Keywords
Bronchial asthma, Breathing retraining, Papworth technique, Physiotherapy, Pulse rate, Diastolic Blood pressure, Systolic blood pressure, Peak expiratory flow rate, Cardiorespiratory adaptation

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Received-22-05-2026
Revised-20-06-2026
Accepted-25-06-20.26
Doi:10.1922/ejprd.v34i4s.1509

European Journal of Prosthodontics and Restorative Dentistry (2026) 34(4S), 636-646

Effectiveness of Retrained Breathing Programme and Papworth Breathing Technique on Cardiorespiratory Adaptations in Bronchial Asthma patients: A randomized controlled study

ABSTRACT
Background: Despite the various advancements in pharmacological approaches, bronchial asthma still continues to be one of the serious global health issues. In recent times, the retrained breathing techniques have been found to be of great interest to bronchial asthma patients for the management of their symptoms and imsproving their quality of life. Apart from respiratory impairment, asthma can influence cardiovascular parameters such as systolic blood pressure, diastolic blood pressure, and pulse rate due to increased sympathetic activity and respiratory distress. Breathing retraining techniques have been proposed as effective adjunctive interventions to improve cardiorespiratory function and autonomic balance in individuals with asthma.
Aim: To evaluate the effectiveness of a physiotherapy-based retrained breathing programme on systolic blood pressure, diastolic blood pressure, and pulse rate in patients with bronchial asthma and to compare its effects with the Papworth breathing technique.
Methodology: An experimental study was conducted among 170 patients diagnosed with bronchial asthma. Participants were randomly allocated into an intervention group receiving the Retrained Breathing Programme (n=87) and a control group receiving the Papworth Breathing Technique (n=83). Both groups continued their prescribed medications throughout the study period. The interventions were administered for 30 days. Systolic blood pressure, diastolic blood pressure, and pulse rate were measured using standard clinical procedures at baseline (Day 1), mid-intervention (Day 15), and post-intervention (Day 30). Statistical analysis was performed using paired t-tests, independent t-tests, repeated measures ANOVA and Cohen'D test.
Results: The intervention group demonstrated significant reductions in systolic blood pressure and pulse rate following the retrained breathing programme compared to the control group ($p<0.05$). The post-intervention pulse rate was 82.72±4.27 bpm in the Breathing Retraining Programme group and 82.30±4.40 bpm in the Papworth Breathing Technique group. 82 Repeated measures analysis revealed significant effects of time and group interaction for systolic blood pressure and pulse rate. The post-treatment systolic blood pressure was 131.94±9.02 mmHg and 133.53±8.80 mmHg, respectively, while the diastolic blood pressure was 81.49±2.44 mmHg and 81.74±3.78 mmHg, respectively. Although diastolic blood pressure showed improvement over the intervention period, the difference between the two groups was not statistically significant ($p>0.05$).
Conclusion: The physiotherapy-based retrained breathing programme is effective in improving systolic blood pressure and pulse rate among patients

with bronchial asthma, while changes in diastolic blood pressure were comparable to those achieved with the Papworth breathing technique. This study suggest that breathing retraining may serve as a beneficial adjunct to conventional asthma management for improving cardiovascular as well as respiratory outcomes.

INTRODUCTION

Asthma is a chronic inflammatory disease of the airways characterized by increased airway responsiveness and recurrent episodes of wheezing, shortness of breath, chest tightness, and coughing, particularly during the night and early morning hours. These symptoms are often triggered by exposure to allergens such as house dust mites, pollen, and animal dander. The condition involves persistent inflammation of the bronchial airways mediated by various inflammatory cells, including eosinophils, mast cells, T lymphocytes, neutrophils, and airway epithelial cells. This inflammatory process results in bronchial hyperresponsiveness, excessive mucus production, and narrowing of the airways, ultimately causing airflow obstruction. Over the past few decades, the prevalence of asthma has risen worldwide, making it one of the most prevalent chronic respiratory disorders affecting people of all ages and contributing substantially to healthcare costs and impairment in quality of life. [1]

The common symptoms of asthma include breathlessness, wheezing, cough, chest tightness, and shortness of breath. Additionally, functional disorders of the respiratory tract and vocal cords associated with asthma may contribute to symptoms such as wheezing, chest tightness, and dyspnoea.. The severity and occurrence of these symptoms differ among individuals. It may fluctuate over time depending on factors such as environmental exposure, physical activity, emotional stress and treatment adherence. In many patients, the symptoms worsen during exercise, respiratory infections or exposure to irritants such as smoke, pollution and strong odours. Persistent symptoms may interfere with daily activities, sleep quality, occupational performance and overall physical functioning.[2]

Individuals with asthma have a distinct response to exercise. Regular physical activity can improve aerobic fitness and reduce breathing effort during mild and moderate activities. It has been shown to improve cardiovascular endurance, exercise tolerance and respiratory efficiency in individuals with asthma. Improved physical conditioning may reduce exercise-induced bronchoconstriction and enhance the ability of patients to perform daily activities with less respiratory insufficiency. Furthermore, participation in appropriately supervised physical activity programs can improve psychological wellbeing and reduce fear associated with exertional dyspnoea.[3]

