International
Journal of Medical and Exercise Science
(Multidisciplinary, Peer Reviewed and Indexed Journal)

ORIGINAL ARTICLE

COMPARATIVE STUDY ON THE EFFECT OF ACTIVE CYCLE OF BREATHING TECHNIQUE WITH ACAPELLA VS BUTEYKO BREATHING TECHNIQUE WITH ACAPELLA ON PEAK EXPIRATORY FLOW RATES AND FUNCTIONAL EXERCISE CAPACITY AMONG SUBJECTS WITH BRONCHIAL ASTHMA	Search engine: www.ijmaes.org

R. Fradeena Pertishila[1] , J R. Tejas Sri[2], S. Nagaraj[3]

Authors:

[2]Lecturer in Physiotherapy, Sri Lalithambigai Medical College and Hospital, Dr. M.G.R Educational and Research Institute, Chennai, India. Mail Id: tejassri0309@gmail.com

[3]Vice Principal, College of Physiotherapy, Jaya College of Para Medical Science, Chennai, TN, India.

Corresponding Author:

[1]Lecturer in Physiotherapy, Sri Lalithambigai Medical College and Hospital, Dr. M.G.R Educational and Research Institute, Chennai, TN, India, Mail Id: fradeena.physio@slmch.ac.in

ABSTRACT

Introduction: Asthma is a common and potentially serious chronic respiratory disease that affects the airways in the lungs. It is distinguished by reversible restriction of airflow. Objective of the study was to find the effect of Active Cycle of Breathing Technique with the adjunction of ACAPELLA on Peak Expiratory Flow Rates and Functional Exercise Capacity among subjects with bronchial asthma. To study the effect of BUTEYKO Breathing Technique with the adjunction of ACAPELLA on Peak Expiratory Flow Rates and Functional Exercise Capacity among subjects with bronchial asthma, also to compare the effect of ACBT with ACAPELLA versus BBT with ACAPELLA on Peak. **Methodology:** Total duration of the study 6 months and Individual treatment duration is 3days/week for 6 weeks. The subjects were selected by simple random sampling methods. Frequency Of Treatment was Treatment session - Both groups perform intervention for 30 minutes/session twice a day for 3days/week. Inclusion criteria were Confirmed diagnosis of Bronchial Asthma by the physician, Age group between 20 to 40 years of both Genders. ACT Total Score 16 - 24 (on target). Descriptive Statistics done to find Mean & Standard deviation for Continuous variables, namely Age, PEFR and 6MWT Score. Intra Group Analysis done by Paired Samples t-test, Inter Group Analysis – Independent Samples t-test. **Result:** The difference between two Treatments (A and B) in terms of average increase in PEFR is not statistically significant ($t = -0.12$, $p = 0.902 > 0.05$). Though, the mean increase in PEFR for Group B (52.00) is slightly greater than that of Group A (51.33), the difference in mean scores is not statistically significant. **Conclusion:** The study concluded that Treatment A (ACBT with ACAPELLA) is equally effective as Treatment B (BBT with Acapella) in terms of mean increase in PEFR and 6MWT.

Keywords: ACAPELLA, BUTEYKO, Breathing Technique, Bronchial asthma, Peak Expiratory Flow Rates

Received on 10th February 2026; Revised on 23rd February 2026; Accepted on 27th February 2026
DOI:10.36678/IJMAES.2026.V12I01.04

INTRODUCTION

Asthma is a common and potentially serious chronic respiratory disease that affects the airways in the lungs. It is distinguished by reversible restriction of airflow[1]. Breathing becomes challenging as a result of the inflammation and airway constriction it produces. Numerous things, such as allergens like pollen or dust mites, pollution, physical activity, stress, and respiratory diseases, can cause it. Immunoglobulin E binds to allergens in asthma and causes mast cells and basophils to release inflammatory mediators like histamine[2].

The airway inflammation in asthma leads to variable levels of lower airway obstruction that affects both the small and large airways. Recurrent airflow limitation is caused by bronchoconstriction, airway oedema, chronic mucus formation and airway remodelling. Airway hyper responsiveness is associated with airway inflammation and underlies the presentation of symptoms in asthma. Hyper responsiveness not only contributes the symptoms of bronchoconstriction and airflow limitations, but also has been shown to be associated with a decline in lung function (Kenneth P Hough., 2020) [3].

Coughing, wheezing, chest tightness, and shortness of breath are some of the symptoms of asthma. When someone has asthma, their airways repair and change as a result of ongoing inflammation. This process is known as airway remodelling. The thickness of the airway wall and the amount of mucus secreted are both impacted by the increase in mucus glands. the inflammatory secretions that encourage airway closure and raise surface tension. Collagen deposits cause the reticular basement membrane to thicken as well, which thickens the airways and exacerbates obstruction of the airways[4].

Asthma occurs at all ages but predominantly in early life that one half of the cases develop before age of 10 and another third occur before the age of 40. In childhood there is 2:1 male/female preponderance, but sex ratio equalizes by age 30. A chronic respiratory condition affecting millions of individuals worldwide is asthma. The World Health Organization (WHO) estimates that over 339 million people worldwide suffer from asthma, which causes over 400,000 deaths annually.

Active Cycle of Breathing Technique: Active Cycle Breathing Technique (ACBT) is the most routinely used technique for bronchial hygiene decreasing the rate of inflammation and infection and improving the lung functions by removing secretions [5].

The first phase which helps you relax the airways. The second phase which helps to get the air behind the mucus plugs. The third phase helps force the mucus out of the lungs. There is no equipment needed for ACBT. Compared to traditional chest therapy, ACBT is particularly successful in clearing bronchial secretions and is a simple technique to learn and put into practice [6].

