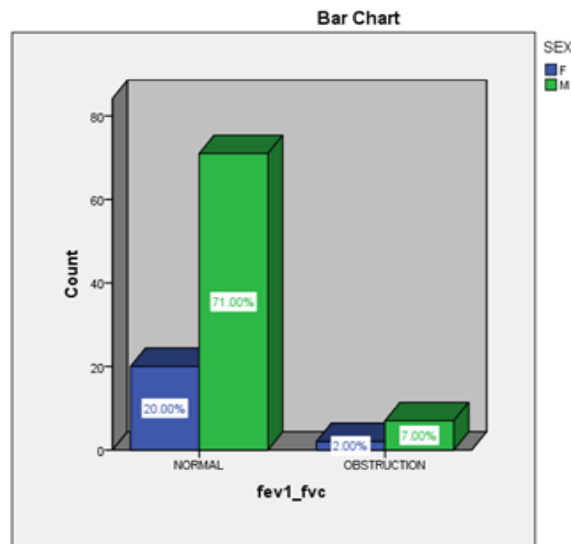


Figure 3: Shows FEV1/FVC of both sexes

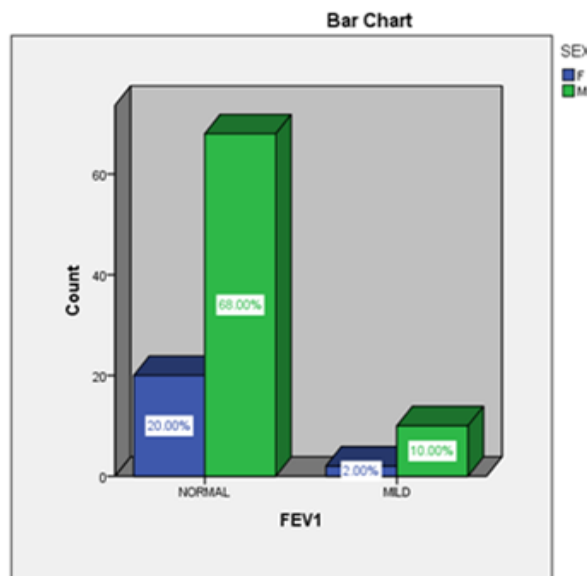


Figure 4: Shows FEV1 of both sexes

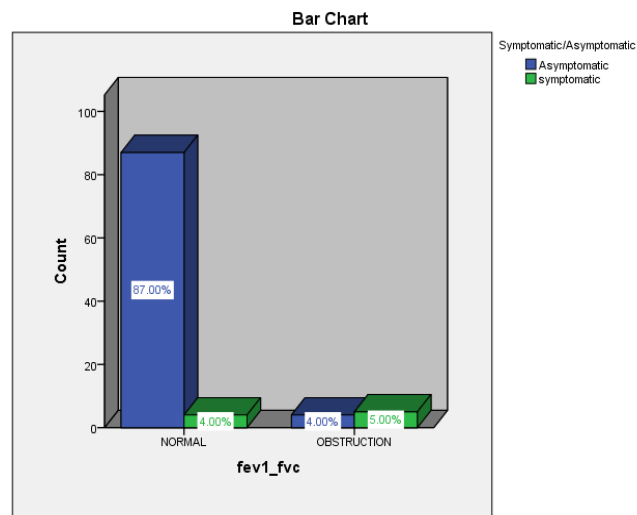


Figure 5: 4% of asymptomatic and 5% of symptomatic patients show decreased FEV1/FVC values