Exercise training may also reduce the perception of breathlessness through other mechanisms, including strengthening of the respiratory muscles. Strengthening of the respiratory muscles improves respiratory muscle endurance and reduces the work of breathing. It allows patients to perform physical activities more comfortably. Improved respiratory muscle function may also contribute to better chest wall mobility, enhance ventilation and improve gas exchange. Consequently, respiratory rehabilitation has become an important adjunct in the comprehensive management of asthma.[4]

According to the 2009 Physiotherapy Guidelines, breathing retraining (as part of CPT) incorporates a reduction in the respiratory rate and/or tidal volume with relaxation training, which helps to control the symptoms of asthma and is recommended as level 1++ scientific evidence (Grades A and B). Breathing retraining includes instruction in pursed lip breathing and coordinated breathing with respiratory exercises and has the added benefit of reducing anxiety and stress. Breathing pattern retraining that focuses on gentle, prolonged exhalation addresses the main physiologic impediment of these patients. Breathing retraining aims to correct dysfunctional breathing patterns commonly seen in asthmatic individuals, such as upper chest breathing, pursed lip breathing, hyperventilation and excessive use of accessory muscles. By encouraging slow, controlled and efficient breathing patterns, these interventions can improve ventilatory efficiency and symptom perception. Physiotherapists frequently incorporate breathing retraining into pulmonary rehabilitation programs because of its non-invasive nature and its potential to improve patient self-management skills.[5]

The Papworth breathing technique is a respiratory physiotherapy approach designed to improve breathing control and correct abnormal breathing patterns. Originating at Papworth Hospital in the United Kingdom, this method integrates diaphragmatic breathing with relaxation techniques to encourage more relaxed and efficient respiration. The technique promotes the use of abdominal breathing rather than excessive chest movement, thereby reducing unnecessary activity of the accessory respiratory muscles and minimising upper chest breathing. By facilitating a slower and more controlled breathing pattern, the Papworth technique may enhance ventilatory efficiency, improve respiratory regulation, and contribute to a reduction in symptom severity among individuals with asthma. [6]

The Papworth breathing technique consists of a series of diaphragmatic breathing and relaxation exercises, and teaches patients which muscles to use when breathing and how to avoid breathing too deeply or too fast by emphasising nose breathing. The technique is altered to suit activity; this allows the technique to be integrated by patients into their everyday lives with subsequent improvements in quality of life. Nasal breathing facilitates warming, humidification and filtration of inspired air before it reaches the lower respiratory tract, thereby reducing airway irritation. The adaptability of the Papworth technique during different activities such as walking, climbing stairs and performing household tasks enhances patient compliance and long-term adherence. Studies have demonstrated improvements in symptom control, breathing efficiency and health-related quality of life following regular practice of this technique.[6,7]

The technique is most effective when used in combination with asthma medications. It will not replace the need for asthma medications, but may reduce reliance upon, and the frequency with which they are required. When combined with pharmacological management, breathing retraining techniques may improve symptom perception, reduce rescue medication usage and enhance overall disease control. Such interventions empower patients by providing them with self-management strategies that can be applied during episodes of breathlessness or anxiety. Therefore, the Papworth breathing technique represents a valuable adjunctive intervention in the multidisciplinary management of bronchial asthma and may contribute to improved functional capacity and quality of life among affected individuals.[7, 8]

Pulse rate reflects cardiovascular workload and is often elevated in patients with bronchial asthma due to airway obstruction, increased respiratory effort, anxiety, and bronchodilator use. Improvement in breathing and reduction in respiratory distress may lower pulse rate, indicating better cardiopulmonary adaptation and autonomic balance.[9]

Systolic blood pressure is influenced by cardiac output and sympathetic activity and may increase during respiratory distress. Breathing retraining techniques can promote relaxation and reduce sympathetic stimulation, leading to improved circulatory efficiency and lower systolic blood pressure. Diastolic blood pressure is mainly related to peripheral vascular resistance and generally remains more stable than systolic pressure. Although breathing exercises may improve vascular relaxation and autonomic regulation, changes in diastolic pressure are usually less pronounced. Monitoring diastolic blood pressure remains important for assessing cardiovascular adaptation to therapy.[10,11]

This study aims to determine and compare the effectiveness of the Retrained Breathing Programme and the Papworth Breathing Technique in the management of patients with bronchial asthma. The study also aimed to evaluate and analyse changes in Peak Expiratory Flow Rate (PEFR), oxygen saturation (SpO_2), pulse rate, and systolic and diastolic blood pressure before and after treatment on Day 1, Day 15, and Day 30 in both groups, and to compare these outcomes between the two interventions.

METHODS

Patients and methods

The present study was conducted using a quantitative randomised-controlled interventional research design to determine the effectiveness of the Retrained Breathing Programme in comparison with an active controlled intervention incorporating the Papworth Breathing Technique in patients with bronchial asthma. The study was designed to investigate the effect of breathing retraining on selected physiological parameters, particularly pulse rate, systolic blood pressure, and diastolic blood pressure, over a treatment period of one month. The study adopted a pre-test and post-test repeated-measures approach in which measurements were recorded at multiple time points, namely Day 1, Day 15 and Day 30, to evaluate both immediate and progressive treatment responses.