Buteyko Breathing Technique (BBT): The goal of the Buteyko Breathing Technique is to control and reduce breathing in order to enhance overall health and wellbeing. It was created in the 1950s by Konstantin Buteyko, a Ukrainian physician, to aid patients suffering from asthma and it is based on the belief that asthma is caused by hyperventilation and hypocapnia [7]**.** This can be cured in most of the patients using Buteyko breathing techniques to reduce the minute ventilation (S Cooper et al., 2003). This method entails breathing through the nose slowly and shallowly, controlling the breath with the diaphragm,

and holding onto a tiny amount of air after exhaling. The objective is to raise blood levels of carbon dioxide and decrease hyperventilation, both of which can lessen asthmatic patients' symptoms of respiratory illnesses[8-9].

ACAPELLA: It works on Positive Expiratory Pressure Technique (PEP). The acapella is a hand held device causing an oscillatory positive expiratory pressure within the airways, has been proposed as an alternative to more conventional airway clearance techniques.

On performance comparison of two oscillating positive expiratory pressure device acapella vs flutter-the acapella offers advantages to some patients by virtue of its ability to generate OPEP at any angle (eg., with patient supine) and at very low expiratory flows. eg., in severe obstructive lung disease (Robert L Chatburn.,Feb 2003)

Peak Expiratory Flow Meter: The peak expiratory flow is one component of the flow volume manoeuvre. This has been encouraged by the availability of simple devices for its measurement. It also provides a tool for patient to use to monitor their Asthma objectively (Ma Lourdes-2004).

The normal Peak Expiratory Flow range for Indian adult males is 450-650L/min and 350-470L/min for Indian adult females respectively. The PEF equation for Indian adult population in LPM is: MALE = -1.807 (Age) + 3.206 (Height)., FEMALE = -1.454 (Age) + 2.368 (Height)**.**

The patient can identify early indicators of deteriorating asthma with the use of the meter's readings. Asthma Action Plan includes monitoring peak flow figures. PEFR is one of the important and widely used lung function test as it is reliable, easy and reproducible. PEFR is very sensitive and accurate index of airway obstruction and the strength of respiratory muscles. Peak flow rate is the most practical measure in out patients[10-12].

The National Asthma Education and Prevention program guidelines recommend home peak flow monitoring for all patients older than 5 years with moderate to severe asthma [13-15].

The Six Minute Walk Test was found to be reliable and construct valid in patients with bronchial asthma, which strengthens its clinical utility in asthma. (Roy Meys, 2021).

The Six Minute Walk Test is being utilised more often to assess functional ability in a range of patient populations. The 6 MWT is a self-paced test that gauges how far a patient can walk in six minutes on a flat path and the distance covered by the patient after 6 minutes is measured. It is used for assessing the prognosis and response to treatment in various respiratory conditions [16-18]. This test is becoming more and more popular because it is easy to administer, doesn't require complicated equipment.

American Thoracic Society was officially introduced 6MWT in 2002, along with a comprehensive guideline and it is a standard test for clinical pulmonary laboratories. Furthermore, compared to other walk tests, the 6MWT more accurately captures activities of daily life.

Individualized gender specific predicted value for 6 MWT. In Healthy Indian Population is MALE: 523.36 + 47.63, FEMALE: 470.61 + 37.22. Anthropometric variables (age, gender, weight, height and BMI) significantly corelated with 6MWT.

Asthma Control Test – It is reliable, valid and responsive to changes in asthma, control over time. A maximum score of 25 indicates Complete Asthma Control. Between 20-24 represents Well Controlled Asthma. While a score of 19 or below represents Not Well Controlled Asthma. A score less than 16 indicate Very Poorly Controlled Asthma.

Need of the Study: Many studies done till date focus on the treatment for Asthma but very few studies exist comparing breathing techniques with PEP device. Also, there is no study comparing the effect of these two Breathing Treatment Technique with ACAPELLA. Although the worldwide interest in the BUTEYKO method, there is a paucity of studies gathering evidence to support its use. Thus, this study will give an Evidence to improve Peak Expiratory Flow and Functional Exercise Capacity which in turn will improve breathing pattern with Bronchial Asthma.

Aim of the Study: To find and compare the effect of ACBT with Acapella versus BBT with Acapella on Peak Expiratory Flow Rates and Functional Exercise Capacity which was measured by Peak Expiratory Flow Meter and Six Minute Walk Test along with ACT (Asthma Control Test) Questionnaire among the patient with Bronchial Asthma.

Objective of the Study: To study the effect of Active Cycle of Breathing Technique with the adjunction of acapella on Peak Expiratory Flow Rates and Functional Exercise Capacity among patients with asthma. Study the effect of Buteyko Breathing Technique with the adjunction of acapella on Peak Expiratory Flow Rates and Functional Exercise Capacity among patients with asthma. Compare the effect of ACBT with Acapella versus BBT with Acapella on Peak Expiratory Flow Rates and also to find the Functional Exercise Capacity among asthmatic patients.

Design and Methodology

Materials Used

Cones, Stop watch, Measuring instrument (meters) , Acapella (OPEP) Blue and Green , Peak Expiratory Flow Meter , Pillow, Chair , Consent form, Assessment sheet, Six Minute Walk Test sheet , Asthma Control Test Questionnaire form, Sputum cup were used for the study.

METHODOLOGY

Study Design: This study is a pre-test and post- test experimental design comparative in nature.

Study Setting: The study was conducted in the clinical settings in and around Thiruninravur, Chennai.

Study Duration: Total duration of the study for 6 months and Individual treatment duration is 3days/week for 6 weeks.

Sample Methods: The subjects were selected by simple random sampling methods.

