



Comparative Effectiveness of Buteyko Breathing Technique and Pranayama (Yoga Breathing) on Pulmonary Function, Asthma Control, Quality of Life, and Biomarkers in Patients with Bronchial Asthma

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Abstract:

Introduction: A Comparative study was conducted to determine the effectiveness of Buteyko breathing technique Vs Pranayama (Yoga Breathing) on Pulmonary function, asthma control and Quality of Life of among patient with Bronchial asthma. **Design:** Quasi experimental research, design was used in this study. **Material and Methods:** Bronchial asthma patients who fulfills the inclusion criteria, sample size is (n=40) was divided into three groups, assigned to the Experimental group I (Buteyko group n=40), Experimental group II (Pranayama group n=40), Control group n=40. The pre test was conducted for the all three groups, Pulmonary Function test in form of Forced Vital Capacity (FVC), Forced Expiratory Volume in 1 second (FEV1), FVC/FEV1 ratio, Total count, Eosinophil count, IgE and Asthma control and Quality of life of asthma patients also assessed. Then the Experimental group I was taught with Buteyko breathing and Experimental Group II was taught with Pranayama . Control group was given hospital routine treatment for 12 weeks. Post test 1 and post 2 was conducted in 8th week and 12th week. The results were analyzed by parametric and non parametric statistical methods were used. SigmaPlot 14.5 version (Systat Software Inc., San Jose, USA) was used for statistical analysis. **Conclusion:** Buteyko breathing technique and Pranayama showed a significant improvement in

pulmonary Functions, Decrease in Eosinophils and IgE significant decrease in Asthma symptoms, improvement in Quality of life. Comparing Pranayama Buteyko Breathing technique showed statistical significance ($P < 0.001$)

Key words:

Buteyko breathing technique, Pranayama, FVC, FEV1, IgE

Introduction:

Asthma is a chronic respiratory disease that affects the airways in the lungs. It causes inflammation and narrowing of the airways, which makes it difficult to breathe. Asthma symptoms can include coughing, wheezing, chest tightness, and shortness of breath. While there is no cure for asthma, it can be managed with proper treatment and care. Treatment typically involves medications such as inhalers or nebulizers, as well as lifestyle changes like avoiding triggers and maintaining a healthy lifestyle. Asthma is characterized by inflammation and narrowing of the airways, which makes it difficult to breathe. It can be triggered by a variety of factors, including allergens like pollen or dust mites, pollution, exercise, stress, and respiratory infections. The good news is that asthma can be managed with proper treatment and care. This typically involves medications such as inhalers or nebulizers, as well as lifestyle changes like avoiding triggers and maintaining a healthy lifestyle.

Asthma is a chronic respiratory disease that affects millions of people worldwide. According to the World Health Organization (WHO), it is estimated that over 339 million people have asthma, and it is responsible for over 400,000 deaths each year¹. Asthma is more common in developed countries and urban areas, but it is a growing problem in developing countries². In the United States, around 25 million people have asthma, including 7 million children³. The prevalence of asthma in Tamil Nadu is estimated to be around 11.2% among adults and 9.4% among children⁴. Asthma is responsible for a significant burden of morbidity and mortality in Tamil Nadu, with an estimated 2,000 deaths annually⁵. Asthma had a significant impact on physical and emotional well-being, daily activities, and social interactions⁶. A study published in the *Journal of Asthma and Allergy* in 2020 found that patients with uncontrolled asthma had significantly lower quality of life scores compared to those with controlled asthma⁷. *European Respiratory Journal* in 2020 found that patients with severe asthma had worse quality of life compared to those with non-severe asthma, and those psychological factors such as anxiety and depression played a significant role in the impact of asthma on quality of life⁸. Asthma can be diagnosed as Pulmonary function tests, such as spirometry, can help diagnose asthma by assessing lung function and detecting obstructive patterns in breathing and Pulmonary function tests can help assess the severity of asthma by measuring lung function and determining the degree of airway obstruction⁹. IgE and eosinophils play important roles in the pathophysiology of asthma. IgE - Immunoglobulin E (IgE) is an antibody that plays a key role in the allergic

response. In asthma, IgE binds to allergens and triggers the release of inflammatory mediators, such as histamine, from mast cells and basophils. This inflammation leads to airway hyperresponsiveness and broncho constriction, which can cause asthma symptoms. 2. Eosinophils - Eosinophils are a type of white blood cell that play a role in the immune response to parasitic infections and allergic reactions¹⁰. Complimentary therapy and Alternative medicines plays major role in Asthma control along with treatment. The complimentary therapies includes Breathing techniques, Yoga in form of Pranayama, Buteyko breathing technique etc.

Buteyko breathing exercise is a technique that focuses on controlling and reducing breathing to improve health and well-being. It was developed by a Ukrainian medical doctor, Konstantin Buteyko, in the 1950s as a way to help people with respiratory disorders, such as asthma and chronic obstructive pulmonary disease (COPD)¹¹. The technique involves breathing slowly and shallowly through the nose, using the diaphragm to control the breath and maintaining a small amount of air in the lungs after exhaling. The aim is to reduce hyperventilation and increase carbon dioxide levels in the blood, which can help to reduce symptoms of respiratory disorders¹². Buteyko breathing exercise is often used as a complementary therapy alongside other treatments for respiratory disorders, such as medication and pulmonary rehabilitation. It has also been found to have benefits for stress reduction, anxiety, and sleep quality. The Buteyko breathing technique is a method of controlled breathing that is often used as a complementary therapy for respiratory disorders such as asthma and chronic obstructive pulmonary disease (COPD). The technique involves breathing slowly and shallowly through the nose, using the diaphragm to control the breath, and maintaining a small amount of air in the lungs after exhaling. The goal is to reduce hyperventilation and increase carbon dioxide levels in the blood, which can help to reduce symptoms of respiratory disorders.

Pranayama is a Sanskrit word that translates to "breath control" or "extension of the life force". It is a technique used in yoga that involves controlled breathing practices. Pranayama techniques aim to regulate the breath, enhance lung function, and improve overall health and well-being. Pranayama techniques involve various breathing patterns and rhythms, such as deep breathing, alternate nostril breathing, and bhramari (humming bee) breath. These techniques are often practiced in combination with other yoga practices, such as meditation and physical postures. Pranayama has gained attention as a potential complementary therapy for respiratory disorders, such as asthma and chronic obstructive pulmonary disease (COPD), due to its ability to improve respiratory muscle function stress, and improve lung function. It has also been found to have benefits for reducing anxiety, promoting relaxation, and improving overall mental and physical health. Pranayama is traditionally taught under the guidance of a skilled yoga teacher and can be adapted to suit individual needs and abilities. It is generally considered a safe and effective practice, but should be practiced with caution by those with certain health conditions or medical concerns. While more research is needed to fully understand the benefits of pranayama, it is a simple and accessible technique that can be helpful for anyone looking to improve their breathing and overall health and well-being.

