



## The Bacterial Colonization in Patients with Chronic Obstructive Pulmonary Disease (COPD)

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### ABSTRACT

This study investigates the bacterial colonies' numbers in COPD patients. Two groups of people were included in this study; 25 healthy individuals' groups and 32 COPD patients' groups, which were further subdivided into three subgroups; 12 smokers, 13 secondhand smokers, and 7 nonsmokers. The sputum sample of each individual was collected to identify bacterial colonization. The results showed different types of bacterial isolates in the two studied groups. *Streptococcus pneumonia* and *Staphylococcus aureus* are the most common bacterial isolates in the patients' group. The numbers of bacterial colonization among the COPD individual are greater than the healthy individual group.

**Keywords:** COPD, Lung functions, Bacterial colonies

### INTRODUCTION

Chronic Obstructive Pulmonary Disease (COPD) is a chronic inflammatory lung disease that restricted the lung's air-flow. World Health Organization described that COPD is not one single disease but an umbrella term used to describe chronic lung diseases that cause limitations in lung airflow. The airflow restriction is mostly progressive and related to an abnormal inflammatory reaction of the lungs to harmful atoms or gases. COPD considers the top 10 causes of death that has an increasing prevalence and mortality. It is characterizing by a progressive weakening in lung function and inflammatory changes [1-6]. Previous studies have decided that patients with COPD have bacterial colonization in the lower respiratory tract which may be a significant construction of airway inflammation [7,8]. The main clinical findings of COPD include shortness of breath, cough, and production of sputum with acute exacerbations periods that characterizes by increased cough, more breath shortness, changing of the sputum color, and increase in production of sputum [9,10]. The most important factor to cause inflammation in the lung is smoking which leads to the progression of COPD caused by bacterial colonization [5,11-13]. Stable chronic obstruction patients showing more airway inflammation and the grade of inflammation is positively related to the severity of airway obstruction with more bronchial inflammation in patients with lower FEV1 (Forced Expiratory Volume at the first second of expiration) [14-17]. Earlier studies performed to evaluate the relationship between the airway's bacterial colonization, inflammation, and lung function have been cross-sectional in design, and have note spoke the important relationship between these parameters [18-20]. Additional study has talking that bacterial colonization leads to increase airway inflammation and can contribute to the accelerated progression of airway obstruction [13,21].

#### The Aim of the Study

The study was aimed to investigate the most common bacterial colonies in COPD patients during the stable state as compared with healthy peoples, and to show the number of bacterial colonies with a decline in lung function as reflected by lung volume measurement.

### MATERIAL AND METHODS

#### Patients Sample

This study was carried out on two groups: 32 patients with COPD within the range of age (26-65), and 25 healthy

subjects as a control, within the age range (28-62 years old). COPD patients' group was more subdivided into three subgroups: 12 smokers, 13 second-hand smokers, and 7 non-smokers.

**Collections of Sputum Sample**

Samples of Sputum were kept in a sterile container from each individual and analyzed bacteriologically by culturing on; MacConkey agar, blood agar, and nutrient agar. The Petri dishes were incubated for 24 hrs at 37°C. Bacterial isolates were diagnosed roughly according to the appearance of colonies and gram staining.

**Evaluation of Lung Function**

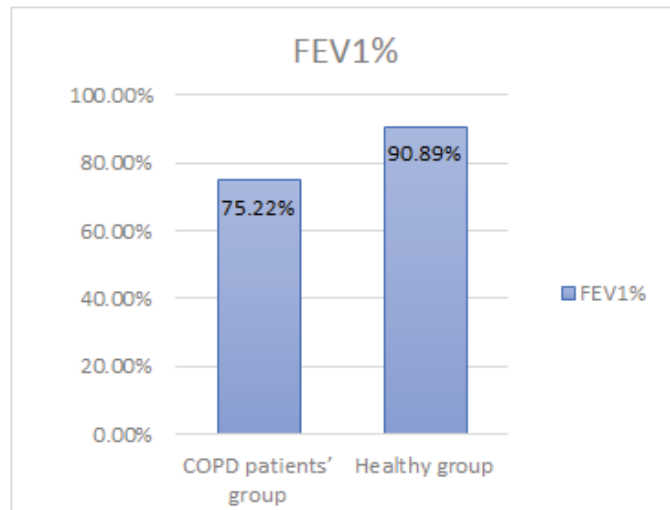
Lung function was rating by measurement of the pulmonary function tests FEV1 (Forced Expiratory Volume), FVC (Forced Vital Capacity), and FEV1% (the ratio of FEV1/FVC) which are the most common parameters used to evaluate the lung function and to give the respiratory diagnosis if the individual was healthy or with allergic lower airway disease such as COPD. The medical instrument used to measure the lung volumes is the medical micro lab spirometer.