Subjects: A total of 30 subjects were selected at clinical settings, Thiruninravur in simple sampling method who fulfilled the inclusion and exclusion criteria and after collected data, the patients divided randomly into two experimental groups as Group A & Group B consisting of 15 patients each.

Study Method

Group A- Receives treatment with ACBT with Acapella

Group B- Receives treatment with BBT with Acapella

Frequency of Treatment

Treatment session - Both groups perform intervention for 30 minutes/session twice a day for 3days/week.

Criteria for Selection

Inclusion criteria

- Confirmed diagnosis of Bronchial Asthma by the physician.
- Age group between 20 to 40 years of both Gender.
- Patient who is on regular treatment (medication/ inhalers for bronchial asthma)
- Patient with minimum history of asthma for at least two years Patient who is willing to participate in the study.
- ACT Total Score 16 - 24 (on target).

Variables

Independent variables

- Active Cycle of Breathing Technique.
- Buteyko Breathing Technique
- Acapella (Positive Expiratory pressure technique).

Dependent variables:

Peak Expiratory Flow Rates and Functional Exercise Capacity (Six Minute Walk Test)

Outcome Measures:

- Peak Expiratory Flow Rate (PEFR)
- Six Minute Walk Test (FEC)

Parameters of the Study

- Peak Expiratory Flow Meter values
- Six Minute Walk Distance values

Procedure:

Orientation of the subjects: Before the treatment all the subjects were explained about this study and the procedure to be applied. They were asked to inform if they feel any discomfort during the course of study. Total of 30 subjects were selected for the study were based on the inclusion criteria, random, sampling techniques was used in the allocation of subjects into Group A & Group B.

Informed written consent was obtained from the subject. Asthma Control Test Questionnaire was given for all to answer all the questions regarding the frequency of asthma symptoms over past 4 weeks and the data were collected.

Pre –Test:

The primary outcome measures are the value of Peak Expiratory Flow Rates in Litres/Minute and Six Minute Walk Test values in Meters was measured before the commencement of the program (Day 1).

Post- Test:

The primary outcome measures are the value of Peak Expiratory Flow Rates in Litres/Minute and Six Minute Walk Test values in Meters was measured at the end of 6th week of the program.

Group A was treated with Active Cycle Breathing Technique with Acapella Group B

was treated with Buteyko Breathing Technique with Acapella.

ACAPELLA Device: (Both Group A & Group B)

Procedure:

Select the device (the acapella is available in two colour coded models). The green acapella (DH) is high frequency model for patients able to maintain an expiratory flow for 15 LPM or greater for three seconds. The blue acapella (DM) is low frequency model for patients not capable of maintaining an expiratory flow of 15 LPM for 3 seconds.

With the first use of the acapella, ensure that the frequency adjustment dial is turned counter - clockwise to the lowest frequency - resistance setting. Frequency/Resistance increase clockwise. Selecting the proper resistance range produces the desired I: E ratio 1:3 to 1:4. The patient performed the acapella between 1-5 dialled settings, or a setting that was tolerated by the patient.

Subjects were asked to seat in a comfortable position leaning forward with elbows supported on a table and neck slightly extended in order to open up the airway. The acapella was held horizontally and tilted slightly upwards in order to get maximal oscillatory effect and was place in the mouth.

Movement of the acapella upwards increases the pressure and frequency. While doing the procedure the patient must keep the cheeks flat and use the abdominal muscles effective exhalation. The vibration of the chest may be palpated by the patient to provide feedback. Inspiration was done through the nose. Place the mouth piece light in mouth; maintain a tight seal on the mouth piece during inspiration. Instruct the patient to relax and perform breathing control. Patient should inspire the volume of air greater than normal tidal volume but less than total lung capacity. Instruct the patient to slowly inhale ¾ maximum breathing capacities. Instruct the patient to hold breath 2-3 seconds. Direct the patient to exhale to functional residual capacity (FRC) actively, but not too forcefully through the device. Emphasize the importance of inhaling slowly, breath holding and suppressing the urge to cough. The patient should be able to exhale for 3-4 seconds while the device vibrates if the patient cannot maintain an exhalation for this length of time, adjust the dial clockwise.

Clockwise adjustment increases the resistance of the vibrating orifice, which will allow the patient to exhale at low flow rate. An each acapella session consists of 5 to 10 breaths followed by huffing.

Remove mouth piece and perform 2-3 “huffs” or “cough” to raise secretions as needed. Repeat the session 4-8 times for 10-15 minutes of treatment.

The inspiratory phase is followed by a slow prolonged exhalation. Device is not gravity dependent and can be performed easily. Device can be used in line with aerosol /nebulizer treatments. No care giver is needed once technique is mastered and independence promoted.

To avoid dizziness due to hyper ventilation, a patient should refrain from forced exhalation. It may be necessary to pause every 5 to 10 exhalations before resuming the session. At any point make sure the subject should not to inhale through the MOUTH.

Acapella Cleaning Instructions: There are four parts to the device and it comes out easily. Remove the mouth piece. Lift cover by pressing forefinger and thumb along ribbed surfaces by mouthpiece, it opens to a 90 Degree angle. Gently remove cover from base. Lift out rocker assembly which is white, this is one piece. You should now have four individual parts. Soak in warm soapy water. Rinse thoroughly. Air dry all 4 parts and does it not less than once weekly.

In the hospital the equipment should be sterilised according to infection control recommendations.

Frequency of Treatment:
30 minutes per session, twice a day, 3 days per week.
Treatment duration: 6 weeks.

Group A

(ACBT AND ACAPELLA): Active Cycle of Breathing Technique

The subjects (n=15) assigned to this group received Active Cycle of Breathing Technique**.**

Patient position: Sitting, lying or side lying.

Therapist position: Walk standing position.

