Assess the Efficacy of Incentive Spirometer on Dyspnea and Pulmonary Functions of Chronic Obstructive Pulmonary Disease Patients at Sree Balaji Medical College and Hospital, Chennai

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How to cite this article:

K Mageswari Mohanram. Assess the Efficacy of Incentive Spirometer on Dyspnea and Pulmonary Functions of Chronic Obstructive Pulmonary Disease Patients at Sree Balaji Medical College and Hospital, Chennai. Journal of Emergency and Trauma Nursing. 2020;1(1):27–49.

Abstract

Background: Chronic Obstructive Pulmonary Disease (COPD for short) occurs when permanent blockages form within the pulmonary system that interfere with the transfer of vital gasses. There are two underlying disorders that can cause COPD: Emphysema and chronic Bronchitis. Incentive spirometer is a type of bronchial hygiene therapy. This helps to increase the inhaled lung volume, improve in get rid of mucus or secretions and to avoid serious lung infections in COPD patients.

Objectives: (1) To assess the level of dyspnea and pulmonary functions before and after the use of incentive spirometer among COPD patients. (2) To evaluate the effectiveness of incentive spirometer between experimental and control group. (3) To findout the association between selected demographic variables and the levels of dyspnea and pulmonary functions in the experimental group after using incentive spirometer.

Materials and Methods: Quasi–experimental Pre-test – Post-test Control Group design were used. Non-probability purposive sampling technique used. The sample size for this study was fourty COPD patients out of which 20 patients were considered as Control group and another 20 patients as Experimental group.

Results: The obtained Paired '*t*' test value for the experimental group is 21.5 was markedly significant at $p < 0.01$ level whereas in the control group there was no significant difference found ($t = 1.94$, $p = 0.06$) and also there is significant difference noted in the pulmonary parameters ($p = 0.01$) between experimental and control group after using incentive spirometer.

Conclusion: The study proved that incentive spirometer is effective in improving pulmonary functions of COPD patients.

Keywords: Chronic Obstructive Pulmonary Disease; Vital gasses; Emphysema and chronic Bronchitis; Incentive spirometer.

Introduction

COPD is a disease state characterized by the presence of airflow obstruction caused by chronic bronchitis or emphysema. The airflow obstruction is generally progressive, may be accompanied by airway hyperactivity and may be partially reversible. It is a progressive lifethreatening lung disease that causes breathlessness (initially with exertion) and predisposes to exacerbations and serious illness.[1]

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Received on 20.01.2020, **Accepted on** 15.02.2020

WHO estimates that COPD affects 600 million people worldwide and is the 4th leading cause of death and 12th leading cause of disability, killing more than 2.74 million people each year. It's prevalence is highest in countries where cigarette smoking is very common. By 2020, COPD will become the 3rd leading cause of death and the 5th leading cause of disability worldwide.

COPD is one whose burden is rising fastest in the world. The magnitude of the disease spurred the Global initiative for Chronic Obstructive Lung Disease (GOLD) in 2001. COPD is an important public health challenge that is both preventable and treatable

GOLD criteria is "COPD is a disease state characterized by airflow limitation is usually both progressive and associated with an abnormal inflammatory response of the lungs to noxious particles or gases".[2]

Chronic obstructive pulmonary disease (COPD) is a progressive and debilitating respiratory condition that leads to significant burden, both medically and financially. Cigarette smoking is the main risk factor for developing COPD. An estimated 64–210 million people worldwide are living with a diagnosis of COPD.[3]

Smoking had been the prime cause for COPD, as 90% of cases reported with COPD were smokers. Sometimes even non-smokers could suffer from this disease by passive smoking. Due to its association with smoking and environmental pollution, the burden is much higher in low and middle-income countries.[4]

The patients with COPD is associated with a set of breathing related problems like chronic cough, spitting or coughing mucus (expectoration), breathlessness upon exertion and progressive reduction in the ability to exhale.[5]

Patients with acute exacerbations of COPD are at higher risk for disease detoriation, including reduced quality of life and increasing rates of hospitalisations. Exercises has emerged as a primary modality for improving quality of life of COPD patients. Incentive spirometer is a type of bronchial hygiene therapy. It's purpose is to promote complete lung expansion and to prevent pulmonary problems.[6]

Incentive Spirometer is a simple instrument which provides visual and auditory feed-back to the patient while performing inspiration, so that patient can achieve their preset goals. It encourages deep breathing and a sustained inspiration. The use of incentive spirometry improves respiratory muscle strength and Quality of Life of COPD patients.[6]

Statement of the problem

Assess the efficacy of incentive spirometer on dyspnea and pulmonary functions of chronic obstructive pulmonary disease patients at Sree Balaji Medical College and Hospital, Chennai.

Objectives

1. To assess the level of dyspnea and pulmonary functions before and after the use of incentive spirometer among COPD patients.
2. To evaluate the effectiveness of incentive spirometer between experimental and control group.
3. To findout the association between selected demographic variables and the levels of dyspnea and pulmonary functions in the experimental group after using incentive spirometer.

Materials and Methods

Research Approach

Quasi – experimental research approach

Research Design

Pre-test – Post-test Control Group design

Setting of the study

Medical wards at Sree Balaji Medical College & Hospital, Chennai.

Population

All the COPD patients who were admitted in the medical wards of Sree Balaji Medical College & Hospital, Chennai during the data collection period and were fulfilling the selection criteria.

Sampling Technique

Non-probability purposive sampling technique

Sample Size

The sample size for this study was fourty COPD patients out of which 20 patients were considered as Control group and another 20 patients as Experimental group.

Description of the Tools

The research tool used for this study consisted of 2 sections.

Section I : Interview Schedule

(a) Demographic Data.

(b) Modified Borg's Rating Scale to assess the level of Dyspnea.

Section II : Observational Checklist

(a) Observational Checklist to assess the Pulmonary Functions namely Forced inspiratory volume, Peak expiratory flow rate, Oxygen saturation, Chest expansion and Breath holding time.

(b) Observational Checklist for monitering the performance of using incentive spirometer.

Section I

(a) Demographic Data: It included age, sex, education, marital status, occupation, family monthly income, family history of COPD, duration of illness, habits and chronic exposure.

(b) Modified form of Borg's Rating Scale to assess the subjective interpretation of dyspnea. This standardized scale was developed by G.V. Borg, 1982. This is a categorical scale with ratio properties.

Section II

(a) The observational checklist consisted of 5 parameters for assessing the pulmonary functions namely forced inspiratory volume, peak expiratory flow rate, oxygen saturation, chest expansion and breath holding time. Each pulmonary parameters was graded into four levels ; normal, mildly decreased, moderately decreased and severely decreased based on the value obtained. Each pulmonary parameters were measured as follows,

(i) *Forced Inspiratory Volume:* It was measured by using Triflo-II Incentive Spirometer, the patient was advised to sit and encouraged to hold the incentive spirometer to face level. Then placed the mouth piece in the mouth and instructed the patient to inhale to his maximum effort. This is repeated for three times with the interval of 30 seconds and best of three readings were taken.

(ii) *Peak Expiratory Flow Rate:* The patients was asked to sit and take a deep breath and hold it. Adviced to blow forcefully through the mouth piece of peak flow meter 3 times with an interval of 30 seconds. The best of the three readings were taken and measured with 'Pulmo Peak' - Peak Flow Meter (Wright's Scale).

(iii) *Oxygen Saturation:* To measure Oxygen Saturation Pulse Oxymeter is connected and the probe is fixed to the index finger of the patients. The reading is monitered till a stabilized reading is got and then recorded.

(iv) *Chest Expansion:* To measure Chest Expansion, patient was asked to stand up and take a deep breath and hold the breath. The inch tape was placed around the chest and the measurement was taken at the midlevel of 4^{th} intercostal space. Same way patient was asked to exhaled fully and the measurement was taken. The difference between these two measurements gives chest expansion.

(v) *Breath Holding Time:* The patient was made to sit in a comfortable position and was asked to take a deep breath and hold by pinching the nose. The patient was instructed to report when he/she was no longer able to hold the breath by raising the finger. This time was noted as breath holding time

(b) Obsevational Checklist was formulated to observe whether the patients followed all the steps of procedure when using incentive spirometer. It also included a column for number of days performed by the patients.

Scoring Procedure

The Modified Borg's Rating Scale graded the level of dyspnea into 10 levels with a score ranging from 0 to 10. The maximum score was 10. A low score of zero indicates no breathlessness and a high score of ten indicates maximum breathlessness.

The observational checklist consisted 5 parameters for assessing the pulmonary functions namely forced inspiratory volume, peak expiratory flow rate, oxygen saturation, chest expansion and breath holding time. Each pulmonary parameters was graded as follows,

(a)	Normal	4
(b)	Mildly decreased	3
(c)	Moderately decreased	2
(d)	Severely decreased	1

The possible maximum score was 20 and minimum score was 5. High score indicates good pulmonary functions and low score indicates poor pulmonary functions.

Methods of Data Collection

Formal Permission for Data collection was sought from the Dean, Sree Balaji Medical College & Hospital. COPD patients admitted in the medical wards were selected for the study according to the preset criteria and informed about the procedure and oral consent was obtained. The first 20 subjects were assigned to the control group and next 20 subjects were assigned to the experimental group.