The study included patients aged 14 to 65 years with a diagnosis of mild persistent bronchial asthma who were receiving regular medical treatment. Individuals of both sexes and from diverse occupational and socioeconomic backgrounds were eligible for inclusion if they exhibited characteristic asthma symptoms, including dyspnea, chest tightness, cough, and wheezing. To ensure that the observed effects could be attributed to the breathing interventions, individuals with conditions affecting cardiac or pulmonary function, recent exacerbations of asthma, pregnancy, recent thoracic or abdominal surgery, or an inability to comply with the treatment protocol were excluded from the study .

The study population consisted of patients diagnosed with bronchial asthma who fulfilled the inclusion criteria and were receiving treatment from the Out-Patient Department and In-Patient Department of the Department of Kayachikitsa, Government Ayurvedic College and Hospital, Guwahati, Assam. The participants were recruited from both rural and urban areas of Kamrup district after obtaining informed consent. A total of 203 patients were initially screened for eligibility, of whom 13 participants were excluded because they did not satisfy the inclusion criteria. Consequently, 190 eligible participants were included and randomly allocated into two equal groups consisting of 95 participants each. During the follow-up period, 12 participants from the Retrained Breathing Programme group and 8 participants from the Papworth Breathing Technique group were lost to follow-up. Therefore, the final statistical analysis included 170 participants, comprising 87 participants in Group A and 83 participants in Group B. The study population included 84 males (49%) and 86 females (51%), with an overall mean age of 36.31 ± 10.21 years. The mean age in Group A was 37.68 ± 10.97 years, whereas the mean age in Group B was 34.88 ± 9.21 years.

After eligibility screening and obtaining informed consent, participants were randomly allocated using a simple random sampling technique into two groups. Out of 190 participants initially randomized, 87 participants in Group A and 83 participants in Group B completed the study and were included in the final analysis. Attrition included 12 participants lost to follow-up in Group A and 8 participants lost to follow-up in Group B.

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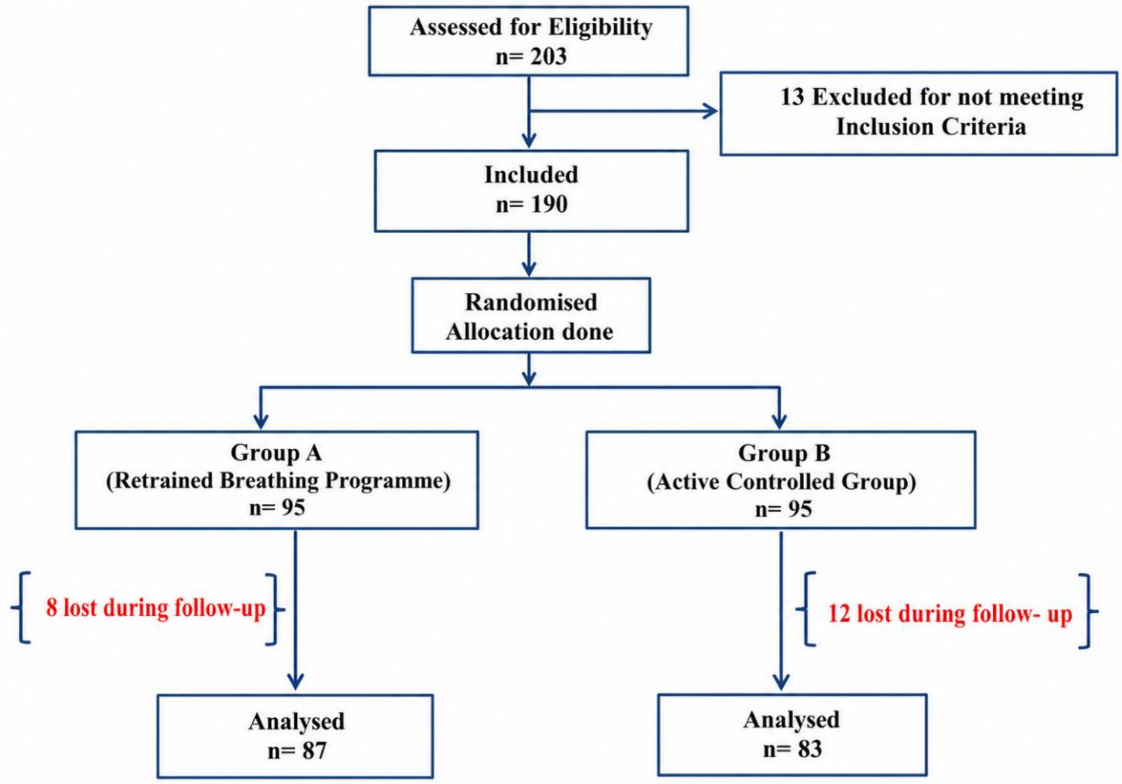
- **Recruitment of Participants (Consort Diagram)**



Interventions

Participants allocated to Group A received the Retrained Breathing Programme, which consisted of a structured six-step therapeutic breathing intervention specifically designed for bronchial asthma management. The programme aimed to improve respiratory efficiency, activate the parasympathetic nervous system, reduce respiratory effort and hyperventilation, improve diaphragmatic function and breathing control, reduce anxiety and stress, and enhance symptom management during both stable and acute phases of asthma. The intervention incorporated deep relaxation, wave breathing, softening of inhalation, complete diaphragmatic exhalation similar to pursed-lip breathing, extended pause techniques and postural orientation exercises. The intervention was administered in a structured sequence under supervision to ensure proper technique and participant compliance.