**RESULTS**

The findings of lung function tests are showing significant variations between the two studies groups in the three main lung functions tests FEV1, FVC, and FEV1%, illustrated in Table 1, and also find seven bacterial strains isolated from the patients with COPD. The most common bacterial isolates included are *Streptococcus pneumonia* and *E. coli*. While 3 bacterial strains were isolated from the healthy group, most of them belong to *Streptococcus pyogenes* (Figure 1).

**Table 1 Illustrated the three main lung functions, the number of bacterial types, and the most bacterial strain in the main study groups**

Groups	Number of Patients	FEV1	FVC	FEV1%	Number of bacterial types	The most common bacterial colonies
		Mean				
COPD patients' group	32	2.55	3.39	75.22%	7	<i>Streptococcus pneumonia</i>
Healthy group	25	3.59	3.95	90.89%	4	<i>Streptococcus spp.</i>



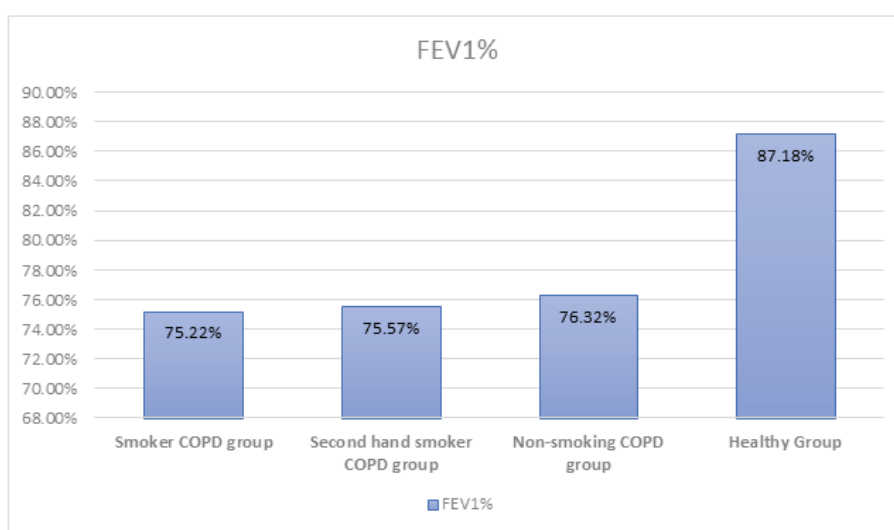
**Figure 1 Shown the FEV1% and main study group**

Table 2 shows the values of pulmonary function tests and the differences between the subgroups of the COPD group and the healthy group. This table shows that there are significant variances between the smoker, second-hand smoker, and non-smoking patients and the healthy group in all pulmonary function tests FEV1, FVC, and FEV1%. There are also significant variances between COPD smoking patients and healthy subjects in FEV1, FVC, and FEV1% (Figure 2). On the other hand, there is no significant difference between the three subgroups smoking, second-hand smoker, and non-smoking of the COPD patients in all of these lung parameters. The table also shows that smoker

COPD patients have the highest number (7) of bacterial isolates types, and the most common bacterial isolates are *Staphylococcus aureus* and *E. coli*.

**Table 2** Illustrated the values of pulmonary functions tests, numbers of bacterial types, and most common bacterial colonies in the subgroup of the study

Groups	Number of Patients	FEV1	FVC	FEV1%	Number of bacterial types	The most common bacterial colonies
		Mean				
Smoker COPD group	12	2.55	3.39	75.22%	7	<i>Staphylococcus aureus</i>
Second hand smoker COPD group	13	2.63	3.48	75.57%	6	<i>E. coli</i>
Non-smoking COPD group	7	2.74	3.59	76.32%	6	<i>Streptococcus pneumonia</i>
Healthy group	25	3.4	3.9	87.18%	4	<i>Streptococcus viridans</i>



**Figure 2** Shown the values of FEV1% in the subgroup of the study

Table 3 shows lung function tests FEV1, FVC, and FEV1% expressed by mean in each isolation of bacteria and the percentage of COPD patient’s bacterial isolates. *Staphylococcus aureus* and *E. coli* are the most dominant bacterial isolates within these subgroups, which showing near the same percentage. Infected patients by these bacterial isolates *Staphylococcus aureus* and *E. coli* have the lowest value of FEV1: (2.2 and 2.25) respectively. While the lowest value of FEV1% was for the patients infected by *Streptococcus pneumonia*, the next dominant bacterial isolates (Figure 3).