Investigator collected the demographic data. Before administering the exercises to each group the dyspnea and pulmonary parameters such as forced inspiratory volume, peak expiratory flow rate, oxygen saturation, chest expansion and breath holding time were measured. The patient was given a clear explanation about the steps of using incentive spirometer and the advantages of doing it. The patients were made to perform the exercises in the separate room. The atmosphere of the room was quiet and pleasing.

Instructions of using Incentive Spirometer

In the fowlers position (at 45* angle) with back rest and one pillow underneath the knees, instruct the individual to exhale slowly and completely. At the end of quiet exhalation, the patient is instructed to inhale through the mouth piece of the incentive spirometer, so as to raise the first two balls in the container and touch at the top of the device taking slow deep inhalation. Following maximum inhalation the patient is instructed to hold the breath for two to five seconds. Following the end-inspiratory hold, the patient should inhale normally between breaths and should relax and breathe normally. Invert the Incentive spirometer and asked the patient to blow forcefully to the maximum extent through the mouth piece. Limit to 5 breaths per minute. The exercise was given 15 minutes per session for 2 times a day for 5 days. During the course of exercise the patients were monitered using an observational checklist which was prepared by the investigator. On 6th day post-test was done by using the modified borg's rating scale and the same pulmonary parameters.

Results

The Data collected were analyzed and presented in the following sequence,

Section I: Distribution of demographic variables of patients with COPD.

Section II: Data on effectiveness of incentive spirometer on dyspnea among COPD patients in the experimental and control group.

Section III: Distribution of subjects according to pulmomary function measures in the experimental group and control group.

Section IV: Data on effectiveness of incentive spirometer on pulmonary functions among COPD patients in the experimental and control group.

Section V: Data on association of the selected demographic variables and the levels of dyspnea and pulmonary functions among COPD patients in the experimental group after using incentive spirometer.

Section 1

In this study majority 35% of COPD patients were in the age group of 61–70 yrs, 65% were males and 95% were married in both experimental and control group. Majority 35% in the experimental group and 50% in the control group were uneducated and having the family monthly income of less than ₹2,500. Regarding occupation majority 40% in the experimental group and 50% in the control group were coolies. Regarding family history of COPD 60% in the experimental group and 70% in the control group were not having any family history of COPD. Majority 30% in the experimental group and 40% in the control group had suffered from COPD between 1–3 yrs. Majority 60% were smokers and 20% were alcoholic in both experimental and control group. Majority 60% in the experimental group and 55% in the control group were not exposed to any chronic exposure like chemicals/ paint or dust/cotton (Table 1 and Figs 1-10).

Table 1: Distribution of Demographic Variables of patients With COPD

Demographic Variables	Experimental Group (n = 40)		Control Group (n = 40)	
	F	%	*F*	%
(1) Age (in years)				
(a) 30–40 yrs	3	15	3	15
(b) 41–50 yrs	5	25	5	25
(c) 51–60 yrs	5	25	5	25
(d) 61–70 yrs	7	35	7	35
(2) Sex				
(a) Male	13	65	13	65
(b) Female	7	35	7	35
(3) Education				
(a) Uneducated	7	35	10	50
(b) Primary/High school	5	25	5	25
(c) Higher secondary	6	30	2	10
(d) Degree/Diploma	2	10	3	15
(4) Marital Status				
(a) Married	19	95	19	95
(b) Unmarried	1	5	1	5
(5) Occupation				
(a) coolie	8	40	10	50
(b) Office workers	6	30	4	20
(c) Unemployed	6	30	6	30
(6) Family Income (per month)				
(a) less than ₹2,500/-	7	35	10	50
(b) ₹2,501–5,000/-	9	45	8	40
(c) ₹5,001–7,500/-	3	15	1	5
(d) Above ₹7,501/-	1	5	1	5
(7) Family history of COPD				
(a) Parents	5	25	3	15
(b) Siblings	3	15	3	15
(c) None	12	60	14	70
(8) Duration of illness				
(a) 1–3 yrs	6	30	8	40
(b) 4–6 yrs	6	30	5	25
(c) 7–9 yrs	6	30	3	15
(d) 10 yrs and above	2	10	4	20
(9) Habits				
(a) Smoking - Yes	12	60	8	40
No	8	40	12	60
(b) Alcoholic -Yes	4	20	4	20
No	16	80	16	80
(10) Chronic Exposure				
(a) Chemicals/Paint	5	25	3	15
(b) Dust/Cotton	3	15	6	30
(c) None	12	60	11	55

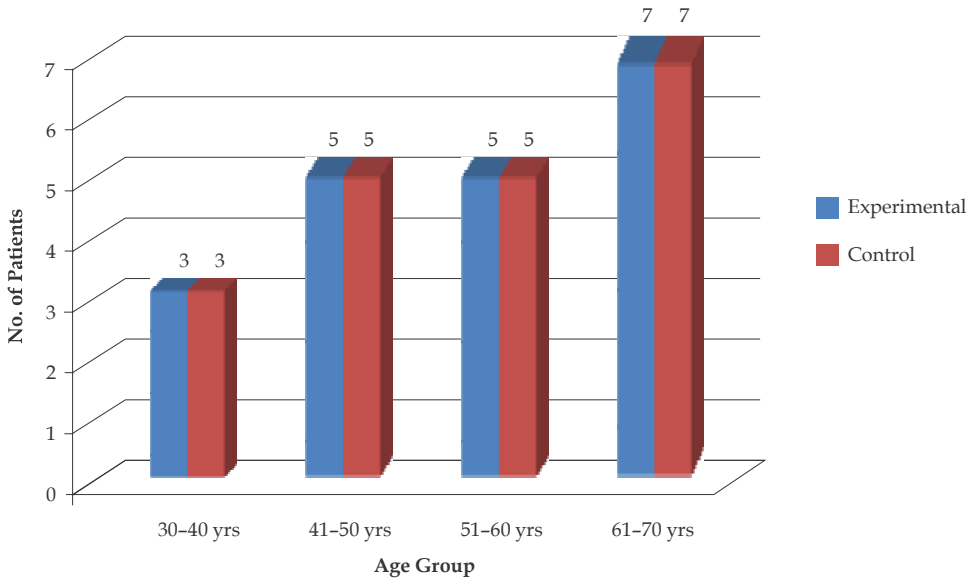

Fig. 1: Age Distribution of the Copd Patients.

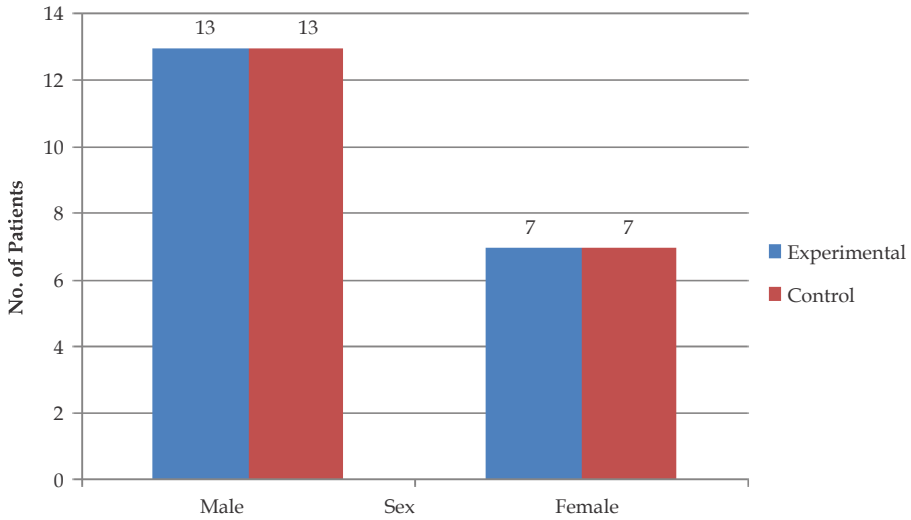

Fig 2: Sex of the Copd Patients.

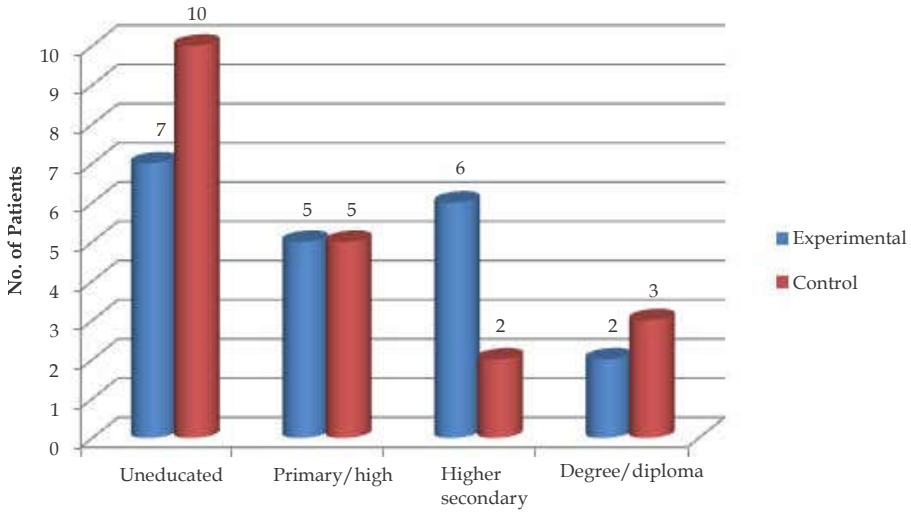

Fig. 3: Educational Status of the Copd Patients.