Pranayama is a breathing technique used in yoga that involves controlled breathing practices. It has gained attention as a potential complementary therapy for asthma due to its ability to improve respiratory muscle function, reduce stress, and improve lung function. A study published in the *Journal of Ayurveda and Integrative Medicine* in 2021 found that pranayama was effective in improving lung function, reducing asthma symptoms, and reducing the need for medication in patients with asthma¹³. Another study published in the *Journal of Asthma* in 2019 found that pranayama was effective in reducing asthma symptoms and improving quality of life in patients with asthma¹⁴.

Comparative studies have been conducted on the effectiveness of Buteyko breathing exercises and Pranayama in managing asthma symptoms. Buteyko breathing exercises focus on reducing hyperventilation and increasing carbon dioxide levels in the body, while Pranayama involves different breathing techniques aimed at improving lung function. Buteyko breathing exercises and Pranayama have been shown to be effective in managing asthma symptoms.

OBJECTIVES:

- To assess the pre test level of biophysiological parameters and biochemical markers among patient with bronchial asthma in Both Groups.
- To determine the effectiveness of Buteyko breathing technique on biophysiological and biochemical parameters among patient with bronchial asthma in Beutyko Group.
- To determine the effectiveness of Pranayama(Yoga Breathing) on biophysiological and biochemical parameters among patient with bronchial asthma in Pranayama Group.
- To assess the post test level of biophysiological and biochemical parameters among patient with bronchial asthma in Both Groups.
- To compare the effectiveness of Buteyko breathing technique Vs Pranayama(Yoga Breathing) on biophysiological and biochemical markers between the groups.
- To associate the demographic variable and the post test level of the biophysiological and biochemical parameters among patient with bronchial asthma in Beutyko Group.

Materials and Methods:

Recruitment and Participants:

A Comparative study was directed to decide the viability of Buteyko breathing procedure Versus Pranayama. This study utilized a quasi-experimental design. After getting formal consent, from Patient with bronchial asthma who were enlisted from the short term facility of a Saveetha Medical college and Hospital, Thandalam. Using the convenience sampling method, 120 patients

with bronchial asthma who met the inclusion criteria were divided into three groups: the Experimental group I (n=40), the Experimental group II (n=40), and the control group (n=40). The pre test was conducted on the following, Pulmonary Function Tests are Forced Vital Capacity(FVC), Forced Expiratory Volume in 1 minute (FEV1) and the Ratio of FVC/FEV1. Inflammatory Markers like Eosinophil count, Total Count, IgE, and Asthma Control and Quality of Life of Asthma Patients were also evaluated for each of the three groups. The Experimental group I practiced Buteyko breathing, while the Experimental group II practiced Pranayama (Yoga breathing) for 20-30 minutes per day for 12 weeks. The control group received standard hospital care. The Post test I & II was conducted in 8th and 12th week.

Inclusion Criteria:

1. Patients 20-60 years of age suffering from Bronchial asthma and confirmed diagnosis of bronchial asthma.
2. Patients who is on regular treatment (Medication, Inhalers) for Bronchial asthma
3. Patients who is willing to participate in the study

Exclusion Criteria:

1. Patients those who were practicing Buteyko Breathing Technique.
2. Patient already trained in Pranayama(Yoga Breathing)
3. Patients with Mental illness.
4. Patients with acute problem (cardio –pulmonary problem, Rib Fracture)
5. Antenatal mothers.
6. Chronic Asthmatic patients(>10yrs) excluded in the study

Interventions: The patients were assigned using a method known as non-probability convenience sampling. Experimental Group I practiced Buteyko breathing technique, Experimental group II practiced Pranayama (Yoga breathing), which were both conveyed by a trained researcher.

Steps of buteyko breathing technique:

Buteyko breathing technique is a therapeutic method aimed at reducing hyperventilation and increasing carbon dioxide levels in the body. It involves a series of breathing exercises that can be used to improve various respiratory conditions, including asthma¹⁸.

- Nasal Breathing
- Breath Holding
- Relaxation

1. When practicing Buteyko breathing, the first thing to remember is to breathe shallowly and controlled. Air should not be sucked in like your last breath; rather, it should be a gentle rhythm of breathing in and out.
2. Buteyko breathing necessitates breathing into the diaphragm, or stomach, rather than the chest, so keep the mouth shut at all times. Make sure to breathe extremely slowly when you do so.
3. Maintain an upright position while sitting and take shallow breaths for approximately two to three minutes. Keep in mind to inhale fully and not in short bursts.
4. Pinch your nose shut and stop breathing (control pause) until you feel the urge to breathe after 2-3 minutes of getting the exhaling part of your breath.

PRANAYAMA'S STEPS:

Pranayama is a type of yoga breathing technique that involves various breathing exercises aimed at improving physical, mental, and emotional health.

Pranayama includes,

- Nadishodana,
- Kapalbhatai,
- Bhastrica

Sit in a comfortable and upright position with your spine straight and shoulders relaxed¹⁹.

1. Close your eyes and take a few deep breaths through your nose, focusing on the sensation of the breath moving in and out of your body.
2. Begin with a few rounds of deep breathing, inhaling deeply through your nose and exhaling slowly through your mouth.
3. Next, practice alternate nostril breathing, also known as Nadi Shodhana. Place your right thumb over your right nostril, inhale deeply through your left nostril, then close your left nostril with your ring finger and exhale through your right nostril. Inhale through your right nostril, close it with your thumb, then exhale through your left nostril. Repeat the cycle, alternating nostrils with each inhalation and exhalation.
4. You can also practice Kapalabhati, a breathing technique that involves rapid and forceful exhalations through the nose. To practice Kapalabhati, sit in a comfortable position with your eyes closed and your hands resting on your knees. Take a deep breath in, then forcefully exhale through your nose, using your abdominal muscles to push the air out. Inhale passively and repeat the exhalations for several cycles.

