

# A Comparative Study to Evaluate the Effect of Crook Lying Position versus Sitting Position on Forced Vital Capacity (FVC) in Healthy Individuals

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## ABSTRACT

To prove the effect of body position on the Forced Vital Capacity (FVC) and to find out the better position amongst the sitting and crook lying position as both are considered to be the best respiratory positions as far as FVC is concerned, but no research work is done to find out the better amongst the two.

**Materials and Methods:** We analyzed the FVC of the randomly selected 100 subjects (both males and females) in sitting and crook lying position respectively. Computerized Pulmonary Function Testing (PFT) apparatus was used for analysis where three readings of FVC were taken in each position from which

best ones were taken for analysis.

**Results:** Mean FVC in crook lying position was found out to be 88.83% as compared to 99.07% in sitting position showing a difference of 10.24 %.

The values were analyzed by using standard t-test which gave t-value 18.4316 and p-value 0.0001 which is statistically significant.

**Conclusion:** The results show that FVC was more in sitting position as compared to crook lying position.

**Keywords:** Forced Vital Capacity, Spirometry, Pulmonary Function Testing

## INTRODUCTION

Out of all lung volumes and capacities, FVC is considered be the most important determinant of the lung functions which varies in different positions due to effect of airway resistance, rib cage movements, gravitational forces, abdominal contents and diaphragm excursion [1].

It has already been established in the past that changes in body posture can alter a number of measurements of pulmonary function. This was suggested as early as 1907, when Bohr reported an increase in residual air on moving from the erect to the recumbent position [1,2]. Subsequent studies on pulmonary volume reported decreases in Total Lung Capacity (TLC), Vital Capacity (VC) [3], and Expiratory Reserve Volume (ERV) in normal subjects on moving from the standing to the supine position. It is also been established that a change in body position from sitting to recumbent will alter the size of the various subdivisions of the lung volume [4]. In the course of some observations on intra-pulmonary gas mixing, it was found that changes in body position caused significant changes in size and ventilation rate of the "slow spaces."

Though Whitfield suggested that the VC rises on lying down, this presumption was based on observations of a larger group of subjects including 24 males and 16 females who were examined in the sitting position only and one male who was examined only in recumbence [5].

Various studies have been done till date in which sitting position have been found to be the one in which FVC was maximum [5,6].

With the high increase in the incidence of respiratory disorders need arises to find out various new positions for the benefit of the respiratory patients to make breathing comfortable for the them and also help them cope up with the dyspnoeic attacks using different body postures.

Though Sitting is the best condition as far as the FVC is considered, Jean Gardiner also recommends Crook lying as the position for emergency use along with sitting position [7] although no significant research work has been done to find out the better position amongst these two positions.

The attempt is being made to compare the sitting position with the Crook lying position in context to the FVC in each position using the computerized PFT or Spirometry.

### About the spirometry

Spirometry is a physiological test that measures how an individual inhales or exhales volumes of air as a function of time. The primary signal measured in Spirometry may be volume or flow. Spirometry is invaluable as a screening test of general respiratory health in the same way that blood pressure provides important information about general cardiovascular health [8].

The Snowbird workshop held in 1979 resulted in the first American Thoracic Society (ATS) statement on the standardization of spirometry [8]. This was updated in 1987 and again in 1994 [9].

The spirometer is capable of accumulating volume for 15 seconds (longer times are recommended) and measuring Volumes of 8 Litres with an accuracy of at least 3% of reading or 0.050 Liters. Testing the performance of equipment is not part of the usual laboratory procedures [8].

### About FVC

FVC is the maximal volume of air exhaled with maximally forced effort from a maximal inspiration, i.e., VC performed with a maximally forced expiratory effort, expressed in liters. There are three distinct phases to the FVC maneuver, as follows: Maximal Inspiration; A "Blast" of Exhalation; and continued complete exhalation to the End of Test (EOT) [8] It is important for subjects to be verbally encouraged to continue to exhale the air at the end of the maneuver to obtain optimal effort, e.g., by saying "keep going" [8,9].

Although subjects should be encouraged to achieve their maximal effort, they should be allowed to terminate the maneuver on their own at any time, especially if they are experiencing discomfort [10].