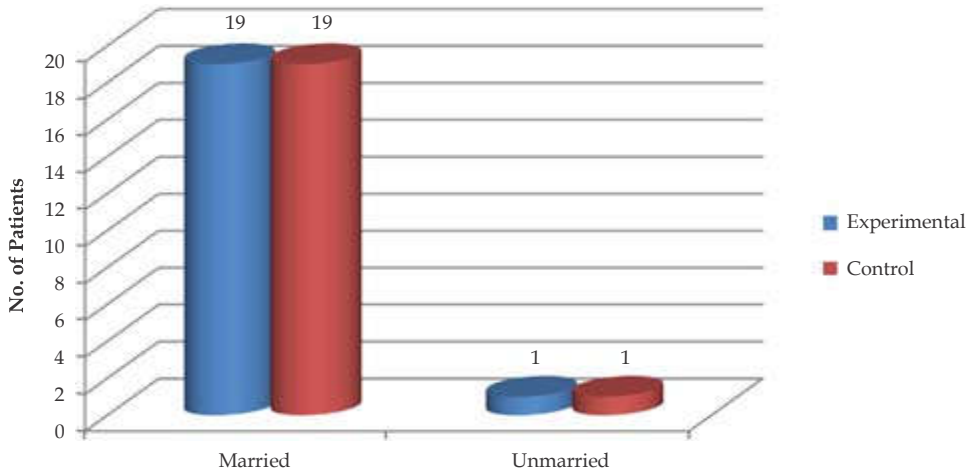

Fig 4: Marital Status of the Copd Patients.

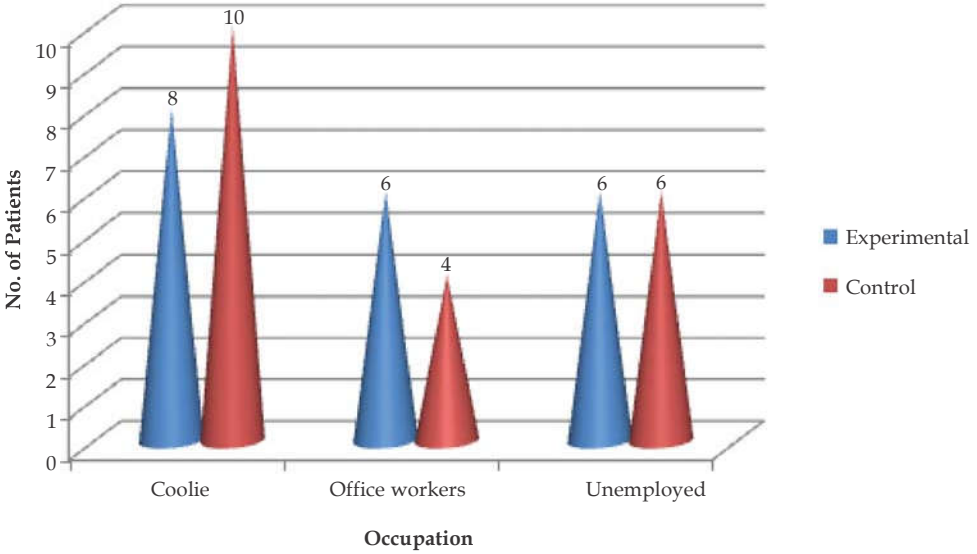

Fig. 5: Occupational Status of the Copd Patients.

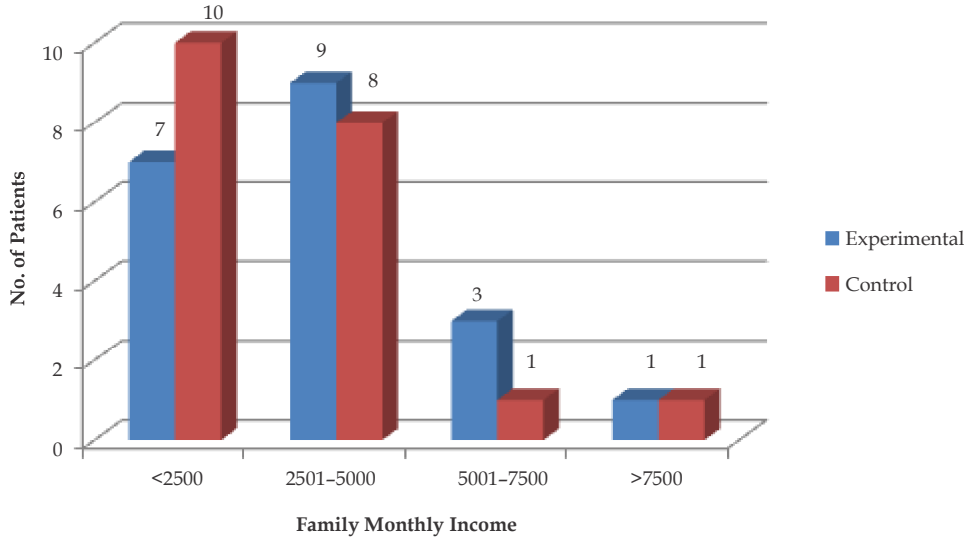

Fig. 6: Family Monthly Income of Copd Patients.

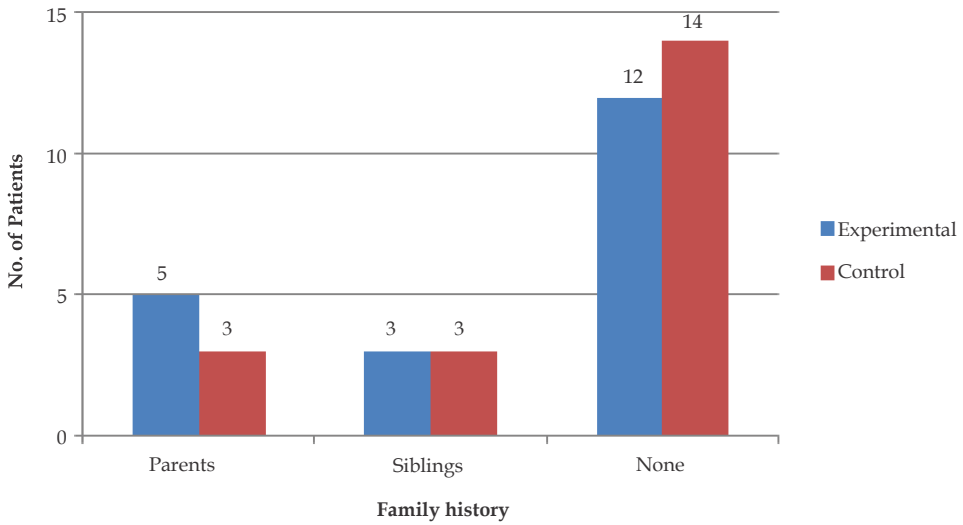

Fig. 7: Family History of Copd Patients.

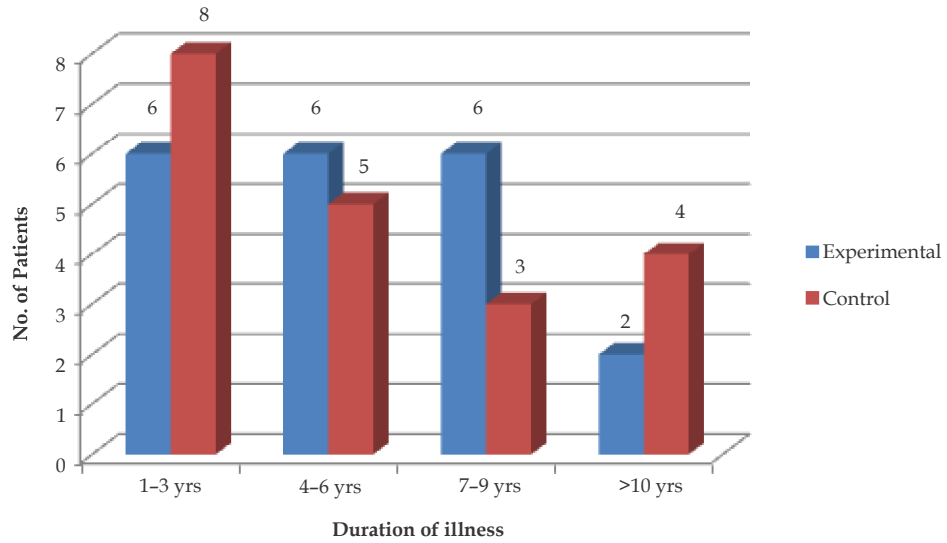

Fig. 8: Duration of Illness of the Copd Patients.

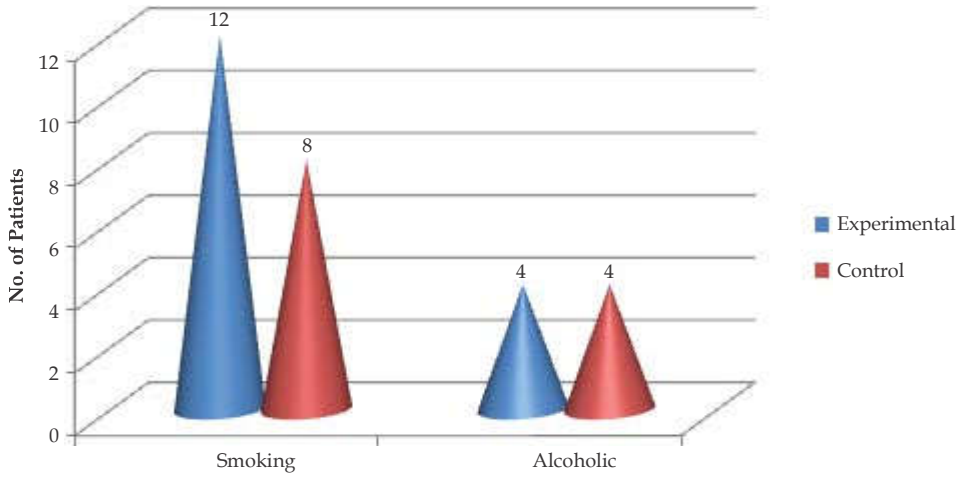

Fig. 9: Habits of the Copd Patients.