**Table 3** Illustrated the percentage of bacteria isolation and lung function tests of bacterial isolates of COPD patients

No.	Bacterial Isolate	Percentage	Mean		
			FEV1	FVC	FEV1%
1	<i>Staphylococcus aureus</i>	70.5	2.2	3.1	70.97%
2	<i>E. coli</i>	70.9	2.25	3.14	71.66%
3	<i>Pseudomonas</i>	11.7	2.75	3.35	82.09%
4	<i>Staphylococcus + Streptococcus</i>	12.1	2.81	3.39	82.89%
5	<i>Streptococcus pneumonia</i>	40.3	2.53	3.57	70.11%
6	<i>Proteus</i>	11.9	3.16	3.93	80.41%
7	<i>Klebsiella</i>	28.5	3.19	14.1	77.80%

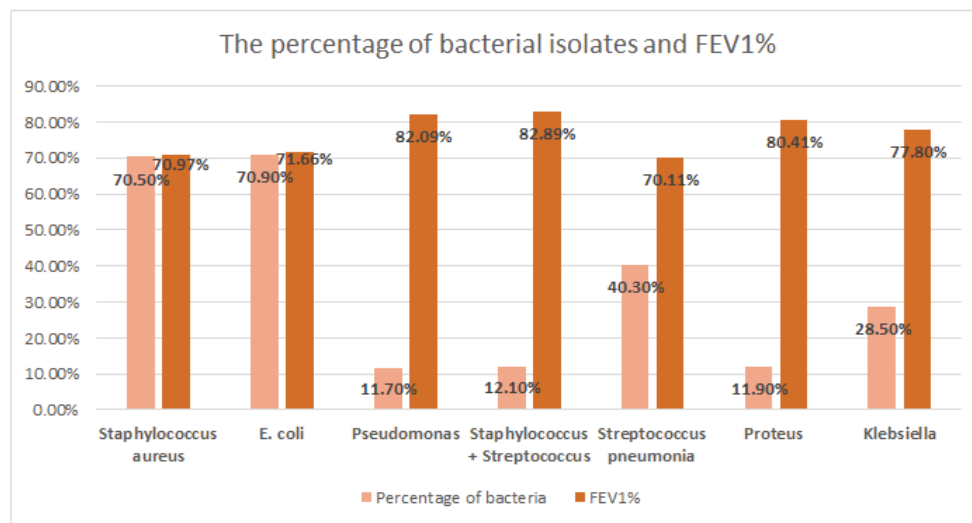


Figure 3 Shown the values of FEV1% and percentage of bacterial isolation

## DISCUSSION

The results of data analysis of this study proved that there is a significant decline in the lung volumes studied FEV1, FVC, and FEV1% of the COPD patients, even during the stable state. A similar finding was observed by another study [22]. The statistical analysis showed that COPD patients have different types of bacterial colonization from sputum samples than healthy groups. There are about seven bacterial strains in COPD patients. These are *Staphylococcus aureus*, *E. coli*, *Pseudomonas*, *Staphylococcus* with *Streptococcus*, *Streptococcus pneumonia*, *Proteus*, and *Klebsiella*. The healthy group has three types of bacteria only. These are *Streptococcus pyogenes*, *Streptococcus viridans*, and *Staphylococcus epidermidis*, as reported by many other studies [23-25], which identified the presence of bacterial colonization in the lower airways of healthy nonsmoking, while another study [18,19] founded that the lower airways of healthy nonsmoking persons are germ-free. In brief, the recent study showed that COPD patients have clear deterioration in lung function tests and increased bacterial colony variations. This result is continual with the other study finding that is the person showed changes in the bacterial colonization nature suffered from a faster decrease in lung function than those with the persistence of one or more bacterial species [26].

## CONCLUSION

The main bacterial colonies in COPD patients were *Streptococcus pneumonia*, *E. coli*, and *Staphylococcus aureus*. This group shows clear declines in lung function tests FEV1, FVC, and FEV1%, compared to the healthy group, which their lower airways occupied by an alternative type of bacterial isolates: *Streptococcus pyogenes* and *Streptococcus viridans* generally. There is clear interaction in the lung volumes between subjects colonized with different bacteria within the same group. To find the final effect of bacterial colonies on lung function tests, more quantitative and qualitative detection is required.

## DECLARATIONS

### Conflicts of Interest

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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