5. Bhastrica can be practiced Take a profound inhale and extend the midsection as relax. Breathe out strongly and take in another inhale with force, Do however many as could be expected under the circumstances without pushing excessively hard
6. End pranayama practice with a few rounds of deep breathing, inhaling through your nose and exhaling through your mouth

Outcome Measures:

The primary outcome measures were Pulmonary function(Forced Vital Capacity(FVC) Forced Expiratory Volume in 1 minute(FEV1), and FVC/FEV1 ratio, physiological parameters like, Heart rate, Blood pressure, Respiratory Rate, Saturation of Oxygen, Bio chemical parameters like complete Blood count, Eosinophil Count, Absolute eosinophil count, IgE. Asthma symptoms, as measured by the Asthma Control Test (ACT). Quality of life of Asthma patients as measured by the Asthma Quality of Life Questionnaire (AQLQ),

Data Analysis:

The data are represented as mean + SEM and analysed by two-way repeated measures analysis of variance (RM ANOVA) for one factor repetition, and Bonferroni ‘t’ test for post hoc multiple comparisons. Factor A, was groups (between group comparison – Control, Buteyko and Pranayama), Factor B, was tests (within group comparison i.e., repetition factor – Pre-test, Post-test 1 and Post-test 2) and the group X test interaction. A probability of 0.05 and less was considered as statistically significant. SigmaPlot 14.5 version (Systat Software Inc., San Jose, USA) was used for statistical analysis.

Ethical Considerations:

The study was conducted in accordance with and was approved by the institutional ethics committee (No.004/09/2021/IEC/ SMCH) Informed consent was obtained from all participants before enrollment in the study.

Results:

S.No.	Parameter	Category	Control	Buteyko	Pranayama	Statistics
1	Gender	Male	20	21	18	$\chi^2 = 0.467$ P = 0.792
		Female	20	19	22	
2	Age (years)	< 30	6	4	6	$\chi^2 = 1.546$ P = 0.956
		31 – 40	9	11	11	
		41 – 50	16	17	13	
		> 51	9	8	10	
3	Occupation	Unskilled/skilled	22	18	20	$\chi^2 = 1.089$

		Clerical/Office	12	13	13	P = 0.896
		Professional	6	9	7	
4	Residence	Urban	5	5	9	$\chi^2 = 2.200$ P = 0.699
		Semiurban	19	20	16	
		Rural	16	15	15	
5	Family history of asthma	Yes	10	7	7	$\chi^2 = 0.938$ P = 0.626
		No	30	33	33	
6	Habit of smoking	Yes	8	11	10	$\chi^2 = 0.637$ P = 0.727
		No	32	29	30	
7	Duration of asthma	< 3 years	14	25	21	$\chi^2 = 6.200$ P = 0.045
		> 4 years	26	15	19	
n = 40 each						

Table 2: Comparison of control and experimental groups on pulmonary function test by two-way RM ANOVA with Bonferroni 't' test.

S.No	Groups and comparisons	Tests	FVC	FEV 1	FVC/FEV 1
1	Control group	Pre-test	4.750±0.9	5.750±0.8	1.150±0.4
	Experimental group I (Buteyko group)	Pre-test	3.575±0.8	6.125±0.7	3.075±0.7
	Experimental group II (Pranayama group)	Pre-test	1.950±0.5	2.625±0.5	1.450±0.5
	Control group	Post-test 1	5.650±0.7	6.600±0.8	1.875±0.4
	Experimental group I (Buteyko group)	Post-test 1	6.175±0.6	8.650±0.5	4.950±0.4
	Experimental group II (Pranayama group)	Post-test 1	4.075±0.3	4.425±0.4	3.300±0.4
	Control group	Post-test 2	5.275±0.6	6.375±0.7	2.350±0.5
	Experimental group I (Buteyko group)	Post-test 2	8.350±0.6	12.025±0.4	6.300±0.4

	Experimental group II (Pranayama group)	Post-test 2	5.050±0.5	5.950±0.4	4.375±0.4
2	Significance among groups (Control, Buteyko and Pranayama)		F = 3.995 P = 0.021	F = 16.681 P = <0.001	F = 13.641 P = <0.001
	Significance among tests (Pre-test, Post-test 1 and Post-test 2)		F = 79.364 P = <0.001	F = 129.582 P = <0.001	F = 66.905 P = <0.001
	Significance in the interaction (groups X tests)		F = 15.122 P = <0.001	F = 29.102 P = 0.001	F = 4.457 P = 0.002
3	Significance between Pre-test (Control and Buteyko)		t = 1.305 P = 0.219	t = 0.441 P = 1.000	t = 2.970 P = 0.010
	Significance between Pre-test (Control and Pranayama)		t = 3.110 P = 0.007	t = 3.674 P = 0.001	t = 0.463 P = 1.000
	Significance between Pre-test (Buteyko and Pranayama)		t = 1.805 P = 0.219	t = 4.114 P = <0.001	t = 2.507 P = 0.039
4	Significance between Post-test 1 (Control and Buteyko)		t = 0.583 P = 1.000	t = 2.410 P = 0.052	t = 4.744 P = <0.001
	Significance between Post-test 1 (Control and Pranayama)		t = 1.749 P = 0.247	t = 2.557 P = 0.035	t = 2.198 P = 0.087
	Significance between Post-test 1 (Buteyko and Pranayama)		t = 1.749 P = 0.247	t = 4.967 P = <0.001	t = 2.546 P = 0.035
5	Significance between Post-test 2 (Control and Buteyko)		t = 3.415 P = 0.002	t = 6.642 P = <0.001	t = 6.094 P = <0.001
	Significance between Post-test 2 (Control and Pranayama)		t = 0.250 P = 1.000	t = 0.500 P = 1.000	t = 3.124 P = 0.006
	Significance between Post-test 2 (Buteyko and Pranayama)		t = 3.665 P = 0.002	t = 7.141 P = <0.001	t = 2.970 P = 0.010