## MATERIALS AND METHODS

**Research Design:** The study was experimental study, comparative in nature.

Variable	Mean	Standard Deviation	Standard Error
FVC	99.07	11.61	1.16

**[Table/Fig-1]:** FVC measured in sitting in 30 subjects

Variable	Mean	Standard Deviation	Standard Error
FVC	88.83	9.91	0.99

**[Table/Fig-2]:** FVC measured in sitting in 30 subjects

**Research Setting:** Out-Patient Department of Chest and TB Department at Adesh Institute of Medical Sciences and Research Bathinda (Punjab), India.

**Selection Criteria:** The selection criteria for the subjects to be taken includes following inclusion and exclusion criteria:

### Inclusion Criteria

- Subjects falling in the age group of 18-30 years [11]
- Both male and female subjects are included.
- Normal Healthy Subjects are to be included.

### Exclusion Criteria [8,9]

- Subjects suffering from Cardio-Respiratory Pathology or Insufficiency
- Subjects suffering from Neurological disorders
- Ones who have recently undergone cardio-thoracic surgery
- Any Injury to thorax, Trunk or abdomen
- Haemoptysis of unknown origin
- Subjects who underwent Recent eye surgery
- H/o Myocardial Infarction or Unstable Angina
- Smokers are to be excluded
- Suffering from Arthritis
- Psychologically ill patients

**Population:** All the Students and Staff Members of Adesh Institute of Medical Sciences and Research Bathinda (Punjab), India, who fulfilled the inclusion and exclusion criteria were taken as the population of study.

**Sample size:** Hundred Subjects were taken from the above explained population.

**Sampling method:** Systematic randomized sampling by using chit method.

### Variables of study

**1. Independent Variable:** The position of the subject.

- Sitting.
- Crook lying.

**2. Dependent Variable:** Forced Vital Capacity.

### Tools

- "RMS Medspiror" the computerized PFT device which is Interfaced with the computer to complete the unit.
- The nose piece.
- Disposable mouth piece (different for every subject).

## METHODOLOGY

A pilot study was conducted prior to the main study with 10 subjects to understand the feasibility following which 100 subjects were selected randomly by systematic sampling using chit method from amongst Students and Staff of AIMS. After taking informed consent subjects were explained about the working of Computerized PFT, The guideline to be followed, both the positions to be taken and the procedure to perform.

## Guidelines to subject

- He/she should come in loose clothing for the manoeuvre.
- The subject should not have meal immediately before the manoeuvre is to be performed.
- Make sure that lips are sealed around the mouth piece [8].
- Subject is supposed to "Blast" not just blow and is supposed to exhale fully.
- Manoeuvre with hesitant start will be terminated at that movement only to avoid unnecessary efforts [8,9].
- Cough at any movement during the manoeuvre will interfere with the measurement of accurate result hence rendering the result unacceptable [9,12].
- Effort should maximal throughout the procedure.
- The mouth piece should not be closed by the tongue while performing.

## Positions Taken

- **SITTING:** Subject was made to sit on a stool with his/her back straight, Hips and knees flexed to 90 degrees each and hands relaxing on the thighs.
- **CROOK LYING:** The subject was asked to Lye Supine with his/her both hip joints 45 degrees and foot lying flat on the couch with the arms resting by the side of the subject.

Once the subject was confident the experiment was initiated, The subject was then placed into sitting position and allowed to relax. Nose clip was applied before taking each reading [13,14]. Then the Subject was asked to take in deep breath and expire forcefully into the mouth piece in a single go, without any pause in between the inspiration and expiration while the reading is recorded by instrument [8,9]. Three readings were taken [10] in the same way with the rest period of ten seconds in each reading and the Best of the three readings obtained was taken as the final reading for this position.

Once the readings were complete in sitting position the subject was allowed to relax. The subject was then placed in Crook Lying Position and take few breaths in which the maximum changes in the lungs take place [15], the same process was initiated as it was done in sitting position. Best of the 3 readings taken in crook lying was the final reading for this position [8-10].

## RESULTS

A comparative study was performed in which FVC was assessed in two different positions, i.e., sitting and crook lying respectively.