Participants allocated to Group B received the Papworth Breathing Technique as an active controlled intervention. The Papworth method emphasised diaphragmatic breathing, slow nasal breathing, prolonged expiration, relaxation training and reduction of hyperventilation patterns. The programme aimed to reduce respiratory distress, decrease anxiety, lower heart rate and improve breathing efficiency during daily activities. Participants were encouraged to minimise upper chest movement, avoid unnecessary sighing and yawning, and integrate breathing control strategies into routine functional activities. The intervention was performed for approximately 5 to 10 minutes twice daily in a quiet environment. Both groups continued their prescribed medical management throughout the study period and practised their respective interventions regularly for one month.

Outcome Parameters

The present study focused on three cardiovascular outcome measures, namely pulse rate, systolic blood pressure and diastolic blood pressure. Pulse rate was selected as an indicator of autonomic nervous system activity and cardiovascular response to breathing interventions, while systolic and diastolic blood pressure were used to evaluate haemodynamic adaptations associated with improved respiratory control and reduction in sympathetic activity.

Pulse rate was measured in beats per minute using a pulse oximeter after allowing participants to rest quietly for at least five minutes before assessment. Participants were instructed to remove rings, nail polish or any object that could interfere with the recording process. The index or middle finger was inserted into the pulse oximeter probe and readings were recorded after the values stabilised for at least five consecutive seconds.

Systolic and diastolic blood pressure were measured using a standard sphygmomanometer according to standardised blood pressure assessment procedures. Participants were seated comfortably with the back supported, feet flat on the floor, legs uncrossed and the arm maintained at heart level for at least five minutes

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before recording. Appropriate cuff size was selected for each participant to ensure measurement accuracy. The cuff was inflated until disappearance of the radial pulse and subsequently deflated slowly at approximately 2 mmHg per second while auscultating over the brachial artery. The first Korotkoff sound was recorded as systolic blood pressure and the disappearance of sounds was recorded as diastolic blood pressure. Measurements were recorded before and after intervention sessions on Day 1, Day 15 and Day 30 in both groups.

Statistical Methods

All collected data were entered into Microsoft Excel and subsequently analysed using IBM SPSS Statistics Version 24. Descriptive statistics were employed to summarise demographic and clinical characteristics of the study population. Continuous variables including pulse rate, systolic blood pressure and diastolic blood pressure were expressed as mean, standard deviation, range and median values, whereas categorical variables such as gender distribution were represented as frequencies and percentages.

To evaluate within-group treatment effects, paired sample t-tests were performed to compare pre-intervention and post-intervention values of pulse rate, systolic blood pressure and diastolic blood pressure within each treatment group. Between-group comparisons were performed using independent sample t-tests to determine whether significant differences existed between the Retrained Breathing Programme and the Papworth Breathing Technique groups following intervention. Cohen's d statistic was calculated to determine the magnitude of treatment effects and to assess clinical significance. Repeated Measures Analysis of Variance (RM-ANOVA) was performed to determine the effects of treatment group, treatment duration and Group × Day interaction on pulse rate, systolic blood pressure and diastolic blood pressure across Day 1, Day 15 and Day 30 assessments. Statistical significance was considered at a p-value less than 0.05.

➨ **Table 1: Day wise Pre and Post comparison of Group A and B Pulse Rate bpm and Independent Sample *t* Test**

Day	Pulse Rate	Group	Mean	SD	Mean Diff	SED	t	df	P-Value
1	Pre	A (n=87)	86.92	3.50	3.81	0.61	6.29	168	0.000
		B(n=83)	83.11	4.37					
	Post	A (n=87)	86.15	3.48	3.13	0.63	4.99	168	0.000
		B(n=83)	83.02	4.62					
15	Pre	A (n=87)	83.05	3.16	0.68	0.57	1.21	168	0.228
		B(n=83)	82.36	4.18					
	Post	A (n=87)	82.31	3.28	-0.11	0.58	-0.19	168	0.847
		B(n=83)	82.42	4.21					
30	Pre	A (n=87)	88.30	75.09	7.06	8.26	0.85	168	0.394
		B(n=83)	81.24	4.34					
	Post	A (n=87)	79.69	3.29	-1.77	0.58	-3.04	168	0.003
		B(n=83)	81.46	4.25					
Aggregate	Pre	A (n=87)	86.09	43.33	3.85	2.76	1.40	508	0.163
		B(n=83)	82.24	4.35					
	Post	A (n=87)	82.72	4.27	0.42	0.38	1.08	508	0.280
		B(n=83)	82.30	4.40					

➨ **Table 2: Day wise Pre and Post comparison of Group A and B Systolic Blood Pressure MMHg and Independent Sample *t* Test**