	(Buteyko and Pranayama)	P =0.001	P =<0.001	P =0.010
6	Significance within Control (Pre-test and Post-test 1)	t = 2.294 P =0.068	t = 2.405 P =0.051	t = 1.962 P =0.153
	Significance within Control (Pre-test and Post-test 2)	t = 1.338 P =0.546	t = 1.768 P =0.235	t = 3.247 P =0.004
	Significance within Control (Post-test 1 and Post-test 2)	t = 0.956 P =1.000	t = 0.637 P =1.000	t = 1.285 P =0.600
	Significance within Buteyko (Pre-test and Post-test 1)	t = 6.628 P =<0.001	t = 7.145 P =<0.001	t = 5.074 P =<0.001
7	Significance within Buteyko (Pre-test and Post-test 2)	t = 7.903 P =<0.001	t = 16.695 P =<0.001	t = 7.915 P =<0.001
	Significance within Buteyko (Post-test 1 and Post-test 2)	t = 5.545 P =<0.001	t = 9.550 P =<0.001	t = 2.909 P =0.012
	Significance within Pranayama (Pre-test and Post-test 1)	t = 5.417 P =<0.001	t = 5.093 P =<0.001	t = 5.006 P =<0.001
8	Significance within Pranayama (Pre-test and Post-test 2)	t = 7.903 P =<0.001	t = 9.408 P =<0.001	t = 7.915 P =<0.001
	Significance within Pranayama (Post-test 1 and Post-test 2)	t = 2.486 P =0.041	t = 4.315 P =<0.001	t = 2.909 P =0.012
	FVC(Forced Vital Capacity) = ----- (% change after inhalation)			
FEV 1 (Forced Expiratory volume in 1 second)= ----- (% change after inhalation)				
Values are mean + SE; n = 40 each in Control, Buteyko and Pranayama groups				

Pulmonary function tests (PFT) in adults can vary depending on their age, sex, height, weight, and any underlying medical conditions they may have. The results are compared to reference values for age, sex, and height, and can help diagnose or monitor respiratory conditions, such as

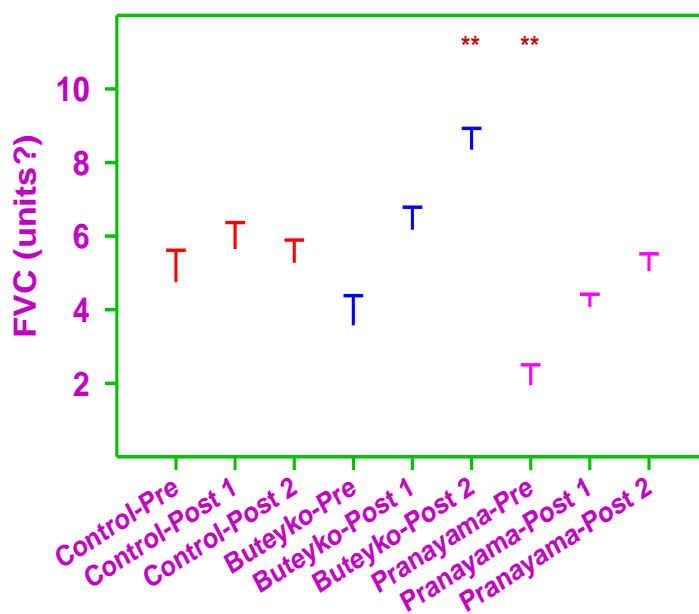
asthma, chronic obstructive pulmonary disease (COPD), and interstitial lung disease. Some common PFT measurements in adults include forced vital capacity (FVC), forced expiratory volume in one second (FEV1), and the ratio of FEV1 to FVC. FVC measures the total amount of air a person can exhale after inhaling as deeply as possible, while FEV1 measures the amount of air that is exhaled in the first second. The ratio of FEV1 to FVC can help identify obstructive lung conditions like COPD, where the airways are narrowed and it is difficult to exhale fully.

The mean and standard error of FVC, FEV1, Ratio of FEV1/FVC of control group, Experimental group I(Buteyko group), Experimental Group II(Pranayama group) are given in Table 1. The mean FVC of Control Pre-test, Buteyko Pre-test, Pranayama Pre-test, Control Post-test 1, Buteyko Post-test 1, Pranayama Post-test 1, Control Post-test 2, Buteyko Post-test 2, Pranayama Post-test 2 are 4.75, 3.57, 1.9, 5.6, 6.1, 4.07, 5.2, 8.35, 5.05 respectively. Two-way RM ANOVA revealed no significant difference in the groups (Control, Buteyko and Pranayama) ($P = 0.068$). The tests (Pre-test, Post-test 1 and Post-test 2) showed statistical significance ($P < 0.001$). The group X test interactions showed significance ($P = <0.001$). Between group comparisons of Pre-test of Control, Buteyko and Pranayama did not show significance ($P > 0.05$). Between group comparisons of Post-test 1 of Control, Buteyko and Pranayama did not show significance ($P > 0.05$). Between group comparisons of Post-test 2 of Control, Buteyko and Pranayama, also did not show significance ($P > 0.05$). Within group comparisons of Pre-test, Post-test 1 and Post-test 2 of Control did not show significance ($P > 0.05$). Though, Buteyko showed a significance ($P=<0.001$) in pretest and Post test 1, and Post test 2, Pranayama group showed significance($P=<0.001$) in pretest and Post test 1, and Post test 2.

The mean FEV1 of Control Pre-test, Buteyko Pre-test, Pranayama Pre-test, Control Post-test 1, Buteyko Post-test 1, Pranayama Post-test 1, Control Post-test 2, Buteyko Post-test 2, Pranayama Post-test 2 are 5.75, 6.12, 2.62, 6.60, 8.65, 4.42, 6.37,12.02, 5.95 respectively. Two-way RM ANOVA revealed significant difference in the groups (Control, Buteyko and Pranayama) ($P = <0.001$). The tests (Pre-test, Post-test 1 and Post-test 2) showed statistical significance ($P < 0.001$). The group X test interactions showed no significance ($P = 0.001$). Between group comparisons of Pre-test of Control, Buteyko and Pranayama did not show significance ($P > 0.05$). Between group comparisons of Post-test 1 of Control, Buteyko and Pranayama did not show significance ($P > 0.05$). Between group comparisons of Post-test 2 of Control, Buteyko and Pranayama, also did not show significance ($P > 0.05$). Within group comparisons of Pre-test, Post-test 1 and Post-test 2 of Control did not show significance ($P > 0.05$). Though, Buteyko showed a significance ($P=<0.001$) in pretest and Post test 1, and Post test 2, Pranayama group showed significance($P=<0.001$) in pretest and Post test 1, and Post test 2.