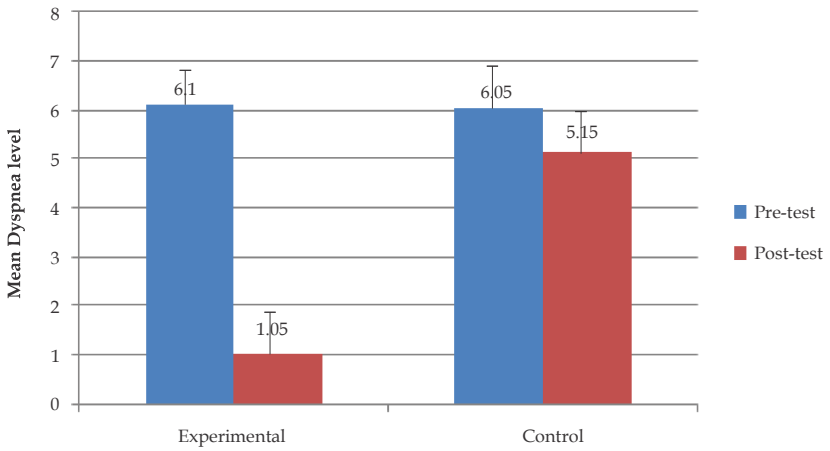

Fig 10: Chronic Exposure of Copd Patients.

Section 2

Table 2 revealed that the mean pre-test dyspnea levels for the experimental and control group were 6.10 and 6.05 whereas the mean post-test levels for the experimental and control group were 1.05 and 5.15 respectively.

The obtained Paired '*t*' test value for the experimental group is 21.5 was markedly significant at $p < 0.01$ level whereas in the control group there was no significant difference found ($t = 1.94$, $p = 0.06$). It showed that dyspnea level was reduced after using incentive spirometer in the experimental group (Table 2 and Fig. 11).

Table 2: Comparison of Mean Pre-test and Post-test Dyspnea Levels of the Experimental Group and Control Group

Experimental Group ($n = 20$)			Control Group ($n = 20$)		
Pre-test	**Post-test**	**Paired 't' Test Value**	**Pre-test**	**Post-test**	**Paired 't' Test Value**
Mean (SD)	**Mean (SD)**		**Mean (SD)**	**Mean (SD)**	
6.10 (0.91)	1.05 (1.15)	21.5 $p < 0.01$**	6.05 (1.32)	5.15 (1.74)	1.94 $p = 0.06$#

**Highly significant

#Not significant

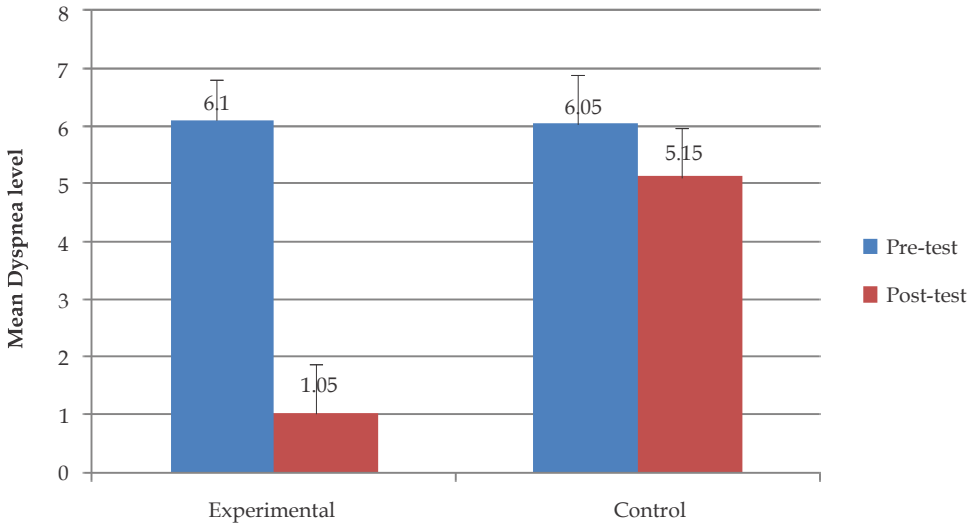

Fig. 11: Comparison of Mean Pretest and Posttest Dyspnea Levels of the Experimental Group and Control Group.

Table 3 revealed that the mean dyspnea level 1.05 of the experimental group after using incentive spirometer is lower than the mean dyspnea level 5.15 of the control group. The obtained '*t*' value is 10.65 which is significant at $P < 0.01$ level. This indicates that the difference between the means 4.10 is a true difference and has not occurred by chance. The difference between the two means could be due to the effect of incentive spirometer. It is inferred that the incentive spirometer is effective in reducing dyspnea (Fig. 12).

Table 3: Comparison of Mean Post-test Dyspnea Levels of the Experimental Group With Control Group After Using Incentive Spirometer

Group	Mean	SD	Mean Difference	Un-paired '*t*' Test Value	Level of significance
Experimental Group	1.05	1.15	4.10	10.65	$p < 0.01$**
Control Group	5.15	1.74			

**Highly significant

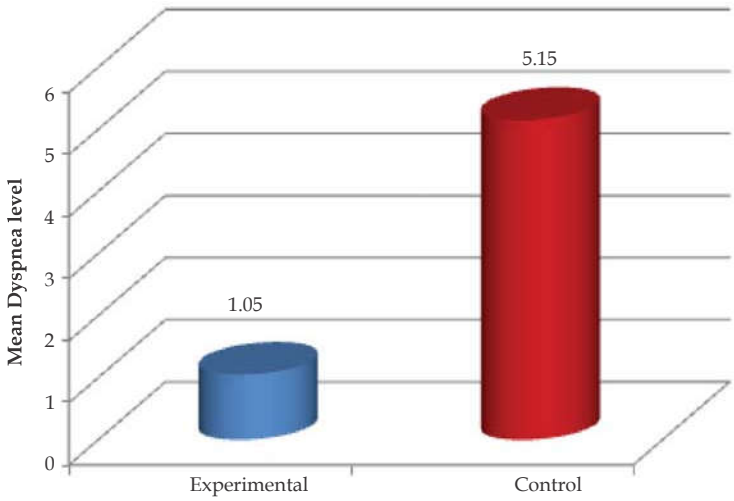

Fig 12: Comparison of Mean Posttest Dyspnea Levels of the Experimental Group with Control Group After Using Incentive Spirometer.

Section 3

Table 4 revealed that distribution of subjects according to the pulmonary function measures in the pre-test and post-test of the experimental group. Based on the pulmonary function measured the subjects were classified into 4 groups ; normal, mildly decreased, moderately decreased and severely decreased.

With regard to Forced inspiratory volume obtained in the experimental group, none of them had normal forced inspiratory volume in the pre-test, whereas majority 95% of them had normal forced inspiratory volume in the post-test. There is an increase in the forced inspiratory volume of the experimental group after using incentive spirometer.

Based on the Peak expiratory flow rate obtained, majority 55% of the subjects had severely decreased peak expiratory flow rate in the pre-test whereas 55% of them had normal peak expiratory flow rate in the post-test. The above data showed that the peak expiratory flow rate of the experimental group increased after using incentive spoirometer.

Based on the Oxygen saturation level obtained in the experimental group all the subjects had normal oxygen saturation both in the pre-test and post-test.

Based on the Chest expansion obtained, 85% had severely decreased chest expansion in the pre-test whereas none of them had severely decreased chest expansion in the post-test. This showed that the chest expansion improved after using incentive spirometer in the experimental group.

Regarding Breath holding time obtained, none of them had normal breath holding time in the pre-test, whereas in the post-test 55% of subjects had normal breath holding time and none of them had severely decreased breath holding time. The above data showed that the breath holding time of the experimental group increased after using incentive spirometer.