Procedure: Active cycle of breathing technique can be performed in sitting, lying or side-lying positions. Initially, should start in a sitting position until comfortable and confident to try different ones. Extensive evidence supports its effectiveness in sitting or gravity assisted positions.

A minimum of five minutes in each productive position is recommended. The ACBT may be performed with or without an assistant providing vibration, percussion and shaking. Self-percussion/compression may be included by the patient.

(A) Breathing Control Technique:

The patient is asked to breathe in and out gently through nose if can. If not, breathe through mouth instead. Ask the patient to let go of any tension in body with each breath out and keep shoulders relaxed. Gradually make the breaths slower. The patient is asked to keep their palms on stomach to help to focus on breathing and to relax. Breathing control should continue until the person feels ready to progress to the other stages in the cycle.

(B) Thoracic expansion or deep breathing exercise:

The patient is asked to keep the chest and shoulders relaxed. The patient now takes a long, slow, deep breath in, through nose if can. At the end of the breath in, hold the air in lungs for 2-3 seconds before breathing out (this is known as an inspiratory hold). Breathe out gently and relaxed, like a sigh. Repeat 3 – 5 times. The patient is asked to keep their hands on ribs cage for feedback during thoracic expansion exercise or Deep Breathing Exercise. If the patient feels light headed then it is important that they revert back to the breathing control phase.

(C) Forced Expiratory Technique:

The patient is asked to Huff 1-2huffs where the secretions from smaller airways reach the larger airways and cough at different, controlled lengths to move mucus. This huffing should be repeated until all mucus has

been huffed out of the lungs followed by coughing to clear the secretions out.
Repeat the whole cycle for about 15-20 minutes until the chest feels clear.

Frequency of Treatment: 30 minutes per session, twice a day, 3 days per week.

Treatment Duration: 6 weeks.

Group B

(BBT AND ACAPELLA)

The subjects (n=15) assigned to this group received the designed Buteyko Breathing Technique.

Each patient was trained by Buteyko Breathing Technique 3 times a week for 15-20 minutes in a session for 6 weeks.

The time of the session was in the morning at least two hours after meals. Each patient performed the technique by themselves at home twice daily (in the morning and in the evening, at least two hours after the meals) during the time of the study.

The Buteyko technique involves periods of breath holding, known as 'control-pause' and interspersed with periods of 'shallow breathing or maximum pause'.

Steps in Buteyko breathing technique:

Step 1: "Control Pause" breathing:

The patient is asked to sit in an upright and relaxed position, by relaxing the shoulders and resting the back against the chair or comfortably on the floor.

Patient is asked to take the normal relaxed breath with closed eyes and focus on breathing without any change before taking control pause. Now the patient is asked to take a small breath in (2s) and a small breath out (3s) SLOW BREATHING for 2-3 minutes.

Hold the nose on the "out" breath, with empty lungs but not too empty. Holding the nose is necessary to prevent the air entering into the airways.

The patient is asked to count how many seconds that he or she can comfortably last by holding the nose before he or she needs to breathe in again. The patient is asked to hold the breath until he or she feels the first need (URGE OF AIR) to breathe in, and then is asked to release the nose and breathe in.

The control pause should not be more than 30 secs, this may lead to take a deep breath.

Step 2: Shallow Breathing

Shallow breathing phase – subject is instructed to take shallow breaths, only through nose, keeping the mouth shut for 4-5 minutes. Then after the exhalation, control pause test is repeated, and the time of control pause is recorded for any improvement.

The routine is repeated 10 -15 minutes in a row.

Frequency of Treatment: 30 minutes per session, twice a day, 3 days per week.

Treatment Duration: 6 weeks.

Outcome Measurement

Assessment Procedure: Before starting the intervention program for all subjects (n=30), they were asked to get PFM on their own and were measured using the Breath O Meter (cipla Ltd., India) with EU (European Union) scale and asked to record their highest number regularly twice a day over a period for two- weeks when asthma was under Good Control.

The highest number value marked as "PERSONAL BEST" peak flow.

A) Instructions Given To Use Peak Expiratory Flow Meter

1. Insert the mouth piece into the meter, if not already fitted. Ensure the pointer is set at zero (L/min).
2. Hold the PFM so that your fingers are clear of the scale and slot. Do not obstruct the holes at the end of the PFM.
3. Stand up if possible (or) sitting preferably, take a deep breath, place the peak flow meter in the mouth and hold horizontally, closing the lips around the mouth piece, then blow as hard and as fast as you can.
4. Note the number on the scale indicated by the pointer.
5. Return the pointer to zero (L/min) and repeat the procedure twice move to obtain three readings. Mark the highest of the three readings on your peak flow chart. The highest of these three readings is your daily peak flow.
6. Measure your peak flow rate close to the same time each day in morning and in the early evening. You should record the PEFR twice daily.
7. Do the test before taking any inhalers or as instructed by the healthcare provider.
8. Keep a chart of your PEFR.

Measurement: The best of three readings is used as the recorded value of the Peak Expiratory Flow Rate. Peak flow readings are often classified into 3 zones of measurement according to the American Lung Association. According to American Lung Association,

- Green zone represents 80-100 %of usual normal PEFR signals - All clear.
- Yellow zone represents 50-80% 0f usual or normal PEFR signals - Caution.
- Red zone indicates less than 50 % of usual or normal PEFR signals - Medical Alert.

B) The Six Minute Walking Test (6MWT): Walking is an activity perform daily by all individual except more severely impaired. Six

Minute Walk Test was administrated and adhered to the guidelines of American Thoracic Society standards. The subjects were given orientation to the test on the day. Each subject was instructed to walk as far as possible during a Six Minute period, in a long corridor 30meter walking course with 100 - ft hallway without any exercise equipment. The length of the corridor was marked every 3meter.The turnaround points was marked with a cone.