Day	BP MMHg S	Group	Mean	SD	Mean Diff	SED	t	df	P-Value
1	Pre	A (n=87)	134.10	9.54	-0.15	1.41	-0.11	168	0.916
		B(n=83)	134.25	8.85					
	Post	A (n=87)	134.20	9.62	0.03	1.43	0.02	168	0.985
		B(n=83)	134.17	8.98					
15	Pre	A (n=87)	131.94	8.72	-1.36	1.35	-1.00	168	0.316
		B(n=83)	133.30	8.91					
	Post	A (n=87)	131.83	8.86	-1.50	1.36	-1.10	168	0.273

		B(n=83)	133.33	8.90					
30	Pre	A (n=87)	129.94	8.21	-3.12	1.29	-2.42	168	0.017
		B(n=83)	133.06	8.60					
	Post	A (n=87)	129.79	8.07	-3.29	1.28	-2.58	168	0.011
		B(n=83)	133.08	8.59					
Aggregate	Pre	A (n=87)	132.00	8.97	-1.54	0.79	-1.96	508	0.050
		B(n=83)	133.54	8.77					
	Post	A (n=87)	131.94	9.02	-1.59	0.79	-2.01	508	0.045
		B(n=83)	133.53	8.80					

- **Table 3: Day wise Pre and Post comparison of Group A and B Diastolic Blood Pressure MMHg and Independent Sample *t* Test**

Day	BP MMHg D	Group	Mean	SD	Mean Diff	SED	t	df	P-Value
1	Pre	A (n=87)	81.36	7.01	-0.99	0.84	-1.18	168	0.240
		B(n=83)	82.35	3.18					
	Post	A (n=87)	81.94	2.76	-0.42	0.46	-0.92	168	0.360
		B(n=83)	82.36	3.18					
15	Pre	A (n=87)	81.44	2.39	-0.31	0.41	-0.76	168	0.451
		B(n=83)	81.75	2.94					
	Post	A (n=87)	81.48	2.41	-0.25	0.41	-0.61	168	0.540
		B(n=83)	81.73	2.93					
30	Pre	A (n=87)	81.05	2.03	0.05	0.69	0.07	168	0.947
		B(n=83)	81.00	6.12					
	Post	A (n=87)	81.03	2.04	-0.09	0.57	-0.15	168	0.880
		B(n=83)	81.12	4.88					
Aggregate	Pre	A (n=87)	81.28	4.42	-0.42	0.39	-1.08	508	0.281
		B(n=83)	81.70	4.35					
	Post	A (n=87)	81.49	2.44	-0.25	0.28	-0.90	508	0.369
		B(n=83)	81.74	3.78					

- **Table 4: Cohen's D Statistics for Studying Effectiveness**

Group	Intervention	Group	Mean	SD	Cohen D
Pulse Rate bpm	Pre	A	86.09	43.33	0.12
		B	82.24	4.35	
	Post	A	82.72	4.27	0.10
		B	82.30	4.40	
BP MMHg Systolic	Pre	A	132.00	8.97	-0.17
		B	133.54	8.77	
	Post	A	131.94	9.02	-0.18
		B	133.53	8.80	
BP MMHg	Pre	A	81.28	4.42	-0.10

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Dystolic		B	81.70	4.35	
		A	81.49	2.44	-0.08
	Post	B	81.74	3.78	

Diagram 1 Effectiveness of Pulse Rate:

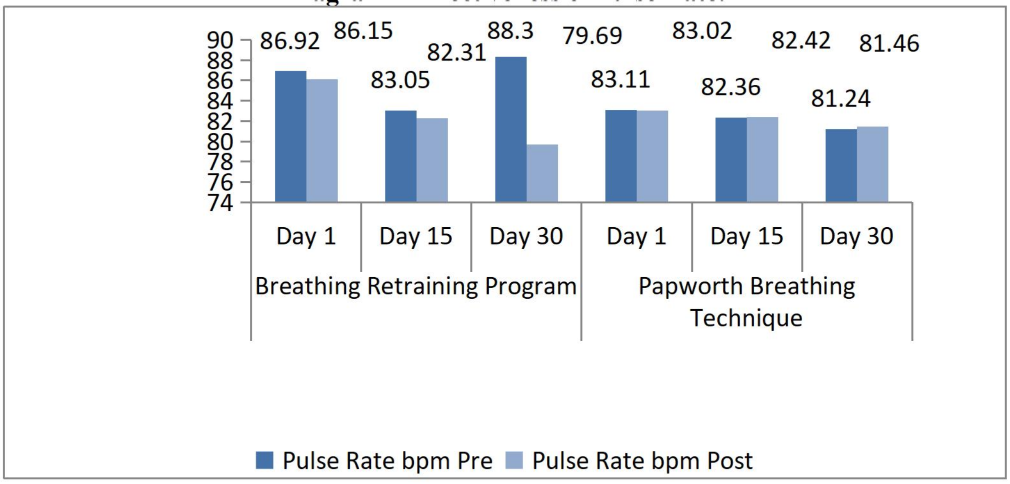
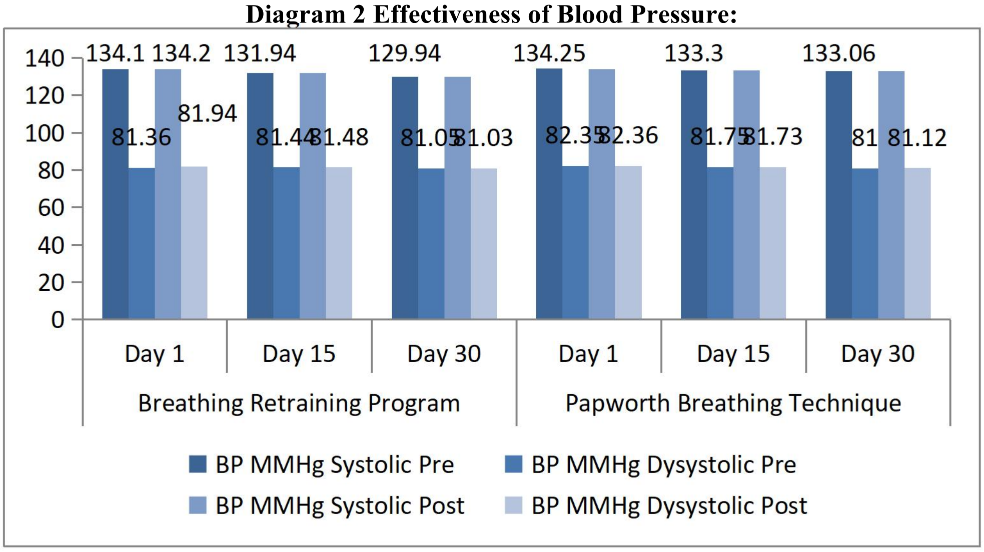