The mean ratio of FEV1/FVC of Control Pre-test, Buteyko Pre-test, Pranayama Pre-test, Control Post-test 1, Buteyko Post-test 1, Pranayama Post-test 1, Control Post-test 2, Buteyko Post-test 2, Pranayama Post-test 2 are 1.15, 3.07, 1.45, 1.87, 4.95, 3.30, 2.35, 6.30,4.37 respectively. Two-way RM ANOVA revealed significant difference in the groups (Control, Buteyko and Pranayama) ($P = <0.001$). The tests (Pre-test, Post-test 1 and Post-test 2) showed

statistical significance ($P < 0.001$). The group X test interactions showed no significance ($P = 0.002$). Between group comparisons of Pre-test of Control, Buteyko and Pranayama did not show significance ($P > 0.05$). Between group comparisons of Post-test 1 of Control, Buteyko and Pranayama did not show significance ($P > 0.05$). Between group comparisons of Post-test 2 of Control, Buteyko and Pranayama, also did not show significance ($P > 0.05$). Within group comparisons of Pre-test, Post-test 1 and Post-test 2 of Control did not show significance ($P > 0.05$). Though, Buteyko showed a significance ($P < 0.001$) in pretest and Post test 1, and Post test 2, Pranayama group showed significance ($P < 0.001$) in pretest and Post test 1, and Post test 2. The results showed significance ($P < 0.001$) in FVC, FEV1, ratio of FEV1/FVC within group of Experimental group I (Buteyko group) and Experimental group II (Pranayama group). Control group did not show any significance ($P > 0.05$)



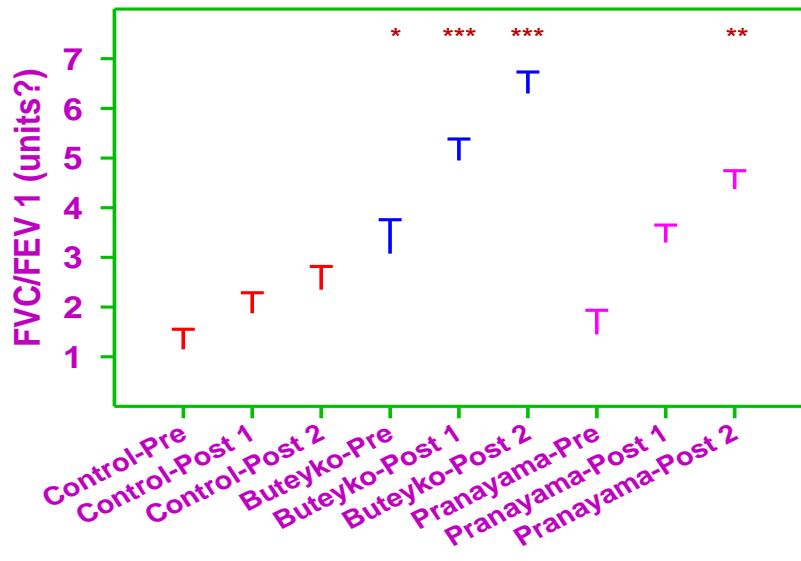
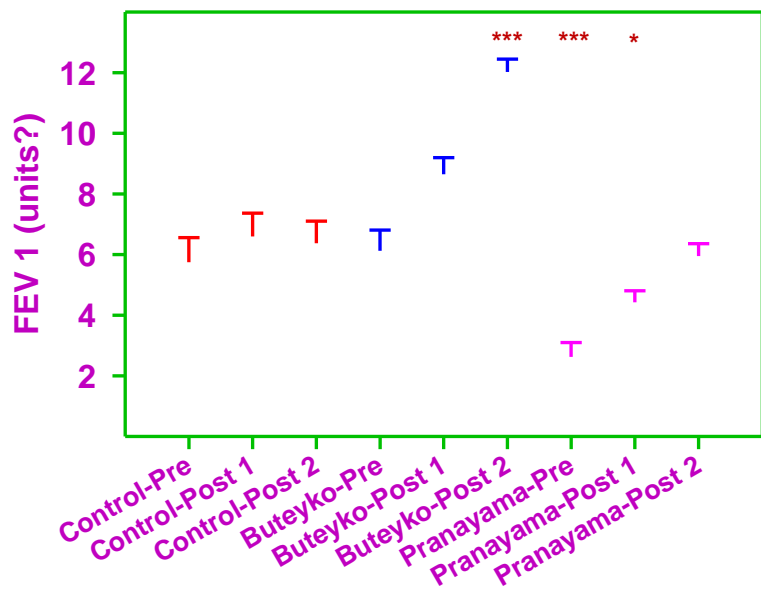


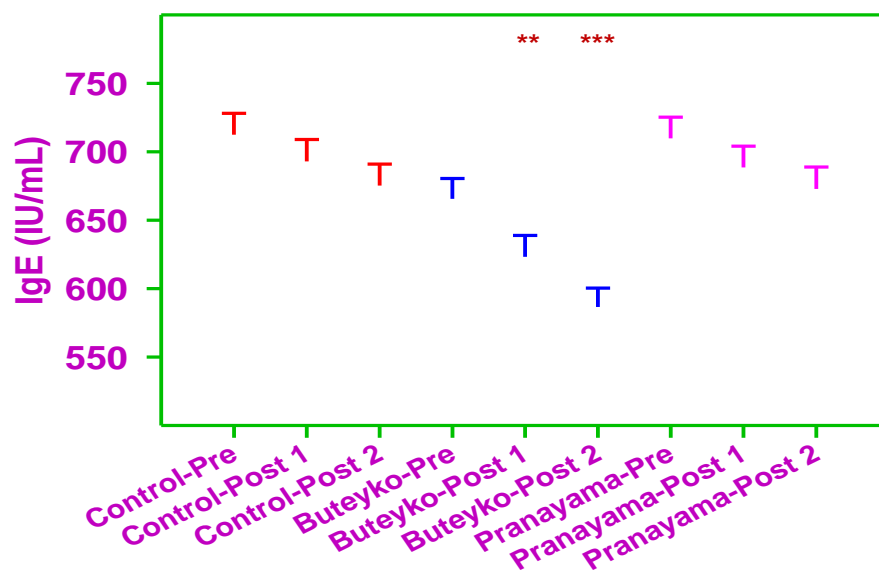
Table : 3 Comparison of control and experimental groups on respiratory parameters by two-way RM ANOVA with Bonferroni 't' test.