Subject was instructed to walk without running or jogging with their own intensity and was allowed to stop and rest during the test. The distance covered over a time period of 6 minutes is used as the outcome of Functional Exercise Capacity of an individual. Instructions and verbal encouragement given to the subjects every minute were

standardized. Reason for stopping the test (either subject fatigue perception, breathlessness, hemodynamic instability, chest pain, dizziness, leg cramps and fall were additional criteria for immediately stopping of the test were documented.

Before and after the Six Minute Walk Test the following data were obtained: the Pulse Rate, the Respiratory Rate, Blood Pressure and Dyspnoea by using Modified Borg's scale.

The readings were recorded.

Statistical Methodology

Descriptive Statistics of all measures – Group A :

Descriptive Statistics:

Mean & Standard deviation for Continuous variables, namely Age, PEFR and 6MWT Score. Frequency distribution of category variables, such as Gender

Inferential Statistics:

Intra Group Analysis – Paired Samples t-test
Inter Group Analysis – Independent Samples t-test

Data Analysis

Group A					
	Count	**Min**	**Max**	**Mean**	**SD**
Age	15.00	22.00	40.00	31.33	5.84
PEFR_Pre	15.00	250.00	500.00	378.00	85.37
6MWT_Pre	15.00	240.00	420.00	344.67	49.98
PEFR_Post	15.00	310.00	550.00	429.33	80.13
6MWT_Post	15.00	330.00	530.00	443.33	60.43

Table 1:

Descriptive Statistics of all measures – Group B

Group B					
	Count	**Min**	**Max**	**Mean**	**SD**
Age	15.00	21.00	40.00	31.33	6.23
PEFR_Pre	15.00	240.00	500.00	363.33	83.55
6MWT_Pre	15.00	270.00	420.00	351.33	42.91
PEFR_Post	15.00	300.00	540.00	415.33	77.17
6MWT_Post	15.00	360.00	530.00	441.33	46.12

Table 2:

Gender Distribution

Gender	Group A	Group B
Male	8 (53%)	8 (53%)
Female	7 (47%)	7 (47%)
Total	**15 (100%)**	**15 (100%)**

Table 3:

Two groups, Group A and Group B, underwent different treatments: Group A received Treatment A (ACBT along with Acapella), while Group B received Treatment B (BBT along with Acapella).

From the above descriptive statistics, it can be clearly seen that both groups comprised 15 participants each, with similar age distributions, averaging around 31 years old. The standard deviation of age was slightly higher in Group B compared to Group A.

Before treatment, Group A had a higher mean Peak Expiratory Flow Rate (PEFR_Pre) at 378.00 compared to Group B's 363.33. However, Group B had a slightly higher mean 6Minute Walk Test distance (6MWT_Pre) at 351.33 compared to Group A's 344.67.

After treatment, both groups showed improvements in PEFR (i.e., PEFR_Post) and 6MWT (i.e, 6MWT_Post) compared to their pre-treatment values. Group A had a higher mean PEFR_Post of 429.33 compared to Group B's 415.33. Similarly, Group A had a

higher mean 6MWT_Post of 443.33 compared to Group B's 441.33.

Regarding gender distribution, both groups had an equal split between male and female participants, with 53% male and 47% female in each group.

On the whole, both Treatment A and Treatment B, administered along with the Acapella device, showed improvements in pulmonary function and exercise capacity in participants. However, Group A tended to have slightly higher post-treatment values for both PEFR and 6MWT compared to Group B. However, further analysis is required to determine the significance of these differences and to evaluate the effectiveness of each treatment protocol. Hence, the significance of the change in the scores of both the outcome measures is tested and are shown in the Inferential Statistics presented in the next section.

Inferential Statistics: Intra-Group Analysis (Within Group Analysis) – Treatment A

Testing the effect of Treatment A in increasing the value of PEFR

Output of Paired t-test:

t-Test: Paired Two Sample for Means		
	A_PEFR_Pre	***A_PEFR_Post***
Mean	**378.00**	**429.33**
SD	**85.37**	**80.13**
Observations	15.00	15.00
df	14.00	
t Stat	**-17.67**	
P(T<=t) one-tail	**0.000**	

Table 4:

RESULT

The evidence is sufficient to conclude that there is significant effect of Treatment A in increasing the value of PEFR (t = -17.67, p = 0.000 < 0.05). In addition, the mean score of PEFR has increased from 378 to 429.33, which confirms that Treatment A is significantly effective in increasing the value of PEFR.

Testing the effect of Treatment A in increasing the value of 6MWT

Output of Paired t-test:

t-Test: Paired Two Sample for Means		
	A_6MWT_Pre	***A_6MWT_Post***
Mean	**344.67**	**443.33**
SD	**49.98**	**60.43**
Observations	15.00	15.00
df	14.00	
t Stat	**-13.18**	
P(T<=t) one-tail	**0.000**	

Table 5:

RESULT

The evidence is sufficient to conclude that there is significant effect of Treatment A in increasing the value of 6MWT (t = -13.18, p = 0.000 < 0.05). In addition, the mean score of 6MWT has increased from 344.67 to 443.33, which confirms that Treatment A is significantly effective in increasing the value of 6MWT.