Diagram 2 Effectiveness of Blood Pressure:



RESULTS

The final study population consisted of 170 participants who completed the intervention protocol and outcome assessments. Of these, 87 participants (51.18%) were allocated to the Retrained Breathing Programme group, while 83 participants (48.82%) were allocated to the Papworth Breathing Technique group. The study included 84 male participants and 86 female participants, indicating an almost equal gender distribution. The age of participants ranged from 18 to 63 years, with an overall mean age of 36.31 ± 10.21 years. Baseline demographic characteristics between the groups were comparable, indicating homogeneity of the study population and supporting the validity of subsequent comparisons between interventions.

Effectiveness of Intervention

The findings of the present study demonstrated that both breathing interventions produced favourable effects on cardiovascular parameters in patients with bronchial asthma. However, the Retrained Breathing Programme produced comparatively greater improvements in pulse rate and blood pressure regulation than the Papworth Breathing Technique.

In relation to pulse rate, post-intervention comparisons between groups did not reveal a statistically significant difference ($t = 1.08$, $p = 0.28$; Cohen's $d = 0.05$).

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Nevertheless, repeated measures ANOVA demonstrated significant group effects ($F = 12.76$, $p < 0.001$), significant time effects ($F = 235.99$, $p < 0.001$) and significant Group × Day interaction effects ($F = 90.43$, $p < 0.001$), suggesting progressive improvement in pulse rate over the duration of the intervention and indicating that participants responded differently across assessment days. The findings suggest that both interventions contributed to improved autonomic regulation and cardiovascular adaptation in bronchial asthma patients.
With regard to systolic blood pressure, the Retrained Breathing Programme demonstrated superior effectiveness compared with the Papworth Breathing Technique. The post-intervention mean systolic blood pressure was 131.94 ± 9.02 mmHg in the Retrained Breathing Programme group and 133.53 ± 8.80 mmHg in the Papworth Breathing Technique group, with the between-group difference reaching statistical significance ($t = -2.01$, $p = 0.045$; Cohen's $d = 0.18$). Repeated measures ANOVA further confirmed significant group effects ($F = 33.426$, $p < 0.001$), significant time effects ($F = 55.195$, $p < 0.001$) and significant Group × Day interaction effects ($F = 20.035$, $p < 0.001$), indicating progressive reduction in systolic blood pressure throughout the treatment period and superior effectiveness of the Retrained Breathing Programme.
For diastolic blood pressure, both interventions produced modest improvements over time. The post-intervention mean diastolic blood pressure was 81.49 ± 2.44 mmHg in the Retrained Breathing Programme group and 81.74 ± 3.78 mmHg in the Papworth Breathing Technique group. However, the between-group difference was not statistically significant ($t = -0.90$, $p = 0.369$; Cohen's $d = 0.08$). Repeated measures ANOVA also demonstrated no significant group effect ($F = 1.23$, $p = 0.259$) and no significant Group × Day interaction effect ($F = 0.277$, $p = 0.758$), although a significant time effect was observed ($F = 11.55$, $p < 0.001$), indicating gradual physiological adaptation over the study period in both intervention groups. The findings of the present study suggest that both the Retrained Breathing Programme and the Papworth Breathing Technique were effective in improving pulse rate, systolic blood pressure, and diastolic blood pressure in patients with bronchial asthma. However, the Retrained Breathing Programme was found to be more effective than the Papworth Breathing Technique, particularly in improving pulse rate and systolic blood pressure. Although both interventions resulted in improvements in diastolic blood pressure, the overall findings indicate that the Retrained Breathing Programme provides superior cardiovascular benefits and may serve as a more effective adjunctive physiotherapeutic intervention in the management of bronchial asthma.