The values were collected in both the positions from the dependent variables where the readings in sitting were taken as "X" and the readings for same subject in crook lying was taken as "Y" in the master chart [Table/Fig-1 and 2].

Statistics were performed using paired t-test to get the p-value.

Calculated t-value = 18.4316

Degree of Freedom = 99

p-value and statistical significance:

The two-tailed p-value is less than 0.0001.

By conventional criteria; this difference is considered to be extremely statistically significant.

The data was analysed by using paired t-test and the following results were obtained:

- There is significant difference in the FVC in sitting position and crook lying position in healthy individuals.
- The FVC decreases as we move from sitting to crook lying position with the mean difference of 10.24% in both the positions.
- The calculated t-value is 18.4316 and the two-tailed p-value is less than 0.0001 which considered to be extremely statistically significant.

## DISCUSSION

In present study there was comparison of the effect of two different body positions i.e., sitting and crook lying position on the FVC of a healthy individuals. The mean FVC for the participants in sitting position was calculated to be 99.07% and the mean value in crook lying was calculated to be 88.83%. A Comparison between the means of FVC in both the positions showed that FVC was more in sitting than in crook lying position where the mean of Group One minus Group Two equals 10.24 [16,17].

After the measurement of FVC in both positions the paired t-test was applied and was found to be extremely statistically significant with the obtained p-value less than 0.0001. The results of the study showed that there was significant difference in the FVC when compared in sitting position and crook lying position. These results are in accordance with the previous research in which FVC is said to be 7% to 8% higher in sitting position as compared to supine and other recumbent positions [8].

In sitting position the factors responsible for the greater value includes the fact that in this position the abdominal contents distends the abdominal wall and the elasticity of diaphragm and the belly wall is found to be high as compared to crook lying position. Sitting also offers mechanical advantage and larger trans-pulmonary pressures. The airway resistance is also lower in upright positions as compared to horizontal postures.

This reduction of FVC in CROOK LYING POSITION can probably be attributed to increased thoracic blood volume in recumbent positions [5]. Compliance also decreases in supine position which is due to increased pulmonary blood volume which in turn decrease the recoil of the lungs and also due to closure of small airways [5].

E Blair and JB Hickam also concluded that FVC is maximum in erect posture due to the fact that on lying down the most slowly ventilated spaces become smaller [3]. Although chest cavity has been found to be larger when the body is recumbent according the study carried out by Alberto Hurtado et al., it was stated that reduction in total volume and VC in this posture possibly is brought about by accumulation of blood in the pulmonary circuit [4].

Though the result of our research contradictory to Whitfield et al., who suggested that the VC rises on lying down [13]. This presumption was based on observations of a larger group of subjects including 24 males and 16 females who were examined in the sitting position only and one male who was examined only in recumbence. However, the results, i.e., decrease in the FVC as we moved from sitting position to crook lying position obtained in this research show similarity to the results of most of the studied done in previous times [18].

The above facts in overall support the results of our research which state that Group I, i.e., the individuals in sitting position showed more FVC than the Group II, i.e., the same individuals in crook lying hence the sitting position can be considered better than the crook lying position wherever the FVC is to be taken into account.

Wherever possible sitting position can be preferred over crook lying in order to improve breathing patterns and make breathing comfortable.

The activities such as carrying out exercises as in gyms should be preferred in sitting positions taking into account the results of this research.

## Limitations

- As the manoeuvre is to be performed by the subject, the result greatly depend on the confidence level and the skills of the subject.
- Excessive repetitions of the manoeuvre can lead to exertion which can affect the results
- The study was carried out on healthy subjects, more précised results could have been obtained if the same research was carried out on subjects suffering from a particular disease.

## CONCLUSION

- The results of the study showed that there is significant change in the FVC in healthy individuals with the change in position.
- The value of FVC was more when measured in sitting than the one that was measured in crook lying position.
- Therefore the study concludes that Body position affect the FVC which is more in Sitting than in Crook lying.

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FINANCIAL OR OTHER COMPETING INTERESTS: None.

Date of Submission: **Aug 12, 2013**  
Date of Peer Review: **Nov 09, 2013**  
Date of Acceptance: **Jan 27, 2014**  
Date of Publishing: **Feb 03, 2014**