Intra-Group Analysis (Within Group Analysis) – Treatment B

Testing the effect of Treatment B in increasing the value of PEFR

Output of Paired t-test:

t-Test: Paired Two Sample for Means		
	B_PEFR_Pre	***B_PEFR_Post***
Mean	**363.33**	**415.33**
SD	**83.55**	**77.17**
Observations	15.00	15.00
df	14.00	
t Stat	**-11.57**	
P(T<=t) one-tail	**0.000**	

Table 6:

RESULT

The evidence is sufficient to conclude that there is significant effect of Treatment B in increasing the value of PEFR ($t = -11.57$, $p = 0.000 < 0.05$). In addition, the mean score of PEFR has increased from 363.33 to 415.33, which confirms that Treatment B is significantly effective in increasing the value of PEFR.

Testing the effect of Treatment B in increasing the value of 6MWT

Output of Paired t-test:

t-Test: Paired Two Sample for Means		
	B_6MWT_Pre	***B_6MWT_Post***
Mean	**351.33**	**441.33**
SD	**42.91**	**46.12**
Observations	15.00	15.00
df	14.00	
t Stat	**-12.32**	
P(T<=t) one-tail	**0.000**	

Table 7:

RESULT

The evidence is sufficient to conclude that there is significant effect of Treatment B in increasing the value of 6MWT ($t = -12.32$, $p = 0.000 < 0.05$). In addition, the mean score of 6MWT has increased from 351.33 to 441.33, which confirms that Treatment B is significantly effective in increasing the value of 6MWT.

Inter-Group Analysis (Between Group Analysis)

Comparing the effects of Treatments A and B in terms of changes in the values of PEFR

Output of Independent Samples t-test:

t-Test: Two-Sample Assuming Equal Variances		
	A_PEFR_Diff	***B_PEFR_Diff***
Mean	**51.33**	**52.00**
SD	**11.25**	**17.40**
Observations	15.00	15.00
df	28.00	
t Stat	**-0.12**	
P(T<=t) two-tail	**0.902**	

Table 8:

RESULT

The difference between two Treatments (A and B) in terms of average increase in PEFR is not statistically significant (t = -0.12, p = 0.902 > 0.05). Though, the mean increase in PEFR for Group B (52.00) is slightly greater than that of Group A (51.33), the difference in mean scores is not statistically significant. Hence, the evidence is not sufficient to conclude that Treatment A (or B) is significantly effective than Treatment B (or A) in terms of mean increase in the values of PEFR.

Comparing the effects of Treatments A and B in terms of changes in the values of 6MWT

Output of Independent Samples t-test:

t-Test: Two-Sample Assuming Equal Variances		
	A_6MWT_Diff	***B_6MWT_Diff***
Mean	**98.67**	**90.00**
SD	**29.00**	**28.28**
Observations	15.00	15.00
df	28.00	
t Stat	**0.83**	
P(T<=t) two-tail	**0.414**	

Table 9:

RESULT

The difference between two Treatments (A and B) in terms of average increase in PEFR is not statistically significant (t = -0.12, p = 0.902 > 0.05). Though, the mean increase in PEFR for Group B (52.00) is slightly greater than that of Group A (51.33), the difference in mean scores is not statistically significant. Hence, the evidence is not sufficient to conclude that Treatment A (or B) is significantly effective than Treatment B (or A) in terms of mean increase in the values of PEFR.

The difference between two Treatments (A and B) in terms of average increase in 6MWT is not statistically significant (t = 0.83, p = 0.414 > 0.05). Though, the mean increase in 6MWT for Group A (98.67) is slightly greater than that of Group B (90.00), the difference in mean scores is not statistically significant. Hence, the evidence is not sufficient to conclude that Treatment A (or B) is significantly effective than Treatment B (or A) in terms of mean increase in the values of 6MWT.

Conclusion: The intra-group analysis showed that both Treatment A and Treatment B are significantly effective in increasing the values of PEFR and 6MWT scores. However, the intergroup analysis compared the two treatment groups in terms of changes in both the outcome measures and the corresponding result showed that Treatment A is not significantly different from that of Treatment B in terms of mean increase in PEFR and 6MWT scores.

Hence, we conclude that Treatment A (ACBT along with Acapella device) is equally effective as Treatment B (BBT along with Acapella device) in terms of mean increase in PEFR and 6MWT.

DISCUSSION

In this study to compare the effect of ACBT with Acapella versus BBT with Acapella on Peak Expiratory Flow Rates and Functional Exercise Capacity which was measured by Peak Expiratory Flow Meter and Six Minute Walk Test along with ACT (Asthma Control Test) Questionnaire among the Ssubject with Bronchial Asthma[20-24].

Before the treatment all the subjects were explained about this study and the procedure to be applied. They were asked to inform if they feel any discomfort during the course of study. Total of 30 subjects were selected for the study were based on the inclusion criteria. Random, sampling techniques was used in the allocation of subjects into Group A & Group B. Informed written consent was obtained from the subject. Asthma Control Test Questionnaire was given for all to answer all the questions regarding the frequency of asthma symptoms over past 4 weeks and the data were collected [25-27].

Group A- Receives treatment with ACBT with ACAPELLA and Group B- Receives treatment with BBT with ACAPELLA

PRE -TEST

The primary outcome measures are the value of Peak Expiratory Flow Rates and Six Minute Walk Test values in meters was measured before the commencement of the program (Day1).

POST- TEST

The primary outcome measures are the value of Peak Expiratory Flow Rates and Six Minute Walk Test values in meters was measured at the end of 6th week of the program.

Testing the Effect of (Treatment A) In Increasing the Value of PEFR

The evidence is sufficient to conclude that there is significant effect of Treatment A in increasing the value of PEFR ($t = -17.67$, $p = 0.000 < 0.05$). In addition, the mean score of PEFR has increased from 378 to 429.33, which confirms that Treatment A is significantly effective in increasing the value of PEFR.

Julvainda Eka Priya Utama (2020) Stated that the ACBT increase Peak Expiratory Flow Rate In asthma patients. The PEFR expected to be evaluate simultaneously, to assess the stages of improvement for asthma patients.