Table 4: Distribution of Subjects According to Pulmonary Function Measures in the Experimental Group

Pulmonary Parameters	Pre-test		Post-test	
	f	%	*f*	%
(1) Forced inspiratory volume				
(a) Normal	0	0	19	95
(b) Mildly decreased	10	50	1	5
(c) Moderately decreased	7	35	0	0
(d) Severely decreased	3	15	0	0
(2) Peak expiratory flow Rate				
(a) Normal	0	0	11	55
(b) Mildly decreased	5	25	7	35
(c) Moderately decreased	4	20	2	10
(d) Severely decreased	11	55	0	0
(3) Oxygen saturation				
(a) Normal	20	100	20	100
(4) Chest expansion				
(a) Normal	0	0	3	15
(b) Mildly decreased	1	5	6	30
(c) Moderately decreased	2	10	11	55
(d) Severely decreased	17	85	0	0
(5) Breath holding time				
(a) Normal	0	0	11	55
(b) Mildly decreased	4	20	7	35
(c) Moderately decreased	12	60	2	10
(d) Severely decreased	4	20	0	0

Table 5: Distribution of Subjects According To Pulmonary Function Measures in the Control Group

Pulmonary Parameters	Pre-test		Post-test	
	f	%	*f*	%
(1) Forced inspiratory volume				
(a) Normal	0	0	1	5
(b) Mildly decreased	1 0	50	12	60
(c) Moderately decreased	5	25	6	30
(d) Severely decreased	5	25	1	5
(2) Peak expiratory flow rate				
(a) Normal	2	10	2	10
(b) Mildly decreased	2	10	4	20
(c) Moderately decreased	5	25	8	40
(d) Severely decreased	11	55	6	30
(3) Oxygen saturation				
(a) Normal	19	95	20	100
(b) Mildly decreased	1	5	0	0
(4) Chest expansion				
(a) Normal	0	0	0	0
(b) Mildly decreased	0	0	0	0
(c) Moderately decreased	2	10	5	25
(d) Severely decreased	18	90	15	75
(5) Breath holding time				
(a) Normal	1	5	1	5
(b) Mildly decreased	3	15	5	25
(c) Moderately decreased	12	60	9	45
(d) Severely decreased	4	20	4	20

Table 5 reveals the distribution of subjects according to the pulmonary function measures in the pre-test and post-test of the control group. As like experimental group subjects were classified as normal, mildly decreased, moderately decreased and severely decreased.

With regard to Forced inspiratory volume obtained in the control group, none of them had normal forced inspiratory volume in the pre-test while only one subject had normal forced inspiratory volume in the post-test. There was not much difference observed between the two readings.

Based on the peak expiratory flow rate obtained in the control group, 55% of the subjects had severely decreased peak expiratory flow rate and only 10% had normal peak expiratory flow rate in the pre-test while 30% had severely decreased and the 10% had normal peak expiratory flow rate in the post-test. This showed that there was not much difference observed between the two readings.

Based on the oxygen saturation obtained in the control group, 95% in the pre-test and 100% in the post-test had normal oxygen saturation

Based on the chest expansion obtained in the control group, majority 90% of the subjects had severely decreased and none of them had normal chest expansion in the pre-test while majority 75% of the subjects had severely decreased chest expansion and none of them had normal chest expansion in the post-test. This showed that there was not much difference observed between the two readings.

Based on the breath holding time obtained in the control group, majority 60% had moderately decreased and 20% of the subjects had severely decreased breath holding time in the pre-test while majority 45% had moderately decreased and 20% had severely decreased breath holding time in the post-test. This showed that there was not much difference observed between the two readings.

Section 4

Data on effectiveness of Incentive Spirometer on pulmonary functions among COPD patients in the experimental and control group

Table 6 revealed that there is significant difference exist between the mean pre-test and post-test pulmonary function values of the experimental group after using incentive spirometer. The obtained Paired '*t*' test values for forced inspiratory volume –15.31 ($p < 0.01$), subsequently for peak expiratory flow rate –8.11 ($p < 0.01$), oxygen saturation –1.97 ($p = 0.06$), chest expansion –31.01 ($p < 0.01$) and breath holding time –22.7 ($p < 0.01$). It reflects that there exist true difference between pre-test and post-test values of pulmonary parameters in the experimental group.

Table 7 it indicates the mean pre-test and post-test pulmonary function values of the control group. The obtained Paired '*t*' test values for forced inspiratory volume –1.74 ($p = 0.09$) subsequently for peak expiratory flow rate –1.59 ($p = 0.11$), oxygen saturation –1.99 ($p = 0.06$), chest expansion –0.96 ($p = 0.34$) and breath holding time –0.97 ($p = 0.33$). It is inferred that there was no significant difference between pre-test and post-test pulmonary parameters in the control group (Figs. 13(A)-13(E)).

Table 6: Comparison of the Mean Pre-test and Post-test Pulmonary Function Values of the Experimental Group

Pulmonary Parameters	Experimental Group	Mean	SD	Paired '*t*' Test Value	Level of Significance
Forced Inspiratory Volume	Pre-test	810.00	120.96	15.31	$p < 0.01$**
	Post-test	1180.00	52.31		
Peak Expiratory Flow Rate	Pre-test	206.50	54.12	8.11	$p < 0.01$**
	Post-test	371.00	120.00		
Oxygen Saturation	Pre-test	98.05	1.64	1.97	$p = 0.06$#
	Post-test	98.85	0.22		
Chest Expansion	Pre-test	1.99	0.75	31.01	$p < 0.01$**
	Post-test	3.98	0.81		
Breath Holding Time	Pre-test	16.60	6.55	22.7	$p < 0.01$**
	Post-test	30.85	7.39		

**Highly significant

#Not significan

Table 7: Comparison of the Mean Pre-test and Post-test Pulmonary Function Values of the Control Group

Pulmonary Parameters	Control Group	Mean	SD	Paired 't' Test Value	Level of Significance
Forced Inspiratory Volume	Pre-test	795	107.63	1.74	$p = 0.09$#
	Post-test	855.5	109.90		
Peak Expiratory Flow Rate	Pre-test	199.5	65.4	1.59	$p = 0.11$#
	Post-test	232.5	65.6		
Oxygen Saturation	Pre-test	98.15	2.41	1.99	$p = 0.06$#
	Post-test	98.30	1.54		
Chest Expansion	Pre-test	1.88	0.73	0.96	$p = 0.34$#
	Post-test	2.10	0.72		
Breath Holding Time	Pre-test	15.95	7.79	0.97	$p = 0.33$#
	Post-test	18.35	7.7		

#Not significant

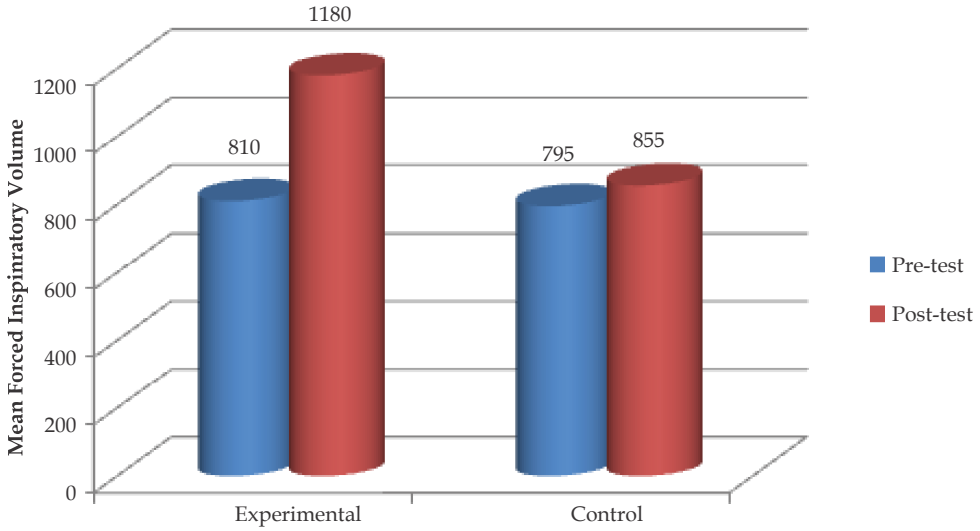

Fig. 13(A): Comparison of Mean Pretest and Posttest Forced Inspiratory Volume of the Experimental Group and Control Group.

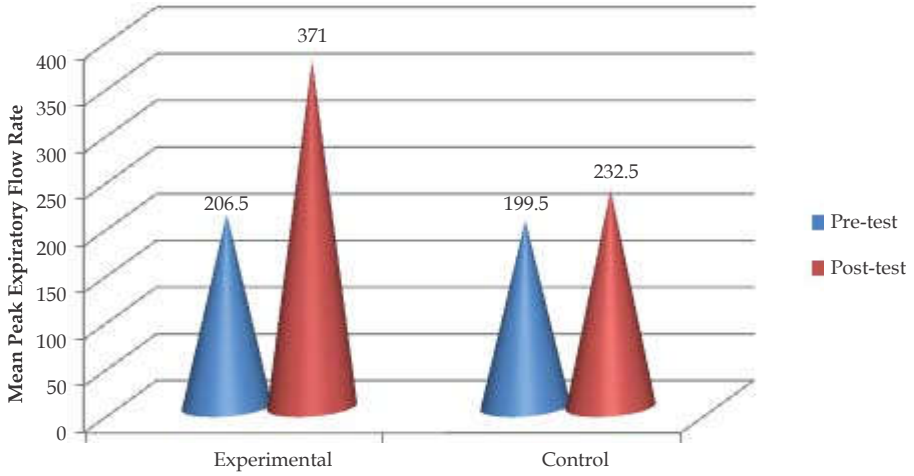

Fig. 13(B): Comparison of Mean Pretest and Posttest Peak Expiratory Flow Rate of the Experimental Group and Control Group.