S.No	Groups and comparisons	Tests	WBC	Eosinophil count	Ig E
1	Control	Pre-test	11179.6±139.2	612.6±14.5	712.5±15.6

	Buteyko	Pre-test	10931.2±210	562.0±25.5	665.6±14.9
	Pranayama	Pre-test	11126.8±117.6	643.0±6.6	709.8±15.5
	Control	Post-test 1	11087.4±139.8	606.8±12.8	693.0±16.0
	Buteyko	Post-test 1	10636.7±233.7	514.8±19.3	623.3±15.6
	Pranayama	Post-test 1	11024.8±112.9	625.4±13.7	688.5±15.6
	Control	Post-test 2	10971.7±139.7	595.1±13.1	675.3±15.6
	Buteyko	Post-test 2	10301.9±218.3	454.0±14.4	586.6±13.7
	Pranayama	Post-test 2	10879.5±109.6	607.2±13.7	672.8±16.0
2	Significance among groups (Control, Buteyko and Pranayama)		F = 2.319 P = 0.103	F = 17.074 P = <0.001	F = 6.780 P = 0.002
	Significance among tests (Pre-test, Post-test 1 and Post-test 2)		F = 65.918 P = <0.001	F = 29.363 P = <0.001	F = 74.567 P = <0.001
	Significance in the interaction (groups X tests)		F = 9.091 P = <0.001	F = 7.739 P = <0.001	F = 5.585 P = <0.001
3	Significance between Pre-test (Control and Buteyko)		t = 1.068 P = 0.863	t = 2.178 P = 0.092	F = 2.151 P = 0.100
	Significance between Pre-test (Control and Pranayama)		t = 0.227 P = 1.000	t = 1.309 P = 0.577	F = 0.123 P = 1.000
	Significance between Pre-test (Buteyko and Pranayama)		t = 0.840 P = 1.000	t = 3.487 P = 0.002	F = 2.028 P = 0.134
4	Significance between Post-test 1 (Control and Buteyko)		t = 1.937 P = 0.165	t = 3.959 P = <0.001	F = 3.200 P = 0.005
	Significance between Post-test 1 (Control and Pranayama)		t = 0.270 P = 1.000	t = 0.802 P = 1.000	F = 0.205 P = 1.000
	Significance between Post-test 1 (Buteyko and Pranayama)		t = 1.667 P = 0.294	t = 4.761 P = <0.001	F = 2.995 P = 0.010
5	Significance between Post-test 2 (Control and Buteyko)		t = 2.879 P = 0.014	t = 6.072 P = <0.001	F = 4.070 P = <0.001
	Significance between Post-test 2 (Control and Pranayama)		t = 0.396 P = 1.000	t = 0.522 P = 1.000	F = 0.115 P = 1.000
	Significance between Post-test 2 (Buteyko and Pranayama)		t = 2.482 P = 0.043	t = 6.594 P = <0.001	F = 3.955 P = <0.001
6	Significance within Control (Pre-test and Post-test 1)		t = 1.688 P = 0.278	t = 0.482 P = 1.000	F = 2.689 P = 0.023
	Significance within Control (Pre-test and Post-test 2)		t = 3.806 P = <0.001	t = 1.441 P = 0.453	F = 5.127 P = <0.001
	Significance within Control (Post-test 1 and Post-test 2)		t = 2.118 P = 0.106	t = 0.959 P = 1.000	F = 2.438 P = 0.047

7	Significance within Buteyko (Pre-test and Post-test 1)	t = 5.392 P = <0.001	t = 3.875 P = <0.001	F = 5.844 P = <0.001
	Significance within Buteyko (Pre-test and Post-test 2)	t = 11.523 P = <0.001	t = 8.859 P = <0.001	F = 10.896 P = <0.001
	Significance within Buteyko (Post-test 1 and Post-test 2)	t = 6.131 P = <0.001	t = 4.984 P = <0.001	F = 5.051 P = <0.001
8	Significance within Pranayama (Pre-test and Post-test 1)	t = 1.870 P = 0.188	t = 1.447 P = 0.447	F = 2.938 P = 0.011
	Significance within Pranayama (Pre-test and Post-test 2)	t = 4.527 P = <0.001	t = 2.940 P = 0.011	F = 5.103 P = <0.001
	Significance within Pranayama (Post-test 1 and Post-test 2)	t = 2.657 P = 0.025	t = 1.492 P = 0.411	F = 2.938 P = <0.001

RR = Respiratory rate (breaths/min); SpO₂ = Oxygen saturation (%)
 Values are mean + SE; n = 40 each in Control, Buteyko and Pranayama groups
 Complete the table from the report given below -



The mean Total count Pre-test, Buteyko Pre-test, Pranayama Pre-test, Control Post-test 1, Buteyko Post-test 1, Pranayama Post-test 1, Control Post-test 2, Buteyko Post-test 2, Pranayama Post-test 2 are 11179.6, 10931.2, 11126.8, 11087.4, 10636.7, 11024.8, 10971.7, 10301.9, and 10879.5 respectively. Two-way RM ANOVA revealed no significant difference in the groups (Control, Buteyko and Pranayama) (P = 0.821). The tests (Pre-test, Post-test 1 and Post-test 2) showed statistical significance (P = <0.001). The group X test interactions showed statistical

significance ($P \leq 0.001$). Between group comparisons of Pre-test of Control, Buteyko and Pranayama did not show significance ($P > 0.05$). Between group comparisons of Post-test 1 of Control, Buteyko and Pranayama did not show significance ($P > 0.05$). Between group comparisons of Post-test 2 of Control, Buteyko and Pranayama, also did not show significance ($P > 0.05$). Within group comparisons of Pre-test, Post-test 1 and Post-test 2 of Control and pranayama group did not show significance ($P > 0.05$). Though, Buteyko group showed significance in pre test and post test 1 ($P \leq 0.001$) and pretest and post test 2 ($P \leq 0.001$) post test 1 and Post test 2 ($P \leq 0.001$). Pranayama group showed a significance in pretest and post test 2 ($P \leq 0.001$). Buteyko group showed significance decrease in Total count compared to other control and Pranayama groups. The mean Absolute Eosinophil count Pre-test, Buteyko Pre-test, Pranayama Pre-test, Control Post-test 1, Buteyko Post-test 1, Pranayama Post-test 1, Control Post-test 2, Buteyko Post-test 2, Pranayama Post-test 2 are, 612.6, 562.0, 643.0, 606.8, 514.8, 625.4, 595.1, 454.0, and 607.2, respectively. Two-way RM ANOVA revealed significant difference in the groups (Control, Buteyko and Pranayama) ($P \leq 0.001$). The tests (Pre-test, Post-test 1 and Post-test 2) showed statistical significance ($P \leq 0.001$). The group X test interactions showed significance ($P \leq 0.001$).