DISCUSSION

The present study was undertaken to determine and compare the effectiveness of a Retrained Breathing Programme and the Papworth Breathing Technique in the management of patients with bronchial asthma, with particular emphasis on selected cardiovascular parameters including pulse rate, systolic blood pressure and diastolic blood pressure. Bronchial asthma is not merely a disease of airway inflammation and obstruction; it also influences cardiorespiratory responses through increased work of breathing, sympathetic overactivity, anxiety and recurrent episodes of dyspnoea. Therefore, interventions capable of improving breathing efficiency may simultaneously contribute to favourable cardiovascular adaptations. The findings of the present study demonstrated that the Retrained Breathing Programme produced superior improvements in selected cardiorespiratory parameters when compared with the Papworth Breathing Technique, with respect to pulse rate and systolic blood pressure. These findings suggest that breathing retraining have an important role as an adjunct non-pharmacological intervention in improving autonomic regulation and physiological stability in patients with bronchial asthma. The present study revealed a progressive reduction in pulse rate among participants receiving the Retrained Breathing Programme over the one-month intervention period. The post-intervention pulse rate in Group A reduced from 86.15 beats per minute on Day 1 to 82.31 beats per minute on Day 15 and further decreased to 79.69 beats per minute on Day 30. Conversely, participants in the Papworth Breathing Technique group exhibited comparatively smaller changes, with pulse rate values remaining relatively stable throughout the study period. Repeated measures ANOVA demonstrated significant group effects, significant time effects and significant group-by-time interaction effects, indicating that the observed reduction in pulse rate was strongly influenced by both the intervention itself and the duration of practice. The reduction in pulse rate observed following the Retrained Breathing Programme may be explained by improvements in autonomic nervous system regulation. Patients with bronchial asthma frequently experience increased sympathetic nervous system activity due to airway narrowing, respiratory distress, fear of breathlessness and increased respiratory effort. This heightened sympathetic activity often manifests clinically as tachycardia and increased cardiovascular workload. The retrained breathing intervention incorporated slow diaphragmatic breathing, prolonged expiration, relaxation techniques and breathing pauses, all of which are known to stimulate vagal activity and promote parasympathetic dominance. Increased parasympathetic activity decreases sinoatrial node firing, thereby reducing heart rate and improving cardiovascular efficiency. Furthermore, breathing retraining reduces the tendency toward hyperventilation and rapid shallow breathing, both of which are common in patients with asthma. By encouraging slower respiratory rates and improved diaphragmatic function, the intervention reduces respiratory muscle workload and oxygen consumption, ultimately decreasing cardiac demand and pulse rate. The relaxation component of the programme may also have contributed to reduced anxiety and emotional stress, factors that are known to influence heart rate variability and sympathetic activation. The findings of the present study are in agreement with the work of M. Thomas et al. (2003), who reported clinically meaningful improvements in symptoms and quality of life following physiotherapy-based breathing retraining in asthma patients. Similarly, Grammatopoulou et al. (2011) demonstrated that breathing retraining improved physiological indices and asthma control over time. Andreasson et al. (2022) also reported improvements in overall physiological functioning following breathing exercise interventions in patients with uncontrolled asthma. Collectively, these studies support the present findings that breathing retraining contributes to improved autonomic regulation and cardiovascular responses in bronchial asthma patients. The present study demonstrated a gradual reduction in systolic blood pressure among participants undergoing the Retrained Breathing Programme. Mean systolic blood pressure in Group A decreased from 134.10 mmHg on Day 1 to 131.94 mmHg on Day 15 and further to 129.94 mmHg on Day 30. In comparison, only minimal reductions were observed in the Papworth Breathing Technique group. Independent sample t-test analysis demonstrated a statistically significant difference between the two groups during post-intervention assessment, indicating greater effectiveness of the Retrained Breathing Programme in improving systolic blood pressure.