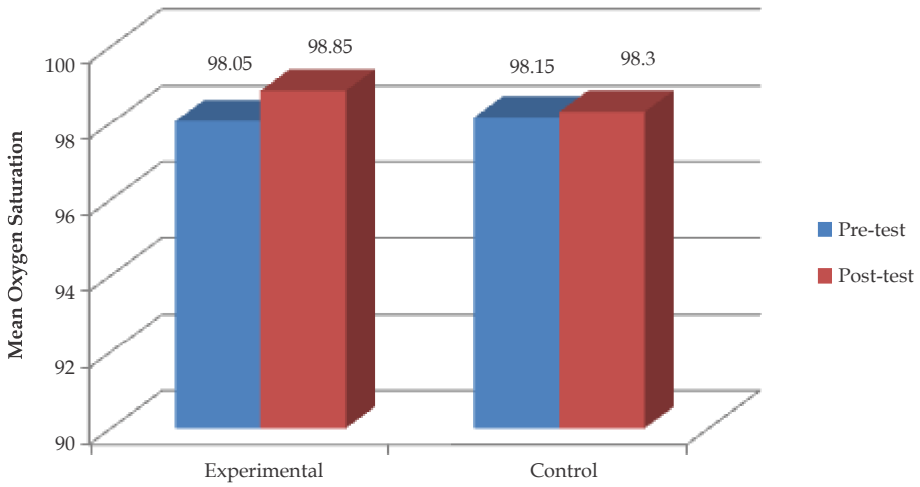

Fig. 13(C): Comparison of Mean Pretest and Posttest Oxygen Saturation of the Experimental Group and Control Group.

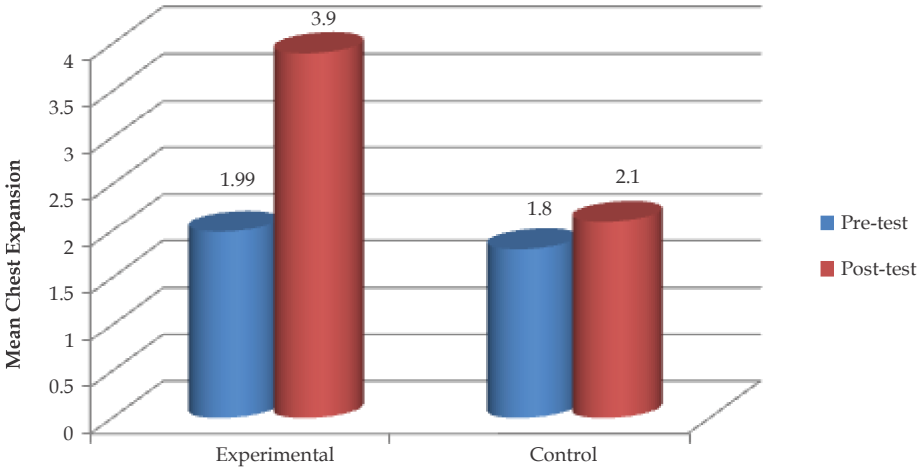

Fig. 13(D): Comparison of Mean Pretest and Posttest Chest Expansion of the Experimental Group and Control Group.

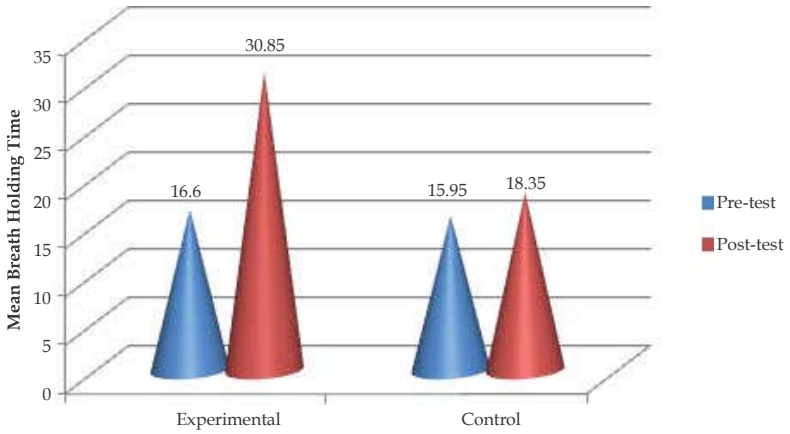

Fig. 13(E): Comparison of Mean Pretest and Posttest Breath Holding Time of the Experimental Group and Control Group

Table 8 and Figs 14(A)-14(E) revealed that the comparison of the mean post-test pulmonary function values of the experimental group with control group after using incentive spirometer.

Regarding Forced inspiratory volume the mean 1180 and standard deviation 52.31 of the experimental group when computed with the mean 855 and standard deviation 109.9 of the control group reveals that the Unpaired '*t*' test value is 10.80 which showed a high significance at $p < 0.01$ level.

Regarding Peak expiratory flow rate the mean 371 and standard deviation 120 of the experimental group when computed with the mean 232.5 and standard deviation 65.6 of the control group reveals that the Unpaired '*t*' test value is 6.03 which showed a high significance at $p < 0.01$ level.

Regarding Oxygen saturation the mean 98.85 and standard deviation 0.22 of the experimental group when computed with the mean 98.30 and standard deviation 1.54 of the control group reveals that the Unpaired '*t*' test value is 1.56 ($p = 0.13$). There is no significant difference found with oxygen saturation.

Regarding chest expansion the mean 3.98 and standard deviation 0.81 of the experimental group when computed with the mean 2.10 and standard deviation 0.72 of the control group reveals that the Unpaired '*t*' test value is 17.5 which showed a high significance at $p < 0.01$ level.

Regarding Breath holding time the mean 30.85 and standard deviation 7.39 of the experimental group when computed with the mean 18.35 and standard deviation 7.7 of the control group reveals that the Unpaired '*t*' test value is 11.5 which showed a high significance at $p < 0.01$ level.

It is inferred that there exist significant difference in pulmonary functions of COPD patients mainly the forced inspiratory volume, peak expiratory flow rate, chest expansion and breath holding time between experimental group and control group after using incentive spirometer. It is inferred that incentive spirometer is effective in improving pulmonary functions of COPD patients.

Table 8: Comparison of Mean Post-test Pulmonary Function Values of The Experimental Group with Control Group After Using Incentive Spirometer

Pulmonary Parameters	Group	Mean	SD	MD	Un paired 't' Test Value	Level of Significance
Forced Inspiratory Volume	Experimental Group	1180	52.31	325	10.80	$p < 0.01$**
	Control Group	855	109.90			
Peak Expiratory Flow Rate	Experimental Group	371	120	138.5	6.03	$p < 0.01$**
	Control Group	232.5	65.6			
Oxygen Saturation	Experimental Group	98.85	0.22	0.55	1.56	$p = 0.13$#
	Control Group	98.30	1.54			
Chest Expansion	Experimental Group	3.98	0.81	1.88	17.5	$p < 0.01$**
	Control Group	2.10	0.72			
Breath Holding Time	Experimental Group	30.85	7.39	12.50	11.5	$p < 0.01$**
	Control Group	18.35	7.7			

**Highly Significant

#Not Significant

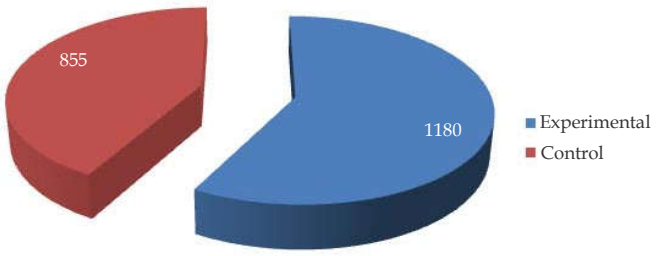

Fig. 14(A): Comparison of Mean Posttest Forced Inspiratory Volume of the Experimental Group with Control Group After Using Incentive Spirometer.

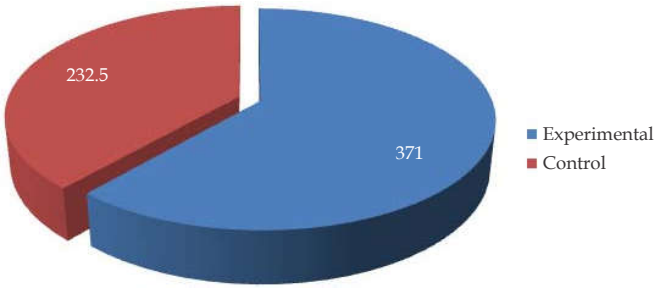

Fig. 14(B): Comparison of Mean Posttest Peak Expiratory Flow Rate of the Experimental Group with Control Group After Using Incentive Spirometer.

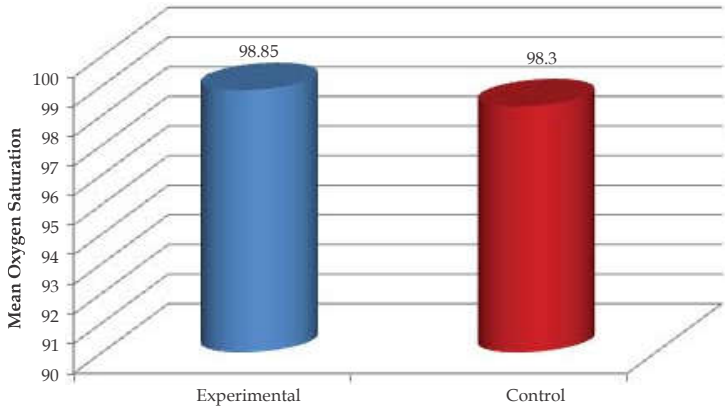

Fig. 14(C): Comparison of Mean Posttest Oxygen Saturation of the Experimental Group with Control Group After Using Incentive Spirometer.