Between group comparisons of Pre-test of Control, Buteyko and Pranayama did not show significance ($P > 0.05$). Between group comparisons of Post-test 1 of Control and Buteyko showed significance (< 0.001), Post test 2 control and Buteyko and Post test 2 Buteyko and pranayama showed significance (< 0.001). Within group comparisons significance within Buteyko Pre-test and Post-test 1, Post test 1 and Post-test 2 and pretest and post test 2 showed statistical significance ($p \leq 0.001$) Control group and pranayama did not show significance ($P > 0.05$). Though, Buteyko showed a significant decrease in Absolute eosinophil count Post-test 2, but were within the clinical limits. The mean IgE Pre-test, Buteyko Pre-test, Pranayama Pre-test, Control Post-test 1, Buteyko Post-test 1, Pranayama Post-test 1, Control Post-test 2, Buteyko Post-test 2, Pranayama Post-test 2 are, 712.5, 665.6, 709.8, 693.0, 623.3, 688.5, 675.3, 586.6, and 672.8 respectively. Two-way RM ANOVA revealed no significant difference in the groups (Control, Buteyko and Pranayama) ($P = 0.002$). The tests (Pre-test, Post-test 1 and Post-test 2) showed statistical significance ($P \leq 0.0001$). The group X test interactions showed significance ($P \leq 0.001$). Between group comparisons of Pre-test of Control, Buteyko and Pranayama did not show significance ($P > 0.05$). Between group comparisons of Post-test 1 of Control, Buteyko and Pranayama did not show significance ($P > 0.05$). Between group comparisons of Post-test 2 of Buteyko also showed significance ($P < 0.001$). Post test 2 Buteyko and pranayama showed significance ($P < 0.001$) Within group comparisons of Pre-test, Post-test 1 and of Control did not show significance ($P > 0.05$). Though, Buteyko and Pranayama showed a significant decrease in IgE pretest, Post test 1 and Post-test 2, ($P \leq 0.001$) but were within the clinical limits.

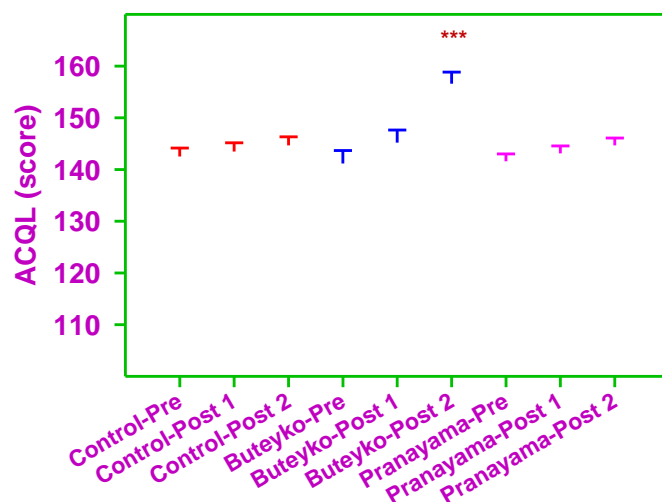
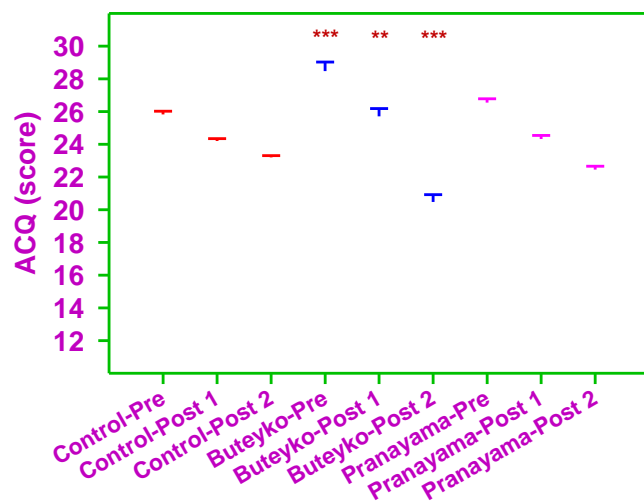
Table:4 Comparison of control and experimental groups on pulmonary function test by two-way RM ANOVA Bonferroni 't' test.				
S.No	Groups and comparisons	Tests	Asthma Control	Asthma Quality of Life
1.	Control	Pre-test	25.825±0.2	142.525±1.6
	Buteyko	Pre-test	28.474±0.6	141.175±2.5
	Pranayama	Pre-test	26.550±0.2	141.600±1.4
	Control	Post-test 1	24.200±0.1	143.475±1.6
	Buteyko	Post-test 1	25.711±0.5	145.200±2.4
	Pranayama	Post-test 1	24.325±0.2	143.125±1.4
	Control	Post-test 2	23.200±0.1	144.675±1.6
	Buteyko	Post-test 2	20.474±0.4	156.600±2.2
	Pranayama	Post-test 2	22.450±0.2	144.675±1.4
2.	Significance among groups (Control, Buteyko and Pranayama)		F = 0.824 P = 0.441	F = 1.804 P = 0.169
	Significance among tests (Pre-test, Post-test 1 and Post-test 2)		F = 732.44 P = <0.001	F = 493.509 P = <0.001
	Significance in the interaction (groups X tests)		F = 86.500 P = <0.001	F = 201.723 P = <0.001
3.	Significance between Pre-test (Control and Buteyko)		t = 5.859 P = <0.001	t = 0.509 P = 1.000
	Significance between Pre-test (Control and Pranayama)		t = 1.625 P = 0.319	t = 0.349 P = 1.000
	Significance between Pre-test (Buteyko and Pranayama)		t = 4.255 P = <0.001	t = 0.160 P = 1.000
4.	Significance between Post-test 1 (Control and Buteyko)		t = 3.341 P = 0.003	t = 0.651 P = 1.0000
	Significance between Post-test 1 (Control and Pranayama)		t = 0.280 P = 1.000	t = 0.132 P = 1.000
	Significance between Post-test 1 (Buteyko and Pranayama)		t = 3.065 P = 0.008	t = 0.783 P = 1.000
5.	Significance between Post-test 2 (Control and Buteyko)		t = 6.031 P = <0.001	t = 4.500 P = <0.001
	Significance between Post-test 2 (Control and Pranayama)		t = 1.681 P = 0.284	t = 0.000 P = 1.000
	Significance between Post-test 2 (Buteyko and Pranayama)		t = 4.372 P = <0.001	t = 4.500 P = <0.001
6.	Significance within Control (Pre-test and Post-test 1)		t = 7.367 P = <0.001	t = 2.448 P = 0.045
	Significance within Control (Pre-test and Post-test 2)		t = 11.901 P = <0.001	t = 5.540 P = <0.001
	Significance within Control (Post-test 1 and Post-test 2)		t = 4.534 P = <0.001	t = 3.092 P = 0.007
	Significance within Buteyko (Pre-test and Post-test 1)		t = 12.210 P = <0.001	t = 10.372 P = <0.001