Mohammed Shamakh (2020)– Japer.in: Stated that the study was conducted randomly classified into three equal groups. Group A received ACBT. Group B and C received ACBT and Acapella respectively. Outcome measures were measures after 6 months of self-management at home. They concluded that ACBT alone showed lesser improvement than ACBT with Acapella PEP device.

Testing the Effect of (Treatment A) In Increasing the Value of 6MWT

The evidence is sufficient to conclude that there is significant effect of Treatment A in increasing the value of 6MWT ($t = -13.18$, $p = 0.000 < 0.05$). In addition, the mean score of 6MWT has increased from 344.67 to 443.33, which confirms that Treatment A is significantly effective in increasing the value of 6MWT.

Sundus S, Memoona S.,(2017)Stated that the Active Cycle Of Breathing Technique is very beneficial intervention for improving quality of life and Functional Capacity Using Six Minute Walk Test of patient with mild to moderate Asthma The study was cohort design included 38 patients mean age [41.131$\pm$ 14.711] of both genders with mild to moderate asthma.

In The Intra-Group Analysis (Within Group Analysis) – Group B

Testing the Effect of (Treatment B) In Increasing the Value of PEFR

The evidence is sufficient to conclude that there is significant effect of Treatment B in increasing the value of PEFR ($t = -11.57$, $p = 0.000 < 0.05$). In addition, the mean score of PEFR has increased from 363.33 to 415.33, which confirms that Treatment B is significantly effective in increasing the value of PEFR.

Mistry PB, Palkar A., (2021) conducted an experimental study on a total of 30 carpenters among the age group of 35 to 45 years was included in the study. Peak Expiratory Flow was taken before giving BBT for four weeks, 2 sessions per week. The difference of pre and post PEFR was then calculated and the data was statistically analysed using paired T-Test. The study concluded that Buteyko Breathing Techniques helps to improve PEFR.

In The Intra-Group Analysis (Within Group Analysis) – Group B

Testing the Effect of (Treatment B) In Increasing the Value of 6mwt

The evidence is sufficient to conclude that there is significant effect of Treatment B in increasing the value of 6MWT (t = -12.32, p = 0.000 < 0.05). In addition, the mean score of 6MWT has increased from 351.33 to 441.33, which confirms that Treatment B is significantly effective in increasing the value of 6MWT.

Jai Bondre, DR. Pallavi Chicholikar (2023), The experimental study was conducted on 28 subjects. The BBT explained to the participants, pre and post outcome measure of Six Minute Walk Test was noted. In this study participants between the age group 25 to 35 years are 38 participants and between the age group 36 to 45 years are 63 participants. After conducting this study, it was recorded that walking distance of individual in 6MWT improved from 392.14+/-71.80M to 469.28+/-72.76M after Buteyko Breathing Technique.

Inter-Group Analysis (Between Group Analysis)

Comparing the Effects of Treatment A and B In Terms Of Changes

In The Values of PEFR

In this study the difference between two Treatments (A and B) in terms of average increase in PEFR is not statistically significant (t = -0.12, p = 0.902 > 0.05). Though, the mean increase in PEFR for Group B (52.00) is slightly greater than that of Group A (51.33), the difference in mean scores is not statistically significant. Hence, the evidence is not sufficient to conclude that Treatment A (or B) is significantly effective than Treatment B (or A) in terms of mean increase in the values of PEFR.

Andrea Herrena-Sanchez et.al (2019) stated that the Peak Flow Meter has got greater sensitivity in airway obstructions and it is useful in the diagnostic of asthma and it measures the PEFR with reversibility of >20% suggest asthma. The PEF showed higher specificity with FEV1 <59%.

Aside from lifestyle modifications like avoiding triggers and leading a healthy lifestyle, complementary therapies include breathing training programmes, active cycle breathing techniques, Buteyko breathing techniques, and more can be effective in improving patient reported outcomes such as symptoms, QoL and may reduce the use of rescue broncho dilator medication in asthmatics.

Current Devices seem to be effective in terms of mucous expectoration and pulmonary function improvement[28-30]. These days, bronchial asthmatic patients are also advised to use devices. The Oscillatory Positive Expiratory Pressure device plays an important role in bronchial hygiene, which consists of a mechanical oscillatory device called the Acapella. On performance comparison of two Oscillating Positive Expiratory Pressure device Acapella Vs Flutter-The Acapella offers advantages to some patients by virtue of its ability to generate PEP at any angle (eg., with patient supine) and at very low expiratory flows[31].

Inter-Group Analysis (Between Group Analysis)

Comparing the Effects of Treatment A and B In Terms Of Changes in the Values of 6mwt

In this study the difference between two Treatments (A and B) in terms of average increase in 6MWT is not statistically significant ($t = 0.83$, $p = 0.414 > 0.05$). Though, the mean increase in 6MWT for Group A (98.67) is slightly greater than that of Group B (90.00), the difference in mean scores is not statistically significant.

Hence, the evidence is not sufficient to conclude that Treatment A (or B) is significantly effective than Treatment B (or A) in terms of mean increase in the values of 6MWT.

The Six Minute Walk Test was found to be reliable and construct valid in patients with bronchial asthma, which strengthens its clinical utility in asthma**.** The Six Minute Walk Test is being utilised more often to assess Functional Capacity in a range of patient populations. The ACT score is significantly improved after the treatment given for both groups.

ML Jinsibin **(**Cherraan's Institute of Health Sciences Coimbatore, Tamilnadu, India. May2018) conducted a comparative study with ACBT Versus BBT among asthmatic patients and concluded that Buteyko Breathing Technique is effective than Active Cycle of Breathing with an outcome measures of PEFR and Modified Borg's Dyspnoea Scale.