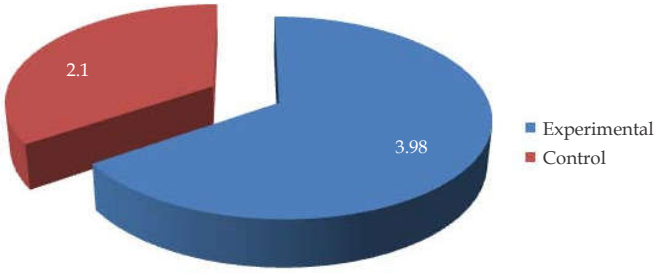

Fig. 14(D): Comparison of Mean Posttest Chest Expansion of the Experimental Group with Control Group After Using Incentive Spirometer.

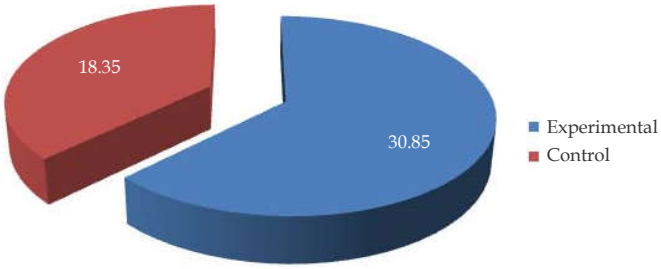

Fig. 14(E): Comparison of Mean Posttest Breath Holding Time of the Experimental Group with Control Group After Using Incentive Spirometer.

Section 5

Data on association of the selected demographic variables and the levels of dyspnea and pulmonary functions among COPD patients in the experimental group after using incentive spirometer

Table 9 revealed that there is no significant association between dyspnea level and the demographic variables like age, sex, education, smoking, chronic exposure and duration of illness.

Table 10 revealed that there is no statistically significant association between Forced inspiratory volume and the demographic variables like age, sex, education, smoking, chronic exposure, and duration of illness.

Table 9: Association of the Selected Demographic Variables and the Dyspnea Levels of The Experimental Group After Using Incentive Spirometer

Demographic Variables	Dyspnea Level			X^2 Value	Significance
	No Breathlessness	Very Slight Breathlessness	Very Slight Breathlessness		
(1) Age					
(a) 30–40 yrs	3	0	0		
(b) 41–50 yrs	4	0	1	10.2	$p = 0.12$#
(c) 51–60 yrs	1	4	0		
(d) 61–70 yrs	3	3	1		
(2) Sex					
(a) Male	7	4	2	1.2	$p = 0.53$#
(b) Female	4	3	0		
(3) Education					
(a) Uneducated	5	2	0		
(b) Primary/High School	2	3	0	8.1	$p = 0.22$#
	2	2	2		
(c) Higher secondary	2	0	0		
(d) Degree/Diploma					
(4) Smoking					
(a) Yes	6	4	2	1.49	$p = 0.47$#
(b) No	5	3	0		
(5) Chronic exposure					
(a) Chemicals/Paint	1	3	1	4.6	$p = 0.32$#
(b) Dust/Cotton	3	0	0		
(c) None	7	4	1		
(6) Duration of illness					
(a) 1–3 yrs	4	1	1		
(b) 4–6 yrs	3	3	0	4.8	$p = 0.56$#
(c) 7–9 yrs	2	3	1		
(d) 10 yrs and above	2	0	0		

#Not Significant

Table 10: Association of the selected Demographic Variables and the Forced Inspiratory Volume of the Experimental Group After Using Incentive Spirometer

Demographic Variables	Forced Inspiratory Volume		X^2 Value	Level of Significance
	Normal	Mildly Decreased		
(1) Age (in years)				
(a) 30–40 yrs	3	0		
(b) 41–50 yrs	5	0	1.95	$p = 0.58$#
(c) 51–60 yrs	5	0		
(d) 61–70 yrs	6	1		
(2) Sex				
(a) Male	12	1	0.57	$p = 0.45$#
(b) Female	7	0		

Demographic Variables	Forced Inspiratory Volume		X^2 Value	Level of Significance
	Normal	Mildly Decreased		
(3) Education				
(a) Uneducated	7	0		
(b) Primary/High school	5	0	2.46	$p = 0.48$#
(c) Higher Secondary	5	1		
(d) Degree/Diploma	2	0		
(4) Smoking				
(a) Yes	1	11	0.04	$p = 0.83$#
(b) No	0	8		
(5) Chronic exposure				
(a) Chemicals/Paint	0	5	0.70	$p = 0.71$#
(b) Dust/Cotton	0	3		
(c) None	1	11		
(6) Duration of illness				
(a) 1–3 yrs	5	1		
(b) 4–6 yrs	6	0	2.46	$p = 0.49$#
(c) 7–9 yrs	6	0		
(d) 10 yrs and above	2	0		

= Not significant

Table 11 reveals that there is a statistically significant association with Peak expiratory flow rate and age at the level of $P < 0.05$. Remaining variables such as sex, education, smoking, chronic exposure and duration of illness were not have significant association with peak expiratory flow rate (Fig. 15).

Table 11: Association of the Selected Demographic Variables and the Peak Expiratory Flow Rate of the Experimental Group After Using Incentive Spirometer

Demographic Variables	Peak Expiratory Flow Rate			X^2 Value	Level of Significance
	Normal	Mildly Decreased	Moderate Decreased		
(1) Age (in years)	3	0	0		
(a) 30–40 yrs	4	1	0		
(b) 41–50 yrs	3	1	1	10.36	$p < 0.05$*
(c) 51–60 yrs	1	5	1		
(d) 61–70 yrs					
(2) Sex	6	5	2		
(a) Male	5	2	0	1.73	$p = 0.42$#
(b) Female					
(3) Education					
(a) Uneducated	3	3	1		
(b) Primary/High school	3	2	0	2.93	$p = 0.82$#
(c) Higher Secondary	3	2	1		
(d) Degree/Diploma	2	0	0		
(4) Smoking	2	5	5		
(a) Yes	0	2	6	2.68	$p = 0.26$#
(b) No					
(5) Chronic exposure					
(a) Chemicals/Paint	0	3	2	4.64	$p = 0.32$#
(b) Dust/Cotton	0	0	3		
(c) None	0	6	6		
(6) Duration of illness					
(a) 1–3 yrs	4	1	1		
(b) 4–6 yrs	4	1	1	5.15	$p = 0.53$#
(c) 7–9 yrs	2	4	0		
(d) 10 yrs and above	1	1	0		

= Not significant

* = Significant

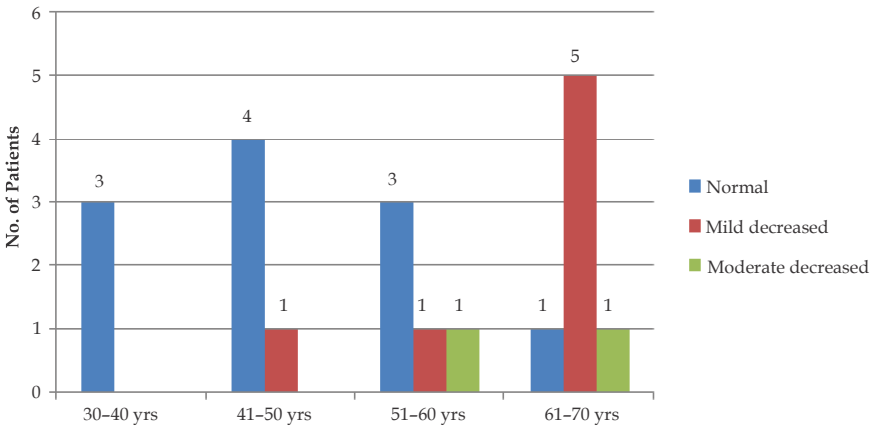

Fig. 15: Association of the Age and Peak Expiratory Flow Rate tf the Experimental Group After Using Incentive Spirometer.

Table 12 reveals that there is no statistically significant association between oxygen saturation and the demographic variables like age, sex, education, smoking, chronic exposure and duration of illness.

Table: 13 reveals that there is a statistically significant association with Chest expansion and the demographic variables like age and education at the level of P<0.05. Remaining variables such as sex, smoking, chronic exposure and duration of illness were not have significant association with chest expansion (Figs.16 and 17).