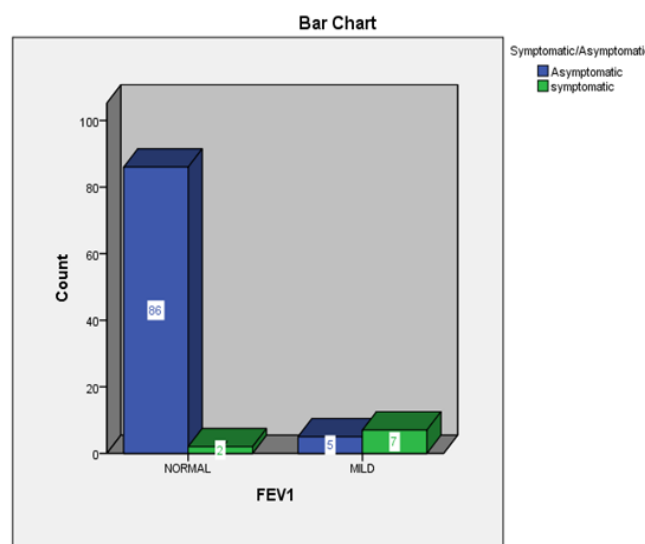


Figure 6: Shows 5% of asymptomatic and 7% of symptomatic patients show decreased FEV1 values

**Discussion**

Currently E-cigarette or vape associated lung injury(EVALI) is a crucial matter of debate across the world as Electronic cigarette smoking is gaining dramatic popularity and is steadily spreading among the adolescents, high income, urban population around the world. There is increasing evidence demonstrating adverse respiratory effects of vaping. In particular, an outbreak of E-Cigarette and Vaping-Associated Lung Illness (EVALI) brought the short-term respiratory consequences of vaping into question. The importance of vaping cessation is paramount, because the nidus for EVALI is vaping. Beyond EVALI, e-cigarette use has been associated with self-reported chronic cough, phlegm production, and wheezing. [9] Most Spiro-metric studies of e-cigarette users have focused on acute changes in airflow immediately after a vaping session. Pulmonary physiology is affected by e-cigarette aerosol inhalation, with increased airway reactivity, obstruction, inflammation and

emphysema. Our Research thus far demonstrates the multifarious aspects of e-cigarette use and its correlation with lung functions. These aspects are Firstly the duration of smoking and No: of puffs inhaled per day, Secondly the development of clinical features and bronchi-tic symptoms and thirdly the severity or degree of lung obstructions in the vape users. This is an assessment of the impact of at least 6-month use of e-cigarettes on lung function. In the present study we have tried to associate the duration of smoking and number of puffs per day with the lung functions of E-cigarette users. Out of 100 study participants, 78% of them were males and 20% were females, mean age among the study population was 24, Mean FEV1-108.2 and Mean FEV1/FVC-81.6.

Reductions in FEV1 and the ratio of FEV1 to forced vital capacity (FEV1/FVC) shows significant long lasting structural lung damage. Similar findings were observed by Jeffrey E Gotts that after years of exposure to e-cigarettes, significant decrease in

FEV1 is observed along with acute changes in airflow after a vaping session. [10] Further studies have shown the relation between the toxic ingredients present in e-cigarettes and its effects on humans. A study from the University of North Carolina found that the two primary ingredients found in e-cigarettes—propylene glycol and vegetable glycerin—are toxic to cells and that the more ingredients in an e-liquid, the greater the risk of developing mild diffusion impairment. Both the U.S. Surgeon General and the National Academies of Science, Engineering and Medicine have warned about the risks of inhaling secondhand e-cigarette emissions, which are created when an e-cigarette user exhales the chemical cocktail created by e-cigarettes. [11] Also A study conducted by a research group at the Harvard School of Public health found that the chemical flavoring Diacetyl found in E-Cigarettes is linked to popcorn lung. This chemical is found in many e-cigarette flavors, added to "e-juice" liquid to complement flavorings such as vanilla, maple, coconut and more. Plus, e-cigarette vapor also contains formaldehyde, another chemical linked to popcorn lung. [12]

To the best of our knowledge, FIG-1 Indicates that the study observes 9% of symptomatic e-cigarette users and FIG-2, 5 and 6 add to the significant correlation between e cigarette users and the presence of increasing Bronchi-tic symptoms such as wheezing, dry cough, chest pain and discomfort which could have clinical, economical and public health implications. These findings are in accordance to the results of a cross-sectional study by Wang MP et al, [13] were consistent of Chinese adolescents, among whom a greater than twofold increased risk of bronchitis symptoms associated with e-cigarette use was observed. In addition, a 2-year follow-up study by Dharma N Bhatta et al [14] on association between e-cigarette use and incident respiratory diseases (i.e., COPD, chronic bronchitis, emphysema, and asthma) indicated that e-cigarette is an independent risk factor for obstructive lung diseases. The Academies; report also states there is moderate evidence that youth who use e-cigarettes are at increased risk for coughing and wheezing and an increase in asthma exacerbation. [15] In the present study, the smoking index of e cigarette users had a significant association with the lung volumes with P-Value <0.05.