Hence, this study is conducted by using PEP (Acapella) device with two breathing techniques and statistically analysed and concluded that Treatment A (ACBT with Acapella) is equally effective as Treatment B (BBT with Acapella) in terms of mean increase in PEFR and 6MWT.

Limitations: The sample size was limited. The study was limited with the specific age group 20 to 40years. The study was of short duration. No long term follow up of patient. Frequency of attacks was not recorded. It was not able to assess the other psychological aspects of the patients.

Recommendations: The feature studies need to be done with larger group and long term follow up. The feature studies need to be done with children and elderly population.

The study can be done on age and gender specific individuals. The Study can be conducted by using different outcome measures like Forced Expiratory Volume in One Second and Forced Vital Capacity and partial pressure of oxygen and carbon di oxide to evaluate the reliability of Acapella in improving pulmonary function of patients with bronchial asthma which could be measured by computerized Pulmonary Function Test.

CONCLUSION

The intra-group analysis showed that both Treatment A and Treatment B are significantly effective in increasing the values of PEFR and 6MWT scores. However, the intergroup analysis compared the two treatment groups in terms of changes in both the outcome measures and the corresponding result showed that Treatment A is not significantly different from that of Treatment B in terms of mean increase in PEFR and 6MWT scores.

REFERENCES

1. Sheetusingh, Suddeep salvi, 2020 (prevalence time trends and treatment practices of Asthma in India, The Global Asthma network study) ERJ OPEN RES 2022 April, 8(2):00528-2021
2. Bruton A and Thompson N. 2011(The role of breathing training in asthma Management) curr opin allergy clinimmunol., 11(1): 53-7
3. Megh.V.Chavdaa and Hetshri M Shah 2016 (To compare the efficacy of pursed lip breathing and BBT to reduce the symptoms of exercise induced Asthma in obese children) International Journal of current research 1018,PP 35058-35064, July 2016
4. Scooper et al 2003-Effect of two breathing exercise in asthma (Buteyko breathing technique and Pranayama) RCT Thorax 58:674-679
5. Ammani Prasad(2008) Robert L cowie, diane P, 2008- (A RCT of BBT as an adjunct to conventional management of Asthma). Resp. Medicine 102:726-736
6. Jenifer A Prayor and Ammani Prasad 2008 (PT for respiratory and cardiac problem adult and pediatrics 4th edition)
7. Katrin Vagedas, Silja kuderer, Rainer Ehmann, Matthias Kohl, Jan Vagedas, (Effect of BBT on Clinical and functional parameters in adult patient with Asthma) European Journal of medical research Vol.29, Article no:42(11 Jan 2024)
8. Yosreah Mohamed, Sabah ELderiny, Dr. Lobns Ibrahim, Tanta, Egypt (The effect of BBT among patients with bronchial Asthma) [published on 5.6.2019) JMNP 2019; 2(2): 0110
9. Dupler Hassan (2012).“Effect of Buteyko breathing technique on patients with bronchial asthma”. Egyptian Journal of Chest Diseases and Tuberculosis, 61, 235–241
10. Mistry PB, Palkar A, Kumar A., 2021 (The effect of Buteyko Breathing technique on peak expiratory flow rate in carpenters) Int J health Sci res.2021;11(6):47-51
11. Pryor JA, Webber BA, Hodson ME. Effect of chest physiotherapy on oxygen saturation in patients with cystic fibrosis. Thorax 1994; 45: 77
12. Bipin puneet et al.,(2012)Impact of ACBT on the management of functional capacity in patients with obstructive lung disease. Jospt 2012 sep 9
13. Lewis LK, Williams MT, Olds TS. The active cycle of breathing technique: A systematic review and meta-analysis. Respiratory medicine. 2012 Feb 1;106(2):155-72.
24. 23.Shereen Hamed elsayed et al.,(2015) the effect of active cycle of breathing technique on patients with COPD International journal of respiratory medicine.
25. CS Thompson et al.,(2015)the effectiveness of active cycle of breathing technique and flutter device in asthma. Turkish journal of cardiorespiratory2015:25:110-5.
26. Sundus S; Memoona S Allama Iqbal medical college (effect of ACBT in adult asthma patient in Pakistan) Vol 1 no1(2017)
27. Patterson JE, Bradley JM, Hewitt O, Bradbury I, Elborn JS. Airway clearance in bronchiectasis: A randomized crossover trial of active cycle of breathing techniques versus Acapella®. Respiration. 2005;72(3):239-42.
28. A Hristara – Papadopoulou, JTsanakas G Diomou (current devices of respiratory

Physiotherapy) hippo kratia OCT-DEC2008, 12(4): 211-220

29. Alves CE, Nunes LQ, and Melo PL: Mechanical Analysis of an Oscillatory Positive Expiratory Pressure Device used in respiratory Rehab, conf Proc IEEE eng Med Biol Soc. 2010; 2477-80.
30. Robert L Chatburn.,T A Volsko, 2003, On performance comparison of two oscillating positive expiratory pressure device acapella vs flutter ., Respiratory care 48 (2),124-130,2003
31. Mohammed Shamakh, Nagwa Badr(Acapella VS hand held PEP on pulmonary functions in management of COPD) JADV. Pharm EDUC.RES.2020; 10(2): 27-34

R. Fradeena Pertishila , J R. Tejas Sri, S. Nagaraj (2026) Comparative Study on The Effect of Active Cycle of Breathing Technique With ACAPELLA Vs BUTEYKO Breathing Technique With ACAPELLA On Peak Expiratory Flow Rates And Functional Exercise Capacity Among Subjects With Bronchial Asthma, ijmaes; 12(1); 2749-2768.