Table 12: Association of the Selected Demographic Variables and the Oxygen Saturation of the Experimental Group After Using Incentive Spirometer

Demographic ariables		Oxygen Saturation	X^2 Value	Level of Significance
		Normal		
1	**Age (in years)**			
	(a) 30–40 yrs	3		
	(b) 41–50 yrs	5	0	p = 1.0#
	(c) 51–60 yrs	5		
	(d) 61–70 yrs	7		
2	**Sex**			
	(a) Male	13	0	p = 1.0#
	(b) Female	7		
3	**Education**			
	(a) Uneducated	7		
	(a) Primary/High School	5	0	p = 1.0#
	(c) Higher Secondary	6		
	(d) Degree/Diploma	2		
4	**Smoking**			
	(a) Yes	12	0	p = 1.0#
	(b) No	8		
5	**Chronic exposure**			
	(a) Chemicals/Paint	5	0	p = 1.0#
	(b) Dust/Cotton	3		
	(c) None	12		
6	**Duration of illness**			
	(a) 1–3 yrs	6		
	(b) 4-6 yrs	6	0	p = 1.0 #
	(c) 7–9 yrs	6		
	(d) 10 yrs and above	2		

= Not significant

Table 13: Association of the Selected Demographic Variables and the Chest Expansion of the Experimental Group After Using Incentive Spirometer

Demographic Variables		Chest Expansion			X^2 Value	Level of Significance
		Normal	Mildly Decreased	Moderate Decreased		
1	**Age (in years)**					
	(a) 30–40 yrs	2	1.	0		
	(b) 41–50 yrs	1	1	3	10.76	$p < 0.05$*
	(c) 51–60 yrs	0	2	3		
	(d) 61–70 yrs	0	2	5		
2	**Sex**					
	(a) Male	3	4	6	2.15	$p = 0.32$#
	(b) Female	0	2	5		
3	**Education**					
	(a) Uneducated	0	1	6		
	(b) Primary/High School	0	2	3	16.4	$p < 0.05$*
	(c) Higher Secondary	1	3	2		
	(d) Degree/Diploma	2	0	0		
4	**Smoking**					
	(a) Yes	6	4	2	1.49	$p = 0.29$#
	(b) No	5	2	1		
5	**Chronic exposure**					
	(a) Chemicals/Paint	3	1	1	2.47	$p = 0.65$#
	(b) Dust/Cotton	1	2	0		
	(c) None	7	3	2		
6	**Duration of illness**					
	(a) 1–3 yrs	2	2	2		
	(b) 4–6 yrs	0	2	4	6.26	$p = 0.39$#
	(c) 7–9 yrs	0	2	4		
	(d) 10 yrs and above	1	0	1		

= Not significant.

* = Significant.

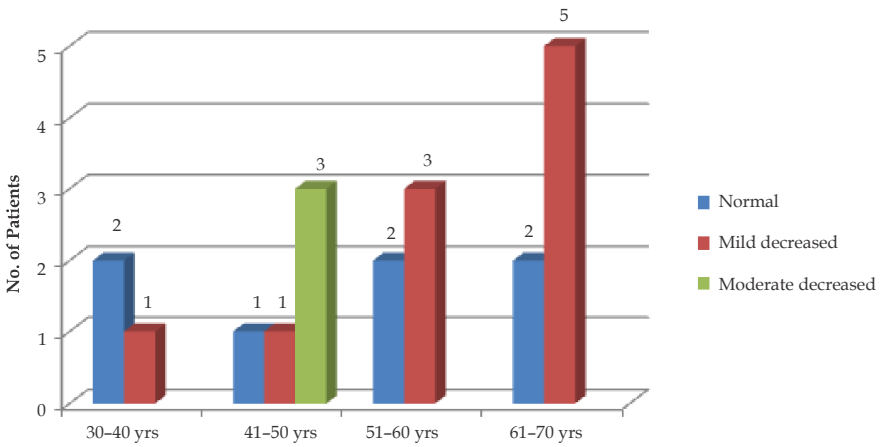

Fig. 16: Association of the Age and Chest Expansion of the Experimental Group After Using Incentive Spirometer.

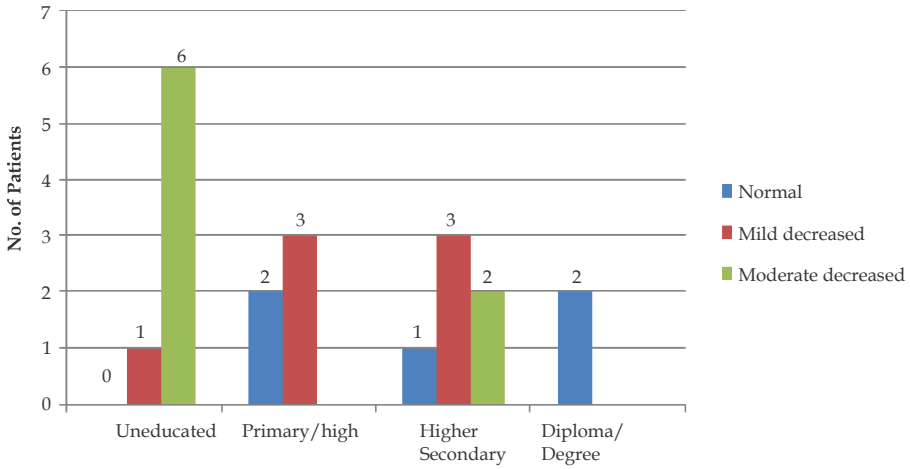

Fig. 17: Association of the Education and Chest Expansion of the Experimental Group After Using Incentive Spirometer.

Table 14 reveals that there is a statistically significant association with Breath holding time and education at the level of $p < 0.05$. Remaining variables such as age, sex, smoking, chronic exposure and duration of illness were not have significant association with breath holding time (Fig. 18).

Table 14: Association of the Selected Demographic Variables and the Breath Holding Time of the Experimental Group After Using incentive Spirometer

	Demographic Variables	Breath Holding Time			X^2 Value	Level of Significance
		Normal	Mildly Decreased	Moderate Decreased		
1	**Age (in years)**					
	(a) 30–40 yrs	3	0	0		
	(b) 41–50 yrs	2	2	1	6.58	$p = 0.36$#
	(c) 51–60 yrs	4	1	0		
	(d) 61–70 yrs	2	4	1		
2	**Sex**					
	(a) Male	9	3	1	3.07	$p = 0.21$#
	(b) Female	2	4	1		
3	**Education**					
	(a) Uneducated	2	4	1		
	(a) Primary/High School	4	1	0	12.3	$p < 0.05$*
	(c) Higher Secondary	3	2	1		
	(d) Degree/Diploma	2	0	0		
4	**Smoking**					
	(a) Yes	1	3	8	1.68	$p = 0.43$#
	(b) No	1	4	3		
5	**Chronic exposure**					
	(a) Chemicals/Paint	0	2	3		
	(b) Dust/Cotton	0	0	3	4.08	$p = 0.39$#
	(c) None	2	5	5		
6	**Duration of illness**					
	(a) 1–3 yrs	4	1	1		
	(b) 4–6 yrs	3	3	0	2.64	$p = 0.85$#
	(c) 7–9 yrs	3	2	1		
	(d) 10 yrs and above	1	1	0		

* = Significant

= Not significant

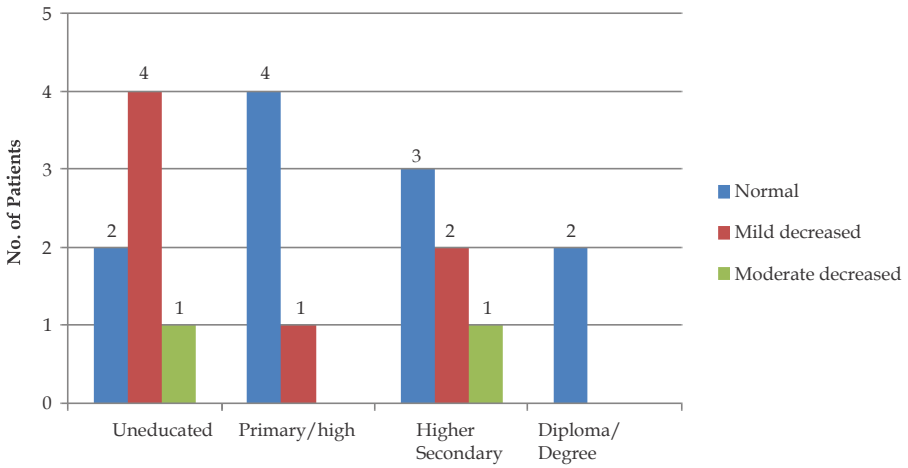

Fig. 18: Association of the Education and Breath Holding Time of the Experimental Group After Using Incentive Spirometer.

Discussion

The use of incentive spirometer for COPD patients is beneficial in reducing dyspnea and improving pulmonary functions. It prevents pulmonary problems by increasing ventilation to the dependent parts of the lungs by increasing inhaled lung volume. Incentive spirometer motivates the patient by visual feedback. It is inferred that there exist significant difference in pulmonary parameters ($p < 0.01$) and the level of dyspnea (t' value –10.65, $p < 0.01$) among COPD patients in experimental and control group. It is inferred that incentive spirometer is effective in improving pulmonary functions of COPD patients.

Discussion

A study was conducted among COPD patients with the aim to evaluate the effects of Incentive Spirometry on pulmonary function tests, arterial blood gases, dyspnoea and health-related quality of life in patients hospitalized for COPD. A total of 27 consecutive patients admitted for COPD exacerbations were recruited for the study. In total, 15 used IS for 2 months, together with medical treatment. The remaining 12 were given only medical treatment. Pulmonary function and blood gases were measured. Assessment of dyspnoea by visual analogue scale (VAS) and quality of life using the St. George's Respiratory Questionnaire (SGRQ) were performed at admission and after 2 months of treatment. The result showed that the activity, impact and total scores for the SGRQ improved (all $p = 0.0001$), $PaCO_2$ ≤ values decreased ($p = 0.02$), PaO_2 and PAO_2 values increased ($p = 0.02$ and $p = 0.01$, respectively) in the Incentive Spirometry treatment group. It proved that the use of Incentive Spirometry appears to improve arterial blood gases and health-related quality of life in patients with COPD exacerbations

Conclusion

The use of incentive spirometer for COPD patients is beneficial in reducing dyspnea and improving pulmonary functions. It prevents pulmonary problems by increasing ventilation to the dependent parts of the lungs by increasing inhaled lung volume. Incentive spirometer motivates the patient by visual feedback.

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