The physiological basis for this reduction may be attributed primarily to improved autonomic balance and suppression of sympathetic nervous system activity. Bronchial asthma is commonly associated with chronic sympathetic stimulation resulting from recurrent episodes of dyspnoea, hypoxia, anxiety and increased respiratory effort. Sympathetic activation leads to peripheral vasoconstriction and increased arterial pressure. Slow and controlled breathing exercises have been shown to increase vagal tone, improve baroreceptor sensitivity and promote peripheral vasodilation, ultimately reducing arterial blood pressure. The prolonged expiratory component of the Retrained Breathing Programme may have further contributed to improved intrathoracic pressure regulation and enhanced venous return, thereby reducing cardiorespiratory strain. Additionally, the relaxation phase incorporated within the intervention may have decreased circulating catecholamine levels, particularly adrenaline and noradrenaline, resulting in reduced cardiac workload and lower systolic blood pressure values. Therefore, the observed reduction in systolic blood pressure may reflect improved cardiovascular adaptation secondary to enhanced respiratory control. The findings of the present study are consistent with previous literature reporting favourable cardiorespiratory responses following breathing interventions. Thomas et al. (2003) demonstrated improvements in physiological functioning following breathing retraining in asthma patients. Andreasson et al. (2022) similarly reported improvements in patient outcomes following breathing exercise programmes. Moreover, Joseph et al. (2005) demonstrated that slow breathing exercises improve arterial baroreflex sensitivity and significantly reduce systolic blood pressure through autonomic modulation. These observations strongly support the cardiovascular benefits observed in the present study. With regard to diastolic blood pressure, the present study demonstrated only minimal changes following both interventions and no statistically significant difference was observed between the two groups. Although repeated measures analysis identified a significant effect of time, neither the group effect nor the interaction effect reached statistical significance, indicating that both interventions produced comparable outcomes with respect to diastolic blood pressure. The absence of a significant reduction in diastolic blood pressure may be explained by the physiological determinants of diastolic pressure itself. Unlike systolic blood pressure, which is strongly influenced by cardiac output and sympathetic activation, diastolic blood pressure is primarily dependent on peripheral vascular resistance and arterial compliance. These vascular characteristics generally require longer intervention durations and more substantial physiological adaptations before clinically meaningful changes become evident. The majority of participants in the present study had baseline diastolic blood pressure values within normal physiological limits, thereby reducing the potential for significant improvement. Consequently, although breathing retraining may have contributed to improved autonomic balance and relaxation, the magnitude of these changes may not have been sufficient to produce measurable reductions in resting diastolic pressure within the one-month study duration. The findings of the present study are comparable with those of Grammatopoulou et al. (2011), who reported improvements in asthma control and physiological variables without substantial alterations in resting haemodynamic parameters. Similarly, Andreasson et al. (2022) observed improvements in asthma-related quality of life and respiratory outcomes with minimal effects on resting cardiovascular variables. These findings suggest that breathing retraining primarily influences respiratory mechanics and autonomic regulation, whereas changes in diastolic blood pressure may require longer intervention periods to become evident. Overall, the findings of the present study suggest that the Retrained Breathing Programme is capable of producing favourable cardiovascular adaptations in patients with bronchial asthma, particularly with regard to pulse rate and systolic blood pressure. The intervention appears to improve autonomic balance through enhancement of parasympathetic activity and reduction of sympathetic overactivity, thereby reducing cardiovascular stress associated with chronic respiratory dysfunction. Although significant improvements in diastolic blood pressure were not observed, the temporal trends indicate the possibility of long-term benefits with prolonged intervention duration. Therefore, the results of the present investigation support the incorporation of the Retrained Breathing Programme as an effective adjunctive physiotherapeutic intervention alongside

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conventional medical management in patients with bronchial asthma for improving both respiratory efficiency and selected cardiovascular parameters. Based on the findings of the present study, it is recommended that the Retrained Breathing Programme be incorporated as an adjunctive physiotherapeutic intervention in the routine management of patients with bronchial asthma. Since the intervention demonstrated superior improvements in pulse rate and systolic blood pressure compared to the Papworth Breathing Technique, its implementation may contribute not only to respiratory rehabilitation but also to cardiovascular stabilization in asthmatic individuals. This study indicate that breathing retraining interventions are compatible with conventional pharmacological management and can be safely integrated into comprehensive asthma rehabilitation programmes. The Retrained Breathing Programme demonstrated beneficial effects on both respiratory control and cardiovascular parameters without causing any adverse effects or requiring sophisticated equipment. Its simplicity, cost-effectiveness and ease of application make it suitable for clinical settings, outpatient departments and home-based rehabilitation programmes. Furthermore, improved autonomic regulation achieved through breathing retraining may contribute to enhanced exercise tolerance, reduced cardiovascular stress and improved overall quality of life among patients with bronchial asthma. Comparison of the three cardiovascular parameters evaluated in the present study demonstrated that pulse rate exhibited the greatest responsiveness to the Retrained Breathing Programme, followed by systolic blood pressure, whereas diastolic blood pressure showed the least degree of change. The marked reduction in pulse rate suggests that breathing retraining primarily influences autonomic nervous system activity by reducing sympathetic stimulation and enhancing parasympathetic tone. Systolic blood pressure also demonstrated significant improvement, indicating reduced cardiovascular workload and improved haemodynamic regulation resulting from slow and controlled breathing patterns. In contrast, diastolic blood pressure showed only minimal changes and failed to demonstrate significant between-group differences. This may be attributed to the fact that diastolic blood pressure is predominantly determined by peripheral vascular resistance and arterial compliance, which generally require longer intervention periods to undergo measurable physiological changes. Therefore, among the cardiorespiratory variables assessed in the present study, pulse rate emerged as the most sensitive indicator of autonomic adaptation to breathing retraining, followed by systolic blood pressure, while diastolic blood pressure appeared comparatively resistant to short-term intervention effects. Overall, the comparative findings suggest that the Retrained Breathing Programme exerts its primary influence through modulation of autonomic function and reduction of sympathetic overactivity, resulting in more pronounced improvements in pulse rate and systolic blood pressure than in diastolic blood pressure. These observations further support the superiority of the Retrained Breathing Programme over the Papworth Breathing Technique in producing favourable cardiovascular adaptations in patients with bronchial asthma.

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