	Significance within Buteyko (Pre-test and Post-test 2)	t = 35.350 P =<0.001	t = 39.748 P =<0.001
	Significance within Buteyko (Post-test 1 and Post-test 2)	t = 23.140 P =<0.001	t = 29.376 P =<0.001
	Significance within Pranayama (Pre-test and Post-test 1)	t = 10.087 P =<0.001	t = 3.930 P =<0.001
	Significance within Pranayama (Pre-test and Post-test 2)	t = 18.587 P =<0.001	t = 7.924 P =<0.001
	Significance within Pranayama (Post-test 1 and Post-test 2)	t = 8.500 P =<0.001	t = 3.994 P =<0.001
ACQ- Asthma Control Questionnaire, ACQL- Asthma Quality of Life Questionnaire Values are mean + SE; n = 40 each in Control, Buteyko and Pranayama groups			

The mean Asthma Control Questionnaire Pre-test, Buteyko Pre-test, Pranayama Pre-test, Control Post-test 1, Buteyko Post-test 1, Pranayama Post-test 1, Control Post-test 2, Buteyko Post-test 2, Pranayama Post-test 2 are, 25.8, 28.4, 26.5, 24.2, 25.7, 24.3, 23.2, 20.4, and 22.4 respectively. Two-way RM ANOVA revealed no significant difference in the groups (Control, Buteyko and Pranayama) (P =0.441). The tests (Pre-test, Post-test 1 and Post-test 2) showed statistical significance (P=<0.001). The group X test interactions showed significance (P =<0.001). Between group comparisons of Pre-test of Control and Buteyko showed significance (P =<0.001) and Pranayama did not show significance (P > 0.05). Between group comparisons of Post-test 1 of Control, Buteyko and Pranayama did not show significance (P > 0.05). Between group comparisons of Post-test 2 of Control and Buteyko, Buteyko and pranayama showed significance (P <0.001). Within group comparisons of Pre-test, Post-test 1 and Post-test 2 of Control, Buteyko and Pranayama showed significance (P <0.001). Though, Buteyko and Pranayama showed a significant decrease in Asthma Control. The mean Asthma Quality of life Questionnaire Pre-test, Buteyko Pre-test, Pranayama Pre-test, Control Post-test 1, Buteyko Post-test 1, Pranayama Post-test 1, Control Post-test 2, Buteyko Post-test 2, Pranayama Post-test 2 142.5, 141.17, 141.6, 143.4, 145.2, 143.1, 144.6, 156.6, 144.6

Two-way RM ANOVA revealed no significant difference in the groups (Control, Buteyko and Pranayama) (P =0.780). The tests (Pre-test, Post-test 1 and Post-test 2) showed statistical significance (P=<0.0001). The group X test interactions show significance (P =<0.001). Between group comparisons of Pre-test of Control, Buteyko and Pranayama did not show significance (P > 0.05). Between group comparisons of Post-test 1 of Control, Buteyko and Pranayama did not show significance (P > 0.05). Between group comparisons of Post-test 2 of Control and Buteyko showed significance (P=<0.001) and Pranayama, also did not show significance (P > 0.05). Within group comparisons of Pre-test, Post-test 1 and Post-test 2 of Control did not show significance (P > 0.05). Significance within Buteyko (Pre-test and Post-test 1), Significance within Buteyko (Pre-test and Post-test 2) Significance within Buteyko (Post-test

1 and Post-test 2), shows significance ($P < 0.001$), Pranayama shows Significance within Pranayama (Pre-test and Post-test 1) & Significance within Pranayama (Pre-test and Post-test 2), Post test 1 and Post test 2 shows significance ($P < 0.001$) Though, Buteyko and Pranayama showed a significant increase in Quality of life Asthma patients .



Discussion

The primary objective of this pilot study was to compare and contrast the effects of the Buteyko breathing method with Pranayama (Yoga breathing) on biochemical and physiological markers. There are a number of breathing exercises that can be used to control asthma, but there are many different approaches and mechanisms that have been proposed. Both the Buteyko method and Pranayama have been shown to be good at treating respiratory problems, but their

approaches and methods are different. While Pranayama focuses on improving lung function and increasing oxygen levels, the Buteyko method focuses on reducing hyperventilation and increasing carbon dioxide levels. Pranayama and the Buteyko method are two specific breathing exercises that have been shown to be helpful in the management of respiratory conditions like asthma. Buteyko breathing technique and Pranayama showed a Significant improvement in pulmonary Functions, Decrease in Eosinophils and IgE significant decrease in Asthma symptoms, improvement in Quality of life. Comparing Pranayama Buteyko Breathing technique showed statistical significance($P < 0.001$) This study was supported by Prasanna et al. (2015)²⁰, who conducted a study on the effects of Buteyko breathing exercise on newly diagnosed asthmatics. Overall, the results showed a decrease in asthma symptoms and an increase in peak expiratory flow rate²⁰. The ongoing review gives proof that Buteyko breathing method and Pranayama showed a critical lessening in Asthma Control, improvement in Personal satisfaction Post-test 2, yet were inside as far as possible.

Conclusion

The current study demonstrates that, while within the clinical limits, the Buteyko breathing technique and pranayama demonstrated a significant increase in asthma control and decrease in asthma symptoms and an improvement in quality of life.. Buteyko breathing technique and Pranayama showed a Significant improvement in pulmonary Functions, Decrease in Eosinophils and IgE significant decrease in Asthma symptoms, improvement in Quality of life. Comparing Pranayama Buteyko Breathing technique showed statistical significance($P < 0.001$)

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Conflict of Interest

Conflict of interest declared none

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