FIG-3 shows that 7% of males and 2% of females showed mild to moderate obstructions in the FEV1/FVC ratios and FIG-4 shows 10% of males and 2% of females showed obstructions in FEV1 values. In agreement with the findings presented in our study, Flouris et al. (2013) conducted a study on the acute effect of active and passive e-cigarette smoking on lung function. They concluded that short-term use of e-cigarettes generates smaller changes in lung function. [16] Similarly, the present

study findings are in accordance with those reported by Sultan Ayoub Meo et al, which confirms a significant impairment in lung function parameters in the ENDS group and observed a pattern of peripheral obstructive airway impairment. [17] The lung function test parameters that were found to be significantly decreased in e-cigarette users were forced expiratory volume(FEV1), forced expiratory ratio (FEV1/FVC), forced expiratory flow-25% (FEF25%), forced expiratory flow-50% (FEF50%), forced expiratory flow-75% (FEF75%), forced expiratory flow-25%-75% (FEF25%-75%), and forced expiratory flow-75%-85% (FEF75%-85%).The pathophysiological phenomenon could be that the increase in peripheral flow resistance is allied to the acute narrowing of the diameter of the peripheral airways, which could be due to confined mucosal edema, smooth muscle contraction, and bronchospasm or secretions. These findings have a general message for the global health community on the potential harm of e-cigarettes on lung function. In another study of Chorti et al, it was also documented that short-term and passive usage of one e-cigarette resulted in short-term lung obstruction. [18] Contrary to the findings presented in this study, Vardavas et al. determined the effect of using e-cigarette for a period of 5 minutes on lung function parameters. [19] They did not report a reduction in lung function parameters FVC, FEV1, and FEV1/FVC ratio. But Gennimata et al reported that 10 minutes of e-cigarette use caused prompt airway obstruction. [20] However, Boulay ME's studies [21] have shown that the use of e-cigarettes free of nicotine, with a mixture of Propylene glycol and glycerol, did not significantly affect the pulmonary function or symptoms of subjects. The present study, although modest in its size, scope, and conclusions, offers vital findings on the potential harm of e-cigarettes. Obviously, larger sample size studies are needed to examine the long-term use of e-cigarettes. With the knowledge of research we understand that lung undergo numerous changes in response to e-cigarette use however, a stricter sale control, a proper regulation of the industry including flavor restriction, as well as further toxicological studies, including their chronic effects, are warranted. [22]

## Conclusion

In the present study of the use of E-cigarettes and its detrimental effects on lung function, obstructive lung conditions, and to study the duration of E-cigarette smoking and its correlation with lung function of the population coming to Sree Balaji Medical College, Chromepet we found that Smoking Index(years of smoking and number of puffs per day) of the individual has direct correlation with various medical Comorbidities and there is significant association between patient's FEV1/FVC LEVELS. The number of puffs was an

important risk factor, were the Insouciant teenagers and young adults were affected more due to fantasy and addiction. General obstruction, difficulty in breathing, lung scarring, shortness of breath, lung injury and haemorrhage were the most common symptoms observed in E- cigarette users. The Penn State Electronic Cigarette Dependence Index is a good screening tool due to its high specificity for screening of E – cigarette users compared to the normal tobacco smoking index. As there is a noticeable increase in the number of puffs and the duration of smoking, there is a mild decrease in the FEV1, FVC, FEV25/75 and FEV1/FVC values. Thus, the erroneous belief that E-cigarettes are less harmful to health than tobacco-containing cigarettes must be addressed with urgency. While we are not yet seeing incidents of EVALI at present in India, it is better to be pre-emptive and dispel the myth that it is safe. Counselling on the cessation of vaping and offering them the needed support can make a difference in the patient's lives.

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